AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2018

PHYSICS
PAPER 1

6091/01

Sec 4 Express

Date: 16 August 2018
Duration: 1 hour

Name: ……………………………………( )

Class: ……………

READ THESE INSTRUCTIONS FIRST:

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class number and registration number on the optical answer sheet (OAS) provided.

There are **forty** questions in this paper. Answer **all** questions.
For each question, there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the optical answer sheet (OAS) provided.

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **20** printed pages

1 Pendulum **A** makes 20 complete oscillations in 10 s. Pendulum **B** makes 15 complete oscillations in 15 s. Both pendulums were displaced by a small angle before their oscillations.

Which of the following statements must be true?

A Pendulum **B** has a shorter period than pendulum **A**.

B The string of pendulum **B** is longer than that of pendulum **A**.

C The mass of the bob of pendulum **B** is smaller than that of pendulum **A**.

D The angle of swing of release for pendulum B is smaller than that of pendulum **A**.

2 A pair of vernier calipers is used to measure the thickness of a coin.

Diagram 1 shows the reading with the jaws closed. Diagram 2 shows the reading when the jaws are closed around the coin.

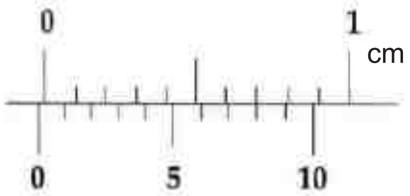


Diagram 1

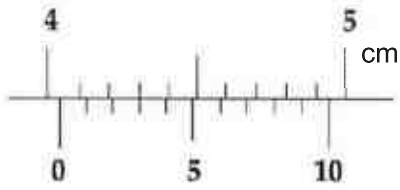


Diagram 2

What is the zero error and the actual thickness of the coin?

	Zero error / cm	Corrected reading / cm
A	-0.02	4.05
B	-0.02	4.01
C	+0.08	3.95
D	+0.08	4.11

3 A student uses a micrometer screw gauge to measure the diameter of a ball bearing. Diagram 1 shows the zero error of the gauge and diagram 2 shows the measurement of the diameter before it is corrected.

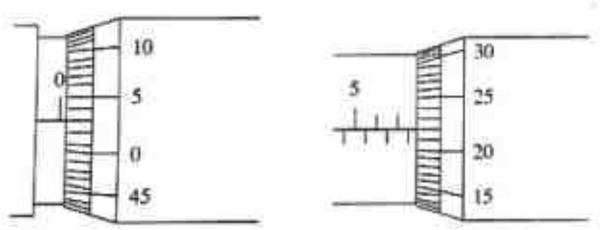
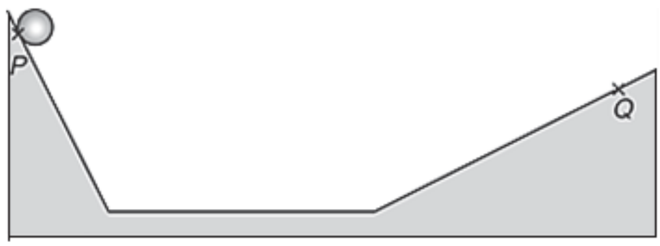


Diagram 1 Diagram 2

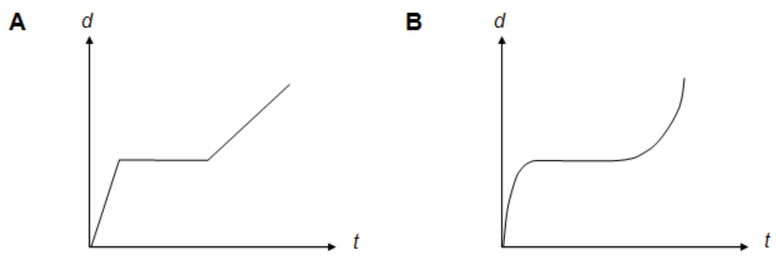
What is the true diameter of the ball bearing?

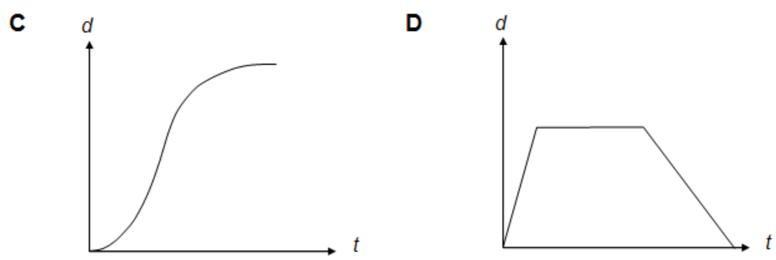
A 7.19 mm **B** 7.69 mm **C** 7.72 mm **D** 7.75 mm

4 A sphere runs along a smooth rail from **P** to **Q** as shown.



Which of the following graphs best represents the variation of the distance *d* travelled by the sphere with time *t*?



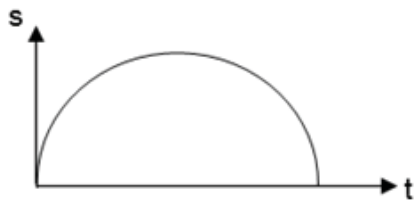


5 A bicycle accelerates from a speed of 2.0 m/s to 10 m/s in 8.0 s.

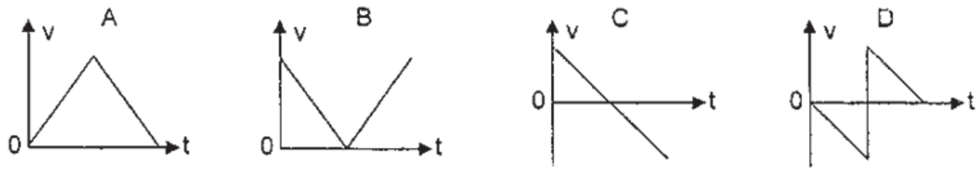
What is its average speed during the journey?

A 4.0 m/s **B** 5.0 m/s **C** 6.0 m/s **D** 7.0 m/s

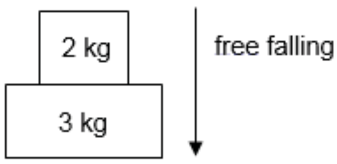
6 The diagram shows the graph of displacement ***s*** against time ***t*** for a body moving in a straight line.



Which of the following shows the graph of speed ***v*** against time ***t*** for this body?

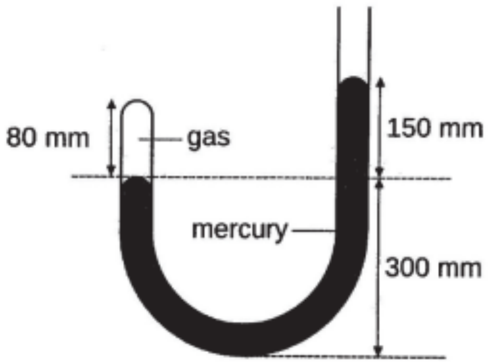


7 Two metal blocks are stacked one on top of the other as shown in the diagram below. They are dropped in vacuum, falling together freely under earth's gravitational field. What is the net force acting on the 3 kg metal block during the fall?



A 10 N **B** 20 N **C** 30 N **D** 40 N

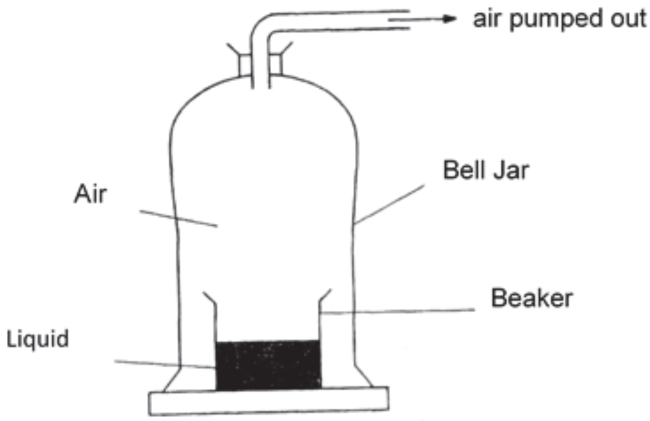
8 The diagram shows a gas trapped in the left arm of a manometer containing mercury.



If the atmospheric pressure is 760 mm Hg, what is the pressure of the trapped gas?

A 80 mm Hg **B** 150 mm Hg **C** 680 mm Hg **D** 910 mm Hg

9 A beaker of liquid is placed under a bell jar. The pressure of the air above the liquid is reduced and some liquid evaporates. This causes the liquid to become colder.



Why does the temperature of the liquid fall?

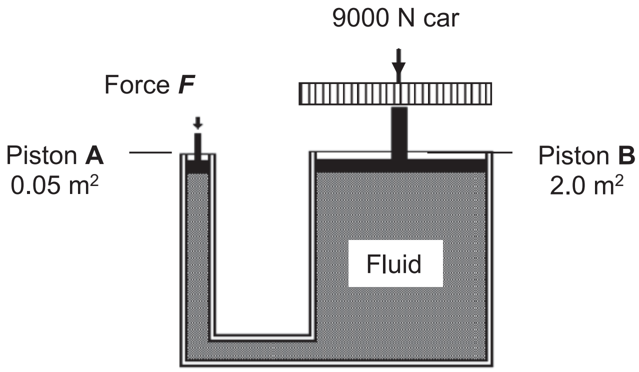
A The air molecules blow away the liquid molecules.

B The air molecules cool down the liquid.

C The higher energy molecules leave the liquid.

D There are fewer molecules of liquid in the beaker.

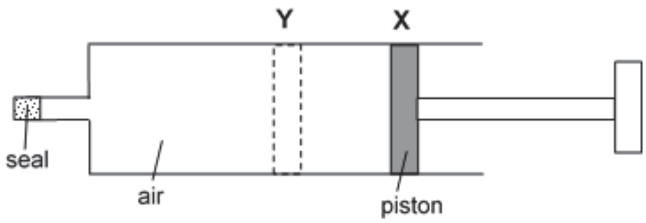
10 A hydraulic lift is used to support a car of weight 9000 N.



Piston **A** has a cross-sectional area of 0.05 m^2 while piston **B** has a cross-sectional area of 2.0 m^2. What is the force **F** needed to support the weight of the car?

A 225 N **B** 450 N **C** 900 N **D** 3600 N

11 The outlet of a syringe is sealed and air is trapped in the syringe. The temperature of the air is kept constant.



Why does the pressure of the air increase when the piston is pushed from **X** to **Y**?

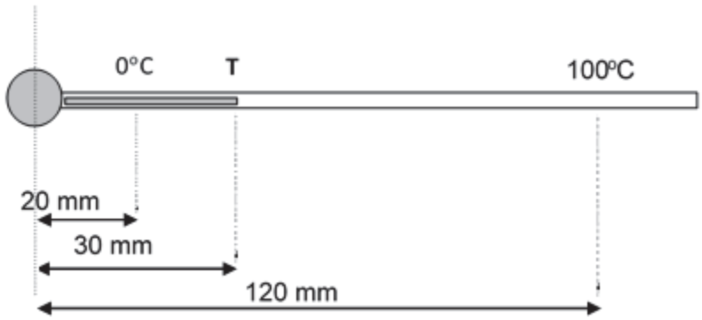
A The air molecules are moving faster.

B The collision between the air molecules increases.

C The forces between air molecules increases.

D The rate of collision of the air molecules with the wall increases.

12 A mercury-in-glass thermometer is shown. What is the temperature when the mercury thread is at **T**?



A 10 °C **B** 25 °C **C** 30 °C **D** 40 °C

13 Water of mass 0.87 kg at 90 °C is poured into an insulated metal container of mass 0.50 kg at 20 °C. The final temperature of water is 86.2 °C. If the specific heat capacity of water is 4200 J $kg^{-1}K^{-1}$, what is the specific heat capacity of the metal in J $kg^{-1}K^{-1}$?

A 360 **B** 380 **C** 420 **D** 480

14 Which statement about a fixed mass of gas is correct?

A As pressure increases at constant temperature, the volume decreases.

B As pressure increases at constant temperature, the volume increases.

C As temperature increases at constant pressure, the volume decreases.

D As temperature increases at constant volume, the pressure decreases.

15 What describes the volume and shape of a gas or liquid at constant temperature?

A The volume of a gas is fixed but its shape is not fixed.

B The volume of a gas is not fixed and its shape is not fixed.

C The volume of a liquid is fixed and its shape is fixed.

D The volume of a liquid is not fixed but its shape is fixed.

16 Air in a closed container contains smoke, illuminated by bright light. When viewed through microscope, bright specks of light are seen moving at random.
Which statement is correct?

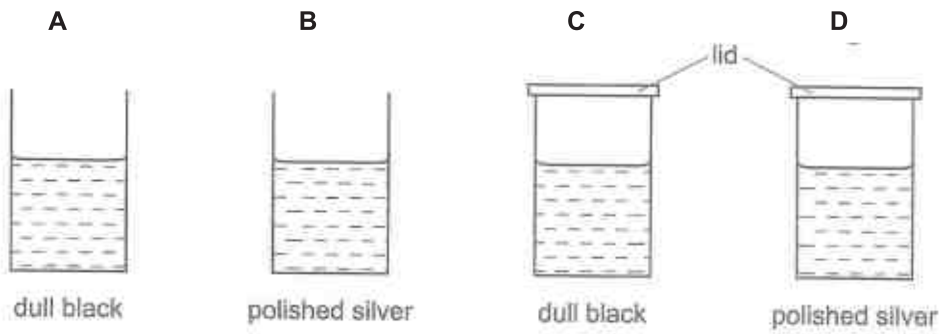
A The random motion of the specks is faster in a vacuum.

B The specks move faster when the air is at a higher temperature.

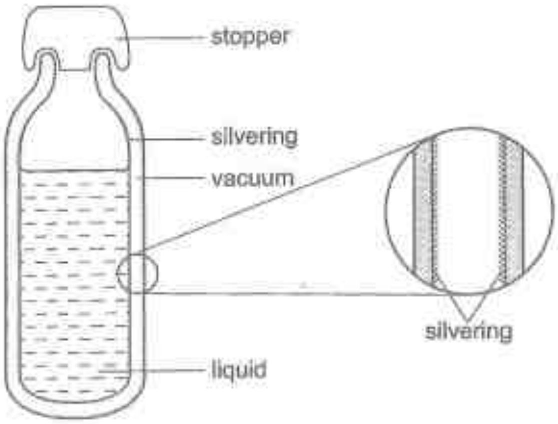
C The specks seen are molecules of air in rapid random motion.

D When the light is turned off, the specks slow down and stop moving.

17 The diagram shows four identical cans with their outside surfaces painted either dull black or polished silver. Each can contains the same volume of water, initially at 80 °C.
After five minutes in a cool room, which can contains the hottest water?



18 The diagram shows a vacuum flask and an enlarged view of a section through the flask wall.



The main reason for the silvering is to reduce heat transfer by

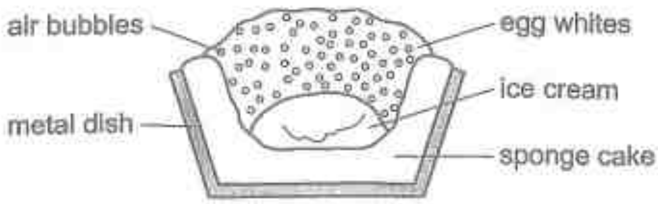
A conduction only.

B conduction and convection.

C radiation only.

D radiation and convection.

19 A cook makes the pudding 'baked Alaska'.



The pudding is placed in a very hot oven until the top of the egg white turns brown. It is then removed from the oven.
Why does the ice cream stay cold?

A Air is a good conductor of heat and conducts the heat away from the ice cream.

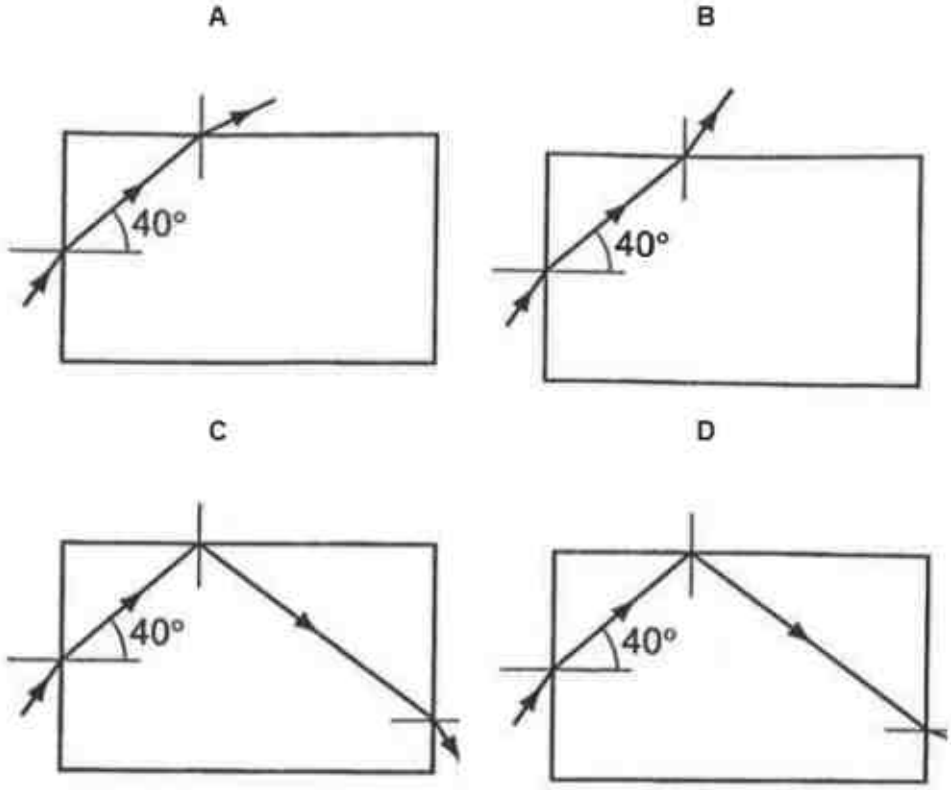
B Air is a poor conductor of heat and slows the heat from reaching the ice cream.

C The metal dish is a good conductor of heat and conducts the heat away from the ice cream.

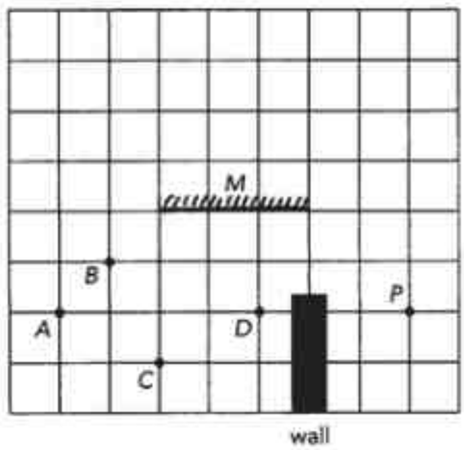
D The metal dish is a poor conductor of heat and slows the heat from reaching the ice cream.

20 A ray of light is incident on one side of a rectangular glass block. The angle of refraction is 40° in the glass. The critical angle for light in glass is 42°.

Which diagram shows the path of this ray?

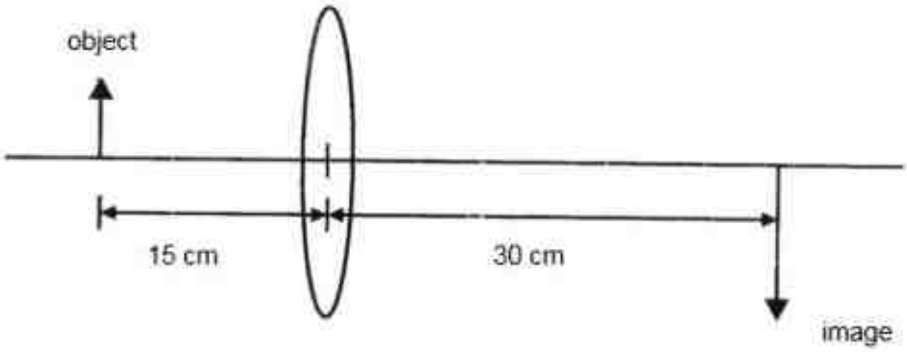


21 The figure below shows the top view of an empty room with a vertical plane mirror **M** at the middle. Rachel stands at point **P** and looks into the mirror.



Which object **cannot** be seen by Rachel in the mirror?

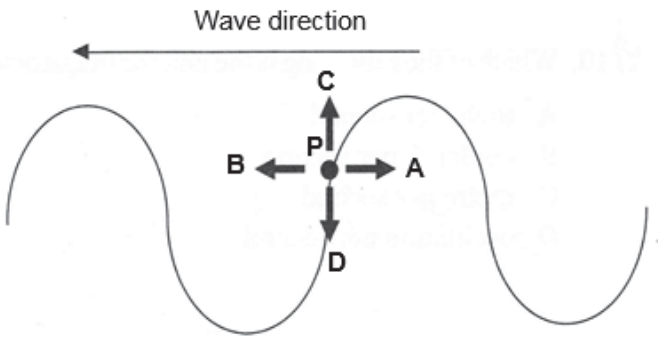
22 When an object is placed 15 cm in front of a convex lens the image is formed 30 cm behind the lens.



How would the size of the image and the image distance change when the object is moved 5 cm further away from the lens?

	Size of image	Image distance
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

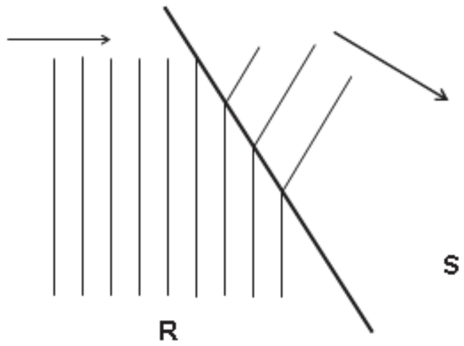
23 A point **P** is marked on a rope before the rope is set to oscillate. At the particular instance shown, what is the direction of movement of the point **P**?



24 It takes 0.25 s to generate one complete wavelength in a ripple tank. The wavelength of each wave produced is 6.0 cm. What is the speed of the wave?

A 0.0417 cm s^{-1} **B** 1.5 cm s^{-1} **C** 3.0 cm s^{-1} **D** 24.0 cm s^{-1}

25 The figure shows water traveling from Section **R** to **S** in a ripple tank.



Which statement is correct?

A The frequency is higher in section **S**.

B The water is shallower in section **S**.

C The water is deeper in section **S**.

D The waves move slower in section **S**.

26 Waves **P** and **Q** are components of the electromagnetic spectrum. **P** has a longer wavelength than **Q**. Which of the following statements is **true** about **P** and **Q**?

A **P** is radiowave and **Q** is infrared radiation.

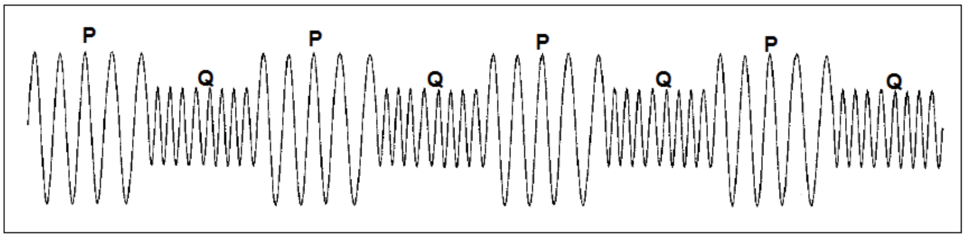
B **P** can travel faster than **Q** in vacuum.

C **Q** has a lower frequency than **P**.

D **Q** is ultraviolet ray and **P** is X-ray.

27 A police sounds its siren when travelling to an emergency. The siren produces two different sounds **P** and **Q**, which are emitted alternately.

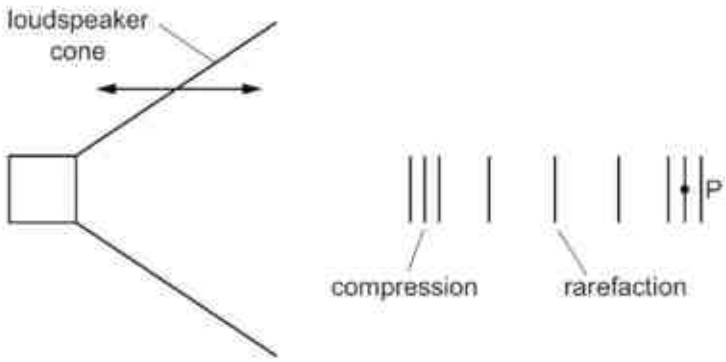
The diagram represents the sound emitted by the siren.



Which of the two sounds **P** and **Q** is the softer and which has the lower pitch?

	Softer sound	Sound of lower pitch
A	P	P
B	P	Q
C	Q	P
D	Q	Q

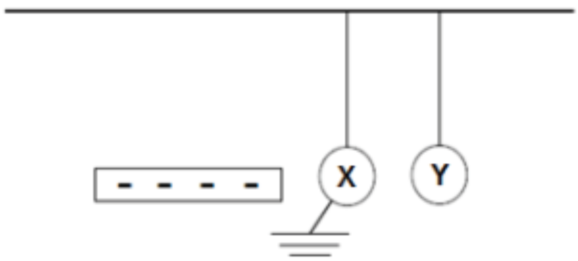
28 Compressions and rarefactions are sent out from a loudspeaker cone as it vibrates backwards and forwards. The frequency of vibration is 50 Hz.



A compression is at point **P**. How much time elapses before the next rarefaction arrives at **P**?

A 0.010 s **B** 0.020 s **C** 25 s **D** 50 s

29 A negatively charged rod is brought near two isolated metal balls **X** and **Y**. **X** is then earthed momentarily as shown in the diagram. If the rod is then removed, how would the balls be charged?



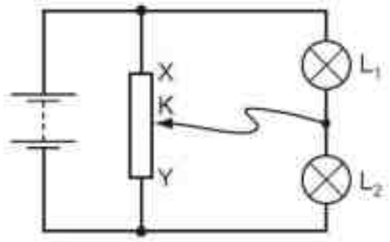
	X	Y
A	negative	positive
B	neutral	neutral
C	positive	negative
D	positive	neutral

30 A resistor with resistance **R** is made from a length **L** of resistance wire with a cross-sectional area **A**. A second resistor with resistance 3**R** is made from wire of the same material with a cross-sectional area of 0.5**A**.

What length of wire is needed for the second resistor?

A 2 **L**   **B** 1.5 **L**   **C** **L**   **D** 0.5 **L**

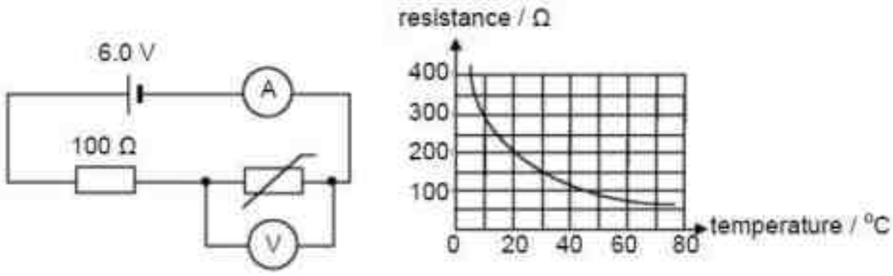
31 The diagram shows a potential divider circuit with two identical lamps **L_1** and **L_2**.



What will happen to the brightness of the lamps when contact **K** is moved towards **X**?

	lamp L_1	lamp L_2
A	Brighter	Brighter
B	Brighter	Dimmer
C	Dimmer	Brighter
D	Dimmer	Dimmer

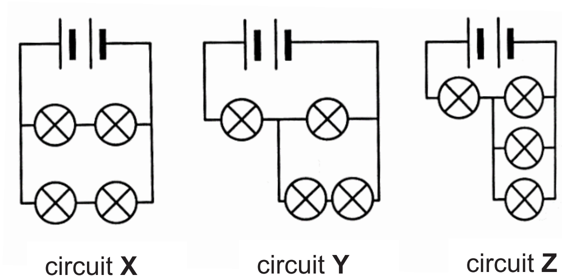
32 The diagram shows the resistance–temperature graph of a thermistor in a circuit.



What are the current and voltage when the temperature of the thermistor is 30 °C?

	Current /A	Voltage / V
A	0.024	2.4
B	0.024	3.6
C	0.040	2.4
D	0.040	3.6

33 In circuits **X**, **Y** and **Z** shown, all the lamps are identical and they use identical dry cells.



What is the descending order of resistance in each circuit?

A **X**, **Y** and **Z**

B **X**, **Z** and **Y**

C **Y**, **Z** and **X**

D **Z**, **Y** and **X**

34 An electrical cable contains three wires: live, neutral and earth. The cable is correctly wired to a plug which contains a 3 A fuse. The cable insulation becomes damaged and the bare metal wires are exposed. Five possible events may occur.

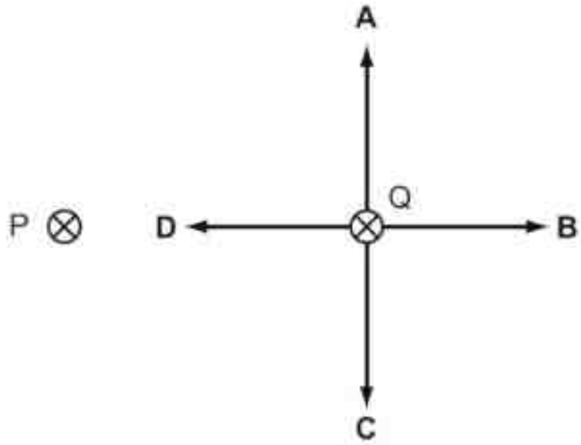
- A person touches the earth wire.
- A person touches the neutral wire.
- A person touches the live wire.
- The live wire touches the neutral wire.
- The live wire touches the earth wire.

How many of these events will cause the fuse in the plug to blow?

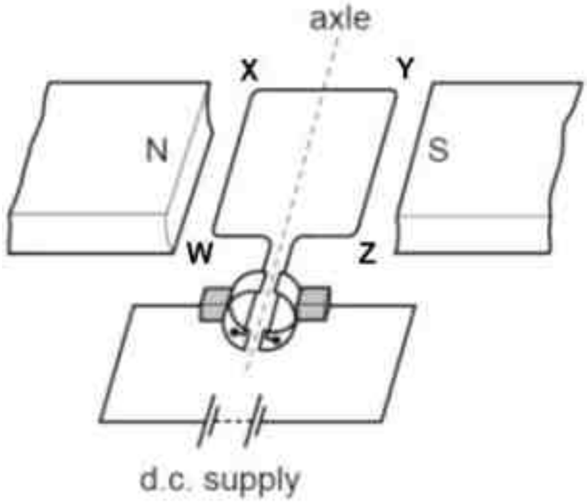
A 2 **B** 3 **C** 4 **D** 5

35 **P** and **Q** represent two, parallel, straight wires carrying currents into the plane of the paper. **P** and **Q** exert a force on each other.

Which arrow shows the force on **Q**?



36 The diagram below shows a simple d.c. motor.



When the switch is closed, which of the following statements is/are correct?

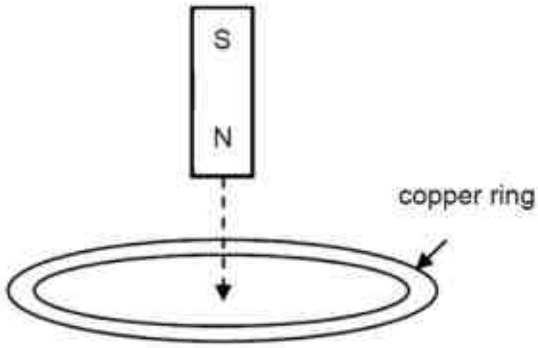
I A current will flow round the coil in the direction **WXYZ**.

II The coil will rotate in a clockwise direction about the axle.

III The split-ring commutator will reverse the direction of the current every 360°.

A I only **B** I and II only **C** I and III only **D** I, II and III

37 A magnet is dropped vertically through a copper ring.



Which of the following statements is **incorrect**?

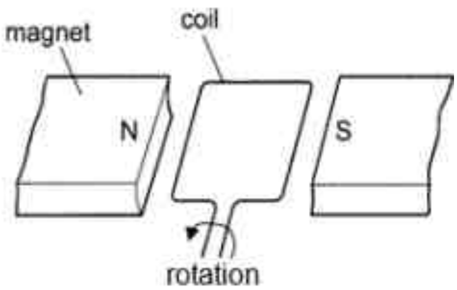
A A current flows in the ring just before the magnet passes through the ring.

B A current flows in the ring just after the magnet passes through the ring.

C The magnet slows down just before it passes through the ring.

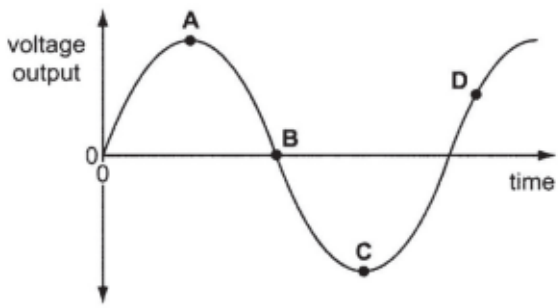
D The magnet accelerates just after it passes through the ring.

38 The diagram shows part of an a.c. generator when its coil is in a horizontal position.



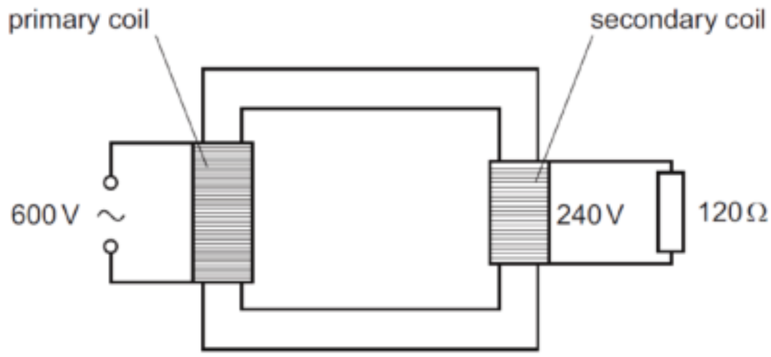
The graph below shows the voltage output plotted against time.

Which point on the graph shows the coil in a vertical position?



39 An ideal transformer has a primary voltage of 600 V and a secondary voltage of 240 V.

The secondary coil is attached to a resistor of resistance 120 Ω.



What is the power dissipated in the resistor and the current in the primary coil?

	Power / W	Current / A
A	120	0.20
B	120	5.0
C	480	0.80
D	480	1.3

40 An oscilloscope is used to display the waveforms of 2 alternating current (a.c.) input.

Diagram 1 shows the oscilloscope trace produced by the first input of voltage 2.0 V and frequency 50 Hz.

Diagram 2 shows the trace produced by the second input. The controls on the oscilloscope are set at the same values.

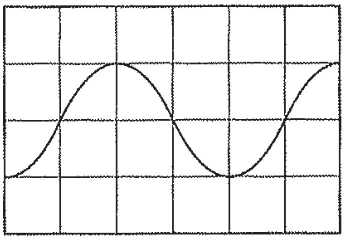


Diagram 1

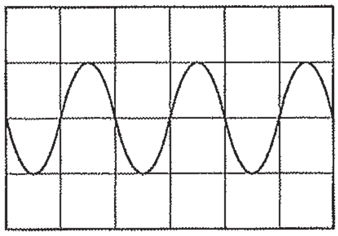


Diagram 2

What is the voltage and frequency of the second input?

	Voltage / V	Frequency / Hz
A	1.0	50
B	2.0	25
C	2.0	100
D	4.0	50

END OF PAPER
Setter: Mr Luqman

AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2018

PHYSICS
PAPER 2

6091/02

Sec 4 Express

Date: 14 August 2018
Duration: 1 h 45 min

Name: ……………………………………….(   )

Class: ……………

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write down your name, class and register number on this page and on any additional writing papers.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer all questions. Question 12 has a choice of parts to answer.

Information for candidates:
Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
Section A	/ 50
Section B	/ 30
TOTAL	/ 80

This question paper consists of **19** printed pages

Section A

Answer **all** the questions in this section.

1 A rubber ball is dropped freely from a height of 20 m. The ball hits the ground at time t and rebounds vertically upwards with half its maximum velocity. The maximum velocity of the ball just before it hits the ground for the first time is V.

(a) In the axes below, sketch the velocity-time graph of the ball from the point of release to the time when it has rebounded to its new maximum height. (Ignore air resistance) [2]

(b) Using information from the graph, determine the velocity of the ball just before it hits the ground for the first time.

velocity = ………………………………. [2]

(c) Find the displacement of the ball after it has rebounded to its maximum height.

displacement = ………………………………. [2]

(d) State the change in velocity of the ball during its rebound.

change in velocity = ………………………………. [1]

2 Fig. 2.1 shows three cylinders **X**, **Y** and **Z** are supported by three ropes that passes through ring **R**.

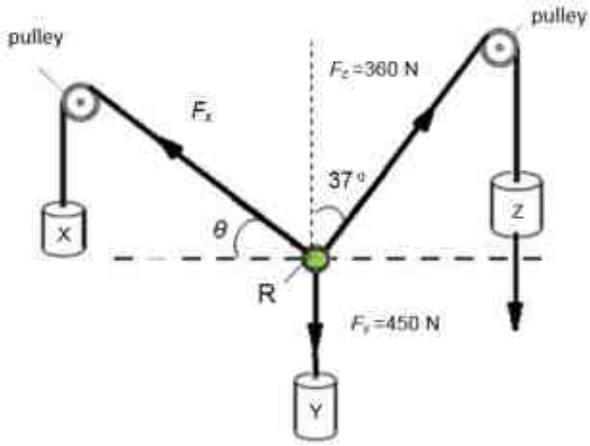


Fig. 2.1

Ring **R** is in equilibrium under the action of three forces F_x, F_y and F_z.

Draw a vector diagram to find F_x and angle θ.

F_x = ……………………………….

angle θ = ……………………….. [4]

3 A uniform rod **AB** of length 3 m weighs 10 N. It is suspended by two identical strings at points **X** and **Y** as shown in Fig. 3.1. T_1 and T_2 are the tension in the strings.

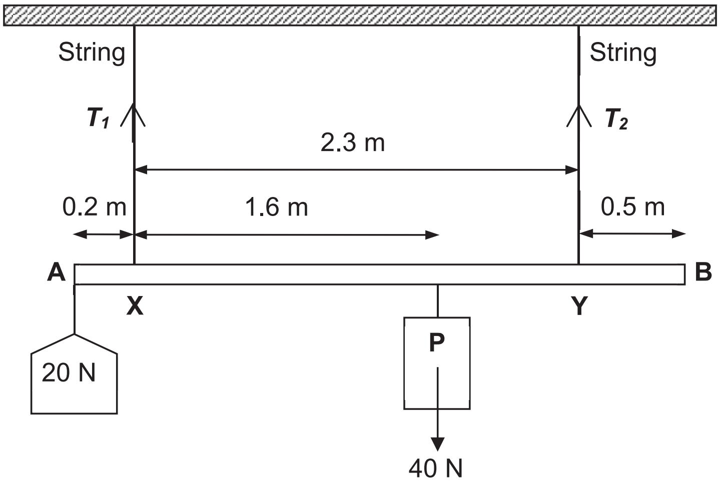


Fig. 3.1

Two weights, 20 N and **P**, are hung from the rod at point **A** and 1.6 m from **X** respectively.

(a) Draw the weight of the rod in Fig. 3.1 and label it **W**. Indicate clearly its distance from point **A**. [1]

(b) Determine T_2, the tension of the string at **Y**.

T_2 = ... [2]

(c) Hence, or otherwise, determine T_1, the tension of the string at **X.**

T_1 = ... [1]

4 A small jet plane which can carry six people is shown in Fig. 4.1.

Fig. 4.1

The mass of the fully-loaded jet plane is 2560 kg. It is initially at rest. When the jet plane is taking off, the two jet engines can exert a total thrust force of 8000 N and the friction between the wheels and the ground is 340 N. Both forces remain constant at these values during take-off.

(a) Calculate the acceleration of the plane as it starts to move.

acceleration = ………………………………. [2]

(b) Explain what happens to this acceleration as the jet plane speeds up.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………... [2]

(c) The average acceleration during take-off is 2.2 m/s^2.

(i) Calculate the time that the jet plane will take to reach a take-off speed of 55 m/s.

time = ………………………………. [1]

(ii) Determine the minimum length of the runway that is required for the jet plane to take off.

minimum length = ………………………………. [2]

(d) Suggest why the wheels of the jet plane are folded into the body of the jet plane after take-off.

………………………………………………………………………………………………………

……………………………………………………………………………………………………… [1]

5 Fig. 5.1 below shows a long vertical glass tube with one end immersed in mercury and the other connected to a vacuum pump at **A**. The tube fits tightly into a bell jar. With an opening at **B** and all air in the glass tube pumped out via **A**, the mercury rises to a maximum height of 76.0 cm above the dish.

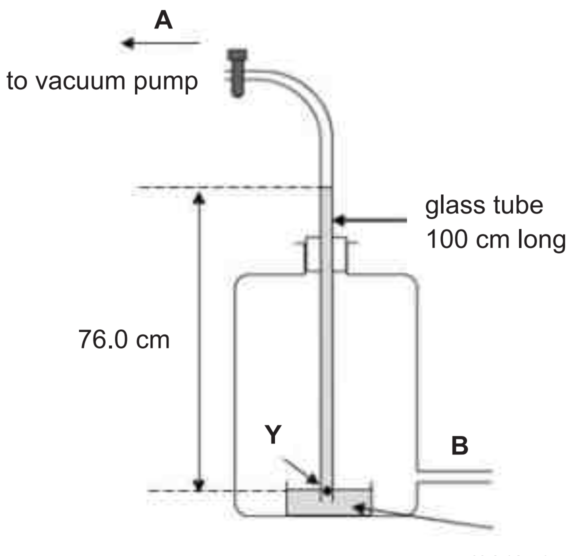


Fig. 5.1

(a) Explain why the mercury only can rise to a maximum height of 76.0 cm.

………………………………………………………………………………………………………

………………………………………………………………………………………………………

……………………………………………………………………………………………………….... [2]

(b) If the density of mercury is 13600 kg/m^3, calculate the pressure at **Y** in pascals.

pressure = ………………………………. [2]

(c) A container of air initially at atmospheric pressure is connected to **B** and heated over a flame as shown in Fig. 5.2.

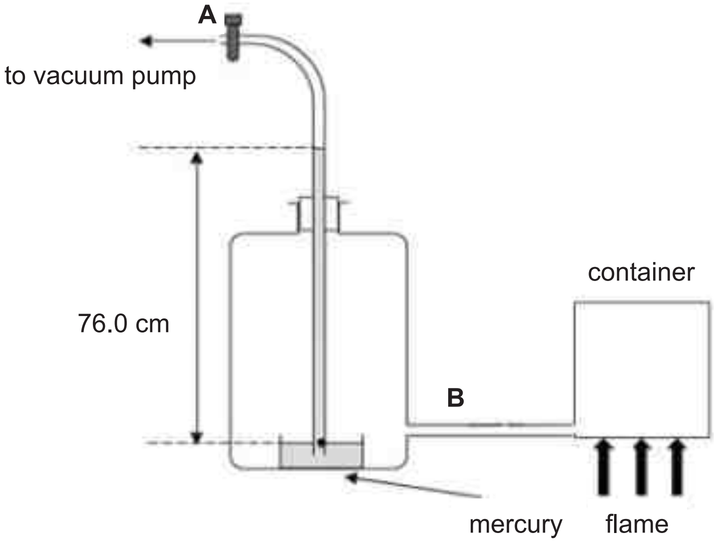


Fig. 5.2

Using kinetic theory of matter, explain whether the height of mercury column rises, falls or remains the same.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [3]

6 John conducts an experiment to determine the specific latent heat of vaporisation of water.

He places an immersion heater fully immersed in water in an open steel container. The voltage across the immersion heater is 240 V and the current which passes through the heating element is 1.6 A. John measures the mass of water after steady boiling is achieved, and again after another 8 minutes. He discovers that the mass of water in the container decreases by 0.075 kg during the 8 minutes.

(a) Calculate the specific latent heat of vaporisation of water.

specific latent heat of vaporisation = ………………………………. [2]

(b) Is the value calculated in (a) higher than the actual specific latent heat of vaporization of water? Explain why.

....

....

.... [2]

(c) John's friend Ali comments that it is better to use a vacuum flask to contain water rather than a steel container. Explain why this is so.

....

.... [1]

7 A collector views a postage stamp of height 1.5 cm through a lens. The lens is 2.0 cm from the stamp and the ratio of height of image to height of object is 3.0.

(a) In Fig. 7.1, complete the full scale ray diagram to determine the image of the stamp [3]

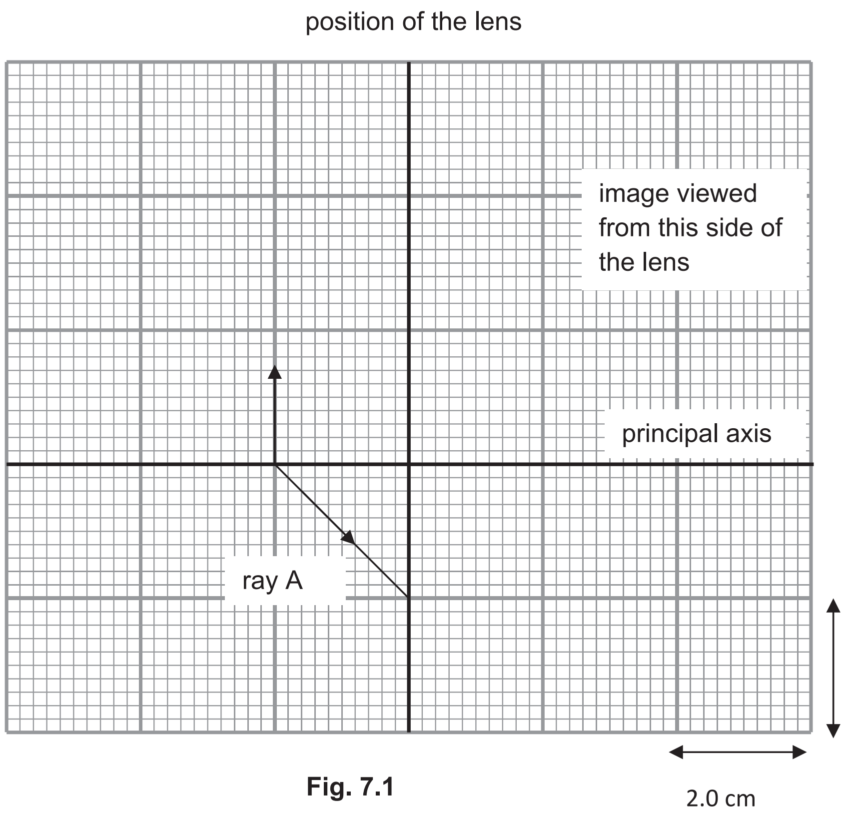


Fig. 7.1

(b) State what is meant by a virtual image.

....

.... [1]

(c) Use your drawing to determine the focal length of the lens.

focal length = ………………………………. [1]

(d) On Fig. 7.1, complete the path of ray A after passing through the lens. [1]

8 **(a)** An acetate rod held in the hand may be charged positively by rubbing it with a cloth, but a copper rod held in the hand cannot be charged this way.

(i) Explain how the acetate rod acquires positive charges when rub with a cloth.

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(ii) Explain why a copper rod held in a hand cannot acquire charges by rubbing with a cloth.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

(b) Fig. 8.1 shows a light positively charged acetate rod hung freely with an insulating thread. An earthed metal sphere is then brought near it.

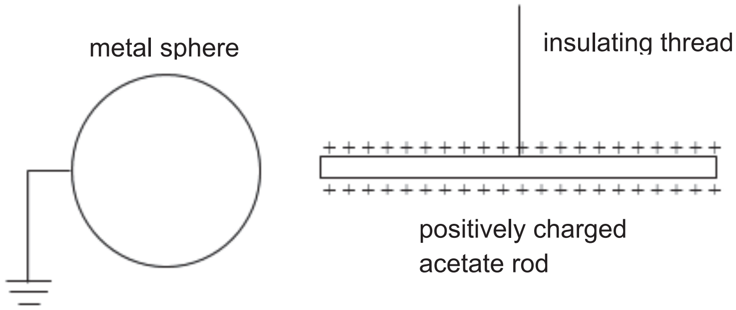


Fig. 8.1

(i) State what happens to the light acetate rod?

....

.... [1]

(ii) Draw the charges on the metal sphere in Fig. 8.1. [1]

9 Fig. 9.1 shows part of a power transmission system. Electricity from the power station is transmitted to end users via transmission cables.

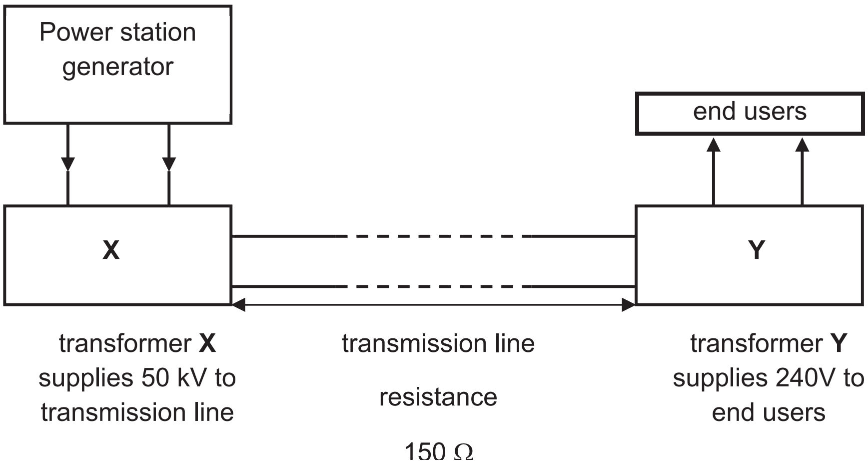


Fig. 9.1

(a) If the power station is transmitting a power of 3.0 kW at 50 kV from transformer **X** to transformer **Y**, calculate the current flowing through the transmission lines.

current = ………………………………. [1]

(b) Calculate the power loss in the transmission lines which has 150 Ω resistance.

power loss = ………………………………. [1]

(c) With reference to your answers from (a) and (b), explain why the power station does not transmit the same power to the houses at 240 V?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………... [2]

Section B

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Q12**.

10 Some countries do not have enough supply of water from rain or from rivers. The scientists in these countries are exploring new ways of getting water. In Canada, one scientist suggests making use of icebergs found in the Atlantic Ocean to obtain water. Icebergs, which are made from fresh water, can be towed to a port in the country. Once they arrive, they are allowed to melt either in the sun or by energy from a local power station.

Based on the Table 10.1, you are required to evaluate the feasibility of towing an iceberg to a port in Canada to obtain fresh water.

Distance between the iceberg and the port in Canada	1.2×10^4 km
Average towing speed	0.75 m/s
Effective surface area of iceberg exposed to the sun	4.5×10^5 m^2
Sun's radiation at the Earth's surface	700 W/m^2
Mass of iceberg	1.5×10^{11} kg
Specific latent heat of fusion of ice	3.4×10^5 J/kg
Electrical power output from local power station	550 MW

Table 10.1

(a) Explain what is meant by the statement *ice has a specific latent heat of fusion of 3.4×10^5 J/kg.*

…………………………………………………………………………………………………..

………………………………………………………………………………………………….. [1]

(b) What is the time taken to tow the iceberg to the port in Canada?

time taken = ……………………………… [1]

(c) Calculate the total amount of solar energy absorbed by the iceberg while it is towed to the port.

solar energy = ………………………………. [2]

(d) **(i)** Estimate the mass of ice melted by the sun as the iceberg is towed to the port.

mass of ice = ………………………………. [2]

(ii) State an assumption that you have made in **(d)(i)**.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

(e) Once the iceberg reaches the port, it can be melted either in the sun or by energy from a local power station. Which is a faster method to melt the ice? Support your answer with appropriate calculations.

……………………………………………………………………………………………...

……………………………………………………………………………………………...

……………………………………………………………………………………………... [2]

(f) Suggest a possible environmental problem of using this method to obtain fresh water.

…………………………………………………………………………………………….. [1]

11 **(a)** Fig. 11.1 shows a simple setup that can be used to detect seismic waves from earthquakes. The setup consists of a bar magnet suspended from a spring hanging from a metal rod. The metal rod transmits vibrations from the Earth and the magnet moves in and out of the coil when there is an earthquake. The coil is connected to a cathode-ray oscilloscope (c.r.o.) that monitors the e.m.f across the coil.

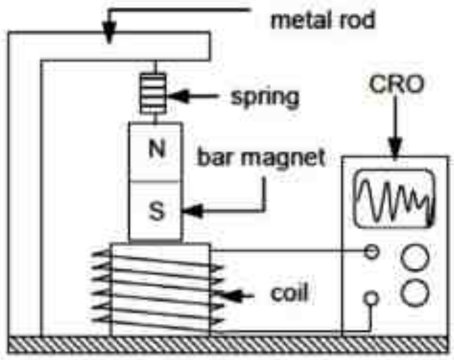


Fig. 11.1

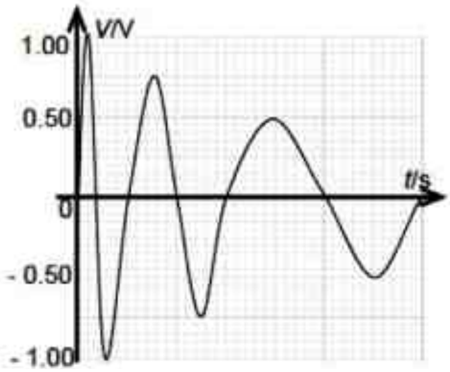


Fig. 11.2

Fig. 11.2 shows the trace that was displayed on the c.r.o. during a particular earthquake. Each complete oscillation of the same magnitude represents one tremor.

(i) Describe and explain how a trace shown on the c.r.o. in Fig. 11.2 is obtained when there is an earthquake.

....

....

....

....

.... [4]

(ii) On Fig. 11.1, indicate the direction of the current in the coil when the south pole of the magnet is moving into the coil. [1]

(b) An output voltage of 2.0 V from a generator is connected to the primary coil of a step-up transformer with a turns ratio of 1:50. The current in the secondary coil is 2.4 mA. The transformer is 75% efficient.

(i) State the metal used for the core of a transformer.

.... [1]

(ii) Calculate the current in the primary coil.

current = ………………………………. [2]

(iii) State two reasons why a typical transformer is not 100% efficient.

…………………………………………………………………………………………

…………………………………………………………………………………………

………………………………………………………………………………………… [2]

12 EITHER

A student makes a 2.0 V battery by connecting two cells of electromotive force (e.m.f.) 2.0 V in parallel. The battery, an ammeter with different ranges and three different resistors are used to set up the circuit shown in Fig. 12.1.

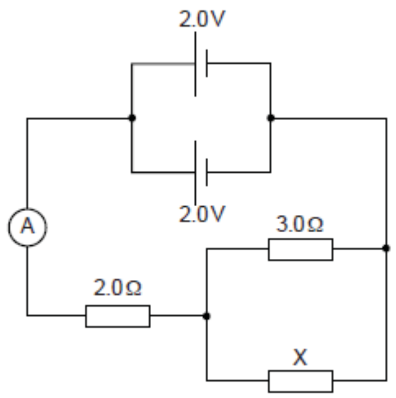


Fig. 12.1

(a) State and explain one advantage of using two cells in parallel rather than using a single 2.0 V cell.

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

………………………………………………………………………………………………….. [2]

(b) The total resistance of the circuit is 4.0 Ω.

Calculate the resistance of **X**.

resistance of **X** = ………………………………. [2]

(c) **(i)** Determine the reading of the ammeter.

reading = ………………………………. [1]

(ii) Suggest a suitable range for the ammeter.

.... [1]

(d) State the potential difference (p.d.) across the [1]

(i) 2.0 Ω resistor, and

p.d. = ...

(ii) 3.0 Ω resistor.

p.d. = ...

(e) The student sets up a second circuit using a variable d.c. power supply, an ammeter and a 12 V metal filament lamp. The circuit is shown in Fig. 12.2.

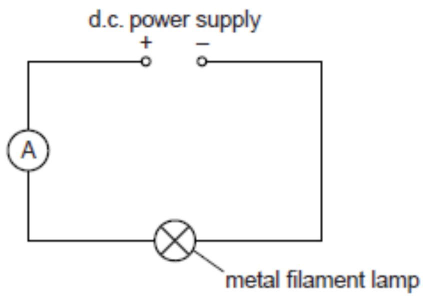


Fig. 12.2

The d.c. power supply is set to 12 V and the ammeter reading is 1.5 A. The student changes the e.m.f. of the d.c. power supply to 6.0 V. The lamp dims and the ammeter reading changes.

(i) State and explain what happens to the resistance of the filament lamp.

....

....

.... [2]

(ii) State whether the new ammeter reading is less than, equal to or greater than 0.75 A.

.... [1]

12 OR

(a) In a particular light experiment, a ray of light is passed through water into air as shown in Fig. 12.3.

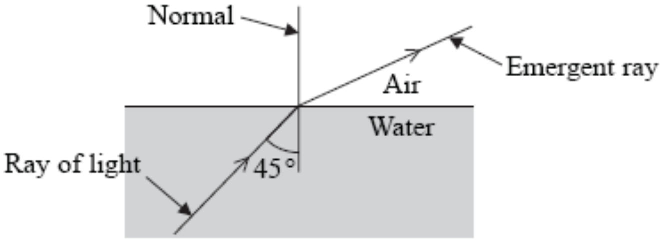


Fig. 12.3

Explain why the ray of light changes its direction when it emerges from water as shown.

……………………………………………………………………………………………..

……………………………………………………………………………………………..

…………………………………………………………………………………………….. [2]

(b) The experiment in (a) is repeated using a semicircular glass block as shown in Fig. 12.4. The refractive index of glass is 1.60.

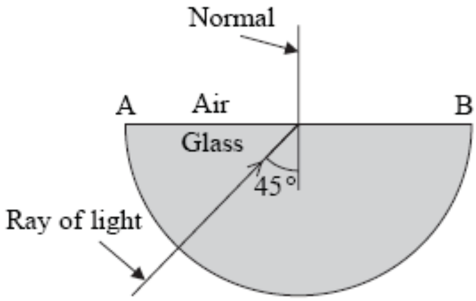


Fig. 12.4

(i) Explain why the ray of light does not change direction when it enters the glass.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

(ii) Explain why the ray of light does not emerge from the straight edge **AB** of the glass block. Show relevant working.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [4]

(iii) On Fig. 12.4, draw accurately the complete path for the ray of light until it emerges from the glass block again. [1]

(iv) The speed of light in air is 3.00×10^8 m / s. Calculate the speed of light in the glass block.

speed = ………………………………. [2]

END OF PAPER
Setter: Mr Luqman

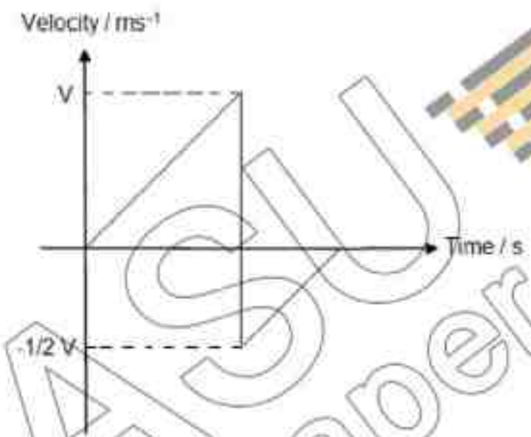
Answers to 2018 PRELIM 4E Physics 6091

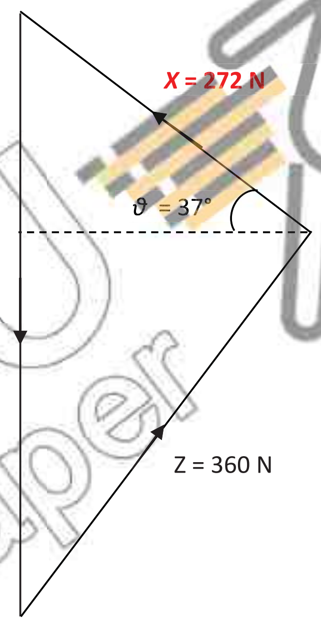
Paper 1

1	B	**11**	D	**21**	D	**31**	C
2	A	**12**	A	**22**	A	**32**	B
3	B	**13**	C	**23**	C	**33**	C
4	C	**14**	A	**24**	D	**34**	A
5	C	**15**	B	**25**	C	**35**	D
6	C	**16**	B	**26**	A	**36**	A
7	C	**17**	D	**27**	C	**37**	D
8	D	**18**	C	**28**	A	**38**	B
9	C	**19**	B	**29**	D	**39**	C
10	A	**20**	C	**30**	B	**40**	C

Paper 2

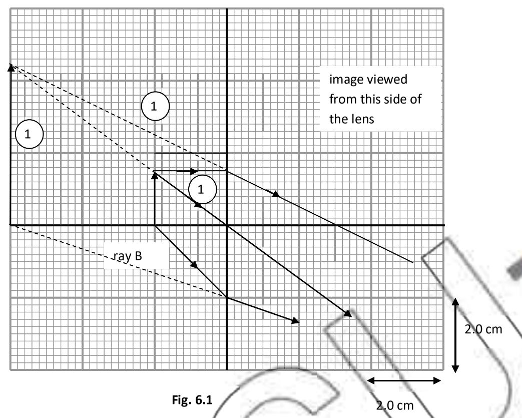
Section A

QN		SOLUTION	MARKER'S REPORT
1	(a)	Correct shape before rebound [1] Correct shape after rebound [1] 	
	(b)	a = (v-u)/t 10 = (v-0)/t t = v/10 ½ x t x v = 20 ½ x (v/10) x v = 20 [1] v^2 = 400 v = 20 m/s [1]	
	(c)	Rebound height = ½ x 1 x 10 = 5m [1]	

	(d)	Displacement of the ball = 20 – 5 = 15 m [1] Changed in velocity = 20 – (-10) = 30 m/s [1]	
2		θ = 37° [1] (accepts 36° to 38°) X = 272 N [1] (accepts X ranges from 250 to 290 N) All arrows points in the correct directions [1] Scale marks only given to students who give a scale **1:50 +/- 10N** only, provided the forces Y and Z are represented correctly and accurately. Else, no mark even if the scale is correct.[1] 	
3	**(a)**	Downward arrow drawn in the middle of the rod. W indicated for weight. Must indicate distance (e.g. 1.5 m from point X) [1]	
	(b)	Taking moments about X, at equilibrium (T_2 x 2.3) + (20 x 0.2) = (10 x 1.3) + (40 x 1.6) [1] [M1: award 1 mark if there are 2 correct calculation of moments] T_2 = 31.739 = 31.7 N [1] (3sf)	

	(c)	Total Upwards Force = Total Downwards Force T1 = 70 N – 31.7 N =38.3N [1]	
4	**(a)**	F = ma 8000 – 340 = 2560 x a [1] a = 2.99 m/s^2 [1]	
	(b)	Acceleration will decrease till it becomes zero [1] Resultant force will decrease because air resistance has increased [1] Acceleration becomes zero when forward force equal air resistance.	
	(ci)	a = (v – u)/ t 2.2 = (55 – 0)/ t t = 25 s [1]	
	(cii)	Distance = Area under Speed Time Graph Dist = ½ (25)(55) [1] Dist = 688 m [1]	
	(d)	To provide a streamline body In order to reduce air resistance [1]	
5	**(a)**	At B, it is open to the atmosphere. Since atmospheric pressure is 76 cm Hg, the mercury can rise to a maximum height of 76 cm. [1] At A, the tube is connected to a vacuum, this means that there is no gas pressure acting on the top surface of liquid in the tube, therefore the mercury will rise to a maximum of 76 cm Hg. [1]	
	(b)	P = hρg = 0.76 x 13600 x 10 [1] = 1.03 x 10^5 Pa [1]	

	(c)	Height <u>increases</u> as pressure on mercury surface increases. [1] When temperature increases, average k.e. of molecules increases. Molecules move faster and hit the mercury surface with <u>greater force</u> and at <u>higher frequency</u>. [1] causing <u>force per unit area</u> or <u>pressure to increase</u>. [1]	
6	**(a)**	$Q = ml_v$ $VIt = ml_v$ $240 \times 1.6 \times 8 \times 60 = 0.075 \times l_v$ [1] $l_v = 2460\ J\ g^{-1}$ or $2{,}460{,}000\ J\ kg^{-1}$ [1]	
	(b)	Yes, it is higher. [1] There is **heat lost** to the surroundings by conduction, convection and radiation. The amount of heat received by the water for boiling is thus **smaller** than the calculated value. [1]	
	(c)	The use of vacuum flask reduces heat lost to the surroundings by conduction, convection and radiation. [1]	

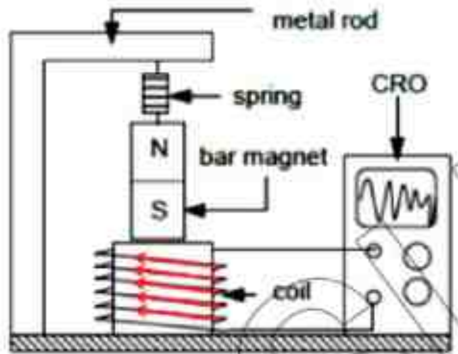
7	(a)	position of the lens  Fig. 6.1	
	(b)	A virtual image is an image that cannot be formed on a screen. [1]	
	(c)	f = 3.0 cm [1]	
	(d)	correct drawing using concept ray from of bottom of object originate from bottom of image [1]	
8	(ai)	The **electrons** are transferred from atoms of the acetate rod to the cloth due to friction of rubbing. [1] Acetate rod loses electrons and become positively charged. [1]	
	(aii)	Copper is a **conductor**. The acquired charges by rubbing will be neutralized by the hand. [1]	
	(bi)	The acetate rod is attracted to the sphere. It moves closer to the sphere. [1]	
	(bii)	Negative charges on the right side of sphere [1]	

9	**(a)**	Current = Power/Voltage = 3000/50000 = 0.06 A [1]	
	(b)	Power loss = 0.06 x 0.06 x 150 = 0.54 W [1]	
	(c)	If the voltage is 240 V, I = 3000/240, will be high. [1] When this current flows through the transmission cable of 150 Ω, the heat generated will be very high. This results in energy loss and monetary loss.[1]	

Section B

QN		**SOLUTION**	**MARKER'S REPORT**
10	**(a)**	3.4×10^5 J of thermal energy is required to change 1 kg of ice from solid to liquid state (or vice versa) without a change in temperature. [1]	
	(b)	Time required = $(1.2 \times 10^4 \times 1000) / 0.75$ = 1.6×10^7 s [1]	
	(c)	Effective solar power received = $(4.5 \times 10^5) \times 700$ = 3.15×10^8 W [1] From P = E / t, E = $3.15 \times 10^8 \times 1.6 \times 10^7$ = 5.04×10^{15} J [1]	

	(di)	From $Q = ml_f$, $m = (5.04 \times 10^{15}) / 3.4 \times 10^5$ [1] $= 1.48 \times 10^{10}$ kg [1] ecf given	
	(dii)	There is no heat gain by the surrounding / All the energy supplied by the sun is absorbed by the iceberg. [1]	
	(e)	Rate of heating by the sun = $(4.5 \times 10^5) \times 700 = 3.15 \times 10^8$ W Rate of heating by the power station = 550 MW = 5×10^8 W [1] Using energy from the power station is a more efficient way to melt the ice. [1]	
	(f)	The ice that melts during the towing process will contribute to rising sea levels which can cause flooding in low-lying areas./ Loss of habitats [1]	
11	**(ai)**	During an earthquake, the magnet moves in and out of coil, producing a change in magnetic flux linking the coil, thus inducing an emf at the solenoid. By Lenz's Law, the direction of the emf changes when the magnet moves in and out of the coil, [1] hence an alternating trace is produced. [1] By Faraday's Law, the magnitude of the induced emf is proportional to the rate of change of magnetic flux linkage, [1] hence a larger tremor will produce a trace with a higher amplitude. [1]	

	(aii)	 [1]	
	(bi)	Soft iron [1]	
	(bii)	V_s = 50 x 2.0 = 100 V 0.75 x $V_pI_p = V_sI_s$ 0.75 x 2.0 x I_p = 100 x 0.0024 [1] I_p = 0.16 A [1]	
	(biii)	Induced (eddy) currents are formed in the core of the transformer. / There is heat loss due to the resistance in the wires. / There is magnetic flux leakage between the primary and secondary coil. (any two) [2]	
12E	**(a)**	Any one of: • The cells last longer Reason: Each cell supplies half the current needed. • The circuit continues to work if one cell is flat. Reason: The circuit is still a closed circuit. • A cell can be replaced without switching off. Reason: The circuit is still a closed circuit. [2]	
	(b)	Total R of circuit= R of 2.0 + (Total R of 3.0 & X in parallel) $4.0 = 2.0 + (1/(3.0) + 1/R_X)^{-1}$ [1] $2.0 = (1/(3.0) + 1/R_X)^{-1}$ $1/(2.0) = 1/(3.0) + 1/R_x$	

		$1/R_X = 1/(6.0)$ $R_X = 6.0\ \Omega$ (2 s.f.) [1]	
	(ci)	$I = V/R$ $= (2.0)/(4.0)$ $= 0.50$ A (2 s.f.) [1]	
	(cii)	0 A to 0.50 A (accept till 5.0 A) [1] e.c.f given	
	d(i) **d(ii)**	p.d.=1.0 V p.d.=1.0 V [1]	
	(ei)	The resistance of the filament lamp decreases. [1] With less voltage across the filament lamp (and hence less current through the lamp), the temperature of the filament lamp decreases. [1]	
	(eii)	The new ammeter reading is less than 0.75 A. [1]	
12O	**(a)**	-Air is optically less dense than water. -Speed of light increases as it gets from water to air -Causing light to bend away from normal 2 marks for all 3 points 1 mark for ½ points	
	(bi)	Angle of incidence is 0°. / incident ray lies along the normal. [1]	
	(bii)	$n = 1 / \sin c$ $c = \sin^{-1} (1 / 1.60)$ [1] $= 38.7°$ [1] Angle of incidence greater than critical angle AND total internal reflection occurs. [1] Light moving from optically denser medium (glass) to optically less dense medium (air). [1]	

	(biii)	45 ° at point of incidence AND Reflected ray straight out into air. [1]	
	(c)	$n = c / v$ $1.60 = 3.00 \times 10^8 / v$ [1] $v = 1.88 \times 10^8$ m / s [1]	

Bukit Batok Secondary School
O-LEVEL PRELIMINARY EXAMINTION 2018
SECONDARY FOUR EXRESS

PHYSICS **6091 / 01**

Paper 1 Multiple Choice

21 August 2018
1115 — 1215 hrs
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class, and class register number on the answer sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages (including this cover page)

1 Which of the following quantities is a base quantity?

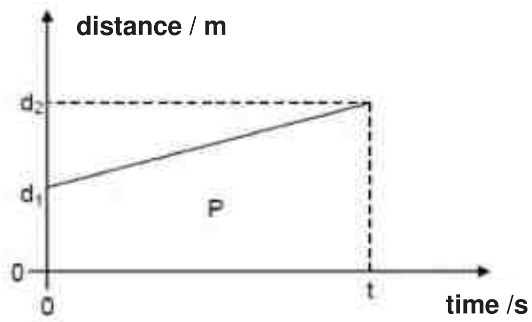
A charge
B energy
C force
D temperature

2 A student wanted to measure the diameter of a pen.

Which steps provide most accuracy in the measurement?

A Take average values of the diameter using a ruler.
B Take average values of the diameter using vernier calipers with zero error.
C Take average values of the diameter using vernier calipers without zero error.
D Take one value of the diameter using a micrometer with zero error.

3 The distance-time graph below shows the distance travelled by a moving car. P represents the area under the graph.



Which of the following expressions would be used to determine the average speed of the car?

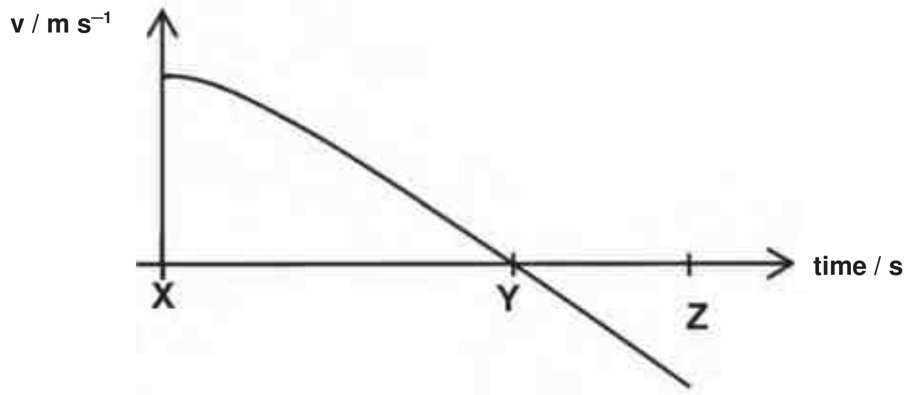
A P / t
B d_2 / t
C (d_2 + d_1) / t
D (d_2 − d_1) / t

4 A bus was travelling at a speed of 20 m/s. When the bus was 50 m from a traffic light, the light turned red. The bus driver reacted immediately and applied a constant braking force for 5.0 s. The bus decelerated at 4.0 m/s^2.

Which of the following correctly describes the motion of the bus?

A The bus stopped past the traffic light.
B The bus stopped at the traffic light.
C The bus stopped before the traffic light.
D The bus continued to move past the traffic light with decreasing speed.

5 A toy rocket is accelerated vertically upwards. The velocity-time graph below shows the relationship between the velocity of the rocket and time.

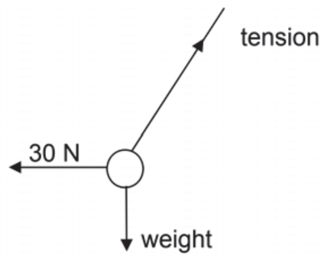


Which of the following statements is/are correct?

(1) The rocket reaches the highest position at instant X.
(2) The resultant force acting on the rocket is zero at instant Y.
(3) The rocket is still in the air at instant Z.

A (1) only
B (3) only
C (1) and (2) only
D (2) and (3) only

6 A pendulum bob of mass 2.0 kg is pulled horizontally to the left by a 30 N force as shown.



Which will be the approximate final tension in the string when the bob is in equilibrium?

A 30 N
B 36 N
C 40 N
D 45 N

7 A constant force of 40 N acts on an object of mass 2.0 kg. The object moves along a rough horizontal surface with an acceleration of 5.0 m/s^2.

What is the average frictional force acting on the object?

A 8.0 N
B 10 N
C 30 N
D 50 N

8 Which property of an object resists a change in the state of rest or motion of the object?

A acceleration
B density
C mass
D volume

9 A bottle full of mercury has a mass of 730 g. When the same bottle is filled with an unknown liquid P, its mass is 100 g. The mass of the empty bottle is 50 g.

Calculate the density of the unknown liquid P. (Take density of mercury to be 13.6 g/cm^3)

A 1.0 g/cm^3
B 2.0 g/cm^3
C 7.0 g/cm^3
D 14.4 g/cm^3

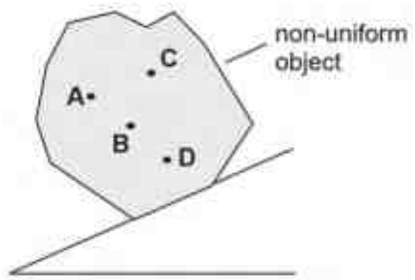
10 A uniform rectangular board (8.0 m x 2.0 m), pivoted at its centre X, is acted on by three forces on the edges.

What is the size of force *F* such that the board remains in equilibrium?

A 40 N
B 45 N
C 85 N
D 90 N

11 A non-uniform object is placed on an inclined plane as shown below.

If the object is just about to topple, which position is the centre of gravity?



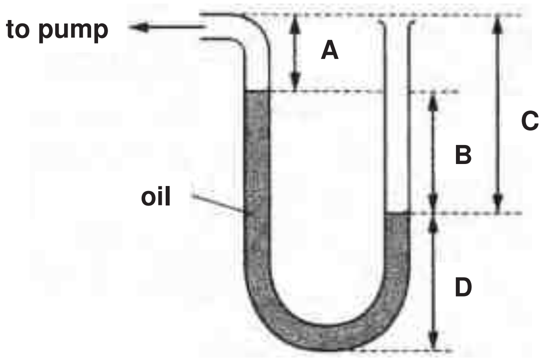
12 A student left two identical, heavy, stone blocks resting on soft earth.
One is vertical and the other is horizontal as shown in the diagram below.

Which row correctly compares the force and the pressure that the two blocks exert on the earth?

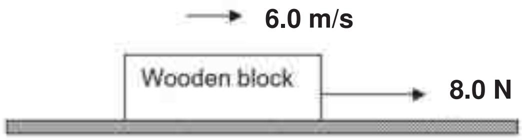
	force	pressure
A	same	different
B	same	same
C	different	different
D	different	same

13 One end of an oil-filled manometer is connected to a pump. The other end is open to the atmosphere.

Which length is used when calculating the difference between pressure of the air in the pump and atmospheric pressure?



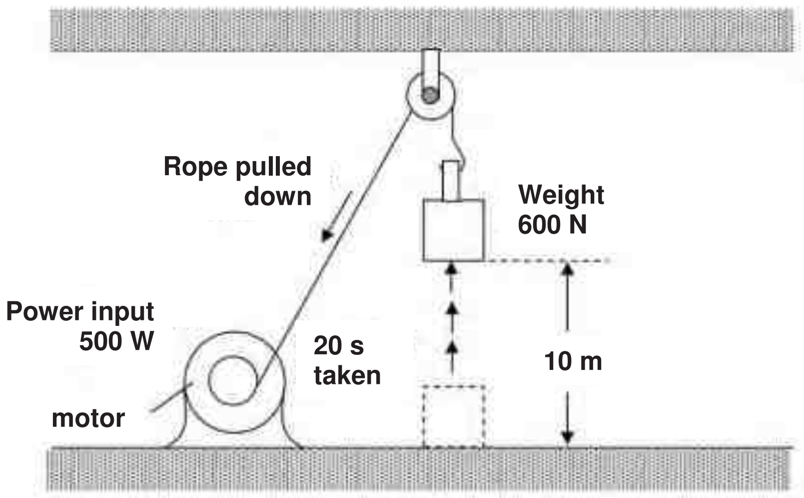
14 A block of wood is pulled along a horizontal bench at a constant speed of 6.0 m/s by a force of 8.0 N.



How much work is done in 5.0 s against the frictional force?

A 40 J
B 48 J
C 240 J
D 480 J

15 The diagram below shows a motor having a power input of 500 W.



It is used to lift a load weighing 600 N through a vertical height of 10 m in 20 s.

What is the useful power output of the motor?

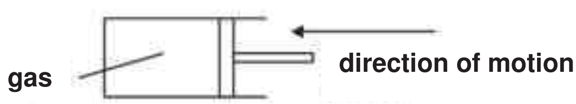
A 300 W
B 390 W
C 500 W
D 800 W

16 When a tennis ball drops onto a hard and smooth horizontal surface, it bounces up and down in the air. The height of each bounce gradually reduces until the ball stops moving.

Which of the following statements is true?

A The kinetic energy of the ball is constant.
B The potential energy of the ball is constant.
C The sum of the kinetic energy and potential energy of the ball is constant.
D The sum of the kinetic energy and potential energy of the ball is not constant.

17 Gas inside a cylinder is cooled slowly to a lower temperature. The pressure inside the cylinder remains constant as the piston moves inwards.



How do the speed of the particles and their rate of collisions with the cylinder and piston compare with their initial values at the higher temperature?

	average speed	rate of collision
A	lower	reduced
B	lower	increased
C	same	same
D	same	reduced

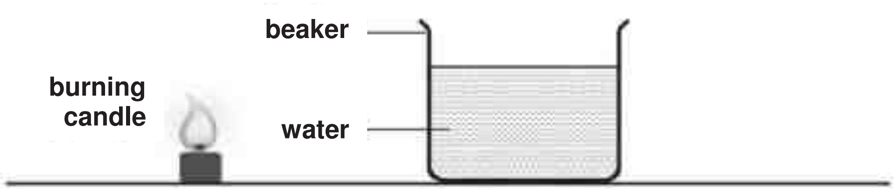
18 The figure below shows a rug and a tiled floor. The rug has been on the floor for a long time.

Which statement(s) correctly explain(s) why the floor feels colder than the rug?

(1) The floor is at a lower temperature than the rug.
(2) The floor is a better conductor of heat than the rug.
(3) The floor has a smaller specific heat capacity than the rug.

A (1) only
B (2) only
C (2) and (3)
D (1), (2) and (3)

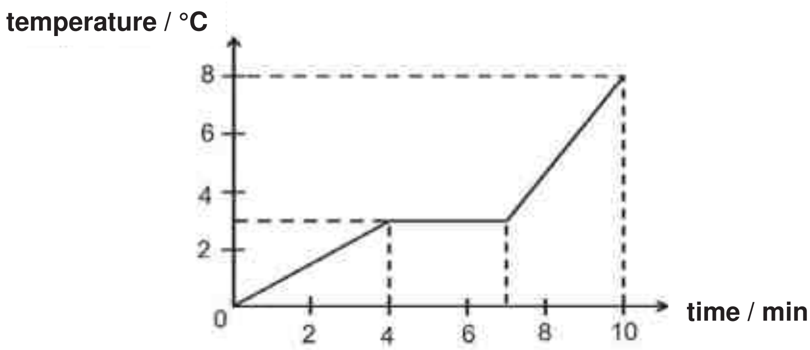
19 The diagram shows a beaker of water placed near a burning candle.



How does thermal energy from the candle reach the water in the beaker?

A conduction, followed by convection
B radiation, followed by conduction
C convection, followed by conduction
D radiation, followed by convection

20 The diagram shows the rise in temperature of 2.0 kg of a substance, X. The substance is initially in solid state and it was heated uniformly at the rate of 2000 J/min.



Which of the following sets of data about X is correct?

	specific heat capacity of solid X in J / (kg °C)	specific latent heat of fusion of X in J / kg
A	8000	6000
B	1330	6000
C	4000	3000
D	1330	3000

21 The water taken from two buckets is mixed together. One bucket contains 5.0 kg of water at 20 °C and the other contains 1.0 kg of water at 80 °C.

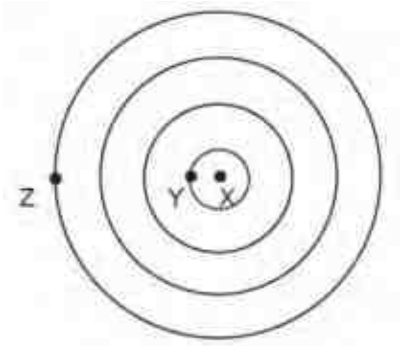
What is the final temperature of the mixture, assuming no heat is lost to the surroundings?

A 30 °C
B 50 °C
C 60 °C
D 70 °C

22 Which of the following changes in physical property **cannot** be used for temperature measurement?

A e.m.f. of a battery
B electrical resistance of a solid
C pressure of a gas
D volume of a liquid

23 The diagram shows circular wavefronts moving from X to Z as seen from the top.



The distance between Y and Z is 1.2 m and the frequency of the dipper at X is set at 15 Hz.

What is the speed of the wave?

A 4.5 m/s
B 6.0 m/s
C 12.5 m/s
D 18.0 m/s

24 A student makes three statements.

(1) All electromagnetic waves can travel in a vacuum and in air.
(2) All waves obey the laws of reflection but some waves do not obey the laws of refraction.
(3) Sound is a longitudinal wave which travels in a direction parallel to the direction of vibrations.

Which statements is/are **not** correct?

A Statement 1
B Statement 2
C Statements 1 & 2
D Statements 2 & 3

25 Statements 1 and 2 are about signals passing through an optical fibre of refractive index of 1.5.

Statement 1: The speed of the signal in the optical fibre is 2.0×10^8 m/s
Statement 2: There is less signal loss in the optical fibre than in a copper cable.

Which statements are correct?

A statement 1 only
B statement 2 only
C statement 1 and 2
D neither of the statements

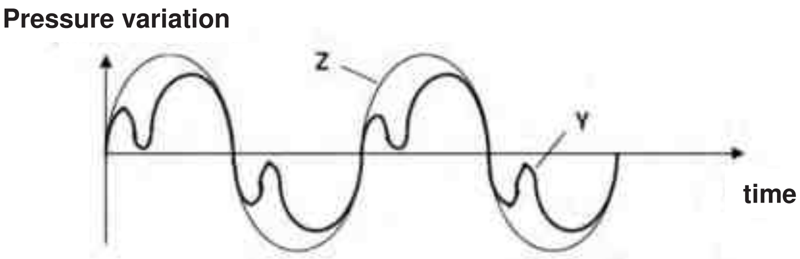
26 Which of the following is arranged in order of decreasing wavelength?

A microwaves, X-rays, visible light
B radio waves, ultraviolet rays, infra-red radiation
C radio waves, visible light, gamma rays
D ultraviolet rays, visible light, infra-red radiation

27 Which electromagnetic wave is most likely to cause structural damage to living cells and tissue?

A infra-red radiation
B microwaves
C radiowaves
D ultra-violet radiation

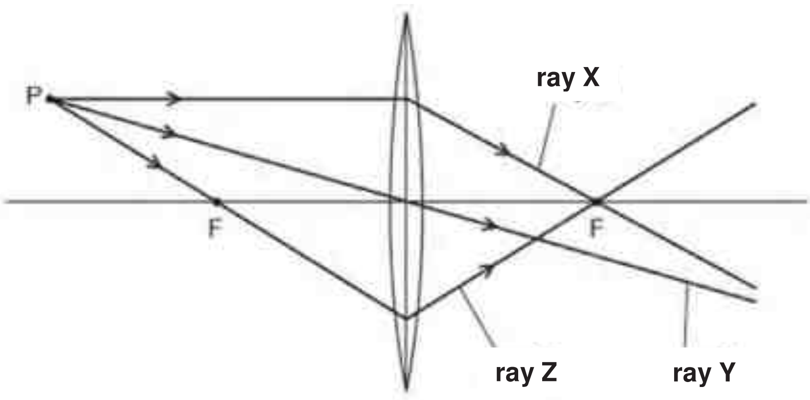
28 The diagram shows waveforms produced by a flute (Y) and turning fork (Z) played by two students.



How does the loudness and pitch of the sound from the turning fork Z compare to flute Y?

A The loudness of Y is lower but has the same pitch as compared to Z.
B Both Y and Z have the same pitch and loudness.
C The loudness of Y is higher and the pitch is lower as compared to Z.
D The loudness of Y is the same and the pitch is higher as compared to Z.

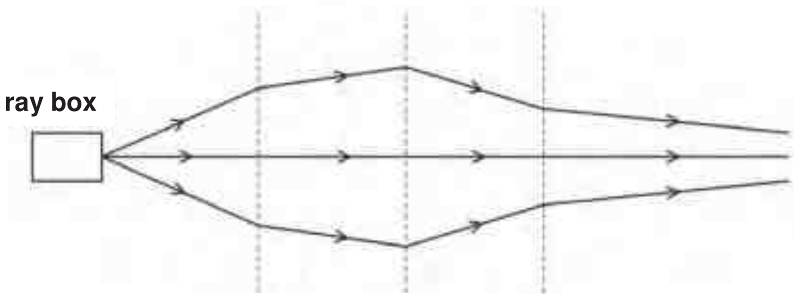
29 A student draws three rays of light from point P through a converging lens.
Each point labelled F is a principal focus of the lens.



Which of the rays is/are drawn correctly?

A ray Y only
B ray Z only
C ray X and Y
D ray X and Z

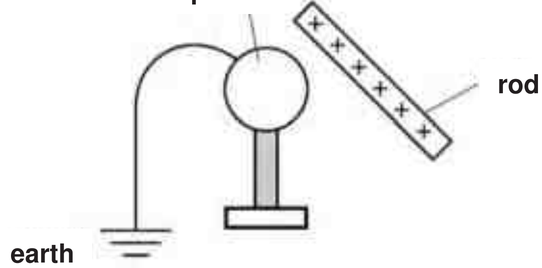
30 The rays of light from a ray-box pass through three lenses placed at positions 1, 2 and 3.



What type of lens is used at each position?

	position 1	position 2	position 3
A	converging	converging	converging
B	converging	converging	diverging
C	diverging	converging	diverging
D	diverging	diverging	converging

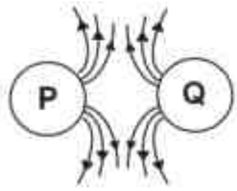
31 A positively charged rod is held close to an earthed metal sphere.



Which of the following describes the charge on the metal sphere?

A It is negative because electrons are attracted towards the rod.
B It is neutral because electrons are attracted towards the rod and protons are repelled.
C It is neutral because it is earthed.
D It is positive because protons are repelled by the rod.

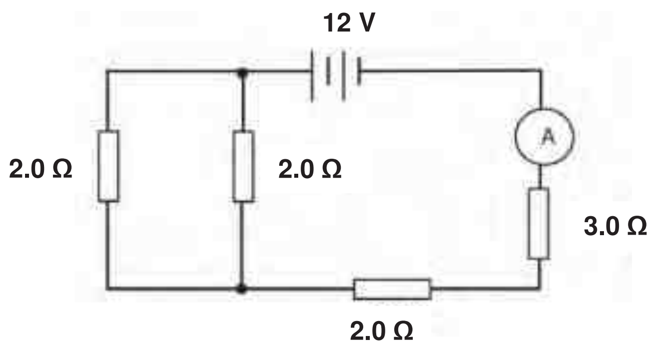
32 The figure below represents the electric field lines in the vicinity of two isolated electric charges, P and Q.



Which statement identifies the charges P and Q?

A Both P and Q are negative.
B Both P and Q are positive.
C P is positive and Q is negative.
D P is negative and Q is positive.

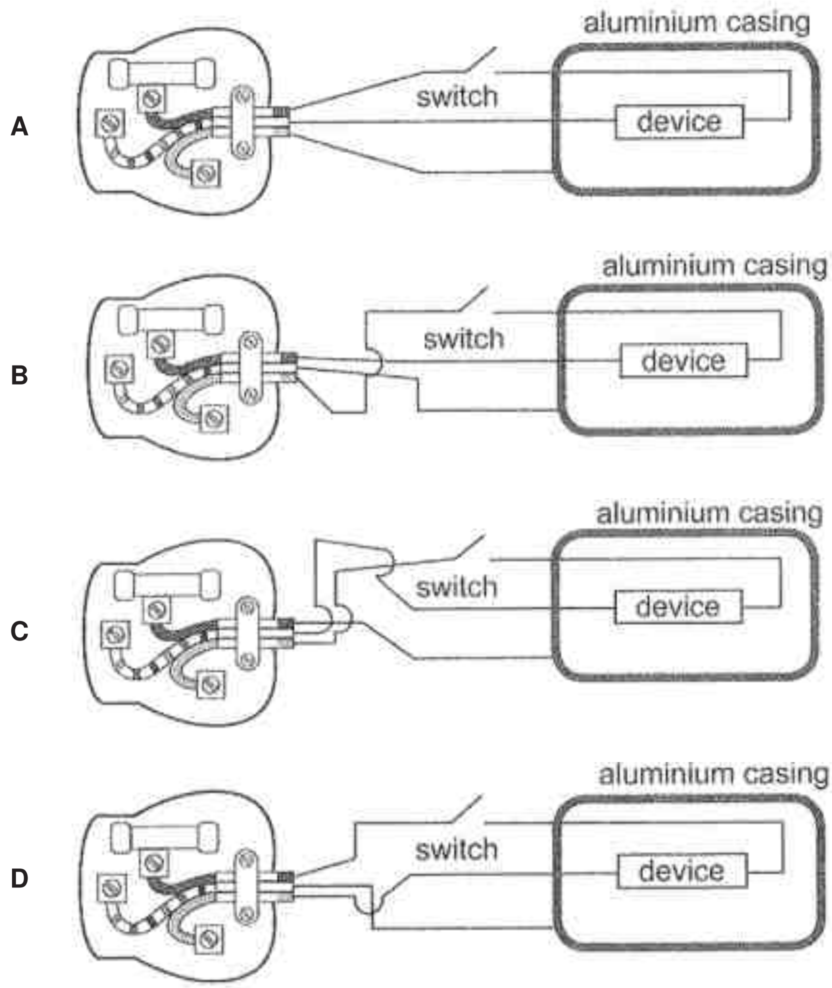
33 A circuit is set up in the diagram below.



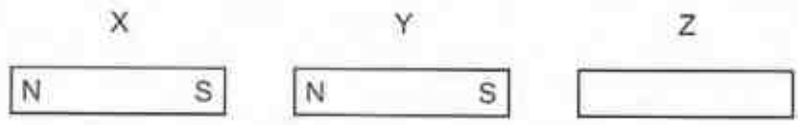
What is the ammeter reading in the circuit?

A 0.50 A
B 0.67 A
C 1.5 A
D 2.0 A

34 Which one of the following electrical appliances is correctly wired to a three-pin plug?



35 The diagram shows three bars placed in a line. X and Y are both magnets. Z is soft iron.

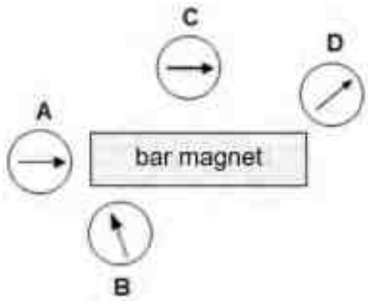


What are the magnetic forces on X and Z due to magnet Y?

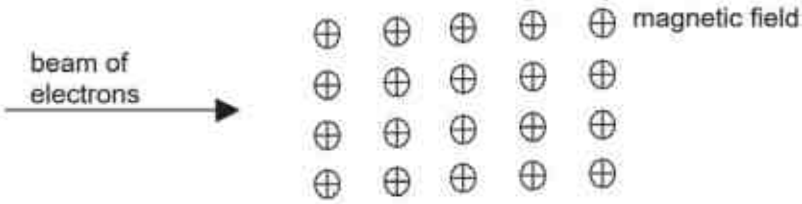
	force on X	force on Z
A	attraction	attraction
B	attraction	repulsion
C	repulsion	attraction
D	repulsion	repulsion

36 Four magnetic compasses are placed near a bar magnet as shown in the figure below.

Which compass is faulty?



37 The following figure shows a beam of electrons entering a magnetic field going into the paper.

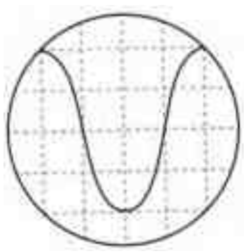


How will the beam of electrons be deflected?

A downwards
B into the paper
C upwards
D out of the paper

38 The diagram shows the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals.

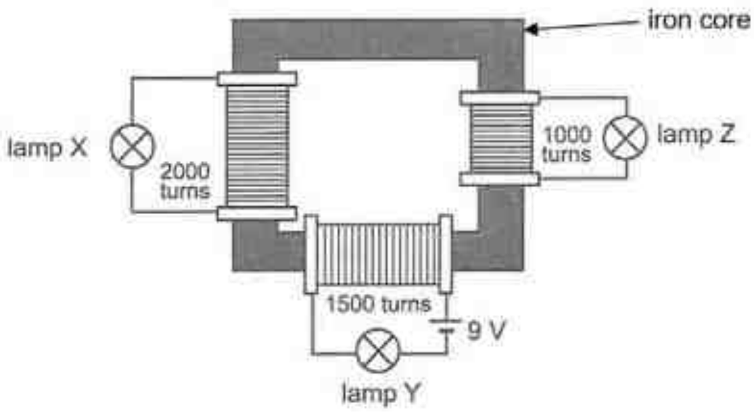
The time-base is set at 2.0 ms / div and the y-gain is set at 2.0 V / div.



Which of the following correctly represents the peak voltage and frequency of the signal?

	peak voltage / V	frequency / Hz
A	4.0	83.3
B	4.0	125
C	8.0	83.3
D	8.0	125

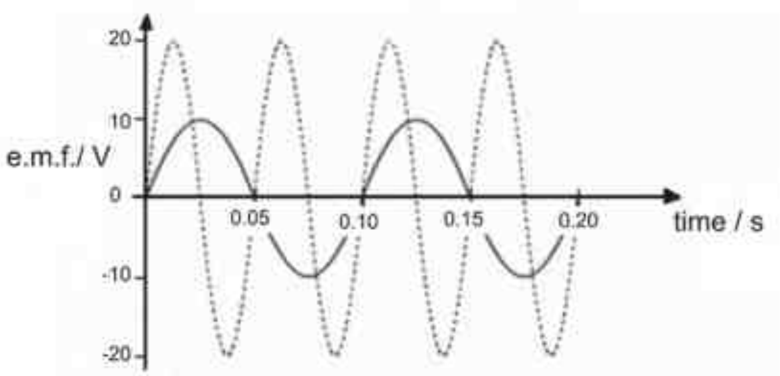
39 Three identical filament lamps, X, Y and Z, are connected to an iron core with multiple coils. The resistance of each lamp is 4.5 Ω and each requires a current of 2.0 A to light up normally.



What can be observed about the brightness of the three lamps?

	lamp X	lamp Y	lamp Z
A	dimmer than normal	normal brightness	brighter than normal
B	brighter than normal	normal brightness	dimmer than normal
C	not lit	normal brightness	not lit
D	not lit	not lit	not lit

40 In the graph shown, the solid curve shows how the e.m.f. produced by a simple a.c. generator varies with time. The dashed (dotted) curve is the output from the same generator after a modification has been made to the generator.



Which modification was made to produce the new output shown?

A The thickness of the coil was doubled.
B A split-ring commutator was added.
C The number of turns in the coil was doubled.
D The speed of rotation of the coil was doubled.

------ END OF PAPER ------

Class	Register Number	Name

Bukit Batok Secondary School
O-LEVEL PRELIMINARY EXAMINATION 2018
SECONDARY FOUR EXPRESS

PHYSICS **6091 / 02**
Paper 2 Theory
17 August 2018
0745 – 0930 hrs
1 hour 45 minutes

Candidates answer on the Question Paper.

Additional Materials: No additional materials needed

READ THESE INSTRUCTIONS FIRST

Write your name, class, and class register number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question **13** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

Take the gravitational field strength, *g* to be 10 N/kg where needed.

At the end of examination, fasten any separate answer paper to the Question Paper.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **19** printed pages (including this cover page).

Section A [50 marks]

Answer **all** the questions in this section.

1 An athlete uses an exercise machine, as shown in Fig. 1.1.

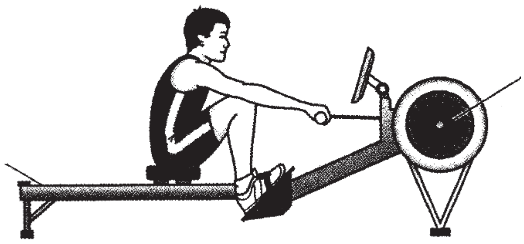


Fig. 1.1

The athlete moves forward and backwards along the track. As he pulls the handle, he moves backwards and the machine displays the force exerted by the handle. At the end of the track, he stops pulling and then returns to the position shown. This is one complete movement.

(a) An accurate value for the average power for one complete movement is obtained.

Describe what measurements are taken and how they are used to find the average power for one complete movement.

....

....

....

....

....

....[4]

(b) Forces act on the athlete as he exercises. Identify an action-reaction pair of forces.

....

....[1]

2 A student stands near the edge of a cliff. He throws a ball upwards, as shown in Fig. 2.1.

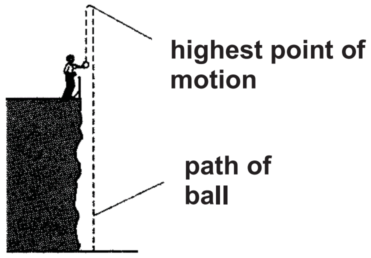


Fig. 2.1

The displacement-time graph for the first 1.0 s of motion is shown in Fig. 2.1. Air resistance is negligble in the first 1.0 s of motion.

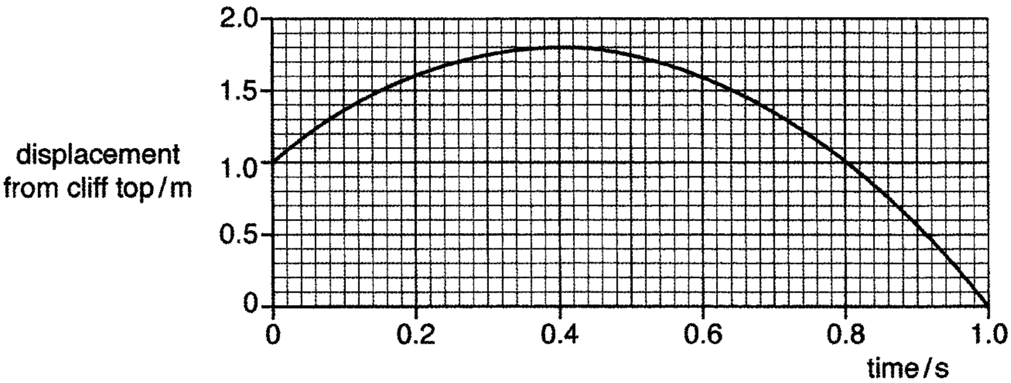


Fig. 2.1

(a) Estimate the average velocity of the ball from t = 0.8 s to 1.0 s

average velocity =…………………..…………….. [2]

(b) The ball continues to fall after 1.0 s. The effect of air resistance becomes significant and the ball eventually reaches terminal velocity.

Describe how the velocity and acceleration of the ball changes as it reaches terminal velocity.

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

…………………………………………………………………………………………………….[2]

3 Fig. 3.1 shows a stationary piston in a cylinder. It consists of a piston on one end and is sealed on the other end.

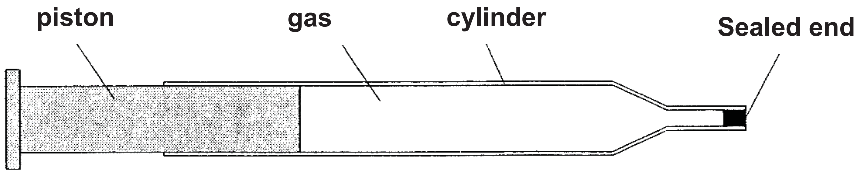


Fig. 3.1

The gas in the cylinder exerts the same pressure on the piston as it does on the sealed end.

(a) Using ideas about molecules, explain why the pressures are the same.

………

………

………[2]

(b) The piston is held in place and the cylinder is cooled. Temperature of the cylinder and gas dropped by 15 °C.

Using ideas about molecules, state and explain the change in pressure of the gas.

………

………

………

………[3]

4 Fig. 4.1 shows steam from a boiler passing through a turbine connected to a generator. Steam passes through the turbine in the coiled copper tube and condenses in the condenser. The internal energy of the seawater rises.

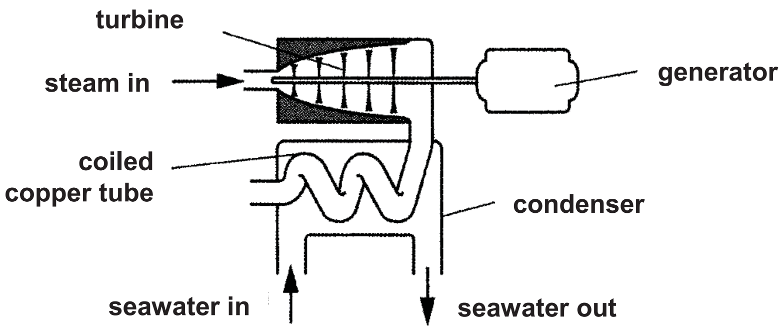


Fig. 4.1

(a) State the effect(s) of condensation of steam on the molecules of the seawater.

……

……

……

……………………………………………………………………………………………………[3]

(b) The seawater enters the condenser at a temperature of 30 °C, and leaves at a temperature of 64 °C. In a certain time, 265 MJ of thermal energy passes into the seawater.

The specific heat capacity of seawater is 3.9 kJ / (kg °C).

Calculate the mass of seawater that enters the condenser in this time.

mass =……………………………………. [2]

5 Fig. 5.1 (drawn to scale) shows rays of light travelling in water from a light source **O**.

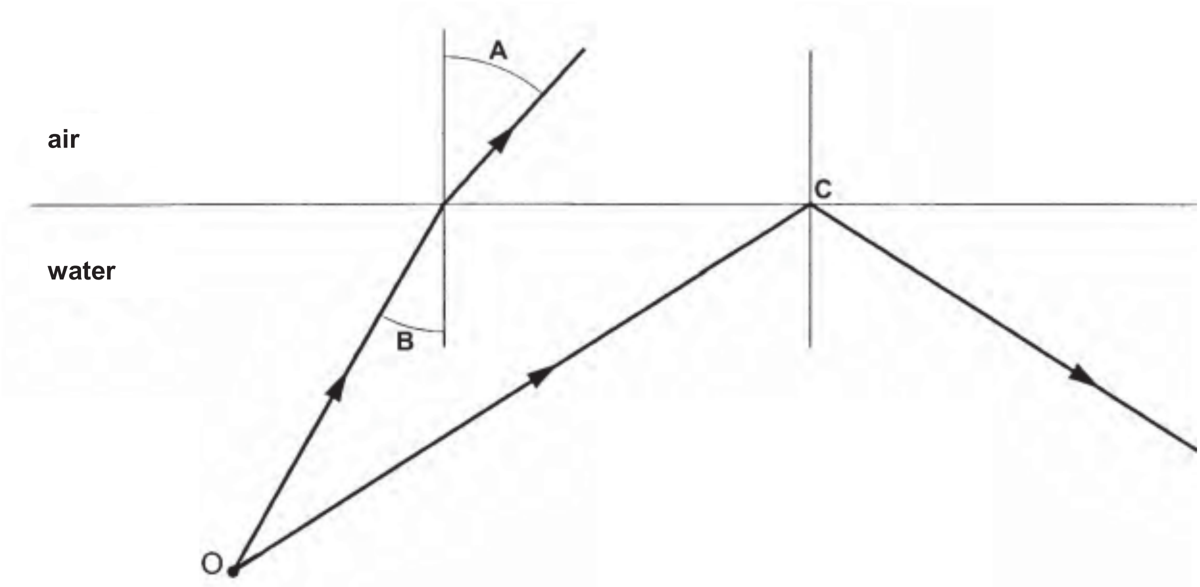


Fig. 5.1 (to scale)

(a) **(i)** Measure and write down the sizes of angles **A** and **B**.

angle **A** =…………………..…… & angle **B** =…………………..…… [1]

(ii) Hence, determine the refractive index of water.

refractive index =…………………..…………….. [2]

(b) Explain why the light ray does **not** escape from the water surface at point **C**.

……….

……….

……[2]

6 Some electrical components are easily damaged if electric charge is placed on them. They are often stored by placing them in contact with a conductor.

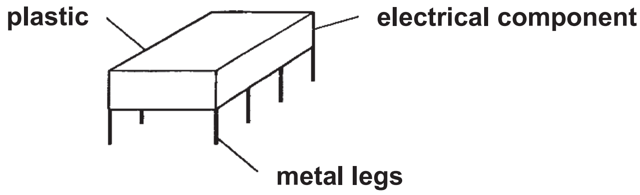


Fig. 6.1

(a) When the component shown in Fig. 6.1 is rubbed with a woollen cloth, the metal legs become negatively charged.

Explain how this happens.

....

....[1]

(b) Fig. 6.2 shows the negative charged metal legs placed near a piece of uncharged aluminium foil which rests on an insulator.

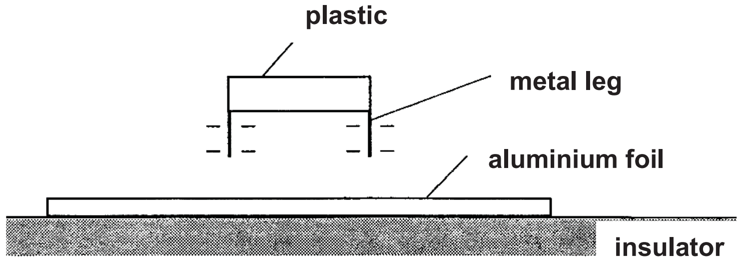


Fig. 6.2

Explain why the aluminium foil is attracted to and sticks to the metal legs.

....

....

....

....[2]

7 Fig. 7.1 shows a coil of wire connected by flexible leads to a switch and a battery.

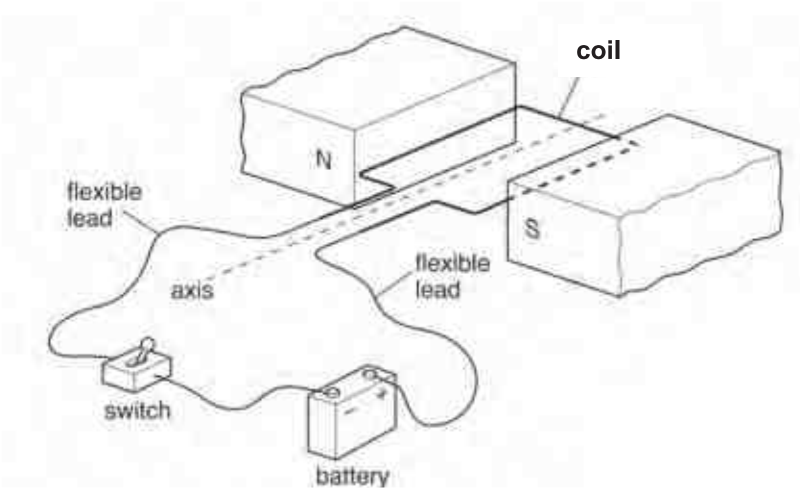


Fig. 7.1

The coil is placed between the poles of a permanent magnet and is free to turn about the axis.
When the switch is closed, forces due to the current act on the sides of the coil.
The coil starts to turn.

(a) **(i)** On Fig. 7.1, draw an arrow to show the direction of the force on the coil next to the N-pole of magnet. [1]

(ii) Explain how you obtained your answer.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………[3]

(b) The coil stops when it is vertical. Explain why the turning effect of the forces is zero at this position.

……………………………………………………………………………………………………

……………………………………………………………………………………………………[1]

(c) In order for the coil to rotate continuously, a split-ring commutator is connected between the battery and the coil.

Explain how the split-ring commutator enables the coil to rotate continuously.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………[2]

8 A student constructs a model of a circuit breaker using an unmagnetized steel core, as shown in Fig. 8.1. The distance from the stiff spring to the pivot is 25 cm. The iron arm can move freely about the pivot.

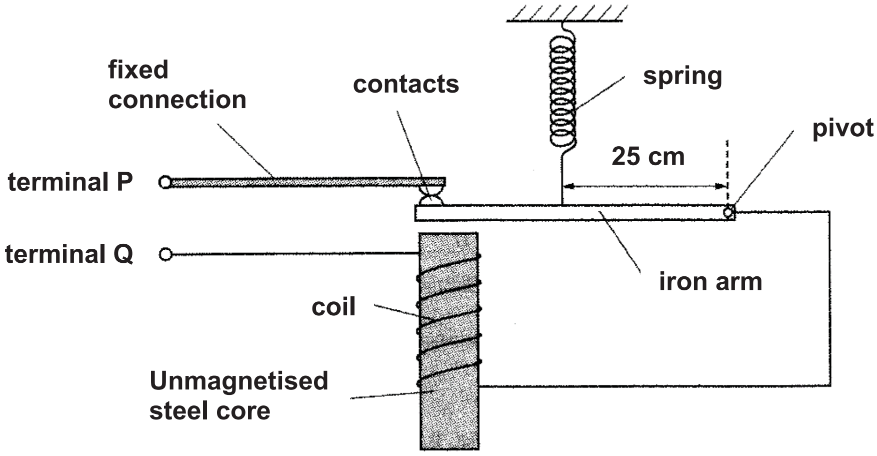


Fig. 8.1

(a) A current flowing from terminal **P** to terminal **Q** causes the contacts to separate. Explain why.

………

………

………

………[3]

(b) The student finds that his model can only be used once.

Suggest and explain **one** reason why.

………

………

………[2]

(c) Suggest and explain **one** modification such that the circuit breaker will be activated to work at a much larger current.

………

………

………

………[2]

9 Fig. 9.1 shows a circuit containing a 12 V filament lamp and a 12 V power supply.

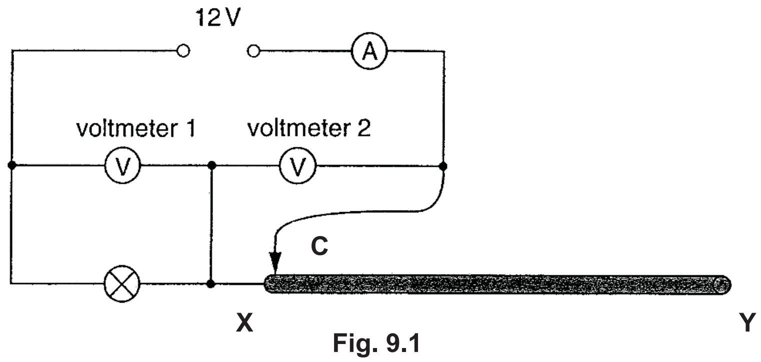


Fig. 9.1

The variable resistor **XY** is made from a long resistance metal wire. The sliding contact **C** moves along the wire from **X** to **Y**.

The wire **XY** obey Ohm's law.

(a) State what happens to the readings of the three meters as C moves from X to Y.
Give numerical values where possible.

voltmeter 1 ……………………………………………………………………………………………..

………

voltmeter 2 ……………………………………………………………………………………………..

………

ammeter ………………………………………………………………………………………………..

………[3]

(b) The variable resistor is adjusted so that the potential difference across the lamp is 4.0 V.
The current flowing through the lamp is 150 mA.

Determine the amount of charge that flows through the lamp in 5.0 minutes.

charge =……………………………………….. [2]

10 A straight length of copper wire lies horizontally between the poles of a U-shaped magnet. Fig. 10.1 shows the two ends of the wire connected to a very sensitive, centre-zero ammeter.

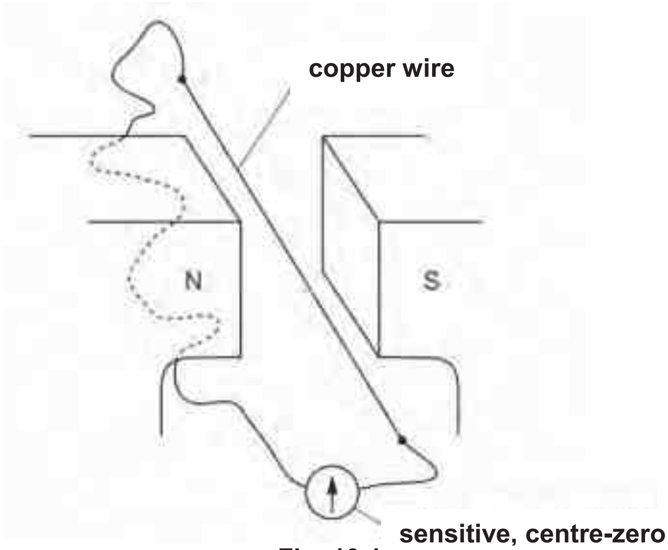


Fig. 10.1

The copper wire is moved upwards quickly between the two magnetic poles. The needle on the ammeter deflects momentarily.

(a) **(i)** Explain why the needle on the ammeter deflects.

....

....[1]

(ii) Draw an arrow on Fig. 10.1 to show the direction of current flowing in the part of copper wire between the two magnetic poles. [1]

(b) The wire is now moved downwards slowly between the two magnetic poles.

State what happens to the needle on the ammeter.

....

....[2]

Section B [30 marks]

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 13**.

11 A length of resistive wire is cut into two pieces **E** and **F**. Each piece of resistive wire is clamped, in turn, between two metal clips, as shown in Fig. 11.1. The length of wire between the clips is 0.7 cm for wire **E** and 2.0 cm for wire **F**.

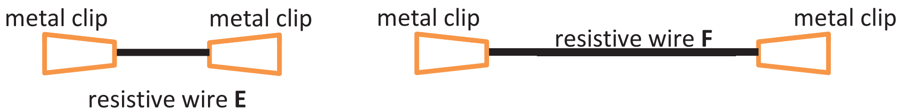


Fig. 11.1

(a) The potential difference (p.d.) across each wire is slowly increased. The p.d. is measured at various values of current. Fig. 11.2 shows the readings obtained.

	wire **E**	wire **F**
current / A	p.d. / V	p.d. / V
0	0	0
0.4	0.04	0.15
0.8	0.08	0.30
1.2	0.14	0.49
1.6	0.23	0.70
2.0	0.37	1.19
2.4	0.70	1.99
2.8	1.10	2.98
3.2	1.50	**not measurable**
3.6	**not measurable**	

Fig. 11.2

(i) Using data from Fig. 11.2, describe the relationship between the current and the p.d. across **E** for high currents.

....

....[1]

(ii) Given that the circuit is in working conditions, suggest why the p.d. is **not** measurable for wire **F** at a high current.

....

....

....[1]

(iii) Determine the resistance of the resistive wire **E** when the current is 1.6 A

resistance =... [1]

(iv) Draw and label a suitable electric circuit diagram of the experiment set up to get the readings of one of the resistive wires in Fig. 11.2. [3]

(v) In one experiment, both the wires and a 1.5 V dry cell were connected in series. Deduce the current flowing through the wire. Explain your answer.

……

……

……

………………………………………………………………………………………………………[2]

(b) The experiment is repeated with a strong wind blowing over the wires by the use of a table fan.

Fig. 11.3 shows the new readings obtained at selected currents.

	wire **E**	wire **F**
current / A	p.d. / V	p.d. / V
0.4	0.03	0.13
0.8	0.06	0.26

Fig. 11.3

(i) Suggest why the values of the p.d. at the same current in Fig. 11.3 are lower than that in Fig. 11.2.

……

……

………………………………………………………………………………………………………[1]

(ii) Suggest one other difference that is seen for readings of p.d. at values of current greater than 0.8 A, as compared to those in Fig. 11.2.

……

………………………………………………………………………………………………………[1]

12 Fig. 12.1 shows the basic structure of a transformer.

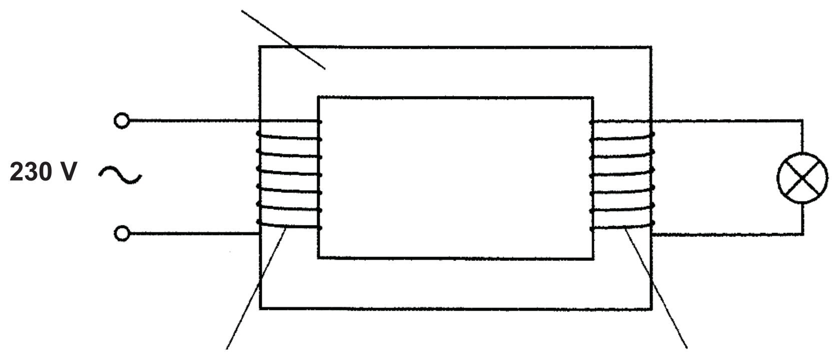


Fig. 12.1

An alternating voltage of 230 V is applied to the primary coil and a voltage is induced in the secondary coil. The secondary coil is connected to a lamp.

(a) Describe what is meant by an *alternating voltage*.

…….

………[1]

(b) Suggest a reason for using an iron core in the transformer.

…….

………[1]

(c) The primary coil has 2200 turns.

Calculate the smallest number of complete turns in the secondary coil that would give an induced voltage of at least 12 V in the secondary coil.

number of turns = ………………………… [2]

(d) The transformer obeys the principle of conservation of energy. A student determines the input power and the output power of the transformer and calculates the efficiency of the transformer.

(i) State the principle of conservation of energy.

……

……

……

……[2]

(ii) The lamp is rated "12 V 1.2 A". Calculate the current in the primary coil when the lamp works normally.

current = ………………………… [2]

(iii) In reality, the primary coil has a current of 0.080 A.
Calculate the efficiency of the transformer.

efficiency = ………………………… [2]

13 EITHER

A national springboard diver trains regularly. At the pool, he climbed up a flight of stairs with a total vertical height of 5.2 m to reach a springboard at the top in 16 seconds. Fig. 13.1 shows him ascending in the air during a jump.

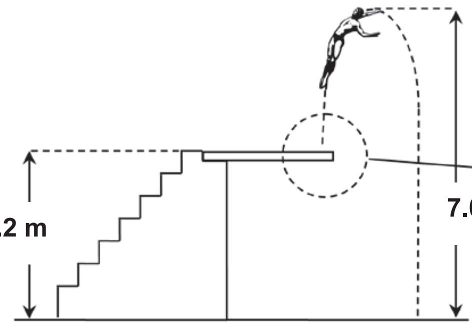


Fig. 13.1

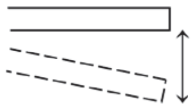


Fig. 13.2

(a) Describe the main energy change when the diver climbed up the flight of steps.

………

………[1]

(b) Given that the diver's weight is 620 N, find his average power during the climb.

average power = ………………………… [2]

(c) The diver used the elastic springboard to propel himself and his centre of gravity reached a maximum height of 7.0 m from the surface of the water before plunging down.

Fig. 13.2 shows the springboard in action when it was used to propel the diver upwards at a certain speed. The springboard moved down a vertical distance of 30 cm during this instant, sprung back to horizontal position, and the diver left the springboard when it was horizontal.

(i) Determine the vertical speed at which the diver left the springboard.

vertical speed = ………………………… [2]

(ii) Find the average upward force exerted by the springboard to propel the diver upwards.

average force = ………………………… [2]

(d) Fig. 13.3 shows a dipper that will vibrate up and down vertically as the wheel turns, creating waves on a water surface. A direct current (d.c.) motor drives a wheel.

Wheel connected to d.c. motor

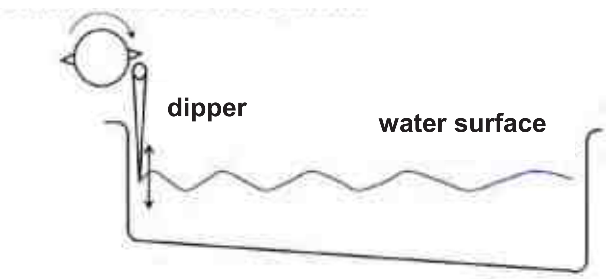


Fig. 13.3

(i) With reference to Fig. 13.3, explain what is meant by transverse wave motion.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………[2]

(ii) The wheel makes 240 revolutions every minute.

Determine the frequency of the vibration of the dipper.

frequency = ………………………… [1]

OR

Fig. 13.4 shows an electric circuit made with a light-dependent resistor (LDR), and a variable resistor (rheostat) that is set to 3.0 kΩ. The potential divider is connected in series with a 12 V power supply and a voltmeter is connected across the LDR.

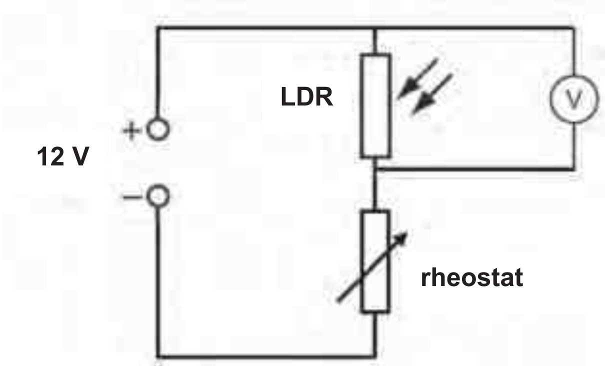


Fig. 13.4

During an experiment, a light was shone on the LDR and the resistance of the LDR was 1000 Ω.

(a) Define *electric current*.

……….

………[1]

(b) Mark out with an arrow on Fig. 13.4, next to the power supply, the direction of conventional current flow. [1]

(c) Calculate

(i) the current in the circuit,

current = ………………………… [2]

(ii) the reading shown on the voltmeter.

reading = ………………………… [2]

(d) Describe and explain how the reading of the voltmeter would change when the light intensity decreases.

…….

…….

…….

……[2]

(e) Describe and explain the effect of increasing the resistance of the rheostat.

…….

…….

…….

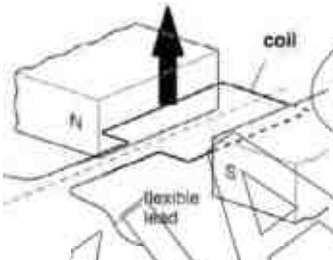
……[2]

------ End of Paper ------

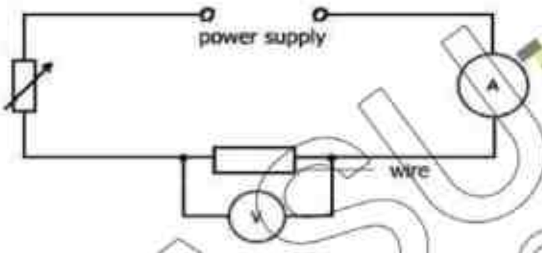
Q	ANSWER	Suggested Reason
1	**D**	Recall. 7 base quantities.
2	**C**	Most accurate method (average of few readings and precise instrument)
3	**D**	Distance travelled ÷ Time taken
4	**B**	Area under speed-time graph = ½ (20) (5.0) = 50.0 m. He reacted immediately. Taking into account negligible human reaction time, he would stop on the line.
5	**B**	Y is the highest point (momentarily at rest at highest point) To stop, speed should be zero.
6	**B**	For right angled triangle, tension = sqrt ($20^2 + 30^2$) = 36.1 N
7	**C**	Push – friction = m a and hence 40 – friction = 2.0 (5.0) Friction = 40 – 10 = 30 N
8	**C**	Recall. Inertia depends on mass.
9	**A**	Volume of bottle = mass / density = 680 / 13.6 = 50 cm^3 Density of P = mass / volume = 50 / 50 = 1.0 g/cm^3
10	**B**	Clockwise moments = anti-clockwise moments 10 (4.0) + 5.0 (1.0) = F (1.0) and hence F = 45 N
11	**B**	Recall. Weight acts through corner (edge) of base.
12	**A**	Recall. Pressure = Force / Area.
13	**B**	Recall. Manometer.
14	**C**	W = F d = 8.0 (6.0 x 5.0) = 240 J
15	**A**	P = F d / t = 600 x 10 / 20 = 300 W
16	**D**	Due to friction, energy is converted to heat and sound and dissipated away.
17	**B**	Pressure inside stays the same so when speed drops the rate of frequency increases due to smaller inner wall surface area.
18	**C**	Heat is lost from feet faster on floor tile due to smaller c and better conductor of heat.
19	**B**	Radiation through the air followed by conduction of heat through glass.
20	**D**	Q = m c Δθ = P t 2000 x 4.0 = 2.0 x c x (3 – 0) and hence, c = 1330 J/(kg °C) Q = m l_F = Pt 2000 x 3.0 = 2.0 x l_F and hence, l_F = 3000 J/kg
21	**A**	Heat gained by colder water = heat lost by hotter water 5.0 x c x (new temperature - 20) = 1.0 x c x (80 - new temperature) 5T - 100 = 80 – T and hence, 6T = 180 °C and so T = 30 °C
22	**A**	Recall. Thermometric property.
23	**B**	wavelength = 1.2/3 = 0.40 m v = f λ = 0.40 x 15 = 6.00 m/s
24	**B**	Statements 2 is incorrect. It can be refracted and reflected.
25	**C**	Speed in fibre = 2.0 x 10^8 m/s apply n = c/v.
26	**C**	Recall.
27	**D**	Recall. Higher frequency implies higher penetrating power and larger ionising power.
28	**A**	Recall. Smaller maximum value (smaller amplitude) and same period.
29	**C**	Ray X and Ray Y are correct.
30	**B**	Converge means rays go nearer after lens. Diverge means ray move farther apart after lens.
31	**A**	Electrons are attracted up from earth. Electrostatic induction.
32	**B**	Recall.
33	**D**	I = V / R = 12 / 6 = 2.0 A (effective resistance = 1 + 2 + 3 = 6 Ω)
34	**D**	Recall. Switch is along live wire. Earth wire touches metal casing.
35	**A**	Unlike poles attract. Z becomes an induced magnet that is attracted to Y.
36	**C**	Magnetic field lines go from right-hand-side pole to left-hand-side pole.
37	**A**	Apply fleming's left hand rule (conventional current to left)
38	**B**	Amplitude = max value of 2 boxes vertically. Frequency = 1 / 4 horizontal boxes.
39	**C**	Y is powered by the d.c. cell. X and Z do not lit due to no changing magnetic field (no a.c. supply).
40	**D**	Halved the period implies twice the frequency. Twice the amplitude implies twice the rate of cutting of magnetic flux (faraday's law)

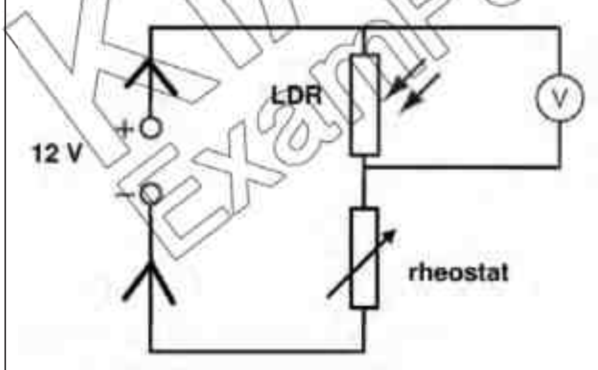
BUKIT BATOK SECONDARY SCHOOL
O-LEVEL PRELIMINARY EXAMINATION
PHYSICS 6091 PAPER 2 – SUGGESTED ANSWERS

Q	**Suggested Answer**
1a	• Record down force (using the force meter already on the machine) • Measure and record down distance = length of rope pulled (using measuring tape or metre rule) • Measure and record down time (using stopwatch) • Calculate Power = (Force x distance) / time • Repeat for another try to get another power reading and then calculate average *Overwhelming majority of candidates did not use instruments to make measurements.*
1b	• Pull on earth on him downwards & Pull by him on earth upwards with same size of force • Pull on man by rope to right & pull by man on rope to the left with same size of force **No marks if no direction mentioned** *Overwhelming majority of candidates did not mention direction and did not mention size.* *Majority of candidates mixed up the bodies involved.*
2a	Velocity = gradient of displacement-time graph = 0 – 1.0 / (1.0 – 0.8) = – 5.0 m/s (accept 5.0 m/s downwards) *Many candidates got the wrong answer of 5.0 m/s*
2c	• Velocity increases by less and less until it becomes constant • Acceleration decreases until it becomes zero *Large majority of candidates overly write.*
3a	• Randomly moving gas molecules hit on the inner wall randomly with equal probability • These collisions exert a force per unit area that is constant all along inner wall *Overwhelming majority of candidates answered same frequency as a condition.* *Majority of candidates are confused between intermolecular collisions and collisions against inner wall surfaces.*
3b	• Speed of gas molecules decrease and they move less vigorously • They hit inner walls with small force and less frequently • Smaller force exerted per unit area on inner walls (smaller pressure) *Most candidates did not mention molecules hitting the inner walls less hard (with less force).*
4a	• Molecules of seawater roll and slide faster • Molecules of seawater move more vigorously • Molecules of seawater move farther apart from each other *Large majority of candidates focused their answer on steam molecules losing heat instead of seawater molecules gaining heat. Some candidates wrote about heat transfer methods.*
4b	Q = m c $\Delta\theta$ 265 000 000 = m (3900) (64 – 30) mass = 1998.5 kg = 2000 kg *Many candidates could not convert 3.9k to 3900. Many candidates mistook 256 for 265.*
5a(i)	angle A = 42 ° and angle B = 30 ° (nearest degree for angle)

Q	**Suggested Answer**
5a(ii)	n = sin (large angle) / sin (smaller angle) = sin A / sin B = sin (42) / sin (30) = 1.34 (no units) *Candidates who wrote sin I / sin r could not score full credit as angle r is larger than angle i.*
5b	• Angle of incidence in water (optically denser medium) is larger than critical angle • Light is travelling from optically denser medium to optically less dense medium • Total internal reflection occurred and light reflects back into optically denser medium *The condition of light trying to move from optically denser to optically less dense medium is not mentioned.*
6a	Metal legs gained (surface) electrons from woollen cloth due to friction. *Large majority of candidates referred to negative charges.*
6b	• The force of attraction between the positive charges on Al and electrons on metals legs is larger than the force of repulsion between the electrons on Al and electrons on metal legs • As the positive charges on Al are now closer to the metal legs than the electrons of Al. • Upward force of attraction is larger than downward weight of Al foil as well *Very few candidates mentioned about the existence of both attraction and repulsion Fewer candidates went on to mention the weight of the Al foil.*
7a(i)	Vertically upwards on coil next to N-pole of magnet  *Candidates are reminded to draw the arrow on the coil using ruler.*
7a(ii)	• By Fleming's left hand rule, left middle finger points in direction of current • Left index finger points in direction of magnetic field lines from N-pole to S-pole • Left thumb points in direction of magnetic (Lorentz) force on coil upwards
7b	Force on coil acts through the pivot (M = F d, d = 0 m, M = 0 Nm) *Overwhelming majority of candidates are confused over the cutting of magnetic flux with moments (M = Fd).*
7c	• It reverses the direction of current in the coil every half a turn • Such that the force on coil nearest to N-pole of magnet is always upwards • It also prevents entangling of the external wires from power source during rotation *The idea of direction of force being reversed is not clearly expressed most of the time.*
8a	• Current in solenoid creates a strong electromagnet with N-pole at top of coil • Bottom left of iron arm is attracted downwards to the solenoid due to magnetic induction as it is now an induced S-pole • Anti-clockwise moment due to downward magnetic force of iron arm about pivot is more than clockwise moment due to upward force of spring about pivot *Overwhelming majority of candidates wrote very simplistic answers, omitting details.*

Q	**Suggested Answer**
8b	• Steel core becomes a permanent magnet that cannot be easily demagnetised. • Iron arm cannot move back up to close the contacts. • Current cannot flow as contacts stay open.
8c	**First point** Much larger current will create a much stronger electromagnet. Hence, we need to reduce the strength of the electromagnet. • Fewer turns of coil of solenoid so that the circuit breaker will not activate at a low current. • Larger distance (> 25 cm) of spring away from pivot for a larger moment to overcome.
9a	• Voltmeter 1 will change from decrease from initial 12 V • Voltmeter 2 will increase from initial 0 V • Ammeter will decrease from initial value *Overwhelming majority of candidates did not specify numbers (12 V, 0V) in their answers.*
9b	Q = I t = 0.15 (5.0 x 60) = 45.0 C (accept 45 C)
10a(i)	The copper wire experiences a temporary change in magnetic flux (of magnets) linked to it (per second), induced an e.m.f.
10a(ii)	Arrow drawn on wire in-between magnets INTO paper  *Very few candidates got the correct answer.*
10b	• Smaller size of momentary deflection • Deflection in the opposite direction (to the left)
11a(i)	The p.d. increases proportionally /uniformly / constantly / linearly as current increases
11a(ii)	• High current caused overheating of the wire ($P = I^2 R$ heating) and wire melted Overwhelming majority of candidates wrote that the voltmeter range is 0 to 3 V and hence could not measure more than 3 V. However, under working conditions, the voltmeter used would definitely be able to. The only exception is for a short-circuit fault (for ammeter) where the current would rise by a lot.
11a(iii)	R = V / I = 0.23 / 1.6 = 0.144 Ω (accept 0.14 Ω)

Q	Suggested Answer
11a(iv)	• Workable circuit to vary current and get p.d. (e.g. use of rheostat or potentiometer or variable power supply) • Correctly drawn circuit symbols and connections with ruler • Able to measure accurately current (ammeter) in wire and p.d. (voltmeter) across wire  **Accept either wire E or wire F** **Do not accept two wires connected in parallel** *Overwhelming majority of candidates did not use a rheostat. A sizeable number did not use ruler to draw straight lines.*
11a(iv)	• Approximately 2.0 A (same current for series connection) • Sum of p.d. in both wires in series is about 0.37 V + 1.19 V = approximately 1.5 V
11b(i)	• Strong wind causes cooling, reducing resistance and hence, by V = IR, reducing p.d. • Conduction of heat away from wire also leads to lower temperature
11b(ii)	• Fig 11.3 is now able to measure p.d. of currents previously not measurable in Fig. 11.2 • Fig. 11.3 shows smaller increase in p.d. as current is increased than Fig. 11.2
12a	• Positive and negative terminals switches position periodically • Size (magnitude) of voltage changes sinusoidally *Large majority of candidates confused current and voltage and mentioned about the changing direction of current flow.*
12b	• Increase the magnetic field strength by concentrating magnetic field lines inside it • Ensures good magnetic flux linkage between primary and secondary coil Overly broad answers such as increasing efficiency were rejected unless candidates went on to elaborate further on why efficiency went up.
12c	$N_S / N_P = V_S / V_P$ $N_S = 12 (2200) / 230$ = 114.8 = 115 turns
12d(i)	• Energy cannot be created nor destroyed. It changes from one form to another. • Total energy in a closed (isolated) system is fixed (constant) *Many candidates did not mention the 2nd point of total energy in a closed system being constant.*
12d(ii)	For 100% ideal transformer (zero loss), $I_s V_s = I_p V_p$ $I_p = (1.2 \times 12) / 230$ = 0.0626 A (accept 0.063 A)

Q	Suggested Answer
12d(iii)	Efficiency = useful output / total input $= I_s V_s \div I_p V_p$ = (1.2 x 12) ÷ (230 x 0.080) = 0.783 (accept 78.3 %) *Overwhelming majority of candidates compared the secondary coil current to the primary coil current.*
EITHER	**EITHER**
13a	Chemical energy → gravitational potential energy (initial and final forms) Kinetic energy → gravitational potential energy (during the run)
13b	P = F d / t = (620 x 5.2) / 16 = 202 W
13c(i)	Ignoring effects of air resistance, Loss in KE = Gain in GPE $\frac{1}{2}$ m v^2 = m g Δh V = sqrt (2 x 10 x 1.8) = 6.00 m/s
13c(ii)	Work done by springboard on man = gain in GPE by man F x d = (620 x 1.8) F = 620 x 1.8 / 0.30 = 3720 N (accept 3700 N) *Overwhelming majority of candidates did not get this correct.*
13d(i)	• The water molecules vibrate vertically up and down, • Perpendicular to the propagation of wave (energy) from left to right
13d(ii)	F = number of vibrations in 1 second = 240 / 60 = 4.0 Hz
OR	**OR**
13a	Rate of flow of electric charge
13b	
13c(i)	I = V / R = 12 / (3000 + 1000) = 0.0030 A *Many candidates lost marks as they left their answer as 0.003 A.* *Candidates are reminded that 1 s.f. answers for calculations such as this is not allowed.*

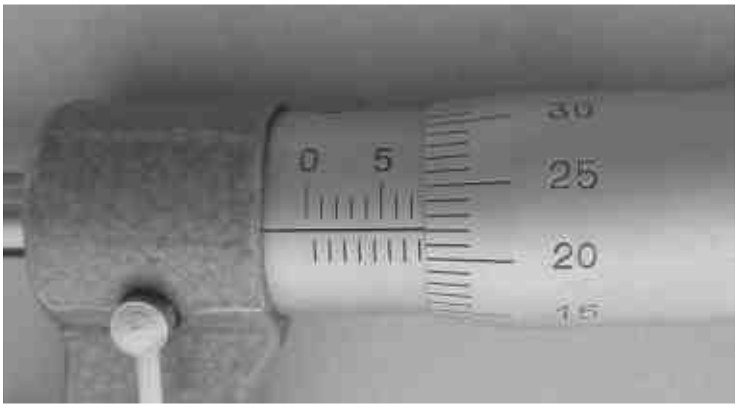
Q	Suggested Answer
13c(ii)	V = IR = 1000 x 0.0030 = 3.00 V Many candidates lost marks as they left their answer as 3 V. *Candidates are reminded that 1 s.f. answers for calculations such as this is not allowed.*
13d	• Voltmeter reading will slowly increase. • Because $V_o = \frac{R_{LDR}}{R_{rheostat}+R_{LDR}} \times V_s$. When light intensity decreases, R_{LDR} increases and Voltage will increase accordingly to the formula *Candidates who did not use the potential divider principle mostly got it wrong as they wrongly assumed that the current would stay constant.*
13e	• **For bright situations, the p.d. across LDR is now smaller.** • **For dark situations, the p.d. across LDR is now smaller as well.** • It will make the circuit less sensitive/needs more changes in light intensity before voltmeter reading change • by increasing $R_{rheostat}$, R_{LDR} must change even more before the voltage will make the corresponding change. *Overwhelming majority of candidates did not know how to approach this question, focusing their answer on the decrease in voltmeter reading for a particular instance only.*

[40 marks]
Answer all questions in this section

1. The light year is defined as the distance light travels in 1 year. Which of the following is the nearest estimate of 1 light year in gigameters (Gm)?

A 100 **B** 1000 **C** 10000 **D** 10000000

2. The following diagram shows the reading on a micrometer screw gauge.

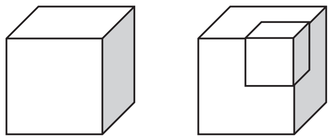


What is the reading on the micrometer screw gauge?

A 7.22 mm **B** 7.72 mm **C** 7.22 cm **D** 7.72 cm

3. A cube of mass 5.0 kg with sides 0.20 m long has a cube of sides 0.10 m cut from its corner as shown. What is the density of the remaining portion?

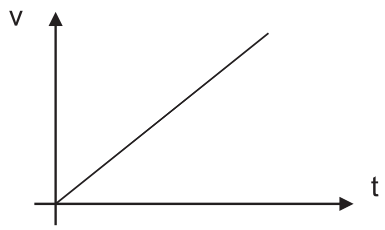
A 25 kg/m³ **B** 547 kg/m³
C 625 kg/m³ **D** 714 kg/m³



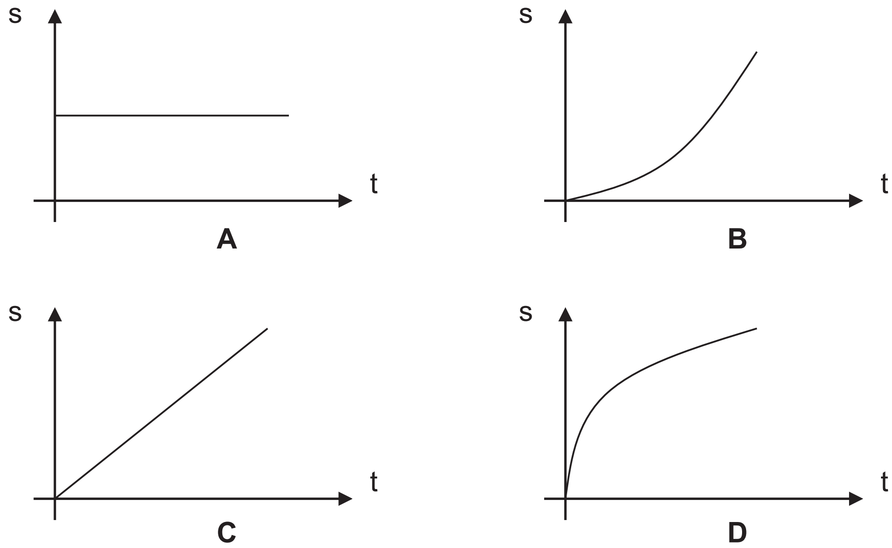
4. The overall stopping distance of a car consists of a 'thinking distance' for the driver to react and the 'braking distance' to stop his car. A driver driving at 20 m/s took 0.50 s to react and a further 5.0 s to stop his car. What is his overall stopping distance?

A 50 m **B** 55 m **C** 60 m **D** 110 m

5. The following graph shows the speed-time graph of a body.



Which of the following graphs shows the distance-time graph of the body?



6. A ball rolling across a field will slow down and eventually stop because

A inertia will cause all objects to remain in a state of rest.

B there is no net force acting on the ball.

C there is a force that acts in the direction opposite its motion.

D the ball has no energy since there is no work done on the ball.

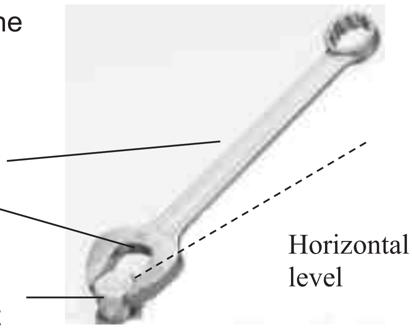
7. A 2000 kg car travelling at a constant velocity of 25 m/s encounters a total resistive force of 50 kN. Assuming there are no other horizontal forces acting on the car, which of these relationships describes the driving force F provided by the engine?

A F = 0 N **B** F < 50 kN **C** F = 50 kN **D** F > 50 kN

8. The pellet of mass 50 mg is fired vertically upwards and reaches a height of 1000 m. What is the total energy at the highest point?

A 0 J **B** 0.5 J **C** 500 J **D** 500000 J

9. A technician tries to loosen a nut with a spanner but the nut does not turn. He has held the spanner above the horizontal level as shown. Which of the following methods is not a logical attempt?

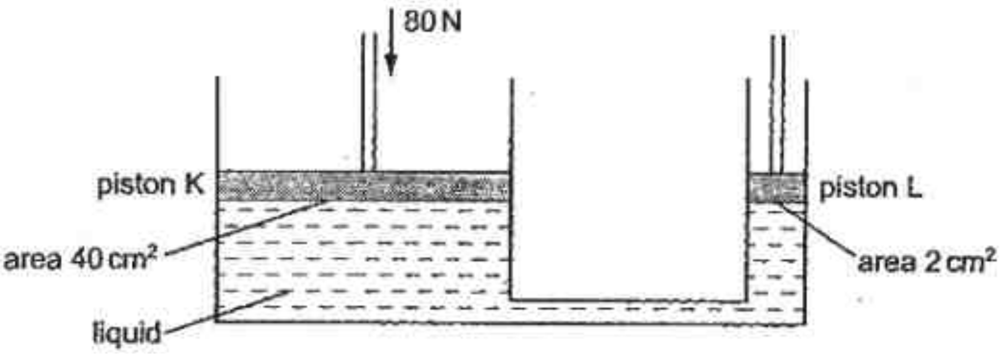


A Use a longer spanner.
B Bring the spanner nearer the horizontal level.
C Apply more force.
D Push the nut further into the gap.

10. A rectangular box of dimensions 4.0 m by 2.0 m by 3.0 m weighs 50 N. What is the minimum pressure it exerts on the surface it rests on?

A 2.1 Pa **B** 4.2 Pa **C** 6.3 Pa **D** 8.3 Pa

11. Which of the following statements is true?



A The force at piston L is 1600 N.
B Piston K will move a longer distance than piston L.
C The pressure at piston K and piston L is the same.
D The pressure at piston K is lower than at piston L.

12. A man lies on a bed of needles. What happens if the number of needles is doubled?

	Force on 1 needle	Force on the man	Pressure at contact
A	Remains the same	Doubled	Remains the same
B	Halved	Remains the same	Halved
C	Remains the same	Doubled	Doubled
D	Halved	Remains the same	Remains the same

13. Illuminated smoke particles, suspended in air, are viewed through a microscope. They appear to move randomly. Which of the following best describes the conversion and transfer of energy that takes place?

A Kinetic energy of air molecules → Kinetic energy of smoke particles

B Potential energy of air molecules → Kinetic energy of smoke particles

C Heat energy from source → Kinetic energy of smoke particles

D Light energy from source → Kinetic energy of smoke particles

14. Which of the following statements is true when the temperature of a solid is raised?

A The molecules expand and the solid occupies a greater volume

B The molecules in the solid start to move around

C The mass of the solid increases as the volume increases

D Heat travels to all parts of the solid in the form of kinetic energy of the molecules

15. A gas in the process of condensation will

A not give off or take in any heat because there is no change in temperature.

B give off heat because its molecules are losing kinetic energy.

C give off heat because intermolecular forces are forming.

D take in heat in order to break the intermolecular forces.

16. Blowing across the surface of a spoon of hot soup will cause it to cool mainly because

A still air is a poor conductor but moving air is good conductor.

B convection cannot occur without blowing.

C blowing across the surface increases the surface area for radiation.

D blowing across the surface allows more evaporation to take place.

17. The interior (which is touching the water) of a vacuum flask designed to hold hot water is shiny because

A shiny surfaces are poor absorbers of radiation.

B shiny surfaces are good absorbers of radiation.

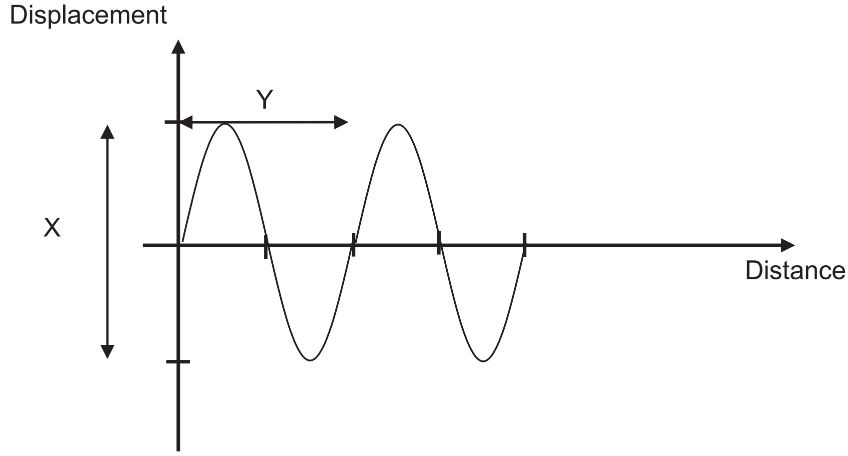
C shiny surfaces are poor emitters of radiation.

D shiny surfaces are good emitters of radiation.

18. A 3 kW kettle containing 500 g of a boiling liquid is placed on a balance. The balance reads 200 g after 5 minutes. What is the value of the specific latent heat of vapourisation of the liquid?

A 2.0 kJ/kg **B** 3.0 kJ/kg **C** 3.0 MJ/kg **D** 4.5 MJ/kg

19. What information can you conclude from the graph describing a wave?



A The amplitude is X. **B** The amplitude is X/2.

C The period is Y. **D** The period is Y/2.

20. Which of the following can be used to calculate the period of a wave?

A frequency divided by wave speed

B frequency divided by the wavelength

C wavelength multiplied by the frequency

D wavelength divided by the wave speed

21. Given that the critical angle of a medium is 45°, what is the refractive index?

A 0.71 **B** 1.00 **C** 1.33 **D** 1.41

22. An object is placed 12 cm from a lens of focal length 8 cm. Which of the following best describes the property of the image?

A real, inverted, diminished **B** real, inverted, magnified

C virtual, upright, magnified **D** virtual, upright, diminished

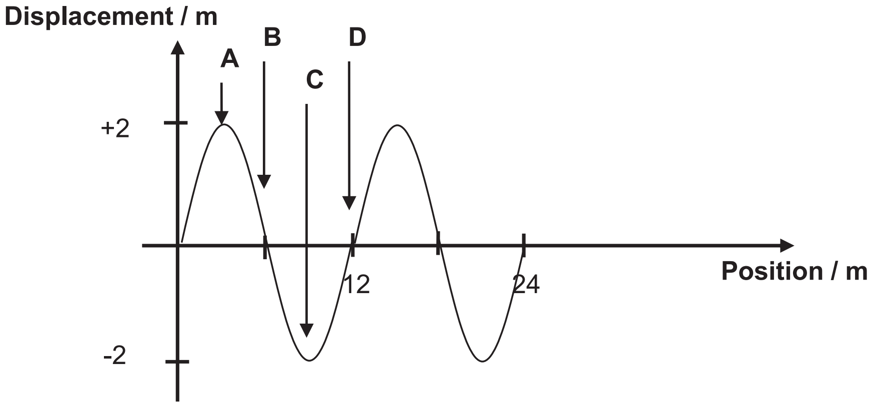
23. The refractive index of water is 1.33. What is the speed of light in water?

A 7.5×10^7 m/s **B** 2.25×10^8 m/s **C** 3.00×10^8 m/s **D** 4.00×10^8 m/s

24. A boy shouts on a mountain and hears the echo from the nearest neighbouring mountain after 2.0 s. Given that the speed of sound in air is 300 m/s, how far is the neighbouring mountain from the boy?

A 75 m **B** 150 m **C** 300 m **D** 600 m

25. The following graph describes a longitudinal wave, with left defined as the positive direction. Which is a region of compression?



26. Which of the following methods can be used to test whether an unknown material X is a magnet?

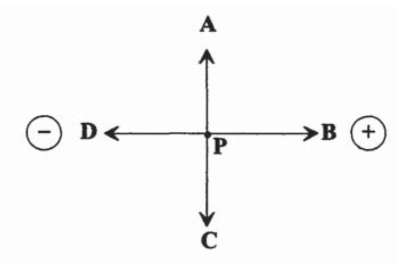
I Find out whether a compass needle is deflected when a wire carrying a current is wound around it.

II Find out whether a North pole of a permanent magnet will attract X.

III Find out whether a South pole of a permanent magnet will repel X.

A I and III only **B** II and III only **C** I and II only **D** III only

27. The diagram shows two charges. In which direction will the electric field act?



28. The diagram shows two insulated metal spheres P and Q. The steps are, in order:

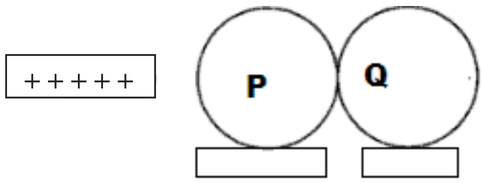
Step 1: Bring the (+) charged rod close to P

Step 2: Momentarily earthed P

Step 3: Separate P from Q

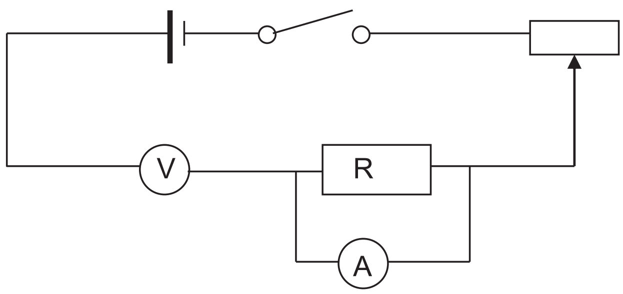
Step 4: Remove the charged rod

What are the charges on P and Q?



Option	A	B	C	D
Charge on P	Positive	No charge	Negative	Negative
Charge on Q	Positive	Positive	No charge	Negative

29. A circuit is set up as shown. The cell has an emf of 3.0 V and the resistance of R is 5.0 Ω.



What are the readings on the ammeter A and voltmeter V when the jockey is adjusted to give minimum resistance and the switch is closed?

Option	A	B	C	D
Reading on A	0.6 A	Shoots to full scale deflection	0 A	0 A
Reading on V	3.0 V	3.0 V	3.0 V	0 V

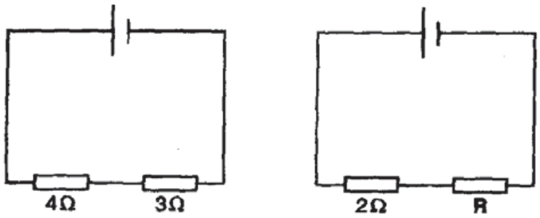
30. Which of the following best describes the characteristics of a thermistor as current increases?

Option	A	B	C	D
Voltage	Increases	Increases	Decreases	Decreases
Resistance	Increases	Decreases	Increases	Decreases

31. A wire has resistance R. A wire half as long with twice the diameter made of the same material will have resistance

A R/8 **B** R/4 **C** R **D** 2R

32. Two identical cells are connected to two circuits. It is found that both circuits have the same current flowing in them. What is the value of R?



A 1.5 Ω **B** 5.0 Ω **C** 7.0 Ω **D** 12.0 Ω

33. The most suitable fuse rating for a heater marked 240 V, 1.2 kW is

A 5 A **B** 7 A **C** 12 A **D** 20 A

34. The cost of a unit (kWh) of electricity is 24 cents. What is the cost, to the nearest cent, to turn on a 0.5 kW computer for 30 minutes?

A \$0.06 **B** \$3.60 **C** \$21.60 **D** \$60.00

35. A current of 4 A flows in the live wire of a socket when the appliance is functioning normally. Which of the following is true?

A A current of 4 A flows in the neutral wire

B A current of 4 A flows in the earth wire

C A current of less than 4 A flows in the neutral wire

D A current of less than 4 A flows in the earth wire

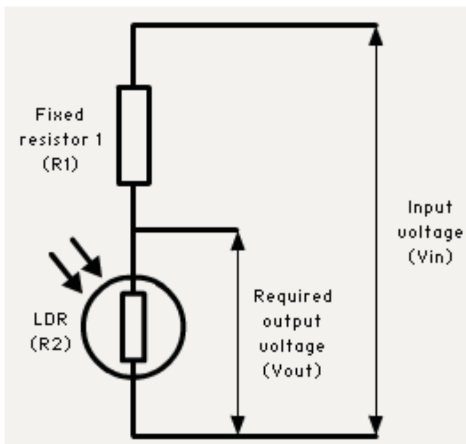
36. A LDR is connected in series with a fixed resistor R_1 = 5.0 Ω. The input voltage is 6 V and the output voltage is 1 V. Which is the likely physical condition of the surrounding?

A bright

B dark

C hot

D cold



37. Which of the following best describes why a magnet will attract a piece of soft iron?

A The piece of soft iron becomes an induced magnet.

B The piece of soft iron becomes a temporary magnet.

C The piece of soft iron becomes a permanent magnet.

D An induced current will flow in the piece of soft iron.

38. A beam of electron experiences a magnetic field from the top to the bottom of the page. A force to the right of the page acts on the electron beam. What is the direction which the electron beam travels and which rule determines the direction?

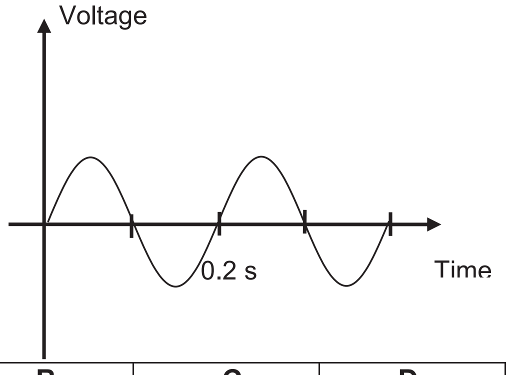
Option	**A**	**B**	**C**	**D**
Direction	Into the page	Into the page	Out of the page	Out of the page
Rule: Fleming's _____ Hand Rule	Left	Right	Left	Right

39. An a.c. input of 240 V is connected to the primary coil of an ideal transformer. The output current is 6 A. Which of the following is a possible combination of the input current and output voltage?

Option	**A**	**B**	**C**	**D**
Input Current	12 A	480 A	1 A	0 A
Output Voltage	120 V	24 V	40 V	0 V

40. An ac generator produces an output voltage as shown in the diagram.

Which of the following best describes the changes if the generator is turned twice as fast?



Option	**A**	**B**	**C**	**D**
Output Voltage	Doubles	Halves	Doubles	Unchanged
Period	Doubles	Doubles	Halves	Doubles

-- END OF PAPER --

Section A (50 marks)

Answer all the questions in the space provided.

1. A car describes a linear motion represented by the graph shown in Fig.1.1.

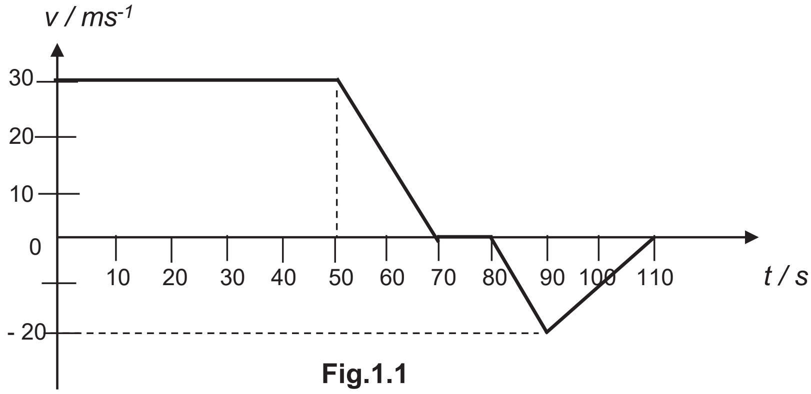


Fig.1.1

(a) **(i)** Describe the motion of the car from t = 0 to 110 s. [2]

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(ii) What is the value of the retardation of the car from t = 50 to 70 s? [1]

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(b) Find the total displacement travelled by the car for the whole journey. [2]

(c) Sketch the displacement-time graph for the car's motion.
Indicate all relevant values. [2]

2. A uniform rod **PQ** of length 80.0 cm and weight 2.0 N is placed on the pivot as shown in Fig. 2.1 below. A spring balance is attached to the other end of the rod. A load of 8.0 N is placed 20.0 cm from the spring balance.

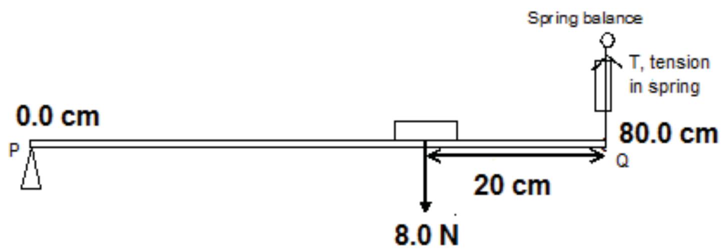

Fig. 2.1

(a) What is the reading on the spring balance in order for the rod to balance horizontally? [2]

(b) Determine the magnitude and direction of the reaction (force) on the pivot. [2]

(c) If the 8.0 N weight is gradually moved along the rod towards **P**, the rod being kept horizontal, state and explain the change in the magnitude of **T**. [2]

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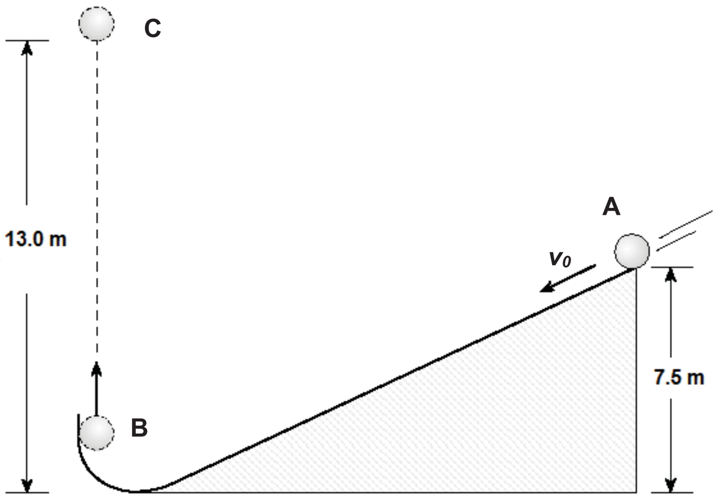
3. A 0.50 kg ball starting from position **A** which is 7.5 m above the ground, slides down from an incline with an initial speed of v_o m/s as shown. Friction on the rough incline produces 10.7 J of heat energy. The ball leaves the incline at position **B** travelling vertically upward and reaches a height of 13.0 m above the floor (position **C**) before Falling vertically down.



(a) State the Principle of Conservation of Energy. [1]

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(b) What is/are the energy/energies that the ball possesses at position **A**? [1]

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(c) Calculate the gravitational potential energy at position **C**. [1]

(d) Calculate the initial speed, v_0, at position **A**. [2]

(e) State one assumption for your calculation in **(d)**. [1]

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4. Fig.4.1 shows the plan view of a fish tank containing one goldfish.
The diagram is drawn **full scale**.

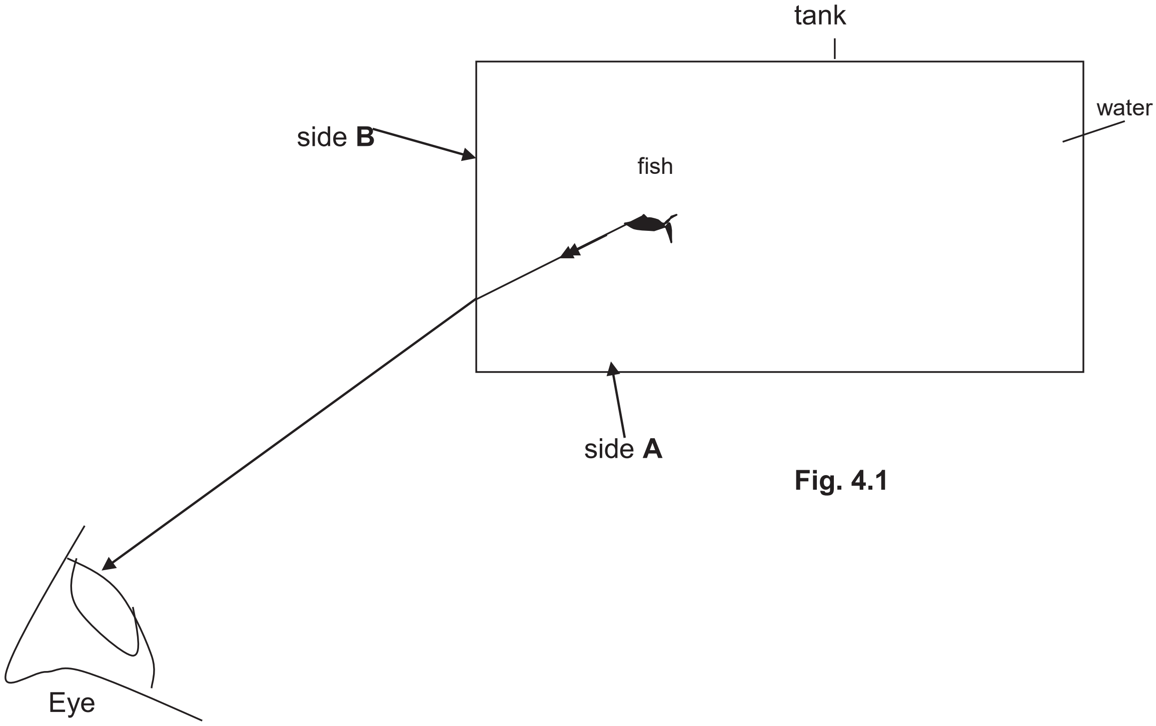

Fig. 4.1

A boy can see two images of the fish when he looks from the position shown.
Fig. 4.1 shows a ray of light, from the fish, that is refracted at side **B** of the tank.
The ray enters the eye as shown.

(a) **Measure** the angle of incidence and refraction and use the angles to determine the refractive index of the water in the tank. [2]

On Fig.4.1,

(b) **(i)** sketch a second **ray** (no need to draw to scale) from the fish to the eye that is refracted at side **A** of the tank,

(ii) show the positions of the **two images** of the fish. [3]

5. **(a)** Explain, by writing about molecules, how the air inside a car tyre exerts a pressure on the walls of the tyre. [2]

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(b) A vessel closed by a piston contained a constant mass of gas. Keeping the temperature of the gas constant, weights are placed on top of the piston which reduces the volume of the gas.

Complete the table below, using the words **increases, decreases** or **no effect** to describe the changes that have occurred. [1]

Property of the gas	**Change that has occurred**
Number of molecules in every cm^3	
Frequency of collisions of the gas molecules with the piston	
Average kinetic energy of the gas molecules	
Pressure of the gas	

6. A light perspex ball is placed near a highly positively charged metal dome in a Van de Graaff generator. The ball swings away from the positively charged metal dome and remains stationary at position **X.** (Fig. 6.1)

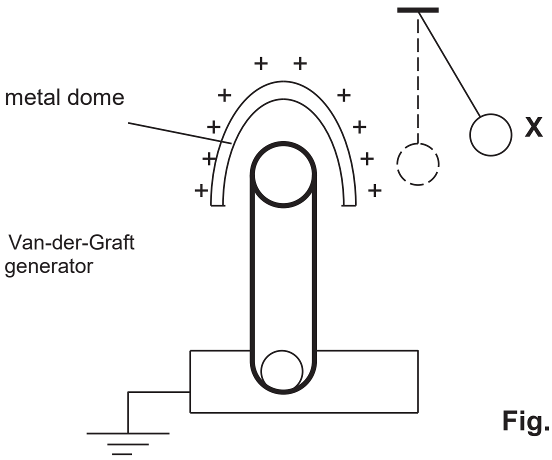

Fig. 6.1

(a) Explain why the perspex ball moves away from the metal dome. [2]

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(b) The perspex ball has a mass of 5.0 g.

At the instant where the ball is stationary at **X**, there is a horizontal electric force, F_E = 0.15 N acting to the right, a tension **T** in the string and the weight **W**, (Fig. 6.2)

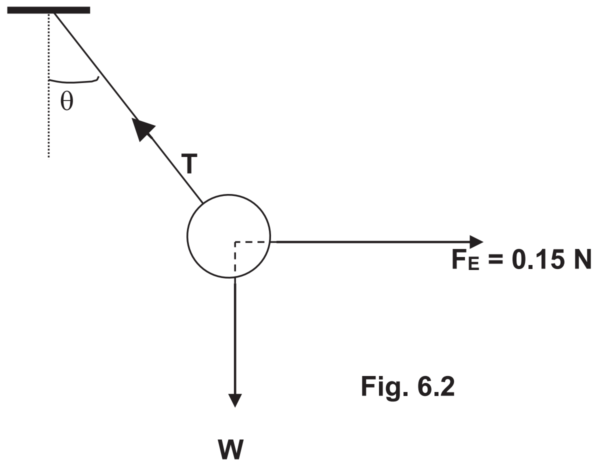

Fig. 6.2

By using a scale drawing, determine the tension **T** and the angle θ that the string makes with the vertical. (Take g = 0.01 N / g) [4]

7. **(a)** Fig. 7.1 shows an electric circuit powered by a 12.0 V battery of negligible internal resistance.

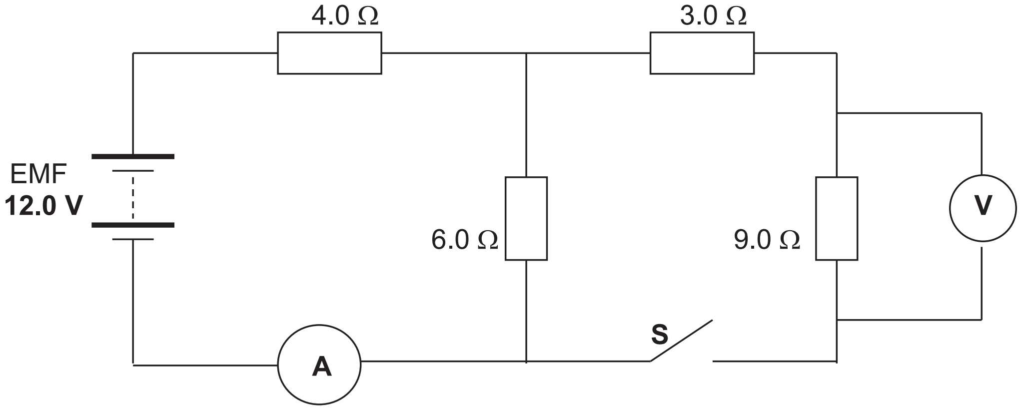

Fig. 7.1

Determine the ammeter and the voltmeter readings when

(i) the switch **S,** is open; [2]

(ii) the switch **S,** is closed. [2]

(b) The same power source is now connected to a potential divider consisting of an LDR and a resistor. (Fig. 7.2).

An LDR (light-emitting diode) is an *input transducer* whose resistance can change according to the amount of light falling on it.

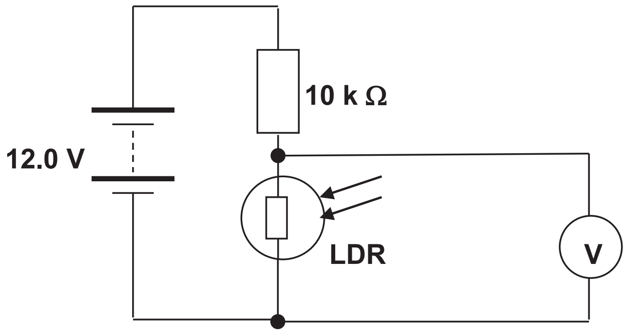

Fig. 7.2

(i) Explain the word '*input transducer'.* [1]

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(ii) What is the resistance of the LDR when the voltmeter reads 2.0 V? [1]

8. A pupil makes a simple d.c motor as shown in Fig. 8.1 using some common materials and connected to a 6.0 V battery.

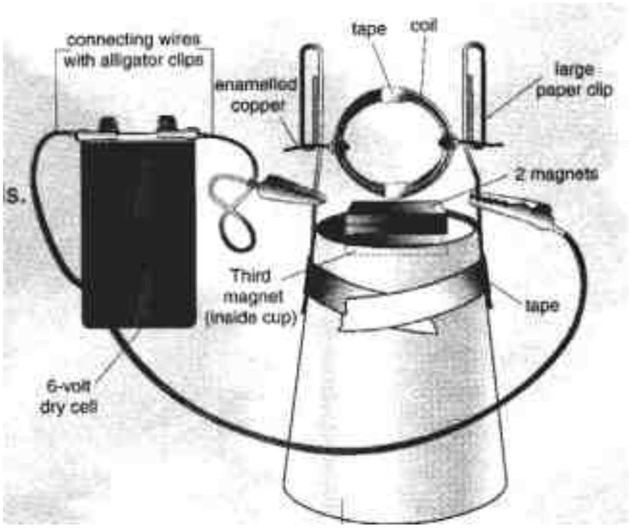

Fig. 8.1

The enamelled copper wire is an insulated wire with **part of its insulation** removed. The ends of the coil are placed on the large paper clip.

When the power source is turned on, the coil is given a *slight push* and the coil begins to *spin*.

(a)(i) Why is the coil given a *slight push*? [1]

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(ii) Explain why the coil starts to rotate continuously. [3]

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(b) If a stronger power source is used, state its effect on the rotation of the coil. [1]

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(c) What is the purpose of the third magnet inside the cup? [1]

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9. Fig. 9.1 shows the structure of a transformer which is used in the transmission of electrical power through the cables.

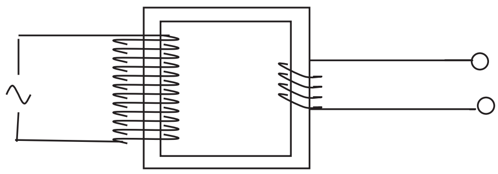

Fig. 9.1

Coil	Number of turns
J	50
K	100
L	1 000
M	1 500

Table 1

An engineer is assigned to build a step-down transformer for stepping down the voltage from 3.3 kV to 220 V in the substation of a housing estate. He has the choice of using four types of coils with different number of turns as shown in Table 1 above.

(a) Based on Table 1, select the most suitable pair of coils for making the primary coil and secondary coil of the transformer. Explain your choice. [2]

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(b) Assume that the transformer is 75 % efficient and the power output is 15 kW, determine the current flowing in the primary coil. [2]

(c) State and explain **one** feature that can improve the efficiency of this transformer. [1]

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-END OF SECTION A-

Section B [30 marks]

Answer all the questions from this section. Question 12 has a choice of section to answer.

10. **Fig. 10.1** shows the hydraulic braking system for a car from the brake pedal to the braking discs of the wheel.

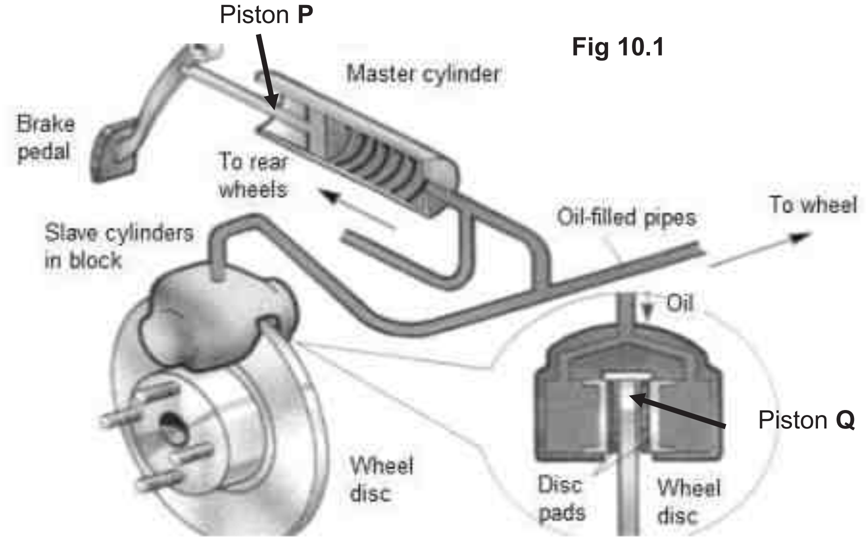

Fig 10.1

A force is applied downwards on the brake pedal in order to slow down the wheels of the car.

(a) Using **Fig. 10.1**, explain clearly how a force applied on the brake pedal can slow down a moving car. [2]

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(b) The surface area of piston **P** in contact with the brake fluid at the master cylinder is 5.0×10^{-4} m^2 and the area of piston **Q** of the slave cylinder is 7.5×10^{-3} m^2.

(i) Explain why the area of piston **P** has to be smaller than piston **Q**. [1]

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(ii) Find the force exerted on Piston **Q** when a force of 120 N is exerted on the brake pedal. [2]

(iii) If piston **P** moves down by 6 cm when the brake pedal is depressed, calculate the distance moved by piston **Q**. [1]

(c) In order to ensure that the braking system functions properly, air cannot be trapped in the brake fluid. Explain clearly how trapped air in the braking fluid can affect the performance of the hydraulic braking system. [1]

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(d) When the road is wet, a sudden hard braking when the car is moving at a high speed can cause the wheels to stop rotating instantly and the car will skid (slide uncontrollably).

(i) Explain why a fast moving car skids on the wet road when the brake is suddenly pressed very hard and the wheels stop rotating. [2]

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(ii) To reduce the possibility of a car skidding on a wet surface, the wheels of the car have specially designed threads as shown in **Fig.10.2**. Suggest how these threads are able to reduce the chances of the car skidding on a wet surface. [1]

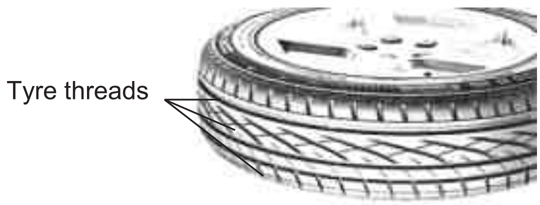

Fig. 10.2

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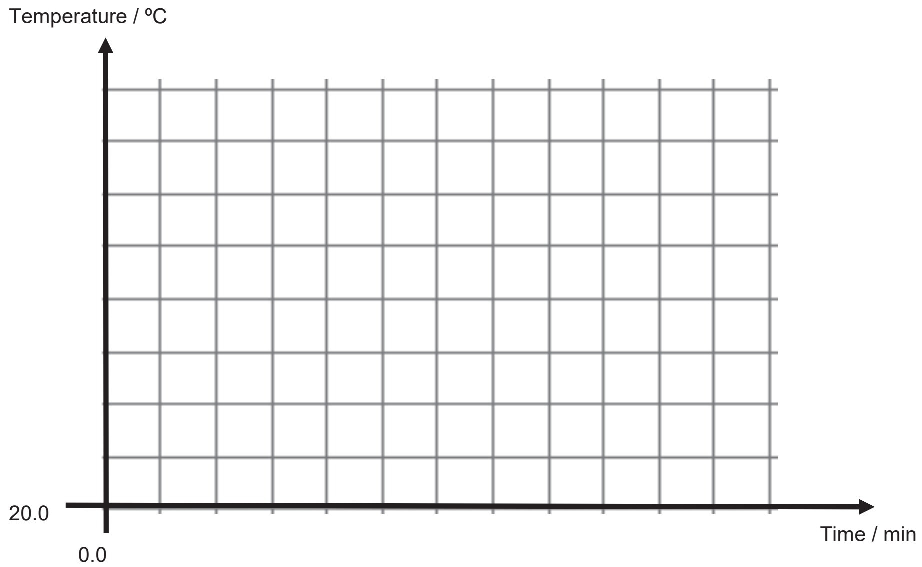
11. (a) 2 kg of pure substance **X** was heated uniformly from its solid state until it reaches the gaseous state. The temperature of **X** was taken in intervals of 5.0 minutes and are tabulated as shown in **Fig.11.1**. Assume that the heat supplied was constant and no heat was lost during the heating process.

Melting point of pure **X** = 40.0 ºC
Boiling point of pure **X** = 70.0 ºC
Time when **X** began melting = 2.5 minutes
Time taken for all of solid **X** to melt = 5.0 minutes
Time when **X** began boiling = 10.0 minutes
Specific latent heat of vaporization of **X** = 30.0 kJ/kg
Power = 100 W

Time / min	**Temperature / ºC**
0.0	25.0
5.0	40.0
10.0	70.0
15.0	70.0
20.0	70.0
25.0	85.0

Fig. 11.1

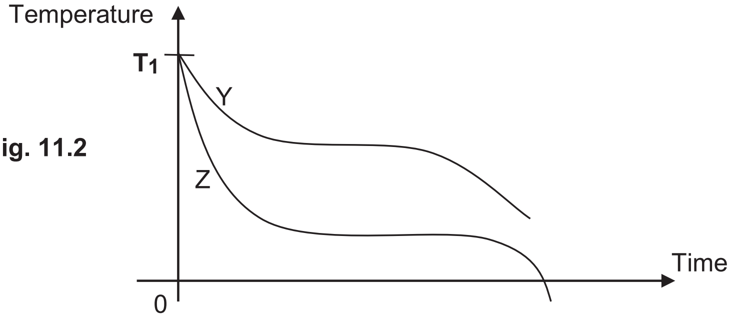


(i) By analyzing the data obtained and using the given information, plot the heating curve of pure substance **X** in the grid lines provided. [3]

(ii) Calculate the specific heat capacity of the solid **X**. [2]

(b) **Fig. 11.2** below shows the cooling curve graphs of two pure liquids, **Y** and **Z,** of the same mass.

Fig. 11.2



(i) Which substance (**Y** or **Z**) has a lower melting point? [1]

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(ii) Which substance (**Y** or **Z**) has a greater specific heat capacity in the liquid state? Explain your answer clearly. [2]

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(iii) Which substance (**Y** or **Z**) has a greater specific latent heat of fusion? Explain your answer clearly. [2]

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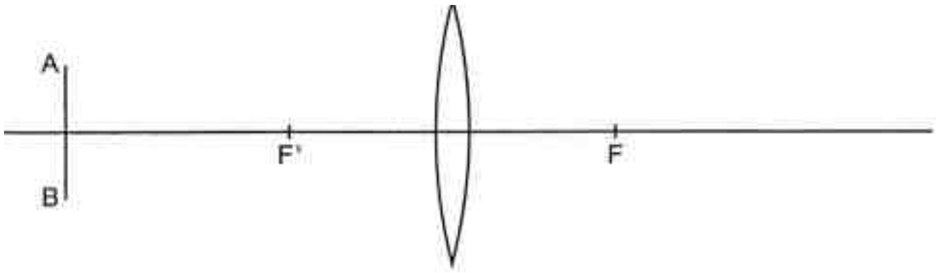
EITHER

12A.(a) **Fig. 12.1** shows an object **AB** near a thin converging lens. The principal foci of the lens are at **F** and **F'**

Fig. 12.1



(i) By means of an accurate drawing, draw rays to find the positions of the images of the points **A** and **B**. [2]

(ii) If object **AB** is brought closer and closer to the converging lens until a distance less than one focal length, describe clearly the changes to the image of **AB**. [2]

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(b) **Fig. 12.2** shows a scaled drawing of an object **PQ** and its image **P'Q'** after passing through a thin converging lens. By locating the position of the converging lens and drawing rays on the diagram, find the focal length of the converging lens. [2]

Fig. 12.2

Focal length = ………………………..

(c) Light rays passing into an eyeball undergo two refractions; once as they pass through the cornea and another as they pass through the lens of the eye. **Fig.12.3** shows how light rays pass through the eyeball and the image of an object is formed at the back of the eye (retina) for an individual with perfect eyesight. For a short-sighted person, the image of a distant object is formed in front of the retina.

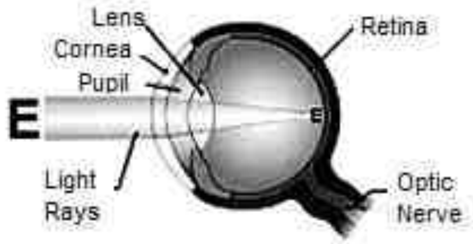

Fig. 12.3

(i) One way to correct short-sightedness is to use a pair of spectacles. Which type of spectacle lens (converging or diverging) would be suitable to correct short-sightedness? Explain your answer clearly. [2]

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(ii) Another method to correct short-sightedness is by performing a 'lasik surgery' which removes a small portion of tissue in the cornea to make the cornea less rounded. Suggest how the less-rounded cornea in front of the eye's lens can help to correct short-sightedness. [2]

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OR

12B. (a) **Fig. 12.4** shows a solenoid with an alternating current (a.c) supply coiled around a soft iron core. An aluminium ring is placed through the soft iron and rests on the solenoid. When the a.c supply is turned on, the ring 'floats' above the solenoid as shown in **Fig. 12.5**.

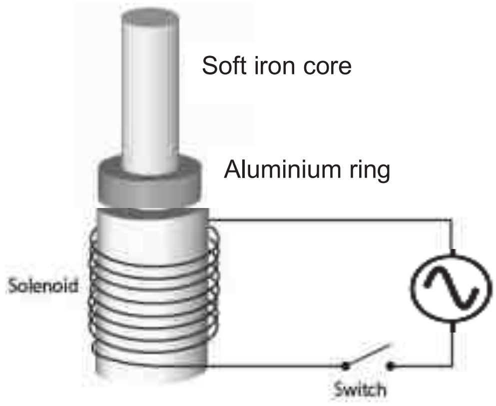

Fig. 12.4

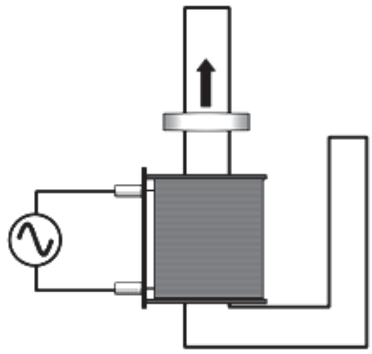

Fig. 12.5

(i) Explain clearly why the aluminium ring 'floats' when the a.c supply is turned on. [3]

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(ii) If the a.c supply is now replaced by a d.c supply, what will be observed after the supply is turned on? [1]

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(iii) The solenoid has an a.c supply but the aluminium ring is replaced with a 'C'-shaped ring instead as shown in **Fig. 12.6.** When the supply is turned on, the C-shaped ring does not 'float' upwards but continued to remain at rest on the solenoid instead. Explain the reason why this happens. [2]

Fig. 12.6

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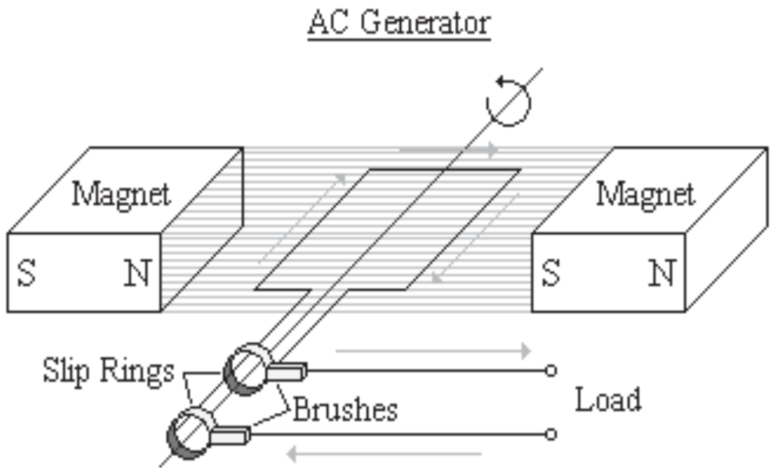
(b) **Fig.12.7** shows a simple a.c generator which has a frequency of 60 Hz and peak voltage 12 V.

Fig. 12.7



(i) Sketch the graph of the voltage produced against time for two complete cycles below. Take the position of the coil to be that in **Fig. 12.7** when time = 0 s. [1]

(ii) If the speed of rotation is **reduced by** ¼ times the original speed, sketch the new graph of the voltage produced on the same axis above. Label this new graph with **(ii)**. [2]

(iii) Explain clearly the differences between the graph for **b(i)** and **b(ii)**. [1]

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--End of Section B—

CCHY 2018 Pure Physics Prelim Exam Mark Scheme

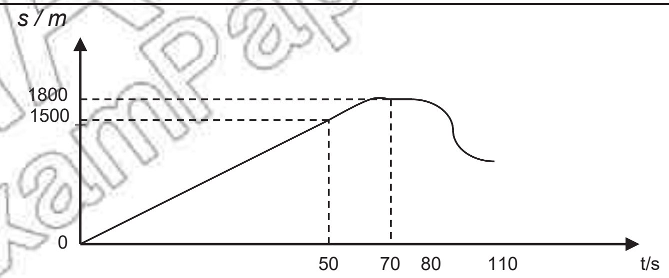
Paper 1

1	**D**	6	**C**	11	**C**	16	**D**	21	**D**	26	**D**	31	**A**	36	**A**
2	**B**	7	**C**	12	**B**	17	**A**	22	**B**	27	**D**	32	**B**	37	**A**
3	**C**	8	**B**	13	**A**	18	**C**	23	**B**	28	**C**	33	**B**	38	**A**
4	**C**	9	**D**	14	**D**	19	**B**	24	**C**	29	**C**	34	**A**	39	**C**
5	**B**	10	**B**	15	**C**	20	**D**	25	**D**	30	**B**	35	**A**	40	**C**

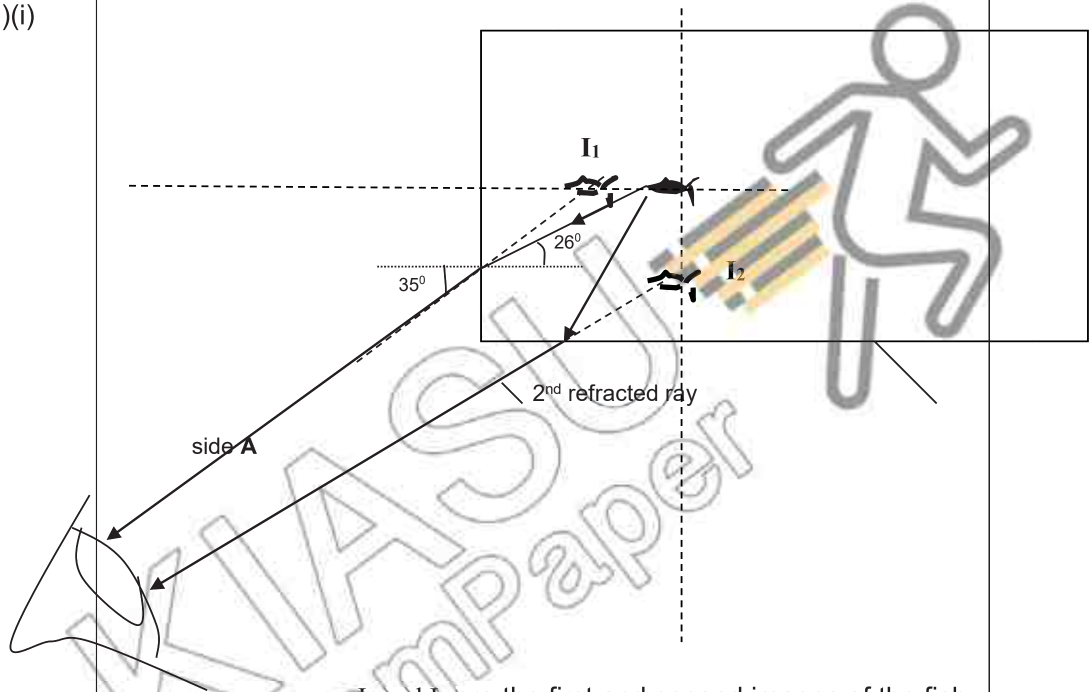
Paper 2

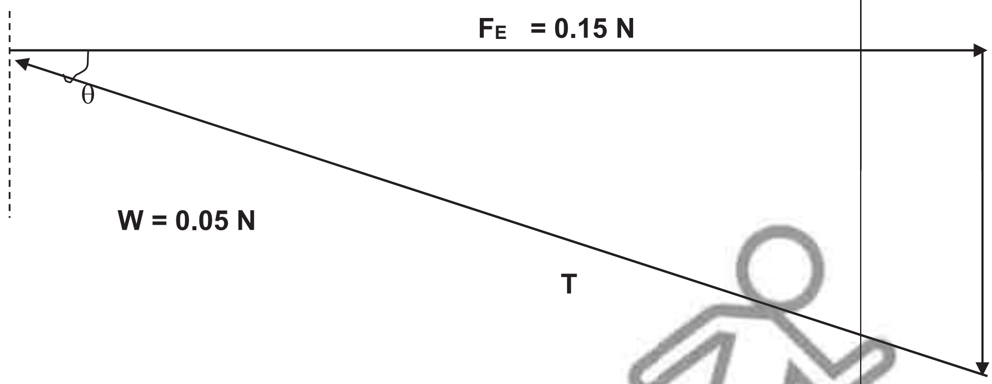
Note: ***1*** *mark will be deducted for not expressing numerical value to 2/3 sig. fig on 1 occasion. 2 marks to be deducted for more than 1 occasion.*
50% mark for each part of qn will be deducted for missing or wrong "unit".

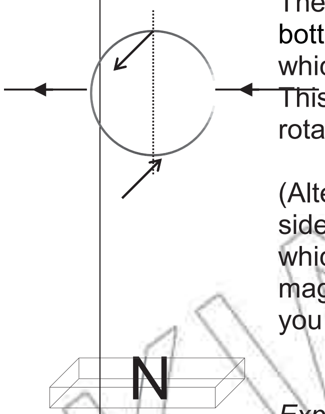
Section A

Qn no.	Suggested Solution	Marks
1(a)(i)	The car travelled at constant speed at 30 m/s from t = 0 to 50 s, then decelerates uniformly to stop from t = 50 s to 70 s, and remain stationary / at rest for a further 10 s, It reverses / change direction and accelerates uniformly	1 1
(ii)	Either, by graphical method Retardation (r) = gradient = 30/ (70-50) = 1.5 ms^{-2} Or, using formula a = (v – u) / t = (0 – 30) / 20 = - 1.5 ms^{-2} or, r = 1.5 ms^{-2} (No mark awarded if working is not shown)	1
(b)	Total displacement = distance moved during the first 70 s - distance moved during t=80 - 110s = ½ (50 + 70) x 30 - { ½ x 30 x 20} = 1500 m	 1 1
(c)	 ➢ Show a **constant slope** for first 50 s up to 1500 m; ➢ a **reducing gradient** for the next 20 s to 1800 m, ➢ a **horizontal line graph** between t = 70 – 80 s at 1800 m ➢ an (increasing and decreasing) **curve** for showing the last 30 s *1 mark will be deducted for not stating / labeling the axes.*	1 1

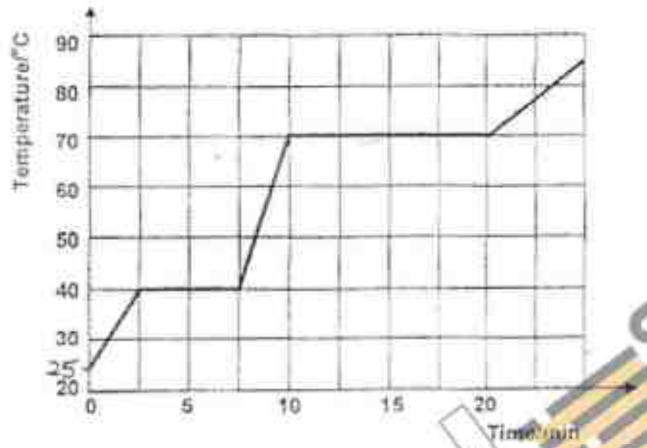
2(a)	*Let the spring balance reading (or tension) be T* *To balance about (pivot) P,* Net moment about P = 0 Total anticlockwise moment = Total clockwise moment T x 80 = (2 x 40) + (8 x 60) T = **7.0 N**	 1 1
(b)	**Either,** Let the reaction force at the pivot be R. Since net force = 0 (not moving / at balance) Hence, Total upward force = Total downward force T + R = 2 + 8 7 + R = 10 R = **3.0 N** Direction of R is (vertically) **upward** **OR , using POM and take moment about the spring position**	 1 1
(c)	Magnitude (size) of the spring balance reading **decreases** The total clockwise moment has <u>decreased</u> as the clockwise moment by the 8 N weight about P has decreased with the reduction in the (perpendicular) distance. To maintain equilibrium, <u>the anticlockwise moment by spring must also decrease proportionately.</u> As moment = force x perpendicular distance (and the distance is constant), the spring force must decrease to <u>compensate the reduction in the moment.</u>	1 1
3(a)	Total energy is always conserved (remain unchanged) Energy cannot be created or destroyed; They can only be converted from one form to other form(s)	1
(b)	kinetic and gravitational potential energy	1
(c)	Ep = mgh = 0.5 x 10 x 13 = **65 J**	 1
(d)	Assume no energy is loss and total energy is conserved, EP (at C) + $W_{friction}$ = total energy at A (PE + KE) 65 + 10.7 = ½ (0.5) (v_0^2) + (0.5 x 10 x 7.5) v_0 = **12.4 m/s** **OR** **E_K** (at A) = Work done against friction + Ep gain ½ (0.5)v_0^2 = 10.7 + (0.5 x 10 x {13 – 7.5}) v_0 = **12.4 m/s**	 1 1
(e)	There is <u>negligible loss of energy</u> due to <u>sound/heat energy</u> (on base)	1
4(a)	Using the Principle of Reversibility of Light **By measurement**	

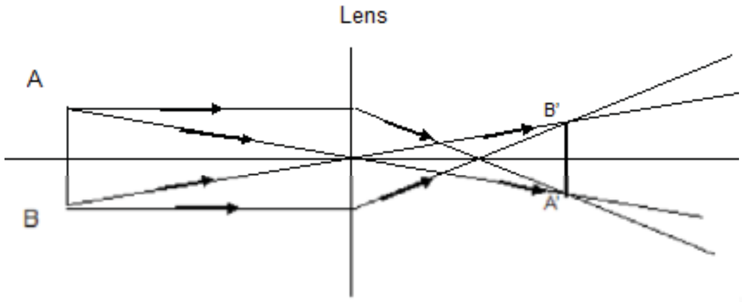
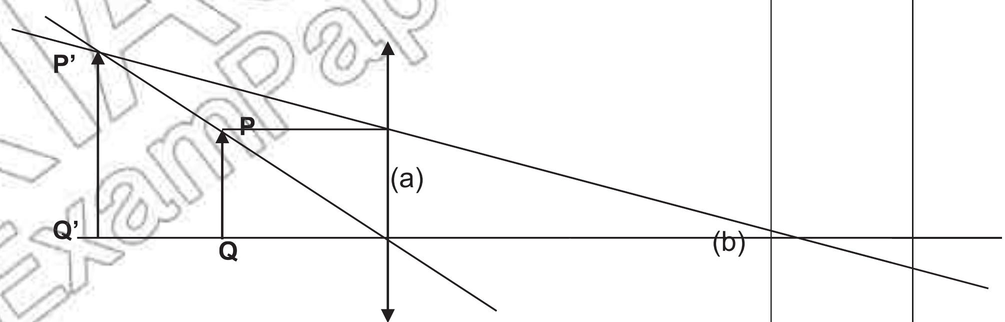
	$\angle i$ (in air) = 35^0 $\angle r$ (in water) = 26^0 ($\pm 1^0$) n_{water} = sin i / sin r = sin 35 / sin 26 = **1.31** (or between 1.28 to 1.39)	1 1
(b)(i)	 I_1 and I_2 are the first and second images of the fish Show correct 2nd refracted ray from side A to eye	1
(ii)	show correct positions of the 2 images, I_1 and I_2	2
5(a)	air molecules moving randomly and <u>bombarding / colliding with the (tyre) walls and rebounding off.</u> exert a <u>force on the unit area</u> of wall's surface. This produces a pressure (as pressure is force per unit area)	1 1
(b)	**Increase , increases, no effect , increases** All 4 are correct	1
6(a)	perspex ball has been charged with induced positive charges on its surface atoms near to the Van de Graaff generator As **like charges repel**, the (+) charged ball will be repelled off by the (+) charged metal dome.	1 1

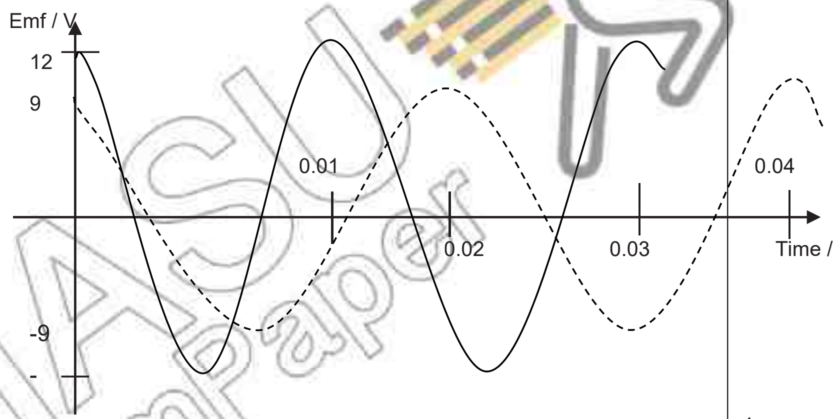
(b)	5 g has a weight (W) of 5 x 0.01 = 0.05 N Scale : 1 cm to 0.01 N (or less)  F_E and **W** are correctly shown (both magnitude and direction) Correct **triangle** shown (or parallelogram showing the **resultant** of F and W) Correct T and θ values (T = 0.16 N , θ = 72^0) *(Deduct 1 mark each for not expressing T to 2 or 3 sf / not labeling the forces on the scale drawing/ not indicating the direction of the force(s)*	 1 1 1 1
7(a)(i)	S open, voltmeter reading is <u>**0**</u> as there is no current. Combined resistance = 4 + 6 = 10 Ω I = V / R = 12 / 10 = 1.2 A Ammeter reads **1.2 A**	1 1
(ii)	S closed, combined resistance = 4 + {(6 x 12) / (6 + 12)} = 8 Ω I = V / R = 12 / 8 = 1.5 A Ammeter now reads 1**.5 A** p.d across 4 Ω = IR = 1.5 x 4 = 6.0 V hence, p.d across parallel network = 12 – 6 = 6 V Current through 9 Ω = V / R = 6 / 12 = ½ A P.d across 9 Ω = IR = ½ x 9 = 4.5 V Voltmeter now reads **4.5 V**	 1 1
(b)(i)	A device that converts <u>other form of energy(s) to electrical energy</u>.	1
(ii)	Using potential divider, As p.d α R at constant I hence R_{LDR} / 10 kΩ = 2 V / 10 V R_{LDR} = **2.0 kΩ**	 1

	Alternatively let $x = R_{LDR}$ $x / (x + 10) = 2 / 12$ $6x = x + 10$ $5x = 10$ $x = \mathbf{2.0\ k\Omega}$	
8(a)(i)	To overcome inertia of the coil so that it can start to turn / enable the conducting (enameled) part of the wire to be in contact with paper clip to allow current to pass into the coil.	1
(ii)	When electric current flows into the coil via the paper clip say from right to left, (assume the coil is vertical, as shown in the diagram) *Explanation of the force set up* it sets up a magnetic field at the bottom coil which interact with the magnetic field of the permanent magnets below (with a north pole up) The net resultant field produces a force pushing the bottom coil (using Fleming's LHR) near the bottom tape which turns the coil. This causes the conducting enameled copper wire to rotate.  (Alternatively, when the coil is slightly displaced to one side, the current produces a magnetic pole in the coil which will cause the coil to turn as it is repel by the magnet pole. If it is attracted, the coil will not turn and you have to displace coil on the other side) *Explanation for continuous rotation* No current flows into the coil when the insulated part of enameled wire is in contact with the paper clip, and hence no more magnetic force. But, inertia will continue to rotate the coil until the conducting enameled copper wire connects up the circuit again. This again set up a force pushing the coil in again, repeating the cycle and causing the coil to continue to turn.	1 1 1
(b)	The rotation speed will increase. *Mention ' increased rotation' – zero mark*	1
(c)	To secure the 2 magnets strongly in the same position on top of the base of holder by attracting them /prevent magnet attracting the coil above it.	1

9(a)	Coils **M**.: Primary coils and coil **K : secondary coil** Comparing the voltages of primary coil to secondary coil: Step down ratio = 3 300 : 220 = 15 : 1 Hence the coils must be step down to the same ratio of 15 : 1 Comparing the turn ratio i.e Coil M : Coil K = 1 500 : 100 = 15 : 1 (*If working is not clearly shown, award maximum 1 mark)*	 1 1
(b)	Input power = 100 / 75 x 15 kW = 20 kW Using **I** = P / V = 20 000 / 3 300 = **6.1 A**	1 1
(c)	Any one of the following….. Laminating the iron core will reduce the power loss due to heat produced by induced current (known as eddy current) in the core itself. Using low resistance (primary and secondary) coils will minimize the amount of heat produced in the coils. To increase the magnetic flux linkage between the primary and secondary coils by using a soft magnetic material (iron core) to link them up…	1
	Section B	
10(a)	A force exerted on the brake pedal **acts on the surface area of Piston P in contact with the oil** in the master cylinder **to create a pressure** This **pressure in the oil is transmitted to all parts of the oil** Since **oil is incompressible, t**his **creates a force pressing on the disc pads** of the wheels. **Friction between the disc pads and the wheels** slows the car down.	1 1
(b)(i)	Since the **pressure acting in the liquid is the same throughout**, A **small area at Piston P would require a smaller force** exerted **to produce a larger force at Piston Q**.	1
(ii)	Force exerted on piston Q = $(F_P \times A_Q)/A_P$ $= (120 \times 7.5 \times 10^{-3})/ 5.0 \times 10^{-4}$ = **1800 N** (Pressure on piston P = $120 / 5.0 \times 10^{-4}$ = 240 000 Pa if got the above wrong) [1]	1 1
(iii)	Assuming no energy loss, $F_P \times d_P = F_Q \times d_Q$ $d_Q = (120 \times 6)/ 1800$ = **0.4 cm**	1
(c)	Since **air is compressible** **Pressure exerted at the master cylinder will not be fully transmitted** to the disc brakes Resulting in a **greater force required at brake pedal to obtain the same force on the disc brake** for the ideal system **Force on Piston Q is smaller**	1
(d)(i)	The fast moving car has **high inertia** On a **wet road, there is less friction between the wheels and the road**	 1

	When wheels suddenly stops turning, the **forward force is greater than the resistive force**	1
(ii)	The threads **allows water to pass through** the surface of the tyre This **increases the friction between the car and the road surface** to prevent skidding.	1
11(a)(i)	 each correct part/shape of the graph with correctly labeled values for axes (total 5 parts) 0 to 2.5 min 2.5 min to 7.5 min 7.5 min to 10 min 10 min to 20 min 20 min to 25 min	2 correct - 1 mark 4 correct - 2 marks All 5 correct - 3 marks
(ii)	Heat energy supplied = power x time = 100 x 2.5 x 60 = **15 kJ** Temperature change = 40 – 25 = **15 °C** Heat capacity of solid Z = Heat energy supplied / (mass x temperature change) = 15 000 / (2 x 15) = **500 J/kg°C**	1 1
(b)(i)	Substance Z	1
(ii)	Substance **Y** When subjected to the **same cooling condition**, the **fall in temperature for substance Y is slower than substance Z** This indicates that a **higher amount of energy needs to be lost** by substance Y compared to Z for the **same amount of fall in temperature**.	1 1
(iii)	Substance **Z** For the **same mass**, **same period of time**, Substance Z takes a **longer time to change state** Indicating that **higher amount of latent heat needs to be lost** by Z compared to Y to change from liquid to solid state	1 1

Either		
12A(a)(i)	 Correct **pair of rays** from A, one refracted through the lens and passing F, the other straight through optical centre Correct **pair of rays** from B, one refracted through the lens and passing F, the other straight through optical centre Correct **smaller straight image** drawn **Arrowheads drawn** for every light ray and **image labelled** with A' and B' (no arrowheads or incomplete arrow heads – minus 1 mark) (image is not straight – minus 1 mark)	1 1
(ii)	As the object is brought nearer to the lens towards one focal length distance, image becomes **magnified** but **remain inverted and real** When the object is less that one focal length distance from the lens, the image becomes magnified, **Upright** and **virtual**.	1 1
(b)	 Correct line passing through top of object and image to locate position of lens, (a) Correct line from object to lens, combined with line (b) Focal length between 5.9 to 6.2 cm	1 1
(c)(i)	**Diverging** lens. Diverging lens will **spread the incoming rays** before it reaches the lens The more diverged rays entering the lens will be **focused at a further distance in the eye** onto the retina	1 1
(ii)	When rays enter the less rounded cornea, it **undergoes lesser refraction/less converging** This causes the lesser refracted rays to be **focused at a further distance in**	1

	the eye after passing through the lens.	1
12B(a)(i)	When the supply is turned on, a **changing magnetic field** is produced around the solenoid The <u>changing magnetic flux/magnetic field lines</u> cutting the aluminium **ring induces an emf on the ring** By **Lenz's law**, the induced emf on the ring is such that the **magnetic field induced around the aluminum ring opposes the magnetic field of the solenoid** that produced it **Like poles** will exist between the aluminium ring and the solenoid And repel the ring upwards since **like poles repel**	1 1 1
(ii)	The ring will **move upwards momentarily** and subsequently **falls back down and rest** on top of the solenoid.	1
(iii)	The C-shaped ring **does not allow current to pass around the aluminium continuously**. This **does not allow any induced current, magnetic force/field to be produced** around the c-shaped ring. Hence the ring will remain at rest on the top part of the solenoid.	1 1
(b)(i)	 Correct sine curve starting from max Correct max. emf, min emf and period	1
(ii)	Correct sine curve (dotted) starting from max Correct max. emf = 9 V min emf = -9 V period = 0.022 s	1 1
(iii)	A rotation 1/4 times slower would result in a) **Output e.m.f = 9.0 V** which is 1/4 times lesser than initial b) **Period becomes 0.022 s** since frequency becomes 45 Hz c) A <u>**slower rotation causes lesser e.m.f to be induced**</u> in the generator <u>**and it the period for each oscillation is longer.**</u>	1

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

PHYSICS (6091/1)

Name: ______________________________ (   )   Class: __________

SECONDARY FOUR EXPRESS **17 September 2018**
PAPER 1 **1 hour**
1200 h – 1300 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the OTAS.

Read very carefully the instructions on the OTAS.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

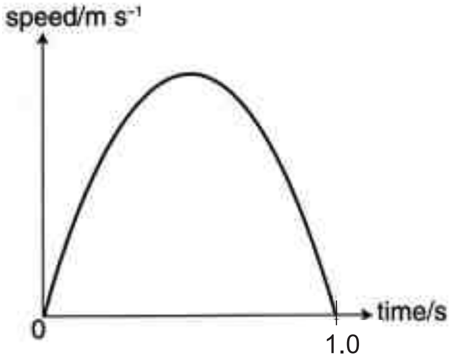
Any rough working should be done in this booklet.

Take the gravitational field strength on Earth, g to be 10 Nkg^{-1}.

This paper consists of **19** printed pages including the cover page.

[Turn over

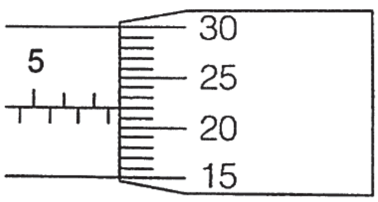
1 The graph shows the speed-time graph of a pendulum bob oscillating from a point.



What is the period of the oscillation of the pendulum bob?

A 5 s **B** 1.0 s **C** 1.5 s **D** 2.0 s

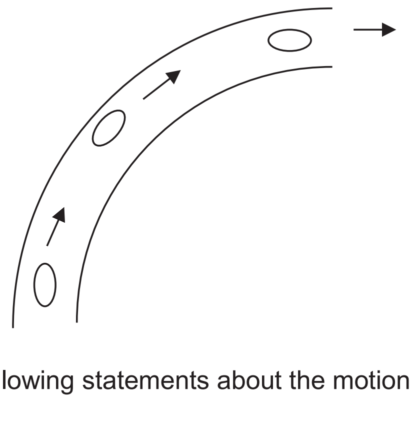
2 The following diagram shows the thickness of 10 metal coins using a micrometer.



What is the thickness of one metal coin?

A 0.72 mm **B** 0.77 mm **C** 5.72 mm **D** 7.72 mm

3 A car travels at *constant speed* round a bend.



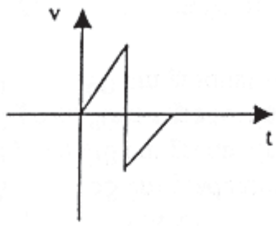
Which of the following statements about the motion of the car is **not** correct?

A The car is accelerating.
B The velocity of the car is uniform.
C The displacement of the car increases.
D The distance covered per unit time by the car is constant.

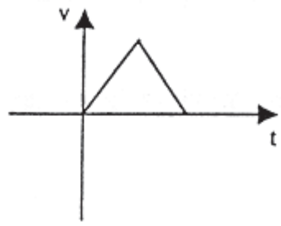
4 A stone is thrown vertically upwards and falls back to its starting point and stops.

Taking velocity in the upward direction as positive, which of the following velocity-time (v-t) graphs is correct?

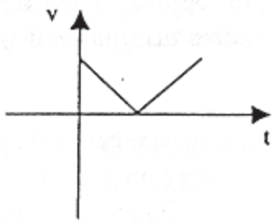
A



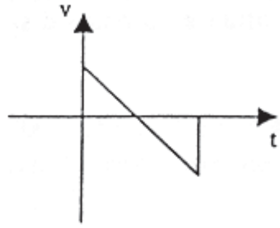
B



C



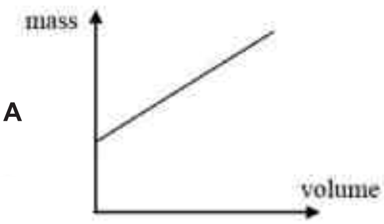
D



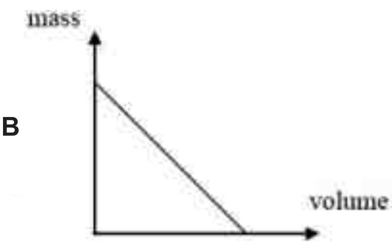
5 Some students want to calculate the density of pure copper. They measured the mass and volume of different samples of pure copper.

Which of the following mass-volume graphs shows their results?

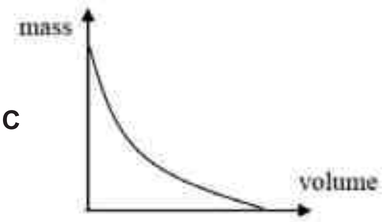
A



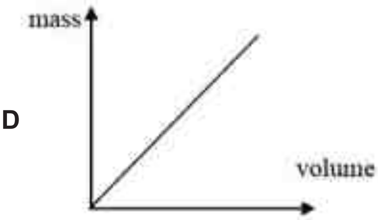
B



C



D



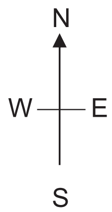
6 A rocket has a mass of 100 kg. The force produced by the engine of the rocket is 3000 N in the direction against the force of gravity.

What is the acceleration of the rocket?

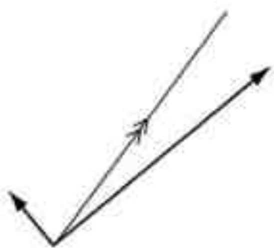
A 10 ms^{-2}
B 20 ms^{-2}
C 30 ms^{-2}
D 40 ms^{-2}

7 An aircraft heads north-east at 400 km/h. The wind is blowing towards the north-west at 100 km/h.

Which vector diagram represents the correct way to obtain the resultant velocity of the aircraft?



A



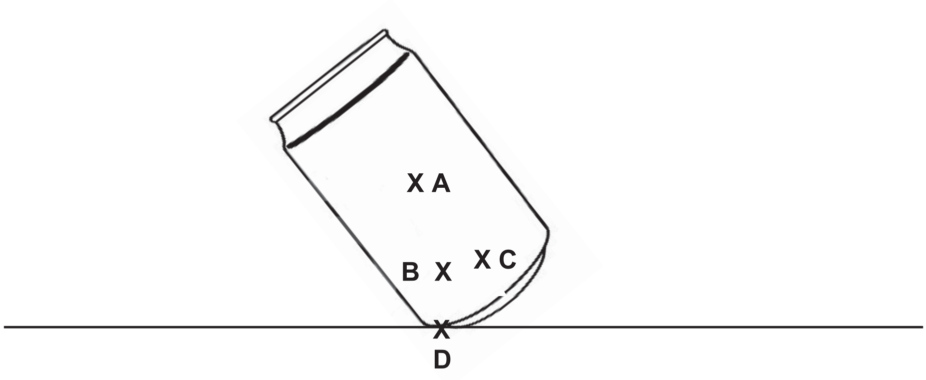
B

C

D

8 The diagram below shows a can of soft drink balanced on its edge.

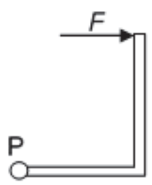
Where is the likely position of the centre of gravity?



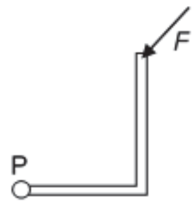
9 A force ***F*** acts on an L-shaped object pivoted at point **P** at different positions.

Which of the following diagrams shows the position where force ***F*** is applied that would result in the lowest magnitude of moment about pivot **P**?

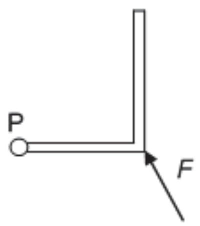
A



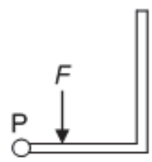
B



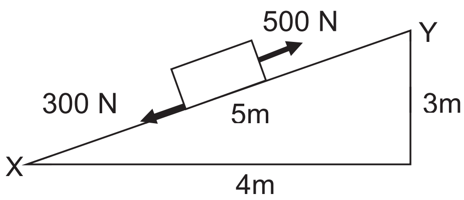
C



D



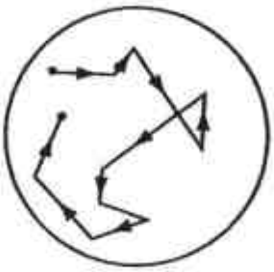
10 A force of 500 N is applied to a box to move it up the ramp as shown. The friction acting on the box is 300 N.



How much work is done against friction?

A 300 J
B 1 200 J
C 1 500 J
D 3 000 J

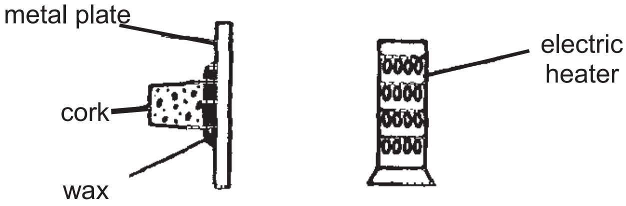
11 Smoke particles in a transparent box are observed using a microscope. A small point of light is seen to move around as shown.



What does this experiment demonstrate about air molecules?

A They are in continuous random motion.
B They can be seen through a microscope.
C They move more quickly when they are heated.
D They move because of collisions with smoke particles.

12 A small cork is fixed with wax to a metal plate. An electric heater is placed close to the plate.

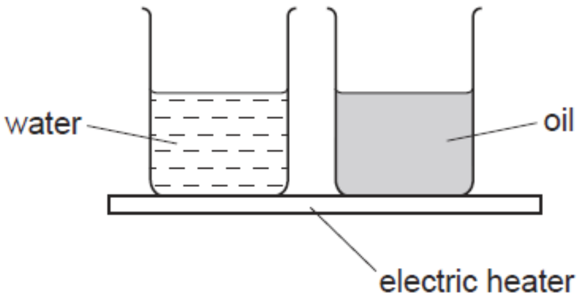


After some time, the wax melts and the cork drops off.

How does heat reach the wax?

A By conduction only
B By conduction and convection
C By radiation and conduction
D By radiation and convection

13 The diagram shows an electric heater being used to heat a beaker of water and a beaker of oil for several minutes. Both beakers are identical in size.



The temperature of the water and the temperature of the oil increase constantly. The rise in temperature of the oil is much greater than that of the water.

Which of the following explains the observation?

A The oil has a higher boiling point than water.
B The oil has a higher heat capacity than water.
C The oil has a lower boiling point than water.
D The oil has a lower heat capacity than water.

14 A piece of wire has an electrical resistance of 2.0 Ω in melting ice and 2.5 Ω in boiling water.

What is the resistance at 20 °C assuming that resistance changes uniformly with temperature?

A 2.1 Ω
B 2.2 Ω
C 2.3 Ω
D 2.4 Ω

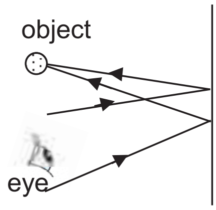
15 The following steps are used to construct and calibrate a thermometer in the Celsius scale. Arrange them in the correct order.

1 Measure the value of the thermometric property at steam point.
2 Choose an appropriate thermometric property.
3 Measure the value of the thermometric property at ice point.
4 Divide the temperature range between the two fixed points into 100 equal parts.

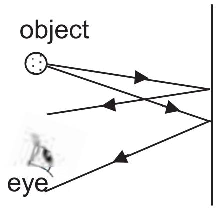
A 3, 2, 1, 4
B 2, 3, 1, 4
C 2, 4, 3, 1
D 4, 2, 3, 1

16 Which of the following ray diagrams is correct?

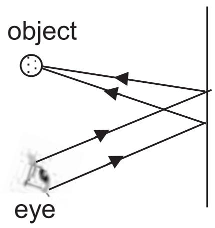
A



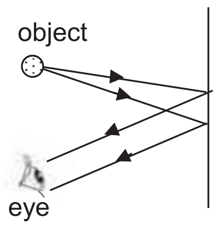
B



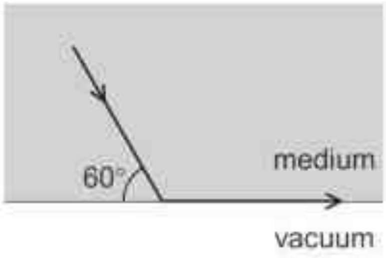
C



D



17 The diagram shows light travelling through a medium. The light reaches the boundary with a vacuum as shown. The light emerges travelling along the surface.

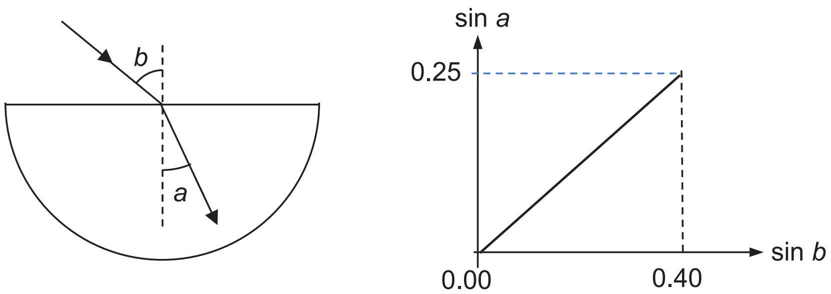


What is the refractive index of the medium?

A $\frac{\sin 30°}{\sin 90°}$ **B** $\frac{\sin 60°}{\sin 90°}$

C $\frac{\sin 90°}{\sin 30°}$ **D** $\frac{\sin 90°}{\sin 60°}$

18 A light beam is incident into a semi-circular glass block and refracted out as shown. A graph of sin *a* against sin *b* is plotted as shown.



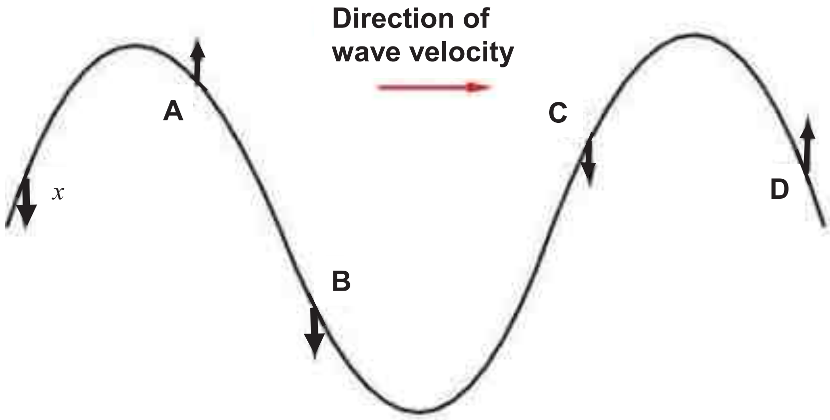
What is the critical angle of the glass?

A 37° **B** 39°

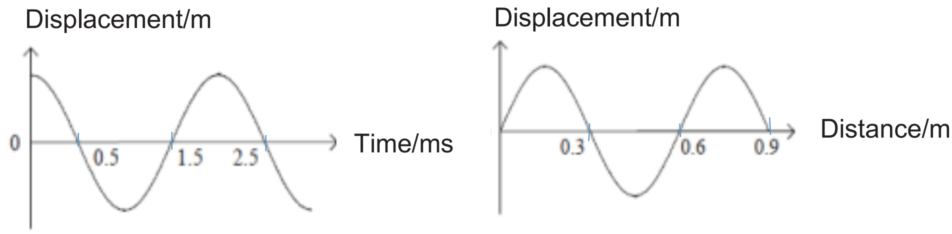
C 51° **D** 53°

19 The diagram shows a section of a wave motion. The particle at position x moves in the direction of the arrow shown.

Which of the following particles at the labelled positions, **A**, **B**, **C** and **D** is incorrect?



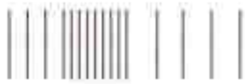
20 The two graphs shown below refer to the same wave.



What is the speed of the wave?

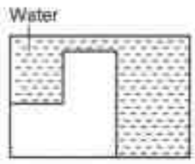
A 0.3 ms^{-1}
B 1.2 ms^{-1}
C 150 ms^{-1}
D 300 ms^{-1}

21 The diagram shows wavefronts moving from left to right as seen from above a ripple tank.

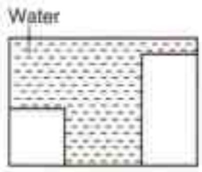


Which of the following shows the correct depth of the water in the tank as seen from the cross-section of the tank?

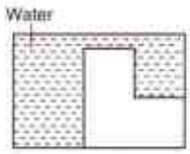
A



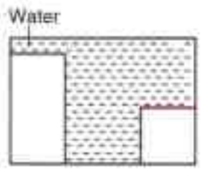
B



C



D



22 Below are three statements about electromagnetic radiation.

- Microwaves may cause the ionisation of cells.
- Radio waves are use in cancer radiotherapy.
- Ultraviolet radiation is used in remote controls for television sets.

How many of the statements are correct?

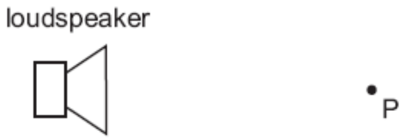
A 0
B 1
C 2
D 3

23 Radio waves, visible light and X-rays are all part of the electromagnetic spectrum.

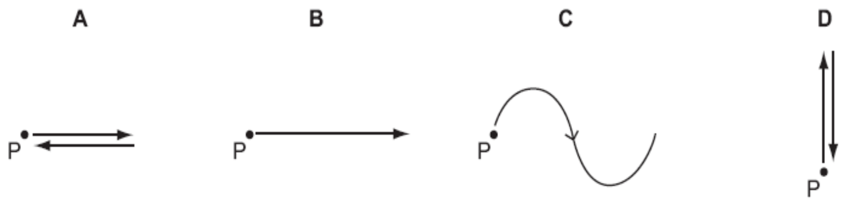
What is the correct order of increasing wavelength?

	shortest	⟶	longest
A	radio waves	visible light	X-rays
B	radio waves	X-rays	visible light
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

24 The diagram shows a loudspeaker that is producing a continuous sound wave of frequency 200 Hz in air.



Which diagram best shows how the sound causes a molecule at P to move during $\frac{1}{200}$ s?

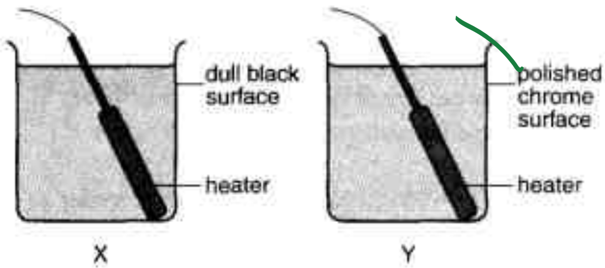


25 The speed of a sound wave is reduced by half when it passes from medium A to medium B.

Which statement below describes the change in the sound wave correctly?

A The frequency is reduced by half.
B The wavelength is reduced by half.
C The frequency becomes twice its initial value.
D The wavelength becomes twice its initial value.

26 In the diagram, two copper cans X and Y with outer surface of different texture are filled with same amount of water at room temperature and heated by heaters of the same power



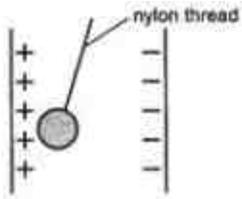
Which of the following statements is correct?

A Water in X boils faster because dull surface is a good absorber of radiation.
B Water in Y boils faster because polished chrome surface is a poor absorber of radiation.
C Water in Y boils faster because polished chrome surface is a poor emitter of radiation.
D Water in both cans take the same length of time to boil because the texture of outer surface will not affect the rate of energy absorbed by the water.

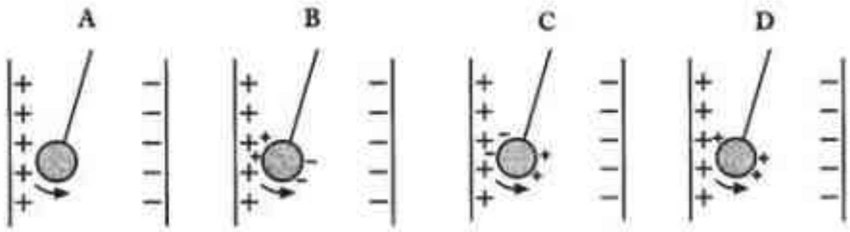
27 Which of the following statements is true?

A All metals are magnetic materials.
B All electrical conductors are magnetic materials.
C All materials that can be electrically charged are magnetic materials.
D All materials that can affect the direction of a compass needle are magnetic materials.

28 A light uncharged conducting ball is moved towards the positive plate.



Which diagram correctly shows the charges on the ball just after it has touched the positive plate?

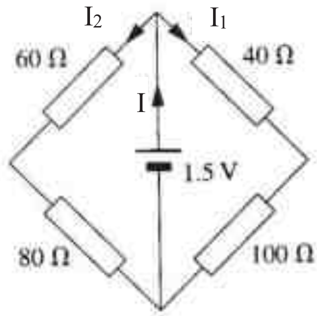


29 The electromotive force of a cell is 2.0 V.

Which of the following statements about the cell is correct?

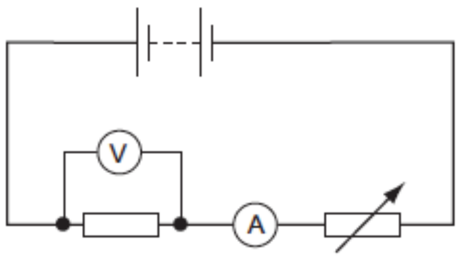
A The cell can supply 2.0 C of charge per second.
B The cell can supply 2.0 W of electrical power per second.
C The cell can supply 2.0 J of energy per coulomb of charge.
D The cell can supply 2.0 J of energy per coulomb of charge per second.

30 What is the current I?



A 5.4 mA
B 11 mA
C 21 mA
D 43 mA

31 The diagram shows a battery, a fixed resistor, an ammeter and a variable resistor connected in series. A voltmeter is connected across the fixed resistor.



The resistance of the variable resistor is reduced.

Which of the following correctly describes the changes in the readings of the ammeter and the voltmeter?

	ammeter	voltmeter
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

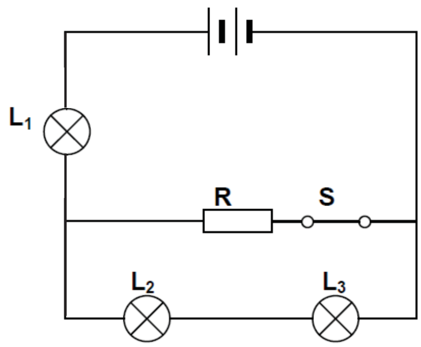
32 The steps taken to charge a conductor are shown below.

1 Place the conductor to be charged on an insulating stand.
2 Remove the charged rod.
3 Place a positively-charged rod near the surface of the conductor.
4 Connect the conductor to the ground.
5 Remove the ground wire.

Which of the following shows the correct sequence of events?

A 1, 3, 4, 2, 5
B 1, 3, 4, 5, 2
C 1, 3, 2, 4, 5
D 3, 1, 2, 5, 4

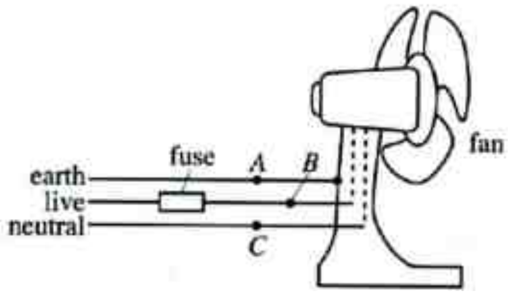
33 Three identical light bulbs, **L_1**, **L_2** and **L_3**, and a resistor **R** are connected as shown in the diagram.



How will the brightness of lamps **L_1**, **L_2** and **L_3** change when the switch **S** is opened?

	brightness of **L_1**	brightness of **L_2**	brightness of **L_3**
A	dimmer	dimmer	dimmer
B	dimmer	brighter	brighter
C	brighter	brighter	brighter
D	brighter	same	same

34 The diagram below shows the simple circuit of an electric fan. Which of the following actions will blow the fuse?

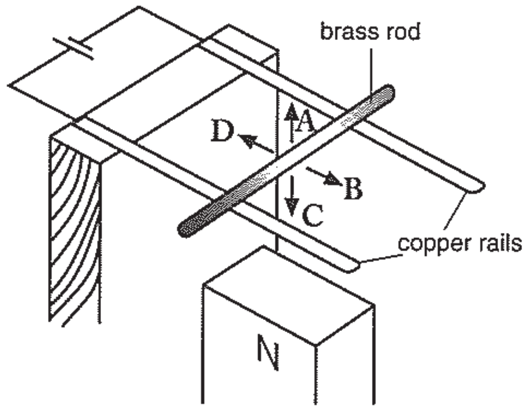


I Point ***A*** touches point ***C***.
II Point ***B*** touches point ***C***.
III Point ***A*** touches point ***B***.

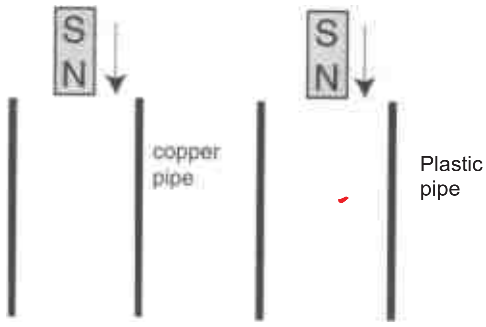
A **I** only
B **I** and **II** only
C **II** and **III** only
D **I**, **II** and **III**

35 The diagram shows a brass rod supported on two copper rails which are connected to a battery. The N-pole of a magnet is placed beneath the rails.

In which direction does the brass rod experience a force?



3 Two magnets are dropped vertically from the same height.

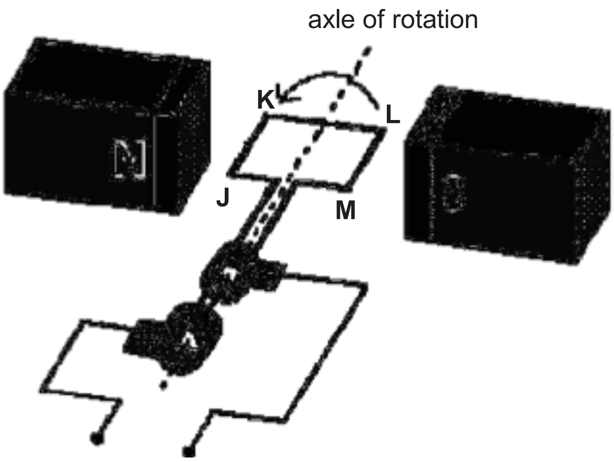


The magnet that dropped through the copper pipe took a longer time to drop through the pipe compared to the other one that dropped through the plastic pipe.

Which of the following is the correct explanation?

A Current is induced in the copper pipe.
B Copper pipe is a non-magnetic material.
C Magnetism is induced in the copper pipe.
D Plastic is a better conductor of electricity.

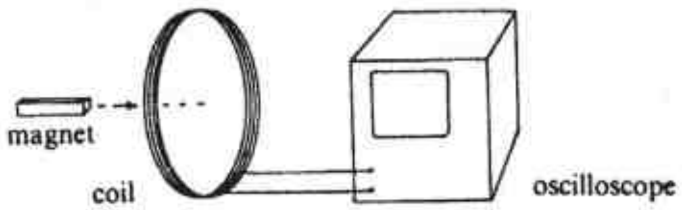
37 The diagram below shows a generator turning in the anti-clockwise direction.



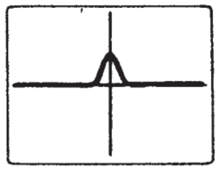
Which row is correct?

	direction of current flow through the coil at the position shown	**position of coil when current through the coil is maximum**
A	J → K → L → M	horizontal
B	J → K → L → M	vertical
C	M → L → K → J	horizontal
D	M → L → K → J	vertical

38 A bar magnet is moved slowly into a coil of wire which is connected to an oscilloscope.

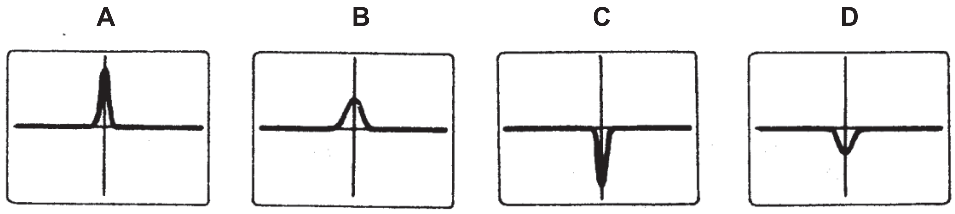


The trace on the oscilloscope is shown below:

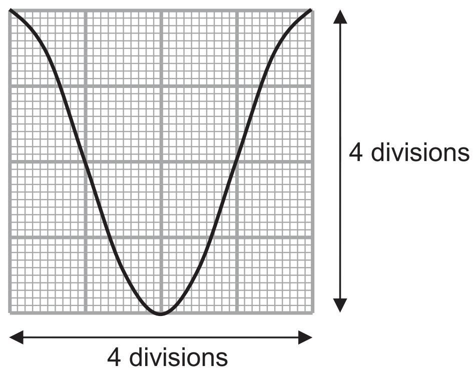


The magnet is then moved back from the coil at a greater speed.

Which trace shows this?



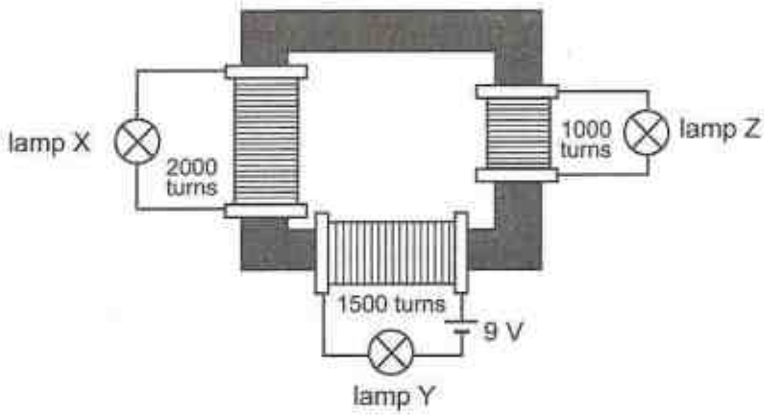
39 The diagram illustrates the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals.



The time-base is set to 2.0 ms/div and the voltage sensitivity is 2.0 V/div.
Which of the following correctly represents the peak voltage and frequency of the signal?

	Peak voltage	Frequency
A	4.0 V	83.3 Hz
B	4.0 V	125 Hz
C	8.0 V	83.3 Hz
D	8.0 V	125 Hz

40 Three identical filament lamps, X, Y and Z, are connected to a transformer with multiple coils. The resistance of each lamp is 4.5 Ω and each requires a current of 2.0 A to light up normally.



What can be observed about the brightness of the three lamps?

	Lamp X	Lamp Y	Lamp Z
A	Dimmer than normal	Normal brightness	Brighter than normal
B	Brighter than normal	Normal brightness	Dimmer than normal
C	Not lit	Normal brightness	Not lit
D	Not lit	Not lit	Not lit

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

PHYSICS (6091/2)

Name: ________________________________ (   )   Class: __________

SECONDARY FOUR EXPRESS **14 September 2018**
PAPER 2 **1 h and 45 minutes**
0800 h – 0945 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.
Write in dark blue or black pen.

Section A (50 marks)
Answer all questions.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer all three questions.
Question 12 has a choice of parts to answer.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

Take the gravitational field strength *g* on Earth to be 10 Nkg^{-1}.

At the end of the examination, ensure that you have submitted all your work.

For Examiner's Use	
Paper 2	**80**

Parent's/Guardian's Signature

This paper consists of **20** printed pages including the cover page.
[Turn over

1 A sky-diver jumps from a high-altitude helicopter as shown in **Fig. 1.1**.

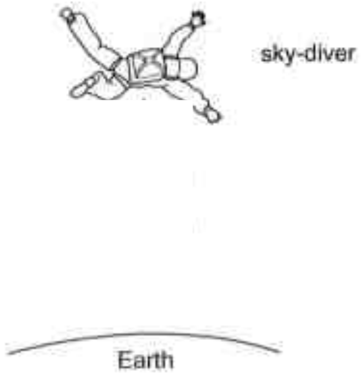


Fig. 1.1

(a) Explain why the acceleration of the sky-diver

(i) is 10.0 ms^{-2} at the start of the jump, [1]

…………………………………………………………………………………

…………………………………………………………………………………

(ii) decreases with time. [2]

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

(b) At one point during the dive, the acceleration of the sky-diver was 7.5 ms^{-2}. The sky-diver and his equipment have a total mass of 90 kg.

Determine the total resistive force acting on the sky-diver at that point. [2]

total resistive force = ………….

2 **(a)** Define *gravitational field strength*. [1]

…………………………………………………………………………………………….

…………………………………………………………………………………………….

(b) A stone is released from rest at an unknown height on the Earth. It reaches the ground after 2.0 s. Assume that air resistance is negligible.

(i) Calculate the velocity of the stone at 2.0 s. [2]

Velocity = …………………

(ii) In the space below, sketch the velocity-time graph of the stone. Indicate time = 2.0 s and its corresponding velocity on the axes. [2]

(iii) Determine the height from where the stone is dropped. [2]

Height = ………………….

3 Fossil fuels will eventually run out. This has led to scientists looking for alternative sources of energy. Tidal stream systems use the kinetic energy of seawater to generate electrical energy during the incoming and outgoing tides.

Fig. 3.1 below shows a twin-turbine system in which flowing seawater turns the turbine blades.

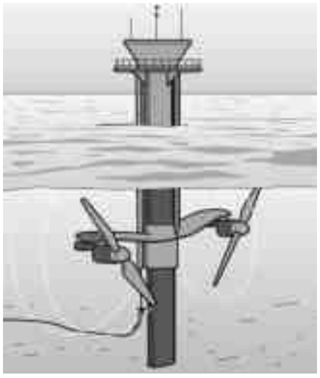


Fig. 3.1

When operating, 9.7×10^5 kg of seawater travelling at a speed of 3.0 ms^{-1} passes through each turbine every second. Each turbine generates 1.2×10^6 W of electrical energy.

(a) Define *power.* [1]

…………………………………………………………………………………………

(b) The input power to each turbine is the kinetic energy of the seawater that flows through each turbine in one second.

Calculate the input power of each turbine. [2]

Input power = ……………

(c) Calculate the percentage efficiency of each turbine. [2]

Percentage efficiency =………….

(d) Suggest one advantage of tidal stream systems over conventional wind farms. [1]

…………………………………………………………………………………………

…………………………………………………………………………………………

4 **Fig. 4.1** shows a very large plane mirror, inclined at 45° to the horizontal, beneath a pattern on the high ceiling of a hall.

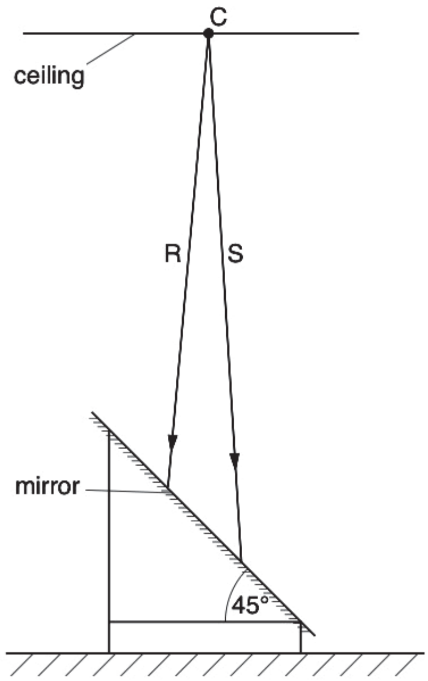


Fig. 4.1

The mirror is set on a stand immediately below the centre **C** of the pattern. **R** and **S** are two rays of light from **C** that strike the mirror.

The diagram is drawn to scale.

(a) On **Fig. 4.1**, mark with a cross (x) the position of **I**, the image of **C**. Label your cross **I**. [1]

(b) Complete the light rays to show how Rays **R** and **S** travel after they strike the mirror. [2]

5 **Fig. 5.1** shows rays from a distant object reaching a converging lens with a focal length of 6.0 cm.

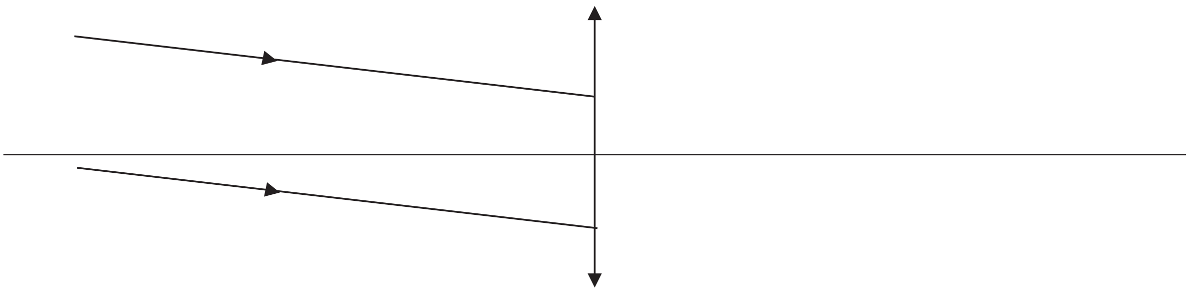


Fig. 5.1

(a) State what is meant by the phrase "*the focal length of a converging lens is 6.0 cm*". [1]

………………………………………………………………………………………………...

………………………………………………………………………………………………...

………………………………………………………………………………………………...

(b) Complete the ray diagram in **Fig. 5.1** to scale to show how the converging lens forms an image. [3]

(c) Describe the effect, if any, on the image when half of the lens is being cut away. [1]

………………………………………………………………………………………………...

………………………………………………………………………………………………...

6 **Fig. 6.1** shows two flat metal plates positioned horizontally, one above the other. The positive terminal of a high-voltage supply unit is connected to the bottom plate and the negative terminal is connected to the top plate.

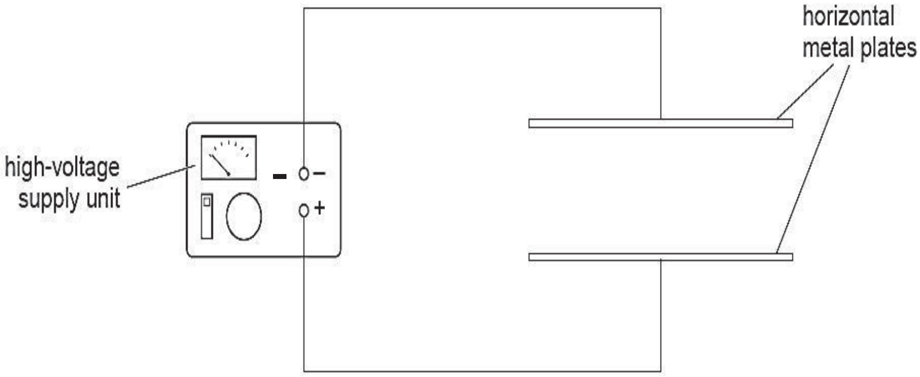


Fig. 6.1

The high-voltage supply is switched on.

(a) On **Fig. 6.1,** draw the shape and the direction of the electric field produced by the horizontal plates. [3]

(b) A small oil droplet is placed between the two metal plates. The oil droplet remains stationary in mid-air.

(i) State the charge of the oil droplet. [1]

…………………………………………………………………………………

(ii) Explain, using your understanding of Newton's laws of motion, how the oil droplet can remain stationary in mid-air. [3]

…………………………………………………………………………………

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7 A lamp is operated from a 12 V d.c supply. The brightness of the lamp is to be varied continuously over a wide range. This is made possible by using a variable resistor **AB** of maximum resistance 6.0 Ω with sliding contact **X**. Two circuits for achieving the desired results are suggested and shown in **Fig 7.1** and **Fig. 7.2**.

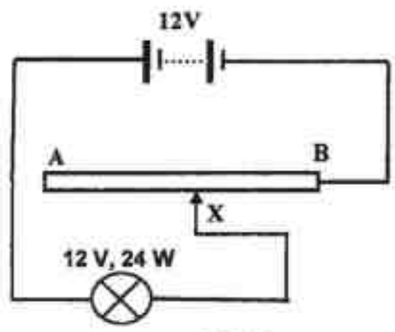

Fig. 7.1

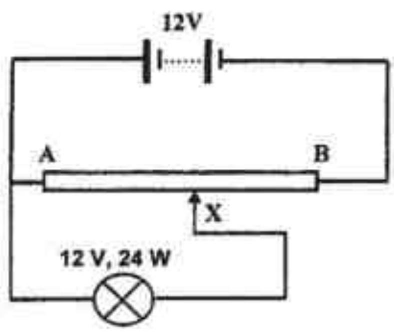

Fig. 7.2

(a) Calculate the resistance of the lamp. [2]

Resistance = …………….

(b) Calculate the maximum and minimum current flowing through the lamp in

(i) circuit in **Fig. 7.1**, [2]

Maximum current = ……………...

Minimum current = …………….....

(ii) circuit in **Fig. 7.2**. [2]

Maximum current = ……………...

Minimum current = …………….....

8 **Fig. 8.1** shows the side view of water waves formed in a ripple tank.

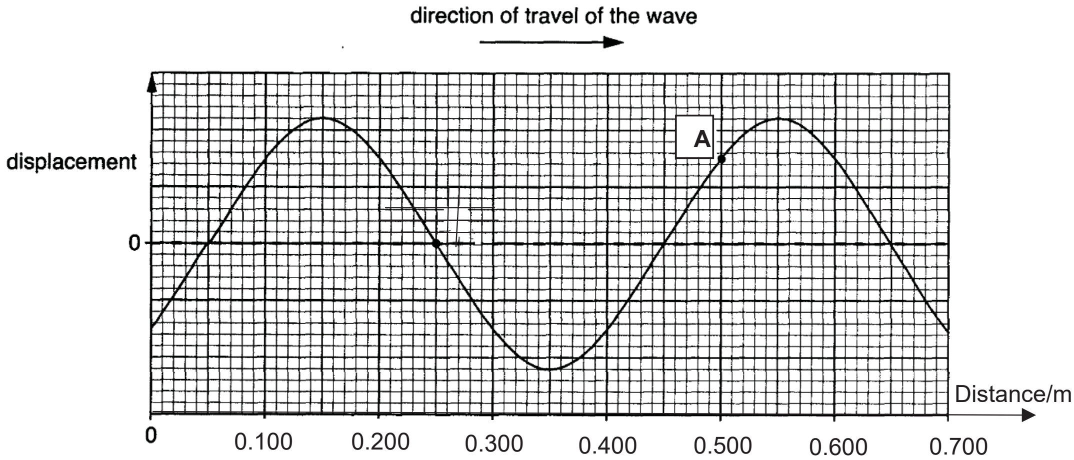

Fig. 8.1

(a) Determine the wavelength of the wave. [1]

Wavelength = …………

(b) Given that the period of the wave is 0.33 s, determine the speed of the wave. [2]

Speed of the wave = …………..

(c) A small piece of styrofoam is floating at **A** on the wave at 0.500 m horizontally from the origin (0,0). State and explain what would be the horizontal distance of the styrofoam from the origin after 2.0 s. [3]

……………………………………………………………………………………….

……………………………………………………………………………………….

……………………………………………………………………………………….

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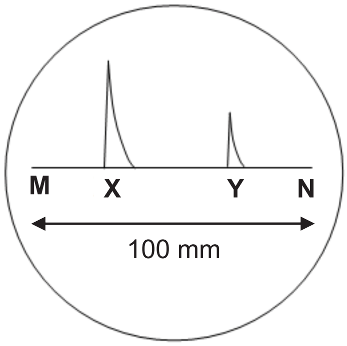
9 The diagram below shows the screen of a cathode ray oscilloscope (CRO). The time-base is set at 0.20 ms/mm and the length of the time-base sweep **MN** is 100 mm.



(a) Calculate the time duration represented by **MN**. [1]

Time = ……………………….

(b) A radar signal, sent from a radar station to a distant aircraft, is displayed on the CRO at **X** and the signal received back from the aircraft is displayed at **Y**. The distance **XY** is 60 mm.

Given that the speed of the radio wave is 3.0×10^{8} ms^{-1}, calculate the distance of the aircraft from the radar station. [2]

Distance = ……………………….

(c) The signal displayed at **Y** is weaker than that at **X**. State a reason why this is so. [2]

………………………………………………………………………………………..

………………………………………………………………………………………..

………………………………………………………………………………………..

Section B
Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 12**.

10 Four transformers, **A**, **B**, **C** and **D** are being investigated. For each transformer, the input voltage is changed and the output voltage measured each time. The results for each transformer are shown by the graphs in **Fig. 10.1.**

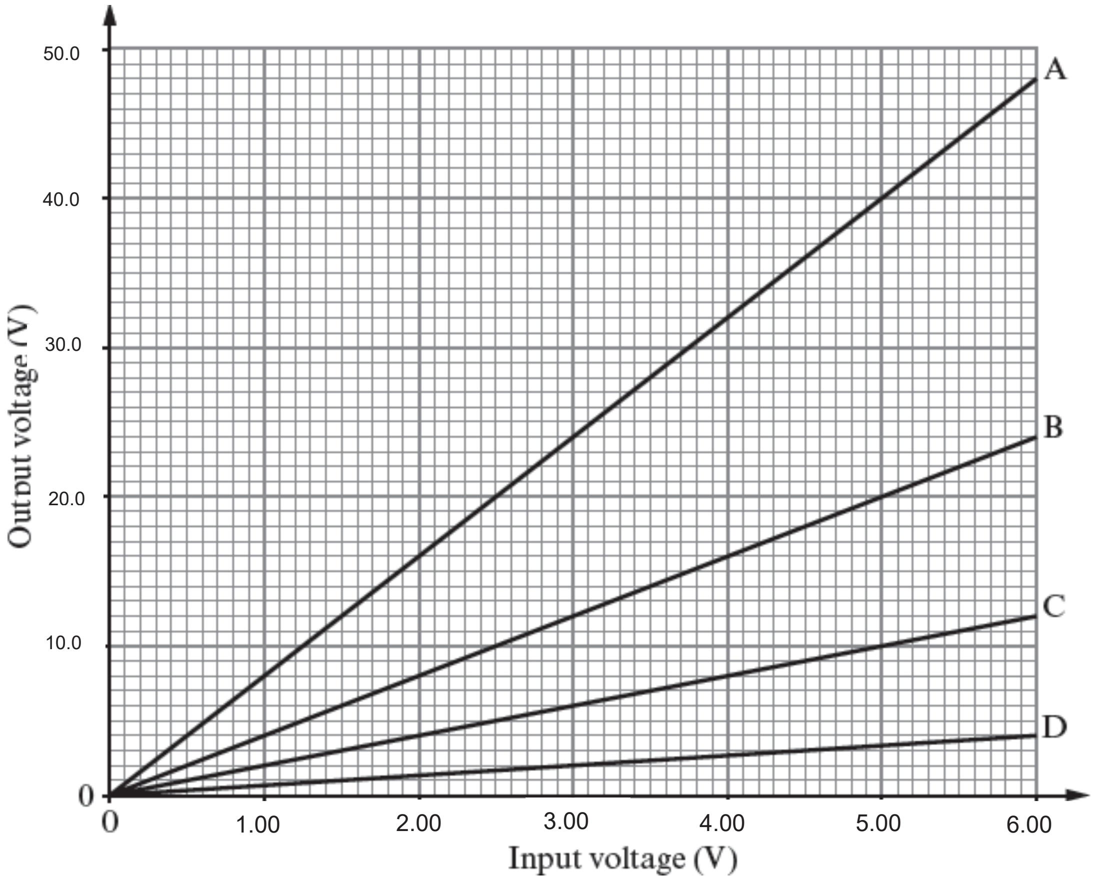


Fig. 10.1

One of the transformers is then used to light up a 12 V lamp from a 3 V power supply as shown in **Fig. 10.2**.

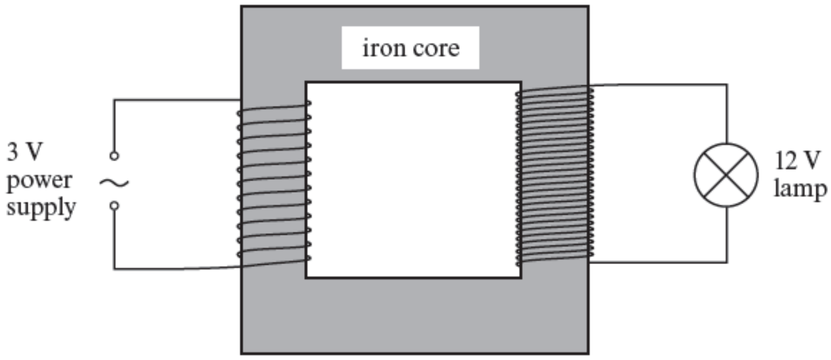


Fig. 10.2

(a) Explain how a current in the primary coil produces an output voltage in the secondary coil. [2]

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

(b) Describe the purpose of the iron core. [1]

…………………………………………………………………………………………

…………………………………………………………………………………………

(c) Use the data on the graphs in **Fig. 10.1** to answer the following questions.

(i) State and explain which transformer, **A**, **B**, **C** or **D**, would be used to light the 12 V lamp to normal brightness, from a 3 V supply as shown in **Fig. 10.2**. [1]

…………………………………………………………………………………

…………………………………………………………………………………

(ii) Transformer **C** contains 50 turns on its primary coil. Calculate the number of turns on its secondary coil. [2]

Number of turns = ……………..….

(iii) Transformer **A** has a current of 0.500 A in the primary coil. Calculate the current in the secondary coil. [2]

Current = ………………………….

(iv) State and explain which transformer, **A**, **B**, **C** or **D**, is **not** suitable to be used for the transmission and distribution of energy from power stations to transmission cables. [2]

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

11 **(a)** **Fig. 11.1** shows a manometer which contains mercury being used to measure the pressure from a gas supply. One end of the tube is connected to the gas supply and the other end is open.

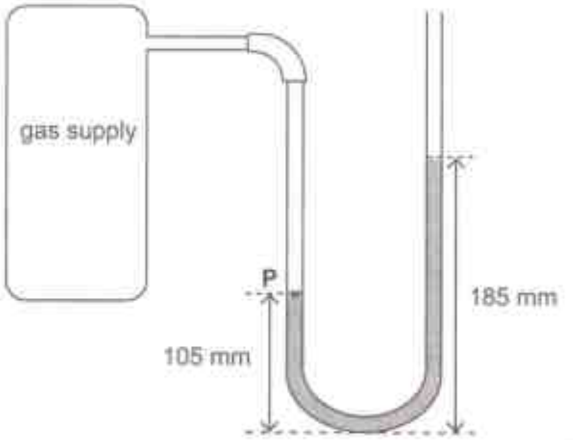


Fig. 11.1

(i) Explain how the gas molecules in the manometer create a pressure. [2]

……………………………………………………………………………………...

……………………………………………………………………………………...

……………………………………………………………………………………...

(ii) Mark and label on the right limb of the manometer in **Fig. 11.1**, a point **Q** in the tube which is at the same pressure as point **P**. [1]

(iii) Given that the density of mercury is 13600 kgm^{-3} and that the atmospheric pressure is 760 mmHg, calculate the pressure of the gas supply in Pa. [3]

Pressure = ……..........

(iv) State how the liquid levels in the tube will change if a manometer tube of a larger bore (inner cross-sectional area) is used. The total amount of mercury is constant. [2]

……………………………………………………………………………………...

……………………………………………………………………………………...

……………………………………………………………………………………...

(b) **Fig. 11.2** shows a long vertical glass tube with one end immersed in mercury and the other connected to a vacuum pump at **A**. The glass tube fits tightly into a bell jar. With an opening at **B** and all air in the glass tube pumped out through **A**, the mercury rises to a maximum height of 760 mm above the level of mercury in the dish.

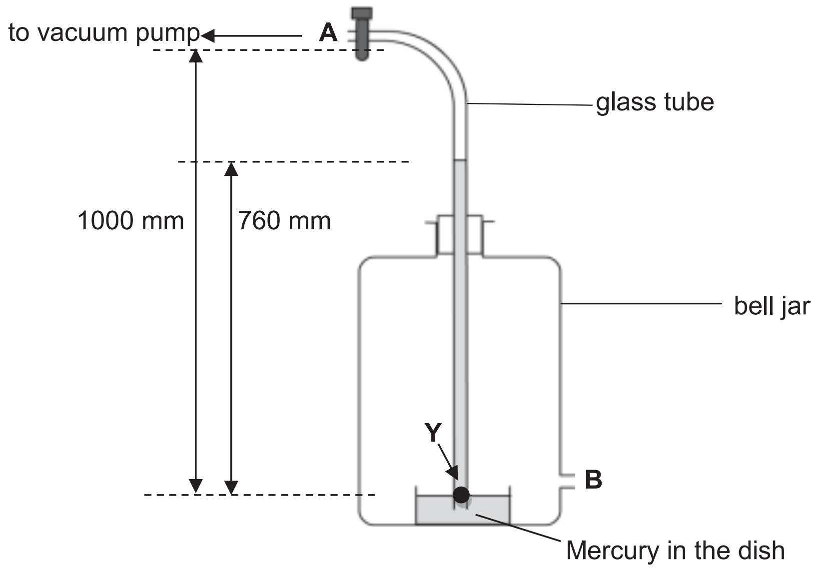


Fig. 11.2

A bicycle pump is now attached to opening **B** and air is being pumped into the bell jar.

State and explain how the mercury column in the glass tube would behave as air is pumped into the bell jar by the bicycle pump. [2]

…………………………………………………………………………………………………

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12 **EITHER**

(a) A veterinarian wants to do a minor surgery on a dog. She sterilizes her instruments, comprising of a scalpel and a hemostat, by immersing them in 2.0 kg of boiling water for 30 minutes. She then quickly transfers the instruments to a well-insulated tray containing 200 g of sterilized water at room temperature (28°C) which fully covers the instruments. After a few minutes, the instruments and water reach the same temperature, y °C.

The mass of the scalpel is 50 g and the mass of the hemostat is 70 g. Both are made from steel with a specific heat capacity of 450 J/kgK. The specific heat capacity of water is 4200 J/kgK.

(i) Determine, in terms of y, the

1. heat lost by the scalpel and hemostat. [2]

Heat lost = ………………………………

2. heat gained by the sterilized water. [1]

Heat gained = …………………………

(ii) From **(a)(i),** write an equation relating the heat exchange between the scalpel, hemostat and water. [1]

……………………………………………………………………………

……………………………………………………………………………

(iii) Hence or otherwise, determine y. [1]

y = ………………………

(b) The apparatus is set up to determine the specific latent heat of fusion of ice as shown in **Fig. 12.1**.

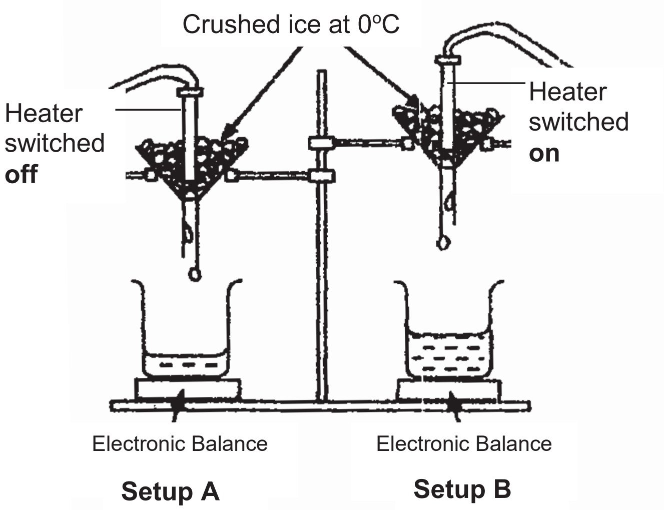

Fig. 12.1

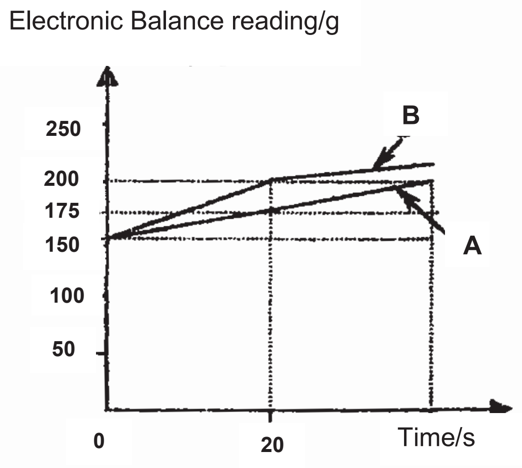

Fig. 12.2

Both setups used similar apparatus and materials. The heater in **A** is switched off while the heater in **B** is switched on. The balance readings are recorded at regular time intervals and the results are plotted against time as shown in **Fig. 12.2**.

(i) State what is meant by the *specific latent heat of fusion* of ice. [2]

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

(ii) Determine the mass of ice melted by the heater in the first 20 s. [1]

Mass of ice = …………...….

(iii) If energy is being supplied at a rate of 400 Js^{-1}, calculate the specific latent heat of fusion of ice, assuming that all the energy released from the heater is absorbed by the ice. [2]

Specific latent heat of fusion = ………………….

12 OR

(a) To investigate a layer of rock underground, an explosion is triggered on the surface of the Earth. **Fig. 12.3** below shows the arrangement.

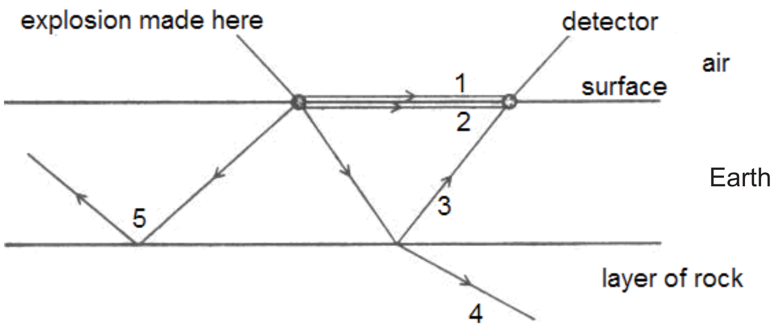

Fig. 12.3

Sound wave from the explosion may travel to the detector through air (**path 1**) or through Earth (**path 2**). It can also be transmitted into the layer of rock by **path 4** with part of wave being reflected at the boundary between the Earth and the layer of rock as indicated by **path 3**.

The time taken for the sound to reach the detector is shown in **Table 12.4**.

Path	**1**	**2**	**3**
Time taken (in seconds) for sound to travel from the source to the detector	0.100	0.020	0.300

Table 12.4

(i) Explain why sound wave takes the shortest time to reach the detector along **path 2**. [1]

....

....

(ii) Given that the speed of sound in air is 330 ms^{-1}, calculate the distance between the source of sound and the detector. [2]

Distance = ...

(iii) Use the answer in part **(ii)** to calculate the speed of sound in Earth. [2]

Speed of sound = ...

(iv) Referring to **path 4**, explain how the speed of sound changes when it travels from Earth to the layer of rock. [1]

……………………………………………………………………………………………

……………………………………………………………………………………………

(b) **Fig. 12.5** shows ultrasound being used to study an unborn baby.

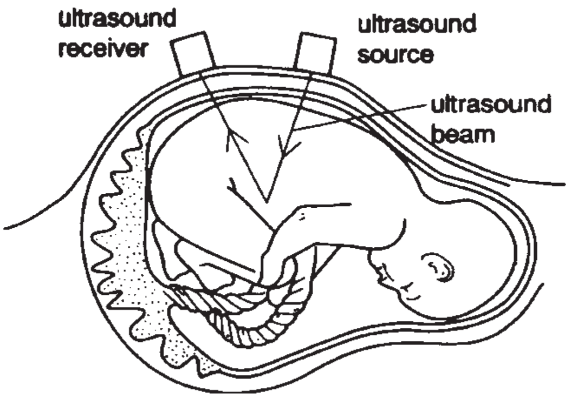

Fig. 12.5

(i) Explain how the vibrations of the source produce waves of ultrasound and suggest how these waves are transmitted through the body tissue to the receiver. [3]

……………………………………………………………………………………………

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……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

(ii) Ultrasound used in medicine has a frequency which is 100 times higher than the maximum frequency that can be heard by humans.

Estimate the frequency that might be used for ultrasound in medicine. [1]

Frequency = ………………………

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PRELIMINARY EXAMINATION 2018
ANSWER KEY

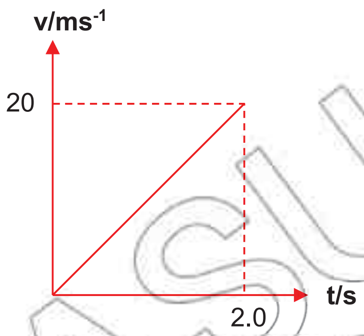
1	D	11	A	21	A	31	A
2	B	12	C	22	A	32	B
3	B	13	D	23	D	33	B
4	D	14	A	24	A	34	C
5	D	15	B	25	B	35	B
6	B	16	B	26	C	36	A
7	A	17	C	27	D	37	C
8	B	18	B	28	D	38	C
9	B	19	B	29	C	39	B
10	C	20	D	30	C	40	C

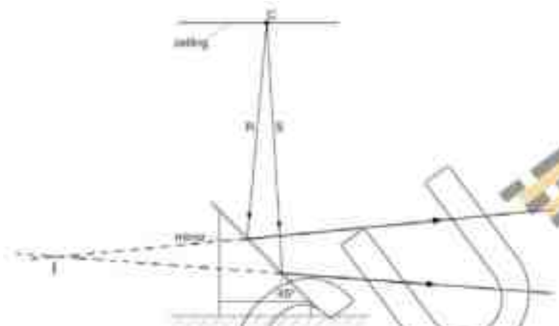
COMMONWEALTH SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS
PRELIMINARY EXAMINATION 2018
MARK SCHEME

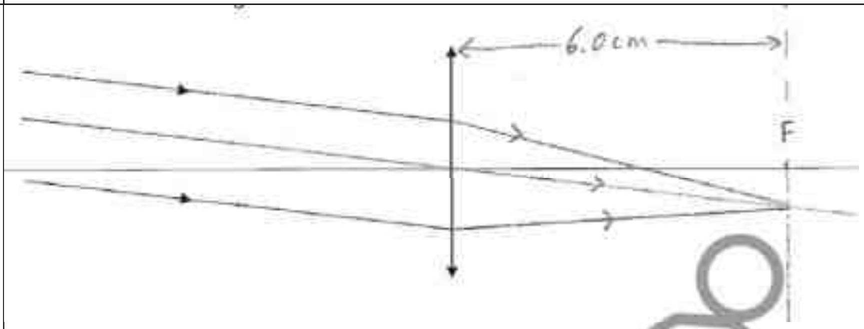
Section A (50 marks)

To deduct one mark per question for errors in significant figures.

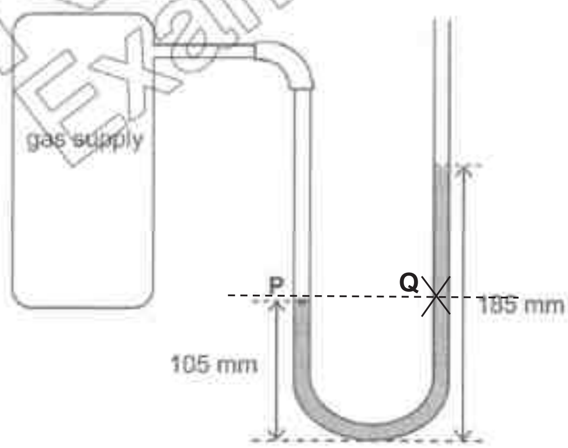
Qn	Answers	Mark
1ai	**Air resistance** is **negligible** Or: No air resistance or resistive force Or: the only force acting is the weight or gravitational force or gravity Or: Resultant force is (due to) the weight or gravitational force	1
1aii	**Air resistance increases** as speed increases **Resultant force decreases** Accept: F_R decreases	1 1
1b	Resultant force = ma = 90 kg x 7.5 ms^{-2} = **675 N** Do not give the first mark if student puts resultant force as the resistive force. Total resistive force = Weight – resultant force = 900 N – 675 N = 225 N = **230 N** (2 sf) Or: Resultant force = ma = 90 kg x 7.5 ms^{-2} = 675 N = **680 N** (2 sf) [1] Total resistive force = Weight – resultant force = 900 N – 680 N = **220 N** (2 sf) [1]	 1 1
	Total mark for Q1	**5**
2a	**Gravitational force per unit mass**.	1

Qn	Answers	Mark
2bi	a = (v-u)/t **10 ms^{-2} = (v – 0 ms^{-1})/2.0s** v = **20 ms^{-1}**	 1 1
2bii	**Straight line** graph with **positive gradient starting from origin.** Correct values of **velocity** of **20 ms^{-1}** and **corresponding time** of **2.0 s** clearly indicated on graph. **Axes labelled with units.**  	1 1
2biii	Area under the graph = **½ x 2.0 s x 20 m/s** = **20 m** The height from which the ball is dropped is 20 m. e.c.f. from (b) (i), (ii)	1 1
	Examiners' comments: Generally well done apart for some students who still sketch the graph with wrong initial speed of 20 m/s. These students need to underline key phrase such as "released from rest" in the question stem to remind themselves.	
	Total mark for Q 2	**7**
3a	**Rate of work done** or **Rate of energy conversion** •	1
3b	**½ (9.7 X 10^5 kgs^{-1}) (3.0 ms^{-1})^2** = **4.4 X 10^6 J/s** or **W** (2 sf)	1 1
3c	**(1.2 x 10^6 / 4.37 x 10^6) x 100%** = 27.5% = **28 %** (2sf) e.c.f. from (b) Or: **(1.2 x 10^6 / 4.4 x 10^6) x 100%** = 27.3% = **27 %** (2sf)	1 1

Qn	Answers	Mark
3d	Any of the following: ○ There is current or water moving throughout the day (but not so for wind blowing in the correct direction). ○ **No noise pollution** for tidal energy. ○ **Do not require large clearance of land space**. ○ Does not obstruct the flight path of **birds**	1
	Total mark for Q 3	**6**
4a	 Image located **correctly and accurately (+/- 1 mm)** and labelled as **I**.	1
4b	Reflected rays drawn correctly (accept either extension to **I** or from measurement of angle of incidence = angle of reflection +/- 1°). One mark for each ray.	2
	Total mark for Q 4	**3**
5a	The **distance between the optical centre**/centre of converging lens/lens axis **and Principal Focus**/Focal Point is **6.0 cm.**	1
5b	A ray is drawn **parallel** to the other two rays and **passing through the optical centre undeviated.** All 3 rays **brought to a focus** on the focal plane. Don't accept image formed at Principal Focus F. at **6.0 cm** (+/- 0.1 cm) **away from the lens**	1 1 1

Qn	Answers	Mark
		
5c	Image becomes **less bright or dimmer**.	1
	Examiners' comments: Many students thought that the image will be halved or image will disappear or become blur. Students need to know that when the half the lens is cut, all the rays that used to be converged by this halve of the lens will no longer reach the image, rays incident on the other half is not affected. Since less light rays reach the image, the image will be less bright.	
	Total mark for Q 5	**5**
6a	Shape: **Vertical straight lines** are drawn from one plate to another with **equal spacing** between them. +/- 1 mm in spacing is allowed Direction: The **arrows** point from bottom plate to top plate	1 1 1
6bi	**Positive.**	1
6bii	The **electrostatics** or electric force (of attraction from the top plate and repulsion from the bottom plate) is **acting upwards** on the oil drop and is **equal to the weight** of the oil drop which acts downwards. As there is **no resultant force** acting on the oil drop, the oil drop remains at rest.	1 1 1
	Total mark for Q 6	**7**
7a	$R = V^2/P$ $= \mathbf{(12\ V)^2 / 24\ W}$ $= \mathbf{6.0\ \Omega}$	 1 1
7bi	Maximum current $= \dfrac{12}{6.0}$ $= \mathbf{2.0\ A}$	1

Qn	Answers	Mark
	Minimum current $= \frac{12}{6+6}$ = **1.0 A**	1
7bii	Maximum current $= \frac{12}{6.0}$ = **2.0 A** Minimum current $= \frac{0}{6.0}$ (accept if working is not written) = **0 A**	1 1
	Total mark for Q 7	**6**
8a	λ = 0.550 m – 0.150 m = **0.400 m**	1
8b	V = λ/T = **0.400 m/0.33 s** = **1.2 ms^{-1}**	1 1
8c	The piece of Styrofoam would be **0.500 m** (horizontally) from the origin. This is because the wave is a **transverse wave** or the movement of styrofoam is perpendicular to the direction of the wave each part of the wave **only oscillates up and down** and not left and right or the Styrofoam vibrates perpendicularly to the direction of the wave Or: waves transfer energy [1] without transferring matter [1] Hence its horizontal distance would remain constant.	1 1 1
	Total mark for Q 8	**6**
9a	100 mm x 0.20 ms/mm = **20 ms** or **0.020 s** or **2.0 x 10^{-2} s**	1
9b	Divide time by 2: e.g. $\frac{0.012}{2}$ or $\frac{12ms}{2}$ d = 3.0 x 10^8 m/s x 0.006 s = **1 800 000 m** or **1.8 x 10^6 m**	1 1
9c	Energy is **absorbed** by the surrounding air. Thus **less energy is received** by the radar.	1 1

Qn	Answers	Mark
	Total mark for Q 9	**5**
10a	The **current** in the primary coil is **alternating**/**changing** The **magnetic flux in the secondary coil** is **changing** continuously**,** hence inducing an emf in the secondary coil.	1 1
b	To **concentrate the magnetic field lines**	1
ci	**B** because the **the output voltage is 12.0 V when the input voltage is 3.00 V.**(as shown on the graph)	1
cii	**N_s/50 = 12.0 V/6.00 V** N_s == **100**	1 1
ciii	**48.0 V/ 6.00 V = 0.500 A/I_s** I_s = **0.0625 A** (3 sf)	1 1
civ	**D** because it is a **step-down** transformer or **current is stepped up** resulting in a **higer power loss in the cables**.	1 1
	Total mark for Q 10	**10**
11ai	The gas molecules are **moving randomly** and **continuously** at high speed. Accept: **constant and random** or **constant random** They **collide with the walls of the container/mercury** thus exerting a **force** on the walls/mercury. The force per unit area is the pressure.	1 1
11aii	 	1

Qn	Answers	Mark
11aiii	185 mm – 105 mm = **80 mm** or **Pressure difference is 80 mmHg** P = 760 mmHg + 80 mmHg = 840 mmHg P = ρgh = **0.840 m x 13600 kgm^{-3} x 10 Nkg^{-1}** = 114 240 = **110 000 Pa** (2 sf) or **114 000 Pa** (3 sf) or **1.14 x 10^5 Pa**	1 1 1
11aiv	The liquid **levels** in **both sides** of the tube will **fall**. However, the **difference** in the two levels will **remain unchanged**.	1 1
11b	As air is pumped into the bell jar, the **pressure of the bell jar increases** above atmospheric pressure. As such, mercury would be forced in to the glass tube making the **mercury column taller/longer**.	1 1
	Total mark for Q 11	**10**
12 EITHER ai1	Heat lost by scalpel and hemostat = **(0.050 kg + 0.070 kg) x (450 J/kgK) x (100°C -*y*)** = (0.120 x 450 x 100) J - (0.12 x 450 x *y*) J = **(5 400- 54 *y*) J** or **54(100 –y) J**	 1 1
ai2	Heat gained by the sterilized water, Q = mcθ = 0.200 kg x 4 200 J/kgK x (*y*-28°C) = **(840*y* - 23 520) J** or **840(y -28) J**	 1
aii	**Heat lost by scalpel and hemostat = heat gained by water** Or: **54(100 –y) = 840(y -28)**	1
aiii	5 400 - 54y = 840*y* - 23520 5 400 + 23520= 840 *y* + 54 *y* 28920 = 894*y* *y* = **32** (2 sf)	 1
bi	Specific latent heat of fusion of ice is the **amount of thermal energy required** to change **unit mass of ice** from its **solid to liquid state,** without a change in temperature.	1 1

Qn	Answers	Mark
bii	Mass of ice melted by the heater alone in the first 20 s = 200 g – 175 g = **25 g**	 1
biii	Latent heat gained by ice = heat supplied by heater Specific latent heat of fusion = Pt / m = (**400 J/s × 20s) / 25g** = **320 J/g**	 1 1
	Total mark for Q 12 EITHER	**10**
12 OR ai	Sound travels **faster in solid** (earth or ground) compared to air.	1
aii	Distance = **330 ms^{-1} x 0.100 s** = **33 m** or **33.0 m**	1 1
aiii	Speed = **33 m /0.020 s** or **33.0 m /0.020 s** = **1700 ms^{-1}** (2sf) or **1650 ms^{-1}** (3sf)	1 1
aiv	The **speed of sound increases**. The refracted wave **bends away from the normal**.	1
bi	<u>Production of ultrasound:</u> **Vibration of the source** at high frequency to and fro **along the direction of the** propagation of the **wave** (or longitudinal wave) produces ultrasound. <u>Transmission through body tissues:</u> The **molecules** of the **body tissue vibrate** backward and forward **in the direction parallel** to the direction of the propagation of **sound** or **wave**. Or: The vibrations of the source results in the formation of a series of **compressions (or region of high pressure) and rarefactions (or region of low pressure)** in the **body tissue.** <u>Transmission to the receiver:</u> When the ultrasound hits the denser part of the tissue, it is **reflected** through the body tissue and is detected by the **receiver (**or go back to the **receiver**).	1 1 1
bii	**2 MHz** or **2 x 10^6 Hz** or **2000 kHz**	1
	Total mark for Q 12 OR	**10**

Candidate Name:	Class:	Index No:

DUNMAN SECONDARY SCHOOL

Where…… discernment, discipline, daring,
determination & duty become a part of life.

PRELIMINARY EXAMINATION 2018

SEC 4 EXPRESS

PHYSICS (REVISED) 6091 PAPER 1

1 hour — **7 August 2018**
0800 – 0900 h — **Tuesday**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighter, glue or correction fluid.
Write your name and index number and class on the Answer Sheet in the spaces provided unless this has been done for you.

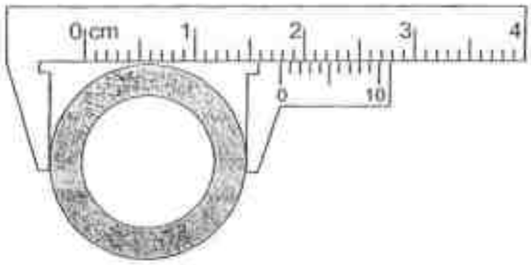
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **17** printed pages including the cover page.

1 The diagram below shows a pair of vernier calipers set to measure a metal pipe. Given that the pipe has an internal diameter of 10.2 mm, what is the thickness of the wall of the metal pipe?



A 2.8 mm **B** 3.8 mm **C** 5.6 mm **D** 7.6 mm

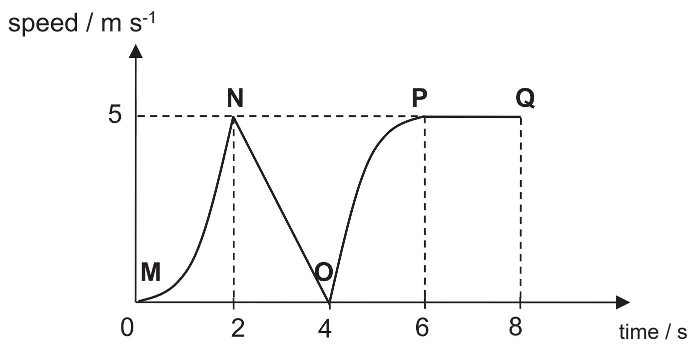
2 The following statements describe various motions.

1. A plane flies due North for 500 km.
2. A tourist travels 100 km on a journey.
3. A snail crawls at 3 mm/s in a straight line towards a carrot.
4. A runner's average speed in a race around a track is 5 m/s.

Which statements describe vector quantities?

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 and 4

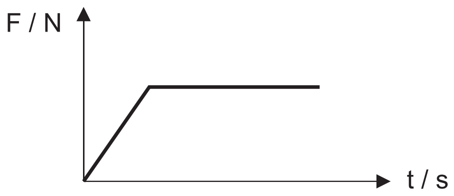
3 The velocity-time graph for a moving object is shown below.



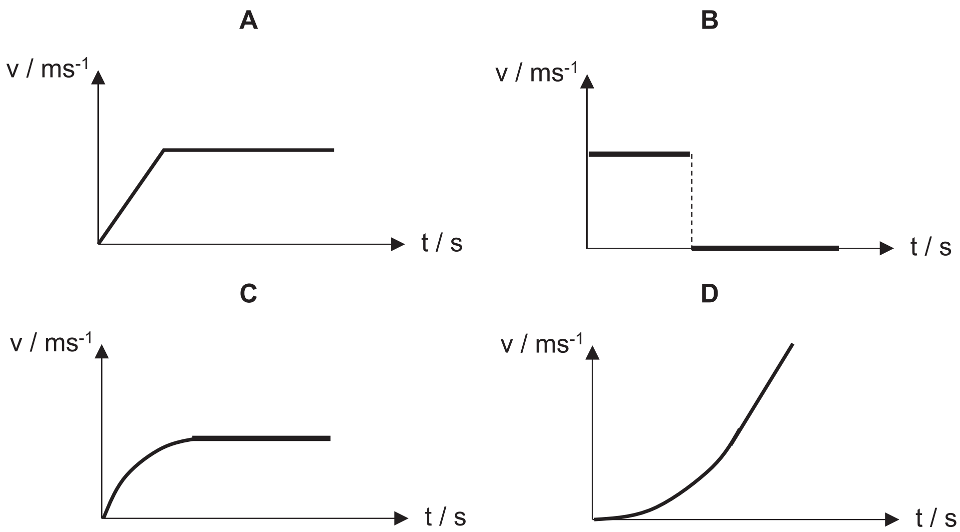
In which region is the acceleration uniform?

A **M** to **N** **B** **N** to **O** **C** **O** to **P** **D** **P** to **Q**

4 A graph of resultant force of a moving car against time is plotted as shown below.



Which of the following velocity-time graphs shows the velocity of the car?



5 Only 2 forces act on an object. If the object is in equilibrium, which of the following condition(s) is/are required?

1 The 2 forces have the same magnitude.
2 The 2 forces are opposite in direction.
3 The 2 forces are in the same direction.
4 The 2 forces are of the same type.

A 1 and 2 only
B 1 and 3 only
C 3 and 4 only
D 1, 2 and 4 only

6 A cyclist is riding at a steady speed on a level road.

According to Newton's Third Law of motion, what is the equal and opposite force to the backward push of the back wheel on the road?

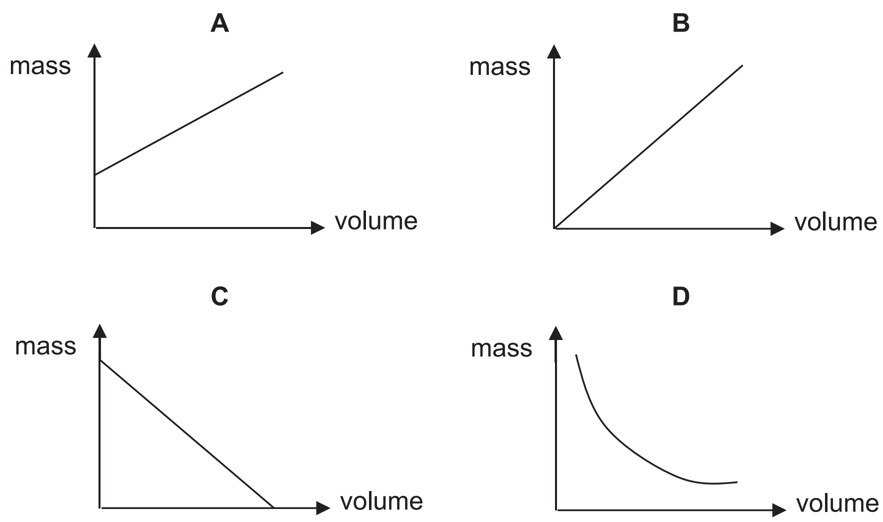
A the tension in the cycle chain

B the total air resistance and frictional force

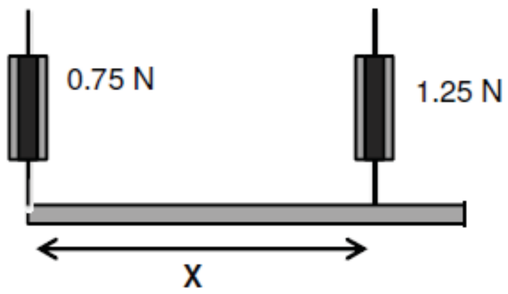
C the force exerted by the cyclist on the pedals

D the forward push of the road on the back wheel

7 Some students measure the masses and volumes of different sized samples of a type of wood. Which graph shows their results?



8 The diagram below shows a uniform metre rule of weight 2.00 N suspended by two spring balances. The tensions on the spring balances are 0.75 N and 1.25 N respectively.



Determine **X**, the distance between the two springs.

A 0.60 m **B** 0.70 m **C** 0.80 m **D** 0.90 m

9 Nathan uses paper clips to balance a toy bird on his finger as shown.

What is the effect of the paper clips?

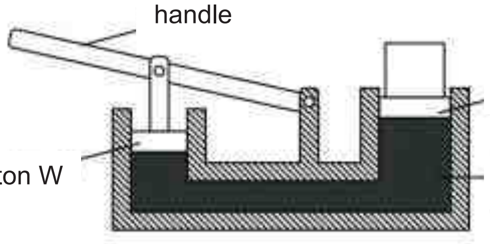
A They help to raise the centre of gravity above his finger.

B They help to raise the centre of gravity to his finger.

C They help to lower the centre of gravity to below his finger.

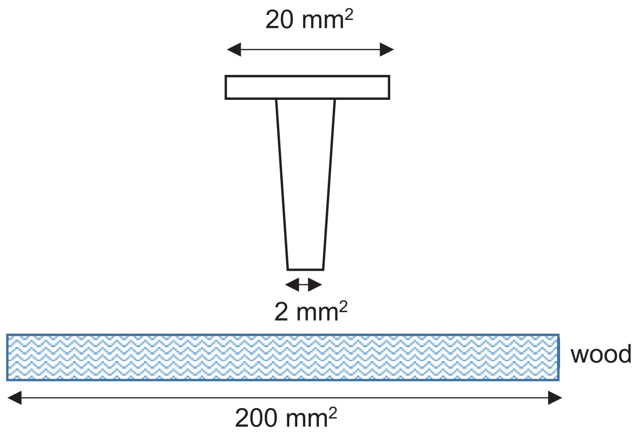
D They do not affect the centre of gravity but increase the weight.

10 The diagram below shows a simple hydraulic jack. Which of the following changes will enable heavier loads to be lifted?



	diameter of W	diameter of Z
A	doubled	remains the same
B	doubled	halved
C	remains the same	halved
D	halved	doubled

11 The diagram shows a nail being knocked into a piece of wood with a force of 60 N.



What is the pressure on the wood?

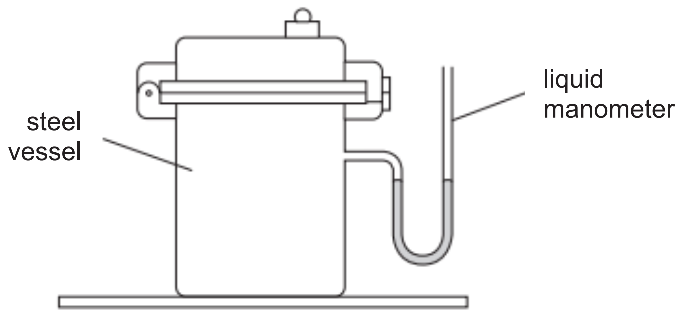
A 30×10 Pa

B 30×10^2 Pa

C 30×10^3 Pa

D 30×10^6 Pa

12 A manometer is used to indicate the pressure in a steel vessel, as shown in the diagram below.



Which option describes the pressure in the vessel as indicated by the liquid manometer?

A It is zero.

B It is between zero and atmospheric pressure.

C It is equal to atmospheric pressure.

D It is greater than atmospheric pressure.

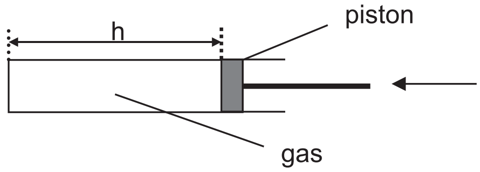
[Turn over

13 A force of 5.0 N exerted on an object causes it to accelerate from a velocity of 0 m/s to 8 m/s in 10 s.

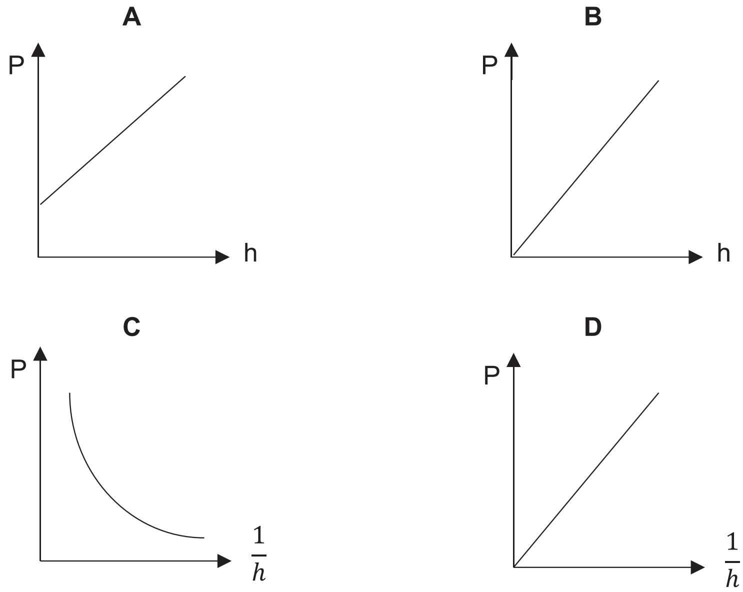
Determine the power of this force.

A 0.40 W **B** 2.0 W **C** 20 W **D** 40 W

14 A column of gas is slowly compressed as shown in the diagram.



Which of the following graphs correctly shows the relation between the gas pressure P and the length of the gas column h?



15 The outer surface of an electric kettle is always kept polished and shiny. What is the purpose of this?

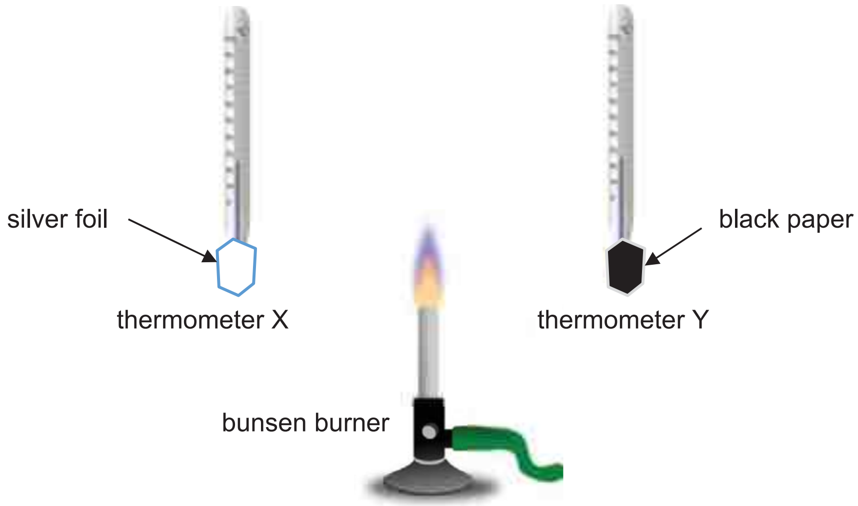
A to stop energy loss by conduction

B to be a poor emitter so as to reduce energy loss

C to reduce energy loss by thermal conduction

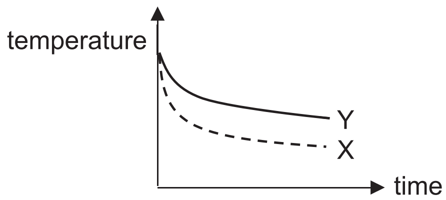
D to reflect any radiation incident on its outer surface

16 The diagram below shows two thermometers, X and Y held at the same distance away from a lighted Bunsen burner. The bulb of thermometer X is wrapped with a silver foil while the bulb of thermometer Y is wrapped with a black paper.

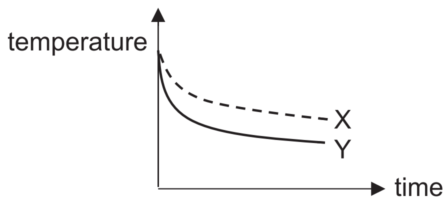


Which of the following graphs show the correct change in temperature of the two thermometers?

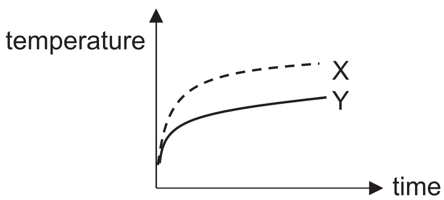
A



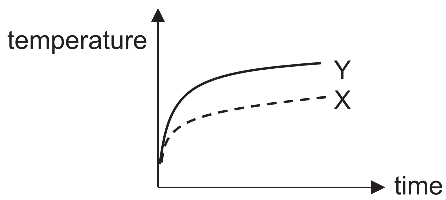
B



C



D

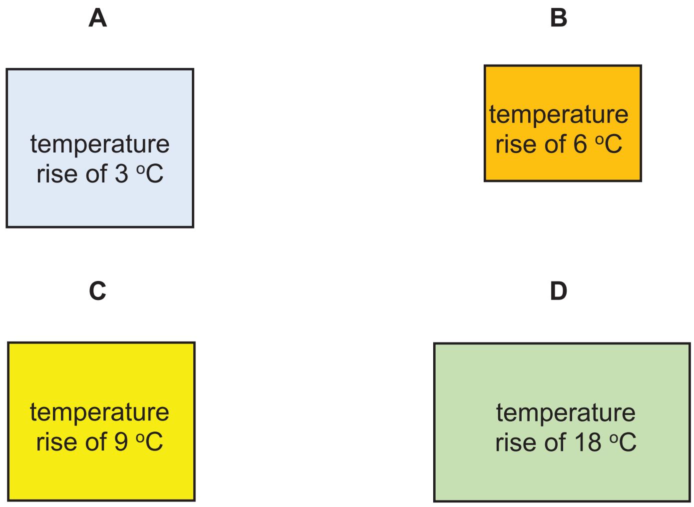


17 When calibrating a thermocouple thermometer, one of its junctions is immersed in melting ice while the other is kept in boiling water. The current reading on the micro-ammeter is 200 μA. If the "hot junction" is immersed in substance X and the reading is 20 μA, what is the temperature of substance X?

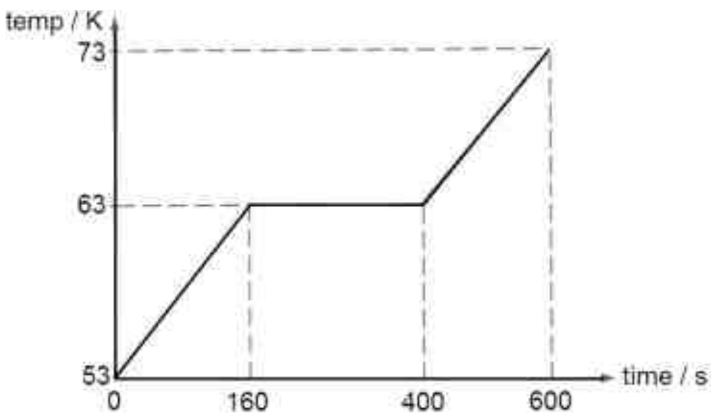
A – 20 °C **B** – 10 °C **C** 10 °C **D** 20 °C

[Turn over

18 The same quantity of thermal energy is applied to four different blocks.
The temperature rise produced is shown on each block.
Which block has the highest heat capacity?



19 The graph below refers to an experiment in which an initially solid specimen of nitrogen absorbs heat at a constant rate. Solid nitrogen has a specific heat capacity of 1.6×10^3 J / kg K and melts at 63 K.



Which of the following are the specific latent heat of fusion and specific heat capacity of liquid nitrogen respectively?

	specific latent heat of fusion	specific heat capacity of liquid nitrogen
A	4.0×10^4 J / kg	1.6×10^3 J / kg K
B	2.4×10^4 J / kg	2.0×10^3 J / kg K
C	1.6×10^4 J / kg	1.6×10^3 J / kg K
D	2.4×10^4 J / kg	6.0×10^3 J / kg K

20 Substance K consists of particles that are close together and sliding past each other randomly. The average speed of the particles in substance K is also gradually increasing.

Which of the following best describes the substance?

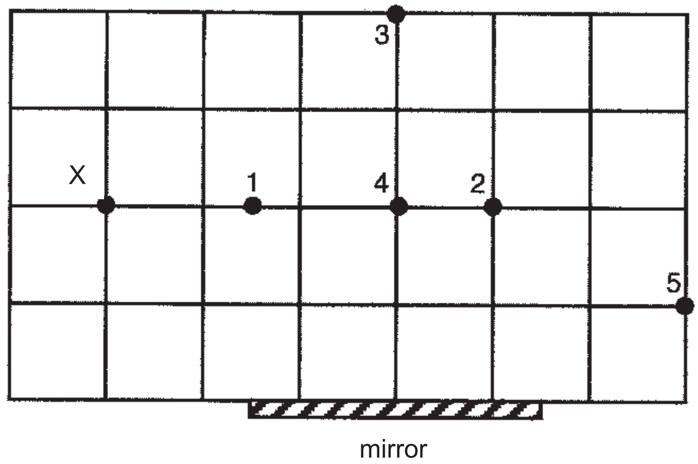
A Substance K is a liquid boiling.

B Substance K is a liquid being heated.

C Substance K is a solid melting.

D Substance K is a solid being heated.

21 A person stands at point X as shown in the diagram below.



Which of the pins (1, 2, 3, 4, 5) will the person be able to see in the mirror?

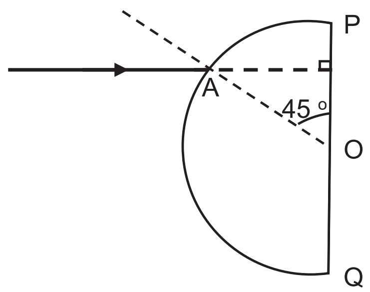
A pins 1 and 3

B pins 2 and 4

C pins 2, 3 and 5

D pins 2, 4 and 5

22 Fig. shows a semicircular glass slab with centre O and critical angle of 45 °.



What happens when a ray of light, perpendicular to the diameter POQ, is incident at A?

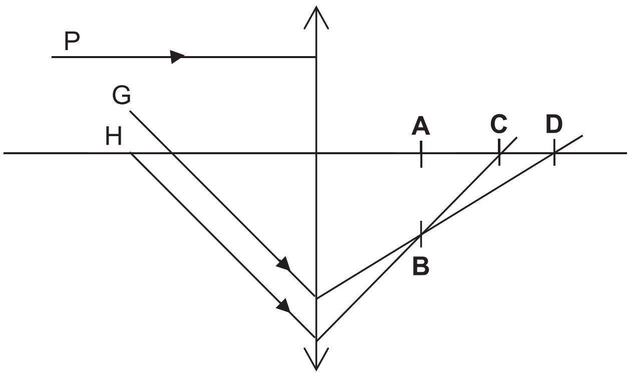
A The light ray emerges as O.

B Total internal reflection occurs at O.

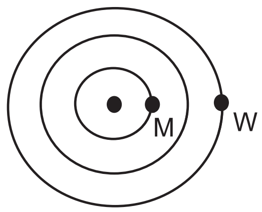
C The light ray emerges at some point between O and P.

D Total internal reflection occurs at some point between O and P.

23 Two parallel rays of light G and H passes through a converging lens as shown below. Which point will ray P pass through?

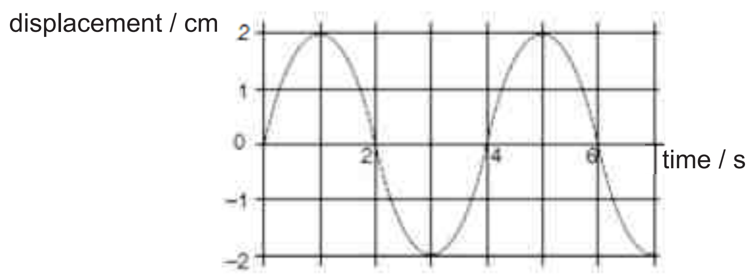


24 A pebble is dropped into still water so that the circular wavefronts are seen to travel outwards with a speed of v. If the wavelength is λ, what is the time taken for the disturbance at M to reach W?



A λ / v **B** λ / 2v **C** 3λ / 2v **D** 2λ / v

25 The graph shows how the displacement of a particle in a wave varies with time.



Which of the following is correct?

A The wave has an amplitude of 2 cm and can be either transverse or longitudinal.

B The wave has an amplitude of 4 cm and can be either transverse or longitudinal.

C The wave has an amplitude of 2 cm and can only be transverse.

D The wave has an amplitude of 4 cm and can only be transverse.

26 The diagram below shows different regions of the electromagnetic spectrum.

radio waves		Z	visible light			gamma rays

Which of the statements below is true of the radiation found in region Z?

A It has a higher speed in glass than in air.

B It has a lower frequency than radio waves.

C It can be used in a remote controller.

D It has a smaller wavelength than gamma rays.

27 Infrared radiation has wavelengths between 700 nm to 1.0 mm.

What is the maximum frequency of infrared radiation in vacuum?

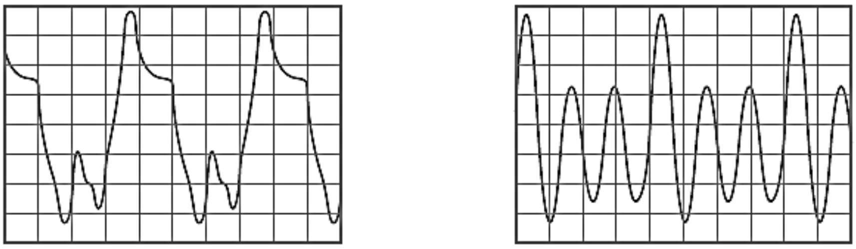
A 3.0×10^{8} Hz

B 3.0×10^{11} Hz

C 4.29×10^{11} Hz

D 4.29×10^{14} Hz

28 Waveforms are shown on a cathode-ray oscilloscope for a flute and a guitar. The oscilloscope settings are the same for both waveforms.



What is/are the similarities between the two sounds?

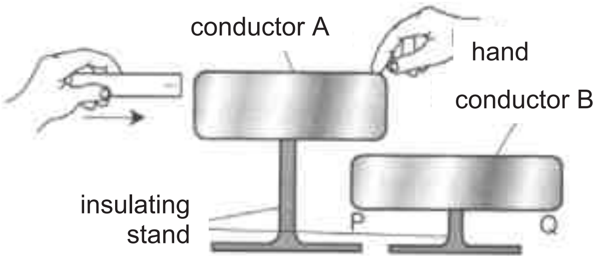
A the loudness only

B the pitch only

C the loudness and the pitch

D they have no similarities

29 A negatively charged rod is brought near conductor A which is earthed momentarily as shown below.



After the rod is removed, what are the resulting charges on conductor B at P and Q?

	P	Q
A	positive	positive
B	positive	negative
C	negative	positive
D	negative	negative

30 A charged cloud carrying a charge of 160 C passes all its charge to the earth through lightning. The lightning lasts for 0.50 ms.
What is the lightning current?

A 80 A **B** 3.2×10^2 A **C** 3.2×10^5 A **D** 0.80×10^5 A

31 Which of the following are correct?

1 An electron will accelerate when placed in an electric field.
2 An electron will always move towards a positively charged object in a straight line.
3 The direction of an electric field at any point is the direction of the force on a small positive charge places at the point.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

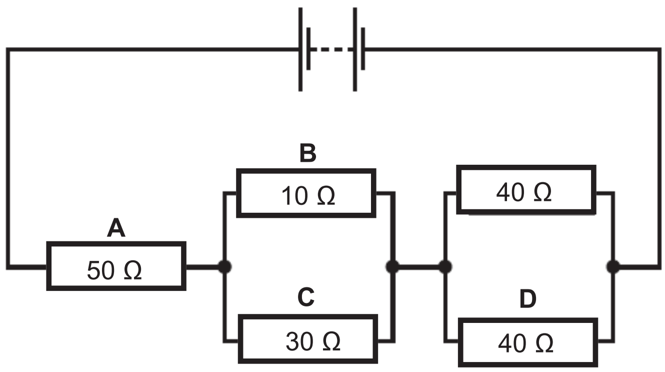
32 A wire of length 8 m has a resistance of 16 Ω. A second wire, made of the same material, has double the resistance and half the cross-sectional radius.

What is the length of the second wire?

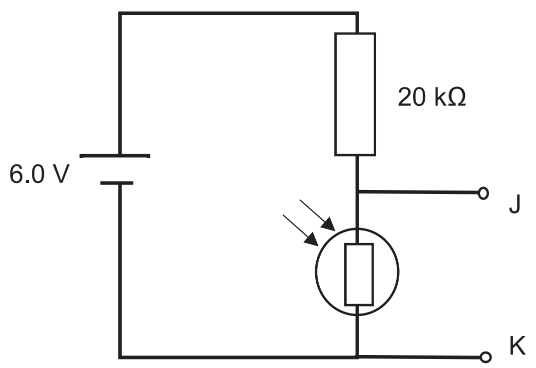
A 4 m **B** 8 m **C** 16 m **D** 64 m

33 The diagram shows a circuit containing five resistors connected to a battery.

In which resistor is the current the smallest?



34 The circuit shows a potential divider, which consists of a fixed resistor and a light-dependent resistor. The potential divider is used to switch on a lamp when it gets dark.



The resistance of the fixed resistor is 20 kΩ. The potential difference across JK is 0.60 V when the lamp is switched on.

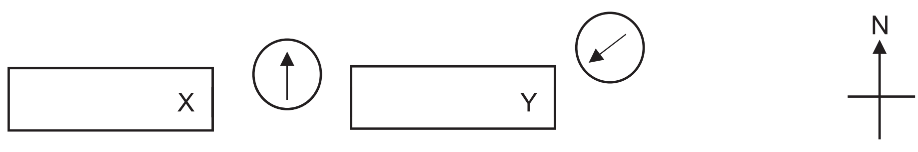
What is the resistance of the light-dependent resistor when the lamp is switched on?

A 1.8 kΩ **B** 2.2 kΩ **C** 160 kΩ **D** 180 kΩ

35 Electrical appliances have voltage and power ratings as listed below. Which has the lowest electrical resistance?

	appliance	voltage	power
A	kettle	240	1500
B	hair dryer	250	20
C	television	240	160
D	washing machine	250	3000

36 The diagram shows the direction of the compass needle when placed near two bar magnets.

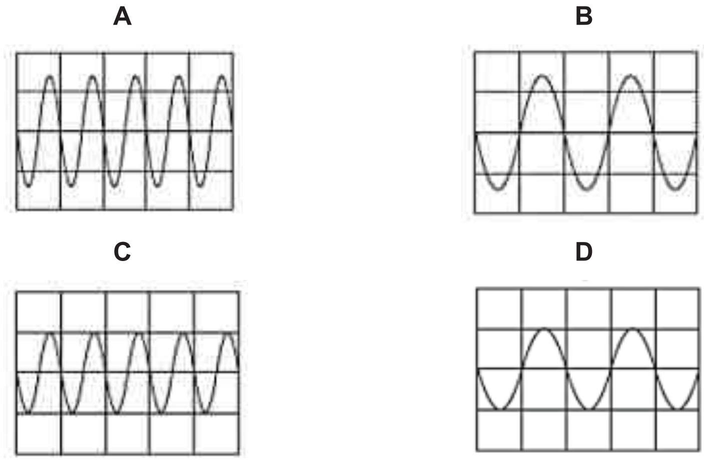


What is the likely poles at X and Y?

	pole at X	pole at Y
A	North	South
B	North	North
C	South	North
D	South	South

37 The Y-input terminals of a cathode ray oscilloscope are connected to a supply of peak value 5.0 V and of frequency 50 Hz. The time-base is set as 10 ms per division and the Y-gain at 5.0 V per division.

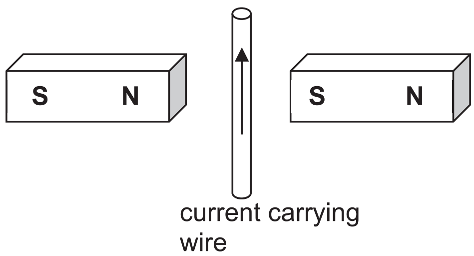
Which trace is obtained?



38 Split-ring commutators can be found in a d.c. motor.
What is the purpose of the split-ring commutator?

- **A** It allows the coil to rotate in the same direction by keeping the direction of the current through the coil constant every half-cycle.
- **B** It allows the coil to rotate in the same direction by reversing the direction of the current through the coil every half-cycle.
- **C** It allows the coil to change its direction of rotation every half-cycle.
- **D** It produces a greater turning effect by becoming magnetically induced.

39 The diagram below shows a wire carrying a current between two permanent magnets.



What would be the direction of the force acting on the wire?

- **A** to the left
- **B** to the right
- **C** into the page
- **D** out of the page

40 The ratio of number of turns in the secondary coil to that in the primary coil of a transformer is 5 : 2.

Determine the primary voltage if the secondary voltage is 240 V.

A 48 V **B** 96 V **C** 120 V **D** 600 V

- - - End of Paper 1 - - -

Candidate Name:	Class:	Index No:

DUNMAN SECONDARY SCHOOL

Where…… discernment, discipline, daring,
determination & duty become a part of life.

PRELIMINARY EXAMINATION 2018

SEC 4 EXPRESS

PHYSICS (REVISED) 6091 PAPER 2

1 hour 45 minutes **31 July 2018**
1115 – 1300h **Tuesday**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name and index number and class on all the work you hand in.
Write in dark blue or black pen on this question paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 10 has a choice of parts to answer.
Write your answers in the spaces provided on the question paper.

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This question paper consists of **20** printed pages including the cover page.

Section A

Answer all the questions in this section in the spaces provided.

The total mark for this section is 50.

1 **(a)** Complete the table. Give the missing prefixes, symbols and value.

prefix	symbol	value
milli	m	
kilo		10^3
	G	10^9

[3]

(b) Underline all of the vector quantities in the list below.

force **energy** **distance** **weight** **acceleration** [1]

(c) Fig. 1.1 shows a ring supported by two strings that hang from a beam.

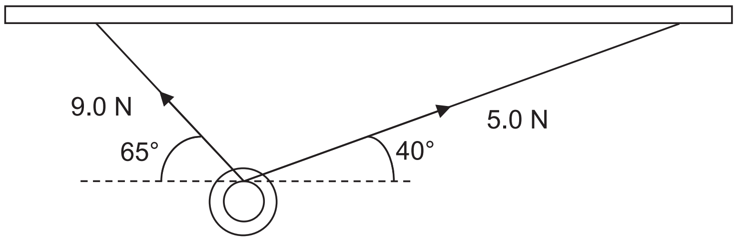


Fig. 1.1

(i) In the space below, draw a labelled diagram to show the resultant of the two tensions in the two strings. Determine the size of the resultant force and the direction between the resultant force and the horizontal.

resultant force = ……………………………………

direction = ……………………………………[3]

(ii) State the weight of the ring.

weight = ……………………………….[1]

2 Fig 2.1 shows a non-uniform plank XY 2.50 m long and weighs 750 N. Spring balances A and B are attached to the plank at a distance of 0.40 m from each end, as shown in Fig. 2.1.

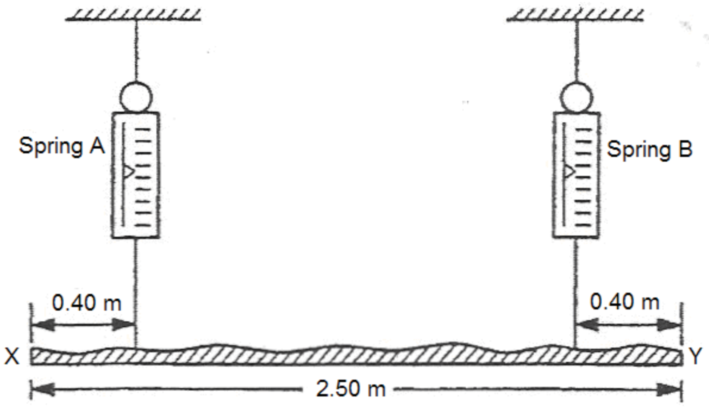


Fig. 2.1

When the plank is horizontal, spring balance A records 400 N.

(a) Calculate the reading on spring balance B.

reading = ……………………………….[1]

(b) On Fig. 2.1,

(i) indicate, clearly with a cross (**X**) a likely position for the centre of gravity of the plank. Label it '**C.G**'. [1]

(ii) mark and label all the forces, with suitable force arrows, acting on the plank. [2]

(c) Taking moment about spring B, calculate the distance of the centre of gravity from the end Y of the plank.

distance = …..…………………………[3]

(d) Explain why is the tension in spring B not considered for the calculation in part **(c)**?

……………………………………………………………………..…….…………

………………………………………………………………………………………..

……………………………………………………………………………………...[1]

3 Fig 3.1 shows a water wave in a ripple tank at t = 0 s. The wave has a speed of 4.0 cm/s at **X**. The water waves crosses a boundary **AB** where the distance between crests changes from 5.0 cm to 8.0 cm.

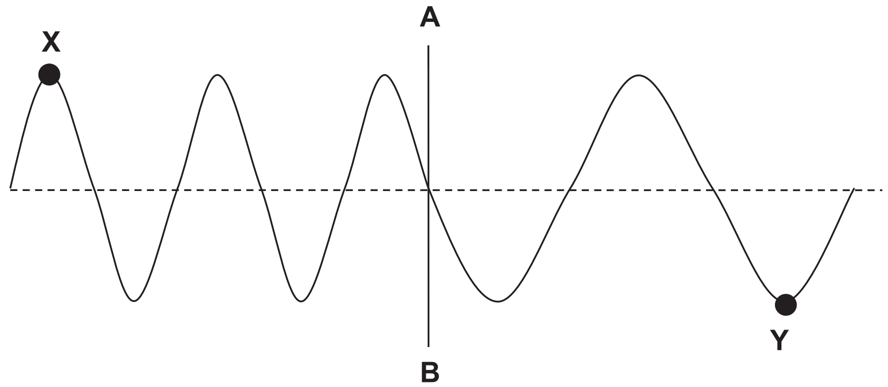


Fig. 3.1 (not drawn to scale)

(a) Calculate the period, T, of the wave before it crosses the boundary **AB**.

period of wave, T = …..…………………………[2]

(b) Calculate the speed of the wave at point **Y**.

speed of wave = ……………………………….[2]

(c) The amplitude of the wave remains constant at 10.0 cm.

(i) Calculate the average speed of the particle at Y.

average speed of the particle at Y = ……………………………….[2]

(ii) State the instantaneous speed of the particle at X.

instantaneous speed of the particle at X = ……………………………….[1]

(iii) In Fig. 3.1, draw the wave for time t = 0.5T, where T is the period of the wave. [1]

4 **(a)** Fig. 4.1 shows a ray of light, from the top of an object PQ, passing through two glass prisms.

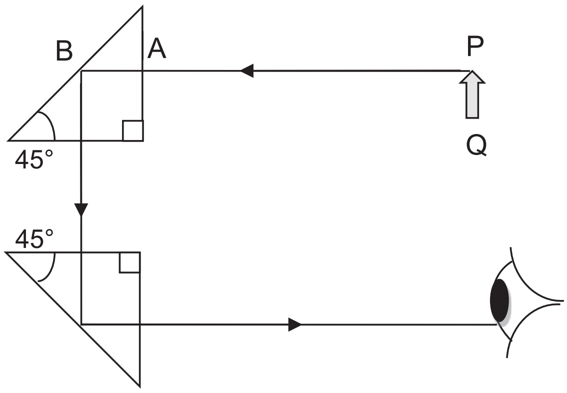


Fig. 4.1

(i) The speed of light as it travels from P to A is 3.0×10^8 m/s and the refractive index of the prism glass is 1.6. Calculate the speed of light in the prism.

speed = ……………………………………[2]

(ii) Calculate the critical angle.

critical angle = ……………………………………[1]

(iii) Explain why the ray AB reflects through 90° at B and does not pass out of the prism at B.

…………………………………………………………………………………………

…………………………………………………………………………………………

……………………………………………………………………………………….[1]

(iv) Draw a second light ray from Q of the object PQ to show that the image seen by the eye is upright. [1]

(b) Fig. 4.2 shows ray of light from the top of an object passing through a lens.

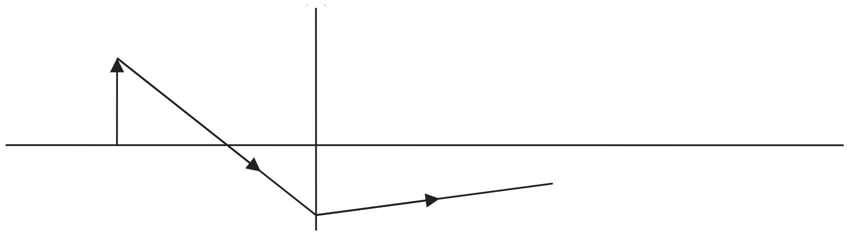


Fig. 4.2

(i) State whether the lens is converging or diverging.

………………………………………………………………………………………..........[1]

(ii) Draw another light ray from the object so that the image of the object can be located. Label the image **I**. [1]

(iii) Locate the principal focus of the lens by drawing another light ray from the object. Label the principal focus **F**. [1]

5 Fig. 5.1 is a graph of current against potential difference (p.d.) for a length of metal wire.

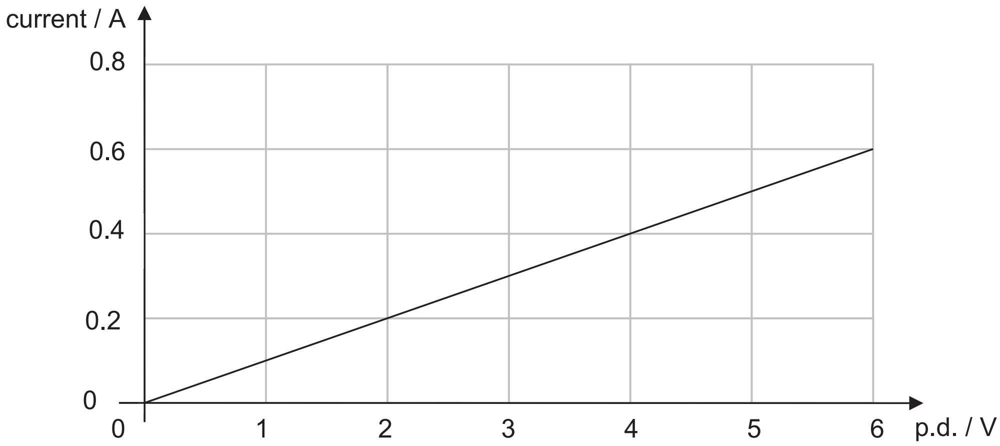


Fig. 5.1

(a) The metal wire obeys Ohm's law. State Ohm's law in words.

…………………………………………………………………………………………………..….

…………………………………………………………………………………………………..….

……………………………………………………………………………………………...[2]

(b) Calculate the resistance of the metal wire.

resistance = …..…………………………[1]

(c) A new wire is made from the same metal as the original wire. The new wire is half the length of the original wire. The diameter of the new wire is half that of the original wire.

(i) Calculate the resistance of the new wire.

resistance = …..…………………………[2]

(ii) On Fig. 5.1 draw a line to show how the current varies with p.d. for the new wire. [1]

6 Fig. 6.1 shows an iron ring suspended by a thread. There is a bar magnet close to the ring. The iron ring is attracted to the magnet.

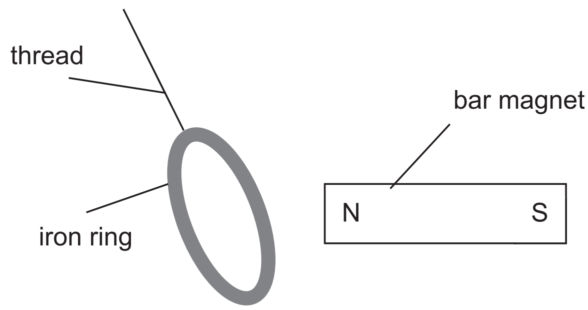


Fig. 6.1

Fig. 6.2 shows a brass ring suspended by a thread, close to a bar magnet.

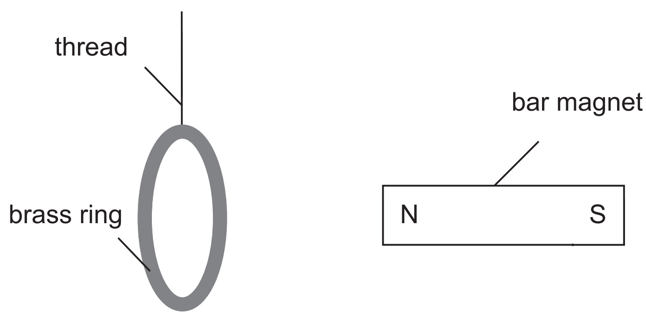


Fig. 6.2

(a) Explain why the brass ring is **not** attracted to the magnet, while the iron ring is attracted to the magnet.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………[2]

(b) When the N-pole of the bar magnet in Fig. 6.2 is moved quickly towards the brass ring, there is an induced current in the ring and the ring moves away from the bar magnet.

(i) Explain why a current is induced in the brass ring.

....

....

....

....[2]

(ii) Explain why the brass ring moves away from the magnet.

....

....

....

....[2]

7 Fig. 7.1 represents the basic structure of a transformer.

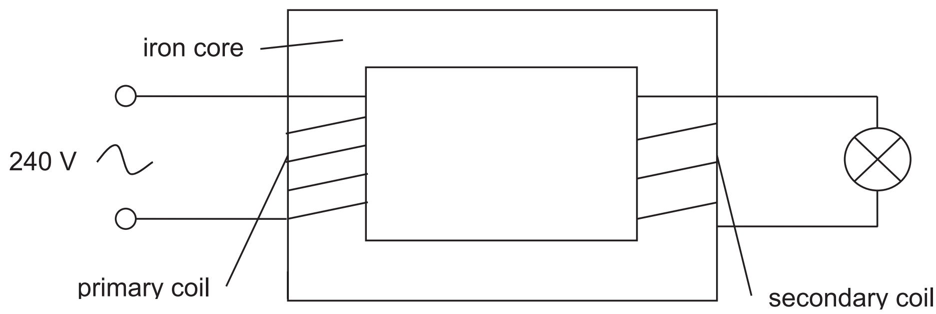


Fig. 7.1

An alternating voltage of 240 V is applied to the primary coil and a voltage is induced in the secondary coil.

(a) **(i)** Describe what is meant by an *alternating* voltage.

....

....

....

....[1]

(ii) Explain why an iron core is used instead of a steel core.

…………………………………………………………………………………………….

…………………………………………………………………………………………….

…………………………………………………………………………………………….

…………………………………………………………………………………………..[1]

(b) The primary coil has 360 turns.

Calculate the smallest number of complete turn in the secondary coil that would give an induced voltage of at least 6.0 V in the secondary coil.

number of turns = …..…………………………[2]

(c) The current in the primary coil is 0.040 A. The current in the secondary coil is 0.6 A and the output voltage is 6.0 V.

Calculate the efficiency of the transformer.

efficiency = …..…………………………[2]

End of Section A

Candidate Name:	Class:	Index No:

Section B

Answer **all** the questions from this section.

Answer only one of the two alternative questions in **Q10**.

The total mark for this section is 30.

8 Read the article below and answer the questions.

Undersea cable systems transport telephone conversations

Telephone conversations are carried across the oceans of the world as brief pulses of light in cable that contain hair-thin fibre optic strands. These strands are made from glass covered by a cladding that is protected by an outer casing, as shown in Fig. 8.1. If the speed of light in cladding is greater than in the core, total internal reflection occurs and all the light is then confined to the core.

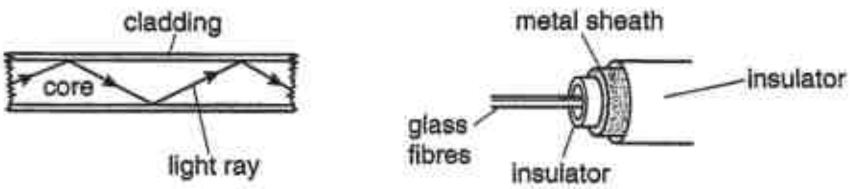


Fig. 8.1

The transmission of light is not 100% efficient as it passes down the fibre since light is absorbed by impurities in the glass. If light travels through 75 km of glass, then only 10% of the signal arrives at the other end. Over long distances, the light signal has to be boosted at underwater repeaters that are powered by an electric current sent along a metal sheath inside the cable. The repeaters connected in series with the same current of 0.80 A through each and a potential difference of 40 V across each repeater. In a typical 7500 km undersea cable there are 100 repeaters. Each kilometer of the metal sheath has a resistance of 0.70 Ω and some of the energy provided by the supply is lost as thermal energy (heat) in the sheath.

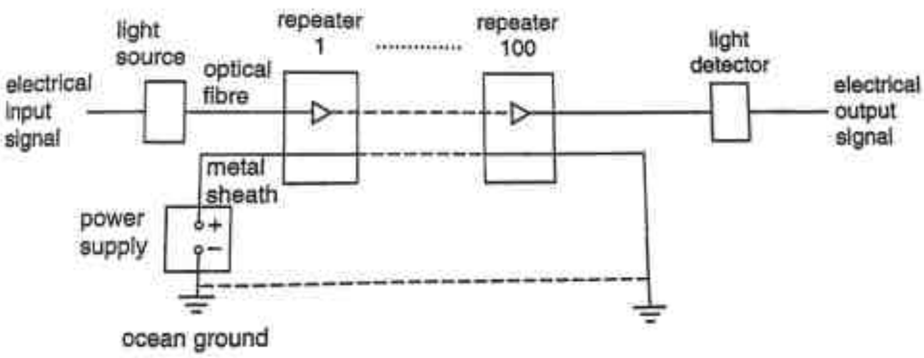


Fig. 8.2

(a) State why repeaters are necessary along an undersea cable.

……………………………………………………………………………………………………

……………………………………………………………………………………………………[1]

(b) Define *critical angle*.

……………………………………………………………………………………………………

……………………………………………………………………………………………………[1]

(c) Explain why the glass strands have to be covered with a cladding as shown in Fig. 8.1.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………[2]

(d) Determine, for a 7500 km undersea cable,

(i) the total potential difference across all the repeaters,

total potential difference = ……………………………[1]

(ii) the total potential difference across the resistance of the metal sheath,

total potential difference = ……………………………[2]

(iii) the potential difference provided by the power supply,

total potential difference = …..…………………………[1]

(iv) the thermal energy (heat) lost from each kilometer of the metal sheath in one day.

thermal energy loss = …..…………………………[2]

9 **(a)** A nuclear bomb test has been conducted on a remote island and observed from a ship which is 100 km away. The nuclear bomb emits both light and sound when exploded.

(i) Given that the speed of sound and light are 340 ms^{-1} and 3.00×10^{8} ms^{-1} respectively, calculate the time taken (in seconds) for the light and sound to travel from the bomb to the ship.

time taken for sound = …..…………………………[1]

time taken for light = …..…………………………[1]

(ii) Hence, or otherwise, calculate the time interval between the observer seeing and hearing the explosion.

time interval = …..…………………………[1]

(iii) Explain any changes to your answer to the time interval in **(ii)** if the bomb exploded in the sea and observed from a submarine. Assume that the distance from the bomb and observer is still 100 km.

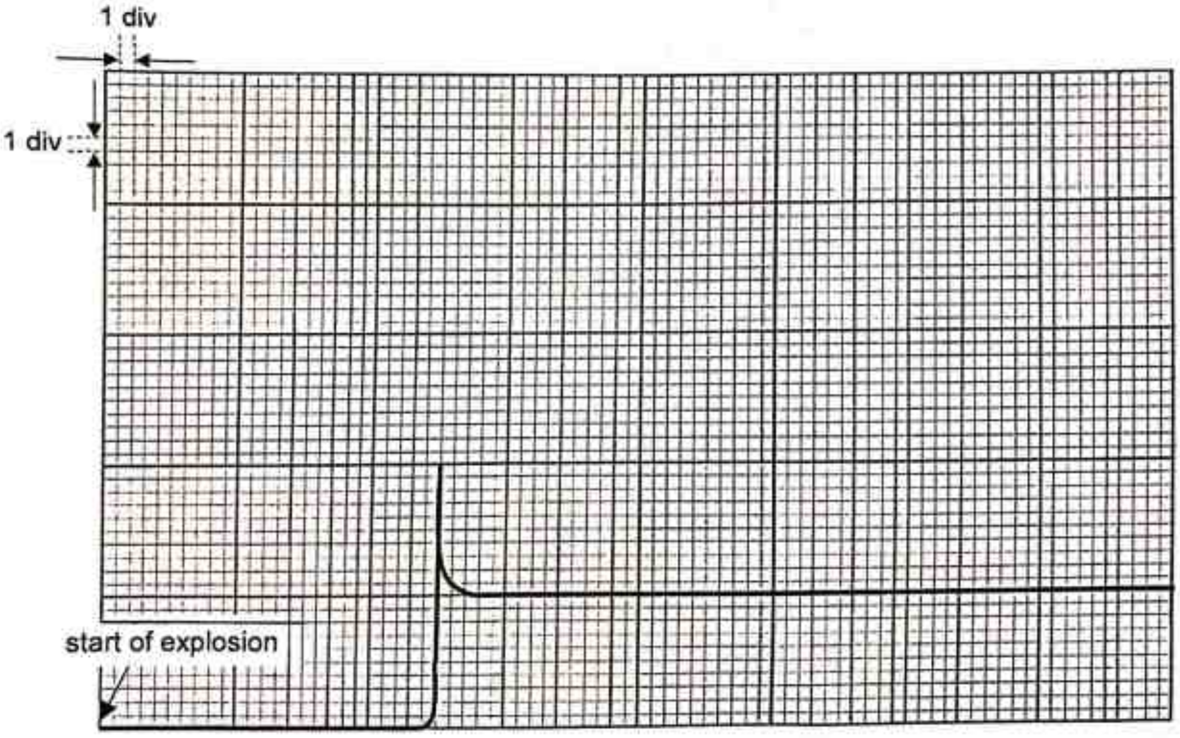
……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………[2]

(b) A nuclear-proof sensor is placed at 1 km away from the bomb site. The sensor detects the amount of light in the environment and sends the signal to an oscilloscope. The display of the oscilloscope is as shown below.



The amount of light is measured in lux. Given that the y-gain scale is 50,000 lux/div and time base scale is 120 ns/div,

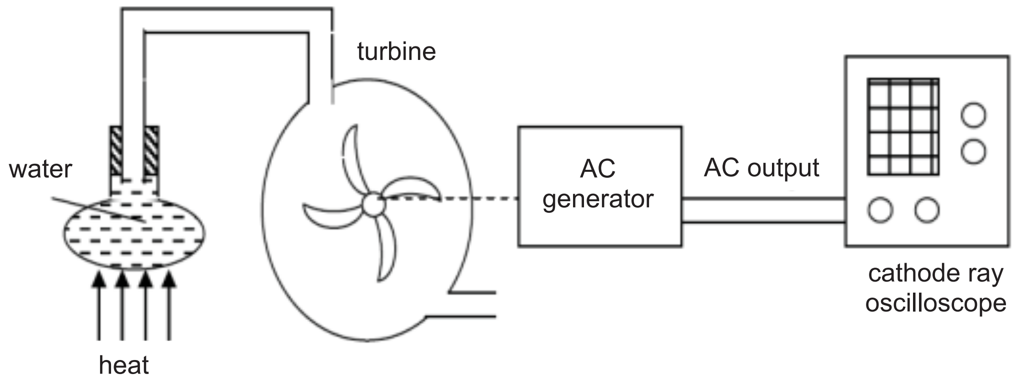
(i) calculate the speed of light emitted by the nuclear bomb based on the display in the oscilloscope and,

speed of light = …..………………………….[2]

(ii) On the grids above, sketch the display if the y-gain and time base scales are adjusted to 25,000 lux/div and 60 ns/div respectively. [3]

10 EITHER

The diagram below shows an experiment to observe how steam can be used to generate power.



An oscilloscope is used to determine the efficiency of the steam generator.

(a) The heat source is an electric heater that requires 20 W of power. Determine the energy consumed by the heater if it is turned on for 5 hours to support the experiment.

energy consumed = ……………………………….[2]

(b) Steam produced by the water is able to oscillate the turbine at 50 revolutions per second. Given that the generator can produce a peak voltage of 0.05 V per revolution every second and a peak current of 2 A, determine,

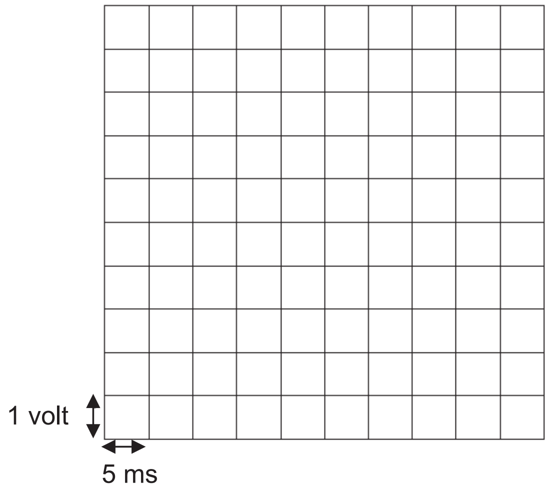
(i) the peak voltage the generator can produce in 1 second with the turbine connected. (Assume there is no loss in energy at this stage.)

peak voltage = ……………………………….[1]

(ii) the maximum power the generator can produce in 1 second.

maximum power = …..…………………………[1]

(c) Using the grid provided, sketch the waveform produced by the AC generator as observed from the oscilloscope.



(d) Determine the maximum energy in kWh, the generator can produce in 4 hours 20 minutes.

maximum energy = …..…………………………[2]

(e) Determine the efficiency of the generator in %.

efficiency = …..…………………………[2]

OR

A student investigates the effects of temperature on the volume of a gas used by a column of air sealed in a capillary tube of cross sectional area of 2.00 mm^2 by a short column of mercury as shown in Fig. 10.1.

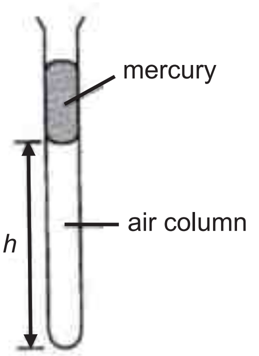


Fig. 10.1

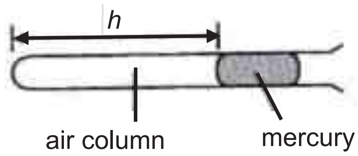


Fig. 10.2

At 20 ^oC, the length of the air column, *h*, was 15.0 cm, the atmospheric pressure is 1.02×10^5 Pa, the length of the mercury column is 2.5 cm and the density of mercury is 13600 kg/m^3.

(a) Calculate the pressure of the air column.

pressure = …..…………………………[2]

(b) Calculate the weight of the mercury column.

weight = …..…………………………[2]

(c) Boyle's Law states that PV = constant, where P is the pressure of the gas and V is the volume of the gas. Sketch the graph of P against $\frac{1}{V}$ for the air column in the capillary tube.

[2]

(d) The capillary tube is not heated. In terms of kinetic theory, state and explain the changes to the length of the air column, if any, that will be observed.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

……………………………………………………………………………………………[3]

(e) The capillary tube is allowed to cool back to 20 °C and placed horizontally as shown in Fig. 10.2. State the new pressure of the air column.

new pressure = ……………………………………[1]

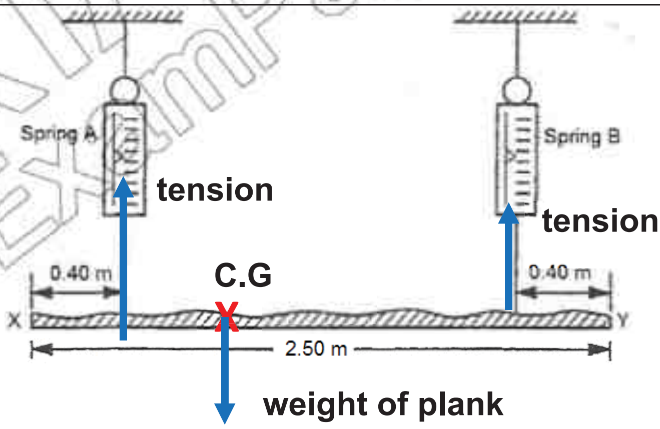
- END OF PAPER -

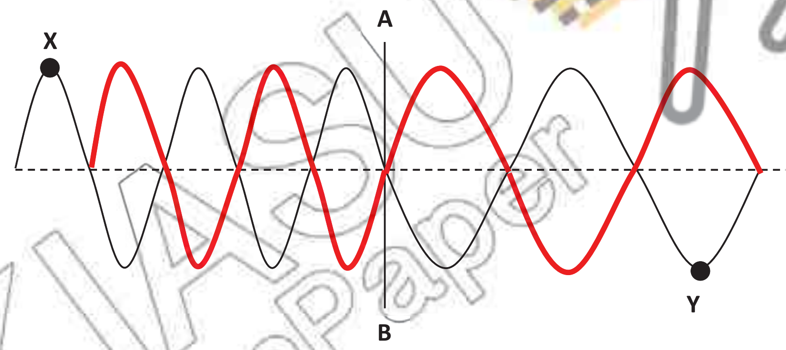
DUNMAN SECONDARY SCHOOL
PRELIMINARY EXAMS 2018
SEC 4 PHYSICS 6091 ANSWER SCHEME

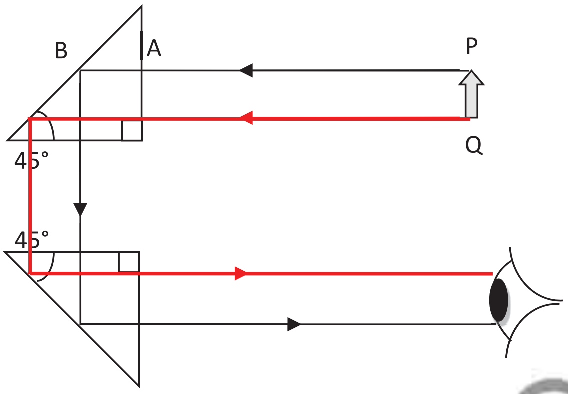
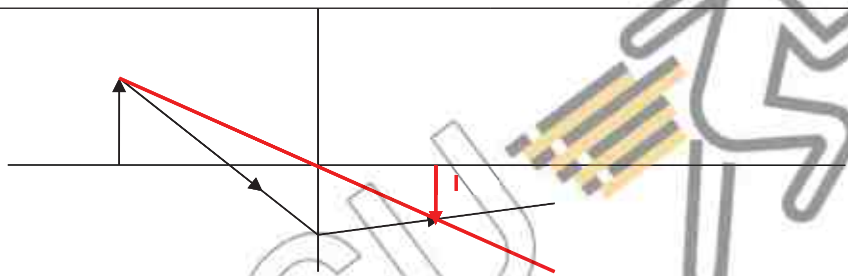
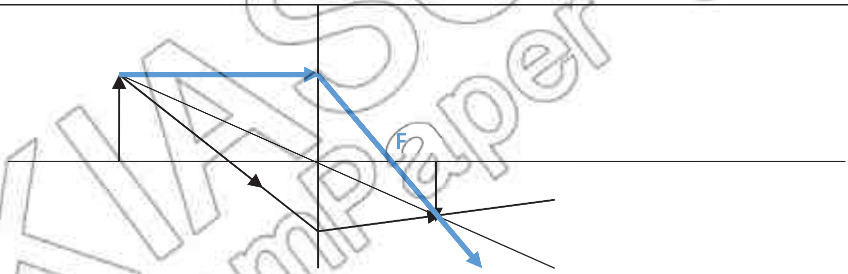
PAPER 1 [40M]

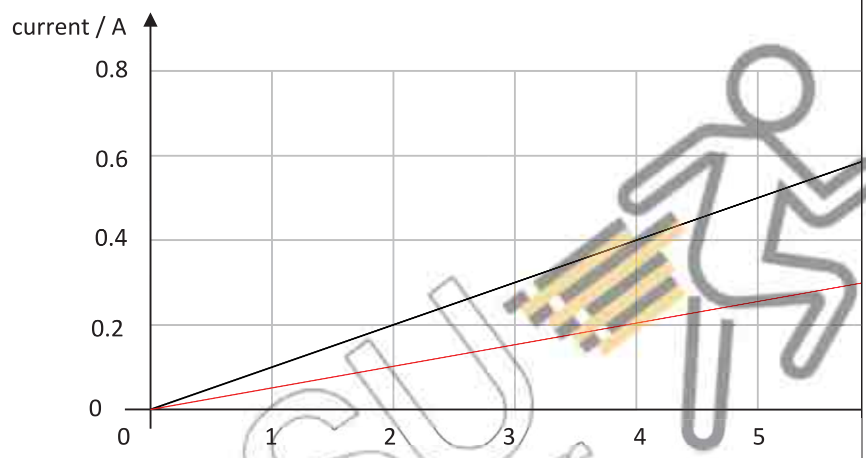
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	B	B	D	A	D	B	C	C	D
Q11	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**
D	C	C	D	B	D	C	A	B	B
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**
D	C	A	D	A	C	D	C	C	C
Q31	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
B	A	C	B	D	A	D	B	C	B

PAPER 2 – SECTION A

1(a)	10^{-3} k giga	B1 B1 B1
1(b)	force, weight and acceleration only (all 3 must be correctly underlined)	B1
1(c) (i)	correctly labelled diagram using tip-to-tail method or parallelogram method (resultant force should have double arrows) resultant force = 11.4 N *(range 11.0 to 11.8 N)* direction = 50 degree to the 5.0 N force OR 25 degree to the 9.0N force or 90° from horizontal	B1 B1 B1
1(c) (i)	11.4 N (answer should be the same as resultant force in c(i))	B1
2(a)	750 – 400 = 350 N	B1
2(b)	 Correct labelling of 'X' and 'C.G' (towards spring A) Correct drawing of 3 arrows representing the 3 forces Correct labelling of the 3 forces (tension A must be longer than tension B)	B1 B1 B1

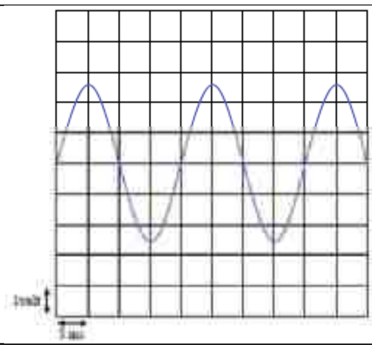
2(c)	By Principle of Moment / OR Taking Spring B to be the pivot, Clockwise moment = anti-clockwise moment 400 x (2.50 – 0.40 – 0.40) = 750 x K K = 0.907 m Distance = 0.907 + 0.40 = 1.31 m	 B1 B1 B1
2(d)	The line of action of the tension in spring B cuts the pivot, hence **perpendicular distance** between the line of action of the force and pivot **is zero**. Hence, as moment = force x perpendicular distance, moment due to the tension in spring B about B will be zero.	B1
3(a)	speed = wavelength / period 4.0 = 5.0 / period period = 1.25 s	 M1 A1
3(b)	frequency = speed / wavelength = 4.0 / 5.0 = 0.80 Hz speed = frequency x wavelength = 0.80 x 0.08 = 0.064 m/s (OR 6.40 cm/s)	 M1 A1
3(c) (i)	At Y, period is also 1.25 s. Average speed = (4 x 10.0) / 1.25 = 32 cm/s (OR 0.32 m/s)	 M1 A1
3(c) (ii)	0.00cm/s (check for 2 or 3 sf)	A1
3(c) (iii)		A1
4(a) (i)	n = 3.0 x 10^8 / speed of light in prism speed of light in prism = 3.0 x 10^8 / 1.6 = 1.88 x 10^8 m/s	 M1 A1
4(a) (ii)	n = 1 / sin c c = sin-1 (1/1.6) = 38.7°	 A1
4(a) (iii)	**Incident angle is 45° which is more than the critical angle 38.7°** **Total internal reflection** occurs hence the ray AB did not pass out of prism at B *reject if students cited incident angle as 90°.	B1

4(a) (iv)	 Correct ray with at least an arrow drawn.	B1
4(b) (i)	Converging lens	B1
4(b) (i)	 	B1
4(b) (i)	 *no arrows deduct 1m	B1
5(a)	Current is directly proportional to the potential difference across the circuit in a metallic conductor if temperature/physical conditions are constant	B1 B1
5(b)	R = V / I = 6 / 0.6 (using any value of V and I from graph) = 10.0 Ω	 A1
5(c) (i)	half the length = 5.0 Ω half the diameter means ¼ of the original area = 5.0 x 4 = 20.0 Ω OR R = ρ(1/2 x L) / (1/4 x A) = 2 x (ρL / A) = 2 x 10.0 = 20.0 Ω	M1 A1

5(c) (ii)		A1
6(a)	Brass is not a ferromagnetic material while iron is. Hence, bar magnet cannot **induce magnetism** in brass. Or hence brass cannot be magnetised to become a magnet.	B1 B1
6(b)	When the N-pole of the bar magnet is moved quickly towards the ring, there is a **change in magnetic flux linking the ring**. Hence, by Faraday's Law, an e.m.f is induced in the ring. As the ring is a **closed loop, a current is hence induced.** Or There is cutting of the magnetic flux linkage in the brass ring, this change in magnetic flux induces an emf and an induced current in the brass ring due to Faraday's Law of EMI.	B1 B1
6(c)	By Lenz.s Law, the direction of the induced current in the ring and hence the **induced magnetic flux will oppose the original change in magnetic flux** due to the bar magnet approaching. Hence, an **induced N-Pole will be created in the brass ring on the side facing the bar magnet** and repel the away from the approaching bar magnet.	B1 B1
7(a) (i)	An alternating voltage is a voltage that changes the direction of its **polarity** periodically.	B1
7(a) (ii)	Iron core is used as it is a soft magnet that can easily be magnetised or demagnetised. While steel cannot be easily magnetised or demagnetised.	B1
7(b)	Ns / Np = Vs / Vp Ns = (6.0 / 240) x 360 = 9.0 turns	 M1 A1
7(c)	Pp = 0.040 x 240 = 9.60 W Ps = 0.6 x 6.0 = 3.60 W Efficiency = (3.6 / 9.6) x 100% = 37.5%	 M1 A1

PAPER 2 – SECTION B

8(a)	Light may be absorbed by the impurities of the glass under the seabed. Hence, light has to be boosted at the repeaters to sure light will **arrive at the output**. or This is to ensure that light signals **will arrive at the output end** given that the transmission of light is not 100% efficient.	B1
8(b)	Critical angle is defined as the **angle of incidence in the optically denser medium** which makes **an angle of refraction of 90º** in the optically **less dense medium**.	B1
8(c)	The cladding acts as a layer of **optically less dense medium** as compared to the glass core. This is to ensure that **total internal reflection is able to occur** in the glass core.	B1 B1
8(di)	(in series) Total potential difference = 40 V x 100 = 4000V	 B1
8(dii)	Total resistance in metal sheath = 0.70 Ω/km x 7500 km = 5250 Ω Total potential difference = IR = 0.80 x 5250 = 4200 V	 B1 B1
8(diii)	Total potential difference = 4200 V + 4000 V = 8200 V	 B1
8(div)	Thermal energy loss = I^2Rt = $(0.80)^2$ x 0.70 x (24 x 60 x 60) = 38707.2 J = 38700 (3 sf) or 39000 J (2 sf)	 M1 A1
9(a)(i)	Time taken for sound = 294 s Time taken for light 3.33 x 10^{-4} m/s	B1 B1
9(a)(ii)	294 s	B1
9(a)(iii)	The time interval will be shorter. The speed of light in water is slower and the speed of sound in water is faster, hence the time interval will be shorter.	B1 B1
9(b)(i)	Time taken = 25 div x 120 ns = 3000 ns Speed of light = 1000 ÷ 3000 x 10^{-9} = 3.33 x 10^8 m/s	 B1 A1
9(b)(ii)	Time base at 50 div Peak of lux is twice the original The equilibrium line at twice the original and the shape of the graph	B1 B1 B1
10 Either		
(a)	E = Pt = 20 x 5 x 60 x 60 = 360 kJ	 M1 A1
(bi)	Peak voltage = 0.05 V x 50 rev/s = 2.5 V	B1
(bii)	Maximum power = IV = 2 x 2.5 = 5.0 W	B1

(c)		B2
(d)	Maximum E = Pt = 0.005 kW x $4\frac{1}{3}$ h = 0.0217 kWh	M1 A1
(e)	Efficiency = [output / input] x 100% = (5 W / 20 W) x 100% = 25%	 M1 A1
10 OR		
(a)	Pressure of air = Pressure of Hg + Pressure of Atmosphere = 0.025 x 13600 x 10 + 1.02 x 10^5 Pa = 105 000 Pa (3sf)	 M1 A1
(b)	P = F/A 3400 = F/ 2 x 10^{-6} F = 6.8 x 10^{-3} N Or Mass = 13600 x (0.025) x (2 x 10^{-6}) = 6.8 x 10^{-4} kg Weight = (6.8 x 10^{-4}) x 10 = 6.8 x 10^{-3} N	 M1 A1 M1 A1
(c)	 B1 – straight line graph from original B1 – correct axes label **(only when graph shape is correct)**	
(d)	When heated, the air molecules **gain energy and moves faster. Rate of collision against the walls of the tube as well as the mercury column increases**. This will **raise the pressure** in the tube to increase **pushing the mercury column upwards**, **increasing the length of the air column**.	B1 B1 B1
(e)	Pressure of air = Pressure of Atmosphere = 1.02 x 10^5 Pa	 B1

Geylang Methodist School (Secondary)
Preliminary Examination 2018

PHYSICS **6091/01**

Paper 1 **Sec 4 Express**

Additional materials : OAS

1 hour

Setter : Mr Yip Cheng Hou

24 August 2018

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Do not open this booklet until you are told to do so.

Answer **all** questions. Shade your answers on the OAS provided.

At the end of the examination, submit OAS and the question paper separately.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark.

Any rough work should be done in this booklet.

Acceleration due to gravity, ***g***, is assumed to be 10 m/s^2 on Earth and 6.67 m/s^2 on Moon unless otherwise specified.

This document consists of **16** printed pages

[Turn over

1 Pressure can be determined using the following formula:

P = F ÷ A
F = m × a

where **P**= pressure (pascal, Pa) **A** = area (m^2) **m** = mass (kg)

F = force (newtons, N) **a** = acceleration ($\frac{m}{s^2}$)

The unit, pascal, is equivalent to

A $\frac{kg}{sm}$ **B** $\frac{s^2}{kgm}$ **C** $\frac{1}{kgs^2m}$ **D** $\frac{kg}{s^2m}$

2 **Fig. 2** shows Jenny's setup of the following experiment.

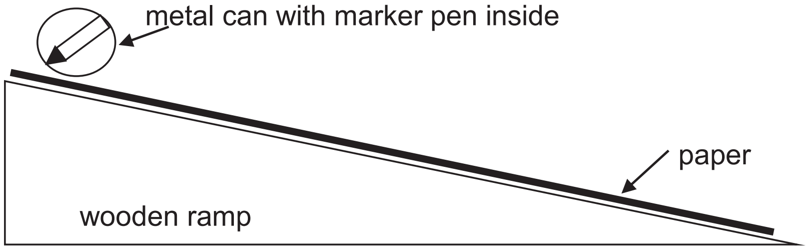
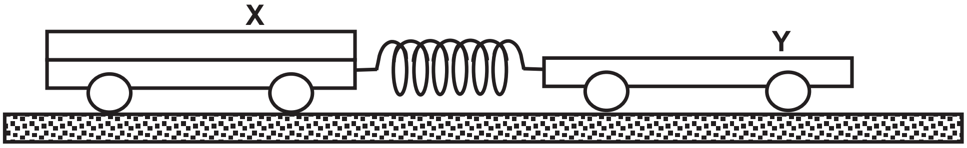


Fig. 2

Jenny released the can and it rolled freely down the ramp without slipping. What would she observe on the paper made by the marker pen?

A The dots get farther apart.
B The dots get closer together.
C The dots gets closer then further apart.
D The dots are equidistant from each other.

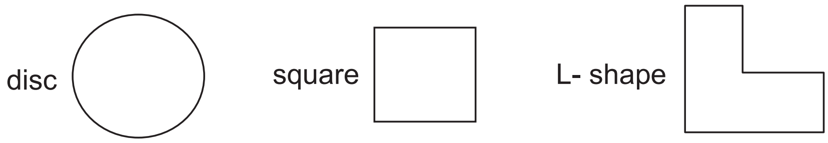
3 Trolley **X** and trolley **Y** are joined together by a stretched spring. Trolley **X** has twice the mass of trolley **Y**. When the trolleys are released, the acceleration of **X** is 1.0 m s^{-2} to the right.



What is the initial acceleration of trolley **Y** to the left?

A 0.5 m s^{-2} **B** 1.0 m s^{-2} **C** 2.0 m s^{-2} **D** 4.0 m s^{-2}

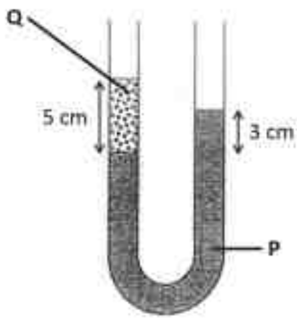
4 Three objects are cut from the same big sheet of metal. They have the same volume but different shapes.



Which of the following statements is **true**?

A They have different mass and position of C.G.
B They have different mass but same position of C.G.
C They have the same mass and position of C.G.
D They have the same mass but different position of C.G.

5 The diagram below shows two immiscible liquids, P & Q, which have been poured into a manometer which is exposed to the atmosphere at the top of both arms.



What is the ratio of the density of Liquid Q to Liquid P?

A 3:5 **B** 5:8 **C** 5:3 **D** 8:3

6 The diagram below shows a uniform metre ruler with a weight of 10 N, under the action of a vertical force of 30.0 N.

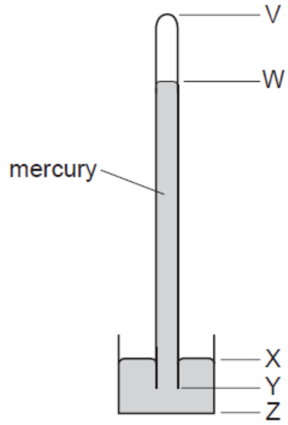
At what mark must a fulcrum be placed to hold the ruler in equilibrium?

A 12.5 cm **B** 16.7 cm **C** 25.0 cm **D** 37.5 cm

7 Which of the following objects has the **least** inertia?

A A robot of weight 300 N travelling on the Moon.
B A robot of weight 300 N travelling on Earth.
C A stationary rock of mass 150 kg on the Moon.
D A stationary rock of mass 150 kg on Earth.

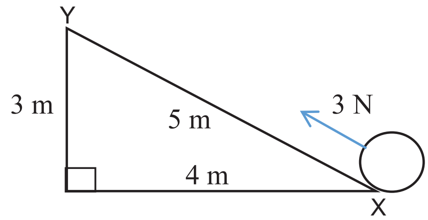
8 The diagram shows a simple mercury barometer.



When the atmospheric pressure increases, which distance increases?

A VW **B** XY **C** YZ **D** WX

9 A ball, which weighs 2 N, is moved up a slope from X to Y, by applying a force of 3 N as shown in the diagram below.



Assuming no energy is lost to the surrounding, what is the gain in kinetic energy, gain in gravitational potential energy and work done on the ball?

	Kinetic Energy	Gravitational Potential Energy	Work Done
A	6 J	6 J	6 J
B	6 J	9 J	6 J
C	15 J	6 J	15 J
D	9 J	6 J	15 J

10 A powerful fan uses a 50 W battery. The fan generates 20 J of heat every second as its motor turns.

What is the efficiency of this fan?

A 28.6 % **B** 40.0 % **C** 60.0 % **D** 250 %

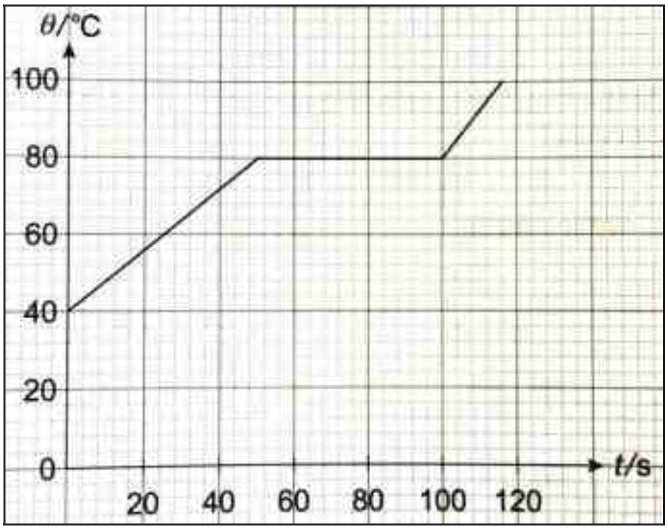
11 Which gives the states of matter in which molecules, at a given temperature, have the smallest spacing between them and move at the lowest speed?

	Smallest spacing between molecules	Molecules have the lowest speed
A	Solid	Solid
B	Liquid	Solid
C	Solid	Liquid
D	Liquid	Liquid

12 Which of these examples has the wrong type of heat transfer associated with it?

	Example	Type of heat transfer
A	Heat from flame to flying pan	Conduction
B	Sunlight warming the interior of a car	Convection
C	Cooling a cup of coffee with a steel spoon	Conduction
D	Heat from burning logs to person beside fire place	Convection

The graph below shows the changes in temperature of a 400 g solid when it is heated by a heater with a rating of 80 W. Use it to answer questions 13 to 15.



13 Which of the following statements show a difference between heat and temperature.

A When 80 W of heat is supplied, the temperature reached 80 °C.
B Heat has a SI unit in Kelvin while temperature SI unit is in °C
C Heat increases when temperature increases.
D Heat remains constant regardless whether temperature changes.

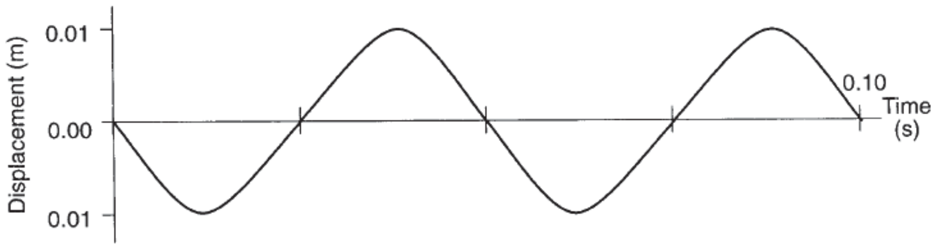
14 Assuming there is negligible energy loss to the surroundings, what is the specific heat capacity of the liquid?

A 10 J/kg°C **B** 160 J/kg°C **C** 240 J/kg°C **D** 1160 J/kg°C

15 Assuming there is negligible energy loss to the surroundings, what is the specific latent heat of fusion of the solid?

A 10 J/kg **B** 167 J/kg **C** 200 J/kg **D** 10000 J/kg

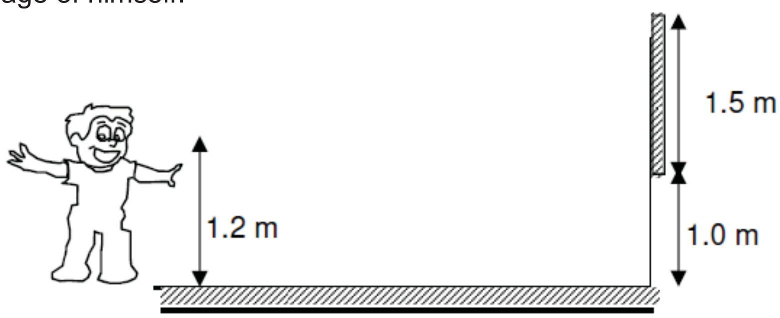
16 The graph shows the vertical displacement of an object floating on water as a wave passes through the water.



What is the frequency of the wave?

A 10 Hz **B** 20 Hz **C** 50 Hz **D** 100 Hz

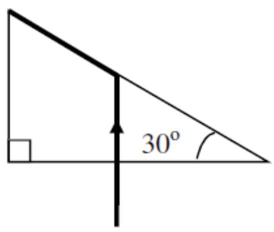
17 A plane mirror 1.5 m in length is hung on a vertical wall with its bottom 1.0 m above ground. A boy with his eyes 1.2 m above ground looks into the mirror to see the image of himself.



What length of himself (below his eyes) can be seen in the mirror?

A 0.4 m **B** 0.8 m **C** 1.0 m **D** 2.0 m

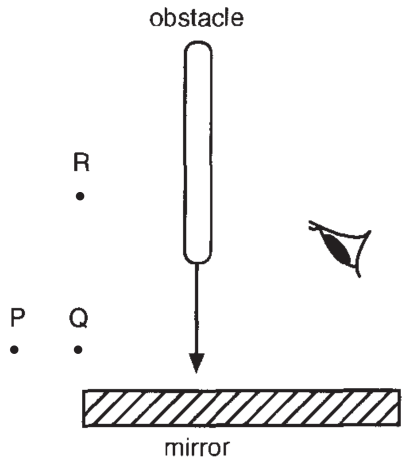
18 A ray of light enters a prism made of material **X** and travels along the path as shown in the figure below.



What is the refractive index of the material **X**?

A 0.50 **B** 1.20 **C** 1.50 **D** 2.00

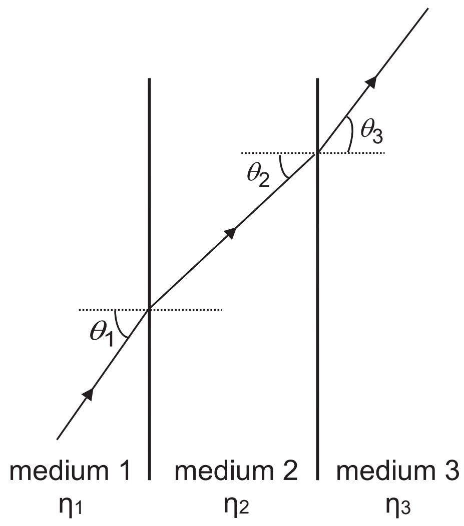
19 Three objects, **P**, **Q** and **R**, are viewed through a plane mirror as shown. An obstacle moves towards the mirror as indicated by the arrow.



Which image will disappear first and which image will disappear last?

	disappears first	disappears last
A	**P**	**Q**
B	**P**	**R**
C	**Q**	**R**
D	**R**	**Q**

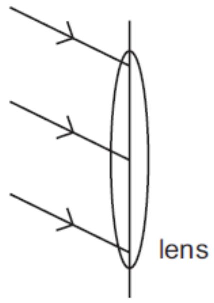
20 A light ray passes through three media of refractive indices η_1, η_2 and η_3 respectively.



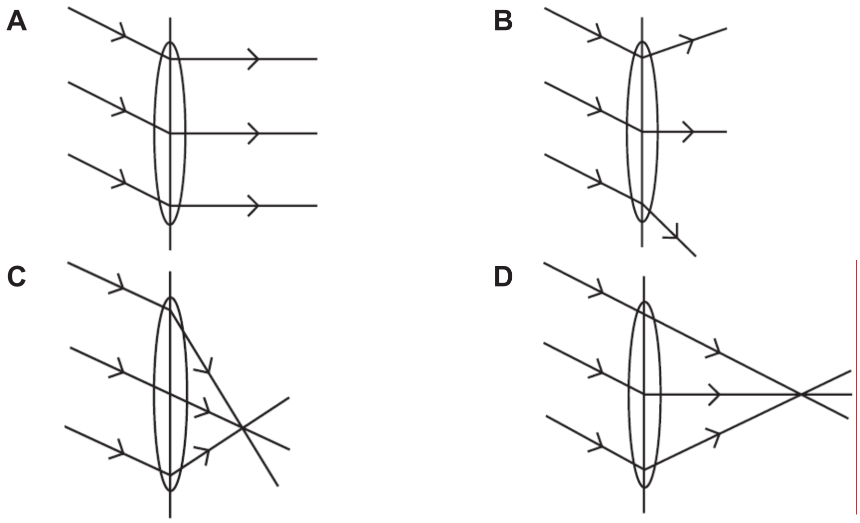
Given that $\theta_1 > \theta_3 > \theta_2$, which of the following is correct?

A $\eta_1 > \eta_2 > \eta_3$ **B** $\eta_2 > \eta_1 > \eta_3$ **C** $\eta_1 > \eta_3 > \eta_2$ **D** $\eta_2 > \eta_3 > \eta_1$

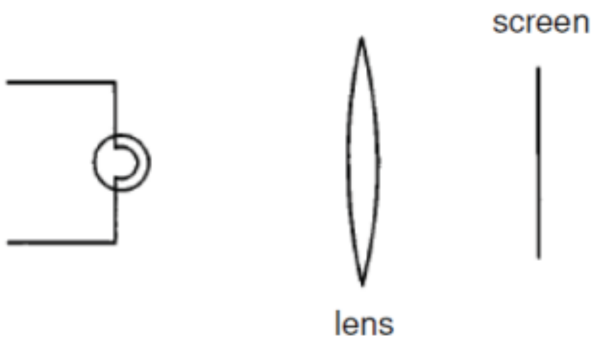
21 Three rays of light fall on a converging lens as shown.



Which diagram shows the path of the rays after passing through the lens?



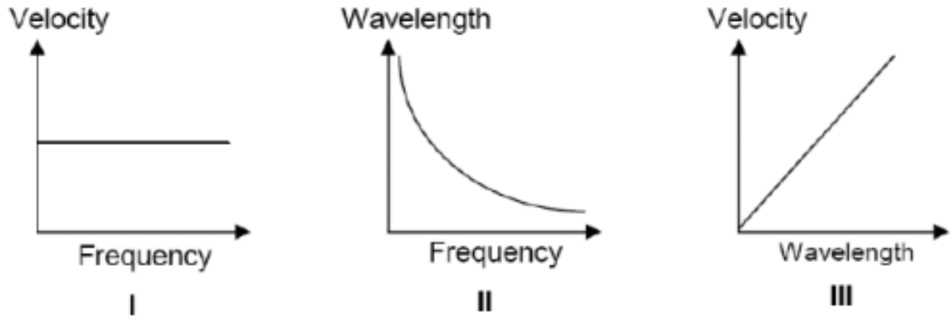
22 A student arranges an illuminated object, a lens and a screen such that the size of the image is twice that of the object. Keeping the distance between the screen and the illuminated object fixed, he exchanges the position of the screen and the illuminated object.



What would be observed on the screen?

A A blurred, magnified image.
B A blurred, diminished image.
C A sharp image twice the size of the object.
D A sharp image half the size of the object.

23 Which of the following graphs about electromagnetic waves travelling in vacuum is/are correct?



A I only **B** I and II only **C** II and III only **D** I, II and III

24 The diagram shows the main sections of the electromagnetic spectrum in order of increasing frequency. Some of the sections are labelled. The section R has a frequency just below that of light.

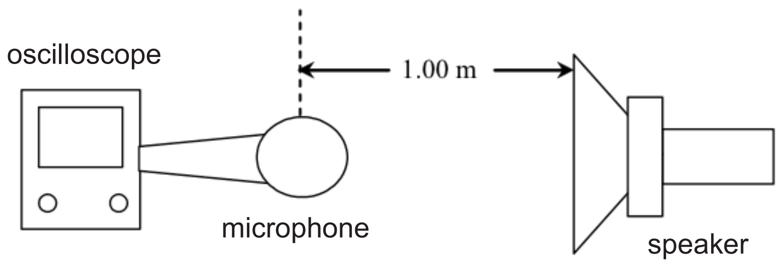
radio waves		R	light			gamma-rays

→ increasing frequency

Which application uses the section R?

A Sterilisation
B Satellite television
C Bread toaster
D Laser pointer

25 The set-up shown in the diagram below consists of an oscilloscope and a speaker that emits a sound wave with frequency 1000 Hz. A microphone placed 1.00 m from the speaker detects the sound emitted by the speaker. A waveform is observed on the oscilloscope representing the sound emitted.



The speaker is then moved to a distance 0.5 m towards the microphone and a new waveform is observed on the oscilloscope. Compared to the earlier waveform, this new waveform has a greater ___________.

A speed **B** amplitude **C** frequency **D** wavelength

26 **Fig. 26.1** is a **full-scale** diagram that shows air particles at their equilibrium positions (represented by dotted lines). When a sound wave passes, particles are displaced into new positions shown in **Fig. 26.2**. **Q** represents a particle.

Fig. 26.1

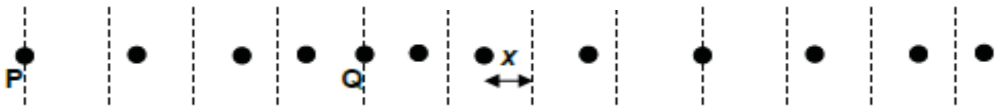


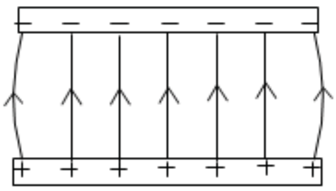
Fig. 26.2

Which of the following statements is false?

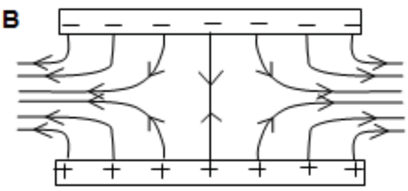
A Point **Q** is the centre of a rarefaction.
B Particles next to **Q** are moving in opposite direction.
C The amplitude of the wave is 1.0 cm.
D The wavelength of the wave is 10.3cm

27 Which of the following diagrams correctly shows the uniform electric field between two charged parallel metal plates?

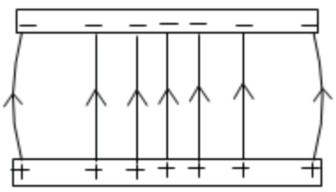
A



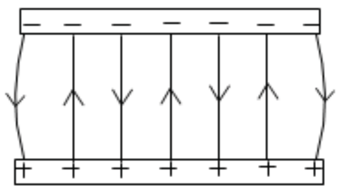
B



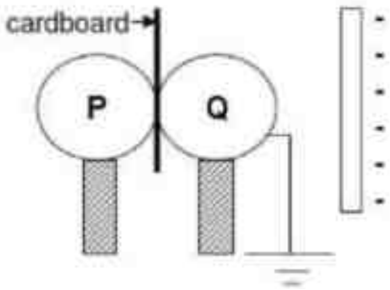
C



D



28 Two uncharged metal spheres **P** and **Q** are placed together with a thick cardboard inserted between them. Both spheres are supported by insulating stands and **Q** is earthed with a wire.

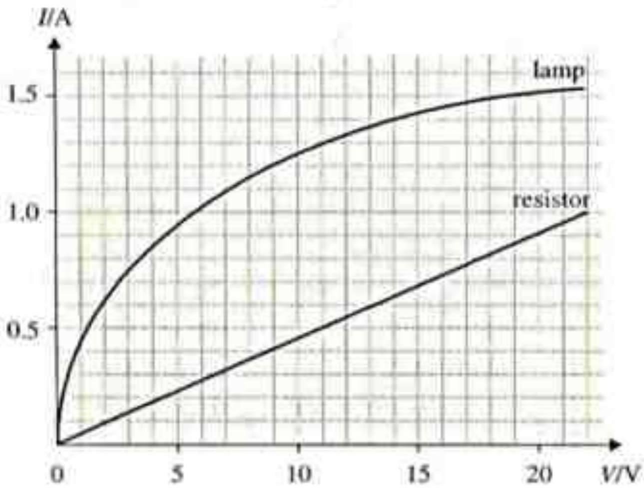


A negatively-charged rod is brought near the spheres as shown.

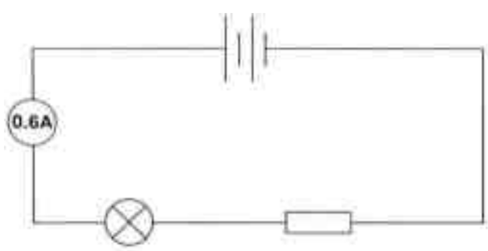
What would be the distribution of charges on spheres **P** and **Q** when the wire is removed followed by the charged rod?

	P	Q
A	negative	positive
B	negative	neutral
C	neutral	positive
D	neutral	neutral

Refer to the following information for Questions 29 and 30.
The graph below shows how the current in a lamp and a resistor varies with the potential difference applied.



The lamp and the resistor are connected in series as shown below, and the ammeter reading is 0.6 A.



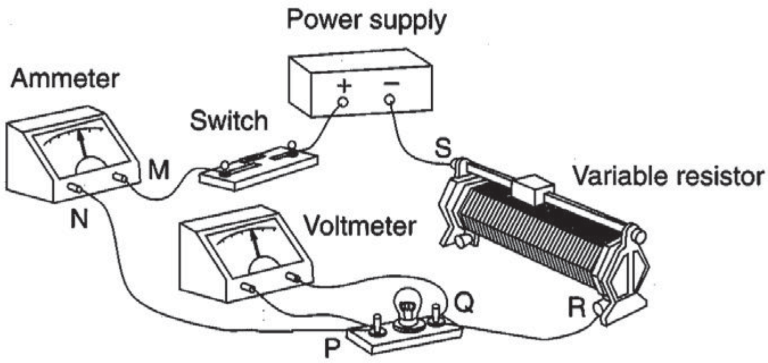
29 Determine the e.m.f. of the circuit.

A 2.0 V **B** 11.0 V **C** 13.0 V **D** 15.0 V

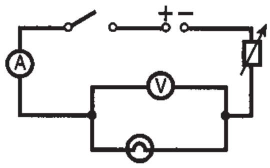
30 Determine the resistance of the resistor.

A 0.046 Ω **B** 0.091 Ω **C** 11.0 Ω **D** 22.0 Ω

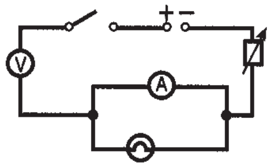
31 The diagram shows an experimental set-up of an electric circuit to determine the resistance of a bulb.



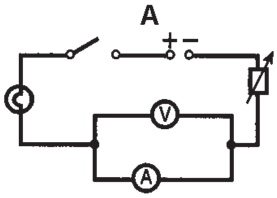
Which one of the following shows the correct circuit diagram?



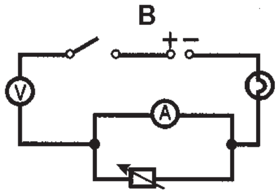
A



B

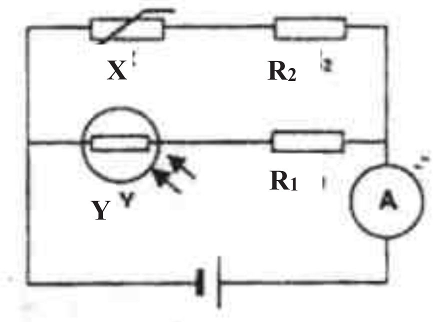


C



D

32 In the circuit shown, **R_1** and **R_2** are identical resistors.



Which of the following changes to the electrical components **X** and **Y** will decrease the reading of the ammeter by the greatest amount?

A Immerse **X** in a beaker of ice water and decrease the light intensity on **Y**.
B Immerse **X** in a beaker of ice water and increase the light intensity on **Y**.
C Immerse **X** in a beaker of hot water and decrease the light intensity on **Y**.
D Immerse **X** in a beaker of hot water and increase the light intensity on **Y**.

33 In a 3-pin plug of a vacuum cleaner, the fuse is missing.
Which of the following statement is correct?

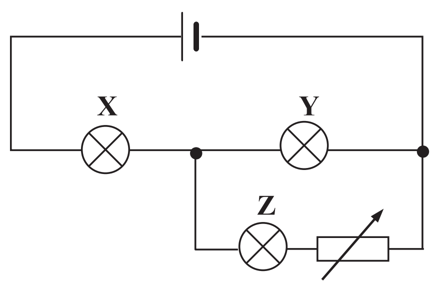
A The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be live.

B The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be safe to handle because the current will flow to earth.

C The vacuum cleaner, once turned on, will shut down at once.

D The vacuum cleaner cannot be turned on.

34 Three identical lamps X, Y and Z are connected in a circuit as shown below.



What will happen to the brightness of the lamps if the resistance of the rheostat is increased?

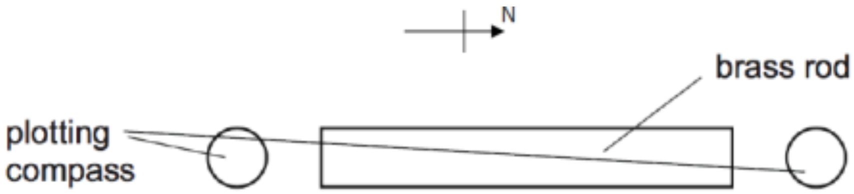
	X	Y	Z
A	Brighter	dimmer	dimmer
B	brighter	brighter	dimmer
C	dimmer	brighter	dimmer
D	dimmer	brighter	brighter

35 A student carries out four tests with a magnet.

Which result shown is **not** correct?

	arrangement		Result
A	S magnet N	S magnet N	Attracts
B	S magnet N	iron bar	attracts
C	N magnet S	iron bar	repel
D	N magnet S	copper bar	no effect

36 A brass rod is arranged in a north-south direction and plotting compasses are placed at each of it ends.



Which diagram shows the positions of the needles of the plotting compasses?

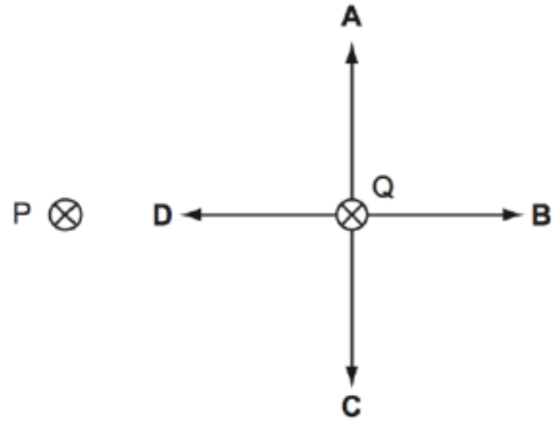
A


B

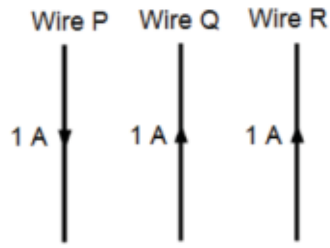

C


D


37 P and Q represents two parallel, straight, wires carrying currents. P and Q exert force on each other. Which arrow shows the force on Q?



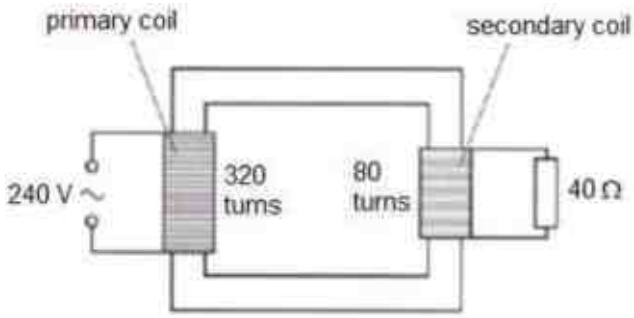
38 Three wires **P**, **Q** and **R** are each carrying a current of 1 A in the direction as shown in the diagram below.



What are the directions of forces acting on the three wires?

	Wire P	Wire Q	Wire R
A	left	left	left
B	right	left	right
C	left	right	left
D	right	right	right

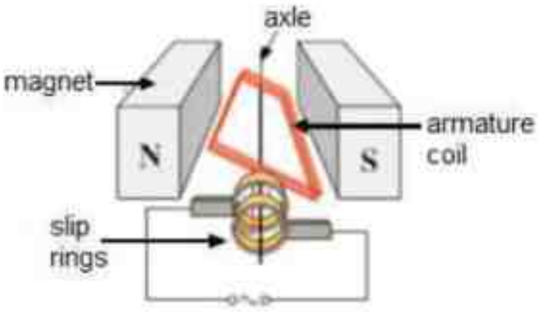
39 The figure below shows an ideal transformer with the secondary coil connected to a 40 Ω load.



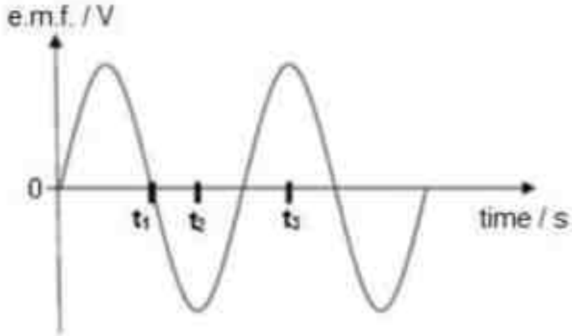
What is the current in the primary coil?

A 0.38 A **B** 1.5 A **C** 2.7 A **D** 6.0 A

40 The diagrams show a simple a.c. generator and the graph illustrating the waveform of the e.m.f. output of the a.c. generator.



simple a.c generator



waveform of the e.m.f. output

Which of the following diagrams correctly shows the plane of the armature coil of the generator, as viewed along the axle from the position of the slip rings, at time intervals denoted by $\mathbf{t_1}$, $\mathbf{t_2}$ and $\mathbf{t_3}$ on the graph?

	t_1	t_2	t_3
A			
B			
C			
D			

END OF PAPER 1

Geylang Methodist School (Secondary)
Preliminary Examination 2018

Candidate Name			
Class		Index Number	

PHYSICS **6091/02**

Paper 2 Physics **Sec 4 Express**

Additional materials : Writing Papers **1 hour 45 minutes**

Setter : Mr Yip Cheng Hou **24 August 2018**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
Write your answers to **Section A** in the spaces provided in the Question Paper.
Write your answers to **Section B** in writing papers provided.
Question 13 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units.
You are advised to show all your working in a clear, orderly manner.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Acceleration due to gravity, ***g***, is assumed to be 10 m/s^2 unless otherwise specified.

For Examiner's Use	
Section A	/50
Section B	/30
Total	/80

This document consists of **19** printed pages and 1 blank page.

[Turn over

Section A

Answer **all** the questions in this section in the spaces provided.

1 Fig. 1.1 shows a virtual image **I** formed by a converging lens from an object of height 1.0 cm.

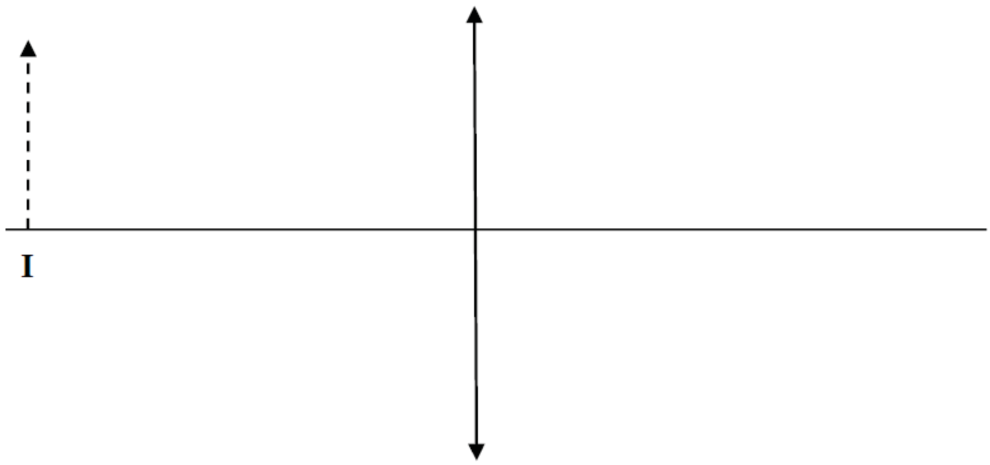


Fig. 1.1

(a) On Fig. 1.1 above, draw rays to determine

(i) the position of the object, Label the object **O**.

(ii) the focal length of the lens.

focal length = …………………… [2]

(b) Fig. 1.2 shows a light ray travelling in the converging lens of refractive index 1.5. The diagram is not drawn to scale.

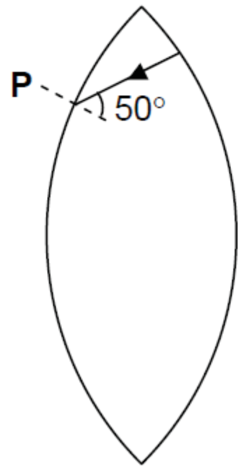


Fig. 1.2

Calculate the critical angle and explain the behaviour of the light after it is incident to the surface P.

………………………………………………………………………………………… [2]

…………………………………………………………………………………………

(c) State a use of a component of the electromagnetic spectrum with the smallest wavelength and describe the effect of absorbing this electromagnetic wave.

………………………………………………………………………………………… [2]

…………………………………………………………………………………………

2 The speed of an ultrasound in air is 340 m/s.

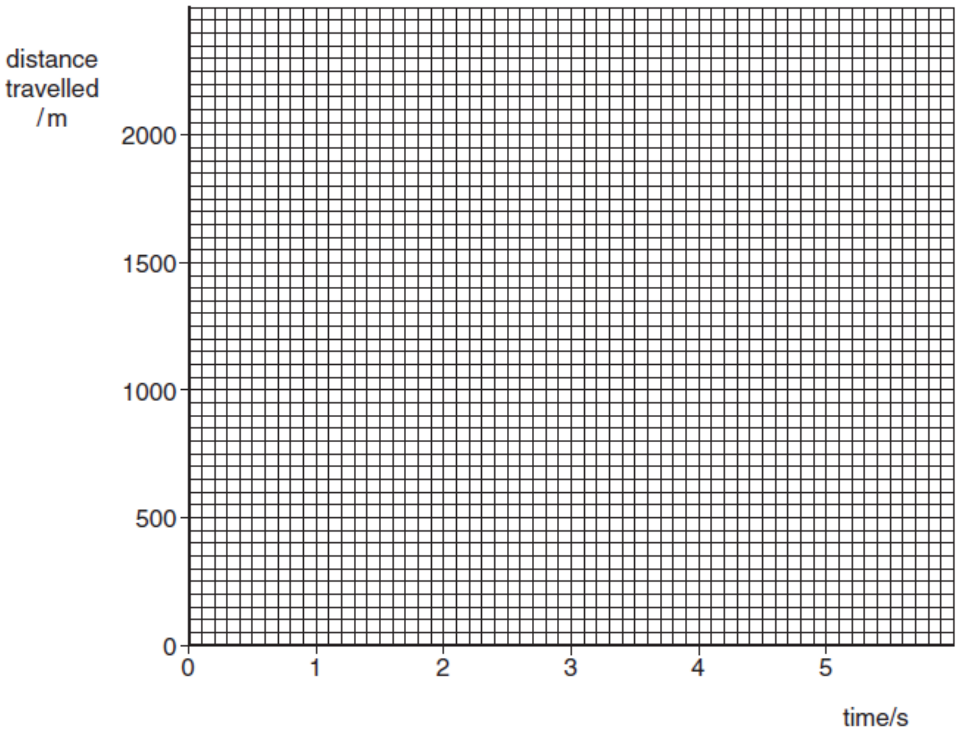
(a) Complete Fig. 2.1 to show how far the ultrasound wave has travelled 2, 3, 4 and 5 seconds after the ultrasound was produced.

time elapsed/s	0	1	2	3	4	5
distance travelled/m	0	340				

[1]

Fig. 2.1

(b) On Fig. 2.2, draw the graph of distance travelled against time for the ultrasound wave.



[3]

Fig. 2.2

(c) State and describe which type of wave is ultrasound.

....

.... [1]

(d) Explain what is wavelength and state the maximum wavelength of the ultrasound.

....

.... [3]

3 In Experiment one, two blocks of mass 5 kg and 10 kg were attached and pulled across a rough ground in the direction shown in **Fig. 2.1**.

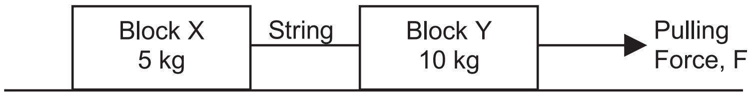


Fig. 2.1

The experiment is then repeated on the same surface but with a different pulling force. The changes in velocities of the blocks for both experiments were measured and tabulated in **Fig. 2.2**.

	Velocity / cms^{-1}	
Time/s	**Experiment One**	**Experiment Two**
1	4	5
2	8	5
3	12	5
4	16	5
5	20	5

Fig. 2.2

(a) Using the values in Experiment One as shown in **Fig. 2.2**, calculate the:

(i) acceleration of the blocks.

acceleration = …………………… [2]

(ii) tension in the string given that the friction between the ground and block X is 3.0 N.

tension = …………………… [2]

(iii) magnitude of the pulling force, F.

pulling force, F = …………………… [2]

(b) In terms of forces, explain why the velocity of the blocks in Experiment One changes over time but remains unchanged in Experiment Two.

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

4 Fig. 4.1 shows a rectangular block of wood on a flat, rough horizontal board.

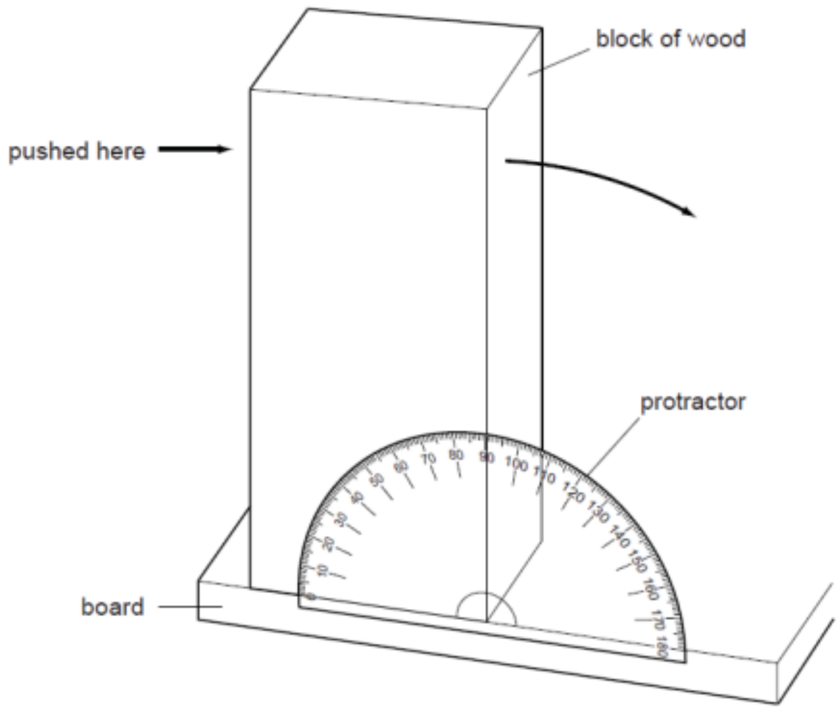


Fig. 4.1

The block is pushed at the top, as shown in Fig. 4.1, and it tilts to the right.

(a) On the front face of the block, draw the line that will be vertical at the instant before the block topples over. [1]

(b) Use the protractor shown on Fig. 4.1 to measure the angle through which the block tilts before it topples over.

angle = …………………… [1]

(c) The block is put back on the board, as in Fig. 4.1. This time, instead of the block being pushed, the left-hand edge of the board is raised.

State the angle that the board makes with the horizontal at the instant the block topples over.

angle = …………………… [1]

(d) Explain, in terms of C.G. and stability, how your answer to **(c)** might differ if the procedure is repeated after the height of the block is reduced.

....

.... [2]

5 **(a)** The principle of conservation of energy states that energy can neither be created nor destroyed. What, then, *does* happen to the energy supplied to a device such as a motor or a television?

....

.... [1]

(b) The television in Fig. 5.1 is switched on to watch a programme. During this time, 720 kJ of electrical energy is supplied.

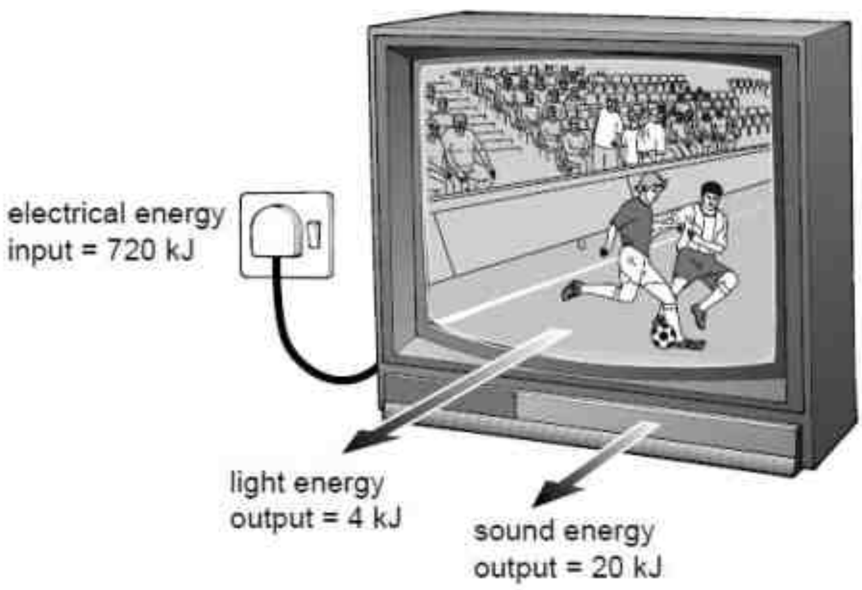


Fig. 5.1

(i) From the information on Fig. 5.1, find the total energy provided for the viewer to see and hear the television during this programme.

energy = …………………… [1]

(ii) Suggest what happens to the rest of the energy supplied.

....

.... [1]

(iii) Calculate how much energy is involved in **(b)(ii)**.

energy = …………………… [1]

(iv) Calculate and comment on the efficiency of the television.

....

.... [2]

6 Fig. 6.1 shows an evaporative cooler, which is a device that cools air through the continuous evaporation of water. Air is cooled by being blown past a cooling pad containing water. The cooling pad is wet by a pump which pumps water up to the top of the pad, from where it trickles down.

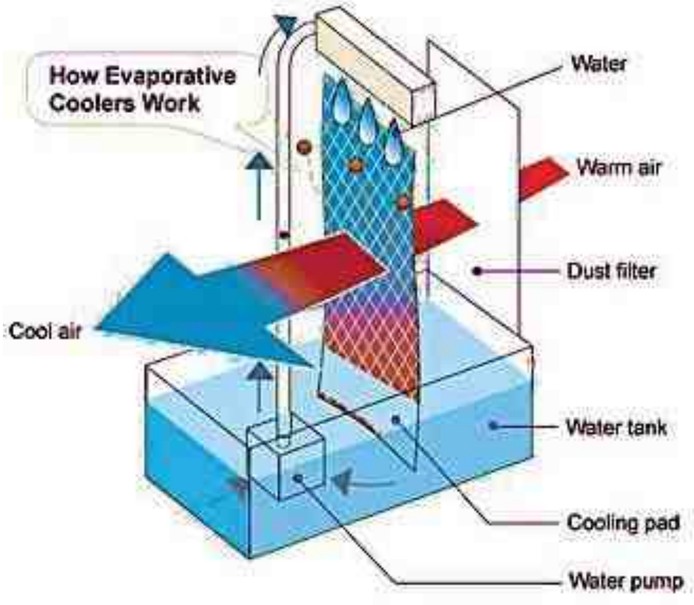


Fig. 6.1

(a) In terms of kinetic model of matter, explain how continuous evaporation of the water causes the air flowing past the cooling pad to be cooled.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(b) Explain whether such evaporative cooling system is more effective in dry or humid atmospheres.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

(c) Suggest one modification that can be made to the design of the evaporative cooler such that the rate of cooling increases.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

7 Two metal saucepans contain the same mass of hot water at the same initial temperature. Pan A is white and pan B is black, but otherwise the two saucepans are identical. Both saucepans are uncovered and cool under the same conditions. The cooling curves for the two saucepans are shown in Fig. 7.1.

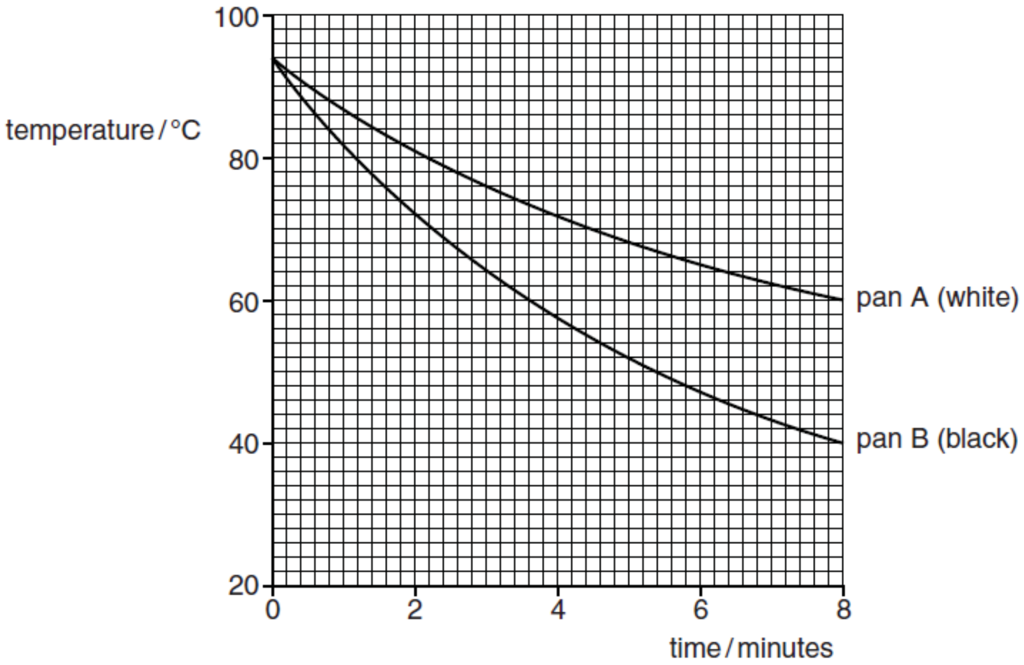


Fig. 7.1

(a) Explain why pan B cools faster than pan A.

....

.... [1]

(b) Describe and explain how Fig. 7.1 is different when the pans are covered and the experiment is repeated.

....

....

.... [2]

(c) Explain what is meant by the specific heat capacity of water is 4200 J/(kg °C).

....

.... [1]

(d) The specific heat capacity of water is very high. Suggest one disadvantage of this when water is used for cooking.

....

.... [1]

(e) The water in pan A cools for 8 minutes, as shown in Fig. 7.1. During this time, the water loses an average of 9000 J of thermal energy per minute.

(i) Calculate the mass of water in pan A.

mass = ……………………

(ii) The mass of water in pan B is the same as that in pan A.
Calculate the thermal energy lost from the water in pan B during the 8 minutes.

loss of thermal energy = …………………… [3]

8 A teacher demonstrates magnetic screening. When a magnet is placed near a small cardboard box, paper clips on the other side of the box are picked up, as shown in Fig. 8.1. When a small piece of soft iron is placed inside the box as shown in Fig. 8.2, the paper clips fall off. Magnetic field lines in each diagram are shown as thin lines.

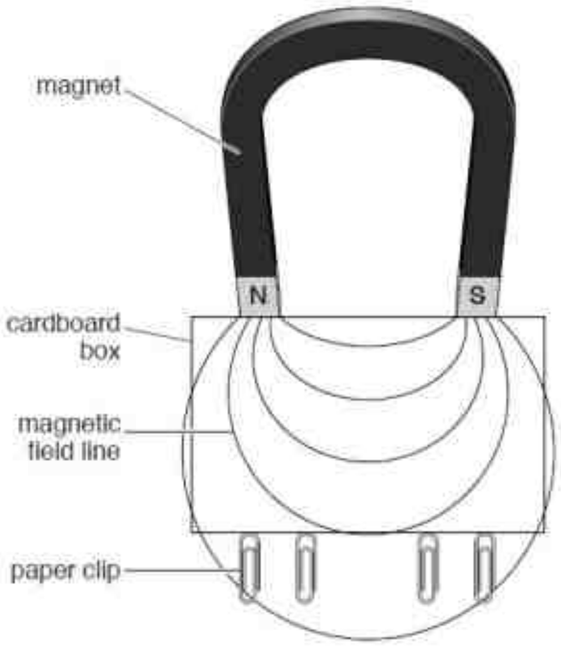


Fig. 8.1

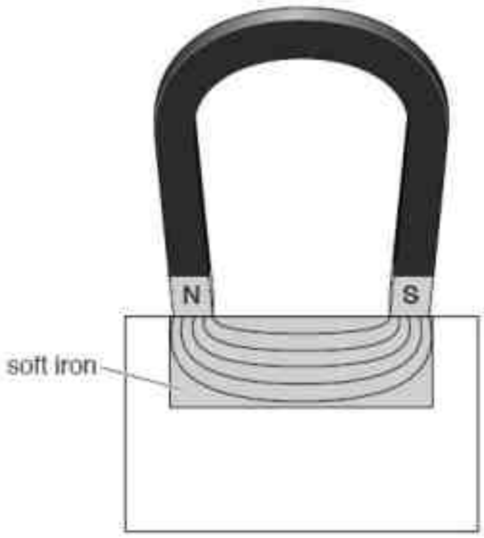


Fig. 8.2

(a) On Fig. 8.1, mark an arrow on each of the magnetic field lines to show its direction. [1]

(b) Explain why placing the soft iron in the box causes the paper clips to fall off.

....

....

.... [2]

9 The apparatus in Fig. 9.1 is called a force-on-conductor balance. When there is an electric current I as shown in XY, there is a force on XY. This force is measured by putting weights in the pan until XY is brought back to its original position.

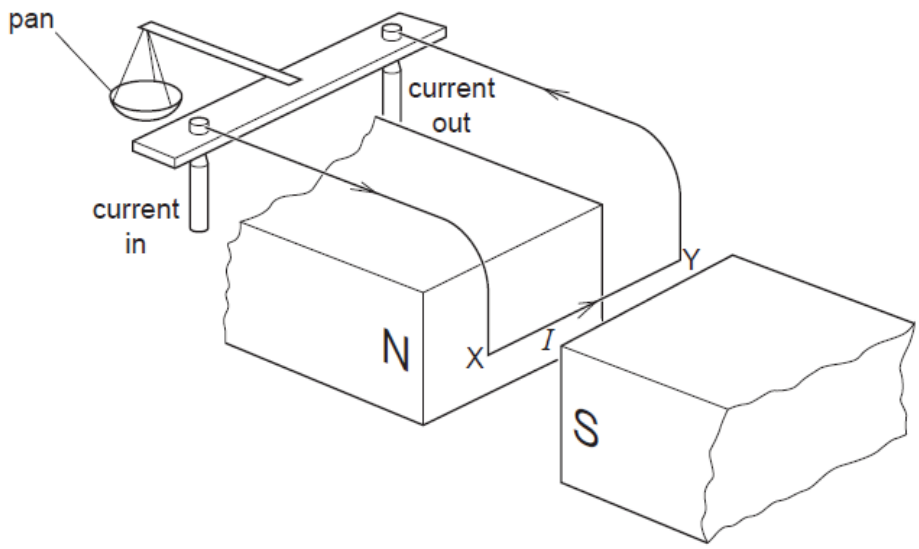


Fig. 9.1

(a) State what would happen if the current direction were from Y to X. [1]

....

(b) A student uses the balance to determine the force F on XY for different currents I. He concluded that F is directly proportional to I based on his results given below.

I / A	0	0.5	1.0	1.5	2.0
F / N	0	0.012	0.023	0.035	0.047

Show clear workings to estimate the force on XY when the current is 1.6 A.

force = ... [2]

END OF SECTION A

Section B

Answer **all** the questions from this section in writing papers provided.
Answer only one of the two alternative questions in **Question 13**.

11 A measuring cylinder contains water which has a density of 1000 kg/m^3.

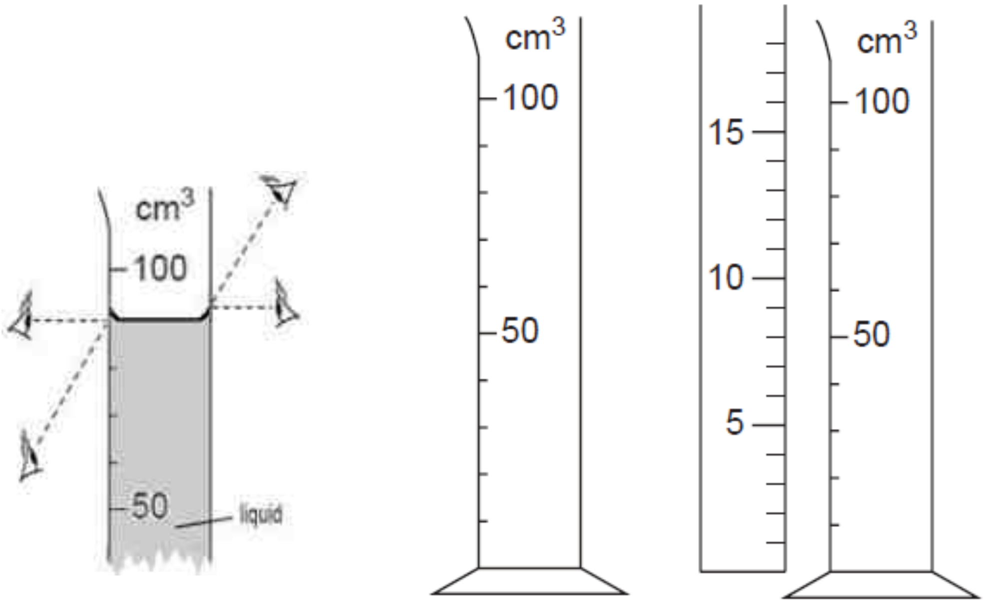


Fig. 11.1 **Fig. 11.2** **Fig. 11.3**

(a) Fig. 11.1 indicates four ways the observer's eye could look when taking the reading from the measuring cylinder. Put a circle around the eye position that gives the correct reading and state the volume of water in the cylinder. [1]

(b) In order to fill the measuring cylinder up to the 100 cm^3 mark, 80 drops of the liquid are added to the liquid already in the measuring cylinder. Calculate the average volume of one drop. [2]

(a) 20 cm^3 of the water in Fig.11.1 is poured into a beaker. On Fig. 11.2, mark the level of the water left in the cylinder. [1]

(b) A rule, calibrated in cm, is placed alongside the measuring cylinder, as shown in Fig. 11.3. What is the length of the measuring cylinder, from zero up to the 100 cm^3 mark? [1]

(c) The volume of a cylinder is found using the equation

volume = cross-sectional area x length.

Determine the cross-sectional area of the cylinder containing water. [2]

(d) Hence, or otherwise, determine the pressure acting on the base by the water left in the cylinder. [3]

12 The circuit in Fig. 12.1 is connected up.

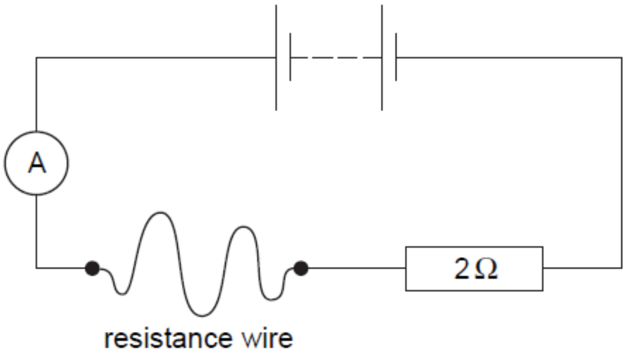


Fig. 12.1

(a) State how does the current in the resistance wire compare with the current in the 2 Ω resistor? [1]

(b) A voltmeter connected across the resistance wire shows the same reading as a voltmeter connected across the 2 Ω resistor. Calculate the combined resistance of the wire and the resistor. [2]

(c) The wire and resistor are disconnected and then reconnected in parallel, as shown in Fig. 12.2.

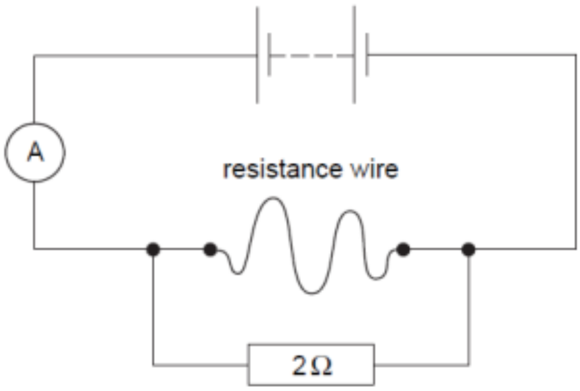


Fig. 12.2

(i) Calculate the new combined resistance of the wire and the resistor. [1]

(ii) Compare the current measured in Fig. 12.2 with the current in Fig. 12.1. [2]

(d) Walls in buildings sometimes develop cracks. The width of a crack can be monitored by measuring the resistance of a thin wire stretched across the crack and firmly fixed on either side of the crack, as illustrated in Fig. 12.3.

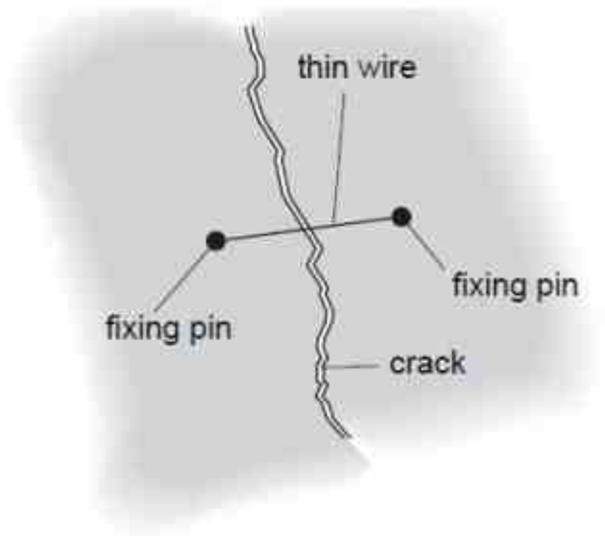


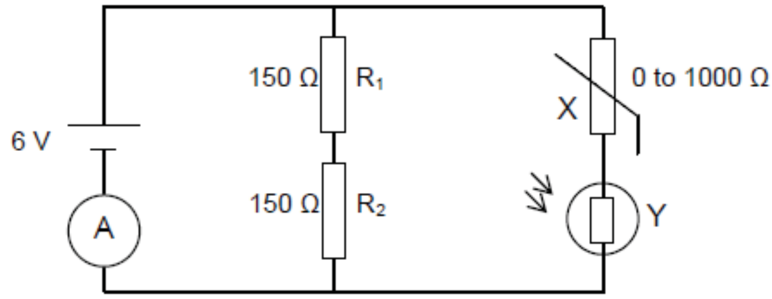
Fig. 12.3

(i) The wall moves and the crack widens slightly. Explain what happens to the resistance of the wire. [2]

(ii) Copy a suitable circuit from Fig. 12.1 or Fig. 12.2 and add a LED light bulb to light up when the crack widens [2]

13 EITHER

The circuit below consists of a 6 V battery source, two resistors of 150 Ω each, LDR and thermistor. The V_{out} across the LDR is connected to a fan which will be switched on when the V_{out} = 6.0 V.



(a) The table shows the range of resistance value for the LDR and thermistor. The resistance of the thermistor varies linearly with temperature.

Instrument	Temperature	Light intensity	Resistance
Thermistor	10 °C		200 Ω
	30 °C		0 Ω
LDR		Bright noon day	50 Ω
		Night	100 Ω

(i) Explain whether the LDR and thermistor are ohmic conductors. [2]

(ii) Calculate the equivalent resistance of the whole circuit when it is during the night and the temperature is 10 °C. [2]

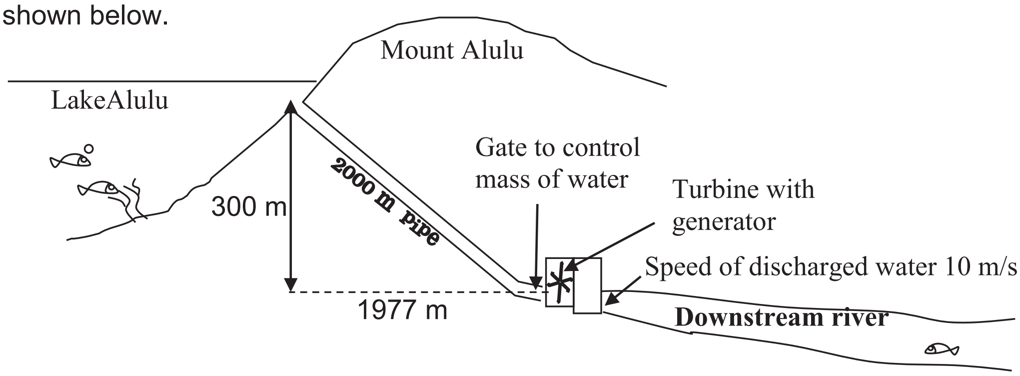
(iii) Find the reading of the ammeter. [1]

(b) **(i)** Show, with clear workings and calculations, whether the fan will be switched on when the temperature is 10 °C during the night. [2]

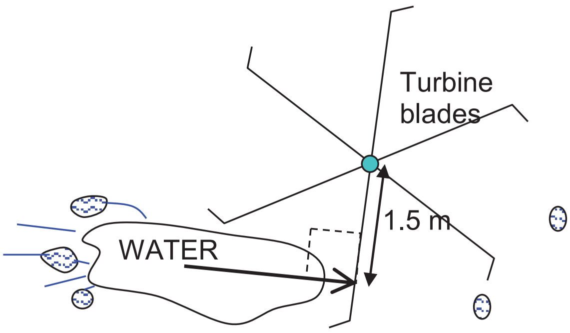
(ii) Show, with clear workings and calculations, a possible pair of conditions for the temperature and light intensity which will cause the fan will to be switched on. [3]

13 OR

The turbine of a hydro-electric power station is built below the level of a lake as shown below.



The turbine is rotated by the running water. It then rotates a group of magnets around a coil in an a.c. generator. The generator is designed such that the magnets would rotate at a constant speed generating an e.m.f of 50,000 V across a coil. The water would be discharged at a constant speed of 10 m/s into the downstream river. The mass of water passing through the blades per second would be controlled by an automatic gate. If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine. The running water would need to produce an anti-clockwise moment by hitting the blades in order to overcome the resisting moment and keep the blades moving at the required constant speed to generate the e.m.f.of 50,000 V. If 10 A of current is drawn from the generator, 17,160 Nm of moment would oppose the rotation and 169.5 kg of water would be needed to hit the blades per second.



The table below shows the data of Mount Alulu hydroelectric power station:

Generated e.m.f. / V	Current drawn from generator / A	Moment required to turn the turbine / Nm	Mass of water hitting the blades per second / kg s^{-1}	Speed of discharged water / ms^{-1}
50,000	10	17,160	169.5	10
50,000	20	34,320	339.0	10

(a) Assuming that water hits one blade at a time at a perpendicular distance of 1.5 m from the the axle as shown below, estimate the force it must exert on the blade when a current of 10 A is drawn from the generator.

(b) Explain why "*If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine*"?

(c) Calculate the amount of energy per second available to the generator when 500 kg of water flows through the turbine per second.

(d) Estimate the current that flows in the generator when 500 kg of water flows through the turbine per second.

(e) Explain briefly why the actual current flowing should be less than your estimated value in **(d)** when 500 kg of water flows through the turbine per second.

END OF PAPER 2

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Geylang Methodist School (Secondary)
Preliminary Examination 2018

PHYSICS **5059/01**

Paper 1 ANSWERS **Sec 4 Express**

Additional materials : OAS

1 hour

Setter : Mr Yip Cheng Hou

24 August 2018

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Do not open this booklet until you are told to do so.

Answer **all** questions. Shade your answers on the OAS provided.

At the end of the examination, submit OAS and the question paper separately.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark.

Any rough work should be done in this booklet.

Acceleration due to gravity, ***g***, is assumed to be 10 m/s^2 on Earth and 6.67 m/s^2 on Moon unless otherwise specified.

This document consists of **16** printed pages

[Turn over

1 Pressure can be determined using the following formula:

$$P = F \div A$$
$$F = m \times a$$

where **P**= pressure (pascal, Pa) **A** = area (m^2) **m** = mass (kg)

F = force (newtons, N) **a** = acceleration ($\frac{m}{s^2}$)

The unit, pascal, is equivalent to

A $\frac{kg}{sm}$ **B** $\frac{s^2}{kgm}$ **C** $\frac{1}{kgs^2m}$ **D** $\frac{kg}{s^2m}$

2 **Fig. 2** shows Jenny's setup of the following experiment.

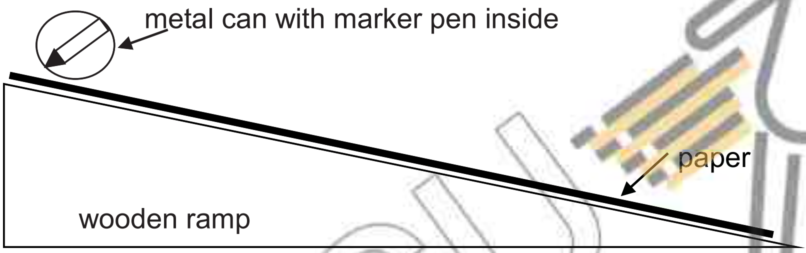
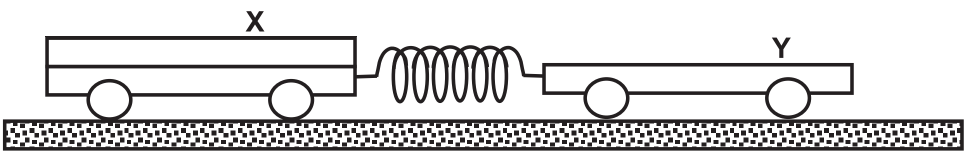


Fig. 2

Jenny released the can and it rolled freely down the ramp without slipping. What did she observe on the paper made by the marker pen?

A The dots get farther apart.
B The dots get closer together.
C The dots gets closer then further apart.
D The dots are equidistant from each other.

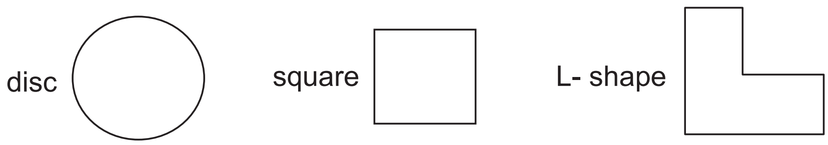
3 Trolley **X** and trolley **Y** are joined together by a stretched spring. Trolley **X** has twice the mass of trolley **Y**. When the trolleys are released, the acceleration of **X** is 1.0 m s^{-2} to the right.



What is the initial acceleration of trolley **Y** to the left?

A 0.5 m s^{-2} **B** 1.0 m s^{-2} **C** 2.0 m s^{-2} **D** 4.0 m s^{-2}

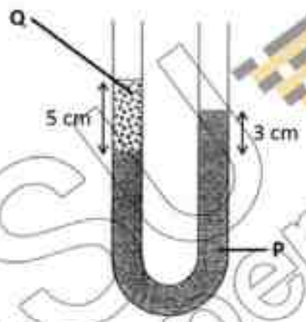
4 Three objects are cut from the same big sheet of metal. They have the same volume but different shapes.



Which of the following statements is **true**?

A They have different mass and position of C.G.
B They have different mass but same position of C.G.
C They have the same mass and position of C.G.
D They have the same mass but different position of C.G.

5 The diagram below shows two immiscible liquids, P & Q, which have been poured into a manometer which is exposed to the atmosphere at the top of both arms.



What is the ratio of the density of Liquid Q to Liquid P?

A 3:5 **B** 5:8 **C** 5:3 **D** 8:3

6 The diagram below shows a uniform metre ruler with a weight of 10 N, under the action of a vertical force of 30.0 N.

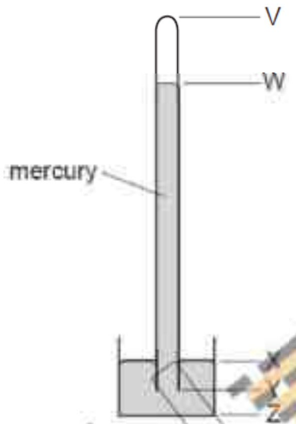
At what mark must a fulcrum be placed to hold the ruler in equilibrium?

A 12.5 cm **B** 16.7 cm **C** 25.0 cm **D** 37.5 cm

7 Which of the following objects has the **least** inertia?

A A robot of weight 300 N travelling on the Moon.
B A robot of weight 300 N travelling on Earth.
C A stationary rock of mass 150 kg on the Moon.
D A stationary rock of mass 150 kg on Earth.

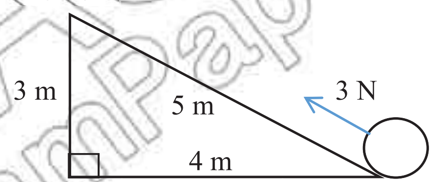
8 The diagram shows a simple mercury barometer.



When the atmospheric pressure increases, which distance increases?

A VW **B** XY **C** YZ **D** WX

9 A ball, which weighs 2 N, is moved up a slope from X to Y, by applying a force of 3 N as shown in the diagram below.



Assuming no energy is lost to the surrounding, what is the gain in kinetic energy, gain in gravitational potential energy and work done on the ball?

	Kinetic Energy	Gravitational Potential Energy	Work Done
A	6 J	6 J	6 J
B	6 J	9 J	6 J
C	15 J	6 J	15 J
D	9 J	6 J	15 J

10 A powerful fan uses a 50 W battery. The fan generates 20 J of heat every second as its motor turns.

What is the efficiency of this fan?

A 28.6 % **B** 40.0 % **C** 60.0 % **D** 250 %

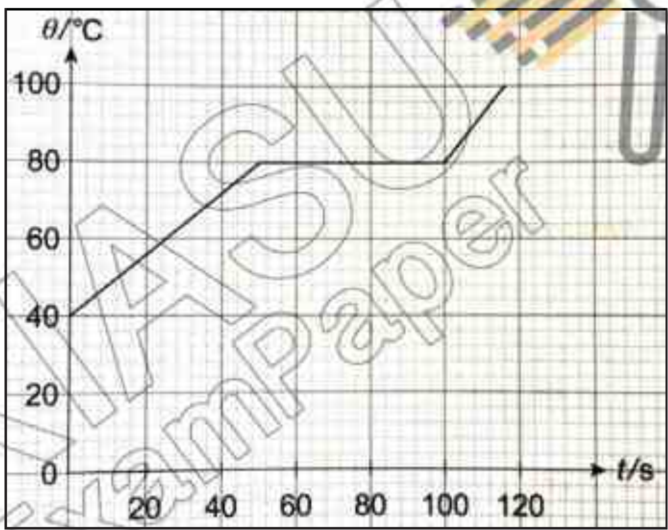
11 Which gives the states of matter in which molecules, at a given temperature, have the smallest spacing between them and move at the lowest speed?

	Smallest spacing between molecules	Molecules have the lowest speed
A	Solid	Solid
B	Liquid	Solid
C	Solid	Liquid
D	Liquid	Liquid

12 Which of these examples has the wrong type of heat transfer associated with it?

	Example	Type of heat transfer
A	Heat from flame to flying pan	Conduction
B	Sunlight warming the interior of a car	Convection
C	Cooling a cup of coffee with a steel spoon	Conduction
D	Heat from burning logs to person beside fire place	Convection

The graph below shows the changes in temperature of a 400 g solid when it is heated by a heater with a rating of 80 W. Use it to answer questions 13 to 15.



13 Which of the following statements show a difference between heat and temperature.

A When 80 W of heat is supplied, the temperature reached 80 °C.
B Heat has a SI unit in Kelvin while temperature SI unit is in °C
C Heat increases when temperature increases.
D Heat remains constant regardless whether temperature changes.

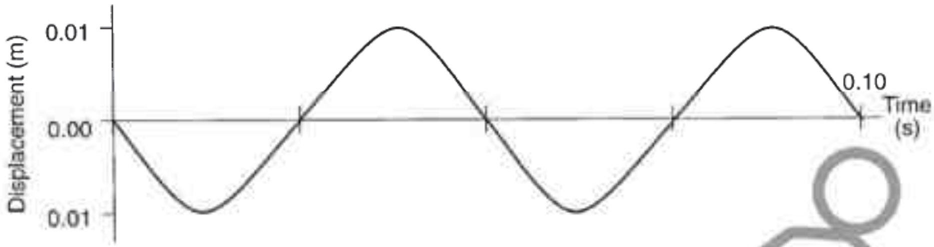
14 Assuming there is negligible energy loss to the surroundings, what is the specific heat capacity of the liquid?

A 10 J/kg°C B 160 J/kg°C C 240 J/kg°C D 1160 J/kg°C

15 Assuming there is negligible energy loss to the surroundings, what is the specific latent heat of fusion of the solid?

A 10 J/kg **B** 167 J/kg **C** 200 J/kg **D** 10000 J/kg

16 The graph shows the vertical displacement of an object floating on water as a wave passes through the water.



What is the frequency of the wave?

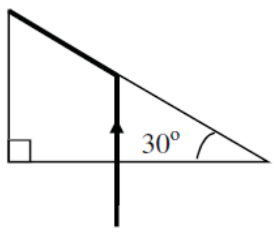
A 10 Hz **B** 20 Hz **C** 50 Hz **D** 100 Hz

17 A plane mirror 1.5 m in length is hung on a vertical wall with its bottom 1.0 m above ground. A boy with his eyes 1.2 m above ground looks into the mirror to see the image of himself.

What length of himself (below his eyes) can be seen in the mirror?

A 0.4 m **B** 0.8 m **C** 1.0 m **D** 2.0 m

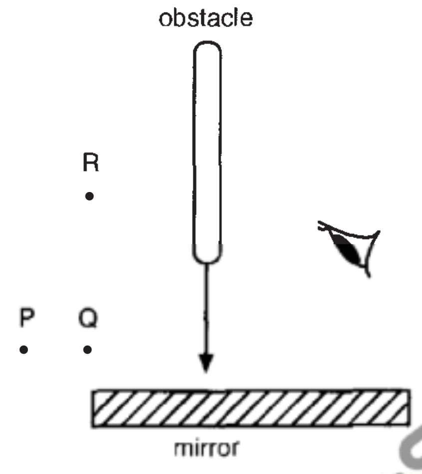
18 A ray of light enters a prism made of material **X** and travels along the path as shown in the figure below.



What is the refractive index of the material **X**?

A 0.50 **B** 1.20 **C** 1.50 **D** 2.00

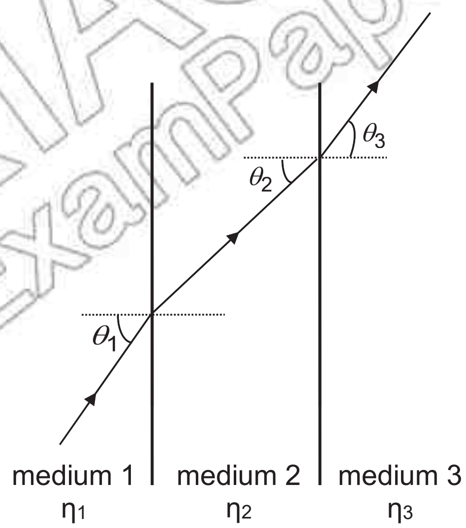
19 Three objects, **P**, **Q** and **R**, are viewed through a plane mirror as shown. An obstacle moves towards the mirror as indicated by the arrow.



Which image will disappear first and which image will disappear last?

	disappears first	disappears last
A	**P**	**Q**
B	**P**	**R**
C	**Q**	**R**
D	**R**	**Q**

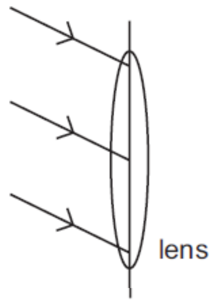
20 A light ray passes through three media of refractive indices η_1, η_2 and η_3 respectively.



Given that $\theta_1 > \theta_3 > \theta_2$, which of the following is correct?

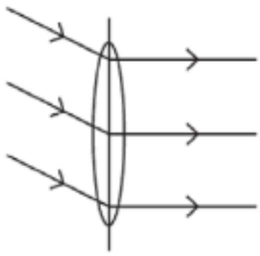
A $\eta_1 > \eta_2 > \eta_3$ **B** $\eta_2 > \eta_1 > \eta_3$ **C** $\eta_1 > \eta_3 > \eta_2$ **D** $\eta_2 > \eta_3 > \eta_1$

21 Three rays of light fall on a converging lens as shown.

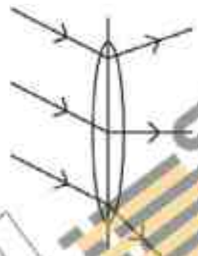


Which diagram shows the path of the rays after passing through the lens?

A

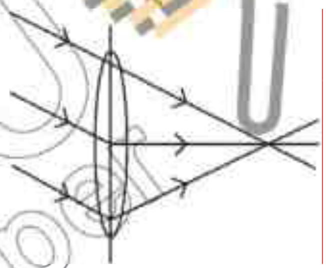


B

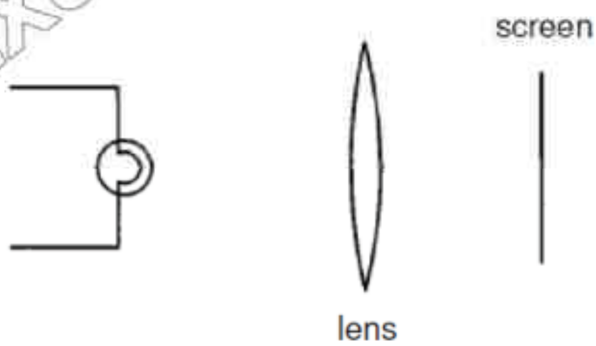


C

D



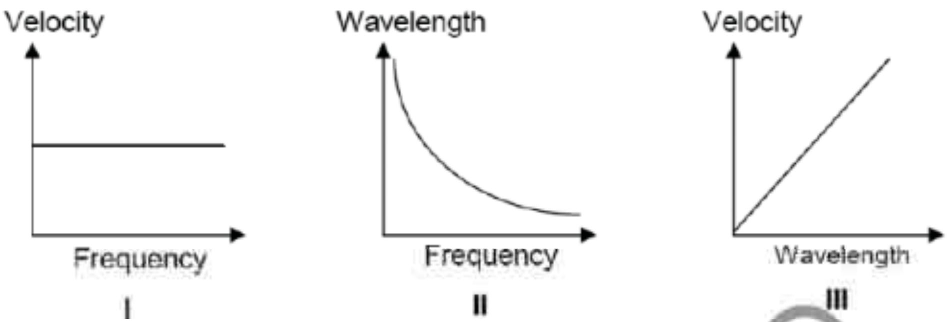
22 A student arranges an illuminated object, a lens and a screen such that the size of the image is twice that of the object. Keeping the distance between the screen and the illuminated object fixed, he exchanges the position of the screen and the illuminated object.



What would be observed on the screen?

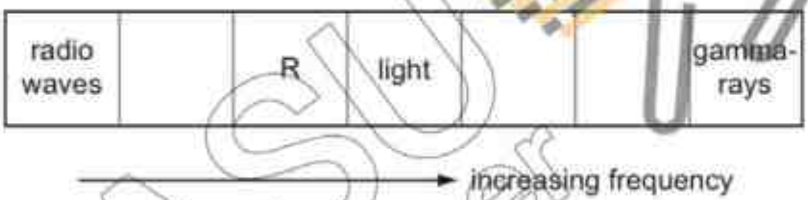
A A blurred, magnified image.
B A blurred, diminished image.
C A sharp image twice the size of the object.
D A sharp image half the size of the object.

23 Which of the following graphs about electromagnetic waves travelling in vacuum is/are correct?



A I only **B** I and II only **C** II and III only **D** I, II and III

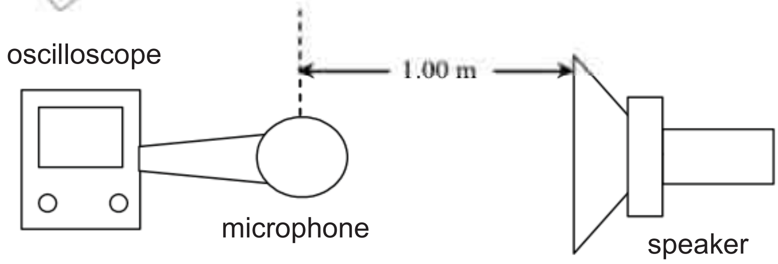
24 The diagram shows the main sections of the electromagnetic spectrum in order of increasing frequency. Some of the sections are labelled. The section R has a frequency just below that of light.



Which application uses the section R?

A Sterilisation
B Satellite television
C Bread toaster
D Laser pointer

25 The set-up shown in the diagram below consists of an oscilloscope and a speaker that emits a sound wave with frequency 1000 Hz. A microphone placed 1.00 m from the speaker detects the sound emitted by the speaker. A waveform is observed on the oscilloscope representing the sound emitted.



The speaker is then moved to a distance 0.5 m towards the microphone and a new waveform is observed on the oscilloscope. Compared to the earlier waveform, this new waveform has a greater ____________.

A speed **B** amplitude **C** frequency **D** wavelength

26 **Fig. 26.1** is a **full-scale** diagram that shows air particles at their equilibrium positions (represented by dotted lines). When a sound wave passes, particles are displaced into new positions shown in **Fig. 26.2**. **Q** represents a particle.

Fig. 26.1

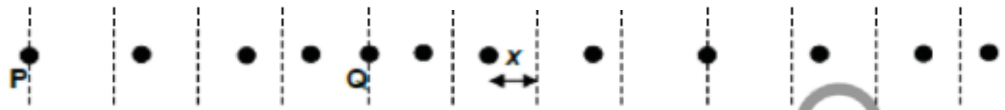


Fig. 26.2

Which of the following statements is false?

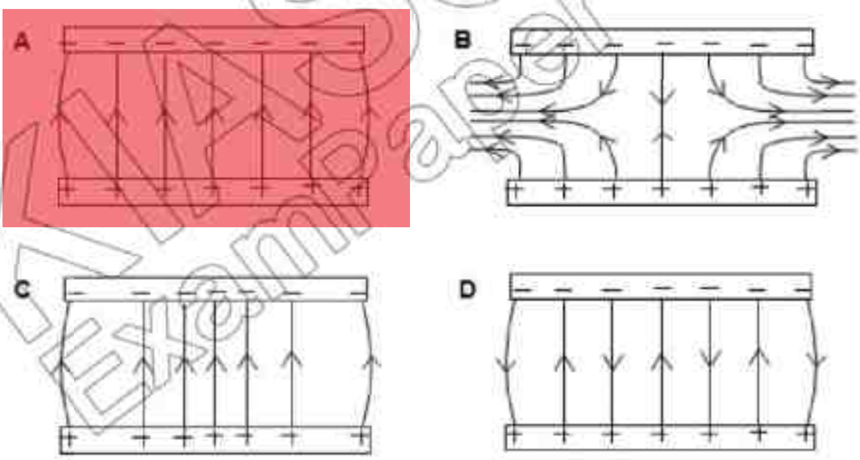
A Point **Q** is the centre of a rarefaction.

B Particles next to **Q** are moving in opposite direction.

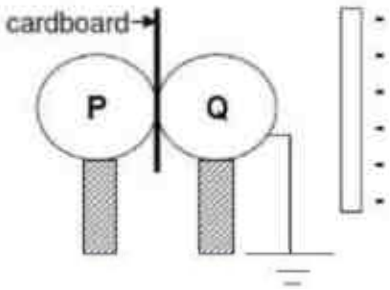
C The amplitude of the wave is 1.0 cm.

D The wavelength of the wave is 10.3cm

27 Which of the following diagrams correctly shows the uniform electric field between two charged parallel metal plates?



28 Two uncharged metal spheres **P** and **Q** are placed together with a thick cardboard inserted between them. Both spheres are supported by insulating stands and **Q** is earthed with a wire.



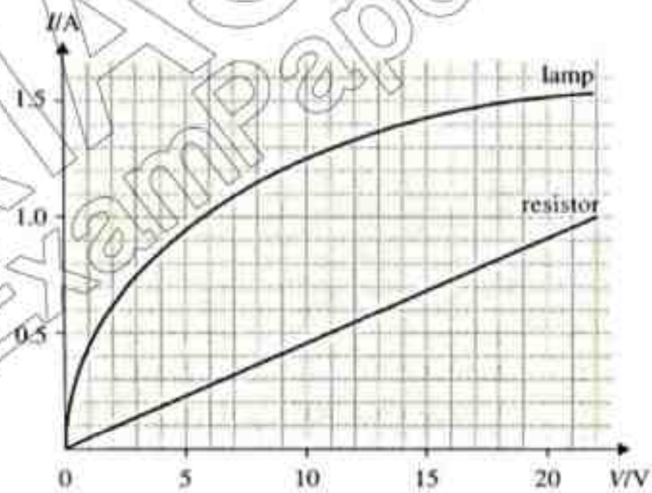
A negatively-charged rod is brought near the spheres as shown.

What would be the distribution of charges on spheres **P** and **Q** when the wire is removed followed by the charged rod?

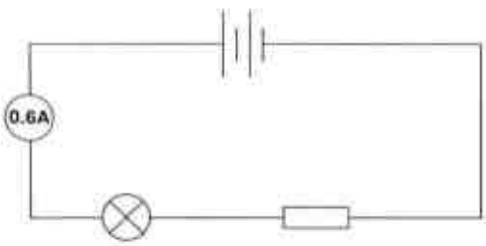
	P	Q
A	negative	positive
B	negative	neutral
C	neutral	positive
D	neutral	neutral

Refer to the following information for Questions 29 and 30.

The graph below shows how the current in a lamp and a resistor varies with the potential difference applied.



The lamp and the resistor are connected in series as shown below, and the ammeter reading is 0.6 A.



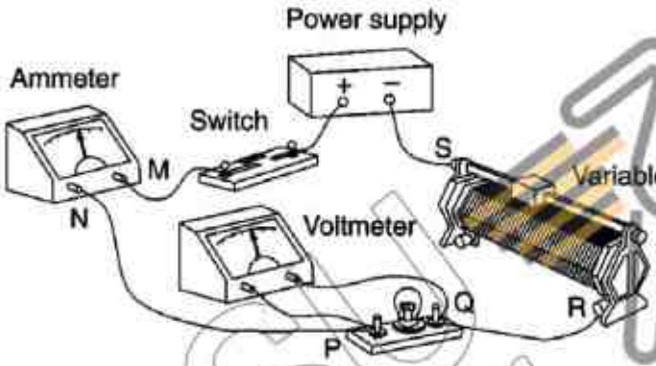
29 Determine the e.m.f. of the circuit.

A 2.0 V **B** 11.0 V **C** 13.0 V **D** 15.0 V

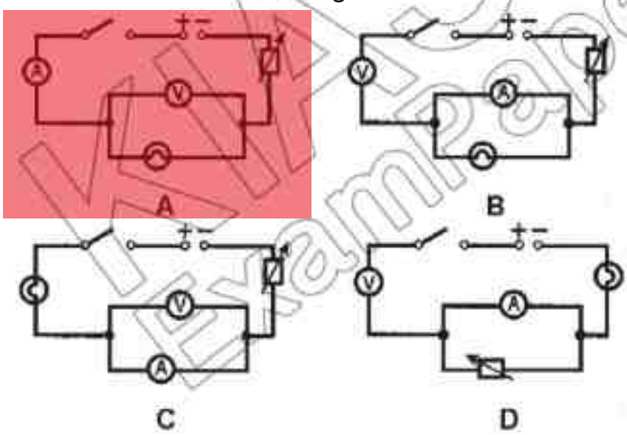
30 Determine the resistance of the resistor.

A 0.046 Ω **B** 0.091 Ω **C** 11.0 Ω **D** 22.0 Ω

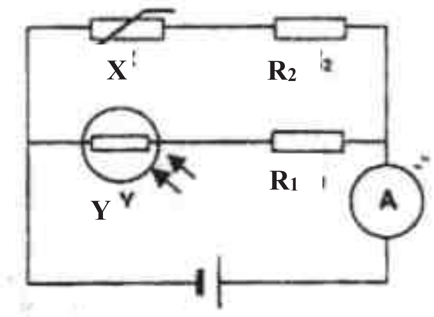
31 The diagram shows an experimental set-up of an electric circuit to determine the resistance of a bulb.



Which one of the following shows the correct circuit diagram?



32 In the circuit shown, **R_1** and **R_2** are identical resistors.



Which of the following changes to the electrical components **X** and **Y** will decrease the reading of the ammeter by the greatest amount?

A Immerse **X** in a beaker of ice water and decrease the light intensity on **Y**.
B Immerse **X** in a beaker of ice water and increase the light intensity on **Y**.
C Immerse **X** in a beaker of hot water and decrease the light intensity on **Y**.
D Immerse **X** in a beaker of hot water and increase the light intensity on **Y**.

33 In a 3-pin plug of a vacuum cleaner, the fuse is missing.
Which of the following statement is correct?

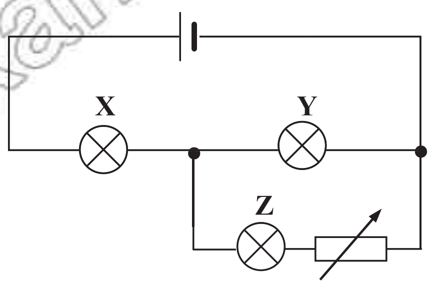
A The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be live.

B The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be safe to handle because the current will flow to earth.

C The vacuum cleaner, once turned on, will shut down at once.

D The vacuum cleaner cannot be turned on.

34 Three identical lamps X, Y and Z are connected in a circuit as shown below.



What will happen to the brightness of the lamps if the resistance of the rheostat is increased?

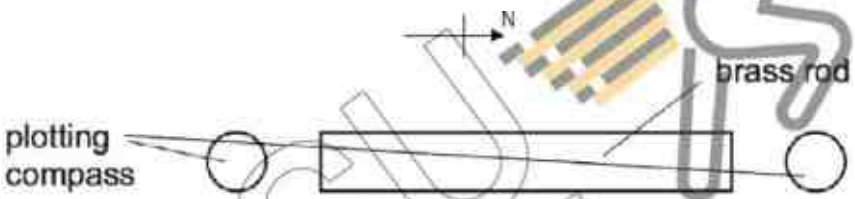
	X	Y	Z
A	Brighter	dimmer	dimmer
B	brighter	brighter	dimmer
C	dimmer	brighter	dimmer
D	dimmer	brighter	brighter

35 A student carries out four tests with a magnet.

Which result shown is **not** correct?

	arrangement		Result
A	S magnet N	S magnet N	Attracts
B	S magnet N	iron bar	attracts
C	N magnet S	iron bar	repel
D	N magnet S	copper bar	no effect

36 A brass rod is arranged in a north-south direction and plotting compasses are placed at each of it ends.



Which diagram shows the positions of the needles of the plotting compasses?

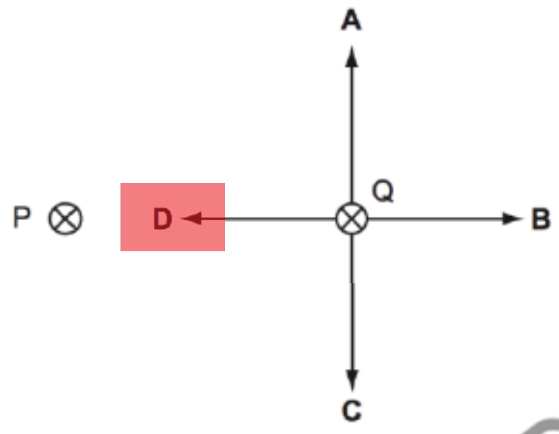
A 

B 

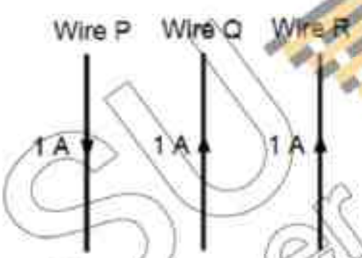
C 

D 

37 P and Q represents two parallel, straight, wires carrying currents. P and Q exert force on each other. Which arrow shows the force on Q?



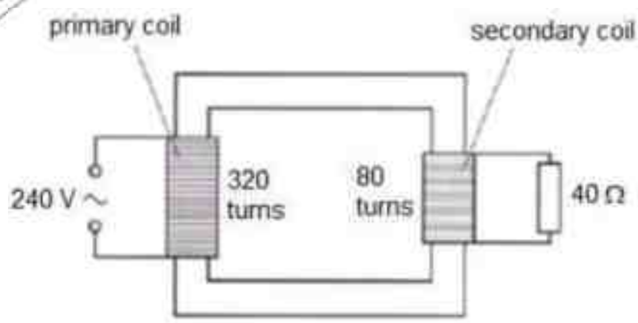
38 Three wires **P**, **Q** and **R** are each carrying a current of 1 A in the direction as shown in the diagram below.



What are the directions of forces acting on the three wires?

	Wire P	Wire Q	Wire R
A	left	left	left
B	right	left	right
C	left	right	left
D	right	right	right

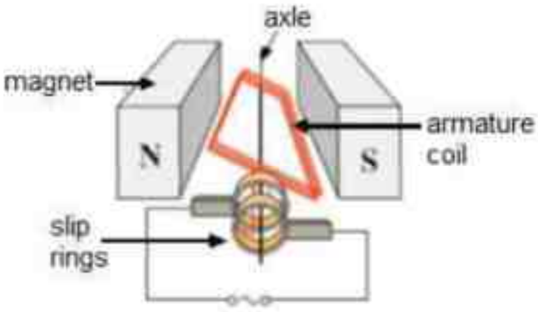
39 The figure below shows an ideal transformer with the secondary coil connected to a 40 Ω load.



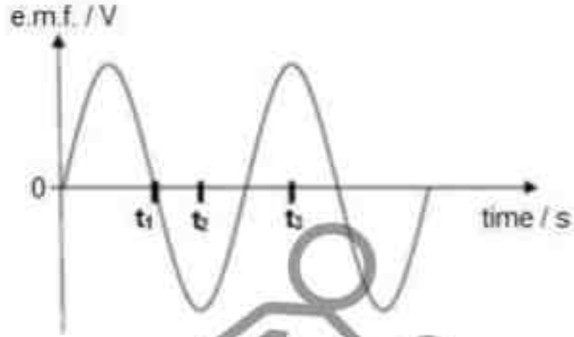
What is the current in the primary coil?

A 0.38 A **B** 1.5 A **C** 2.7 A **D** 6.0 A

40 The diagrams show a simple a.c. generator and the graph illustrating the waveform of the e.m.f. output of the a.c. generator.



simple a.c generator



waveform of the e.m.f. output

Which of the following diagrams correctly shows the plane of the armature coil of the generator, as viewed along the axle from the position of the slip rings, at time intervals denoted by **t_1**, **t_2** and **t_3** on the graph?

	t_1	t_2	t_3
A	│	\	—
B	│	—	—
C	—	│	│
D	—	\	│

END OF PAPER 1

Geylang Methodist School (Secondary)
Preliminary Examination 2018

Candidate Name	ANSWERS		
Class		Index Number	

PHYSICS

5059/02

Paper 2 Physics

Sec 4 Express

Additional materials : Writing Papers

1 hour 45 minutes

Setter : Mr Yip Cheng Hou

24 August 2018

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
Write your answers to **Section A** in the spaces provided in the Question Paper.
Write your answers to **Section B** in writing papers provided.
Question 13 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units.
You are advised to show all your working in a clear, orderly manner.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Acceleration due to gravity, ***g***, is assumed to be 10 m/s^2 unless otherwise specified.

For Examiner's Use	
Section A	/50
Section B	/30
Total	/80

This document consists of **16** printed pages.

[Turn over

Section A

Answer **all** the questions in this section in the spaces provided.

1 Fig. 1.1 shows a virtual image **I** formed by a converging lens from an object of height 1.0 cm.

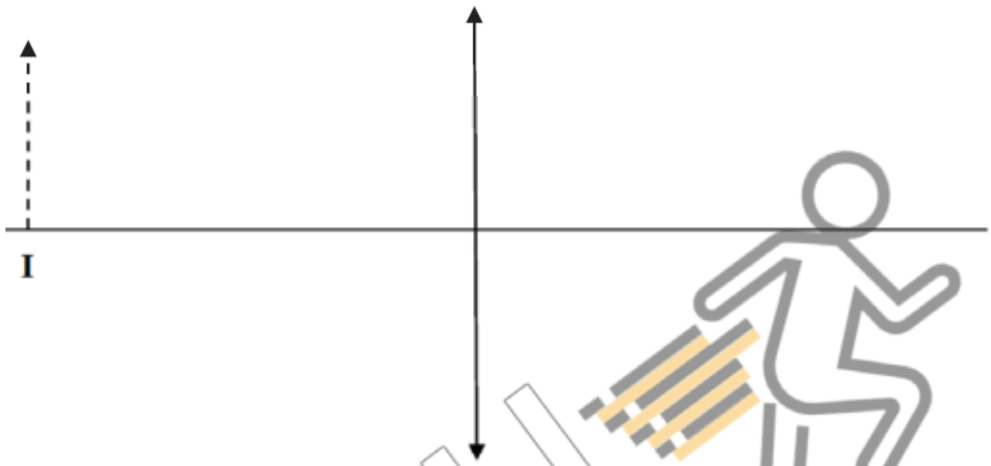
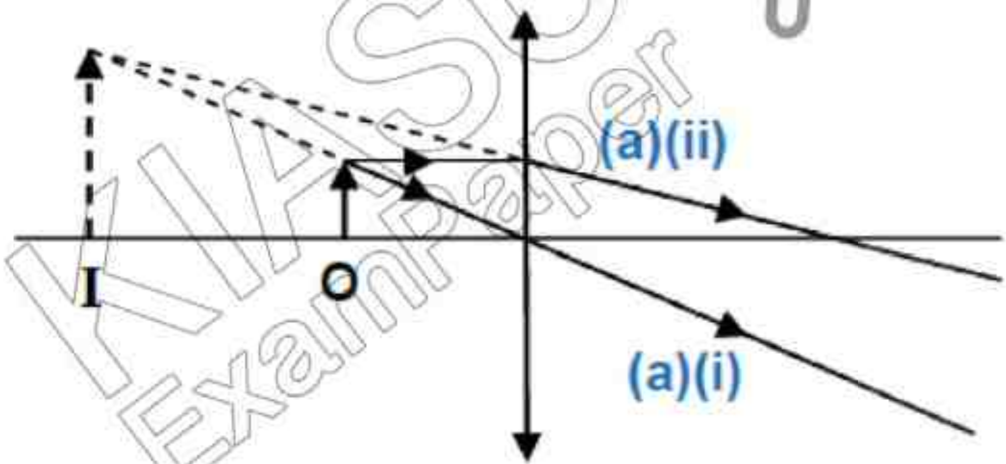


Fig. 1.1



(a) On Fig. 1.1 above, draw rays to determine

(i) the position of the object, Label the object **O**.

(ii) the focal length of the lens.

focal length = 4.1 cm (± 0.3 cm) [2]

(b) Fig. 1.2 shows a light ray travelling in the converging lens of refractive index 1.5. The diagram is not drawn to scale.

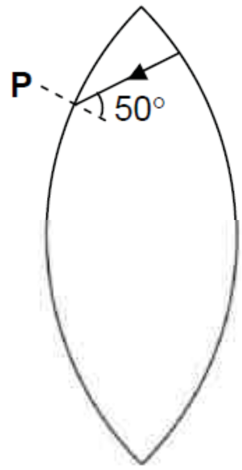


Fig. 1.2

Calculate the critical angle and explain the behaviour of the light after it is incident to the surface P.

....

$n = 1 / \sin c$
$1.5 = 1 / \sin c$
$c = 41.8°$
angle of incidence of 50° which is greater than critical angle of 41.8° so the ray will go through total internal reflection

.... [2]

(c) State a use of a component of the electromagnetic spectrum with the smallest wavelength and describe the effect of absorbing this electromagnetic wave.

....

cancer treatment by destroying cancer cells OR sterilising of surgical instruments destroys or modifies / mutates living tissues and cells

.... [2]

2 The speed of an ultrasound in air is 340 m/s.

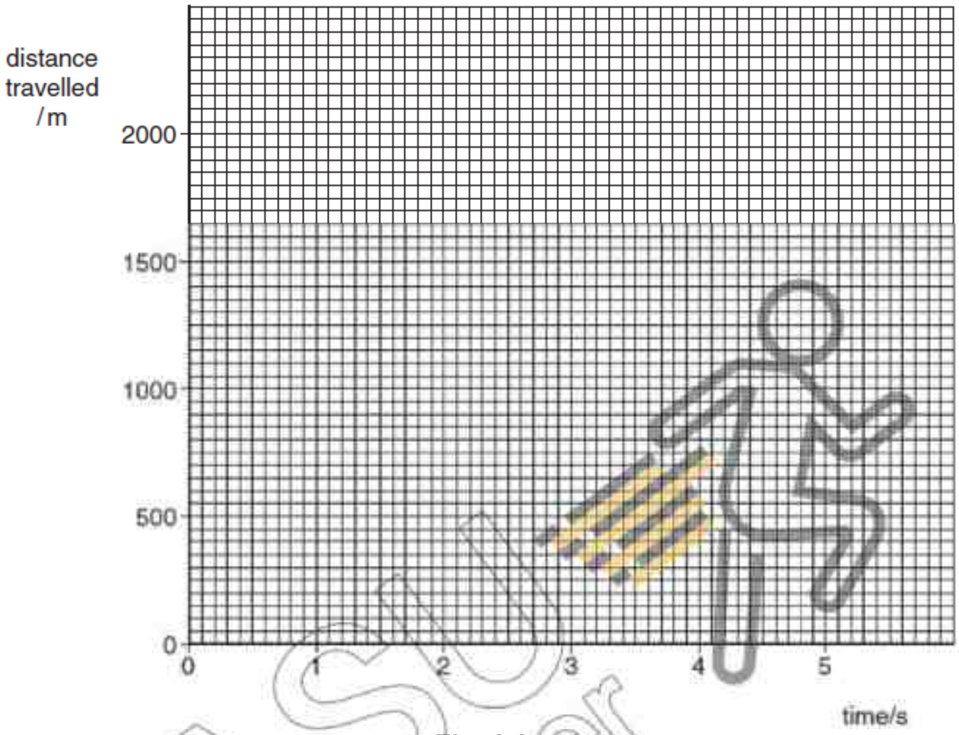
(a) Complete Fig. 2.1 to show how far the ultrasound wave has travelled 2, 3, 4 and 5 seconds after the ultrasound was produced.

time elapsed/s	0	1	2	3	4	5
distance travelled/m	0	340				

[1]

Fig. 2.1

(b) On Fig. 2.2, draw the graph of distance travelled against time for the ultrasound wave.



[3]

Fig. 2.2

(680 1020 1360 1700) 5 points plotted ± ½ small square, ignore 0,0 (e.c.f.)
reasonable best-fit line through points drawn with rule

(c) State and describe which type of wave is ultrasound.

Longitudinal wave that travels parallel to the vibration of wave particles. [1]

(d) Explain what is wavelength and state the maximum wavelength of the ultrasound.

Wavelength is the distance between 2 successive points on the wave that are in phase. Max wavelength = Speed ÷ Min frequency = 0.017 m [3]

3 In Experiment one, two blocks of mass 5 kg and 10 kg were attached and pulled across a rough ground in the direction shown in **Fig. 2.1**.

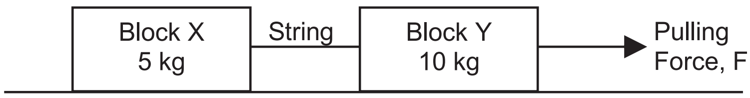


Fig. 2.1

The experiment is then repeated on the same surface but with a different pulling force. The changes in velocities of the blocks for both experiments were measured and tabulated in **Fig. 2.2**.

	Velocity / cms^{-1}	
Time/s	**Experiment One**	**Experiment Two**
1	4	5
2	8	5
3	12	5
4	16	5
5	20	5

Fig. 2.2

(a) Using the values in Experiment One as shown in **Fig. 2.2**, calculate the:

(i) acceleration of the blocks.

acceleration = (v - u) / t
= (20 - 4) / 4
= <u>4 cm/s^2</u> (2)

acceleration = …………………… [2]

(ii) tension in the string given that the friction between the ground and block X is 3.0 N.

T – Friction = Resultant Force
T – 3.0 N = (5 kg)(0.04 m/s^2) (1)
T = <u>3.2 N</u> (1)

tension = …………………… [2]

(iii) magnitude of the pulling force, F.

F – Friction – Tension = Resultant Force
F – 3N – 3.2N = (10 kg)(0.04 m/s^2) (1)
F = <u>6.6 N</u> (1)

pulling force, F = …………………… [2]

(b) In terms of forces, explain why the velocity of the blocks in Experiment One changes over time but remains unchanged in Experiment Two.

In experiment 1, there is a resultant force whereas in experiment 2, there is zero resultant force. (1) Hence in experiment 2, the pulling force is equal to the frictional force. Hence, acceleration is zero (1) indicating that the blocks are moving at constant velocity. [2]

4 Fig. 4.1 shows a rectangular block of wood on a flat, rough horizontal board.

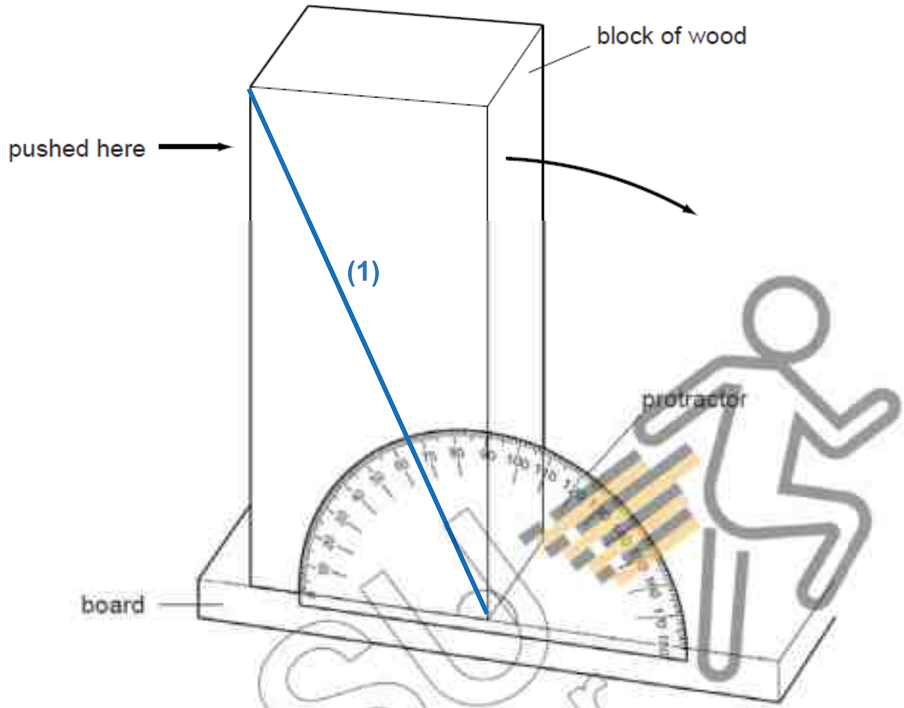


Fig. 4.1

The block is pushed at the top, as shown in Fig. 4.1, and it tilts to the right.

(a) On the front face of the block, draw the line that will be vertical at the instant before the block topples over. [1]

(b) Use the protractor shown on Fig. 4.1 to measure the angle through which the block tilts before it topples over.

24 ~ 26 °

angle = ... [1]

(c) The block is put back on the board, as in Fig. 4.1. This time, instead of the block being pushed, the left-hand edge of the board is raised.

State the angle that the board makes with the horizontal at the instant the block topples over.

same answer as (b)

angle = ... [1]

(d) Explain, in terms of C.G. and stability, how your answer to **(c)** might differ if the procedure is repeated after the height of the block is reduced.

The angle of tilt to topple the block will increase (1) because the C.G of

the block has been lowered so it is more stable (1). [2]

5 (a) The principle of conservation of energy states that energy can neither be created nor destroyed. What, then, *does* happen to the energy supplied to a device such as a motor or a television?

It has been changed / converted / transferred into other forms of energy. [1]

(b) The television in Fig. 5.1 is switched on to watch a programme. During this time, 720 kJ of electrical energy is supplied.

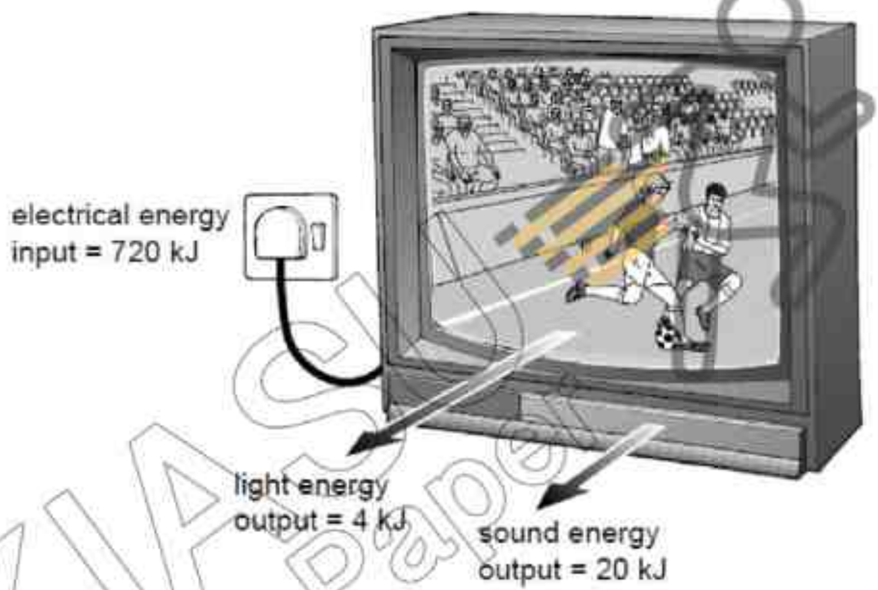


Fig. 5.1

(i) From the information on Fig. 5.1, find the total energy provided for the viewer to see and hear the television during this programme.

energy = **24 kJ** [1]

(ii) Suggest what happens to the rest of the energy supplied.

Lost to the surrounding / converted into energy that are not useful. [1]

(iii) Calculate how much energy is involved in **(b)(ii)**.

energy = **720 - 24 = 696 kJ** [1]

(iv) Calculate and comment on the efficiency of the television.

Useful o/p ÷ total i/p x 100% = 24 / 720 x 100% = 3.33% (1)

Very low in efficiency / very high loss or waste in energy (1)

[2]

6 Fig. 6.1 shows an evaporative cooler, which is a device that cools air through the continuous evaporation of water. Air is cooled by being blown past a cooling pad containing water. The cooling pad is wet by a pump which pumps water up to the top of the pad, from where it trickles down.

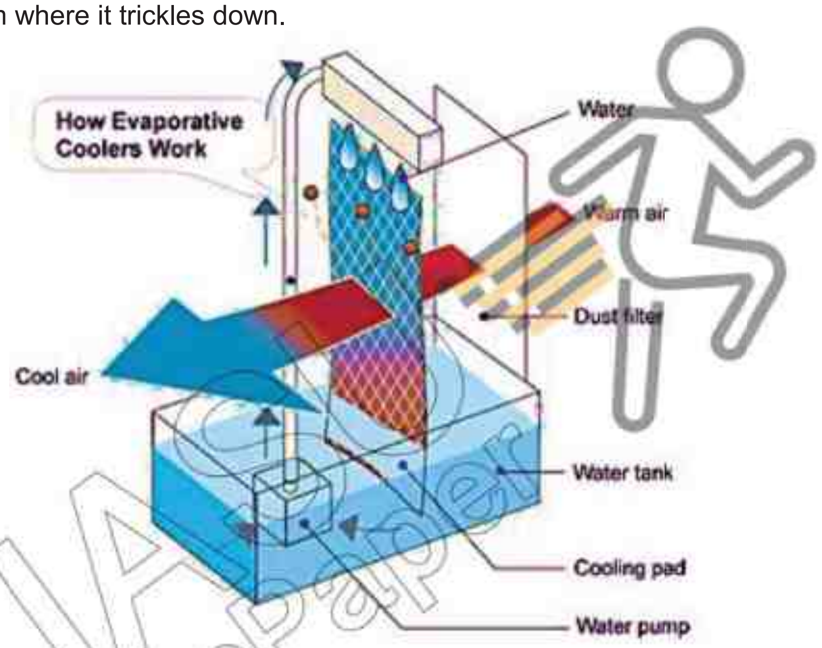


Fig. 6.1

(a) In terms of kinetic model of matter, explain how continuous evaporation of the water causes the air flowing past the cooling pad to be cooled.

The water molecules on the surface of cooling pad absorb thermal energy from the warm air,(1) increasing their internal energy till their overcome strong intermolecular forces enabling them to vaporize, leaving behind less energetic cooler water molecules. (1) The air then exits the cooling pad as cool air. As the new wave of warm air flows past the cooling pads, the same process repeats relying on the cooling process of evaporation.

[2]

(b) Explain whether such evaporative cooling system is more effective in dry or humid atmospheres.

It is more effective in dry atmospheres, because places with high humidity reduces the rate of evaporation.

.... [1]

[That is why windows and entryways must be closed while running a ventilation system]

....

(c) Suggest one modification that can be made to the design of the evaporative cooler such that the rate of cooling increases.

Increasing surface area of the cooling pad increases the rate

....

of thermal loss from the air to the liquid.

.... [1]

7 Two metal saucepans contain the same mass of hot water at the same initial temperature. Pan A is white and pan B is black, but otherwise the two saucepans are identical. Both saucepans are uncovered and cool under the same conditions. The cooling curves for the two saucepans are shown in Fig. 7.1.

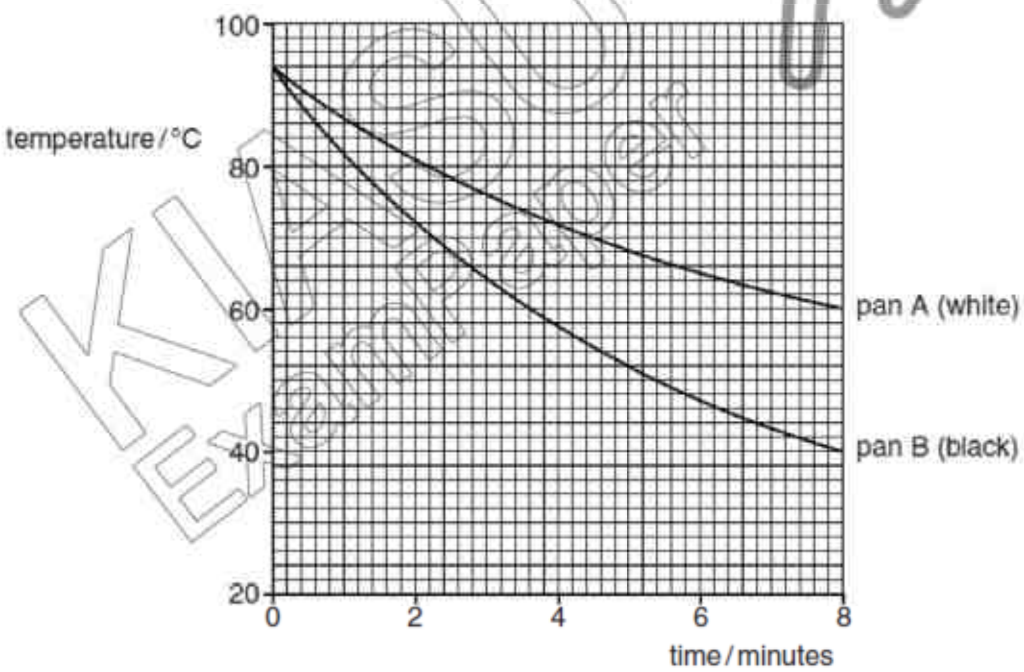


Fig. 7.1

(a) Explain why pan B cools faster than pan A.

Pan B is black which is a better emitter of heat compared to white (1)

[1]

(b) Describe and explain how Fig. 7.1 is different when the pans are covered and the experiment is repeated.

The rate of cooling will be lower OR temperature will take a longer time to drop to a same temperature (1). This is because the cover will reduce heat loss by convection (1).

[2]

(c) Explain what is meant by the specific heat capacity of water is 4200 J/(kg °C).

4200 J of heat is required to increase / decrease the temperature of 1kg of water by 1 °C.

[1]

(d) The specific heat capacity of water is very high. Suggest one disadvantage of this when water is used for cooking.

It will require a high amount of heat (or require a longer time of heating) in order to raise the temperature of water for cooking.

[1]

(e) The water in pan A cools for 8 minutes, as shown in Fig. 7.1. During this time, the water loses an average of 9000 J of thermal energy per minute.

(i) Calculate the mass of water in pan A.

$Q = mc\Delta\theta$

9000 J x 8 min = m x 4200 J/kg°C x (94°C – 60°C)

m = <u>0.504 kg</u> (3 s.f.)

mass = ……………………

(ii) The mass of water in pan B is the same as that in pan A. Calculate the thermal energy lost from the water in pan B during the 8 minutes.

$Q = mc\Delta\theta$

Q = 0.504 kg x 4200 J/kg°C x (94°C – 40°C)

Q = <u>114000 J</u> (3 s.f.)

loss of thermal energy = …………………… [3]

8 A teacher demonstrates magnetic screening. When a magnet is placed near a small cardboard box, paper clips on the other side of the box are picked up, as shown in Fig. 8.1. When a small piece of soft iron is placed inside the box as shown in Fig. 8.2, the paper clips fall off. Magnetic field lines in each diagram are shown as thin lines.

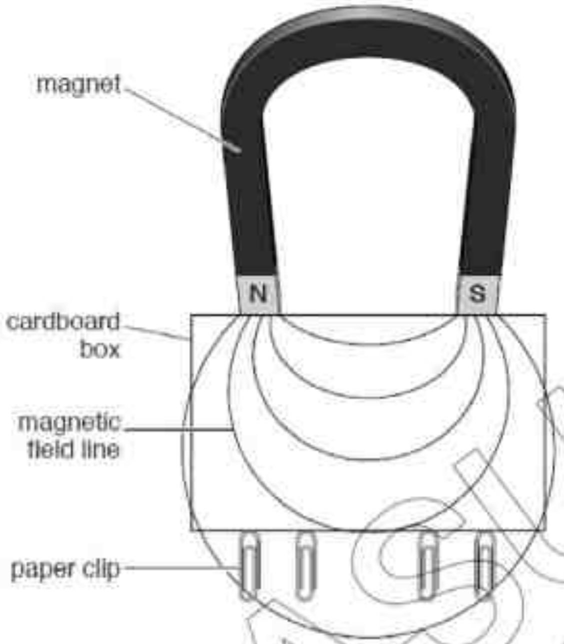


Fig. 8.1

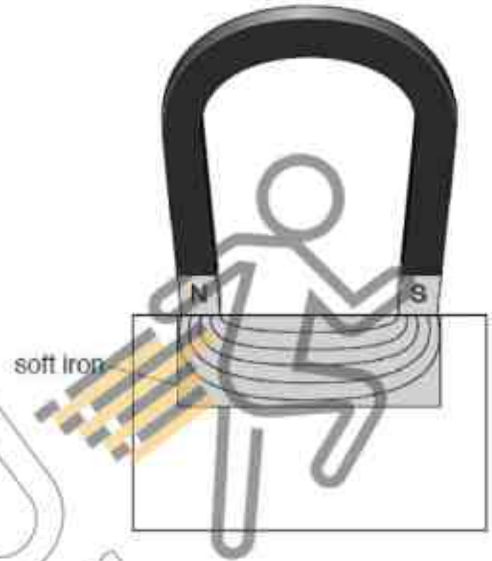


Fig. 8.2

(a) On Fig. 8.1, mark an arrow on each of the magnetic field lines to show its direction. **North to South** [1]

(b) Explain why placing the soft iron in the box causes the paper clips to fall off.

Soft iron is highly permeable to magnetic field (1).

Magnetic field from the magnet does not reach the paper clips so they

demagnetized and fell off (1). [2]

9 The apparatus in Fig. 9.1 is called a force-on-conductor balance. When there is an electric current I as shown in XY, there is a force on XY. This force is measured by putting weights in the pan until XY is brought back to its original position.

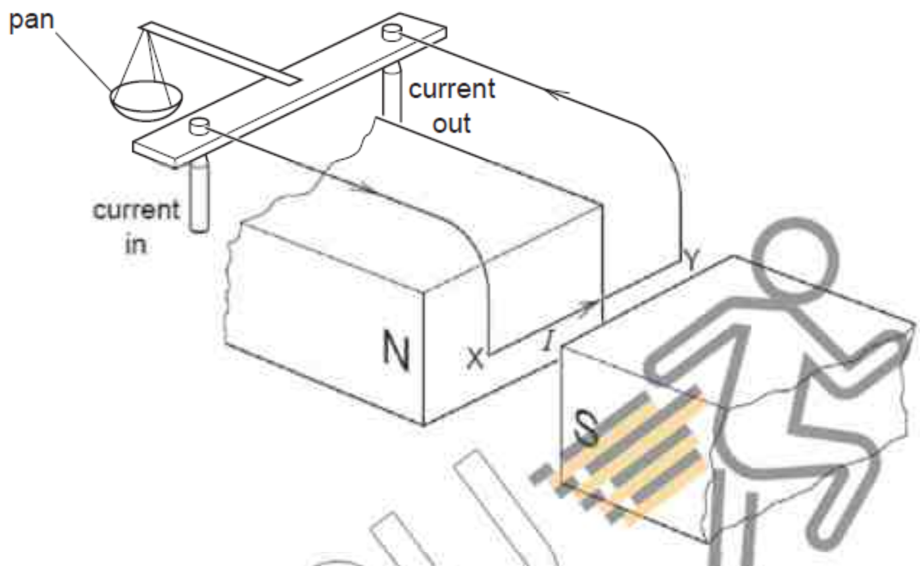


Fig. 9.1

(a) State what would happen if the current direction were from Y to X.
XY would move up / anticlockwise / motion reversed / pan moves down [1]
....

(b) A student uses the balance to determine the force F on XY for different currents I. He concluded that F is directly proportional to I based on his results given below.

I / A	0	0.5	1.0	1.5	2.0
F / N	0	0.012	0.023	0.035	0.047

Show clear workings to estimate the force on XY when the current is 1.6 A.

Assuming (2.0,0.047) is on the best-fit line
m = 0.047 ÷ 2.0 = 0.0235
Using y = mx
y = 0.0235 x 1.6
= 0.036 ~ 0.038 N

force = ... [2]

END OF SECTION A

Section B

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 13**.

11 A measuring cylinder contains water which has a density of 1000 kg/m^3.

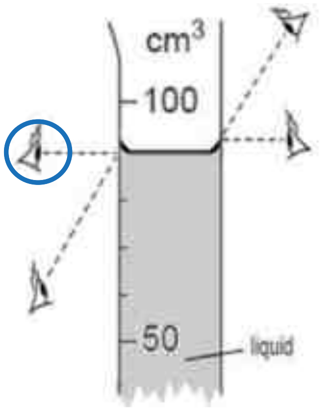


Fig. 11.1

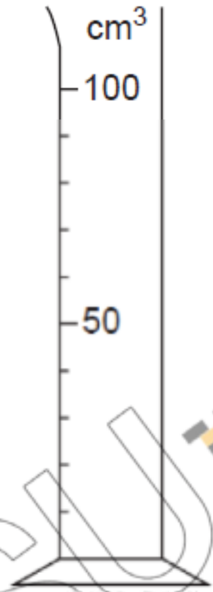


Fig. 11.2

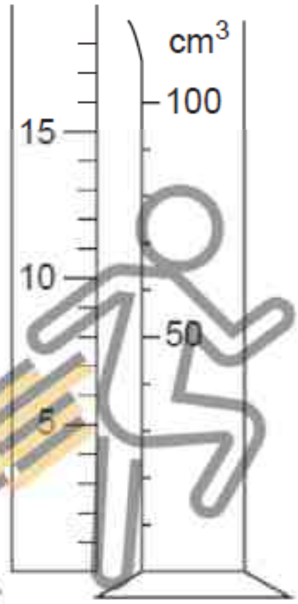


Fig. 11.3

(a) Fig. 11.1 indicates four ways the observer's eye could look when taking the reading from the measuring cylinder. Put a circle around the eye position that gives the correct reading and state the volume of water in the cylinder.

90 cm^3

volume = ______________ [1]

(b) In order to fill the measuring cylinder up to the 100 cm^3 mark, 80 drops of the liquid are added to the liquid already in the measuring cylinder. Calculate the average volume of one drop.

10 cm^3 / 80 = 0.125 cm^3

volume = ______________ [2]

(a) 20 cm^3 of the water in Fig.11.1 is poured into a beaker. On Fig. 11.2, mark the level of the water left in the cylinder. [1]

level shown at 70 (ignore meniscus) ± 1mm

(b) A rule, calibrated in cm, is placed alongside the measuring cylinder, as shown in Fig. 11.3. What is the length of the measuring cylinder, from zero up to the 100 cm^3 mark?

16 cm

length = ______________ [1]

(c) The volume of a cylinder is found using the equation

volume = cross-sectional area x length.

Determine the cross-sectional area of the cylinder containing water.

$100\ cm^3$ = area x 16 cm (1)
area = $100\ cm^3 \div 16$ cm [2]
= $6.25\ cm^2$ (1)

cross-sectional area = ______________

(d) Hence, or otherwise, determine the pressure acting on the base by the water left in the cylinder.

P = Force / Area
= $1000\ kg/m^3$ x $70\ cm^3$ x 10 N/kg ÷ $6.25\ cm^2$ (1) [3]
= ($1\ g/cm^3$ x $70\ cm^3$)÷1000 x 10 N/kg ÷ $0.000625\ m^2$ (1)
= 1120 N/kg or 1120 Pa (1)

pressure = ______________

12 The circuit in Fig. 12.1 is connected up.

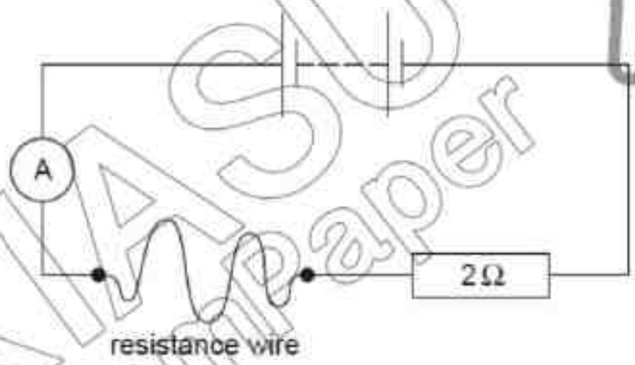


Fig. 12.1

(a) State how does the current in the resistance wire compare with the current in the 2 Ω resistor?

They are the same in amount / magnitude.

....

.... [1]

(b) A voltmeter connected across the resistance wire shows the same reading as a voltmeter connected across the 2 Ω resistor. Calculate the combined resistance of the wire and the resistor.

Same voltmeter reading implies resistance wire is also 2 Ω (1)
∴ combined resistance in series = 2 + 2 = 4 Ω (1)

combined resistance = …………………… [2]

(c) The wire and resistor are disconnected and then reconnected in parallel, as shown in Fig. 12.2.

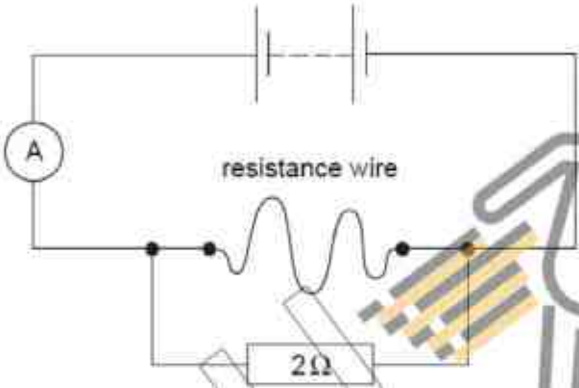


Fig. 12.2

(i) Calculate the new combined resistance of the wire and the resistor.

New combined resistance in parallel = (2x2)/(2+2) = 1 Ω (1)

combined resistance = …………………… [1]

(ii) Compare the current measured in Fig. 12.2 with the current in Fig. 12.1.

Since combined resistance decreased by 4 times, new current will increase (1) by 4 times (1).

[2]

(d) Walls in buildings sometimes develop cracks. The width of a crack can be monitored by measuring the resistance of a thin wire stretched across the crack and firmly fixed on either side of the crack, as illustrated in Fig. 12.3.

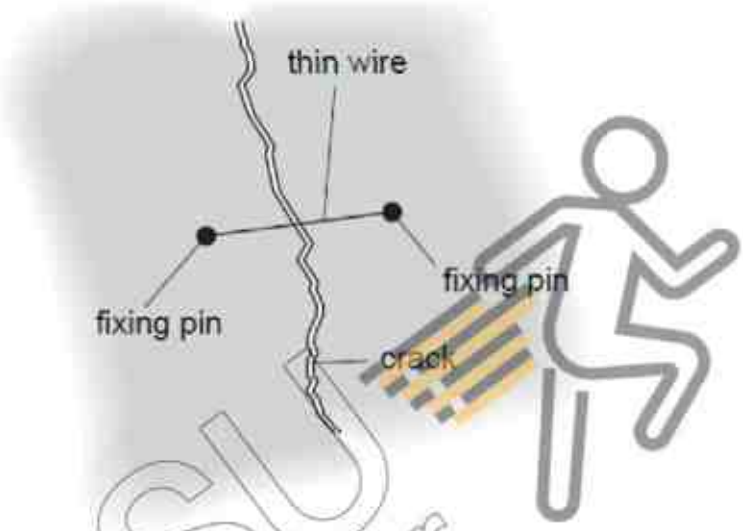


Fig. 12.3

(i) The wall moves and the crack widens slightly. Explain what happens to the resistance of the wire.

Wire stretches/length increases/cross-sectional area decreases (1)

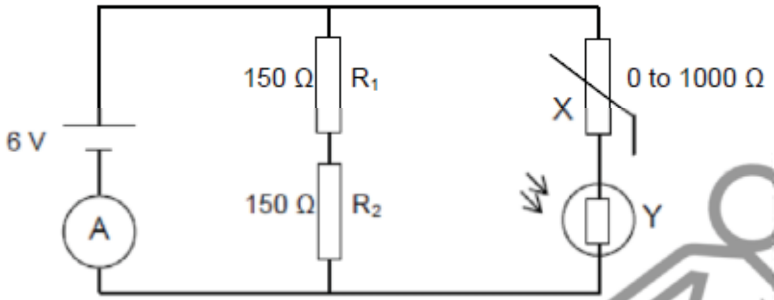
causing the resistance to increase (1). [2]

(ii) Copy a suitable circuit from Fig. 12.1 or Fig. 12.2 and add a LED light bulb to light up when the crack widens. [2]

Suitable circuit chosen from Fig. 12.1 (1) Correct LED symbol connected parallel to the wire (1)

13 EITHER

The circuit below consists of a 6 V battery source, two resistors of 150 Ω each, LDR and thermistor. The V_{out} across the LDR is connected to a fan which will be switched on when the V_{out} = 6.0 V.



(a) The table shows the range of resistance value for the LDR and thermistor. The resistance of the thermistor varies linearly with temperature.

Instrument	Temperature	Light intensity	Resistance
Thermistor	10 °C		200 Ω
	30 °C		0 Ω
LDR		Bright noon day	50 Ω
		Night	100 Ω

(i) Explain whether the LDR and thermistor are ohmic conductors. [2]

No they are non-ohmic because their resistance is not constant / current flowing through them is not directly proportional to the p.d across them.

(ii) Calculate the equivalent resistance of the whole circuit when it is during the night and the temperature is 10 °C. [2]

$1/R_1 + 1/R_2 = 1/R_{net}$
$1/(150 + 150) + 1/(200 + 100) = 1/R_{net}$
$R_{net} = 150\ \Omega$

(iii) Find the reading of the ammeter. [1]

I = V/R
= 6 / 150
= 0.04 A

(b) **(i)** Show, with clear workings and calculations, whether the fan will be switched on when the temperature is 10 °C during the night. [2]

$R_1/(R_2 + R_1) \times 6 = 100/300 \times 6 = 2\ V$

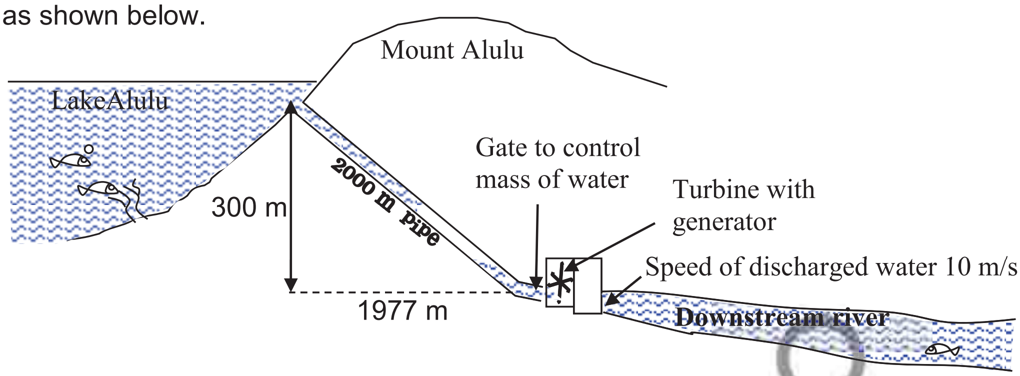
No, fan will not switch on.

(ii) Show, with clear workings and calculations, a possible pair of conditions for the temperature and light intensity which will cause the fan will to be switched on. [3]

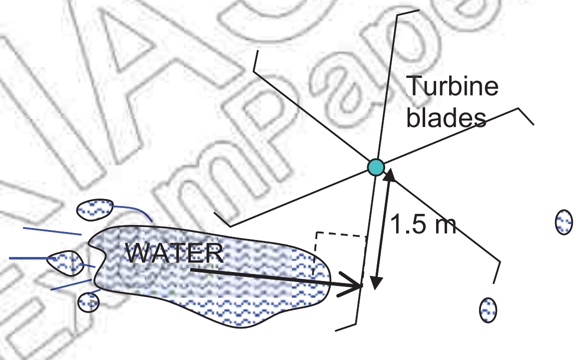
Temperature = 30 °C
Light intensity = night (1)
$V_{out} = R_1/(R_2 + R_1) \times 6$
$= 100/100 \times 6$ (1)
$= 6$ V (1)

13 OR

The turbine of a hydro-electric power station is built below the level of a lake as shown below.



The turbine is rotated by the running water. It then rotates a group of magnets around a coil in an a.c. generator. The generator is designed such that the magnets would rotate at a constant speed generating an e.m.f of 50,000 V across a coil. The water would be discharged at a constant speed of 10 m/s into the downstream river. The mass of water passing through the blades per second would be controlled by an automatic gate.
If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine. The running water would need to produce an anti-clockwise moment by hitting the blades in order to overcome the resisting moment and keep the blades moving at the required constant speed to generate the e.m.f.of 50,000 V. If 10 A of current is drawn from the generator, 17,160 Nm of moment would oppose the rotation and 169.5 kg of water would be needed to hit the blades per second.



The table below shows the data of Mount Alulu hydroelectric power station:

Generated e.m.f. / V	Current drawn from generator / A	Moment required to turn the turbine / Nm	Mass of water hitting the blades per second / kg s^{-1}	Speed of discharged water / ms^{-1}
50,000	10	17,160	169.5	10
50,000	20	34,320	339.0	10

(a) Assuming that water hits one blade at a time at a perpendicular distance of 1.5 m from the the axle as shown below, estimate the force it must exert on the blade when a current of 10 A is drawn from the generator. [2]

Moment = F x d
17160 = F x 1.5 m (1)
∴ F = 11440 N (1)

(b) Explain why "*If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine*"? [2]

According to Lenz's Law, induced current must oppose the change causing it (1). Hence a resisting moment or force is produced by the induced current (1).

(c) Calculate the amount of energy per second available to the generator when 500 kg of water flows through the turbine per second. [3]

Loss in E_p = mgh
= 500 x 10 x 300
= 1 500 000 J (1)
Gain in E_k = $\frac{1}{2}mv^2$
= $\frac{1}{2}$ x 500 x 10^2
= 25,000 J (unused energy) (1)
Energy available = 1 500 000 – 25 000 = 1 475 000 J (1)

(d) Estimate the current that flows in the generator when 500 kg of water flows through the turbine per second. [2]

P = V I
E x t = V I
1 475 000 x 1 = 50 000 x I (1)
∴ I = 29.5 A (1)

(e) Explain briefly why the actual current flowing should be less than your estimated value in (d) when 500 kg of water flows through the turbine per second. [1]

Some work needs to be done to overcome friction in the axle of the turbine. The energy used in this way is converted to heat in the axle.

END OF PAPER 2

Name: ______________________ (   )   Class: _____

Centre Number: _______   Index Number: ________

4E

KRANJI SECONDARY SCHOOL
Preliminary Examination
Secondary 4 Express

PHYSICS **6091/01**

Paper 1 Multiple Choice

Tuesday **20 August 2018** **1 hour**

INSTRUCTIONS TO CANDIDATES

There are **forty** questions in this paper. Answer **all** questions.
For each question there are four possible answers, **A, B, C** and **D**.
Choose the one you consider to be correct and record your choice in **soft pencil** on the OMR provided.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

INFORMATION FOR CANDIDATES

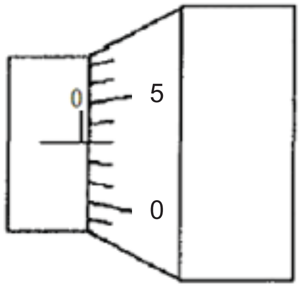
Take the acceleration due to gravity, g, to be 10 m/s^2.

Set by : Koh Tai Xiang

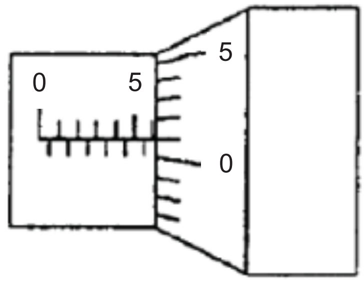
This question paper consists of 16 printed pages.

[Turn over

1 A micrometer screw gauge is used to measure the diameter of a steel ball. A student takes an initial zero error reading and then a reading of the diameter of the steel ball as shown below.



zero error reading

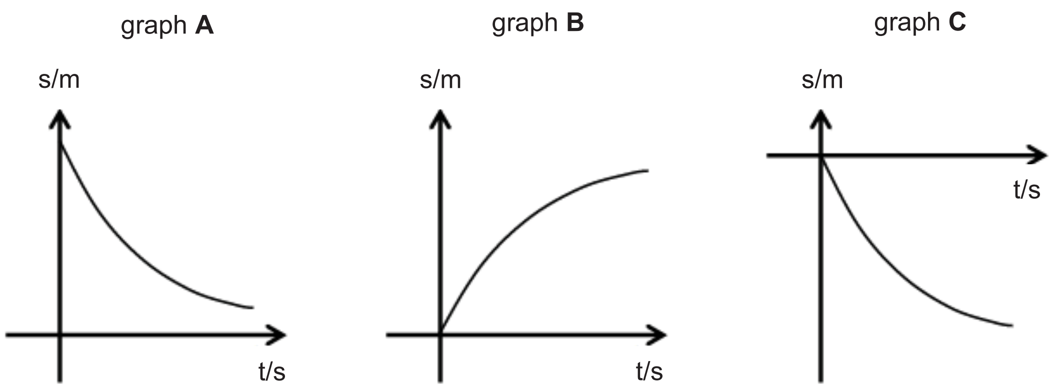


reading of diameter of steel ball

What is the actual diameter of the steel ball?

A 5.48 mm **B** 5.94 mm **C** 5.98 mm **D** 6.04 mm

2 The graphs below show how the displacement, s, of an object changes with time, t.



Which graph(s) show(s) the **distance travelled by** the object increasing at a decreasing rate?

A graph B only
B graph B and C only
C graph A and C only
D all of the above

3 A car driver immediately stepped on the brakes when he saw a cat dashing across the road.

The car decelerated at a constant rate of 10 m/s^2. The car finally came to a stop after it travelled for 45 m.

What is the speed of the car when the driver stepped on the brakes?

A 3.0 m/s **B** 21 m/s **C** 22 m/s **D** 30 m/s

4 A parachutist of mass 70 kg is falling through air when he opens his parachute. After the parachute opens, the initial deceleration of the parachutist is 20 m/s^2.

The gravitational field strength g is 10 N/kg.

What is the initial air resistance acting on the parachutist after the parachute opens?

A 700 N **B** 1400 N **C** 2100 N **D** 2400 N

5 Which of the following statement(s) about an object moving in a straight line through air is correct?

I When it moves at a steady speed, the air resistance acting on it is zero.
II When it moves at a steady speed, the resultant force acting on it is zero.
III When it moves, there is a resultant force acting on it.

A **II** only

B **I** and **III** only

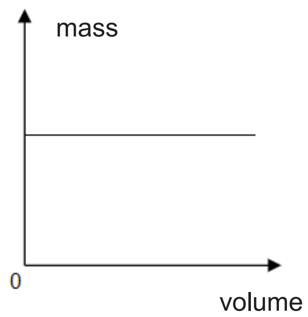
C **II** and **III** only

D **I, II** and **III**

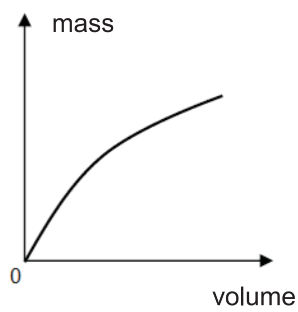
6 In an experiment to determine the density of substance Z, the mass and volume of different samples of Z are measured.

Which of the following graphs shows the correct relationship between the mass and volume of Z?

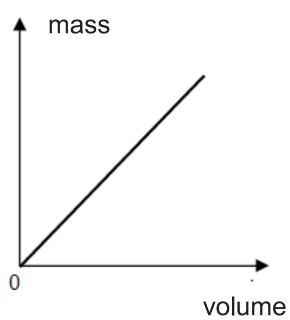
A



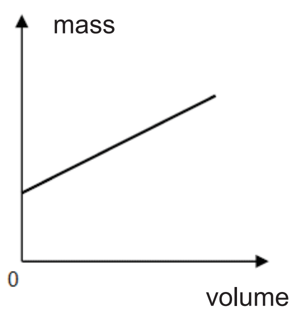
B



C



D

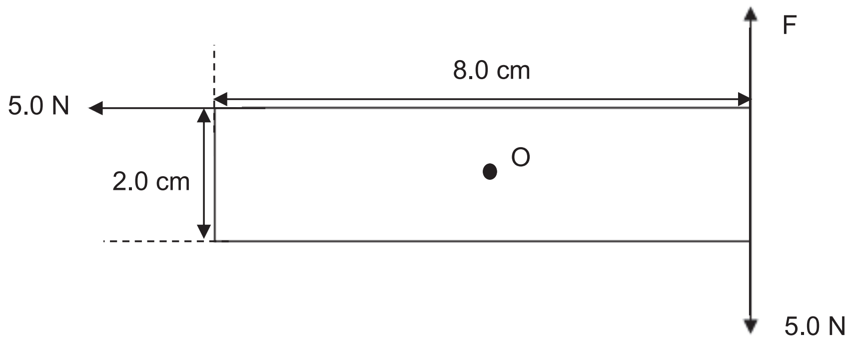


7 A bottle full of water has a mass of 70 g. When the same bottle is filled up with another unknown liquid Y, the total mass is 410 g.

If the mass of the empty bottle is 20 g and density of water is 1.0 g/cm^3, what is the density of Y?

A 7.8 g/cm^3 **B** 8.2 g/cm^3 **C** 13.0 g/cm^3 **D** 20.5 g/cm^3

8 Three forces are applied to a rectangular cardboard of size 8.0 cm by 2.0 cm as shown. The cardboard is pivoted at the centre O.



What is the size of force F such that the cardboard does not rotate about pivot O?

A 3.75 N **B** 5.00 N **C** 6.25 N **D** 10.0 N

9 The diagram below shows a uniform wooden plank with a length of 120 cm. The mass of the wooden plank is 700 g.

If the plank is pivoted at the 70 cm mark, which of the following mass should be used to balance the plank?

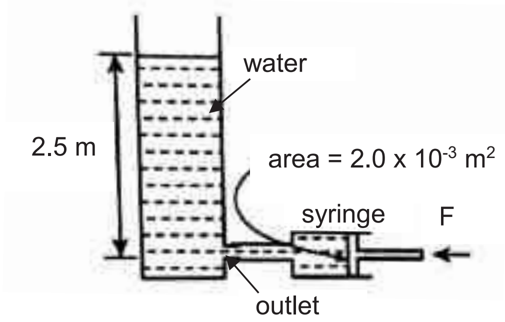
A mass of 70 g placed at 100 cm mark

B mass of 175 g placed at the 30 cm mark

C mass of 350 g placed at the 90 cm mark

D mass of 700 g placed at the 10 cm mark

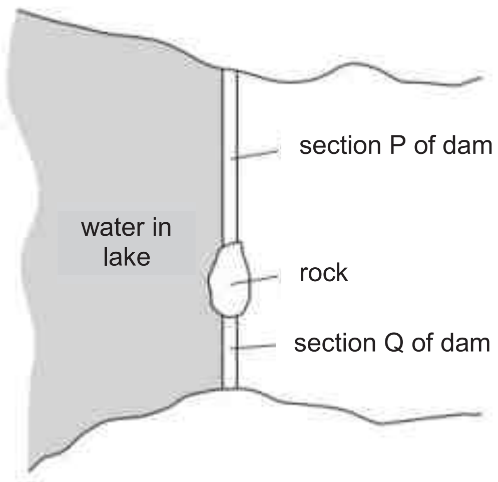
10 The diagram shows a tall cylinder containing some water. A syringe is used to prevent the water from spurting out from the outlet at the bottom of the cylinder. The height of the water above the outlet is 2.5 m. The density of water is 1000 kg/m^3 and the cross-sectional area of the piston of the syringe is 2.0 x 10^{-3} m^2.



What is the minimum force F that must be applied to the piston of the syringe to prevent it from moving outwards?

A 1.25 N **B** 8.0 N **C** 50 N **D** 12500 kN

11 A dam across a lake is divided into two sections by a rock. Section P of the dam is longer than section Q but the two sections are otherwise identical. The water in the lake by the dam is the same depth everywhere. The diagram shows a view from above of the lake and the dam.



The water exerts a total force on each section of the dam and an average pressure on each section of the dam.

Which statement is correct?

A The average water pressure on P equals the average water pressure on Q.

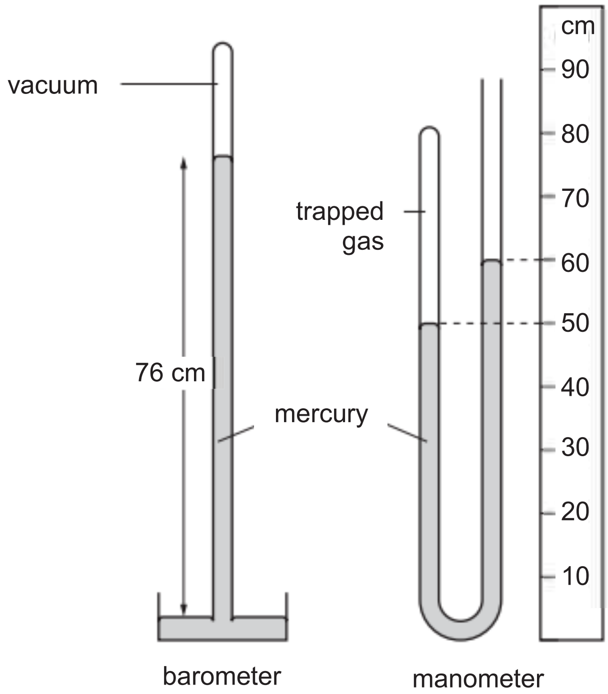
B The average water pressure on P is less than the average water pressure on Q.

C The total force on P equals the total force on Q.

D The total force on P is less than the total force on Q.

12 The diagram shows a simple mercury barometer alongside a mercury manometer.

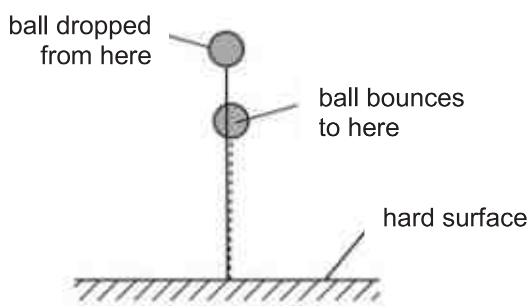
The manometer contains some trapped gas.



What is the pressure of the trapped gas?

A 10 cmHg **B** 50 cmHg **C** 66 cmHg **D** 86 cmHg

13 A ball is dropped on to a hard surface and bounces. It does not bounce all the way back to where it started.



Which statement accounts for this?

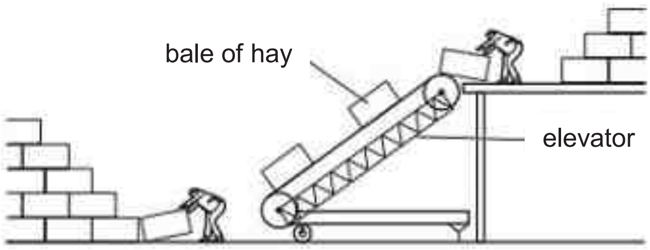
A Energy was destroyed as the ball hit the ground.

B Energy was destroyed as the ball travelled through the air.

C The thermal energy of the ball and its surroundings have increased.

D The chemical potential energy and elastic potential energy of the ball have increased.

14 Two farmers use an electrically powered elevator to lift bales of hay. All the bales of hay have the same mass.

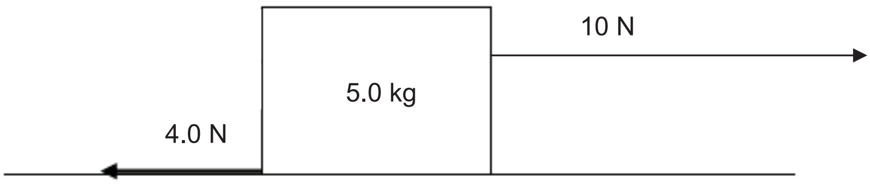


As sunset approaches, they decrease the speed of the elevator so that less bales are lifted up in a given time.

How does this affect the work done in lifting each bale and the useful output power of the elevator?

	work done in lifting each bale	useful output power of the elevator
A	decreases	increases
B	decreases	decreases
C	no change	increases
D	no change	decreases

15 A box with mass of 5.0 kg is pushed through a distance of 20 m along a horizontal surface by a uniform force of 10 N. The frictional force opposing the motion is 4.0 N.



How much of the work done is converted into thermal energy and kinetic energy?

	thermal energy / J	kinetic energy / J
A	80	120
B	120	200
C	80	200
D	120	120

16 When a gas is rapidly compressed to a smaller volume, its temperature increases.

What happens to the gas molecules?

A They move closer together and their average speed decreases.

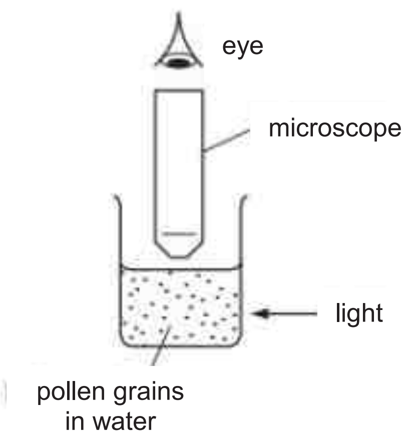
B They move closer together and their average speed increases.

C They decrease in size and their average speed remains unchanged.

D They decrease in size and their average speed increases.

17 Very small pollen grains are suspended in a beaker of water. A bright light shines from the side as shown in the diagram.

Small, bright dots of light are seen through a microscope. The dots move in rapidly changing, random directions.



What are the bright dots?

A pollen grains being hit by other pollen grains

B pollen grains being hit by water molecules

C water molecules being hit by other water molecules

D water molecules being hit by pollen grains

18 Which of the following objects gain heat by radiation only?

A an ice cube at 0 °C, in air

B a car with black metal surfaces at 35 °C, in air under the sun

C a metal ball with white surface at 25 °C, in water at 50 °C

D a shiny metal satellite at 28 °C, in space, facing the sun

19 A student wishes to check the upper and the lower fixed points on a Celsius scale thermometer.

She has four breakers P, Q, R and S.

- Beaker P contains a mixture of ice and salt.
- Beaker Q contains a mixture of ice and water.
- Beaker R contains boiling salt solution.
- Beaker S contains boiling water.

Which two beakers should she use to check the fixed points?

A P and R **B** P and S **C** Q and R **D** Q and S

20 The length of mercury in the bore of a thermometer is 5.0 cm at 0°C and 11.0 cm at 60°C.

What is the length of the mercury in the bore when the temperature is 45 °C?

A 3.3 cm **B** 4.5 cm **C** 8.3 cm **D** 9.5 cm

21 The same quantity of thermal energy is supplied to two solid objects W and X. The increase in temperature of object W is smaller than the increase in temperature of object X.

Which statement explains this?

A W has a higher melting point than X.

B W has a higher density than X.

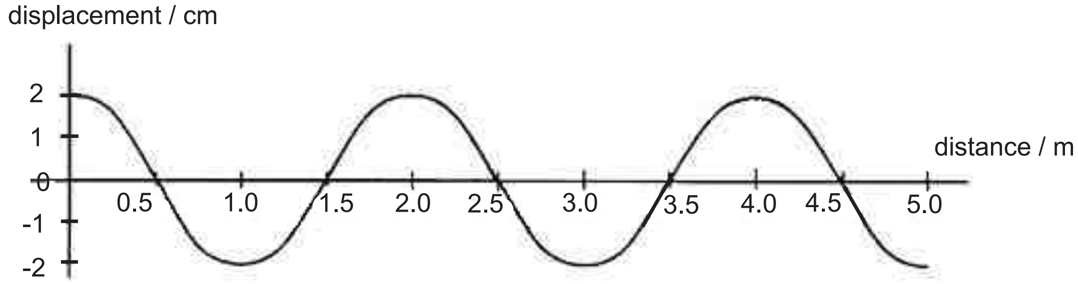
C W has a higher heat capacity than X.

D W is a better thermal conductor than X.

22 What happens to the speed, frequency and wavelength of a water wave as the depth of the water increases?

	speed	frequency	wavelength
A	increases	increases	increases
B	increases	remains constant	increases
C	decreases	increases	remains constant
D	decreases	remains constant	decreases

23 The diagram below shows a wave represented on a displacement-distance graph. The speed of the wave is 30 m/s.

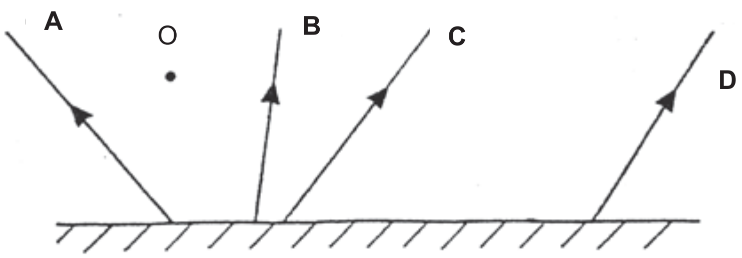


Which of the following information is correct about its amplitude and frequency?

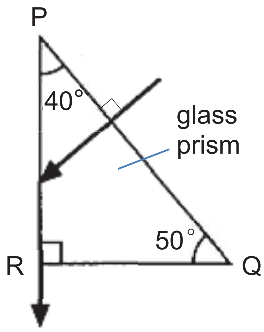
	amplitude	frequency
A	2.0 cm	15 Hz
B	2.0 cm	75 Hz
C	4.0 cm	15 Hz
D	4.0 cm	75 Hz

24 The diagram below shows the plane view of an object O placed in front of a plane mirror.

Which one of the reflected rays of light appears to come from the image of O?



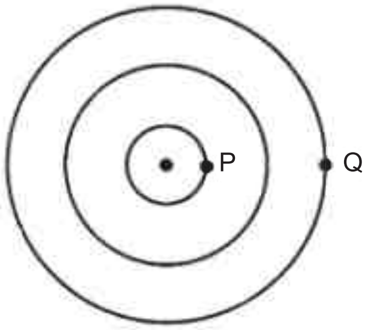
25 A ray of light enters a glass prism perpendicularly to the surface PQ and travels along the path as shown below.



What is the speed of light in glass?

A 1.93×10^8 m/s **B** 2.00×10^8 m/s **C** 2.05×10^8 m/s **D** 2.14×10^8 m/s

26 A pebble is dropped into a still water so that circular wavefronts are seen to travel outwards with a speed *v*.



If the wavelength is *λ*, what is the time taken for the disturbance at P to reach Q?

A $\lambda / (2v)$ **B** λ / v **C** $3\lambda / (2v)$ **D** $2\lambda / v$

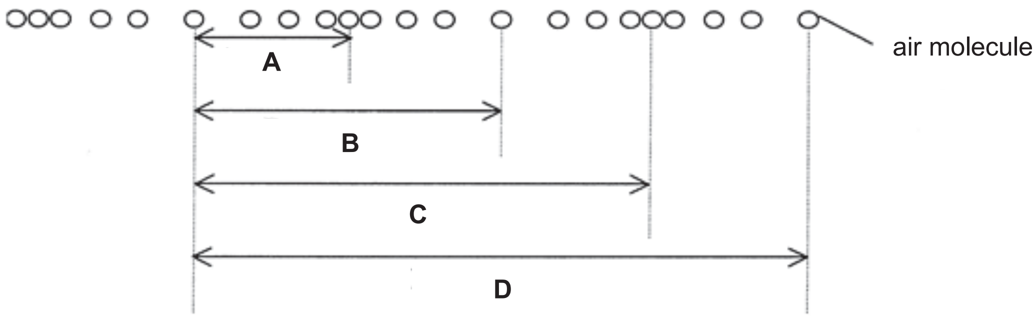
27 An infrared radiation is emitted at 6.7×10^{13} Hz.

What is its wavelength and period of oscillation?

	wavelength / m	period / s
A	4.48×10^{-6}	2.23×10^{5}
B	4.48×10^{-6}	1.49×10^{-14}
C	2.23×10^{5}	2.23×10^{5}
D	2.23×10^{5}	1.49×10^{-14}

28 The diagram below represents the position of the air molecules in a sound wave. The wavelength of this wave is 2.0 cm.

Which distance represents 4.0 cm?



29 Why are humans not able to hear ultrasound?

A The amplitude is too high.

B The frequency is too high.

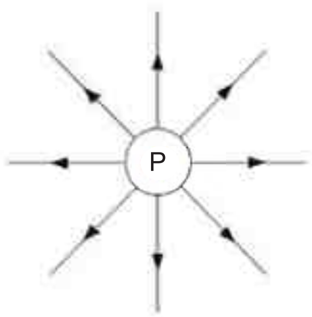
C The speed is too high.

D The wavelength is too long.

30 X, Y, Z and P are light insulated balls suspended on strings. When they are brought near each other, they behave as follows:

X repels Y,
X attracts Z and
Z repels P.

The electric field of P is given in the diagram below.



Which of the following statements must be true?

A Y must be positively charged.

B Y may be positively charged or neutral.

C Y may be neutral or negatively charged.

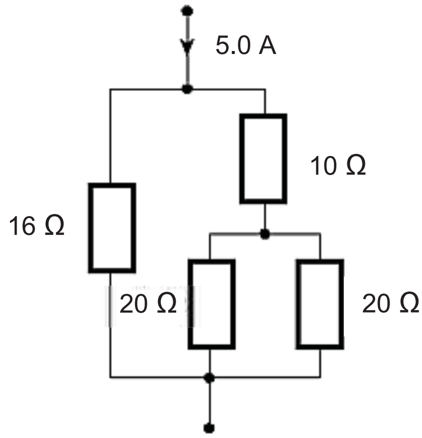
D Y must be negatively charged.

31 A spotlight labelled 240 V, 500 W is connected to a 240 V supply. The spotlight shines at normal brightness for 3 hours.

What is the size of the charge that passes through the spotlight in this time?

A 6.25 C **B** 375 C **C** 5 184 C **D** 22 500 C

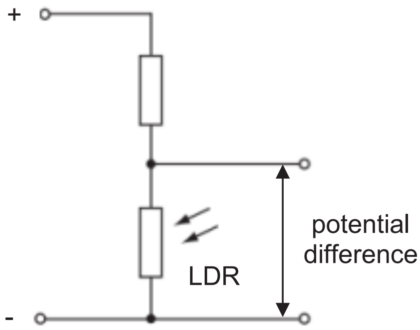
32 The following diagram shows part of a complete circuit.



What is the current through the 16 Ω resistor?

A 1.11 A **B** 1.39 A **C** 2.22 A **D** 2.78 A

33 The diagram shows part of a circuit used to switch street lamps on and off automatically.



Which row shows the effect on the resistance of the light-dependent resistor (LDR) and on the potential difference (p.d.) across it as it gets brighter?

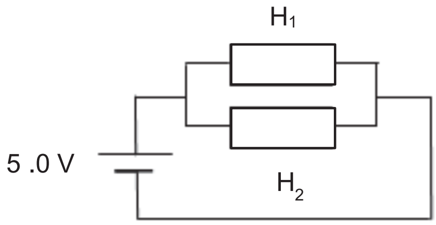
	resistance of LDR	p.d. across LDR
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

34 A 240 V electrical appliance is used for 200 hours. The current in the appliance is 6.5 A.

If one unit of electricity costs \$0.22, what is the cost of using this electrical appliance?

A \$10.56 **B** \$34.32 **C** \$68.64 **D** \$286.00

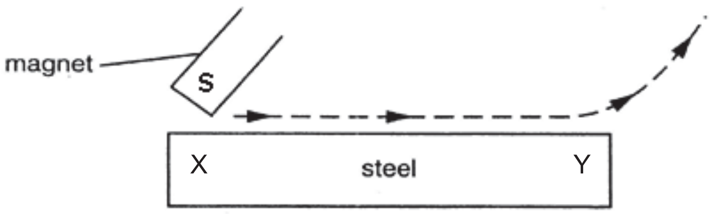
35 The diagram below shows a heater H_1 marked "10 V, 50 W" connected in parallel to another heater H_2 marked "10 V 25 W". Both heaters are connected to a 5.0 V supply.



If P_1 and P_2 are the powers dissipated in heaters H_1 and H_2 respectively, which of the following is correct?

	P_1 / W	P_2 / W
A	12.5	6.25
B	25	50
C	25	12.5
D	50	25

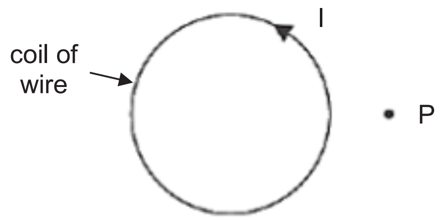
36 A piece of steel can be magnetised by stroking it with a magnet.



When the magnet is moved in the direction shown, which poles are produced at X and at Y?

	pole at X	pole at Y
A	south	south
B	south	north
C	north	south
D	north	north

37 A current I is flowing in a coil of wire in the direction shown.



Which of the following gives the correct direction of the magnetic field at point P?

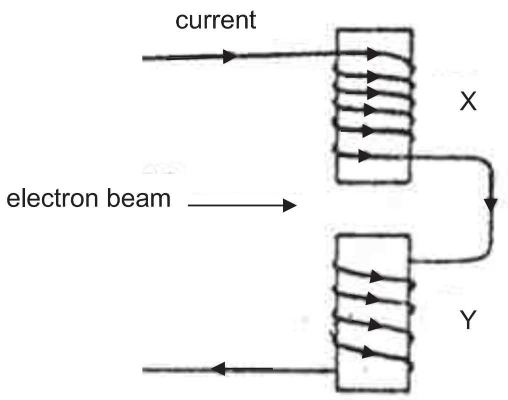
A out of the plane of the paper

B into the plane of the paper

C to the right

D to the left

38 An electron beam passes through a pair of electromagnets X and Y as shown below.



In which direction will the electron beam be deflected?

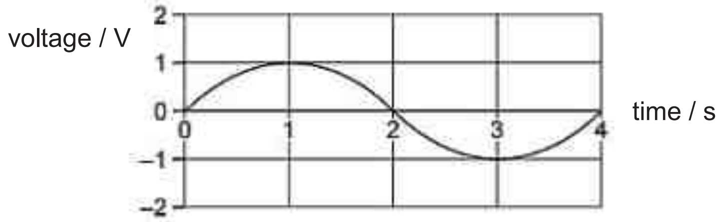
A towards X

B towards Y

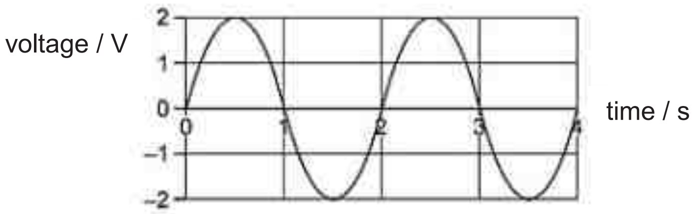
C into the paper

D out of the paper

39 A simple a.c. generator produces a voltage that varies with time as shown.



Some adjustments are made to the a.c. generator to produce the following graph.



What are the adjustments made?

	number of turns of the coil	speed of rotation
A	remains constant	doubled
B	doubled	doubled
C	remains constant	halved
D	doubled	halved

40 A door bell is designed to operate when connected to a 12 V supply. When connected to a transformer the current in the door bell is 1.5 A and it operates normally.

The transformer is connected to the 240 V mains supply and it has an efficiency of 90%.

What current is drawn from the mains supply?

A 0.075 A **B** 0.083 A **C** 27 A **D** 30 A

- End of Paper –

Name: ____________________________ (   )   Class: ________

Section B [30 marks]
Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Q11**.

9 Fig. 9.1 shows a light shuttlecock that is used for playing badminton. In an experiment using electronic apparatus, a shuttlecock is released from rest and the distance d fallen is measured at different times t.

Fig. 9.1

Fig. 9.2 shows the results obtained when the shuttlecock is dropped from a height of a few metres.

t / s	d / m
0	0
0.20	0.19
0.40	0.74
0.60	1.56
0.80	2.56
1.00	3.68
1.20	4.86
1.40	6.06
1.60	7.31
1.80	8.56
2.00	9.81

Fig. 9.2

(a) On Fig. 9.1, draw and label the forces acting on the falling shuttlecock. [1]

(b) Explain how the data in Fig. 9.2 for the light shuttlecock suggest that the speed is increasing at t = 0.40 s.

....

....

.... [1]

(c) Using the data in Fig. 9.2, determine the terminal velocity of the light shuttlecock.

terminal velocity = ... [2]

(d) Explain, in terms of forces,

(i) why the shuttlecock accelerates at first,

....

....

....

....

....

.... [2]

(ii) why the shuttlecock reaches a steady speed.

....

....

....

....

....

.... [2]

(e) Explain what will happen to the terminal speed of a shuttlecock which has a mass added inside the cone of the shuttlecock.

....

....

....

....

.... [2]

10 **(a)** Fig. 10.1 shows a simple alternating current (a.c.) generator which can be used to generate electricity.

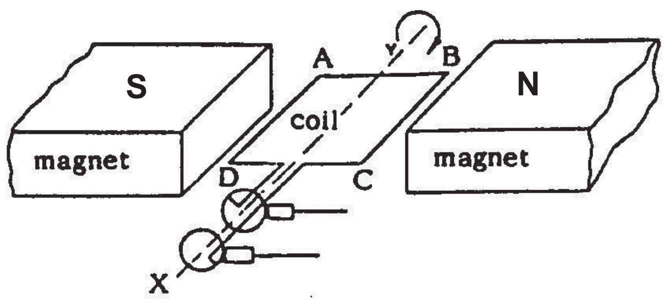


Fig. 10.1

(i) State the name of the two rings shown in Fig. 10.1.

.... [1]

(ii) The rectangular coil is rotated clockwise as shown in Fig. 10.1. Draw an arrow in Fig. 10.1 to indicate the direction of the induced current in wire BC. [1]

(b) A farmer connects a house to the mains supply of electricity. The house is at a long distance from the nearest 230 V mains supply of electricity.

Fig.10.2 shows the mains supply connected to the house.

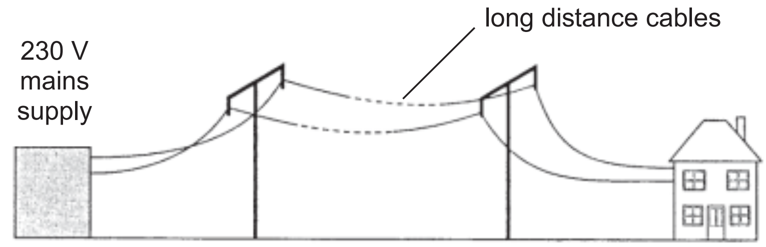


Fig. 10.2

(i) The farmer uses 230 V lamps in the house but they do not light up at their normal brightness. Explain why the lamps are dim.

....

.... [1]

(ii) The farmer added transformers, as shown in Fig.10.3.

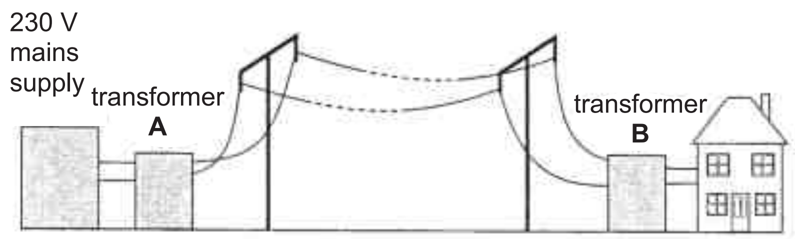


Fig. 10.3

The lamps in the distant house light up at normal brightness. Explain why the lamps are now brighter.

....

....

....

....

.... [2]

(c) Fig. 10.4 shows a transformer with 2 coils, Q and R, which are wound on an iron core.

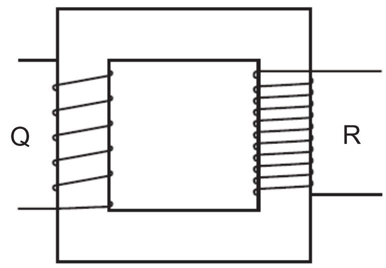


Fig. 10.4

Coil Q has 200 turns and coil R has 600 turns. The e.m.f. induced across coil R is 24 V. The transformer operates with 100% efficiency.

(i) Calculate the voltage of the power supply provided to coil Q,

voltage = ...[2]

(ii) Explain why an alternating current supply should be connected to coil Q in order for the transformer to work properly.

....

....

....

....

....

....

.... [3]

Either

11 A student performs an experiment with a semicircular glass block and a ray of white light. Fig. 11.1 shows the path taken by this ray of light as it enters the glass at P until it hits the straight edge at Q.

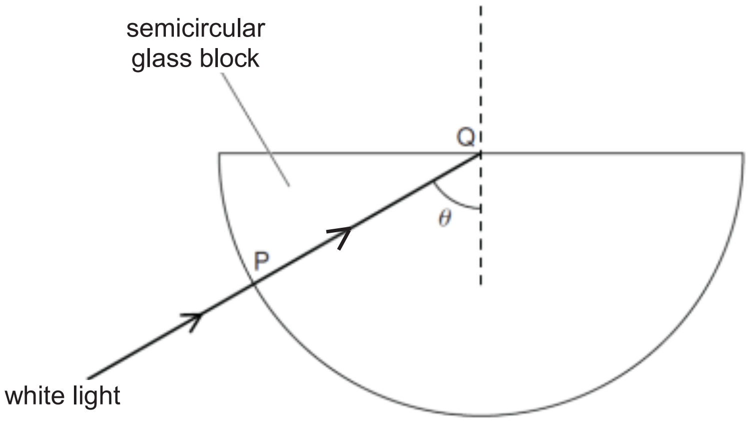


Fig. 11.1

The student finds that there is no change in direction as the ray enters the glass at P and that no light passes out of the glass at Q. The glass block has a refractive index of 1.6.

(a) Explain what is meant by a refractive index of 1.6.

....

.... [1]

(b) Calculate the critical angle of the glass block.

critical angle = ...[2]

(c) Explain why the light ray does not change direction at P.

....

.... [1]

(d) If the angle θ is 60°, explain what will happen to the light ray at Q.

....

....

....

.... [2]

(e) The student directs the ray of light into the glass along different paths by reducing the angle θ slowly.

Describe the changes to the path of light at Q.

....

....

....

.... [2]

(f) Visible light is part of electromagnetic spectrum.

If visible light has a frequency of 6.0×10^{14} Hz in vacuum, calculate its wavelength.

wavelength = ...[2]

OR

11 **(a)** Fig. 11.2 shows an electrical circuit. The e.m.f. of the battery is 6.0 V. R_1 and R_2 are identical resistors. When switch S is open, the ammeter reading is 0.60 A and the voltmeter reading is 2.4 V.

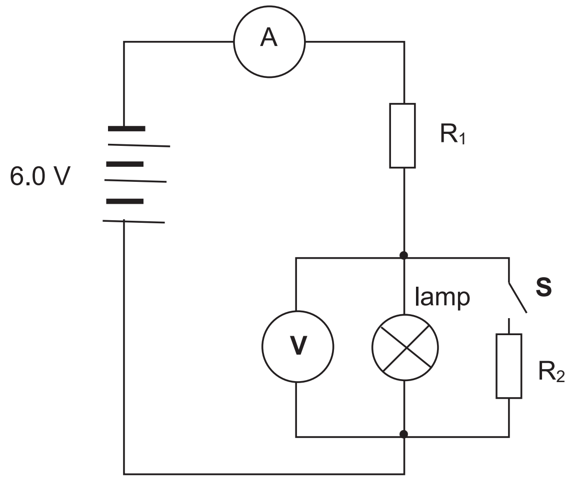


Fig. 11.2

(i) State what is meant by the battery has an *e.m.f. of 6.0 V.*

....

.... [1]

(ii) Calculate the resistance of the lamp.

resistance of lamp = ...[2]

(iii) Calculate the resistance of resistor R_1.

resistance of R_1 = ...[2]

(iv) The switch **S** is then closed. Compare the brightness of the lamp now with the brightness of the lamp when the switch **S** is open. Explain your answer.

....

....

....

.... [2]

(b) Fig. 11.3 shows a simplified diagram of an electrical appliance connected with Live (L), Neutral (N) and Earth (E) wires.

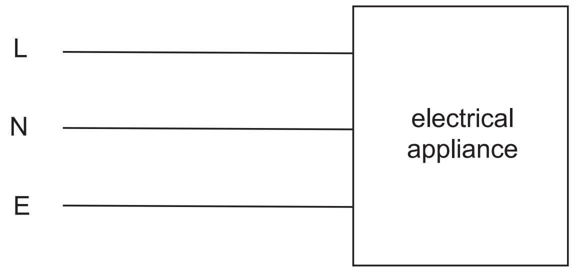


Fig. 11.3

(i) If a fuse is to be added as a safety device in the circuit shown in Fig. 11.3, draw a "X" in Fig. 11.3 where the fuse should be placed. [1]

(ii) Explain your answer for **(b)(i)**.

....

....

....

.... [2]

End of Paper

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
C	D	D	C	A	C	A	A	C	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	D	C	D	A	B	B	D	D	D
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	B	A	C	A	D	B	D	B	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	D	A	C	A	B	B	C	A	B

Physics Prelim P2 Answer Scheme

<u>Section B</u>

9(a)

correct arrows & label

weight and air resistance : [1]

(b) From t = 0.20 s to 0.40 s, the distance travelled travelled is (0.74 – 0.19) = 0.55 m.
From t = 0.40 s to 0.60 s, the distance travelled travelled is (1.56 – 0.74) = 0.82 m.

Since the distance travelled for the same period of time (0.02 s) increases,
the speed of the shuttle cock increases at t = 0.40 s. [1]

(c) terminal velocity = change in distance / time
= (9.81 – 6.06) / (2.00 - 1.40) [1]
= 6.25 m/s [1]

(d)(i) The shuttlecock falls due to its weight.
Its weight acting downwards is greater than the air resistance acting upwards. [1]
There is a downward resultant force. [1]
Thus, the shuttlecock accelerates downwards since a = F/m where m is constant.

(ii) As the speed of the shuttlecock increases, the air resistance acting upwards increases until it is equal to the weight (downwards) of the shuttlecock. [1]
There is no resultant force acting on the shuttlecock, and thus there is no acceleration for the shuttlecock since a = F/m where m is constant. [1]
Hence, the shuttlecock reaches its steady speed.

(e) The shuttlecock with greater mass has a greater weight.
It needs greater air resistance acting against it.
It takes a longer time for the air resistance to be equal to the new total weight. [1]
Thus, a greater terminal speed is reached. [1]

10 (a) (i) Slip rings. [1]

(ii) Direction of induced current is from C to B. [1]

(b) (i) The long distance cables has (relatively high) resistance, [1]
There is power/energy loss (or voltage drop) in the cable since $P = I^2R$. [1]

(ii) Transformer A steps-up the voltage, so the current in the transmission cable is lower.
This reduces the power / energy loss in cable since since $P = I^2R$. [1]
Transformer B is then used to step down the voltage to 230 V which will cause the lamps to light up at normal brightness. [1]

(c) (i) Vs / V p = Ns / Np
24 / Vp = 600 / 200 [1]
Vp = 8.0 V [1]

(ii) A.C. is a current that changes magnitude and direction. [1]
Hence the primary coil Q will produce a changing magnetic field. [1]
(The iron core will concentrate and link the magnetic field to coil R.)
Hence, there will be a change in magnetic field cutting coil R and there will be induced emf/current in coil R. [1]

Either

11 (a) Refractive index is the ratio of speed of light in vacuum to the speed of light in medium (glass) is 1.6. [1]

(b) n = 1/sin c
1.6 = 1/sin c [1]
C = 38.7^0 or 39^0 [1]

(c) The ray hits the surface perpendicularly ($i = 0^0$). Hence, it will not change direction. [1]

(d) Total internal reflection will occur. [1]
It is because the ray is travelling from an optically denser medium to a less dense medium and the angle of incidence is greater than critical angle. [1]

(e) When i = critical angle (39^0), the ray will travel along the horizontal edge of the glass block. [1]
When $i < 39^0$, the ray will refract out of the glass block, bending away from the normal. [1]

(f) v = f x wavelength
$3.0 \times 10^8 = 6.0 \times 10^{14}$ x wavelength
Wavelength = 5.0×10^{-7} m

OR

11 (a) (i) The work done by the source in driving a unit charge round a complete circuit is 6 J. [1]

(ii) Resistance of lamp = V/ I
= 2.4 / 0.6 [1]
= 4.0 Ω [1]

(iii) p.d. across R_1 = 6.0 – 2.4
= 3.6 V
R_1 = V /I
= 3.6 / 0.60 [1]
= 6.0 Ω [1]

(iv) When the switch S is closed, the total resistance of R_1 and lamp decreases (denotes as R'). [1]

The p.d. across the lamp decreases since $V_{lamp} = (R'/ R' + R_1) \times 6.0$.
Thus, the lamp is dimmer as it has lower power, $P = V^2/R$ where R is the resistance of lamp and is constant. [1]

(b) (i) "X" should be on the positive terminal side of the cell. [1]

(ii) When the current exceeds the fuse rating, the fuse will melt and open the circuit. [1]
It will disconnect the circuit from the high voltage at the live wire and prevent overheating of the circuit. [1]

End of Paper

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2018

PHYSICS **6091/01**

Paper 1 Multiple Choice **12 September 2018**

Wednesday 0800 – 0900 **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

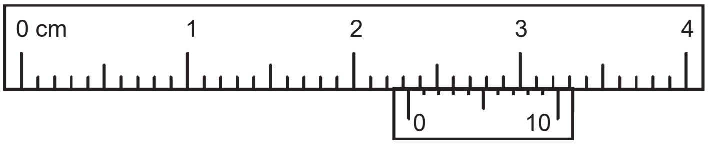
The use of an approved scientific calculator is expected, where appropriate.

Read the instructions on the Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

This document consists of **14** printed pages, including this cover page.

Setter: **[Turn over**

1. The diagram shows a vernier scale.



What is the vernier reading?

A 2.23 cm **B** 2.26 cm **C** 2.33 cm **D** 2.60 cm

2. A pendulum clock makes use of the oscillation of a pendulum to keep time. If the pendulum clock is found to be running slow, what can be done to correct the clock?

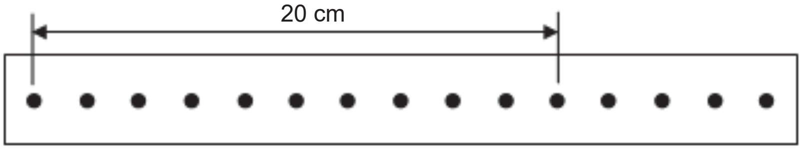
A decrease the amplitude of oscillation
B increase the amplitude of oscillation
C decrease the length of the pendulum
D increase the length of the pendulum

3. A car travels from Singapore to Genting Highlands in Malaysia. The map shows the route.

The route from Singapore to Genting Highlands is 425 km. If the car moves at an average speed of 80 km/h, what is the time taken for the journey?

A 0.19 hour
B 5.3 hours
C less than 5.3 hours as the journey is not a straight line
D more than 5.3 hours as the journey is not a straight line

4. The diagram shows a strip of paper tape pulled under a vibrating arm by a trolley moving at constant speed. The arm is vibrating regularly, making 40 dots per second.



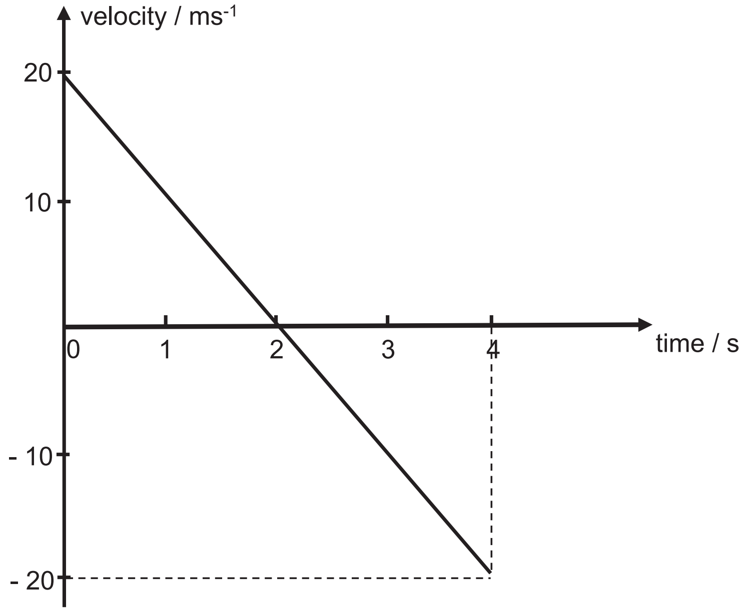
What is the speed of the trolley?

A 0.50 cm/s **B** 2.0 cm/s **C** 80 cm/s **D** 200 cm/s

5. A car accelerates uniformly from 10 m/s to 20 m/s. During this acceleration, the car travels 60 m. What is the acceleration of the car?

A 2.5 m/s^2 **B** 3.0 m/s^2 **C** 4.0 m/s^2 **D** 6.0 m/s^2

6. The graph shows how the velocity of a lump of plasticine varies after being thrown vertically upwards into the air from the ground.



What is the time needed for the plasticine to reach its highest point from the ground?

A 1 s **B** 2 s **C** 4 s **D** 8 s

7. A lion runs at a high speed to catch its prey. There is friction between the lion and the air and between the lion and the ground. Under which conditions of friction will the lion reach its greatest maximum speed?

	friction with air	friction with ground
A	high	high
B	high	low
C	low	high
D	low	low

8. A pulling force of 3.0 N causes a toy car to accelerate on a horizontal surface. The frictional force between the surface and the toy car is 1.0 N. Which of the following statements best describes the subsequent motion of the car when the pulling force is decreased to 1.0 N?

A It will continue to accelerate. **B** It will decelerate.
C It will move with a constant speed. **D** It will stop moving.

9. A child jumps onto a trampoline and bounces upwards.

On the second jump, he bounces higher. What will most likely remain constant on both jumps?

A his acceleration in the air
B his maximum gravitational potential energy
C his maximum kinetic energy
D his speed on contact with the trampoline

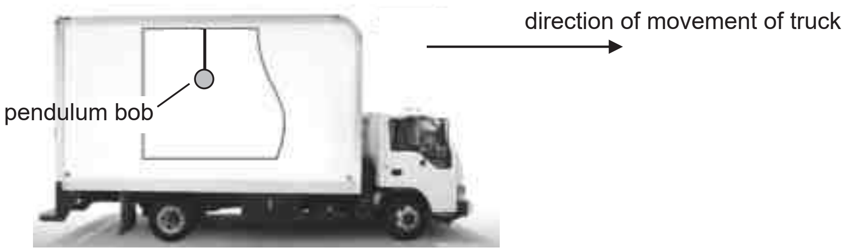
10. The table shows the density of various substances.

substance	density / gcm^{-3}
copper	8.9
iron	7.9
kerosene	0.9
mercury	13.6
water	1.0

Which statement is true?

A 1 g of iron has a smaller volume than 1 g of copper.
B 1 g of mercury has a greater volume than 1 g of water.
C The mass of 1 cm^3 of mercury is greater than 1 cm^3 of all the other substances.
D The mass of 1 cm^3 of water is smaller than 1 cm^3 of all the other substances.

11. A pendulum is attached to the roof of a truck. The truck is initially moving at a constant speed along a straight road.



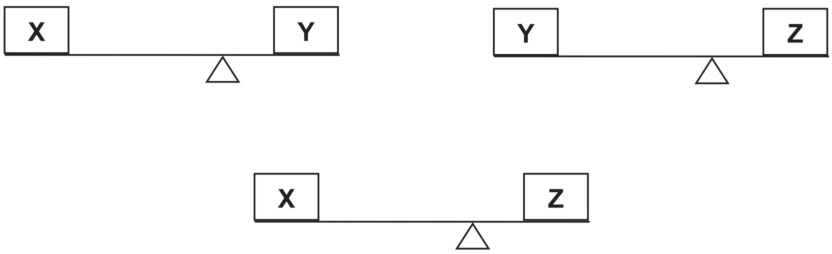
What is the motion of the pendulum bob when the truck starts to slow down?

A It will remain in its original position.
B It will swing to the left.
C It will swing to the right.
D It will swing to the right and left.

12. Which of the following quantities depends on the strength of the gravitational field?

A density   **B** mass   **C** volume   **D** weight

13. The diagrams show how three blocks **X**, **Y**, and **Z** are balanced on a uniform beam.



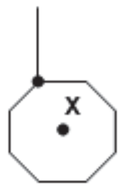
Which of the following shows the three blocks arranged in order of increasing mass?

A **X**, **Y**, **Z**   **B** **X**, **Z**, **Y**   **C** **Y**, **X**, **Z**   **D** **Z**, **Y**, **X**

14. A piece of card has its centre of gravity at **X.**

A

B



C

D

Which diagram shows how it hangs when suspended by a thread?

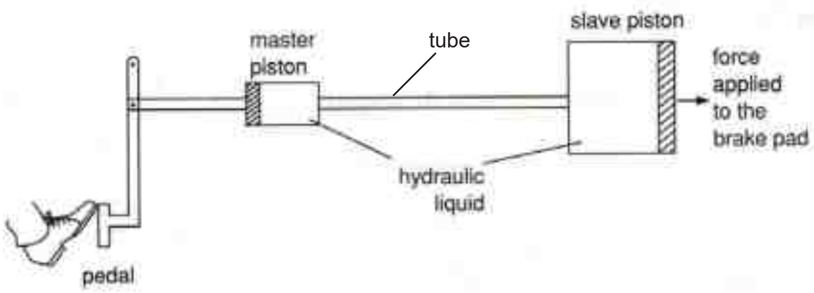
15. A car initially moving with a velocity **v** has kinetic energy **K.** What is the kinetic energy of the car when the velocity is 2**v**?

A **K**   **B** 2**K**   **C** 4**K**   **D** 8**K**

16. A boy pushes a toy cart at constant speed along a level road. What is the biggest energy change?

A chemical potential to heat   **B** chemical potential to kinetic
C kinetic to gravitational potential   **D** kinetic to heat

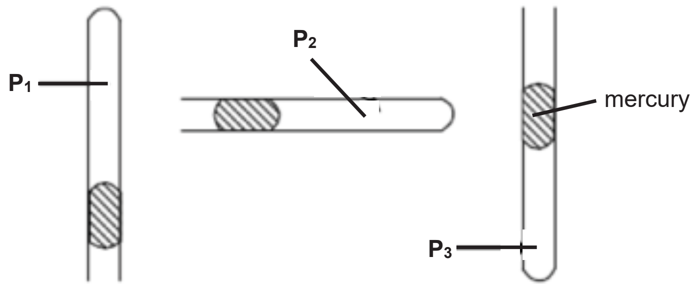
17. The diagram shows a hydraulic brake system used in vehicles. A hydraulic liquid is used to fill the system and a hollow tube links the master piston to the slave piston. Both pistons are cylindrical and the diameter of the slave piston is twice that of the master piston.



If the driver presses down on the pedal such that a force of 450 N is applied on the master piston, what is the force applied by the slave piston to the brake pad?

A 113 N **B** 225 N **C** 450 N **D** 1800 N

18. A column of air is trapped by some mercury in a capillary tube. The capillary tube is held in different positions as shown in the diagram.



P_1, **P_2** and **P_3** are pressures of the enclosed air in the capillary tube. Which relationship is correct?

A $P_1 = P_2 = P_3$ **B** $P_1 > P_2 > P_3$ **C** $P_1 > P_3 > P_2$ **D** $P_3 > P_2 > P_1$

19. Which of the following correctly states the properties of solids, liquids and gases?

	solids	liquids	gases
A	does not flow easily	flow easily	flow easily
B	hard to compress	easily compressed	easily compressed
C	fixed shape	fixed shape	no fixed shape
D	fixed volume	fixed volume	fixed volume

20. Illuminated smoke particles, suspended in air, are viewed with a microscope. They are seen to move randomly. Which of the following best explains the motion of the smoke particles?

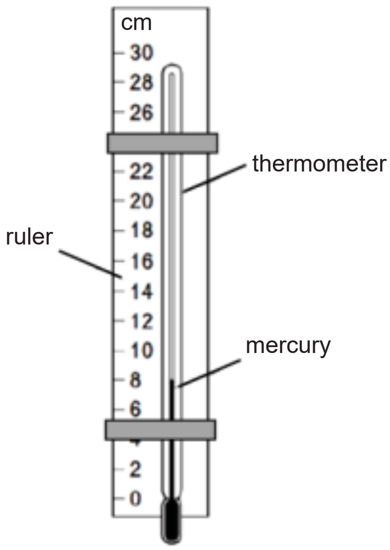
A air molecules are far apart from each other
B air molecules collide with each other
C air molecules move randomly
D smoke particles move randomly

21. A vacuum flask keeps water hot for long periods of time. Which of the following statements are correct?

1 The plastic cap prevents heat loss by radiation.
2 The silvered surfaces reduce heat loss by radiation.
3 The vacuum in the flask prevents heat loss by conduction and convection.

A 1 and 2 only **B** 1 and 3 only
C 2 and 3 only **D** 1, 2 and 3

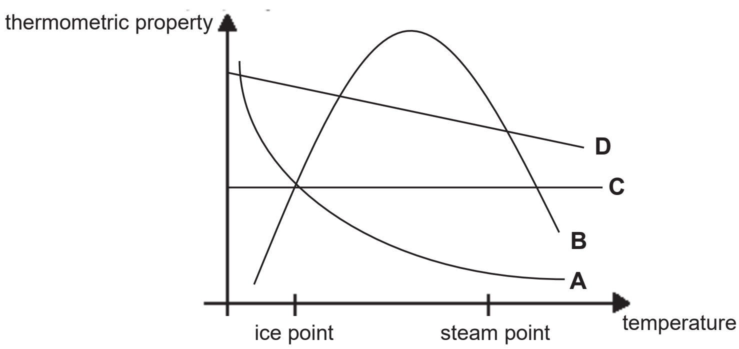
22. An unmarked mercury thermometer is attached to a ruler as shown in the diagram.



When the thermometer is placed in pure melting ice, the mercury level falls to 2.0 cm. When the thermometer is placed in steam above boiling water, the mercury level rises to 22.0 cm. What is the temperature shown by the mercury level in the diagram?

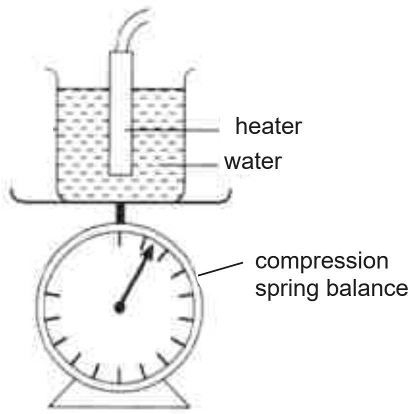
A 6 °C **B** 8 °C **C** 30 °C **D** 40 °C

23. The graph shows how the thermometric property of four substances changes with temperature.



Which substance can be used to construct a temperature scale?

24. The setup shown in the diagram is used to measure the specific latent heat of vaporisation of water.



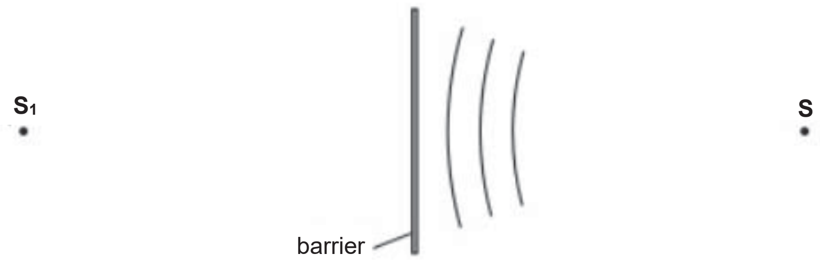
Three readings are taken by the compression spring balance.

m_1 = mass of the setup at the start of the experiment
m_2 = mass of the setup 5 minutes after the water starts to boil
m_3 = mass of the setup 8 minutes after the water starts to boil

If the heater has a power of 80 W, which expression could be used to calculate the specific latent heat of vaporisation of water?

A $\dfrac{14400}{m_1 - m_2}$ **B** $\dfrac{14400}{m_2 - m_3}$ **C** $\dfrac{24000}{m_1 - m_2}$ **D** $\dfrac{38400}{m_1 - m_3}$

25. The diagram represents circular wavefronts coming from **S**. The wavefronts are about to strike a solid barrier from which they will be reflected so as to appear to come from **S_1**.



Which diagram correctly shows the reflected wavefronts?

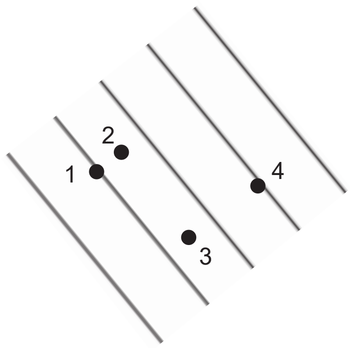
A

B

C

D

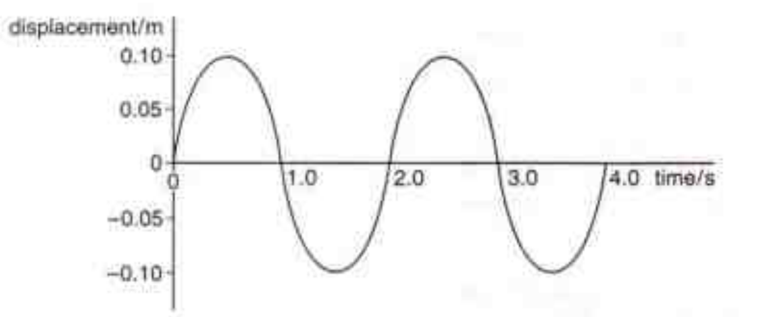
26. Four bottles are floating in a lake. The diagram shows the bottles as seen by a pilot in a hovering helicopter. The lines represent the crests of the waves in the lake.



Which two bottles are on the same wavefront?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

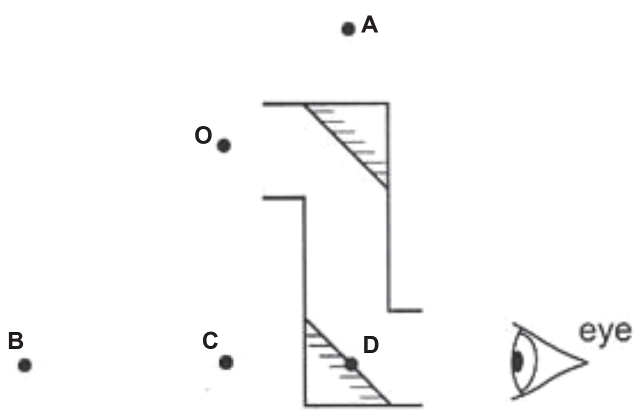
27. The diagram shows how displacement varies with time as a wave passes a fixed point.



What is the frequency of this wave?

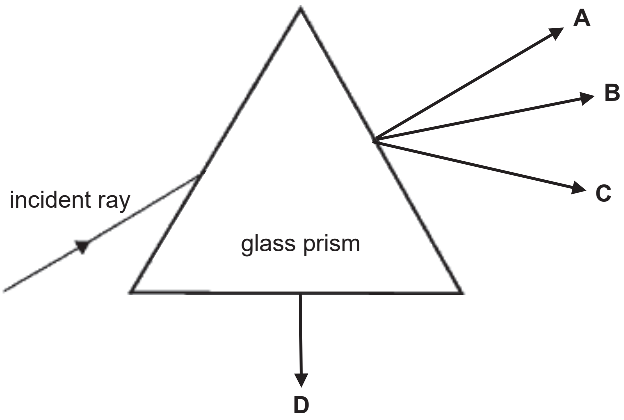
A 0.25 Hz **B** 0.50 Hz **C** 1.0 Hz **D** 2.0 Hz

28. A student looks into a periscope.

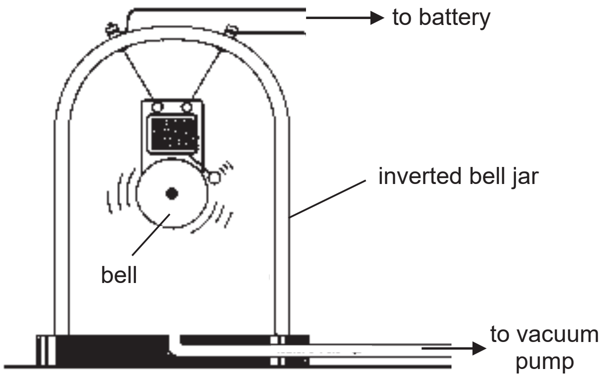


Where will he see the image of the object at **O**?

29. Which of the rays shows the correct direction of the emergent ray when the incident ray strikes the glass prism?



30. The diagram shows a bell ringing inside an inverted bell jar connected to a vacuum pump.



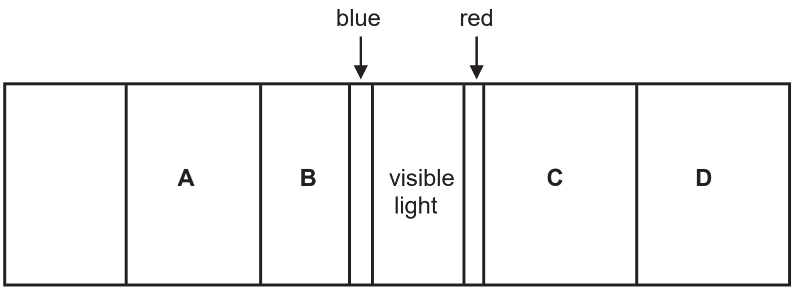
What happens to the pitch and loudness of the sound when the vacuum pump is switched on?

	pitch	loudness
A	decreases	decreases
B	decreases	increases
C	remains the same	decreases
D	remains the same	increases

31. A student faces a wall which is 800 m away and fires a starting pistol. His friend, standing 300 m behind him, hears two sounds. If the speed of sound is 340 m/s, what is the time interval between the two sounds heard by his friend?

A 3.24 s **B** 4.71 s **C** 5.59 s **D** 6.47 s

32. The diagram shows the electromagnetic spectrum, with the blue and red ends of the visible spectrum marked.

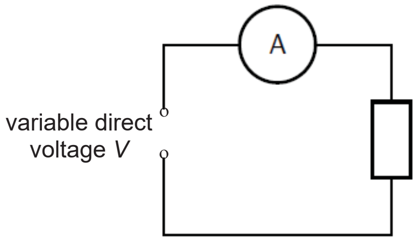


Which section of the spectrum has waves with the longest wavelength?

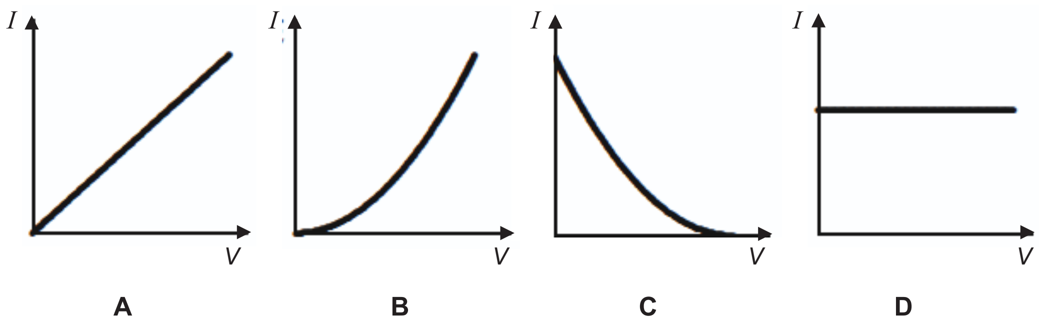
33. Which of the following statements about an electric field is correct?

A It is a field that contains electric charges.
B It is a field that surrounds electric charges.
C It is a region where a metal experiences a force.
D It is a region where an electric charge experiences a force.

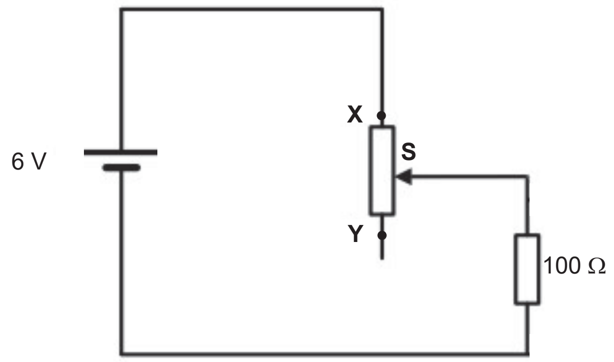
34. A circuit is used to find the current I passing through a fixed resistor for various voltages V.



Which graph shows how the current I varies with voltage V?



35. The diagram shows a 100 Ω resistor connected to a variable resistor.



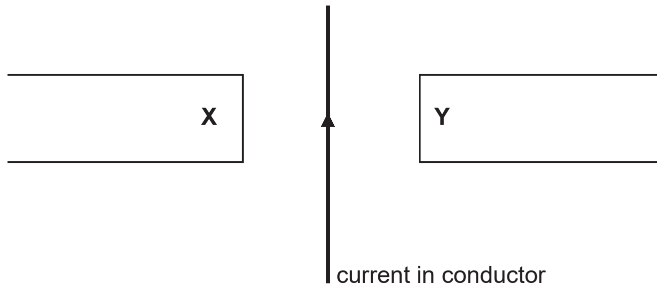
What happens to the potential difference across the 100 Ω resistor as the slider **S** is moved from **X** to **Y**?

A It becomes zero.
B It decreases.
C It increases.
D It remains at 6 V.

36. A mains electrical circuit uses insulated copper cable. The cable overheats. Which of the following changes will prevent the cable from overheating?

A use a thicker copper cable as it has less resistance
B use a thicker insulation to reduce heat loss to the surroundings
C use a thinner copper cable as it has less resistance
D use a thinner insulation to reduce heat loss to the surroundings

37. The diagram shows a current-carrying conductor placed in between two magnets.



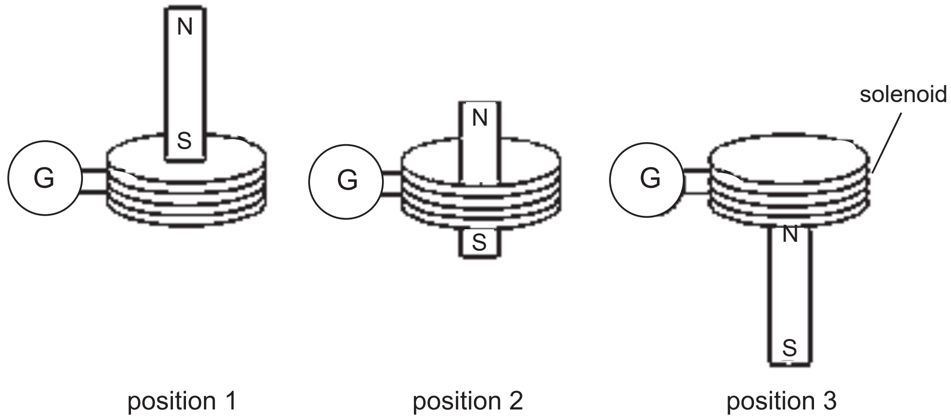
Which magnetic poles at **X** and **Y** will cause the conductor to move into the plane of the paper?

	X	**Y**
A	north	north
B	north	south
C	south	north
D	south	south

38. What is the function of the soft iron cylinder placed between the curved poles of the magnet in a d.c. motor?

A to control the speed of rotation of the coil
B to enable the coil to turn in one direction only
C to increase the forces acting on the coil
D to increase the magnitude of the induced e.m.f. in the coil

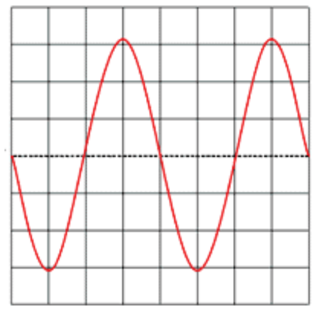
39. A bar magnet is dropped through a solenoid connected to a galvanometer.



At which position(s) will the galvanometer show a deflection?

A 1 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

40. The diagram shows a cathode-ray oscilloscope (c.r.o.) trace for a voltage produced by an a.c. generator. The time base of the c.r.o. is 30 μs/div.



If the coil in the a.c. generator is rotated at three times its current speed, what is the period of the new voltage?

A 10 μs **B** 40 μs **C** 90 μs **D** 360 μs

End of Paper

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2018

PHYSICS **6091/02**

Paper 2 Theory **11 September 2018**

Tuesday 0800 - 0945 **1 hour 45 minutes**

Candidates answer on the Question Paper.
No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.

Write in dark blue or black pen. You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

Section A [50 marks]

Answer **all** questions.

Section B [30 marks]

Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **17** printed pages, including this cover page.

Setter: **[Turn over**

Section A (50 marks)
Answer all the questions in the spaces provided.

1. A suitcase slides down a conveyer belt from an aeroplane as shown in Fig. 1.1. The suitcase starts from rest at **A**, which is at the top of the belt and slides down the belt until it reaches **B** which is 4.0 m below **A**. The suitcase then decelerates as it moves along the horizontal floor.

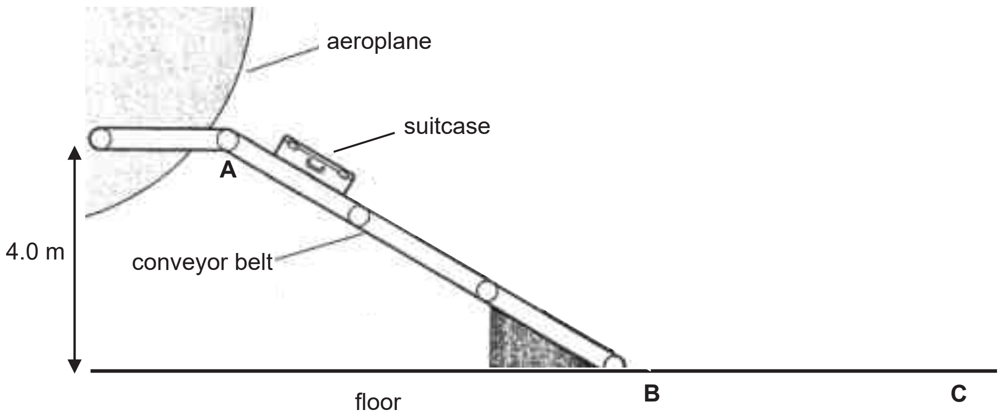


Fig. 1.1

The mass of the suitcase is 20 kg. The suitcase is moving at a horizontal speed of 5.0 m/s at **B**. Take gravitational field strength, g = 10 N/kg.

(a) Describe the energy changes that take place as the suitcase moves from **A** to **B**, and from **B** to **C** in Fig. 1.1. [2]

____

____

____

____

(b) Calculate the efficiency of the suitcase when it moves from **A** to **B**. [2]

(c) The suitcase comes to a rest at **C** three seconds after passing **B**. Determine the average retarding force exerted by the floor on the suitcase. [2]

2. Fig. 2.1 shows a sky diver falling vertically from an aircraft.

Fig. 2.1

(a) On Fig. 2.1, draw and label the forces experienced by the sky diver as he falls. [1]

(b) Fig. 2.2 shows the velocity-time graph for the sky diver during the first 20 s of his jump.

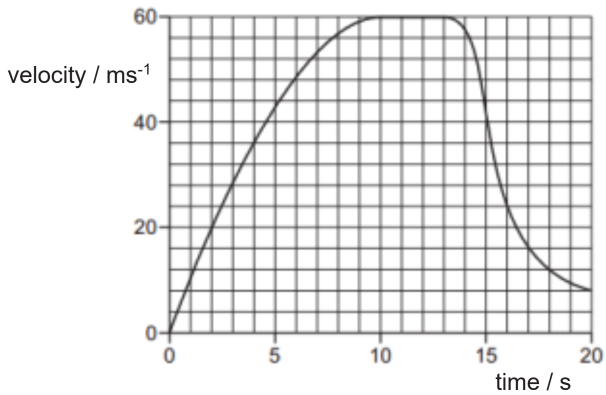


Fig. 2.2

The sky diver falls from rest at time = 0 s and initially accelerates at 10 m/s^2. He reaches a steady velocity after 10 s. At time = 13 s, he opens his parachute.

(i) Explain the motion of the sky diver from 0 to 10 s. [2]

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(ii) On Fig. 2.3, sketch the acceleration-time graph for the sky diver from time = 0 s to time = 13 s. [2]

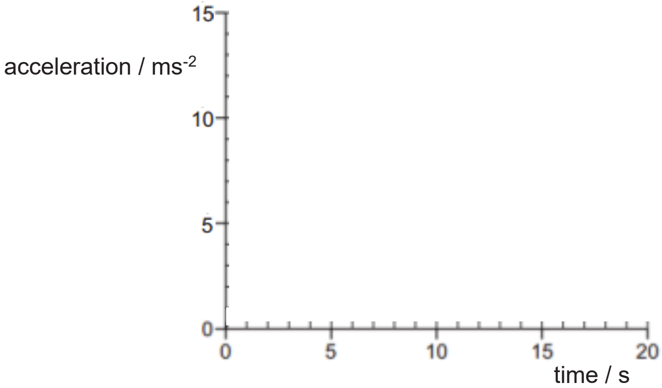

Fig. 2.3

(iii) Explain why the sky diver decelerates after he opens his parachute at time = 13 s. [2]

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3. Fig. 3.1 shows the apparatus that could be used to heat up water in a pot. The exterior wall of the pot is covered with a layer of polystyrene foam.

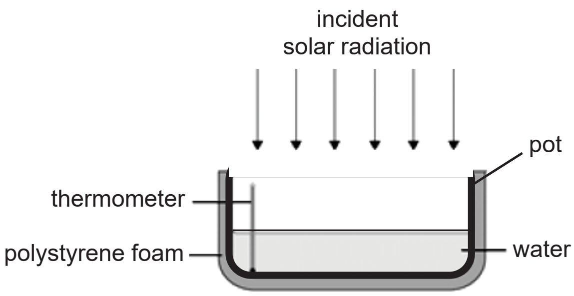

Fig. 3.1

A student puts the pot in direct sunlight and measured the time it took for the temperature of the water to increase. The energy transferred to the water is 5250 J and the time taken for the temperature of the water to increase from 27.0 °C to 29.0 °C is 25 minutes. The temperature of the air outside the pot is 35.0 °C.

(a) Calculate the power supplied by the Sun to the water in the pot. [1]

(b) (i) Other than heat exchange with the surroundings, suggest another reason why the student's results can only be used as an estimate of the power of the Sun. [1]

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(ii) Calculate the mass of the water inside the pot. The specific heat capacity of water is 4200 J/(kg°C). [2]

(c) Describe how the polystyrene foam insulates the pot. [2]

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(d) Explain why the water reaches a steady temperature after some time. [1]

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4. Fig. 4.1 (not drawn to scale) shows part of the path of a ray of light, **PQR**, travelling through an optical fibre. The optical fibre consists of a fibre of denser transparent material, coated with a layer of less dense transparent material. The left side of the fibre is horizontal while the right side of the fibre is bent.

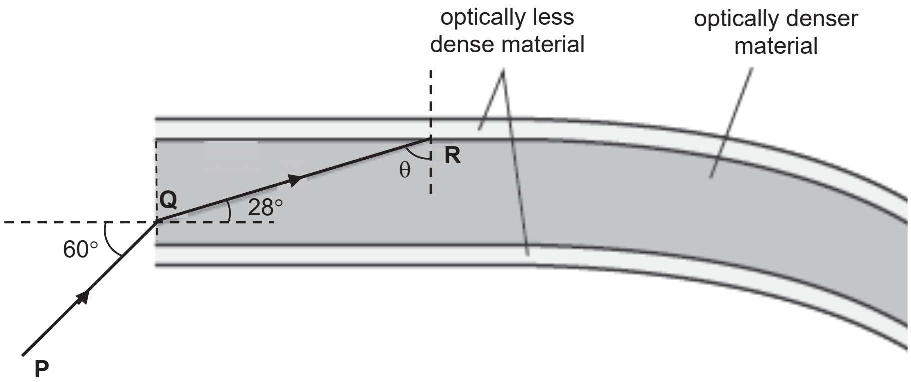

Fig. 4.1

(a) Complete the path of the ray of light until it reaches the end of the optical fibre. [1]

(b) The refractive index of the optically less dense material is assumed to be 1.0.

(i) Determine the minimum angle θ needed for total internal reflection to take place. [3]

(ii) Explain why it is necessary for the denser material to have a refractive index much higher than that of the less dense material. [2]

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(c) Other than the cost incurred, state one advantage of using optical fibres rather than copper wires for transmission of information. [1]

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5. Fig. 5.1 shows an object **AB** near a thin converging lens. The path of one ray from point **A**, passing through the lens, is drawn.

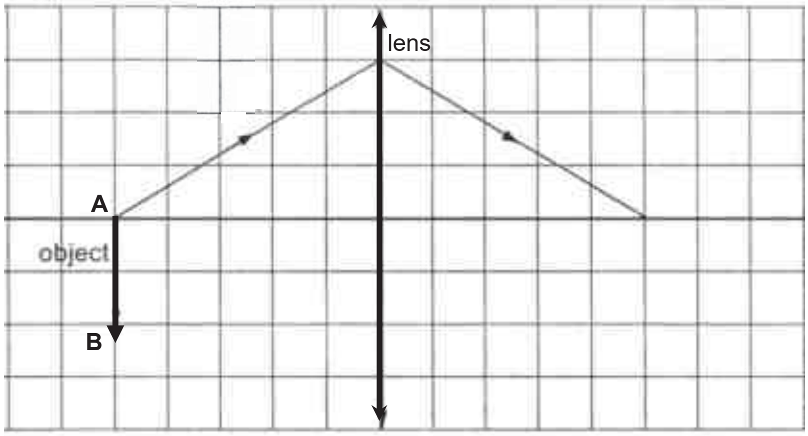

Fig. 5.1

(a) On Fig. 5.1, draw a suitable ray from point **B**, passing through the lens, to locate the position of the image of object **AB**. Label the image **A'B'**. [2]

(b) By drawing another ray from point **B** passing through the lens, mark the focal length of the lens. Label it **f**. [1]

(c) The converging lens may be used to form a virtual image of object **AB**. State where the object is placed, relative to the lens, for a virtual image to be formed. [1]

____

6. Fig. 6.1 shows a large metal sphere **X** supported on an insulating stand. Sphere **X** is connected to earth through switch **S**. A positively charged sphere **Y** is brought very close to sphere **X** and is held in place by two strings, **A** and **B**.

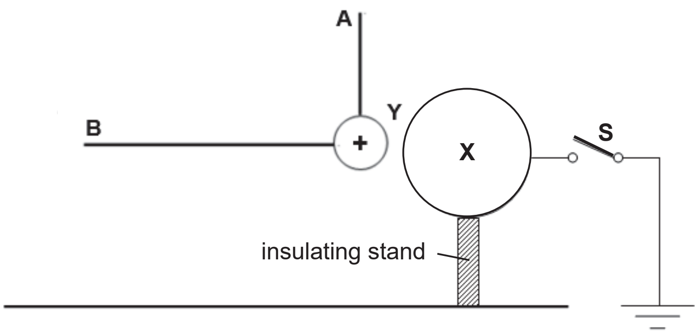

Fig. 6.1

Switch **S** is then closed.

(a) (i) On Fig. 6.1, draw the charge distribution on sphere **X**. [1]

(ii) Explain your answer to (a)(i). [2]

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(b) String **B** is now cut with switch **S** remaining closed.

(i) Describe and explain the subsequent motion of **Y** until it comes to a rest. [3]

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(ii) On Fig. 6.2, draw the final position of rest of **Y**. [1]

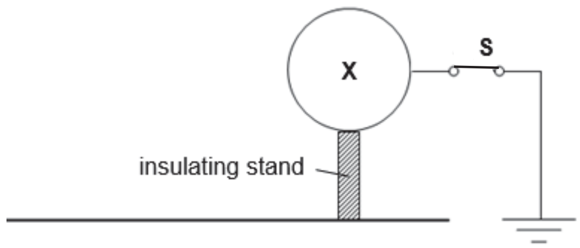

Fig. 6.2

7. Fig. 7.1 shows an electric circuit. **E** is a 1.5 V cell and **T** is a thermistor whose variation of resistance with temperature is shown in Fig. 7.2.

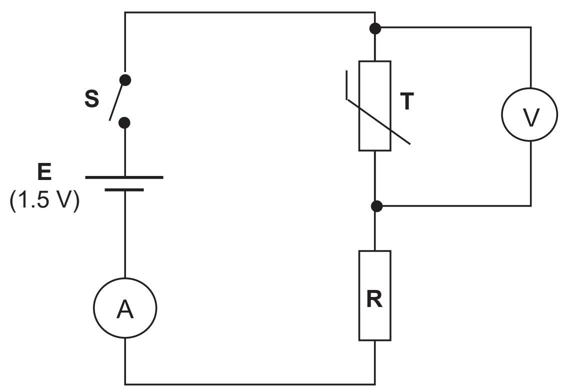

Fig. 7.1

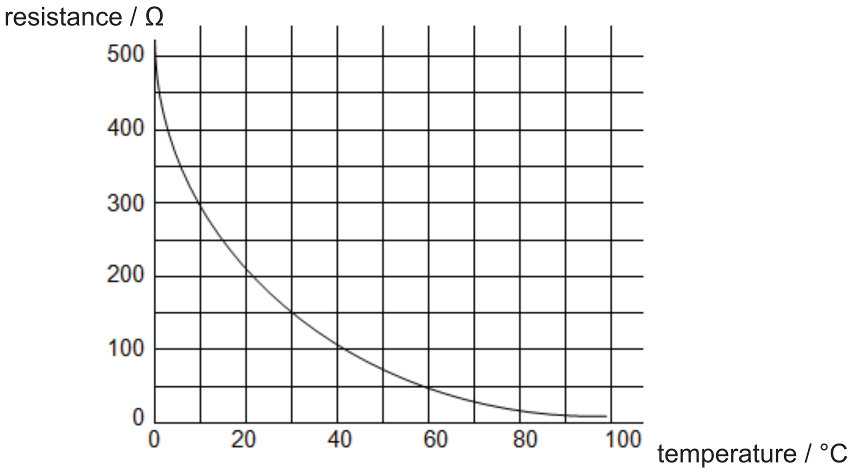

Fig. 7.2

(a) When the thermistor is at 30 °C and switch **S** is closed, the reading on the ammeter is 6 mA. Determine the resistance of resistor **R**. [3]

(b) The temperature of the thermistor increases from 30 °C to 60 °C.

(i) Calculate the reading on the ammeter at 60 °C. [1]

(ii) Explain the change in the potential difference across **T**, if any, when the temperature of the thermistor increases. [2]

8. Fig. 8.1 shows how power cables are used to transmit electrical energy from a power station to the consumers in a village. The power station produces electricity at an alternating voltage of 20 kV. The output voltage of transformer **J** is 285 kV, while the voltage supplied to the consumers is 240 V. Assume that transformers **J** and **K** are ideal.

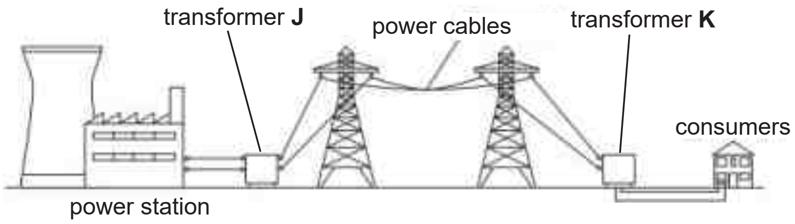

Fig. 8.1

(a) Explain why transformer **J** is not able to transform the voltage of a direct current. [2]

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(b) Calculate the number of turns in the primary coil of transformer **J** if there are 48 000 turns in the secondary coil. [2]

(c) Explain why the voltage of power station was stepped up from 20 kV to 285 kV before being transmitted over the power cables. [2]

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Section B (30 marks)

Answer all the questions in the spaces provided.
Question 11 has a choice of parts to answer.

9. A student investigated how current varies with potential difference for two different lamps **X** and **Y**. Fig. 9.1 shows the readings obtained.

potential difference / V	current in lamp **X** / A	current in lamp **Y** / A
0.0	0.00	0.00
1.0	0.15	0.07
2.0	0.30	0.14
3.0	0.40	0.21
4.0	0.48	0.28
5.0	0.55	0.34
6.0	0.60	0.39
7.0	0.64	0.43
8.0	0.67	0.46

Fig. 9.1

(a) In the space below, draw the diagram of a circuit that the student could use to obtain the results in Fig. 9.1. The current in lamp **X** must be obtained at the same time as the current in lamp **Y**. [2]

(b) State the values of potential difference for which **both** lamp **X** and lamp **Y** behave like ohmic conductors. Explain your answer. [2]

(c) Using Fig. 9.1, explain which lamp has a higher resistance. [2]

(d) Using your answer from (c), explain which lamp is brighter at any potential difference. [2]

(e) The student repeats his investigation with a strong wind blowing over the lamps. Fig. 9.2 shows the readings obtained at a potential difference of 4.0 V.

potential difference / V	current in lamp **X** / A	current in lamp **Y** / A
4.0	0.50	0.31

Fig. 9.2

Explain why the values of current in Fig. 9.2 are different from that in Fig. 9.1 for the same potential difference across the lamps. [2]

10. Fig. 10.1 shows a loudspeaker made by a student. A coil of wire is fixed to one end of the paper cone. When the switch is closed, the paper cone moves to the right.

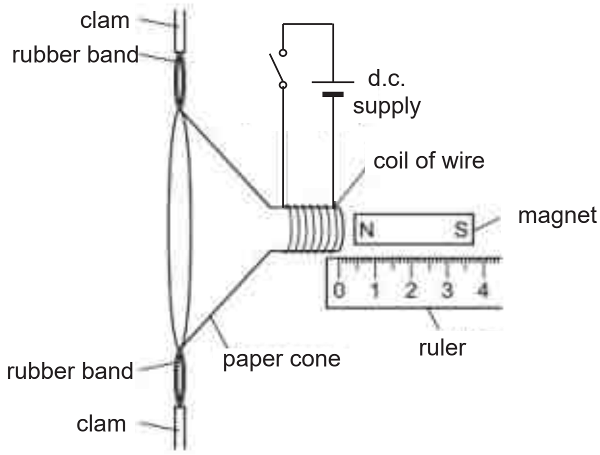

Fig. 10.1

(a) Explain why the paper cone moves to the right when the switch is closed. [3]

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(b) The student investigates how changing the size of the current in the coil of wire affects the horizontal distance moved by the paper cone. The results of the student's investigation are shown in Fig. 10.2.

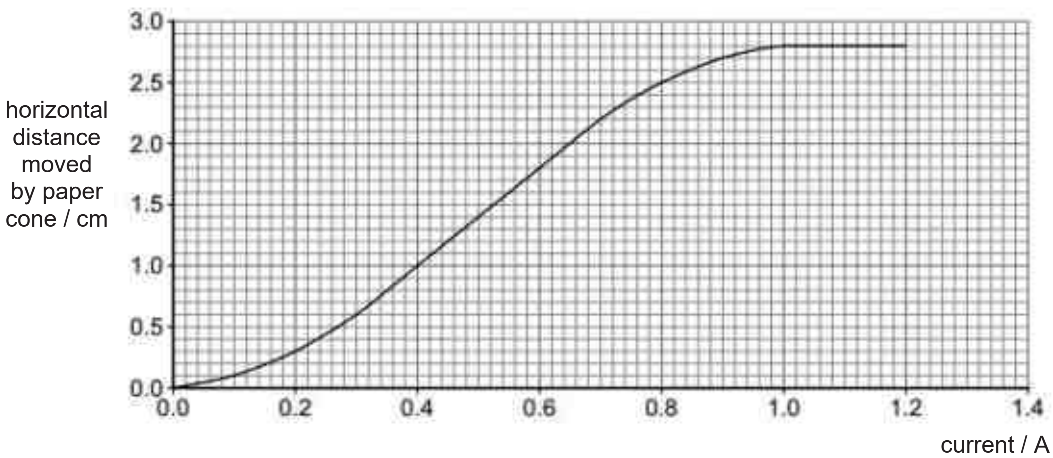

Fig. 10.2

State and explain the results of the student's investigation when the current increases from 0.0 A to 1.0 A. [2]

(c) Sound is produced when there is an alternating current in the coil.

(i) Explain how sound is produced when there is an alternating current in the coil. [2]

(ii) Describe how the particles of the cone provides an example of longitudinal wave motion. [1]

(iii) Explain the difference in the sound heard when the size of the alternating current is increased. [2]

EITHER

11. Fig. 11.1 shows a manometer attached to a tyre to measure the pressure difference between the air inside the tyre and the atmosphere outside. The atmospheric pressure outside the tyre is 100 000 Pa.

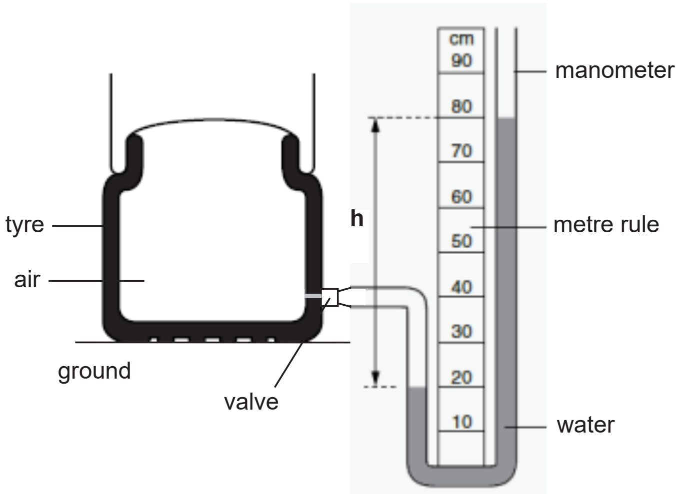

Fig. 11.1

(a) (i) Mark on the manometer, a point **P** where the pressure is 20 cm of water higher than atmospheric pressure. [1]

(ii) Calculate the pressure of the air inside the tyre. The density of water is 1000 kg/m^3 and the gravitational field strength, g = 10 N/kg. [2]

(iii) State what change, if any, will occur to the height **h** if a liquid denser than water is used in the manometer. [1]

____

(b) Describe the motion of air molecules inside the tyre and explain how this results in a pressure exerted by air on the walls of the tyre. [2]

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(c) The tyre goes over a stone as shown in Fig. 11.2.

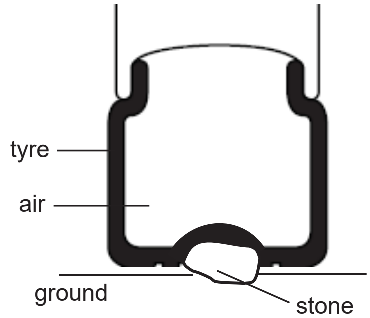

Fig. 11.2

State and explain

(i) how the pressure exerted on the ground changes. [1]

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____

(ii) how the pressure inside the tyre changes. [3]

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OR

11. The weight of a rock, which is more than 20 N, cannot be measured directly using a spring balance with a maximum reading of 20 N. Fig. 11.3 shows a setup that could be used to determine the weight of the rock.

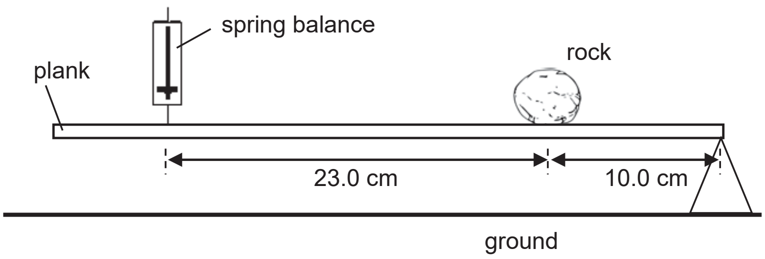

Fig. 11.3

A weightless plank is pivoted with the rock placed 10.0 cm from the pivot. The plank is suspended by a spring balance at a point 23.0 cm from the rock. The plank balances horizontally and the reading on the spring balance is 6.5 N.

(a) (i) State the *principle of moments*. [1]

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(ii) Explain why this setup can enable the weight of the rock to be determined. [2]

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(iii) Calculate the weight of the rock. [2]

(b) The rock falls off the plank and hits the ground with a speed of 7.0 m/s. The vertical distance of the plank from the ground is 2.5 m.

(i) Calculate the time taken for the rock to hit the ground. State two assumptions that you have made during your calculations. [3]

assumption 1: ___

assumption 2: ___

(ii) Calculate the work done on the rock by the force of gravity. [2]

End of Paper

Answers to PRSS Prelim 2018 4E Pure Physics Paper 1

1	C	**11**	C	**21**	C	**31**	B
2	C	**12**	D	**22**	C	**32**	D
3	B	**13**	A	**23**	D	**33**	D
4	C	**14**	C	**24**	B	**34**	A
5	A	**15**	C	**25**	D	**35**	B
6	B	**16**	A	**26**	C	**36**	A
7	C	**17**	D	**27**	B	**37**	B
8	C	**18**	D	**28**	B	**38**	C
9	A	**19**	A	**29**	C	**39**	B
10	C	**20**	C	**30**	C	**40**	B

Answers to PRSS 4E Physics Prelim 2018

Section A

1. (a) From **A** to **B**, gravitational potential energy of the suitcase is converted to kinetic energy and thermal (and sound) energy. [1]
From **B** to **C**, the kinetic energy of the suitcase is converted to thermal (and sound) energy. [1]

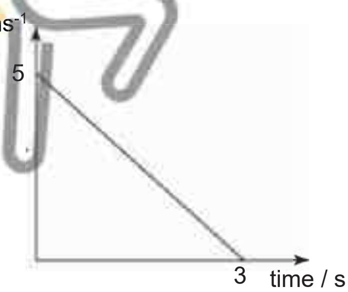
(b) Efficiency = (useful energy output / input energy) x 100%
= (KE at **B** / GPE at **A**) x 100%
= ($\frac{1}{2}$ x 20 x 5.0^2 / 20 x 10 x 4) x 100% [1]
= 31% [1]

(c) Acceleration of suitcase, a = (v - u) / t
= (0 - 5.0) / 3
= - 1.67 m/s^2 [1/2]

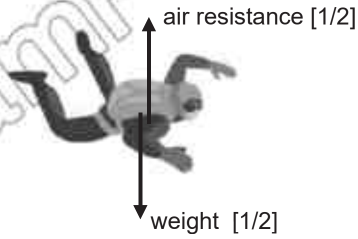
F = ma
0 - retarding force = 20 x (- 1.67) [1/2] ECF
Retarding force = 33.4 N [1] ECF

OR

Work done by retarding force = Loss in KE
F x (1/2 x 3 x 5.0) = ½ x 20 x 5.0^2 [1]
F = 33.3 N [1]

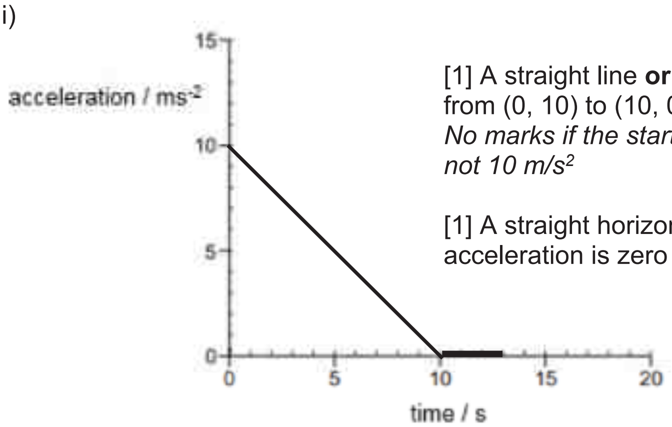


2. (a)



(b) (i) As he falls, his velocity increases [1/2] and this causes the air resistance to increase [1/2].
The (downward) resultant force decreases [1/2], hence his acceleration is decreases [1/2].

(ii)



[1] A straight line **or** curve with negative gradient from (0, 10) to (10, 0).
No marks if the starting value of acceleration is not 10 m/s^2

[1] A straight horizontal line showing that acceleration is zero from 10 to 13 s.

(iii) After the sky diver opens the parachute, the resistive force or air resistance acting on him becomes greater than his weight. [1]
Resultant force on him becomes negative / resultant force acts in a direction opposite (upwards) to his motion [1] and hence he decelerates.

3. (a) Power, P = E / t
= 5250 / (25 x 60)
= 3.5 W [1]

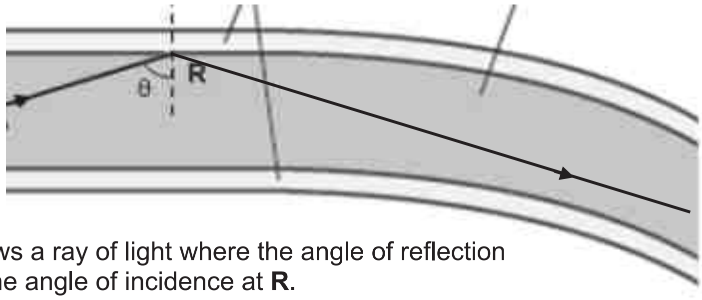
(b) (i) Some of the energy from the Sun is used to heat the pot (as well as the water).
OR
The intensity of solar radiation on the apparatus changed during the 25 minutes.
OR
The thermometer is touching the base of the pot and is not exactly measuring the temperature of the water
OR
Clouds block sun rays from reaching the pot.
OR
The distance of the pot from the Sun is large and some of the Sun's energy is lost before reaching the water.
Any one [1]

(ii) $Q = mc\Delta\theta$
$5250 = m \times 4200 \times (29.0 - 27.0)$ [1]
$m = 0.625$
$= 0.63$ kg or 630 g [1]

(c) The air trapped in polystyrene [1] is a poor conductor of thermal energy [1/2].
Convection is restricted as air is trapped [1/2].
Hence heat transfer by conduction and convection is reduced.

(d) The rate at which the water gains heat from the Sun is equal to the rate of heat loss to the surroundings.
OR
There is no net heat transfer between the water and the surroundings.
Any one [1]

4. (a)



[1] Correctly draws a ray of light where the angle of reflection is equals to the angle of incidence at **R**.

(b) (i) Refractive index, n $= \sin i / \sin r$
$= \sin 60° / \sin 28°$
$= 1.84$ [1]

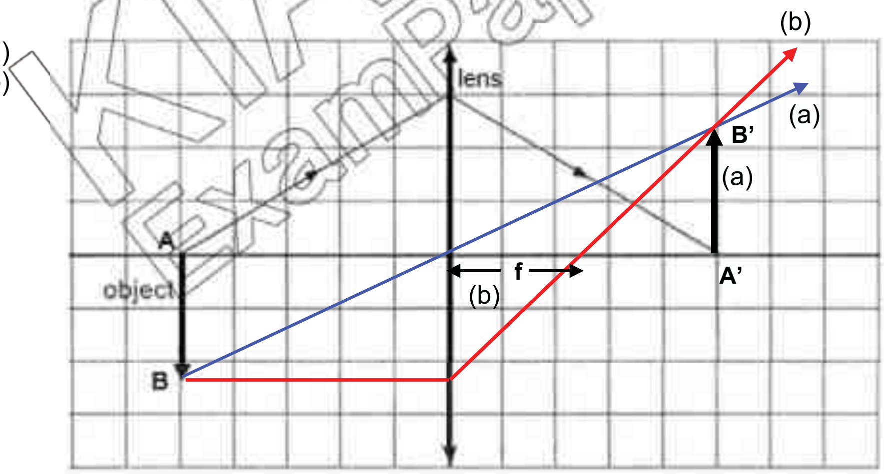
sin c $= 1 / n$
$= 1 / 1.84$ [1/2] ECF
c $= 32.9°$ [1] ECF

Minimum angle $\theta =$ 32.9° [1/2]

(ii) This will ensure a small critical angle. [1]
Total internal reflection will take place more easily / more rays can undergo total internal reflection. [1]

(c) Optical fibres can carry more information than copper wires.
OR
Transmission of information is faster.
OR
There will be lower energy loss / signal loss during transmission.
OR
Information can be transmitted over a longer distance. Any one [1]

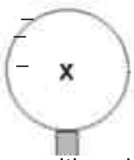
5. (a)
(b)



[1] Draws a ray from **B** passing through the optical centre of the lens.
[1] Draws and label the image **A'B'** correctly.
[1/2] Draws a ray parallel to principal axis and passing through the lens to reach point **B'**.
[1/2] Indicates and label the focal length **f** correctly.

(c) The object must be placed less than the focal length from the lens. [1]

6. (a) (i)

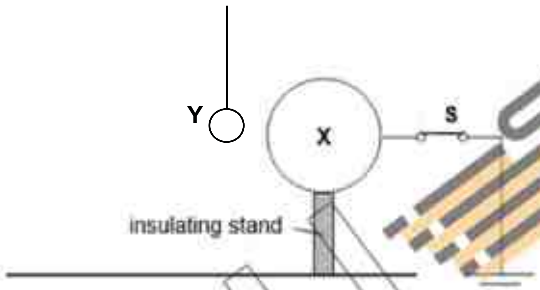


[1] Draws negative charges on the left side of **X** and no positive charges on the right side.

(ii) The positive charges in **Y** attracts electrons from earth [1] as unlike charges attract [1/2].
This induces a negative charge on the left side of **X**. [1/2]

(b) (i) **Y** moves towards **X** [1/2] as unlike charges attract [1/2].
When **Y** touches **X** [1/2], **Y** is discharged / neutralised [1/2] by the earth.
Y then moves away from **X** [1/2] due to gravitational force [1/2] and oscillates before coming to a rest.

(ii)



[1] Draws **Y** being suspended vertically by string **A**.

7. (a) Resistance of the whole circuit = V / I
= 1.50 / (6 x 10^{-3})
= 250 Ω [1]

Resistance of thermistor at 30°C = 150 Ω [1]

Resistance of resistor **R** = 250 - 150
= 100 Ω [1] ECF

OR

Resistance of thermistor at 30°C = 150 Ω [1]

Pd across thermistor = RI
= 150 x 6 x 10^{-3}
= 0.9 V [1/2]

Pd across resistor = 1.5 - 0.9
= 0.6 V [1/2]

Resistance of resistor **R** = 0.6 / 6 x 10^{-3}
= 100 Ω [1]

(b) (i) Resistance of **T** at 60°C = 50 Ω

Current on ammeter at 60°C = V / R
= 1.5 / (50 + 100)
= 10 mA [1] ECF

(ii) When temperature increases, resistance of thermistor decreases [1/2].
This decreases the ratio of resistance of **T** to the total resistance of the whole circuit.
OR
This decreases the ratio of resistance **T** to the resistance of **R**. [1]
The potential difference across **T** decreases. [1/2]

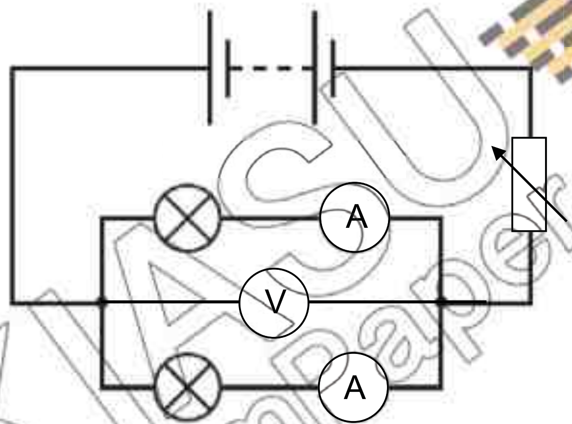
8. (a) A direct current does not produce a continuously changing magnetic field [1/2] in the primary coil of transformer **J** [1/2].
This will not result in electromagnetic induction or no emf will be induced [1/2] in the secondary coil [1/2].

(b) Np / Ns = Vp / Vs
Np / 48 000 = 20 / 285 [1]
Np = 3370 [1] Accept 3368

(c) Stepping up the voltage will reduce the transmission current [1].
As power loss, P = I^2R [1/2], this will reduce power loss as heat [1/2] in the cables.

Section B

9. (a)



Lamps in parallel [1/2] with voltmeter connected in parallel with the lamps [1/2].
An ammeter on each branch to measure the current through lamps. [1/2]
A variable resistor or potentiometer is used to vary the potential difference across the lamps. [1/2]
Deduct ½ mark if battery / power source missing

(b) Values of potential difference is from 0.0 V to 2.0 V. [1/2]
The ratio of potential difference to current is constant / current is proportional potential difference [1] showing that resistance is constant [1/2].

(c) Lamp **Y** has a lower current than lamp **X** [1] for any value of potential difference [1/2].
Lamp **Y** has a higher resistance than lamp **X** [1/2].
*No marks for a simple answer e.g. 'the resistance of **Y** is higher'.*

(d) As power output P = V^2 / R [1/2], **X** has a higher power output as its resistance is lower [1]. Hence **X** is brighter [1/2].
*No marks for a simple answer e.g. '**X** is brighter'.*

(e) Wind removes heat from the lamps [1/2] and lowers their temperature. [1/2]
As temperature lowers, the resistance of the lamps decreases [1/2] and hence current is higher [1/2].

10. (a) When switch is closed, current flows through the coil [1/2] and produces a magnetic field in the coil [1/2]
The right side of the coil is magnetised with a south polarity [1/2]. The magnet attracts the coil [1] as unlike poles attract [1/2] causing the cone to move to the right.

(b) The horizontal distance moved by the cone increases [1/2] non-linearly [1/2] with current.
The strength of magnetic field in the coil increases with current or the coil becomes a stronger electromagnet [1/2] and results in a greater attractive force between the coil and the magnet [1/2].

(c) (i) An alternating current causes the coil to be continuously attracted and repelled by the magnet. [1]
This causes the cone to vibrate [1] and a sound wave is produced.

(ii) The sound produced travel in a direction parallel to the vibration of the particles of the cone. [1]

(iii) The sound heard is louder. [1]
As current increases, the amplitude of vibration [1] of the cone increases.

EITHER

11. (a) (i) Point **P** marked at 60 cm mark on the manometer tube. [1]

(ii) Pressure of air = Atmospheric pressure + ρhg
= 100000 + (1000 x 0.6 x 10) [1]
= 106000 Pa (1.06 x 10^5 Pa) [1]

(iii) **h** decreases. [1]

(b) The air molecules are moving randomly / continuously [1/2] at high speeds [1/2].
When the air molecules hit the walls of the tyre, a force is exerted [1/2] and this since pressure is force per unit area [1/2], a pressure is exerted on the walls.

(c) (i) There is less surface area in contact with the ground [1/2]. Hence pressure increases [1/2].

(ii) The air inside the tyre is compressed or volume of air inside the tyre decreases [1]. The number of air molecules per unit volume inside the tyre increases [1/2] and this increases the frequency of collision between the air molecules and the tyre [1]. Pressure inside the tyre increases [1/2].

OR

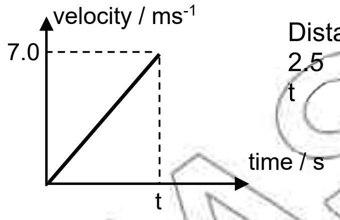
11. (a) (i) For an object in equilibrium, the sum of clockwise moment about a pivot is equal to the sum of anticlockwise moment about the same pivot. [1]

(ii) The clockwise moment due to spring balance is equal to the anticlockwise moment due to rock about pivot [1/2].

As moment = force x perpendicular distance [1/2], a larger perpendicular distance of spring balance from pivot enables a reading less than 20 N / smaller reading [1] to be recorded on the spring balance.

(iii) Clockwise moment about pivot = Anticlockwise moment about pivot
6.5 x 33.0 = W x 10.0 [1]
W = 21.45
= 21.5 N [1] 2 or 3 sf

(b)



Distance travelled = Area under the graph
2.5 = ½ x 7.0 x t [1]
t = 0.714 s [1] 2 or 3 sf

Assumption 1: The rock falls from rest / The initial velocity of the rock is 0 m/s. [1/2]
Assumption 2: The rock is experiencing free fall / accelerates constantly / there is no air resistance acting on the rock. [1/2]

(c) Work done on the rock = F x d
= 21.5 x 2.5 [1] ECF
= 53.8 J [1] 2 or 3 sf ECF

Class Register No.

Candidate Name_______________________________

PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2018
SECONDARY 4 EXPRESS

PHYSICS **6091 / 01**

Paper 1 Multiple Choice **18 September 2018**

1 hour

Additional Materials:
Multiple Choice Answer Sheet

INSTRUCTIONS TO CANDIDATES

Write in soft pencil.
Do not use paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on the spaces provided above and on the Multiple Choice Answer Sheet.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this paper.

This paper consists of **17** printed pages and **1** blank page.
Setter: Mrs Hsu L K

[Turn over

1 Which of the quantity is equivalent to one metre?

A 1.0×10^{-3} mm

B 1.0×10^{-3} Mm

C 1.0×10^{6} km

D 1.0×10^{9} nm

2 Which is a scalar quantity?

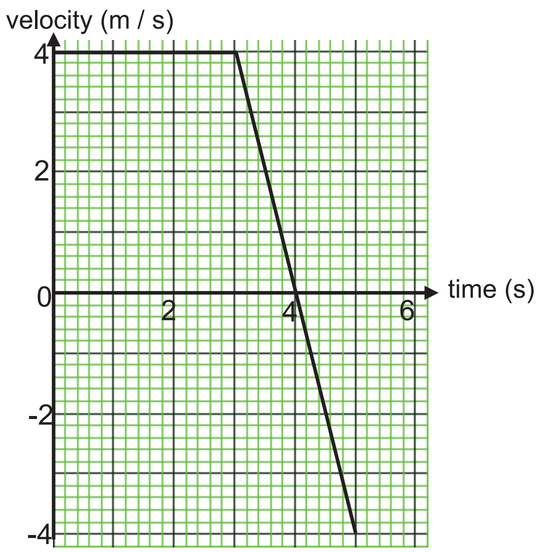
A weight

B electric field

C moment of a force

D electromotive force

3 The diagram shows the velocity-time graph for the motion of a body.



What is its displacement in the first 5 seconds?

A 8.0 m **B** 12 m **C** 14 m **D** 16 m

4 A car of mass 1000 kg is moving at a constant speed of 20 m / s.
What is the average braking force needed for it to come to a stop in 100 m?

A 1000 N **B** 2000 N **C** 3000 N **D** 4000 N

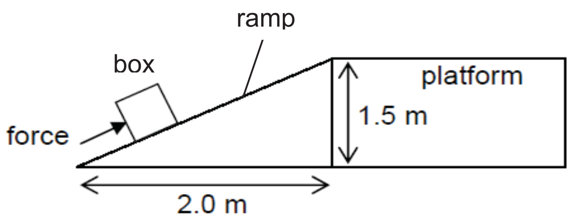
[Turn over

5 A man is standing on a weighing scale inside a lift. The weighing scale reads 500 N when the lift is stationary.

Which option describes correctly the reading on the weighing scale when the lift accelerates upwards and when the lift accelerates downwards?

	lift accelerates upwards	lift accelerates downwards
A	more than 500 N	less than 500 N
B	less than 500 N	more than 500 N
C	500 N	less than 500 N
D	more than 500 N	500 N

6 A man has to push a box weighing 500 N up a ramp from the ground to the raised platform.



Determine the minimum force required.

A 250 N

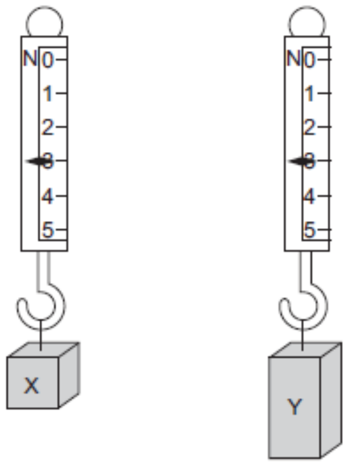
B 300 N

C 500 N

D 750 N

[Turn over

7 Two metal blocks X and Y are hanging from the spring balances at the same location in the laboratory as shown below.



Which statement is true about X and Y?

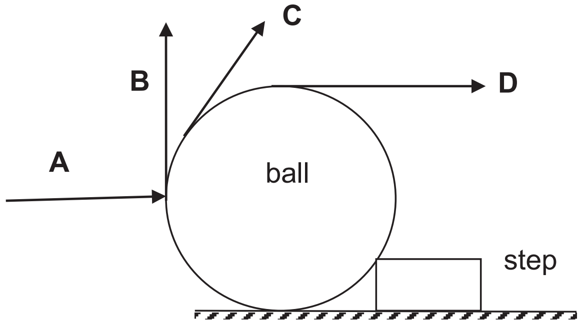
A They have same mass but different weight.

B They have same weight but different density.

C They have different volume and different weight.

D They have different density and different mass.

8 Which force **A**, **B**, **C** or **D** would be the **largest** force required to be exerted in order to push the ball up the step?

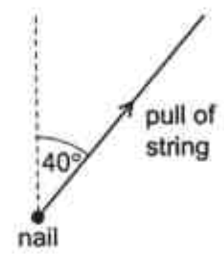


9 An object of mass 2 kg is thrown vertically upwards. The kinetic energy of the object when it is at a height of 3.0 m above the ground is 4.0 J.
Assuming negligible air resistance, what is maximum height reached by the object?
(The gravitational field strength is 10 N / kg.)

A 3.2 m **B** 3.5 m **C** 3.8 m **D** 4.0 m

[Turn over

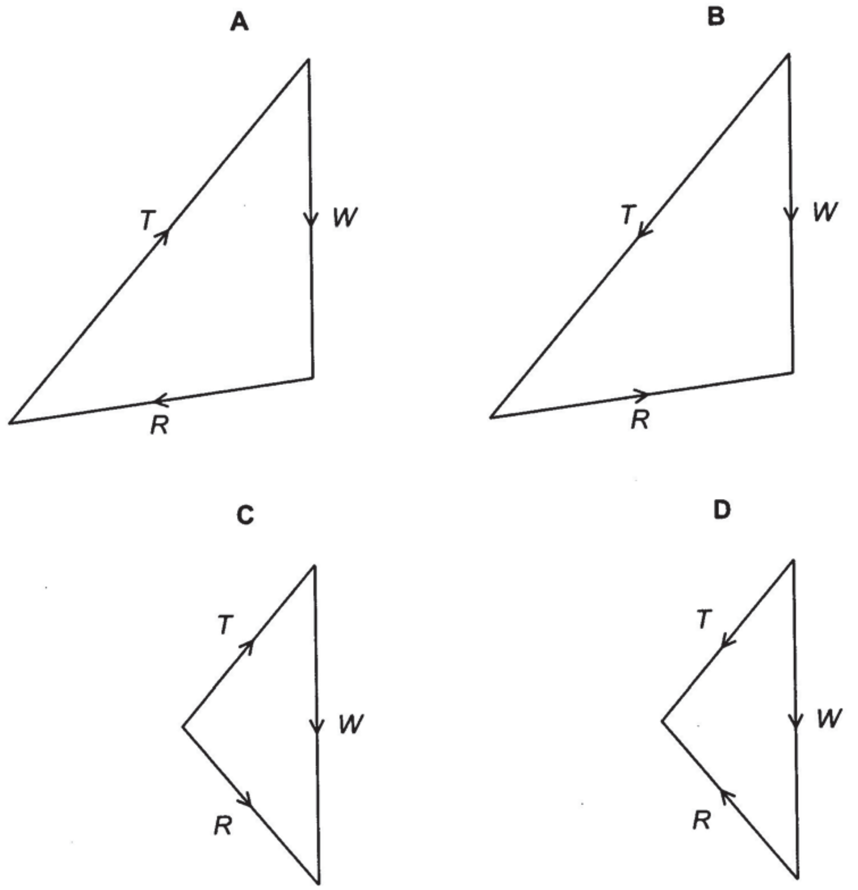
10 A heavy nail is fixed firmly to a wall. It is pulled by a string at 40° to the vertical. The nail does not move.



Three forces act on the nail.

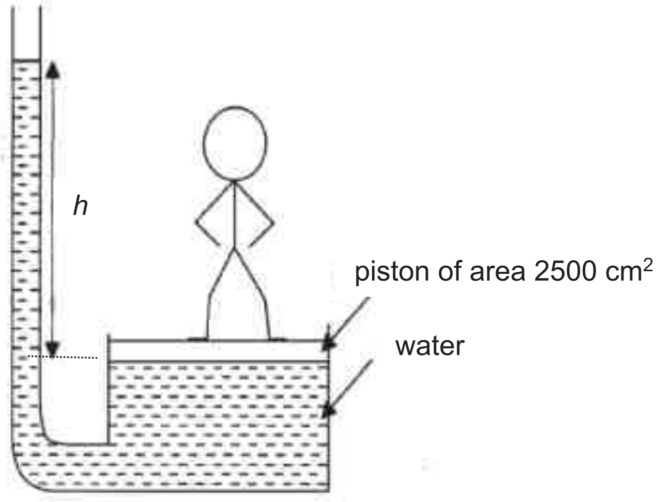
1 its weight W
2 the tension T in the string
3 the reaction force R between the nail and the wall

Which diagram, drawn to scale, represents the three forces in size and direction?



[Turn over

11 In the arrangement shown in the diagram, a person of mass 50 kg is standing on a piston of area 2500 cm^2.



Calculate the height *h* of the column of water.
(The gravitational field strength is 10 N / kg and the density of water is 1000 kg / m^3.)

A 0.2 m **B** 2.5 m **C** 5.0 m **D** 10.0 m

12 When fine pollen grains suspended in water are viewed under a microscope, they are seen to be making small random movements.
Which sentence explains this observation?

A There are convection currents in the water.

B The pollen grains are being hit by water molecules.

C The pollen grains are moving and colliding with one another.

D The pollen grains are living organisms so they move around.

13 The pressure of a gas in a cylinder is the **same** at all points in the cylinder.
Which statement explains this?

A The molecules of the gas are all of the same size.

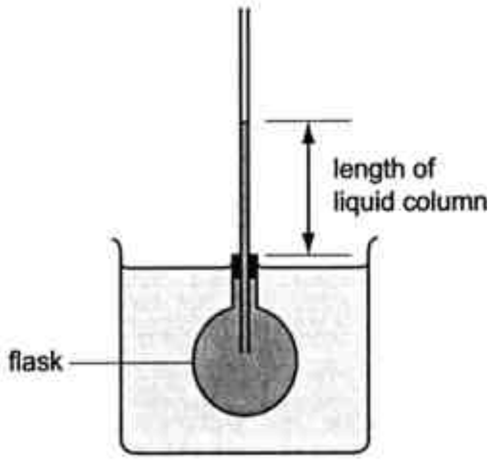
B The molecules of the gas attract one another.

C The molecules of the gas move at different speeds.

D There are many molecules, all moving at random.

[Turn over

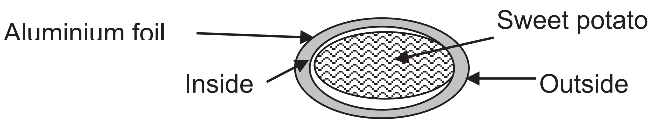
14 The diagram shows a flask of coloured liquid. A narrow tube passes through the stopper. When the flask is left in pure melting ice, the liquid column measured 100 mm. When the flask is left in boiling water, the liquid column measured 250 mm. When the flask is left in oil at a constant temperature, the length of the liquid column became 190 mm.



What is the temperature of the oil?

A 60 °C **B** 90 °C **C** 135 °C **D** 190 °C

15 Aluminium foils are commonly used to wrap sweet potatoes which are to be cooked in a barbecue fire as shown in the diagram.



How should the sweet potatoes be wrapped if the aluminium foil has one shiny side and one dull side?

A The shiny side should be on the outside because it is a better emitter of radiation.

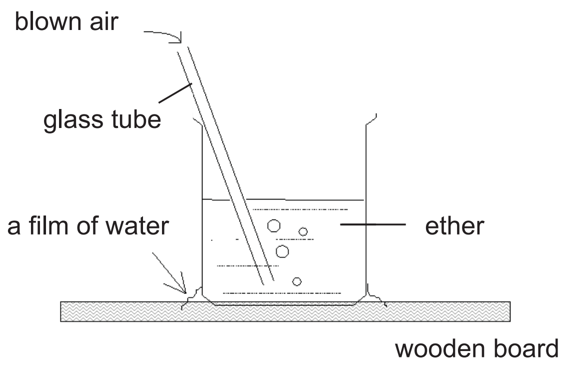
B The shiny side should be on the outside because it is a better conductor of heat.

C The dull side should be on the outside because it is a better absorber of radiation.

D The dull side should be on the outside because it is a better conductor of heat.

[Turn over

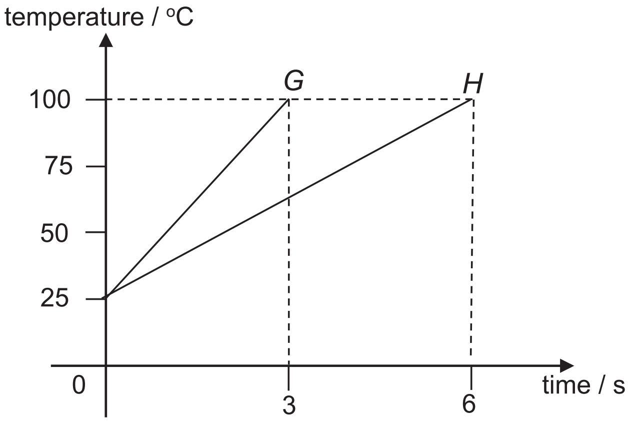
16 Air is blown into ether through the glass tube as shown in the diagram.
After some time, it is observed that the film of water freezes into ice.



Which option **best** describes the processes that results from blowing the air?

	rate of evaporation of ether	temperature of ether	heat transfer
A	increases	rises	from water to ether
B	increases	falls	from water to ether
C	decreases	falls	from ether to water
D	decreases	rises	from ether to water

17 The ratio of the masses of two metal blocks *G* and *H* is 1: 2. They are both heated uniformly using identical heaters. The temperature-time graphs of the blocks are shown below.

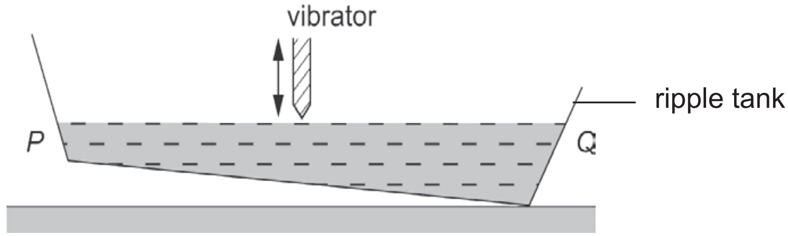


What is the ratio of the specific heat capacities of *G* and *H*?

A 1:1 **B** 1:2 **C** 2:1 **D** 4:1

[Turn over

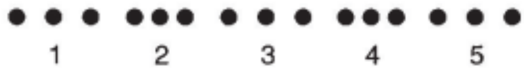
18 A vibrator is placed at the centre of an inclined ripple tank as shown.



How does the wavelength of the water wave change when it is moving towards the two ends *P* and *Q* of the ripple tank?

	towards *P*	towards *Q*
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	no change	no change

19 The diagram shows the position of air particles at a particular instance when a sound wave is passing.



The wavelength is the distance between

A 1 and 2

B 1 and 3

C 1 and 4

D 2 and 5

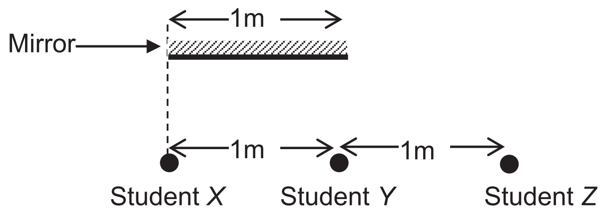
20 The diagram shows different regions of the electromagnetic spectrum with some of the regions identified.

radio waves	**A**	**B**	visible light	**C**	**D**	gamma radiation

Which region contains waves that can be used to detect counterfeit notes?

[Turn over

21 Three students stand 1 m apart in front of a plane mirror that is 1 m long.

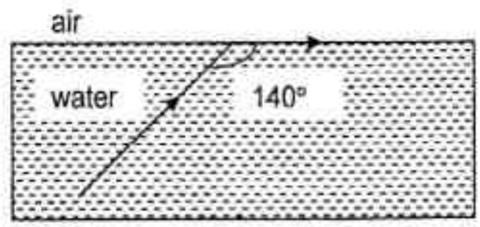


Student *X* stands in line with one edge of the mirror as shown above.

How many students can see the images of the other two?

A 0 **B** 1 **C** 2 **D** 3

22 The diagram shows the path of a ray of light as it strikes the water-to-air boundary.



What is the speed of light in water?

A 1.93×10^8 m / s

B 2.30×10^8 m / s

C 3.00×10^8 m / s

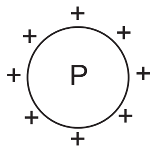
D 3.20×10^8 m / s

23 During a thunderstorm, a bolt of lightning sends out an electric charge of 20 C from a thundercloud to the Earth. If the energy produced by the lightning is about 500 MJ, determine the potential difference between the thundercloud and the Earth.

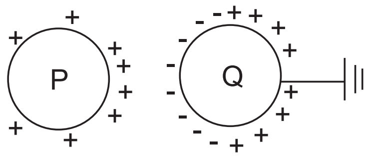
A 25 MV **B** 500 MV **C** 10 000 MV **D** 40 000 MV

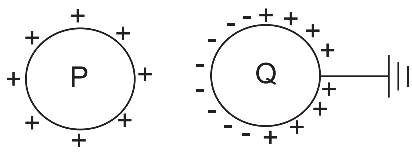
[Turn over

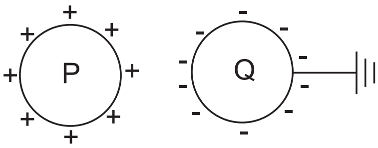
24 An isolated conducting sphere P has a charge distribution shown below.

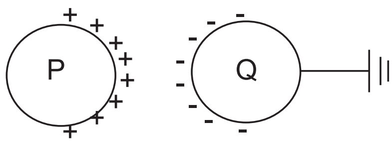


A similar sphere Q, connected to Earth by a long wire, is brought close to P.
Which diagram shows the final distribution of charge on the two spheres?

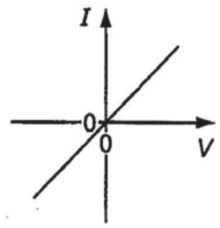
A


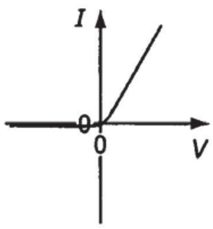
B


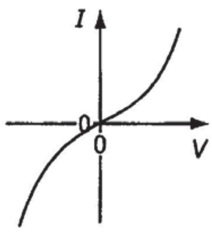
C


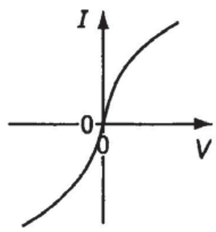
D


25 Which graph shows the I / V characteristic for a semiconductor diode?

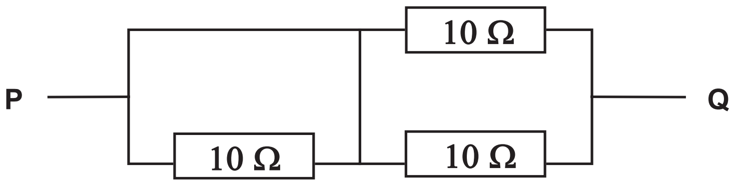
A


B


C


D


26 The diagram below shows a circuit.

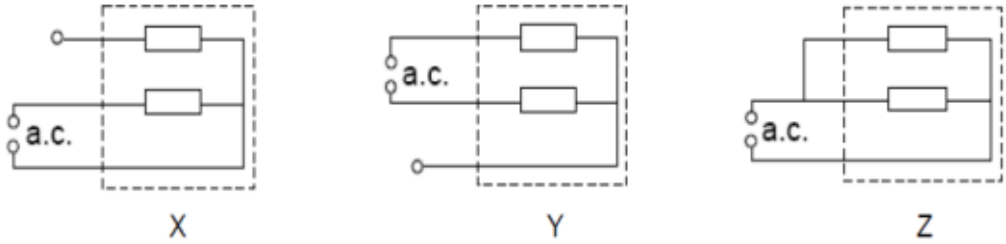


What is the effective resistance between terminals P and Q?

A 5 Ω **B** 15 Ω **C** 20 Ω **D** 30 Ω

[Turn over

27 An electric heater has two heating coils with identical resistances. They can be connected in three different ways as shown in circuits X, Y and Z below.



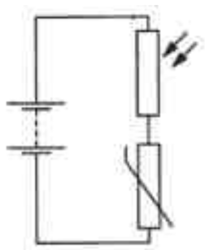
Which of the following correctly ranks the 3 circuits from the lowest to the highest based on the power of the circuit?

	lowest power	medium power	highest power
A	Y	X	Z
B	X	Z	Y
C	Z	X	Y
D	Z	Y	X

28 An electric iron marked 1000 W, 240 V is connected to a 120 V mains supply. What is the power dissipated by the electric iron?

A 250 W **B** 500 W **C** 1000 W **D** 2 000 W

29 A light-dependent resistor (LDR) and a thermistor are connected in series with a battery.



Which conditions cause the potential difference across the LDR to be the smallest?

A bright and cold
B bright and hot
C dark and cold
D dark and hot

[Turn over

30 The cost of a unit (kWh) of electricity is 10 cents.

appliance	power rating	time used
lamp	100 W	5 hours
heater	1.5 kW	3 hours
cooker	3 kW	30 minutes

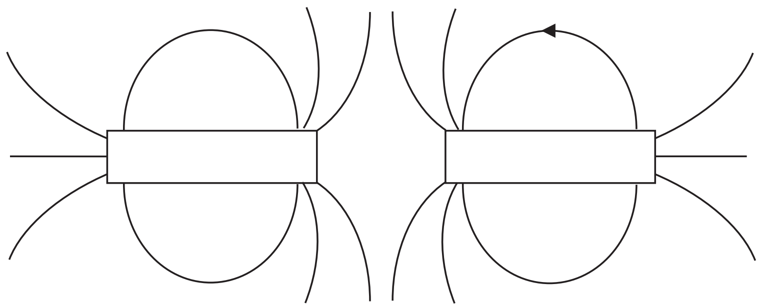
What is the total cost when all these appliances are used in the times shown above?

A 6.5 cents **B** 65 cents **C** 265 cents **D** 5060 cents

31 Which statement best describes an example of induced magnetism?

A A bar magnet attracts a piece of soft iron.
B A bar magnet loses its magnetism if it is repeatedly dropped.
C A bar magnet, swinging freely, comes to rest pointing in the North-South direction.
D Two North poles repel each other, but a North pole attracts a South pole.

32 The magnetic field lines of two bar magnets are shown below. The direction of **one** of the field lines is also shown.

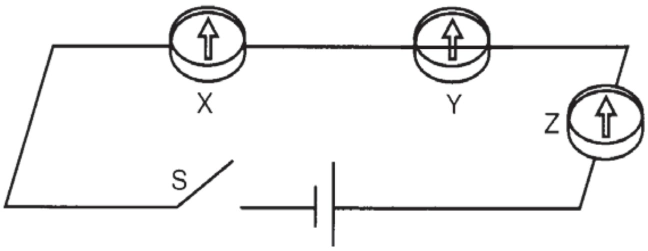


Which diagram represents the correct arrangement of the magnets?

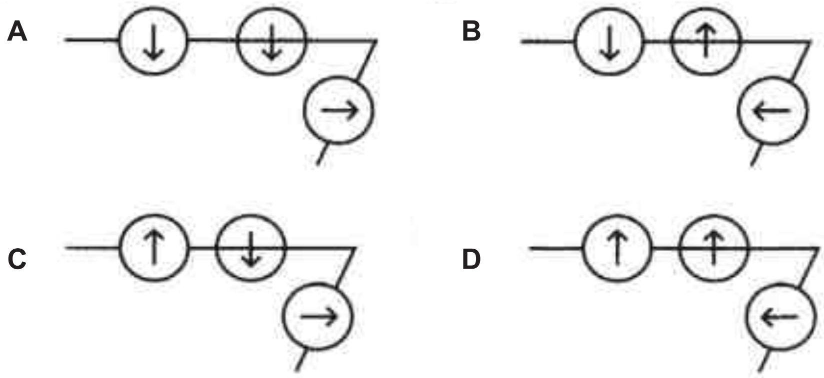
A | N S | | N S |
B | S N | | N S |
C | S N | | S N |
D | N S | | S N |

[Turn over

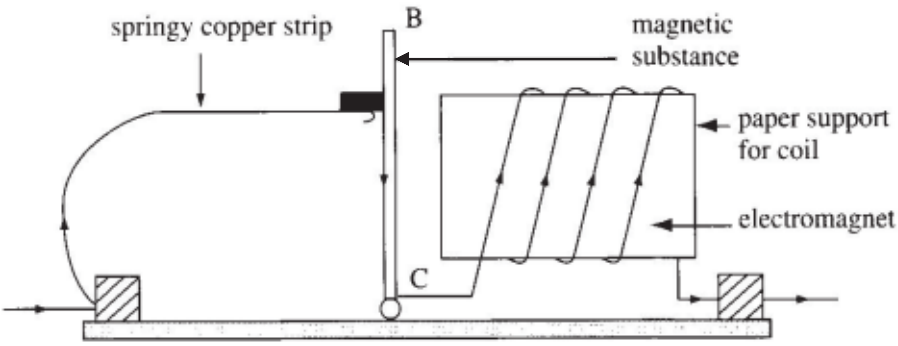
33 The diagram below shows a circuit with a wire connected to a battery and the switch S. The compasses X and Z are placed above the wire and the compass Y is placed below the wire.



When switch S is closed, which diagram correctly shows the orientations of the compass needles?



34 The diagram shows a model circuit breaker. If the current flowing in the circuit is excessive, the electromagnet attracts BC to break the circuit.



Which statement about the circuit breaker is correct?

A BC is best made of copper.

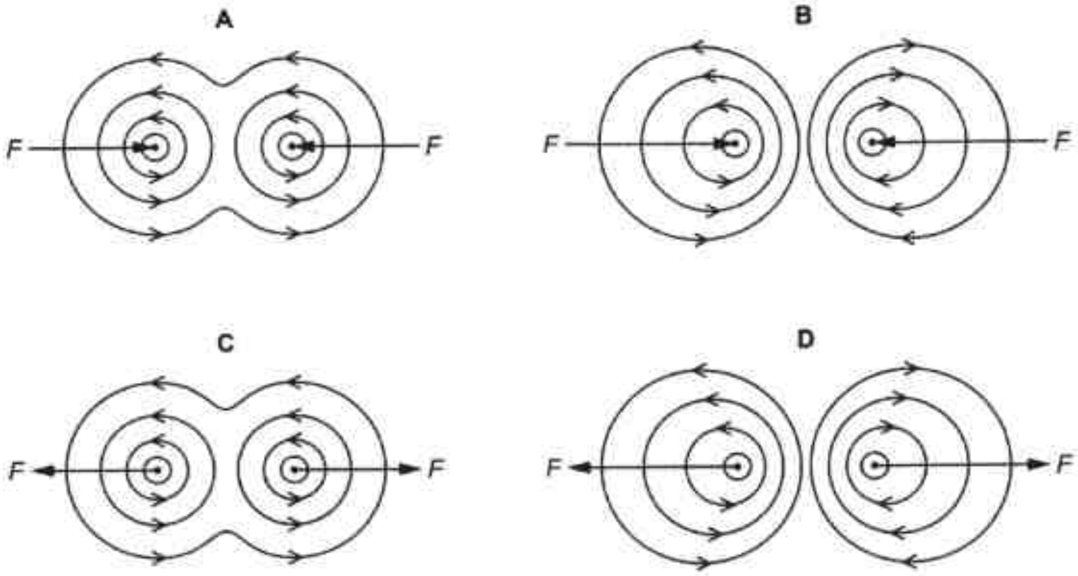
B The circuit breaker is suitable for circuit carrying an alternating current.

C The limiting current in the circuit increases if the current in the circuit is reversed.

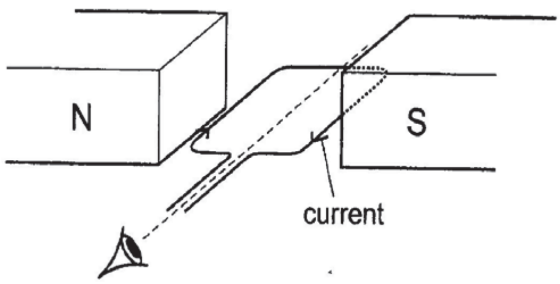
D The limiting current in the circuit will not change by placing a soft iron core inside the coil.

[Turn over

35 Two parallel, vertical wires each carry an upward current.
Which diagram shows the magnetic field pattern around the wires and the direction of the force **F** on each wire?



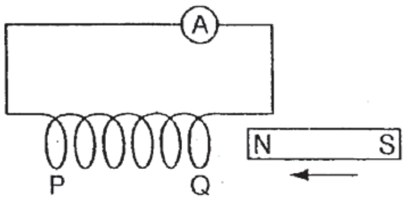
36 The diagram shows a pivoted coil held between the two poles of a magnet.
The pivoted coil carries a steady current in the direction shown.



When the coil is released, it rotates and then stops at an angle ɵ to its initial position.
When viewed as shown, in which direction does the coil rotate and what is the value of ɵ ?

	direction	ɵ
A	anticlockwise	90 °
B	anticlockwise	180 °
C	clockwise	90 °
D	clockwise	180 °

37 A student pushes the N-pole of a bar magnet into the end Q of a long solenoid and observes a deflection to the right on the sensitive ammeter.



Which process will produce a deflection in the same direction?

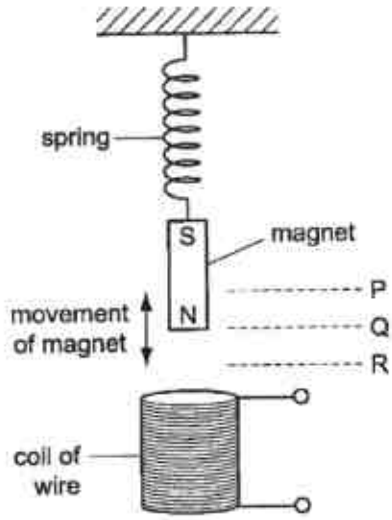
A pulling the N-pole out of end Q

B pulling the S-pole out of end P

C pushing the N-pole into end P

D pushing the S-pole into end P

38 A magnet moves up and down above a coil of wire.
The bottom of the magnet moves up and down between P and R.



Where is the bottom of the magnet when there is no induced electromotive force in the coil?

A at Q only

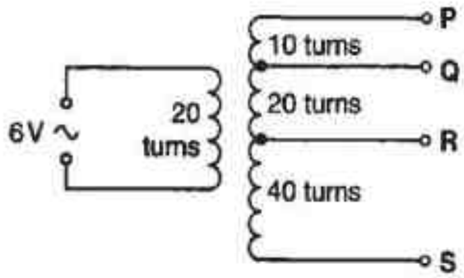
B at R only

C at P and Q

D at P and R

[Turn over

39 The number of turns between each pair of output terminals of a transformer is shown in the diagram.



Between which two terminals will the output be 12 V?

A P and Q

B Q and R

C R and S

D P and R

40 The diagram shows a long transmission line supplying energy at 230 V to two houses X and Y without using transformers. In both houses, electric heaters are switched on.

The occupier of house X switches off the heater in his house.
What happens in house Y?

	the voltage supplied to house Y	the power supplied to house Y
A	decreases	decreases
B	decreases	stays the same
C	increases	increases
D	increases	stays the same

End of Paper

[Turn over

	Class	Register No.
Candidate Name ______________________		

PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2018
SECONDARY 4 EXPRESS

PHYSICS — **6091 / 02**

Paper 2 Theory — **11 September 2018**

1 hour 45 minutes

Candidates answer on the Question Paper.
No additional materials are required.

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams and graphs.
Do not use paper clips, highlighter, glue or correction fluid.

Section A.
Answer **all** questions.

Section B
Answer **all** questions. Question 12 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Total	

This paper consists of **21** printed pages and **1** blank page.
Setter: Mrs Hsu L K

[Turn over

Section A (50 marks)
Answer **all** the questions in this section.

1 A petrol-driven car accelerates from rest to its cruising speed along a straight level road.

(a) State the main energy changes in the car and in its surroundings, when

1. the car is accelerating,

.... [1]

2. the car is cruising at a constant speed.

.... [1]

(b) The car now moves up a slope with constant speed.
Explain whether the rate of petrol consumption will increase, stay the same or decrease.

....

.... [1]

2 A small jet plane which can carry six people is shown in Fig. 2.1.

Fig. 2.1

The mass of the fully-loaded plane is 2560 kg. It is initially at rest. When the plane is taking off, the two jet engines can exert a total thrust force of 8000 N and the friction between the wheels and the ground is 340 N. Both forces remain constant during take-off.

(a) Calculate the acceleration of the plane as it starts to move.

acceleration = ... [2]

[Turn over

(b) Explain what happens to this acceleration as the plane speeds up.

....

....

....

....

.... [2]

(c) The average acceleration during take-off is 2.2 m / s^2.

(i) Calculate the time that the plane will take to reach a take-off speed of 55 m / s.

time taken = ... [1]

(ii) What is the minimum length of the runway that is required for the plane to take off?

minimum length = ... [2]

(d) Suggest why the wheels of the plane are folded into the body of the plane after take-off.

....

.... [1]

[Turn over

3 An archer pulls the string of his bow and it is stretched a horizontal distance of 40 cm as shown in Fig. 3.1. As he releases the string, an average force of 150 N acts on the arrow before it loses contact with the string.

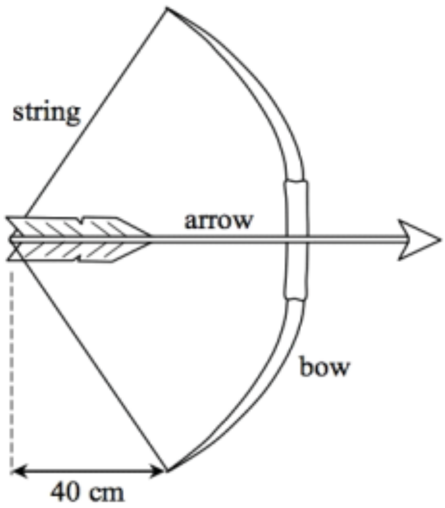


Fig. 3.1

(a) Calculate the average work done on the arrow.

work done = …………………… [1]

(b) What is the speed of the arrow as it leaves the bow, if the arrow has a mass of 100 g?

speed = ..………………… [2]

(c) State **two** ways in which the speed of release may be increased.

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………….. [2]

[Turn over

4 A radar system, such as the one shown in Fig. 4.1, is often used in airports for air traffic control. The system consists of microwave transmitters and receivers arranged in a spherical structure. By emitting microwave signals and receiving reflected signals, the radar system provides tower controllers with information on the movement of aircrafts approaching the airport.

Fig. 4.1

An aeroplane is approaching the airport. The time delay of receiving a microwave signal reflected from the aeroplane is 9.0 x 10^{-5} s.

(a) What is the distance of the aeroplane from the air traffic control system?

distance = ... [2]

(b) The wavelength of the microwave signal is 4 cm. Calculate its frequency.

frequency = ... [2]

[Turn over

(c) Explain why the microwave transmitters and receivers are arranged in a spherical structure.

....

....

.... [1]

(d) Stealth fighter planes are "invisible" to radar systems because they prevent the microwave signals from being reflected back to the receiver of the system. Suggest one way in which stealth fighter planes can achieve this.

....

....

.... [1]

[Turn over

5 Fig. 5.1 shows the temperature changes of a solid substance as thermal energy is supplied to the substance at a constant rate.

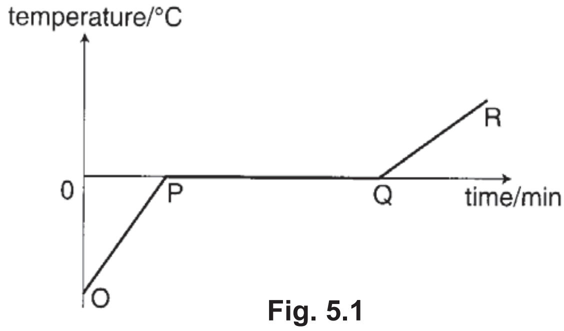


Fig. 5.1

(a) State the process that is happening between **P** and **Q**.

.... [1]

(b) Explain, in molecular terms, what happens to the energy supplied between:

(i) **P** and **Q**;

....

....

....

.... [2]

(ii) **Q** and **R**.

....

.... [1]

(c) State how the specific heat capacity of the liquid differ from the specific heat capacity of the solid, and explain how you deduced this from the graph shown in Fig. 5.1.

....

....

....

....

.... [3]

[Turn over

6 Fig. 6.1 shows the object and its image with ray **X** moving towards a converging lens.

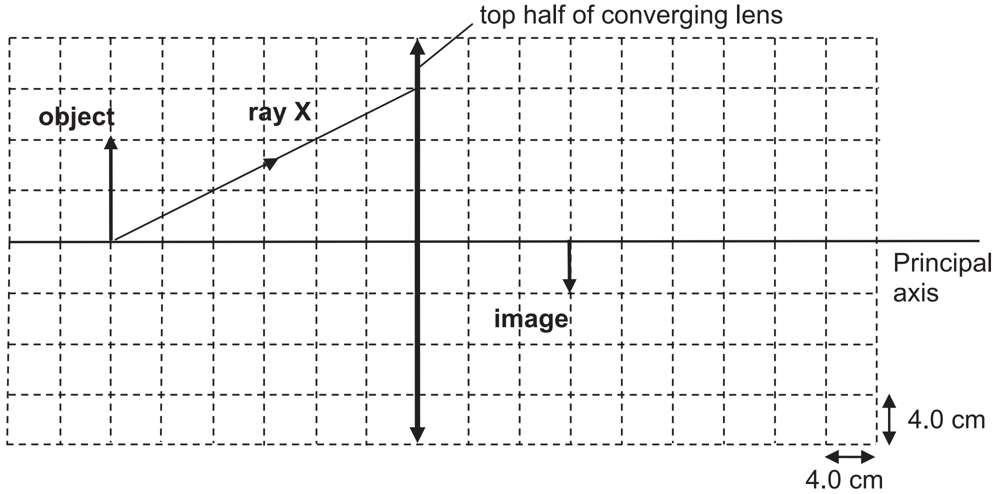


Fig. 6.1

(a) **(i)** Draw, on Fig. 6.1, one ray to locate the focal point of the lens.
Mark the focal point with the letter **F**. [1]

(ii) Determine the focal length of the lens in Fig. 6.1.

focal length = ... [1]

(iii) Complete the path for ray **X**. [1]

(b) If the top half of the converging lens is removed, state and explain whether the image is still formed.

....

....

....

.... [2]

[Turn over

7 A cling film, shown in Fig. 7.1, is a thin plastic film typically used for sealing food items in containers to keep them fresh over a longer period of time. The film clings onto many smooth surfaces and thus can remain tight over the opening of a container without adhesives or other devices. It is made of a material which becomes charged easily.

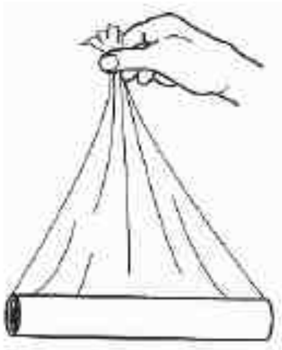


Fig. 7.1

(a) Explain, in terms of charges, how a neutral cling film is different from a charged cling film.

....

....

....

.... [2]

(b) A student tries to peel a cling film from its roll. He does this with much difficulty as he finds that the cling film tends to 'stick' to the roll.
Explain, in detail, why this happens.

....

....

....

....

....

.... [3]

8 **(a)** Fig. 8.1 shows an iron ring suspended by a thread. A bar magnet is held close to the ring. The iron ring is attracted to the magnet.

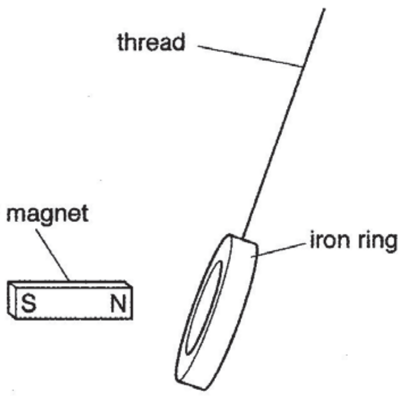


Fig. 8.1

Explain why the iron ring is attracted to the bar magnet.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………….... [2]

(b) Fig. 8.2 shows an aluminium ring suspended by a thread, close to a bar magnet.

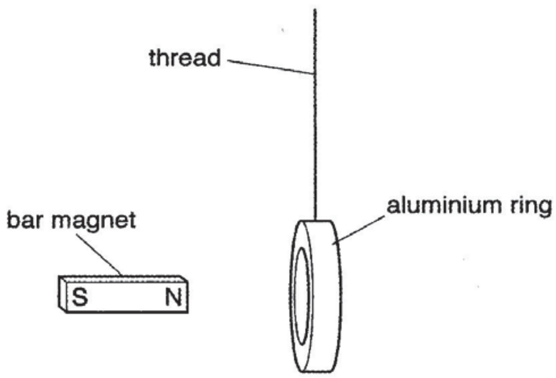


Fig. 8.2

Explain why the aluminium ring is not attracted to the magnet.

…………………………………………………………………………………………………

………………………………………………………………………………………….. [1]

[Turn over

(c) When the N-pole of the bar magnet in Fig. 8.2 is moved quickly towards the aluminium ring, there is an induced current in the ring and the ring moves away from the bar magnet.

(i) Explain why a current is induced in the aluminium ring.

…………………………………………………………………………………………...

…………………………………………………………………………………………...

…………………………………………………………………………………………...

………………………………………………………………………………………….. [2]

(ii) Explain why the aluminium ring moves away from the magnet.

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………...

………………………………………………………………………………………….. [2]

[Turn over

9 An alternating input voltage is applied across the Y-plates of a cathode ray oscilloscope and produces the trace shown in Fig. 9.1.

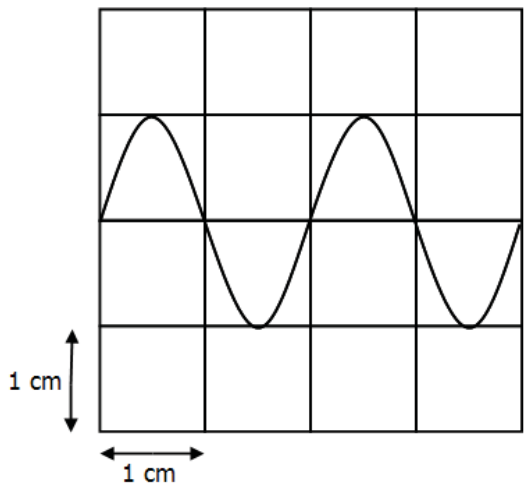


Fig. 9.1

If the peak voltage of the alternating input voltage is 5.0 V and its frequency is 50 Hz, determine the

(a) Y- gain setting,

Y – gain setting = ... V / cm [1]

(b) time - base setting,

time - base setting = ... ms / cm [1]

(c) Sketch on Fig. 9.1, the new trace which will be obtained for the same input voltage if the Y-gain is changed to 10 V per division and the time-base setting to 5.0 ms per division. [2]

[Turn over

Section B (30 marks)
Answer **all** the questions from this section.
Answer **only one** of the two alternative questions in **Question 12**.

10 Fig. 10.1 shows a sonar which is used to determine the speed of a vehicle.
The sonar sends pulses of ultrasound towards oncoming vehicles and receives the reflected pulses.

Fig. 10.1

A time-strip showing when the pulses are emitted and received is printed as shown in Fig. 10.2. The speed of ultrasound in air, at room temperature, is 340 m / s. The car is travelling at a constant speed, v, to the left.

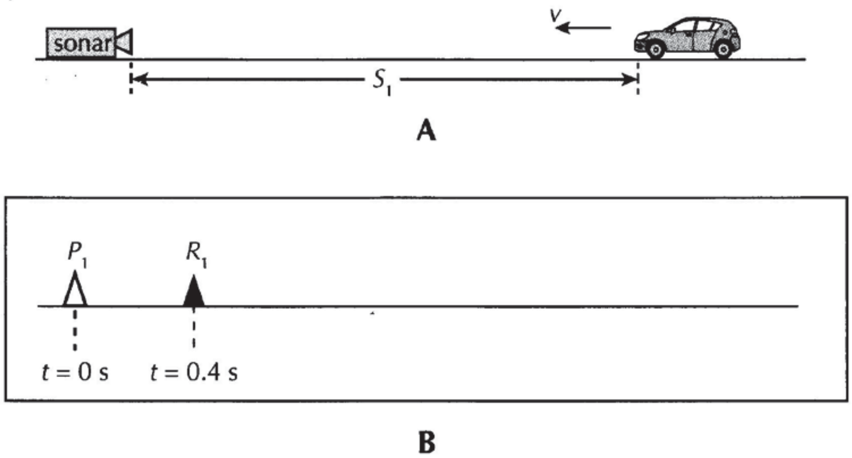


Fig. 10.2 (Not drawn to scale)

(a) At time t = 0 s, the sonar emits a pulse P_1. At time t = 0.4 s, the sonar receives the reflected pulse R_1. The time-strip for these two recorded pulses are shown in Fig. 10.2.

(i) State the time that the emitted pulse P_1 will meet the oncoming car.

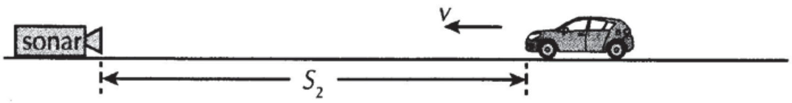
time = ... [1]

[Turn over

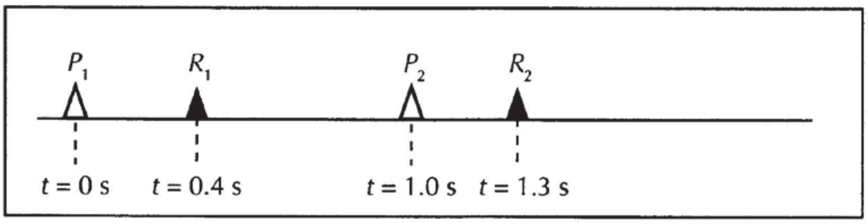
(ii) Calculate the distance S_1 of the car from the sonar.

distance S_1 = ... [2]

(b) At time t = 1.0 s, the sonar emits a second pulse P_2 and receives the second reflected pulse R_2 at time t = 1.3 s. The car is now at a distance S_2 from the sonar. The time-strip for these two recorded pulses are shown in Fig. 10.3.



A



B

Fig. 10.3 (Not drawn to scale)

(i) Calculate the distance S_2 of the car from the sonar.

distance S_2 = ... [2]

(ii) Calculate how far the car has moved to the left during this period of time.

distance moved = ... [1]

[Turn over

(c) Determine the speed, v, of the car.

speed of car v = ... [2]

(d) **(i)** Explain why the reflected pulse is smaller in amplitude than the emitted pulse.

....

.... [1]

(ii) Describe, using ideas about the vibration of molecules in the air, what is meant by *a lower amplitude*.

....

.... [1]

[Turn over

11 Fig. 11.1 shows a rigid rectangular card which has a rectangular hole cut out in the centre.
Fig. 11.2 shows the setup used to measure the acceleration of the card as it falls freely to the ground. A torchlight which is directed towards the light dependent resistor (LDR) is turned on. A computer is used to measure the potential difference across RS.

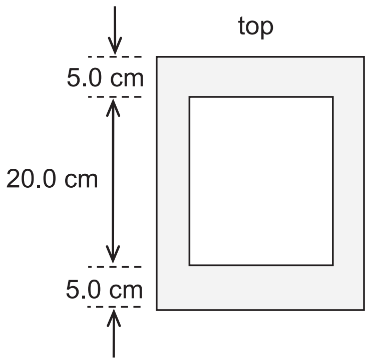


Fig. 11.1

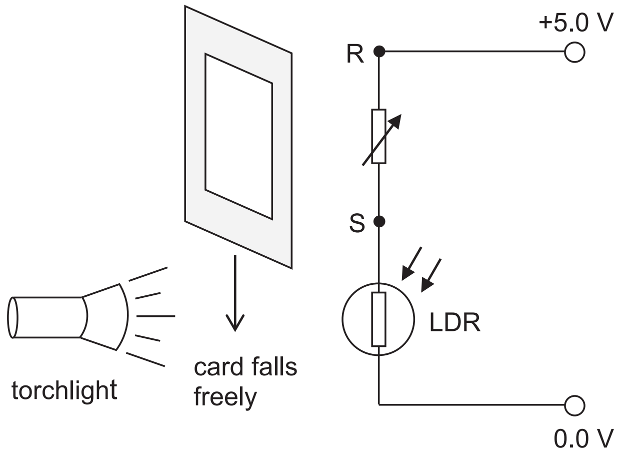


Fig. 11.2

Fig. 11.3 shows the graph of potential difference (p.d.) across RS against time.

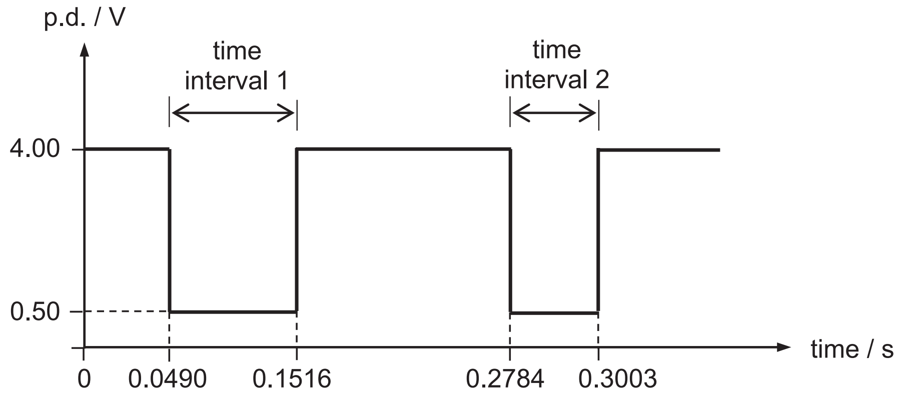


Fig. 11.3

[Turn over

(a) State what happens to the resistance of the LDR as the card falls.

....

....

....

.... [2]

(b) Explain why the p.d. across the variable resistor drops to 0.50 V.

....

....

....

....

.... [2]

(c) Explain why time interval 1 is longer than time interval 2 (as shown in Fig.11.3) when the rigid card falls.

....

....

....

.... [2]

(d) Calculate the average acceleration of the card in cm / s^2.

acceleration = ... cm / s^2 [4]

[Turn over

12 EITHER

In order to check whether a pipe section is leaking, both ends of the pipe are sealed. A syringe is connected to one end while a water manometer is connected to the other end as shown in Fig. 12.1.

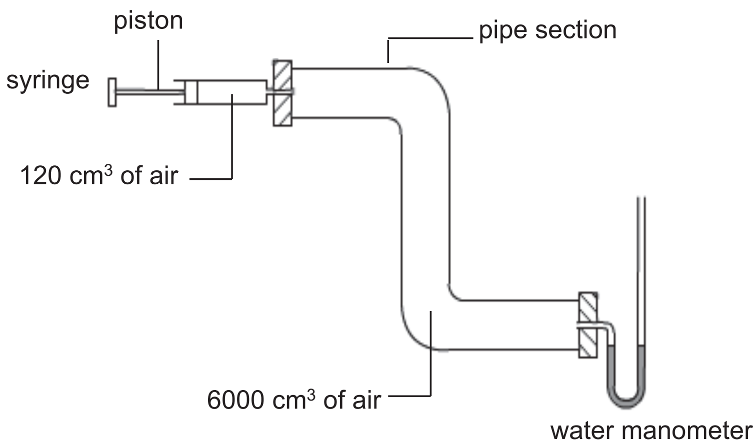


Fig. 12.1

The syringe initially contains 120 cm^3 of air while the pipe has 6000 cm^3 of air.
All the air initially has a pressure of 1.00×10^5 Pa.
The piston of the syringe is then pushed in and held steadily in position.
This causes the volume of air in the syringe to decrease.

(a) Explain, in terms of molecules, why the pressure of the air inside the pipe increases when the piston of the syringe is pushed in.

....

....

....

.... [2]

(b) Assuming that the pipe **does not** leak and the temperature of the air inside the pipe remains constant when the piston is pushed fully in and held in place, calculate

(i) the new air pressure in the pipe in Pa,

pressure = ... Pa [2]

[Turn over

(ii) the difference in water levels in both arms of the manometer.
(Assume the strength of the Earth's gravitational field is 10 N / kg and the density of water is 1000 kg m^{-3}.)

difference in water levels = …………………….. [2]

(c) If the pipe is leaking very slowly, what will be the observation after the piston is pushed fully in and held in place.

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [3]

(d) State one way how the manometer could be modified to give a larger difference in liquid level for the same pressure in the pipe.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

[Turn over

12 OR

A farmer connects a house to the mains supply of electricity.
The house is at a long distance from the nearest 230 V mains supply of electricity.
Fig.12.2 shows the mains supply connected to the house.

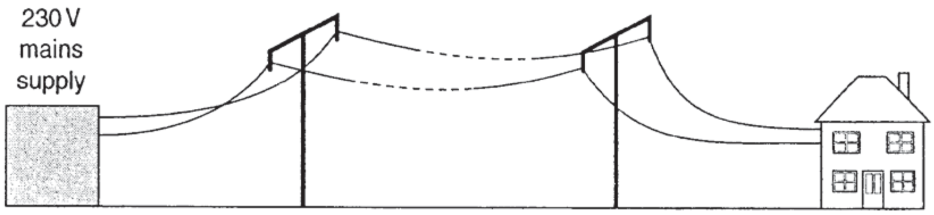


Fig. 12.2

(a) The farmer uses 230 V lamps in the house but they do not light up at their normal brightness. Explain why the lamps are dim.

....

....

....

.... [2]

(b) The farmer added transformers, as shown in Fig.12.3.

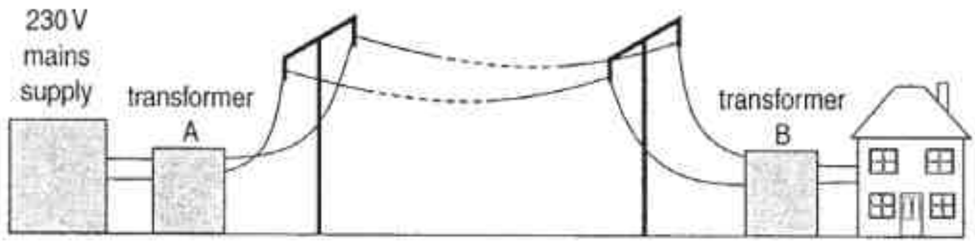


Fig. 12.3

The lamps in the house now light up at their normal brightness.
Explain why the lamps are now brighter.

....

....

....

.... [2]

[Turn over

(c) Explain in detail how a transformer produces an output voltage.

....

....

....

....

....

.... [3]

(d) The 230 V mains supply provides 690 W of power to transformer A in Fig.12.3.

(i) Calculate the current supplied to the transformer.

current = ... [1]

(ii) Calculate the energy supplied to the transformer in 10 minutes.
Give your answer in joules.

energy = ... J [2]

END OF PAPER 2

[Turn over

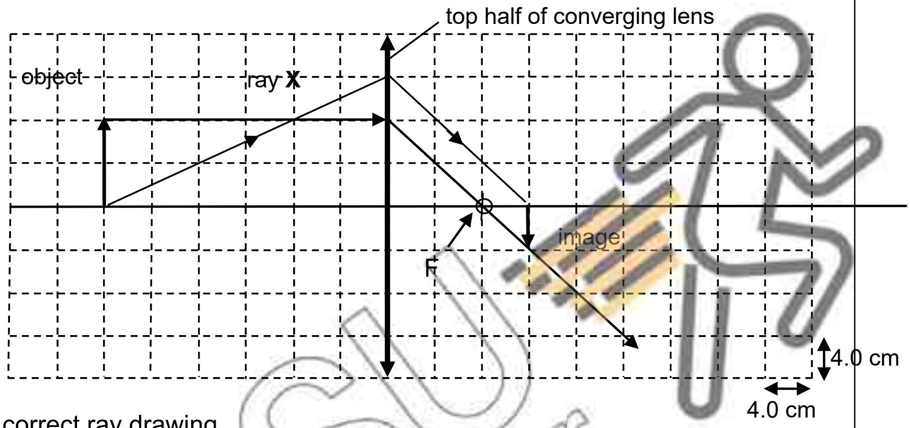
2018 PRELIMINARY MCQ 4E Physics 6091/1

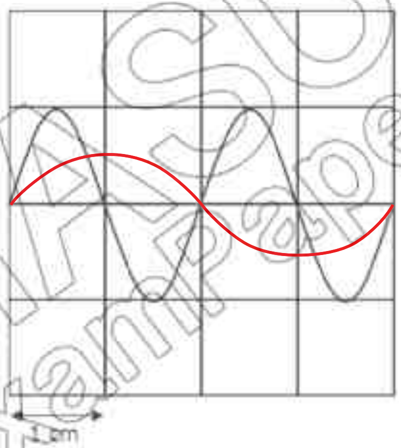
Question No.	Answer	Question No.	Answer
1	D	21	B
2	D	22	B
3	B	23	A
4	B	24	D
5	A	25	B
6	B	26	A
7	B	27	A
8	A	28	A
9	A	29	A
10	A	30	B
11	A	31	A
12	B	32	D
13	D	33	C
14	A	34	B
15	C	35	A
16	B	36	A
17	A	37	D
18	B	38	D
19	B	39	C
20	C	40	C

2018 Preliminary Examination
4E Physics (6091/2)
Marking Scheme

Section A (50 marks)		
Question No.	**Answers**	**Marks**
1(a)	1. Chemical energy in the fuel is primarily converted to kinetic energy of the car. 2. Chemical energy in the fuel is mainly converted to work done against friction and air resistance.	B1 B1
(b)	The rate of consumption of petrol will increase as the car has a net gain in energy due to its increasing gravitational potential energy.	B1
2(a)	F_{net} = 8000 - 340 = 7660 N From F_{net} = ma, a = 7660 / 2560 = 2.99 m/s^2 (3SF)	C1 A1
(b)	As the plane speeds up, the air resistance it experiences increases. Since the forward force is constant, the net force acting on the plane decreases and this leads to a decrease in its acceleration.	B1 B1
(c)(i)	Using a = (v – u) / t, t = (55 – 0) / 2.2 = 25 s	A1
(ii)	Minimum length of runway = area under v-t graph Length = 1/2 x 25 x 55 ECF = 687.5 m = 688 m (3SF)	M1 A1
(d)	The wheels are folded into the body of the plane to reduce air resistance when in flight.	B1
3(a)	Work Done = F x d = 150 x 0.4 (deduct 1 mark if unit is wrong) = 60 J	A1
(b)	½ m v^2 = 60 ½ x 0.100 x v^2 = 60 ECF for energy v = 34.6 m / s (3SF)	M1 A1

(c)	Pull the string a longer horizontal distance back. Use a lighter arrow.	B1 B1
4(a)	Speed of microwave, c = 3 x 10^8 m / s Distance of the aeroplane = 1/2 x (3 x 10^8) x 9.0 x 10^{-5} ECF = 13500 m	B1 A1
(b)	Using v = f λ, f = (3 x 10^8) / 0.04 ECF for value of c = 3 x 10^8 = 7.5 x 10^9 Hz (deduct 1 mark if unit is wrong	M1 A1
(c)	The spherical structure allows microwaves signals to be sent and received from all directions, hence providing the tower controllers with accurate information of all incoming aircrafts.	B1
(d)	The body of the fighter planes absorbs the microwaves and hence prevents them from being reflected back. or The body of the fighter plane is shaped in a way that reflects the microwave signals away from the source.	B1
5(a)	Melting	B1
(b)(i)	Energy is gained by the solid to overcome the intermolecular bonds between the molecules so that there is a change of state from solid to liquid. This results in an increase in the internal potential energy of the liquid molecules.	B1 B1
(ii)	Energy is gained by the liquid to increase the internal kinetic energy of the molecules. So the temperature of the liquid increases.	B1
(c)	The specific heat capacity of the liquid is higher than the specific heat capacity of the solid. gradient of the line = rate of change in temperature of the substance (Δθ / t) P t = m c Δθ so c = P / (m (Δθ / t)) The gradient of the line OP (solid) is greater than the line QR (liquid). The rate of heat supplied (P) to the substance of mass m is constant. Therefore the specific heat capacity c of the solid is smaller than that of the liquid.	B1 B1 B1

6(a)		
(i)	correct ray drawing correct marking of F	C1
(ii)	focal length = 2x4 = 8.0 cm	A1
(iii)	correct subsequent ray drawing for ray X	B1
(b)	The image is still formed as all the rays from the object can still be refracted through the bottom part of the lens.	B1 B1
7(a)	A neutral cling film has an equal number of positive and negative charges while a charged cling film has an excess of either positive or negative charges.	B1 B1
(b)	When the cling film is peeled from the roll, friction between the surfaces will cause electrons to be transferred between the peeled cling film and the one remaining on the roll. One side of the cling film will lose electrons and become positively charged, while the other side will gain electrons and become negatively charged. Since unlike charges attract, the attractive forces between these two sides will cause the cling film to 'stick' to the roll.	B1 B1 B1
8(a)	Iron is a magnetic material so it becomes magnetized by induction with an induced South pole facing the North pole of the bar magnet. Unlike poles attract. So the iron ring is attracted to the bar magnet.	B1 B1
(b)	Aluminium is a non-magnetic material so it will not be attracted to the bar magnet.	B1
(c)(i)	As the bar magnet moves quickly towards the aluminium ring, there is a change in magnetic flux linkage with the ring / cutting of magnetic flux by the ring. So electromagnetic induction occurs and an induced current is produced in the ring.	B1 B1

(ii)	According to Lenz's Law (Law of Conservation of Energy), the induced current flowing in the metal ring will produce its own magnetic field with its North pole facing the North pole of the bar magnet approaching it. Like poles repel so the freely suspended ring will swing away from the bar magnet.	B1 B1
9(a)	Peak voltage = 5.0 V, so Y gain setting = 5.0 V / cm	A1
(b)	T = 1/f = 1/50 = 0.020 s = 20 ms so 1 div = 0.02 ÷ 2 = 0.01s = 10 ms hence, time-base = 10 ms / cm	A1
(c)	 correct height correct period	A1 A1

Section B (30 marks)		
Question No.	**Answers**	**Marks**
10(a)(i)	The emitted ultrasound pulse will meet the vehicle at time t = 0.2 s.	A1
(ii)	Using distance s_1 = constant speed x time taken = 340 m/s x 0.2 s = 68 m	 M1 A1
(b)(i)	Distance s_2 = 340 x (0.3 / 2) = 51 m	M1 A1
(ii)	The difference in distance, $s_1 - s_2$ = 68 – 51 = 17 m ECF	A1
(c)	The time interval between the 2 emitted pulses reaching the car = 1.15 – 0.2 = 0.95 s During this time interval, the car advances 17 m. So the speed of the car, v = 17 / 0.95 = 17.9 m / s (3SF)	C1 A1
(d)(i)	As the sound wave passes through the air and reflects back, part of the wave energy is dissipated into the surrounding air and absorbed by the reflecting surface. So the reflected pulse is smaller in amplitude than the original pulse.	B1
(ii)	The air molecules vibrate with smaller maximum displacement from their original position.	B1
11(a)	When light from the torchlight is blocked by the card, the resistance of the LDR increases. When the light is not blocked by the card and reaches the LDR, the resistance of the LDR decreases.	B1 B1
(b)	When light is blocked by the card, the brightness around the LDR is low, hence the resistance of the LDR increases. When resistance of LDR increases, the potential difference across the LDR also increases. Since the variable resistor is in series with the LDR, when p.d. of LDR increases, the p.d. across the variable resistor will decrease. (emf = $V_{RS} + V_{LDR}$)	 B1 B1

(c)	The time interval 1 is caused by the bottom of the card which reaches the LDR level first OR time interval 2 is caused by the top of the card which it reaches the LDR level later. (Mark can be given if student somewhat makes the correct link between the time intervals and the part of the card)	B1
	When the top of the card reaches the LDR level, the speed of the card is faster due to acceleration caused by gravity, hence the shorter time in interval 2.	B1
(d)	Initial speed = 5.0 / (0.1516 – 0.0490) = 48.73 cm / s	C1
	Final speed = 5.0 / (0.3003 – 0.2784) = 228.31 cm / s	C1
	Time interval = (0.3003 + 0.2784) / 2 - (0.1516 + 0.0490) / 2 = 0.18905 s	C1
	Average acceleration = (v - u) / t = (228.31 – 48.73) / 0.18905 = 950 cm / s^2 (TO 3SF) [A1, ECF allowed]	A1
	or $s = ut + \frac{1}{2}at^2$ $30 = 0 + \frac{1}{2} a (0.3003 - 0.0490)^2$ a = 950 cm/s^2	
12 Either (a)	When the piston is pushed in, the number of molecules per unit volume inside the pipe increases.	B1
	As a result, the frequency of collisions between the air particles and the inner wall of the pipe increases. Hence, the pressure increases.	B1
(b)(i)	$P_1V_1 = P_2V_2$ $P_2 = (1.00 \times 10^5) \times 6120 / 6000$	C1
	$= 1.02 \times 10^5$ Pa	A1
(ii)	$h\rho g = (1.02 \times 10^5) - (1.00 \times 10^5)$ ECF h x 1000 x 10 = 2000	C1
	h = 0.200 m	A1

(c)	The water level in the left arm of the manometer will increase while the water level in the right arm will decrease until both are at the same level.	B1 B1 B1
(d)	Use a liquid with a lower density than water in the manometer.	B1
12 Or (a)	When the current I from the mains supply flows through the long cable of resistance R, electrical energy will be wasted as heat due to the heating effect in the cable. ($P = I^2 R$). So the power (energy) output at the house is lower and the voltage supplied to the house is also lower (< 230 V). Hence the lamps are dim.	B1 B1
(b)	The step-up transformer A increases the voltage but reduces the current I in the cables. So less energy will be wasted as heat in the transmitting cables. So output power at step-down transformer B will be higher than (a) and the voltage supplied to the house is almost 230 V.	B1 B1
(c)	When an alternating current flows through the primary coil (input), it sets up an alternating magnetic field which links with the secondary coil (output) via the soft iron core. Due to the change in magnetic flux linkage with the secondary coil, electromagnetic induction occurs at the secondary coil and an alternating e.m.f. is produced across the ends of the secondary coil.	B1 B1 B1
(d)(i)	$P = I V$ $I = P / V = 690 / 230 = \underline{3.0\ A}$	A1
(ii)	$E = P t = 690 \times 10 \times 60$ $= \underline{414\ 000\ J}$	M1 A1

Note:

- 3SF for final answer – For each mistake, deduct 1 mark up to a maximum of 3 marks per paper.
  (For exact value, need not write answer to 3 SF.)
- No unit written for final answer - For each mistake, deduct 1 mark up to a maximum of 3 marks per paper.
- Method not shown for calculations, then only give mark for Answer.
- Don't give ½ mark.

Setter: Mrs Hsu Lay Keok

THE END

NAME:	CLASS:	INDEX NO:

QUEENSWAY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY 4 EXPRESS

Parent's Signature:

PHYSICS **6091/01**

Paper 1 Multiple Choice **12 Sep 2018**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **18** printed pages.

Setters: Mrs Pang FH, Ms Tan YN **[Turn over**

1 Which unit is equivalent to the unit for power?

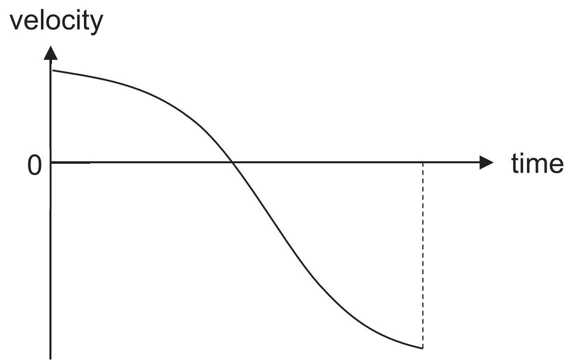
A kg m s^{-1}
B kg m^2 s^{-1}
C kg m^2 s^{-2}
D kg m^2 s^{-3}

2 Forces of 3.0 N and 8.0 N act at a point.

Which one of the following could **not** be the magnitude of their resultant?

A 4.0 N
B 6.0 N
C 9.0 N
D 11 N

3 The graph below shows how the velocity of a mass changes with time.



Which of the following statements about the motion of the mass is **not** true?

A The speed of the mass decreases at an increasing rate and then increases at a decreasing rate.
B The acceleration of the mass is negative throughout its motion.
C The final speed of the mass is larger than its initial speed.
D The total displacement of the mass is positive.

4 A car is decelerating uniformly and its velocity changes from 20 m s^{-1} to 15 m s^{-1} in 4.0 s.

What further distance will it need to travel before it stops completely?

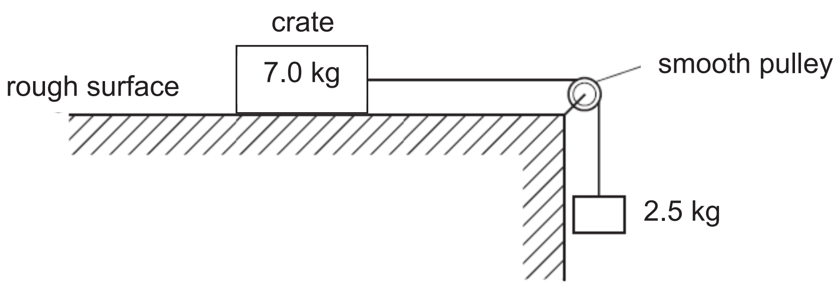
A 13 m
B 90 m
C 160 m
D 210 m

5 A ball is thrown across a flat ground.

Which statement describes the motion of the ball, when the effects of air resistance are negligible?

A The ball lands with the same speed at which it is thrown.
B The speed of the ball is zero at the highest point of the motion.
C The acceleration of the ball is zero at the highest point of the motion.
D The acceleration of the ball is largest at the start and decreases slowly to zero.

6 A crate of mass 7.0 kg rests on a rough horizontal surface. A light string attached to the crate passes over a smooth pulley and supports a load of mass 2.5 kg at its other end.

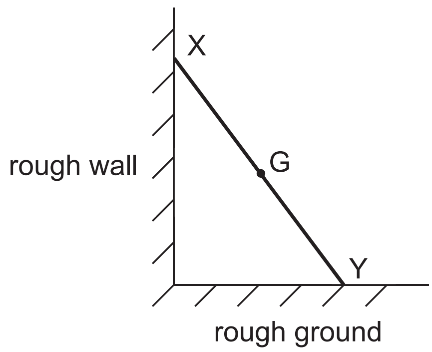


When the crate is released, a frictional force of 5.0 N acts on it. The gravitational field strength is 10 N kg^{-1}.

What is the acceleration of the crate?

A 2.1 m s^{-2}
B 3.1 m s^{-2}
C 4.5 m s^{-2}
D 10 m s^{-2}

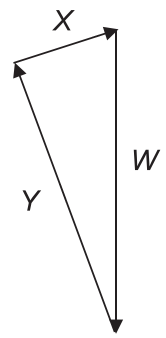
7 A ladder rests on a rough ground and leans against a rough wall.



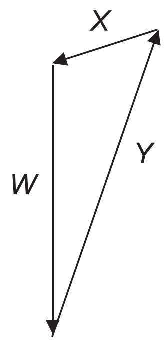
Its weight W acts through the centre of gravity G. Forces also act on the ladder at X and Y. These forces are X and Y respectively.

Which vector triangle represents the forces on the ladder?

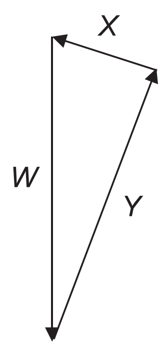
A



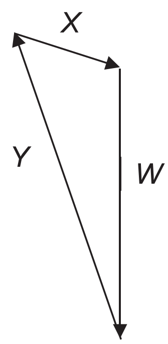
B



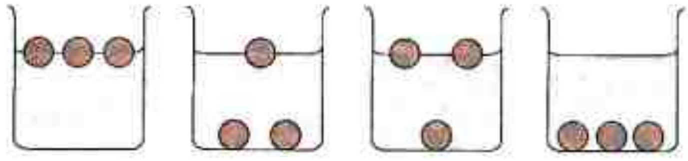
C



D



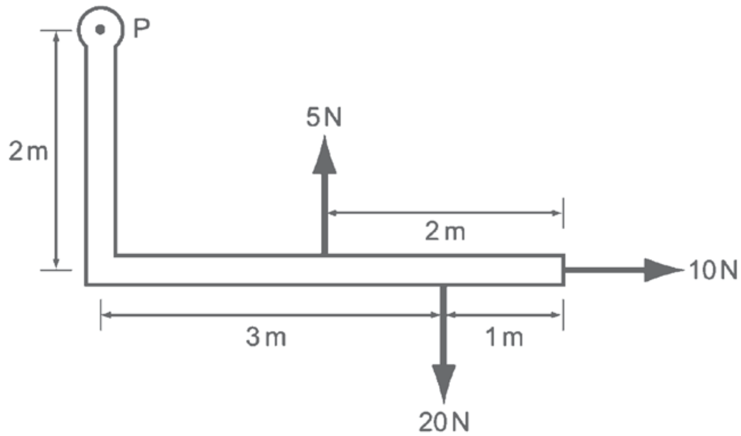
8 Three balls have densities of 0.9 g/cm^3, 1.1 g/cm^3 and 1.3 g/cm^3 respectively. In turn, they are put into four beakers containing different liquids.



Three of the beakers hold oil of density 0.8 g/cm^3, water of density 1.0 g/cm^3 and mercury of density 13.6 g/cm^3. These are

A W, X and Z respectively.
B X, Z and Y respectively.
C Y, Z and X respectively.
D Z, X and W respectively.

9 An L-shaped rigid lever arm is pivoted at point P. Three forces act on the lever arm, as shown in the diagram.

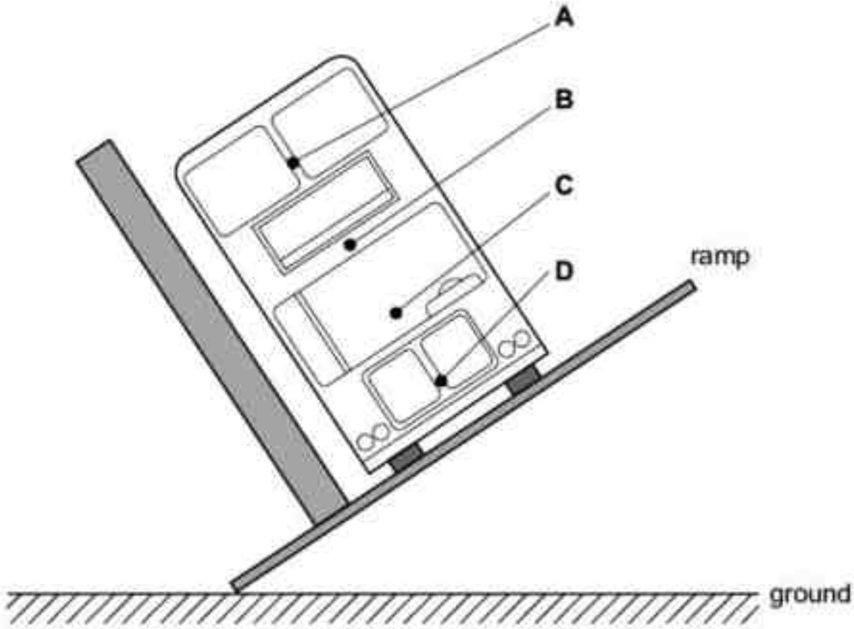


What is the magnitude of the resultant moment of these forces about point P?

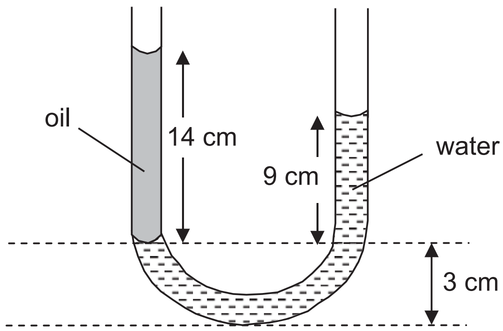
A 30 N m
B 35 N m
C 50 N m
D 90 N m

10 The stability of a bus is tested by tilting it on a ramp. The diagram shows a bus that is just about to topple over.

Where is the centre of gravity of the bus?



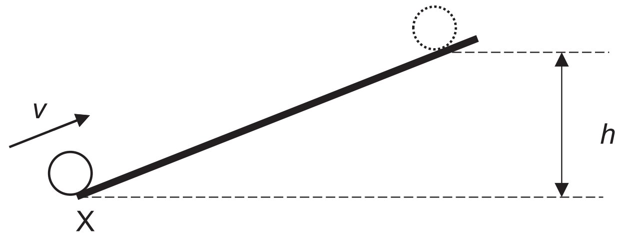
11 The diagram shows a U-tube containing oil and water.



What is the ratio of the density of oil to the density of water?

A 9 : 14
B 14 : 9
C 12 : 17
D 17 : 12

12 An object of mass m slides up a frictionless slope from point X with an initial velocity v, as shown in the figure below. The object comes to a stop at a height h above X.



A second object of mass $3m$ now slides up the same slope from X with a velocity of $\frac{v}{3}$.

What is the height it will rise to?

A $\frac{h}{9}$

B $\frac{h}{3}$

C $\frac{h}{\sqrt{3}}$

D h

13 A student observes the Brownian motion of smoke particles in air with a microscope. She sees moving points of light.

Where do these points of light come from?

A The vibrating air particles only.
B The vibrating smoke particles only.
C The continuously moving air particles only.
D The continuously moving smoke particles only.

14 A vessel contains a gas. Some gas is pumped out of the vessel.

If the volume of the vessel is kept constant, which statement is **not** correct?

A The pressure of the gas decreases.
B The total weight of the vessel decreases.
C The average intermolecular distance decreases.
D The average kinetic energy of the molecules decreases.

15 By what processes does a beaker of hot water lose energy?

A Convection and radiation only.
B Evaporation and radiation only.
C Conduction, convection and radiation only.
D Conduction, convection, evaporation and radiation.

16 Which of the following processes is an illustration of heat transfer by radiation only?

A From the sun to the earth atmosphere.
B From the hot fire place to the rest of the room.
C From a hot flame to the hands placed above the hot flame.
D From the filament of a lamp to the hands placed beside the lamp.

17 Which of the following is **not** one of the steps needed in the determination of the ice point when calibrating a liquid-in-glass thermometer with the Celsius scale?

(i) Immerse the bulb and the lower part of the thermometer stem into a funnel containing pure melting ice.
(ii) Measure the temperature of the first few drops of melted ice which should be 0 °C.
(iii) When the mercury level in the thermometer stem remains steady, mark that level as ice point on the stem.

A (i) only
B (ii) only
C (i) and (ii)
D (i) and (iii)

18 Three liquids with their respective boiling and freezing points are shown in the table below.

	mercury	alcohol	pentane
freezing point	−39 °C	−112 °C	−180 °C
boiling point	357 °C	78 °C	36.5 °C

Which liquid(s) could be filled in a thermometer that can measure between −110 °C and 32 °C?

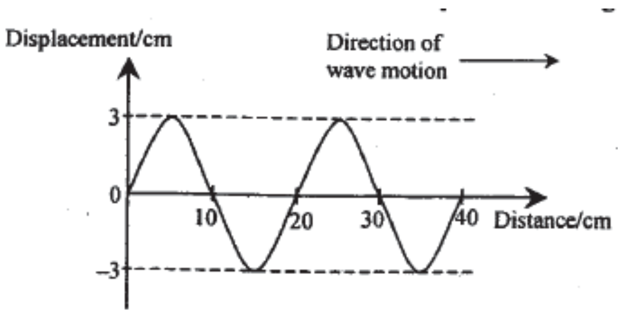
A alcohol
B pentane
C mercury
D alcohol or pentane

19 4 g of hot water at 100 °C is added to some ice at 0 °C. The specific latent heat of fusion of ice is 336 J/g and the specific heat capacity of water is 4.2 J/(g °C).

What is the minimum mass of ice that was melted?

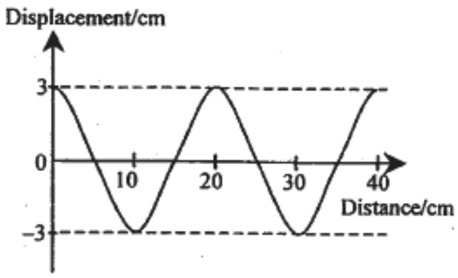
A 5 g
B 4 g
C 3.2 g
D 2.2 g

20 A transverse wave travels along a string with a constant speed. The diagram below shows the shape of the string at a certain instant.

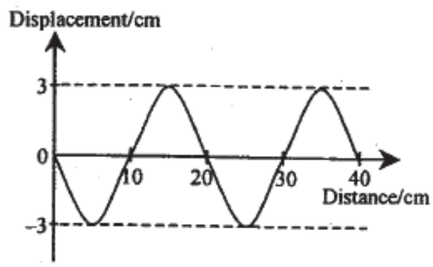


Which of the following diagrams shows the shape of the string at a quarter of a period later?

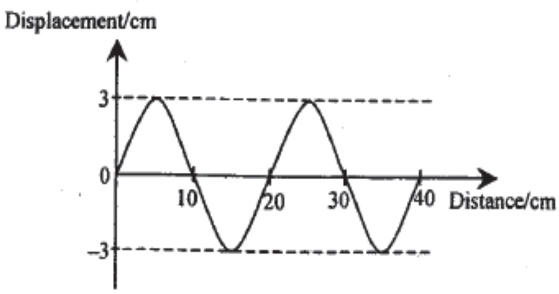
A



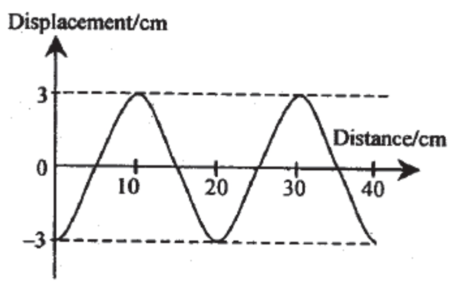
B



C



D



21 A dipper moving up and down makes waves in a ripple tank.

What will happen when the dipper frequency is decreased?

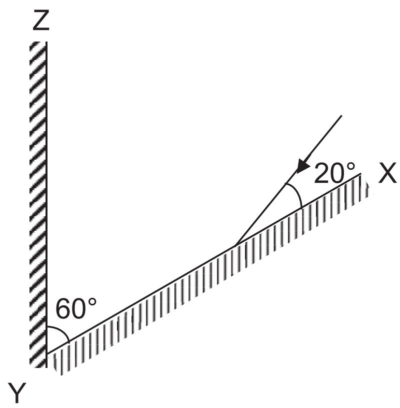
A The waves will be further apart.
B The waves will move more slowly across the tank.
C The waves will move more quickly across the tank.
D The wave peaks will be lower and the troughs higher.

22 Water waves travel across a ripple tank. The horizontal distance between a crest and the neighbouring trough is 25 mm, and the vertical distance between a crest and a trough is 5.0 mm. A crest travels 8.0 cm in 0.50 s.

Which one of the following is correct?

	frequency of water wave / Hz	amplitude of water wave / mm
A	3.2	2.5
B	3.2	5.0
C	6.4	2.5
D	6.4	5.0

23 A ray of light is incident at an angle of 20° to a mirror XY. Another mirror YZ is arranged at an angle of 60° to XY.



After reflection from XY, the ray is incident on YZ.

What is the angle of incidence of the ray at the mirror YZ?

A 10°
B 20°
C 50°
D 70°

24 Fig. (a) shows a light beam entering into a semi-circular glass block at an angle *b* and being refracted at an angle *a*. The angle *b* and its corresponding angle *a* is shown in Fig. (b).

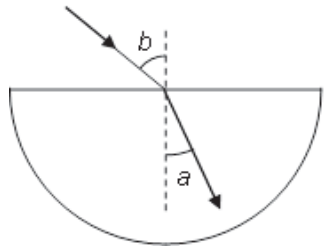


Fig. (a)

***b* / °**	***a* / °**
30	20
70	40

Fig. (b)

What is the critical angle of the glass block?

A 90°
B 50°
C 43°
D 40°

25 Below are four statements about the uses of electromagnetic radiation.

- X-rays are used in radar monitoring of speed of motor vehicles.
- Microwaves are used in satellite communication.
- Gamma rays are used in medical treatment.
- Radio waves are used in intruder alarms.

How many of these statements are correct?

A 1
B 2
C 3
D 4

26 A sonic "tape measure" is used to measure the length of a room. It measures a time interval of 0.06 s between transmitting a sound pulse and receiving the echo. The speed of sound in air is 330 m/s.

How far is the reflecting wall from the "tape measure"?

A 5.5 m
B 9.9 m
C 11.0 m
D 19.8 m

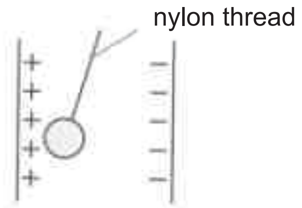
27 The table shows how the speed of sound varies with substances of different densities.

substance	speed of sound in substance / m s^{-1}	density of substance / kg m^{-3}
air (gas)	330	1.29
oxygen (gas)	320	1.43
aluminium (metal)	5100	2710
iron (metal)	5000	7870
lead (metal)	1200	11300

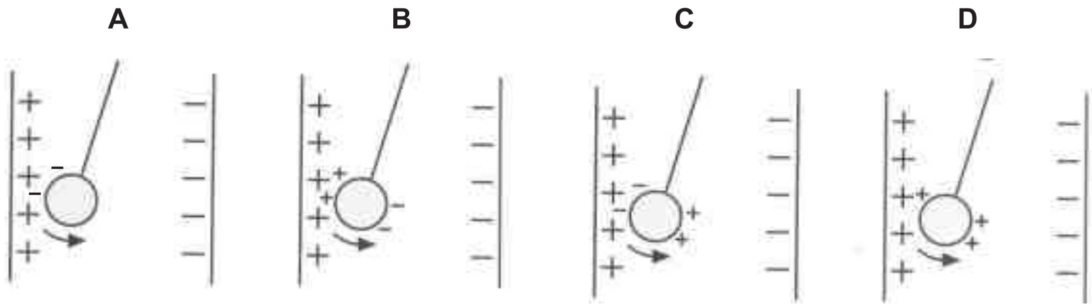
What conclusions about the speed of sound can be drawn from this information?

A The speed is greater in metals than in gases.
B The speed is greatest in the most dense metal.
C The speed is greater in less dense substances.
D The speed increases as the density of the substance increases.

28 A light uncharged conducting ball is moved towards the positive plate.



Which diagram correctly shows the charges on the ball just after it has touched the positive plates?



29 Some observations were made when four charged rods P, Q, R and S are placed near to each other one at a time.

- P repels Q
- P attracts R
- S attracts R

If S is negatively charged, what are the charges on P, Q and R?

	P	Q	R
A	–	–	+
B	–	+	–
C	+	–	+
D	+	+	–

30 The potential difference across a light bulb is 20 V. During a time of 15 s, the amount of electrical energy converted to other forms of energy is 12 J.

What is the current flowing in the light bulb during this time?

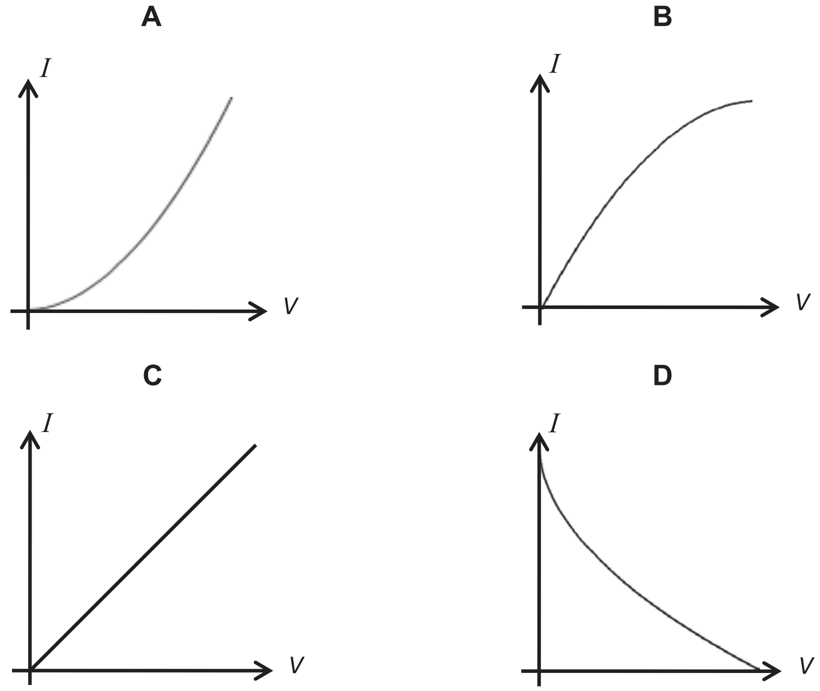
A 0.040 A
B 0.11 A
C 9.0 A
D 25 A

31 What is the definition of the electromotive force (e.m.f.) of a power supply?

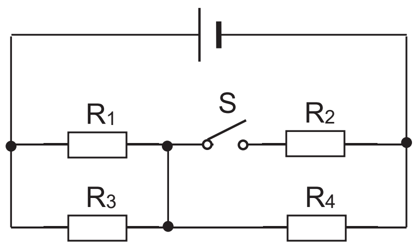
A the potential difference across its terminals when no current is flowing
B the energy converted from other forms to electrical per unit charge which passes through it
C the energy converted from electrical to other forms per unit charge which passes through it
D the potential difference across its terminals if unit potential difference is needed to move unit charge through it

32 Some electric light bulb filaments are made of carbon. It is known that the resistance of carbon filaments decreases as their temperature increases.

Which graph shows how the current I through such a bulb varies with the potential difference V across it?



33 The diagram shows a network of identical resistors R_1, R_2, R_3 and R_4 connected to a cell. When switch S is closed, the power dissipated in each resistor is P.

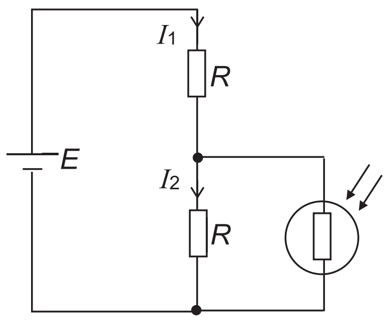


When switch S is opened, what are the powers dissipated in resistors R_3 and R_4?

	power dissipated in R_3	power dissipated in R_4
A	lower than P	remains as P
B	lower than P	lower than P
C	remains as P	greater than P
D	lower than P	greater than P

34 A battery of e.m.f. E is connected to a light dependent resistor (LDR) and two resistors, each of resistance R, as shown.

The resistance of the LDR when it is exposed to bright light is R. The currents in the two resistors are I_1 and I_2 respectively.



How do the currents change when the light intensity on the LDR is reduced to zero ?

	I_1	I_2
A	decrease	decrease
B	increase	decrease
C	decrease	increase
D	increase	increase

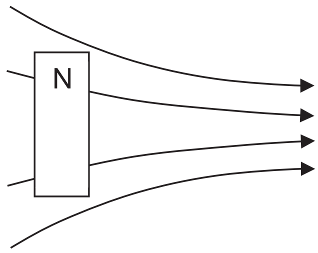
35 A fuse is connected to the neutral wire of a fan.

Which of the following statement(s) is/are correct?

I The fan will not operate if the fuse blow.
II The fan will be safe to touch when the fuse blow.
III The fan will still be connected to the high voltage source when the fuse blow.

A I and II only
B I and III only
C II and III only
D I, II and III

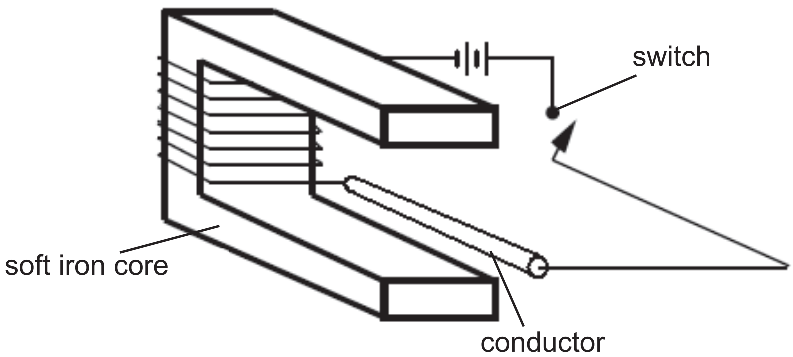
36 A bar magnet is to be placed in a non-uniform magnetic field as shown in the figure below.



Which of the following describes the subsequent motion of the magnet?

	rotation	movement
A	anti-clockwise	to the left
B	anti-clockwise	to the right
C	clockwise	to the left
D	clockwise	to the right

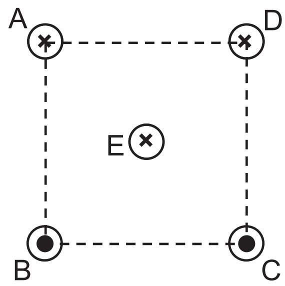
37 A straight conductor rests in the space between two arms of a soft iron core.



After the switch has been closed for a while, in which direction is the magnetic force acting on the conductor?

A up
B down
C left
D right

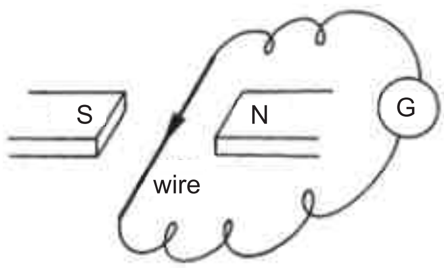
38 Four parallel conductors A, B, C and D, carrying equal currents, pass vertically through the four corners of a square. In conductors A and D, the current is flowing into the page, and in conductors B and C, current is flowing out of the page.



Which of the following **incorrectly** describes the resultant force on conductor E, with current flowing into the page, at the centre of the square?

A The resultant force due to wires A and D points towards line AD, perpendicular to AD.
B The resultant force due to wires B and C points towards line AD, perpendicular to AD.
C The resultant force due to wires B and D points towards line AD, perpendicular to AD.
D The resultant force due to wires A, B, C and D points towards line AD, perpendicular to AD.

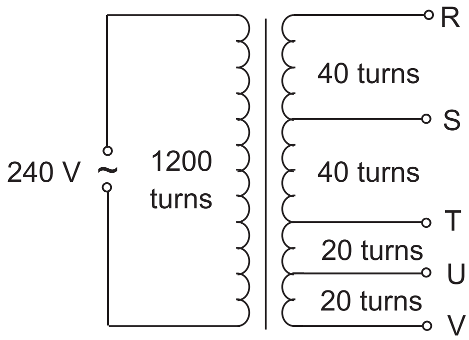
39 The diagram shows an experimental setup showing electromagnetic induction.



In which direction must the wire be moved to induce a current flow in the direction as shown in the diagram?

A vertically upward
B vertically downward
C horizontally towards the north pole
D horizontally towards the south pole

40 A transformer consists of one coil with 1200 turns and a second coil, with total of 120 turns, which can be tapped at various places.



Which pair of terminals should be connected to a 12 V, 24 W lamp for it to be lit normally?

A RU
B SU
C RV
D TV

END OF PAPER

NAME:	CLASS:	INDEX NO:

QUEENSWAY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY 4 EXPRESS

Parent's Signature:

PHYSICS **6091/02**

Paper 2 Theory **11 Sep 2018**

1 hour 45 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A:
Answer **all** questions.

Section B:
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clearly and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
The number of marks is given in brackets [ ] at the end of each question or part question.

	For Examiner's Use	
	Section A	/50
	Q9	/10
	Q10	/10
E / O	Q11	/10
	TOTAL	/80

This document consists of **24** printed pages.

Setters: Mrs Pang FH, Ms Tan YN **[Turn over**

SECTION A
Answer **all** the questions in this section in the spaces provided.
The total mark for this section is 50.

A1 Fig. 1.1 shows an oil-drum as it floats in equilibrium in seawater.

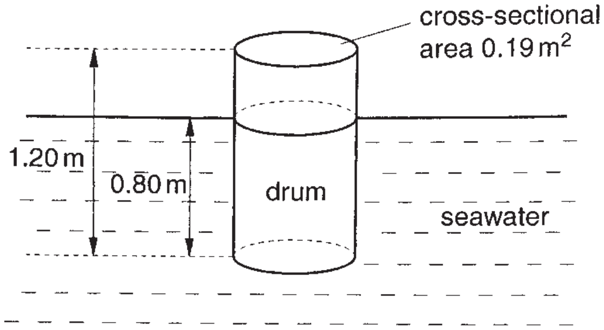


Fig. 1.1

The drum is 1.20 m long and has a cross-sectional area of 0.19 m^2. The length of the drum submerged under water is 0.80 m. The atmospheric pressure above the surface of the water is 1.0×10^5 Pa. The density of seawater is 1.1×10^3 kg m^{-3} and the gravitational field strength is 10 N kg^{-1}.

(a) **(i)** On Fig. 1.1, draw two arrows to show the directions of the forces due to the pressures on the top of the oil-drum and on the base of the oil-drum. [1]

(ii) Calculate the resultant of the two forces in **(i)**.

resultant force = ...[2]

(iii) Hence, determine the average density of the drum and its content.

density = ...[2]

(b) The drum is pushed into the seawater by 5 cm and then released. It oscillates vertically. Fig. 1.2 shows the variation of its vertical displacement s with time t.

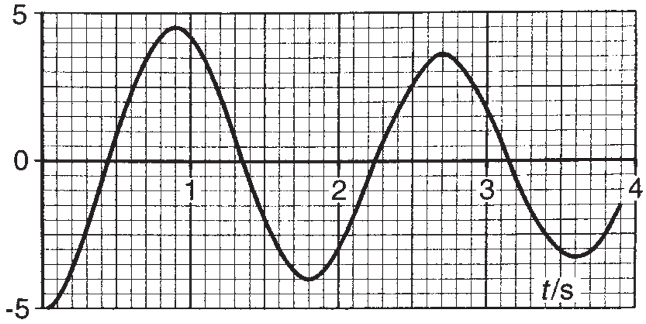


Fig. 1.2

(i) Describe how you would use the graph of Fig. 1.2 to determine the maximum vertical speed of the oil drum.

....

.... [1]

(ii) Explain why the amplitude of the oscillations is not constant.

....

.... [1]

A2 A coil of about 1500 turns of insulated wire is tightly wound on a non-magnetic tube to make a solenoid of mean radius 22 mm, as shown in Fig. 2.1. The total length of the wire in the coil is 207 m. The wire itself has radius 0.86 mm and is made of a material of resistivity $1.7 \times 10^{-8}\ \Omega\,\text{m}$. The coil is connected to a supply of e.m.f. 12 V.

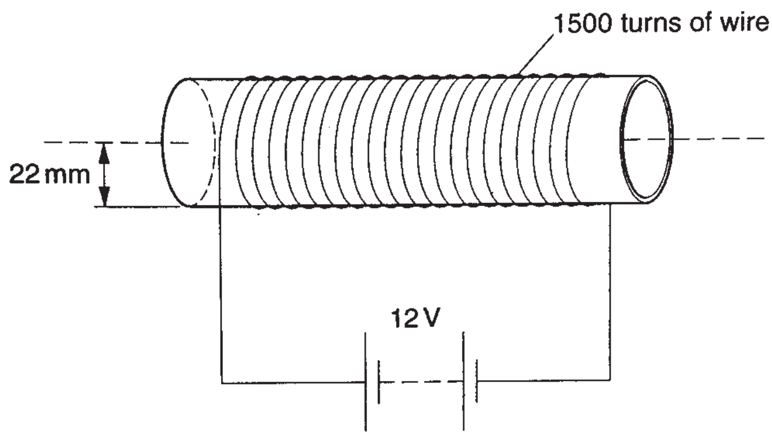


Fig. 2.1

(a) Calculate

(i) the total resistance of the coil,

resistance = ...[2]

(ii) the current in the coil.

current = ...[1]

(b) On Fig. 2.1, draw the pattern of the magnetic field within and around the solenoid. Use arrows to show the direction of the field inside the solenoid. [2]

(c) A U-shaped piece of stiff wire ABCDEF pivoted at BE is inserted into the solenoid, as shown in Fig. 2.2.

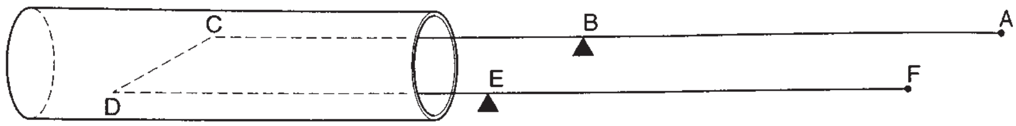


Fig. 2.2

CD has length 25 mm, CB and DE each have length 106 mm.

The stiff wire is first balanced when there is no current in it. A current is then passed through CD and, in order to rebalance the stiff wire, a force of 5.7×10^{-4} N is applied at a distance of 77 mm from the pivot, as shown from the side view in Fig. 2.3.

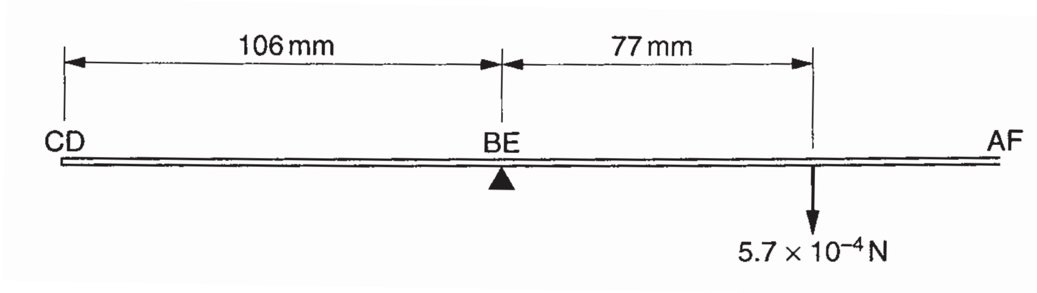


Fig. 2.3

(i) State the direction of current flow in CD.

.... [1]

(ii) Calculate the magnetic force on CD.

magnetic force = ...[2]

A3 **(a)** Give one difference between the two methods of heat transfer: conduction and convection.

....

.... [1]

(b) Explain the following in terms of heat transfer.

(i) When touched, an empty metal cup as shown in Fig. 3.1 feels cold, whereas it feels hot when it contains hot coffee.

Fig. 3.1

....

....

....

....

....[2]

(ii) A double-walled glass as shown in Fig. 3.2 used to serve hot tea does not feel hot when it is being held by the hand.

Fig. 3.2

....

....

.... [2]

A4 Steve wants to find out how much ice is needed to extract the same amount of energy from a room as an air conditioner.

An air conditioner unit of 2 kW is switched on for 24 hours to cool a room to 25 °C.

(a) **(i)** Calculate the amount of thermal energy extracted from the room by the air conditioner in the 24 hours.

thermal energy = ...[1]

(ii) State two assumptions that Steve has made in his calculations.

1. ....

....

2. ....

.... [2]

(b) Calculate the mass of ice at 0 °C needed to extract the same amount of energy as the air conditioner to reach the room temperature of 25 °C.
(The specific heat capacity of water is 4 200 J/(kg °C) and the specific latent heat of ice is 340 000 J/kg.)

mass of ice = ...[2]

A5 Fig. 5.1 shows an incorrect electromagnetic spectrum drawn by a student. The components of the spectrum and the wavelengths are in the wrong order. The values of the wavelengths do not match the correct components of the spectrum.

short wavelength						long wavelength
microwaves	radio waves	ultraviolet	infra-red	gamma rays	X-rays	visible
10^{3} m	10^{-14} m	10^{-10} m	10^{-8} m	10^{-2} m	10^{-6} m	10^{-5} m

Fig. 5.1

(a) On Fig. 5.2, complete the table of the electromagnetic spectrum in the correct order of the various components and their corresponding wavelengths.

short wavelength						long wavelength

Fig. 5.2

[2]

(b) State the speed of all electromagnetic waves in a vacuum.

speed = ...[1]

(c) State one other property, other than speed, that all electromagnetic waves have in common.

.... [1]

(d) Name one effect of absorption of electromagnetic waves by humans.

....

.... [1]

A6 Fig. 6.1 shows a converging lens, of focal length 10 cm, being used as a simple magnifying glass. A virtual image is formed 25 cm from the lens.

The scale used in Fig. 6.1 is 1 cm : 5 cm.

(a) On Fig. 6.1, complete the ray diagram to determine the position of the object.

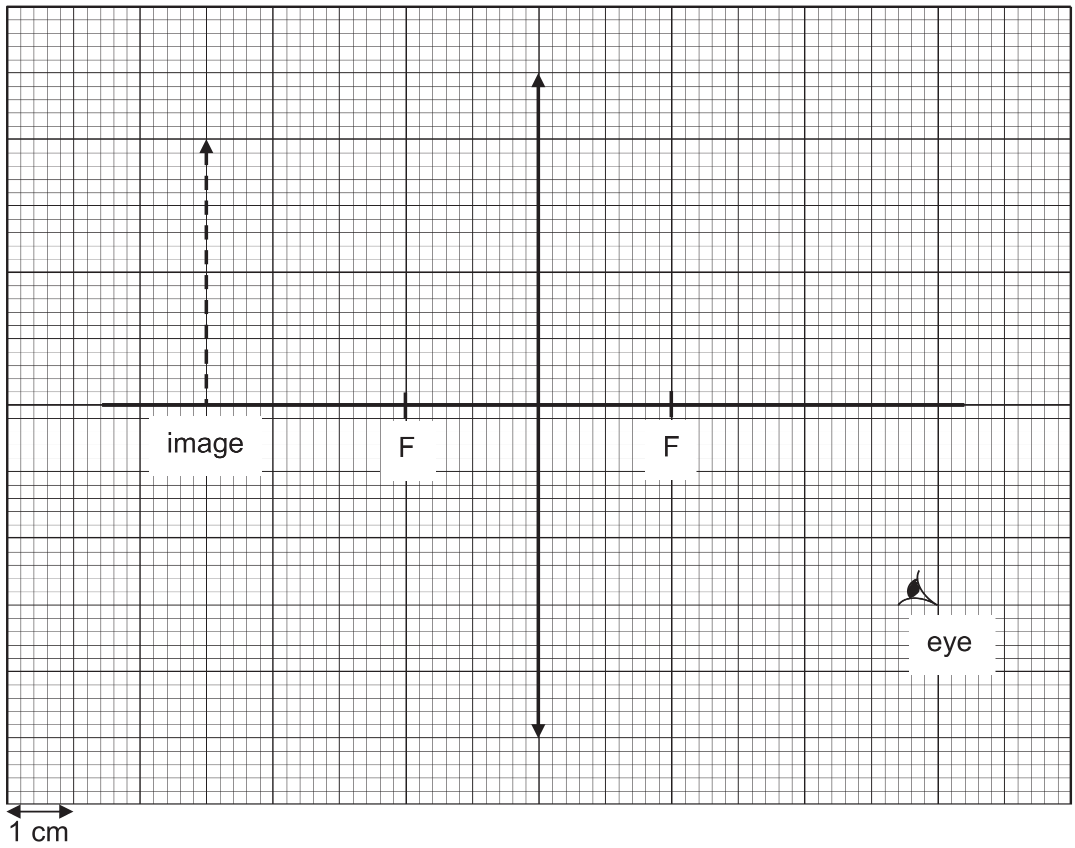


Fig. 6.1

[3]

(b) State two ways in which the image formed by a converging lens used in a camera differs from that formed by a plane mirror.

....

.... [1]

(c) Fig. 6.2 shows an image seen behind a mirror at 25 cm from the mirror. The scale used is 1 cm : 5 cm.

By drawing two rays of light, show how the points P and Q are being formed as seen by an observer E. Show clearly the position of the object, labelled R and S.

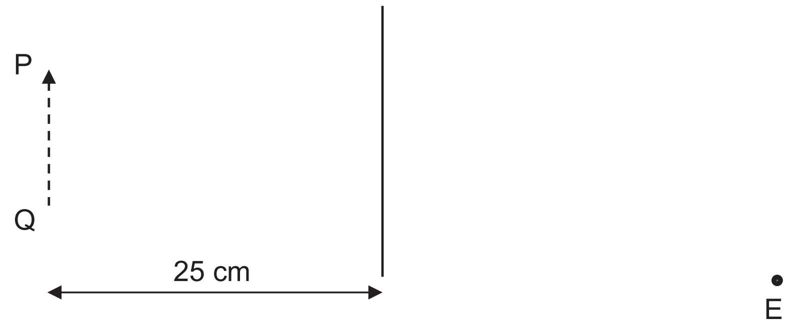


Fig. 6.2

[3]

A7 A negatively charged rod is brought near two neutral isolated balls X and Y. Ball X is then earthed momentarily as shown in Fig. 7.1.

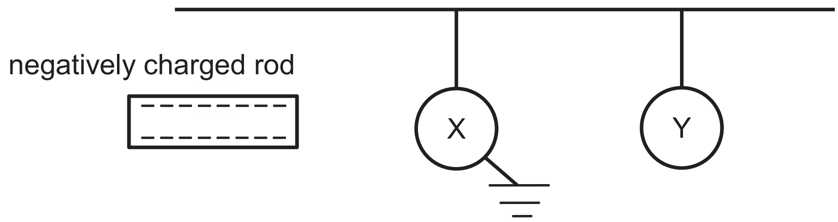


Fig. 7.1

(a) Describe and explain what happens to the two balls when the negatively charged rod is first brought near to them. You are to assume that the balls and rod do not come into contact.

....

....

....

....

....

.... [2]

(b) **(i)** Describe what happens to the charges of ball X when it is earthed momentarily.

....

....

.... [1]

(ii) On Fig. 7.2, draw the positions of the two balls and indicate their charges, if any, when ball X is earthed momentarily.

Fig. 7.2

[1]

(c) State the charges of the two balls when the rod is removed.

....

.... [1]

A8 A fully charged car battery has an e.m.f. of 12 V. This battery can deliver a constant current of 2.0 A for a period of 7.0 hours.

(a) Calculate the total amount of charge passing through the battery in a time of 7.0 hours.

charge = ...[1]

(b) The fully charged car battery is connected to a 0.025 Ω resistor, a starter motor, four sidelights and two headlights as shown in Fig. 8.1. The starter motor is used to start the engine.

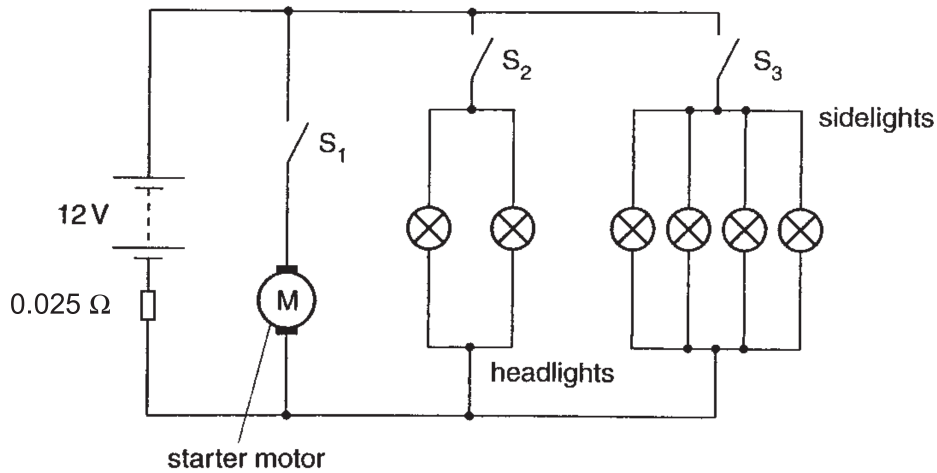


Fig. 8.1

(i) The resistance of each headlight is 3.0 Ω, and the resistance of each sidelight is 24 Ω. Calculate the current in the battery when switches S_2 and S_3 are closed and switch S_1 is open.

current = ...[2]

(ii) The sidelights and headlights are switched on. With S_1 closed, the current in the starter motor is 120 A. Explain why all the lights become less bright when S_1 is closed.

....

....

....

.... [2]

(c) The sidelights are accidentally left on when the car is parked at 9 pm. Determine quantitatively whether the driver is able to start the engine at 6 am the following day.

....

.... [3]

END OF SECTION A

SECTION B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

B9 According to some scientists, battery-powered cars offered many advantages over petrol-driven cars. Rechargeable lead-acid batteries are the most common type of batteries used in cars. Fig. 9.1 shows some properties of petrol, of a particular lead-acid battery and of a typical car.

Petrol	
density	700 kg m^{-3}
chemical energy available	45 MJ kg^{-1}

Typical lead-acid battery	
energy available when fully charged	15 MJ
mass	20 kg
e.m.f.	100 V

Car	
volume of petrol tank	4.0×10^{-2} m^3
Efficiency of transfer of chemical energy of petrol to kinetic energy of car	25%
Drag force at 30 m s^{-1}	580 N

Fig. 9.1

(a) Calculate the chemical energy available from a full tank of petrol.

energy = ...[2]

(b) Calculate the total distance travelled by the car on a full tank of petrol when travelling at a constant speed of 30 m s^{-1} on a level road.

distance = ...[2]

(c) **(i)** Calculate the cost of charging the battery fully if the cost of electricity is $0.28 for one kWh.

cost = ...[2]

(ii) A fully-charged battery delivers a constant current of 8.0 A. Calculate the time in hours before the battery needs to be charged again.

time = ...[2]

(d) **(i)** Calculate the total mass of lead-acid batteries needed to provide the same energy as a full tank of petrol.

mass = ...[1]

(ii) Suggest how your answer to **(i)** may affect the performance of a battery-powered car.

....

.... [1]

B10 The variation with time t of the vertical speed v of a light ball falling through air is shown in Fig. 10.1.

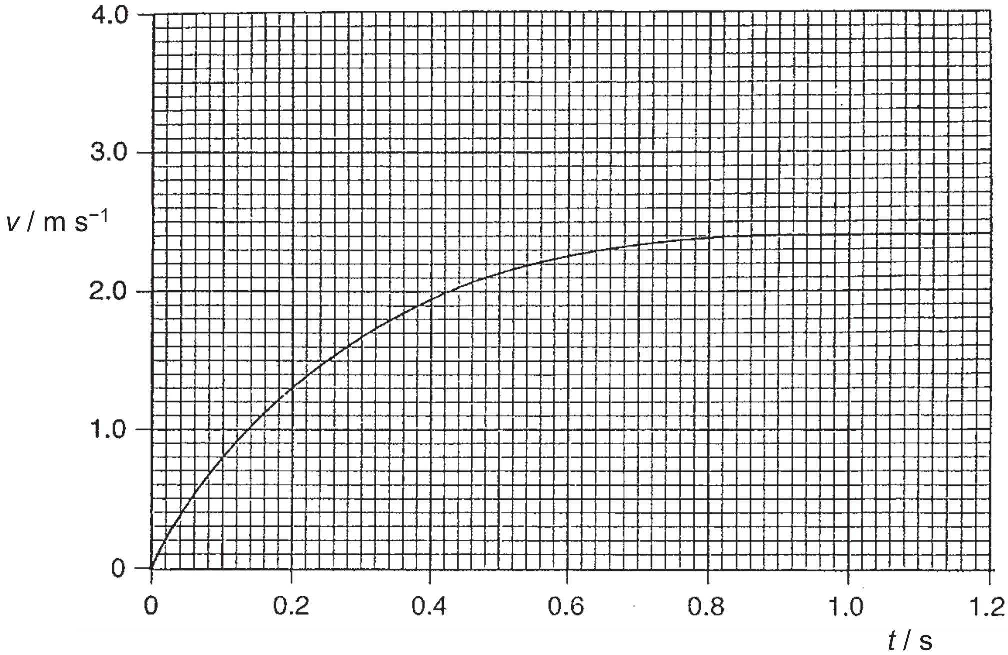


Fig. 10.1

The mass of the ball is 15 g. The gravitational field strength is 10 N kg^{-1}.

(a) On Fig. 10.1, draw a line to show the variation with time t of the vertical speed v of the ball falling from rest in a vacuum. [1]

(b) Use Fig. 10.1 to determine the acceleration of the ball falling through air at time t = 0.20 s. Show your construction on Fig. 10.1.

acceleration = ...[2]

(c) For the air resistance acting on this ball, calculate

(i) the maximum resistive force,

force = ...[1]

(ii) the resistive force at time t = 0.20 s.

force = ...[2]

(d) The ball hits a soft ground and decelerates uniformly at 160 m s^{-2}.

Determine

(i) the time taken for the ball to come to a complete stop,

time = ...[2]

(ii) the distance moved by the ball in the soft ground.

distance = ...[2]

EITHER

B11 Fig. 11.1 shows a coil of wire wound on a piece of soft iron. A magnet is rotated in the gap in the soft iron as shown. When the magnet rotates, the lamp connected to the coil glows.

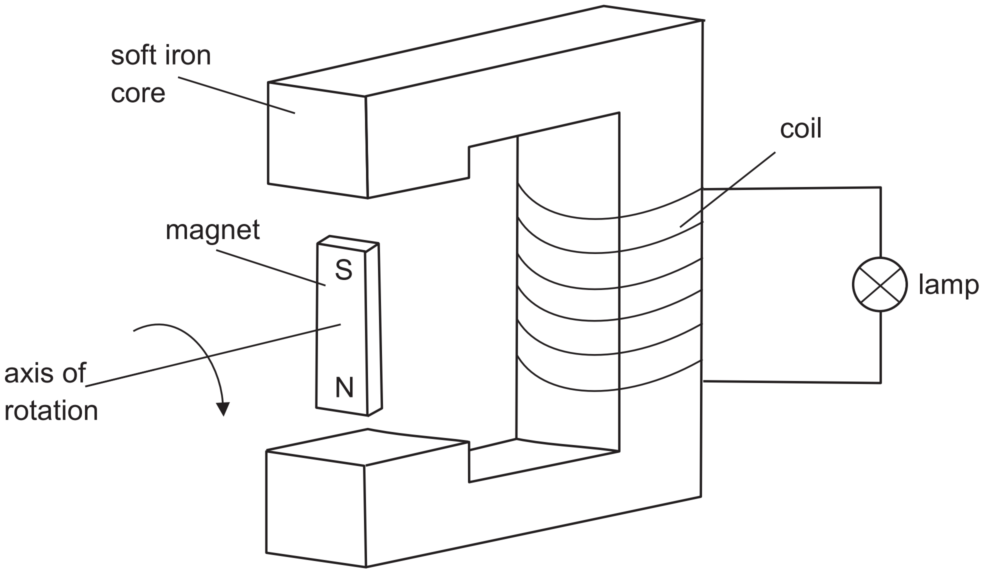


Fig. 11.1

(a) Explain why the lamp glows when the magnet rotates.

....

....

....

.... [2]

(b) Describe two alterations that could be made to the parts of the apparatus for the lamp to glow more brightly.

....

....

.... [2]

(c) State the purpose of the soft iron core.

....

.... [1]

(d) If the U-shaped soft iron is replaced by a piece made from wood, explain if the lamp will still glow when the magnet rotates.

....

....

....

.... [2]

(e) The coil of wire is then wound onto the parts of the soft iron core just above and below the magnet as shown in Fig. 11.2. The magnet is again made to rotate as shown, with the S-pole moving out of the plane of the paper and the N-pole moving into the plane of the paper at the instant shown in Fig. 11.2.

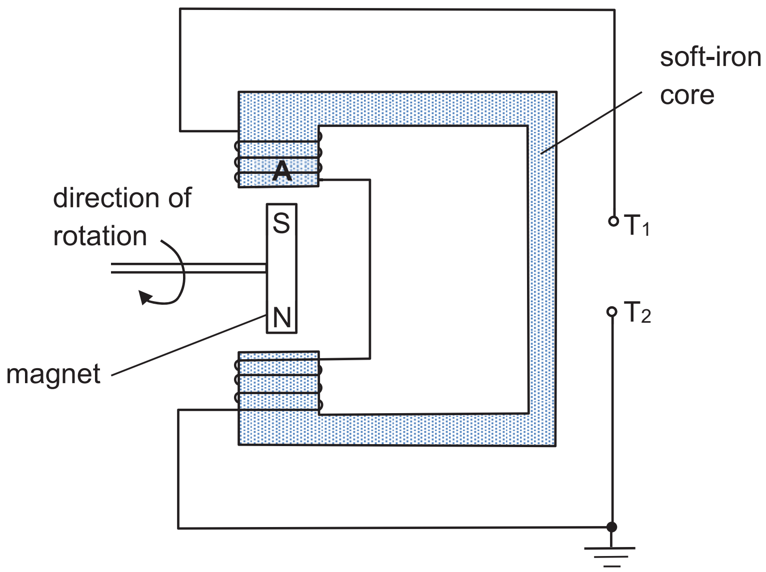


Fig. 11.2

(i) Describe how the magnetic poles induced in part A of the core change during one rotation of the magnet.

....

....

....

....

....

.... [2]

(ii) On Fig. 11.3, sketch the variation of the e.m.f. produced between terminals T_1 and T_2 during one rotation of the magnet. (Assume that T_2 is held at 0 V throughout the rotation.)

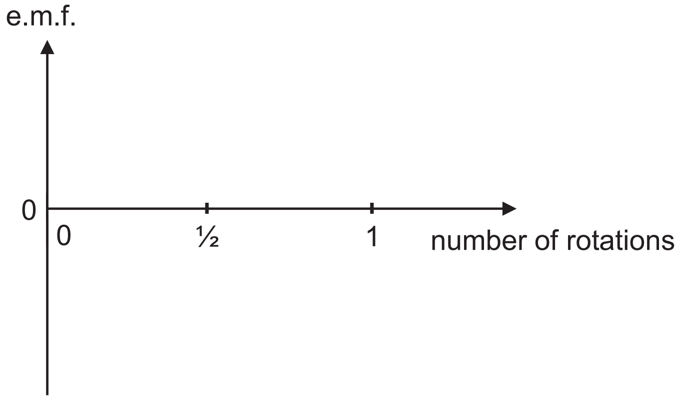


Fig. 11.3

[1]

OR

B11 Fig. 11.4 shows a ruler held at one end onto a bench, with a short length of the ruler projecting out and being vibrated.

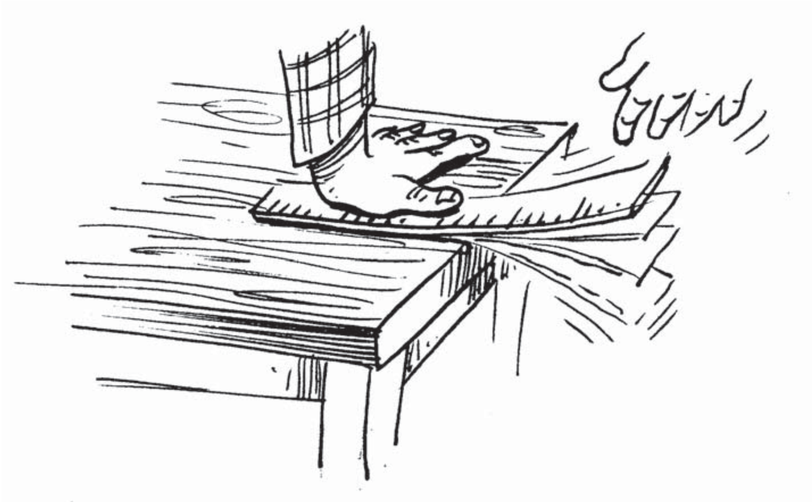


Fig. 11.4

(a) Explain how the vibrating ruler produces sound in the surrounding air.

....

....

....

....

....

....

....

.... [3]

(b) Fig. 11. 5 shows the initial position of some particles before vibration begins and at different times of the sound wave.

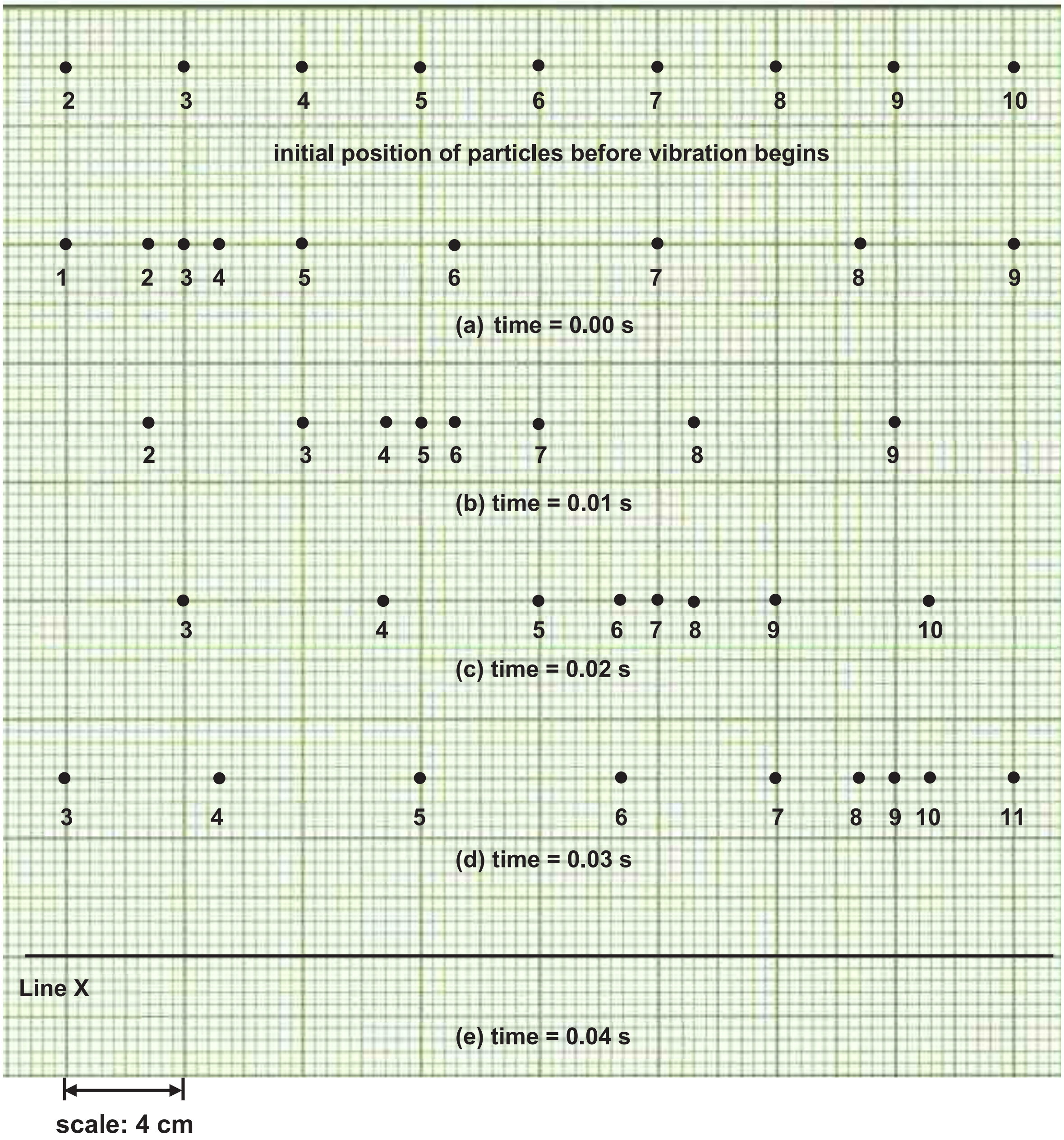


Fig. 11.5

(i) Calculate the frequency of the wave motion.

frequency = ...[1]

(ii) On Fig. 11.5, mark the amplitude of the wave motion. [1]

(iii) Using the given scale, determine the wavelength of the wave motion.

wavelength = ...[1]

(iv) Hence, calculate the speed of the wave.

speed = ...[1]

(v) On Fig. 11.5, draw on line X the positions of particles 3, 5, 7 and 9 at time = 0.04 s. [1]

(vi) On Fig. 11.6, sketch a displacement-time graph of particle 5 from time 0 s to 0.03 s, taking the displacement to the right as positive. Show clearly values on both axes.

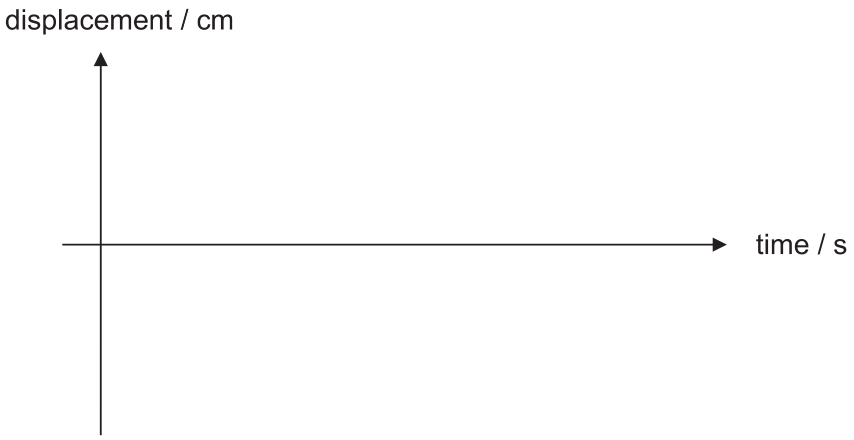


Fig. 11.6

[2]

END OF PAPER

Solutions to 2018 4E Physics Prelim

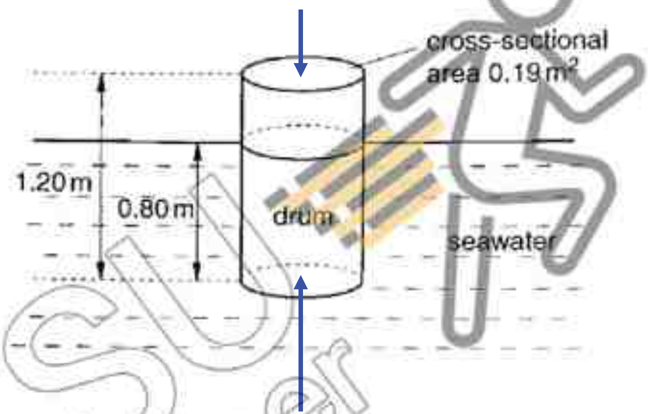
Paper 1

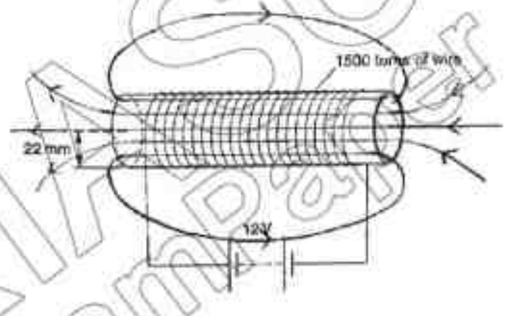
Multiple Choice Questions [40 marks]

1	D	**11**	A	**21**	A	**31**	B
2	A	**12**	A	**22**	A	**32**	A
3	D	**13**	D	**23**	A	**33**	D
4	B	**14**	C	**24**	C	**34**	C
5	A	**15**	D	**25**	B	**35**	B
6	A	**16**	A	**26**	B	**36**	D
7	A	**17**	B	**27**	A	**37**	D
8	D	**18**	D	**28**	D	**38**	C
9	A	**19**	A	**29**	A	**39**	A
10	C	**20**	D	**30**	A	**40**	B

Paper 2

Section A: Structured Questions [50 marks]

Qn	**Solution**	**Mark**
A1(a)(i)		[1] for vertical arrows drawn on the drum
A1(a)(ii)	difference in pressure $= h\rho g$ $= 0.80 \times 1.1 \times 10^3 \times 10$ $= 8800$ Pa resultant force $= 8800 \times 0.19$ = 1672 N ≈ 1670 N	[1] [1]
A1(a)(iii)	weight of drum and its content = 1672 N average density $= \frac{m}{V}$	[1]

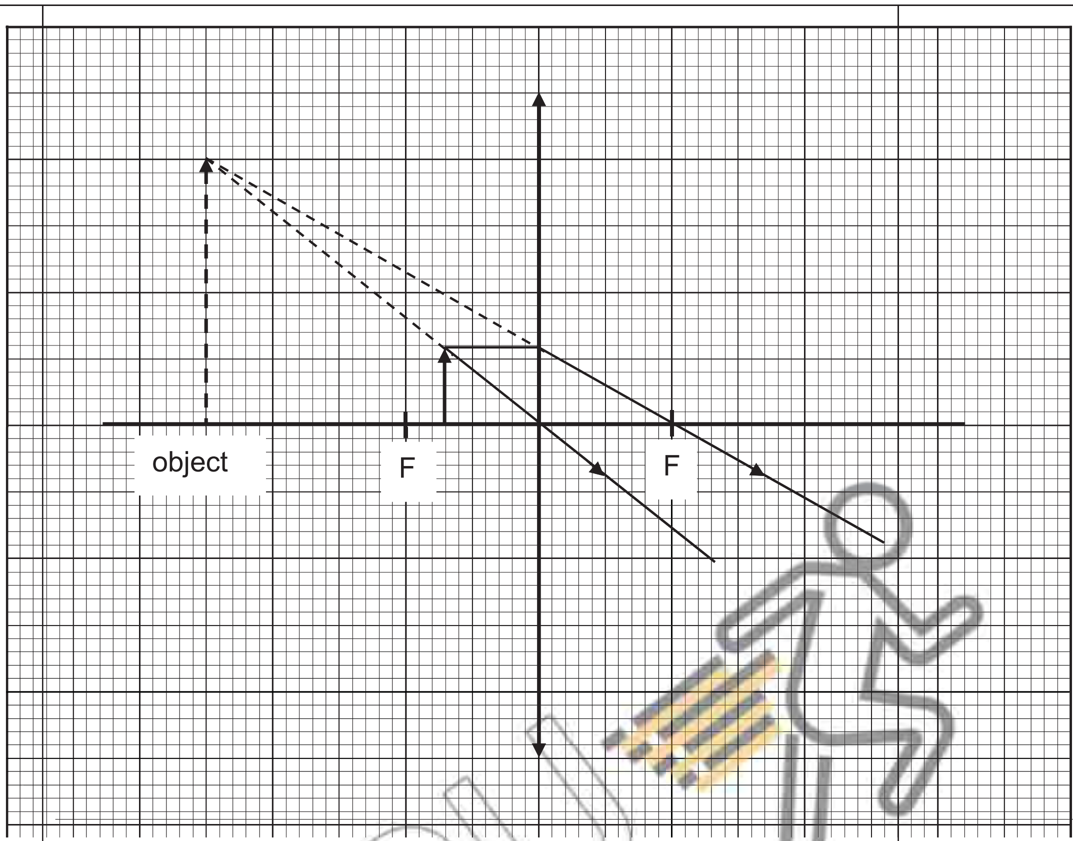
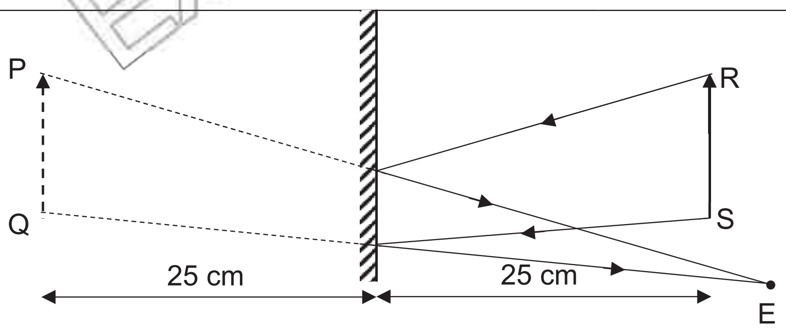
	$=\dfrac{\frac{1672}{10}}{1.20\times 0.19}$ ≈ 733 kg m^{-3}	[1]
A1(b)(i)	Determine the <u>gradient at the steepest part of the graph</u>, where s = 0 cm.	[1]
A1(b)(ii)	There is work done against the resistive force due to water.	[1]
A2(a)(i)	total resistance $=\rho\dfrac{L}{A}$ $=1.7\times 10^{-8}\times\dfrac{207}{\pi\times\left(0.86\times 10^{-3}\right)^{2}}$ $\approx 1.51\ \Omega$	[1] [1]
A2(a)(ii)	current $=\dfrac{V}{R}$ $=\dfrac{12}{1.51}$ ≈ 7.95 A	[1]
A2(b)	 Fig. 2.1	[1] for field pattern [1] for direction of field
A2(c)(i)	The current flows from C to D.	[1]
A2(c)(ii)	Taking moments about the pivot, total anticlockwise moments = total clockwise moments $F\times 106=5.7\times 10^{-4}\times 77$ $F\approx 4.14\times 10^{-4}$ N	[1] [1]
A3(a)	Conduction involves vibrations of particles (without any flow of medium) while convection involves movements of molecules (due to difference in density) Accept: Conduction occurs <u>mainly</u> in solids while convection occurs only in liquids and gases	[1]

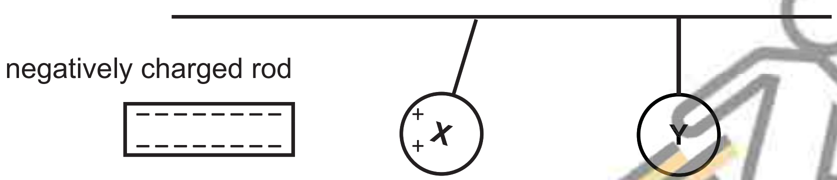
<table>
<tr><td>A3(b)(i)</td><td>Metal is a good conductor of heat. Heat from the hand is conducted away easily on touching an empty metal cup, hence feeling cold; whereas heat from the hot coffee is conducted from the hot coffee to the hand easily when the cup contains hot coffee, hence feeling hot.</td><td>[1]

[1]</td></tr>
<tr><td>A3(b)(ii)</td><td>The double-walled glass has air in between the walls. Air is a bad conductor of heat and so heat from the hot tea is not easily transferred to the hand, hence does not feel hot.</td><td>[1]

[1]</td></tr>
<tr><td>A4(a)(i)</td><td>Energy = Power x time = 2000 x 24 x 3600 = 172,800,000 J
= 173 MJ (3 sf)</td><td>
[1]</td></tr>
<tr><td>A4(a)(ii)</td><td>1. Objects in the room do not release or absorb any thermal energy to or from the room.
2. The air conditioner is 100% efficient.</td><td>
[1]
[1]</td></tr>
<tr><td>A4(b)</td><td>$Q = ml + mc\Delta\theta$
173 MJ = m × 340 000 + m × 4200 × (25 - 0)
173 000 000 = 340 000 m + 105 000 m
173 000 000 = 445 000 m
m = 389 kg</td><td>[1] for working

[1] for answer</td></tr>
<tr><td>A5(a)</td><td><table>
<tr><td>short wavelength</td><td></td><td></td><td></td><td></td><td></td><td>long wavelength</td></tr>
<tr><td>gamma rays</td><td>X-rays</td><td>ultraviolet</td><td>visible</td><td>infra-red</td><td>microwaves</td><td>radio waves</td></tr>
<tr><td>10^{-14} m</td><td>10^{-10} m</td><td>10^{-8} m</td><td>10^{-6} m</td><td>10^{-5} m</td><td>10^{-2} m</td><td>10^{3} m</td></tr>
</table></td><td>[1] for all correct order of components
[1] for all correct corresponding wavelength</td></tr>
<tr><td>A5(b)</td><td>3.0 × 10^8 m/s</td><td>[1]</td></tr>
<tr><td>A5(c)</td><td>They are all transverse waves; carry no electric charge; obey the laws of reflection and refraction.</td><td>[1] any one property</td></tr>
<tr><td>A5(d)</td><td>Causes ionisation in living cells; destruction or modification of living tissues; infra-red heating</td><td>[1] any one effect</td></tr>
</table>

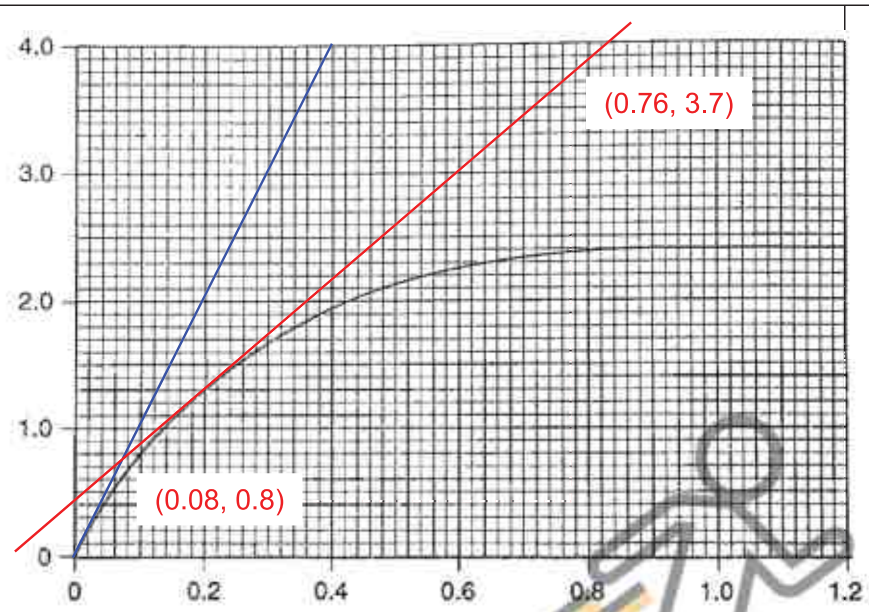
A6(a)		[2] 1 mark for each ray of light [1] position of object (6 to 8 cm from lens)
A6(b)	Converging Lens (Camera): diminished, real, inverted Plane mirror: same size, virtual, upright	[1] 1 mark for any 2 correct corresponding characteristics
A6(c)		[1] correct two rays of light to eye [1] correct two rays from object [1] position of object with correct rays drawn from them. (25 cm from mirror)

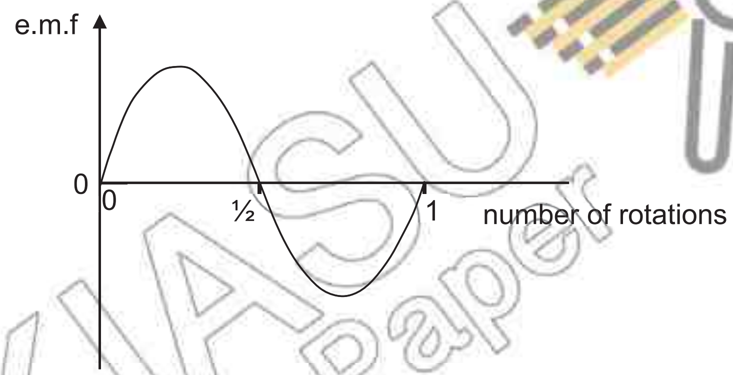
A7(a)	When the rod is brought near to the balls, X moves towards the rod and Y moves towards X. When the negatively charged rod is brought near to X, the charges of X are induced with negative charges of X repelled to the far end, nearer to Y, leaving behind the positive charges of X nearer to the rod. This is due to like charges repel. With the negative charges near to Y, the charges of Y are also induced such that the negative charges in Y are repel away from X, leaving positive charges near to X, making Y moves towards X as unlike charges attract.	[1] description of position of the 2 balls and charges in X and Y [1] explanation with clear concepts
A7(b)(i)	The negative charges of X flow down to earth and the positive charges remain attracted to the negative charges of the rod.	[1] in describing both positive and negative charges of X
A7(b)(ii)		[1] correct positions of X and Y and correct charges shown
A7(c)	X is positively charged and Y is neutral.	[1] correct for both X and Y
A8(a)	$Q = It$ $Q = 2.0 \times 7.0 \times 3600$ $Q = 50400\ \text{C}$	[1]
A8(b)(i)	total resistance across headlights and sidelights $= \left(\frac{2}{3.0} + \frac{4}{24} \right)^{-1}$ = 1.2 Ω total resistance in circuit $= 1.2 + 0.025$ = 1.225 Ω total current in the battery $= \frac{12}{1.225}$ ≈ 9.80 A	 [1] [1]
A8(b)(ii)	The total current in the battery increases from 9.80 A to more than 120 A, and there is a larger potential difference across the 0.025 resistor. Hence, the potential difference across the headlights and sidelights decreases, and the power developed decreases as well. Hence, the lights become less bright.	[1] [1]

A8(c)	Total energy used $= \dfrac{12^2}{6.0+0.025}\ \text{W} \times 9\ \text{h}$ $\approx 0.215\ \text{kWh}$ Total energy supplied by fully charged battery $= 2.0 \times 12\ \text{W} \times 7.0\ \text{h}$ $\approx 0.168\ \text{kWh}$ The battery will be depleted and the driver <u>will not be able to start the engine</u>.	[1] [1] [1]

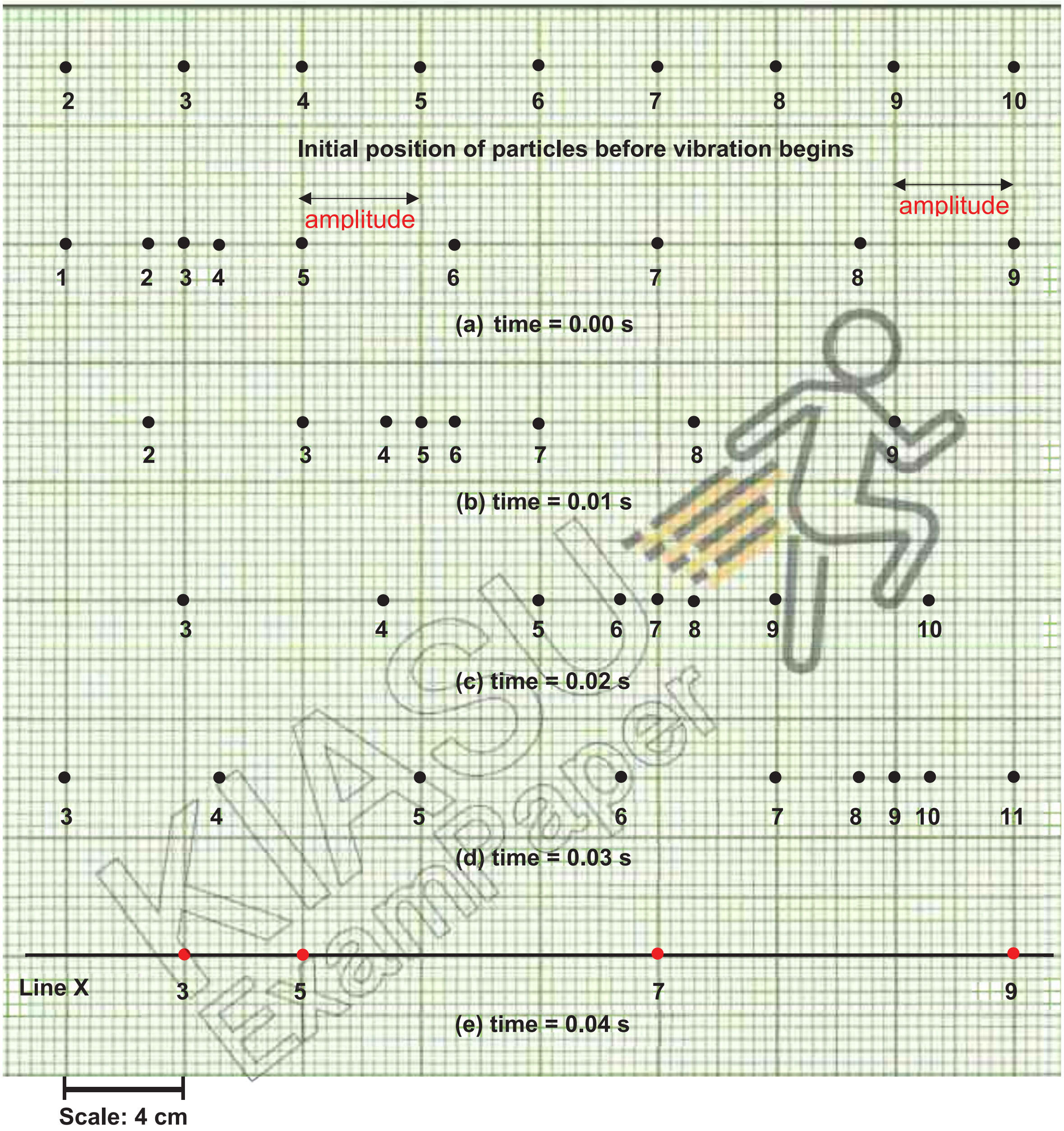
Section B: Structured Questions [30 marks]

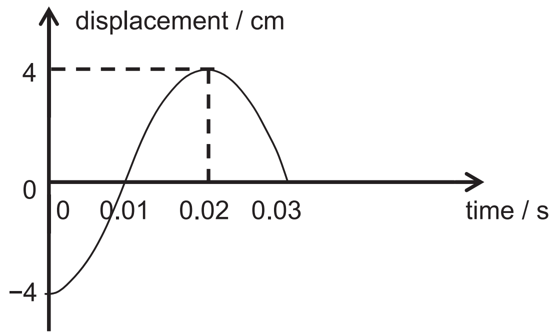
Qn	Solution	Mark
B9(a)	mass of fuel $= \rho V$ $= 700 \times 4.0 \times 10^{-2}$ $= 28\ \text{kg}$ chemical energy $= 45 \times 10^6 \times 28$ $= 1.26 \times 10^9\ \text{J}$	[1] [1]
B9(b)	work done by $F_{driving} = \dfrac{25}{100} \times 1.26 \times 10^9$ $F_{driving} \times d = 3.15 \times 10^8$ Since car is travelling at a constant speed, $F_{driving} = F_{drag}$, $580 \times d = 3.15 \times 10^8$ $d \approx 5.4 \times 10^5\ \text{m}$	[1] [1]
B9(c)(i)	cost $= \dfrac{15 \times 10^6}{3600 \times 10^3} \times \$0.28$ $\approx \$1.17$	[1] [1]
B9(c)(ii)	$E = P \times t$ $15 \times 10^6 = 8.0 \times 100 \times t$ $t = 18750\ \text{s}$ $t \approx 5.21$ hours	[1] [1]
B9(d)(i)	mass required $= \dfrac{1.26 \times 10^9}{15 \times 10^6} \times 20$ = 1680 kg	[1]
B9(d)(ii)	It will have a very large inertia and is difficult to accelerate.	[1] any reasonable answer

B10(a)	 [1] for drawing line that cuts through (0, 0) and (0.4, 4.0)	
B10(b)	acceleration $= \dfrac{3.7-0.8}{0.76-0.08}$ $\approx 4.26 \text{ m s}^{-2}$	[1] for drawing tangent and labelling gradient coordinates [1] for answer
B10(c)(i)	maximum resistive force = W $= 15\times10^{-3}\times10$ $= 0.15 \text{ N}$	[1]
B10(c)(ii)	$W - F_R = ma$ $(0.015\times10) - F_R = 0.015\times4.26$ $F_R \approx 0.0860 \text{ N}$	[1] [1]
B10(d)(i)	$a = \dfrac{v-u}{t}$ $-160 = \dfrac{0-2.4}{t}$ $t = 0.015 \text{ s}$	[1] [1]
B10(d)(ii)	distance travelled = area under *v-t* graph during deceleration $= \dfrac{1}{2}\times0.015\times2.4$ = 0.018 m	[1] [1]
Either B11(a)	When the magnet rotates, there is an induced e.m.f. generated at the coils (producing a current in the lamp) due to the changing magnetic flux linkage produced at the coils.	[1] [1]

B11(b)	Wind more turns of the coil Rotate the magnet faster Use a stronger magnet	[2] for any alterations
B11(c)	The soft iron core will concentrate the magnetic field produced by the coil	[1]
B11(d)	The lamp will still glow but weakly because there will still be changing magnetic flux linkage but poor flux linkage at the coil as wood is not a soft magnetic material.	[1] [1]
B11(e)(i)	As the S-pole moves away from part A, the end of the part A acquires N-polarity. As the N-pole approaches this part, it remains North pole. As N-pole of the magnet moves away from part A, the end of part A acquires S-polarity until S-pole of the magnet reaches part A again.	[1] for the correct polarity when moving away or approaching A [1] for the full description of one rotation of the magnet
B11(e)(ii)		[1] for correct shape and symmetry, with change in direction after half of the rotation
OR B11(a)	When the rule vibrates, the air particles are set in oscillation, with the vibration of air particles near to the ruler that cause oscillation in the adjacent particles. Due to the vibration of particles in a direction parallel to the wave travel, some regions experience a higher density at any instant, while other regions experience a lower density. This sets up regions of compression and rarefaction and sound energy is transmitted to the ears.	[1] [1] [1]
B(11)(b)(i)	$T = 0.04$ s $f = \frac{1}{T} = \frac{1}{0.04} = 25$ Hz	[1]

B11(b)(ii)	Correct indication of amplitude in Fig. 11.5	[1]



B11(b)(iii)	Wavelength (particle 3 to particle 7 shows half wavelength) = 4 × 0.04 m × 2 = 0.32 m or 32 cm	[1]
B11(b)(iv)	Velocity = frequency × wavelength = 25 × 0.32 = 8.0 m/s or 800 cm/s	[1]
B11(b)(v)	Correct positions of particles 3, 5, 7 and 9	[1] for all correct positions
B11(b)(vi)		[1] correct waveform [1] correct labelling of both axes

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2018

SUBJECT	:	PHYSICS 6091/01	DATE	:	11 SEPTEMBER 2018
LEVEL	:	SECONDARY 4 EXPRESS	DURATION	:	1 H

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate **OPTICAL ANSWER SHEET**.

INFORMATION FOR CANDIDATES:

Each correct answer will score one mark. Marks will not be deducted for wrong answers. Any rough working should be done in this booklet. Your total score for Paper 1 will be the number of correct answers given.

This paper consists of 14 printed pages, including the cover page.

1 **Diagram I** shows the scale of a micrometer screw gauge when the gap is closed.

Diagram II shows the same micrometer screw gauge used to measure the diameter of a round pellet.

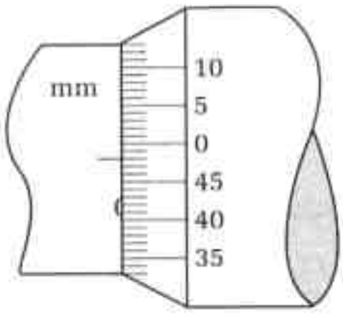


Diagram I

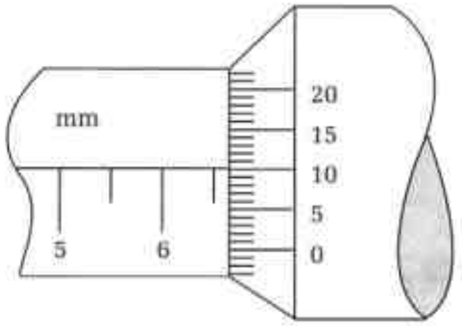


Diagram II

What is the diameter of the pellet?

A 6.58 mm

B 6.60 mm

C 6.62 mm

D 7.08 mm

2 How can the periodic time of a simple pendulum be significantly reduced?

A By increasing the mass of the pendulum.

B By decreasing the mass of the pendulum.

C By increasing the length of the pendulum.

D By decreasing the length of the pendulum.

3 Which of the following statement(s) concerning mass and weight is/are true?

I Mass is constant everywhere.

II Weight is a force that pulls towards the centre of the earth.

III Weight changes from place to place depending on the acceleration due to gravity.

A **I** only

B **I** and **III** only

C **II** and **III** only

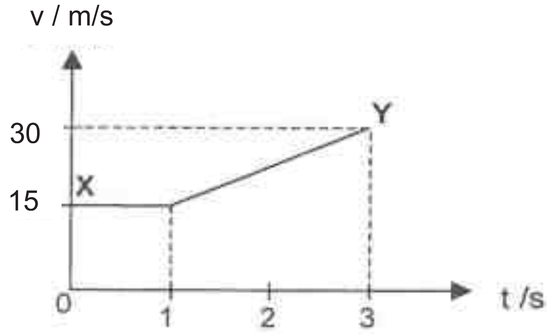
D **I**, **II** and **III**

4 The mass of a paper-clip is 0.50 g and the density of its material is 8.0 g/cm^3. The total volume of a number of paper-clips is 20 cm^3. How many paper-clips are there?

A 80 **B** 160
C 240 **D** 320

5 The diagram shows the speed-time graph of a runner.

What is the average speed of the runner between points **X** and **Y**?

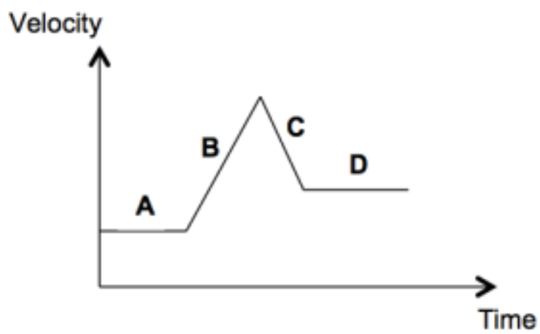


A 20.0 m/s **B** 22.5 m/s
C 25.0 m/s **D** 27.5 m/s

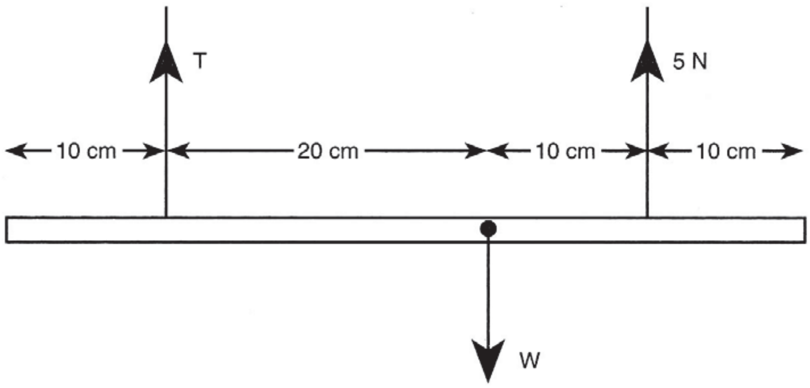
6 How will the acceleration due to gravity be affected if a heavy object is released from a higher position and its mass is halved?

	Higher Position	Halved its mass
A	No change	No change
B	No change	Decreases
C	Increases	Decreases
D	Increases	No change

7 An object moves in a straight horizontal line under a single force. The magnitude and direction of the force change during the motion. The velocity-time graph of the object is shown. Which is the interval where the force did the most work on the object?



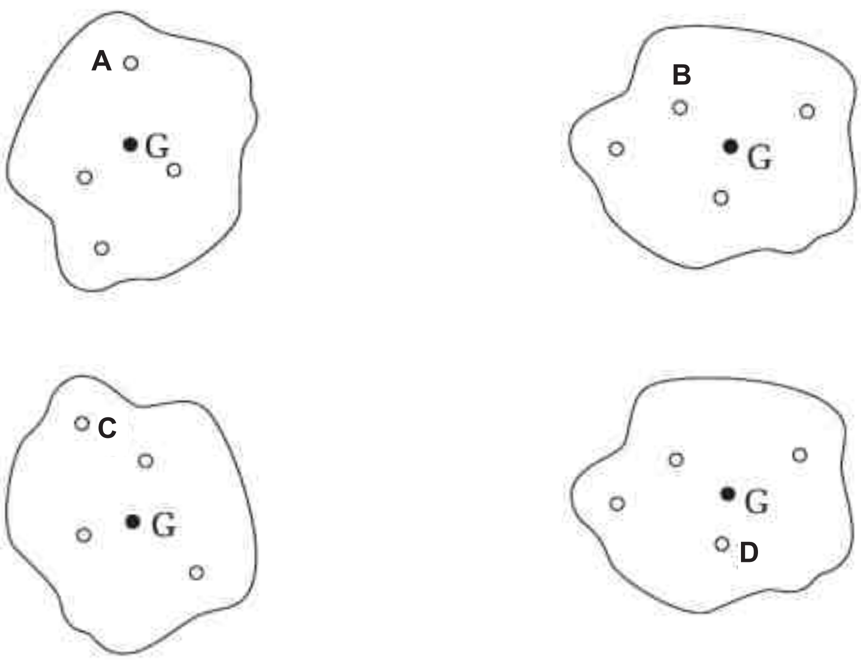
8 A non-uniform rod of unknown weight **W** is suspended by two strings as shown in the diagram. The tension in one of the strings is 5 N.



What is the tension **T** in the other string?

A 2.5 N **B** 5.0 N
C 7.5 N **D** 12.5 N

9 Four holes, **A**, **B**, **C** and **D** are made on a uniform lamina. The centre of gravity of the lamina is at **G**. Which one of the following shows correctly the lamina hanging freely about each of the holes?



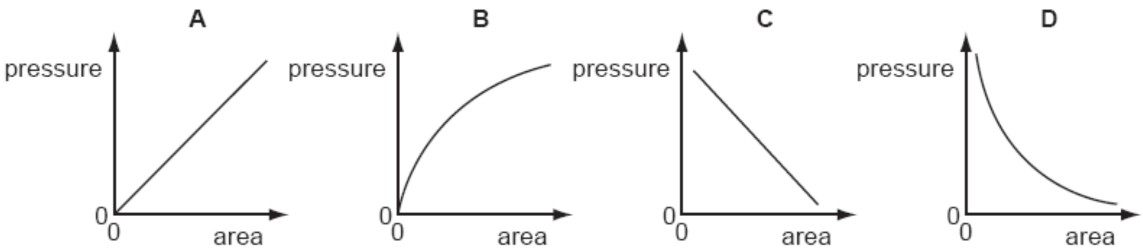
10 Which of the following involve(s) a change in energy of 100 J?

I A mass of 10 kg raised vertically by 100 cm.
II A mass of 2 kg increasing its speed from 10 m/s to 20 m/s.
III A charged particle of 5 C accelerated using a potential difference of 20 V.

A **I** only
B **II** only
C **I** and **III** only
D **I**, **II** and **III**

11 A graph is plotted to show the relationship between the pressure exerted on the table and the base area of the block.

Which one of the following graph shows this relationship?

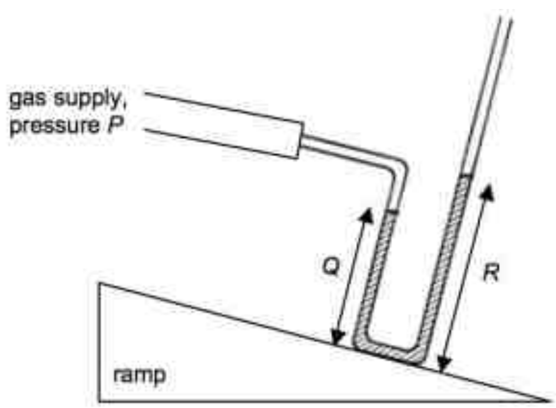


12 The atmospheric pressure is 100 kPa. What is the average force experienced at the bottom of the water tank with length 0.5 m, width 0.4 m and depth 0.6 m? (Density of water is 1000 kg/m^3.)

A 720 N
B 1200 N
C 12720 N
D 21200 N

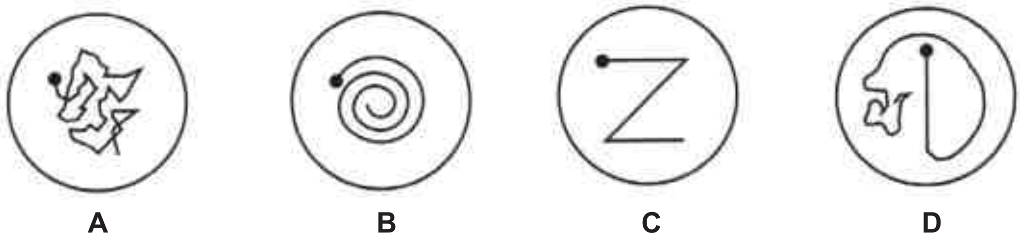
13 A manometer is placed on a ramp connecting to a gas supply with pressure ***P***. The atmospheric pressure is ***H*** metres of mercury.

If the lengths ***Q*** and ***R*** are measured in metres, what is the pressure ***P*** in metres of mercury?



A Exactly ***R*** + ***H***
B Exactly ***R*** – ***Q*** + ***H***
C Lesser than ***R*** + ***H***
D Lesser than ***R*** – ***Q*** + ***H***

14 Which one of the following diagrams best represents the observed paths of chalk powder suspended in still water?



15 At room temperature, we feel that a metal lock is cooler than a wooden door.

Which of the following statement(s) is/are true?

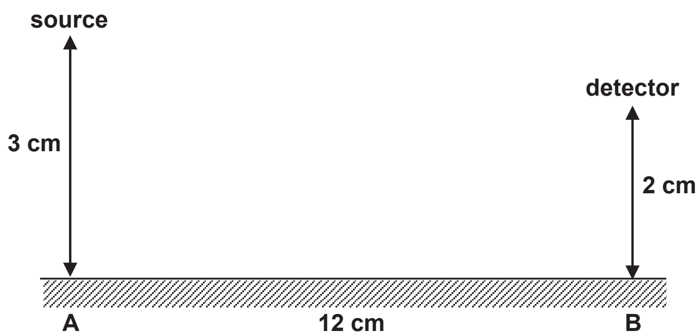
I The temperature of the metal block is lower.
II Metal is a better conductor of thermal energy than wood.
III The transfer of thermal energy in metal is faster than wood.

A **I** only
B **I** and **III** only
C **II** and **III** only
D **I**, **II** and **III**

16 What mass of hot water at 80 °C must be mixed with water at room temperature of 30 °C in order to obtain 10 kg of water at 60 °C?

A 3.75 kg
B 4 kg
C 5 kg
D 6 kg

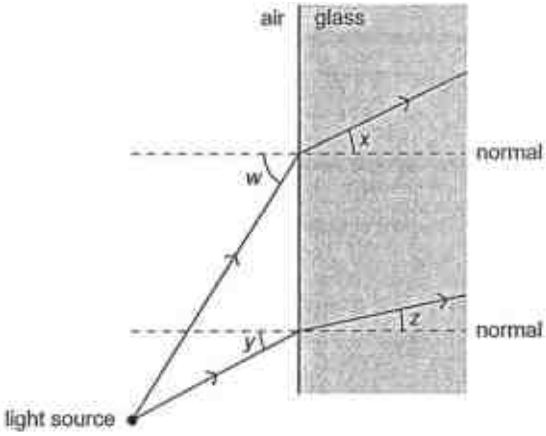
17 A point source of light is located 3 cm above a plane mirror and this reflected ray is detected 2 cm above the mirror at a horizontal displacement of 12 cm.



What is the distance between **A** and the point of incidence?

A 4 cm
B 6 cm
C 7.2 cm
D 8.5 cm

18 The diagram shows two rays of light entering a glass block.



Which one of the following equations is correct?

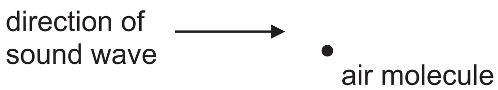
A $\dfrac{w}{x} = \dfrac{y}{z}$ **B** $\dfrac{\sin w}{\sin x} = \dfrac{\sin y}{\sin z}$

C $w \times x = y \times z$ **D** $\sin w \times \sin x = \sin y \times \sin z$

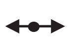
19 If an object is placed 21 cm from a converging lens, the image formed is slightly smaller than the object. What is the approximate focal length of the lens ?

A 5 cm **B** 10 cm
C 18 cm **D** 20 cm

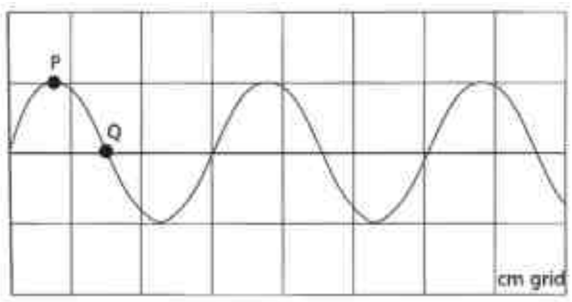
20 When a sound wave passes an air molecule in the direction shown, which diagram shows the correct movement of the air molecule?



A  **B** 

C  **D** 

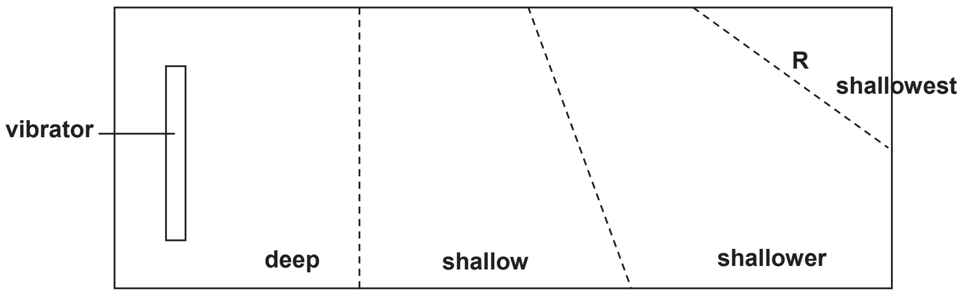
21 The diagram shows a snapshot of a travelling wave that is moving from left to right. The frequency of the wave shown is 30 Hz.



Taking each grid to be 1 cm × 1 cm, which of the following correctly states the amplitude and the speed of the wave?

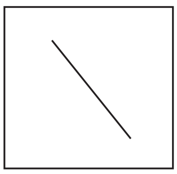
	Amplitude / mm	Speed / m/s
A	10	0.9
B	10	1.8
C	20	2.7
D	20	3.6

22 A ripple tank is set up so that there are different levels of water as shown in the diagram.

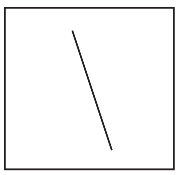


If the vibrator produces straight waves, which one of the following diagrams correctly shows a ripple approaching the region **R**?

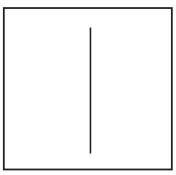
A



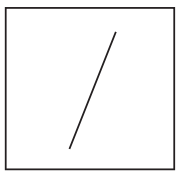
B



C



D



23 Which one of the following statements about the visible spectrum is **not true**?

A Light from the sun does not produce a pure spectrum.
B The visible spectrum includes infra-red and ultra-violet rays.
C A rainbow is actually a spectrum caused by the dispersion of light from water droplets.
D It is seen when white light passing through a prism is dispersed into its component colours.

24 A tennis player hits a ball hard and hears an echo from a wall 0.4 s later. The speed of sound in air is 330 m/s. How far away is the player from the wall?

A 66 m **B** 132 m
C 264 m **D** 825 m

25 Which of the following is/are application(s) of ultrasound?

I Prenatal scanning of foetus
II Cleaning of surgical instruments
III Using a microphone during lecture

A **I** only **B** **II** only
C **I** and **II** only **D** **I**, **II** and **III**

26 **Figure I** shows two metallic spheres **X** and **Y** placed in contact. A positively charged rod **Z** is then brought near them.

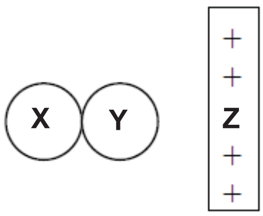


Figure I

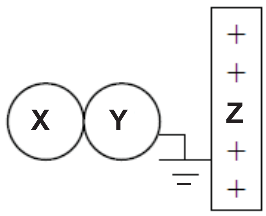


Figure II

If **Y** is earthed without removing **Z** as shown in **Figure II**, which one of the following statements is correct?

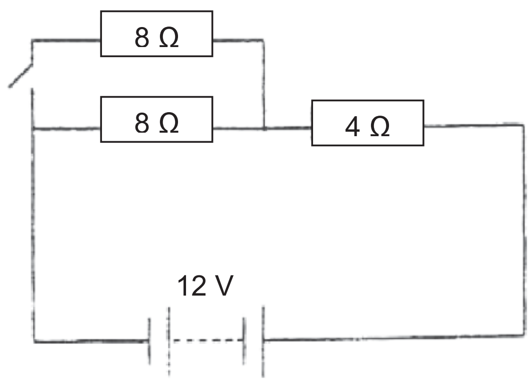
A Both **X** and **Y** will be negatively charged.
B Both **X** and **Y** will be positively charged.
C **X** will be positively charged and **Y** will carry no charge.
D **X** will carry no charge and **Y** will be negatively charged.

27 A battery drives 30 C of charge round a circuit. The total work done is 600 J. What is the electromotive force of the battery?

A 0.05 V **B** 5 V
C 20 V **D** 300 V

28 Resistors of 8 Ω and 4 Ω are connected in series to a 12 V supply as shown in the circuit.

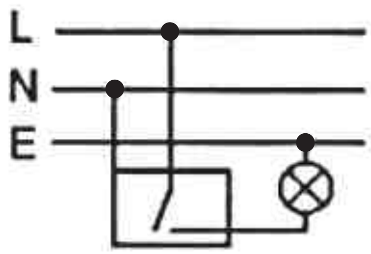
What is the effect of closing the switch on the current drawn from the supply and the potential difference across the 4 Ω?



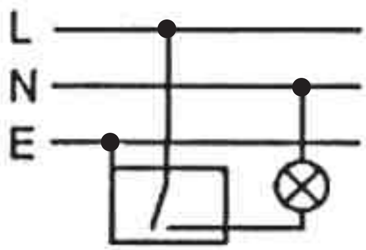
	Current	Potential Difference
A	Decreases by 0.5 A	Decreases by 2 V
B	Unchanged	Increases by 2 V
C	Increases by 0.5 A	Increases by 2 V
D	Increases by 0.5 A	Increases by 4 V

29 Which one of the following diagrams shows the correct connections for a switch and lamp in a lighting circuit? (Key: L – Live, N – Neutral, E – Earth and □ – metal casing)

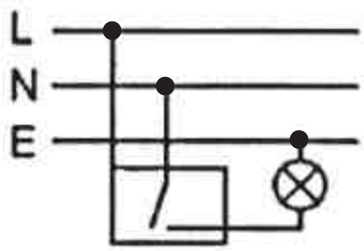
A



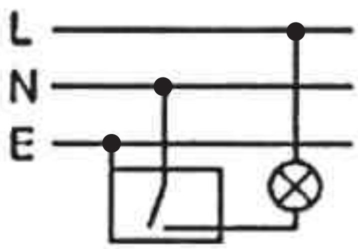
B



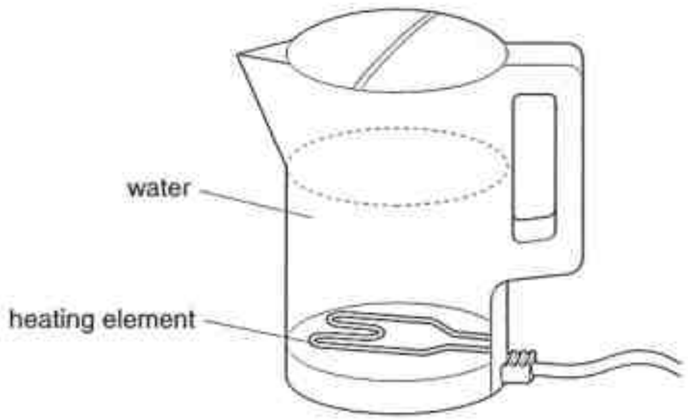
C



D



30 An electric kettle, labelled '220 V, 1 kW' is fitted with a plug containing a 13 A fuse.



It is connected to a 220 V mains supply. The water in it takes a few minutes to boil. When the plug is connected to a 110 V mains supply

A the kettle does not work.
B the fuse in the plug blows.
C the water takes a longer time to boil.
D the heating element of the kettle melts.

31 An electrical heater is used to determine the specific heat capacity of a metal and the following readings are obtained:

mass of metal:	2 kg
time for which heat is supplied:	20 s
temperature rise of metal:	10 °C

It is found that the specific heat capacity of the metal is 720 J/(kg°C).

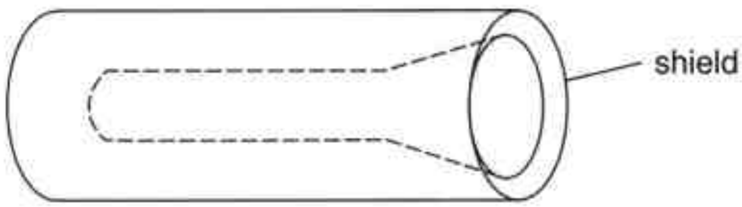
Assuming that 20% of the energy supplied by the heater is lost to the surrounding, what is the power rating of the heater?

A 720 W **B** 864 W
C 900 W **D** 14400 W

32 The best way to demagnetise a magnet is to

A throw it on the ground several times.
B place it along the E-W axis and hammer it.
C place it in a solenoid carrying direct-current and slowly pulling it out.
D place it in a solenoid carrying alternating-current and slowly pulling it out.

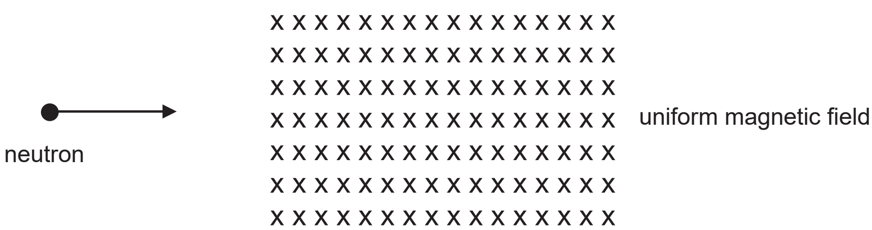
33 The diagram shows a shield designed to protect a cathode-ray tube from the effects of external magnetic fields.



Which one of the following is used to make the shield?

A Steel
B Copper
C Mica
D Soft iron

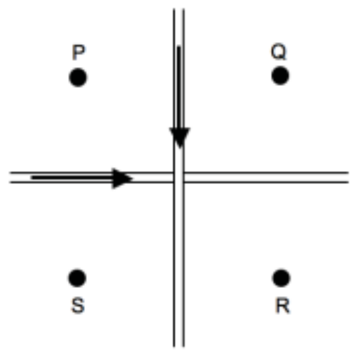
34 A neutron enters a uniform magnetic field perpendicularly as shown in the diagram.



The path that is traced out will be __________ because __________ .

A straight; there is no force acting
B circular; the force is always forward
C spiral; the force is always perpendicular to its motion
D parabolic; the force is always perpendicular to its motion

35 Two long insulated wires carrying **equal** currents are placed perpendicular to each other as shown.



The points **P**, **Q**, **R** and **S** are all at equal distances from the wires.

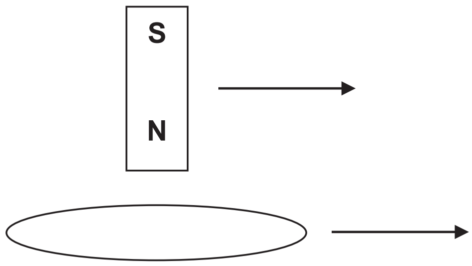
At which point(s) is/are the resulting magnetic field **zero**?

A **P** only
B **Q** only
C **P** and **R**
D **P** and **S**

36 Which part of a simple d.c. motor reverses the direction of current through the coil every half-cycle?

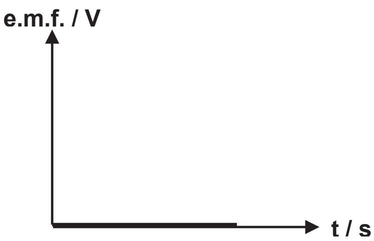
A The armature
B The brushes
C The split-ring commutator
D The slip rings

37 A bar magnet is held above a loop of wire in the position shown below. Both the loop and magnet are moved sideways with the same uniform speed.

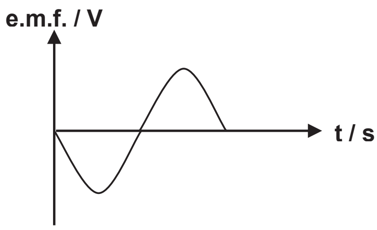


Which of the following graphs ***best*** represents the variation of the magnitude of the e.m.f. induced in the loop?

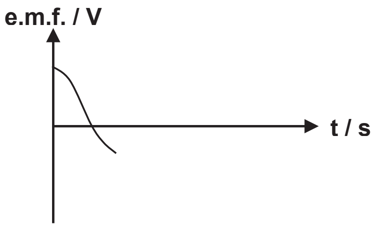
A



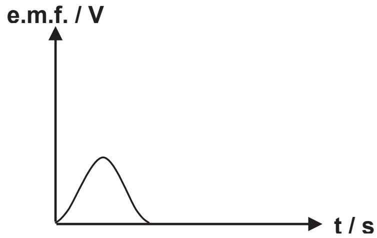
B



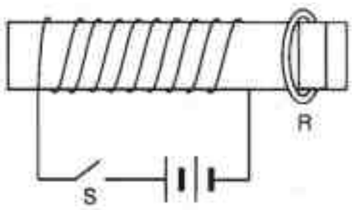
C



D



38 The diagram shows an insulated copper wire coiled around a soft iron rod. A copper ring **R** is placed at one end of the rod. What will happen to the copper ring **R** when the switch **S** is closed?



A The ring becomes heated up.
B The ring becomes magnetized.
C The ring will be attracted to the coil.
D The ring will be repelled from the coil.

39 **Diagram I** shows the oscilloscope trace produced by an input of 2 V at 50 Hz.

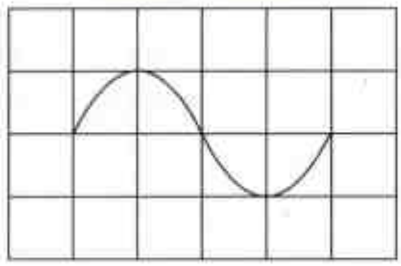


Diagram I

Diagram II shows the trace from a different input on the same oscilloscope.

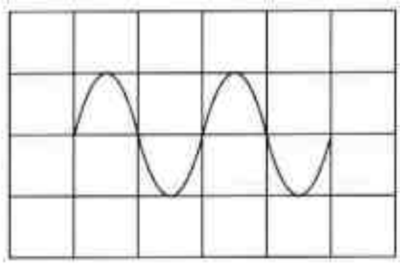


Diagram II

What is the value of the new input?

A 1 V at 50 Hz
B 2 V at 25 Hz
C 2 V at 100 Hz
D 4 V at 50 Hz

40 Which pairs of quantities are **not** proportional?

A Change in temperature and quantity of heat supplied to an object
B Speed and time for an object falling freely from rest through a vacuum
C Current and potential difference for a light bulb when temperature rises
D Resultant force acting on an object along a straight line and its acceleration

END OF PAPER

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2018

SUBJECT	:	PHYSICS 6091/02	DATE	:	20 AUGUST 2018
LEVEL	:	SECONDARY 4 EXPRESS	DURATION	:	1 H 45 MIN

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. This paper consists of **Two (2) Sections**: **Section A** and **Section B**.
2. **Section A:** Answer **ALL** questions. Write your answers in the spaces provided.
3. **Section B:** Answer **ALL** questions.
   Question **11** is **EITHER / OR QUESTION**. **SELECT ONLY ONE PART OF THIS QUESTION**.
4. Calculators may be used where necessary.
5. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES:

Throughout the paper, the acceleration due to gravity on Earth is taken as 10 N/kg **unless stated otherwise**.

The number of marks is given in brackets [ ] at the end of each question.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

PAPER 1	/ 40
PAPER 2	
SECTION A :	/ 50
SECTION B :	
Question 9	/ 10
Question 10	/ 10
Question 11 E/O	/ 10
TOTAL	/ 120
80% Weightage (Paper 1 & 2)	
20% Weightage (Paper 3)	
GRADE	
TARGET GRADE	

Parent's Signature: ______________________

This paper consists of __18__ printed pages, including the cover page.

SECTION A : [50 marks]

Answer **ALL** *questions in this section. Show your working and write your answers in the space provided.*

1 **Diagram I** shows a gate which closes automatically after use.

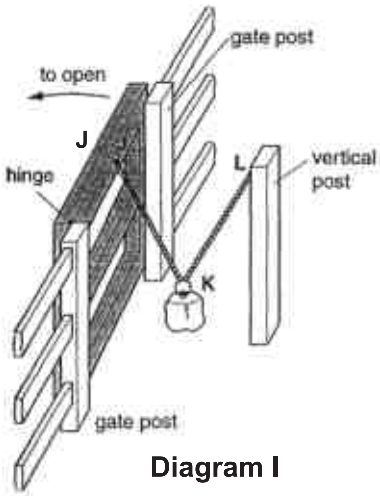


Diagram I

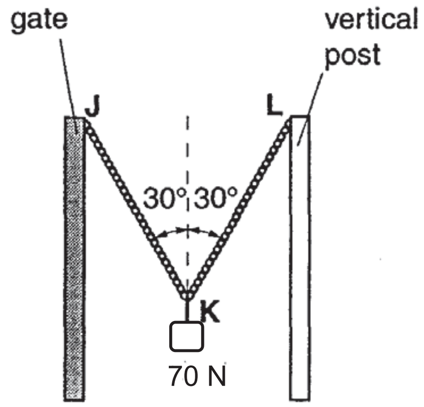


Diagram II

A heavy stone is attached by chains **JK** and **KL** to the top bar of the gate and to the top of a nearby vertical post. Opening the gate raises the stone. When the gate is released, the force exerted by the chains **JK** and **KL** closes the gate.

(a) **Diagram II** shows the instant when the gate is closed and each chain is at 30˚ to the vertical. The plane containing the chains and the stone is at right angles to the gate. By means of a scaled vector diagram, determine the tension in cable **JK** if the weight of the stone is 70 N. You are to indicate the scale used.

Scale used = ... Tension in cable **JK** = ... **[4]**

(b) **Diagram III** shows the top view of the gate.

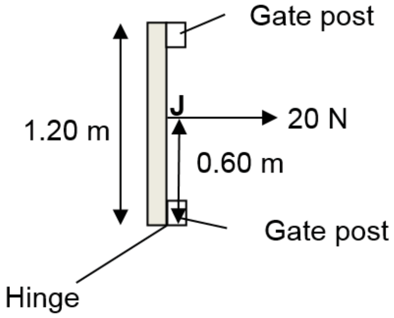


Diagram III

Due to the tension in chain **JK**, there is a horizontal force of 20 N that holds the gate closed as shown in the diagram. A force **F** is applied to the gate to open it.

(i) By means of an arrow, indicate in **Diagram III**, where the force **F** should be applied so that its magnitude is a minimum. Label the force as **F**. **[1]**

(ii) Calculate this minimum force **F** in **(b)(i)** needed to just open the gate.

Minimum force **F** = ... **[2]**

2 **(a)** Define ***work*** and give the name and symbol for an SI unit in which it is measured.

....

....

Unit of work: .... Symbol: .... **[2]**

(b) To push-start a car on a winter's morning (its battery is flat), two people each pushes with a force of 295 N. After pushing for 15 m, the car's engine starts. If at the moment, its kinetic energy is 7400 J, calculate

(i) the work done by the push of the people on the car, and

Work done = ... **[2]**

(ii) the average frictional forces on the car.

Average frictional forces = ... **[3]**

3 **(a)** **(i)** It is observed that solids have fixed shape while liquids do not. Using the property of molecules, explain the observation.

....

....

....

.... **[2]**

(ii) What property of molecules makes gases fill all the space available to them?

....

.... **[1]**

(b) Explain how molecules escape from the surface of an evaporating liquid.

....

....

....

.... **[2]**

(c) Explain how evaporation affects the internal energy of the liquid.

....

....

....

.... **[2]**

4 The wavelength of four electromagnetic waves including infrared wave is given in the following table.

Type of Wave	Wavelength
Infrared wave	0.18 mm
A	0.5 μm
B	10 cm
C	1100 m

(a) Which of the waves, **A**, **B** or **C** is visible light?

.... **[1]**

(b) A TV station broadcasts its programmes at 5×10^3 kHz.

(i) Name the electromagnetic wave used for the broadcast.

.... **[1]**

(ii) Calculate the wavelength of the wave.

Wavelength = ... **[2]**

(c) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space. Why would an X-ray telescope based on Earth **not** be able to detect X-rays emitted from distant stars?

....

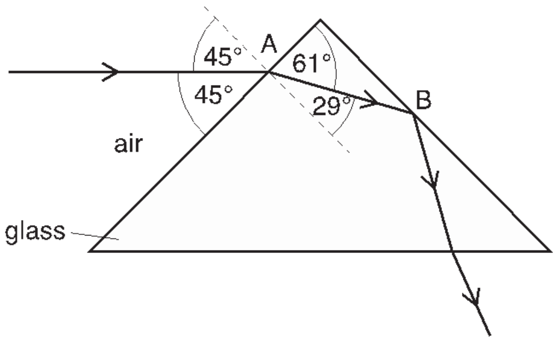
.... **[1]**

(d) State one similar properties of all electromagnetic waves.

....

.... **[1]**

5 The diagram shows the path of a ray of blue light as it passes through a glass prism.



(a) Using the angles shown in the diagram, calculate the refractive index of the glass.

Refractive index = ... **[2]**

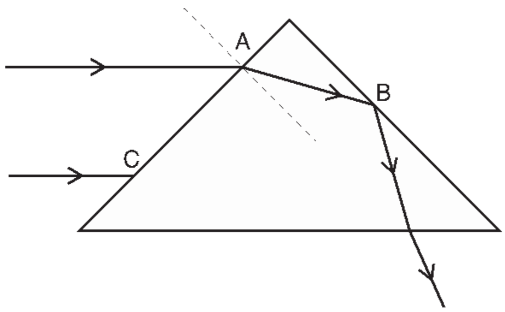
(b) Explain why the ray does not emerge from the prism at **B**.

....

....

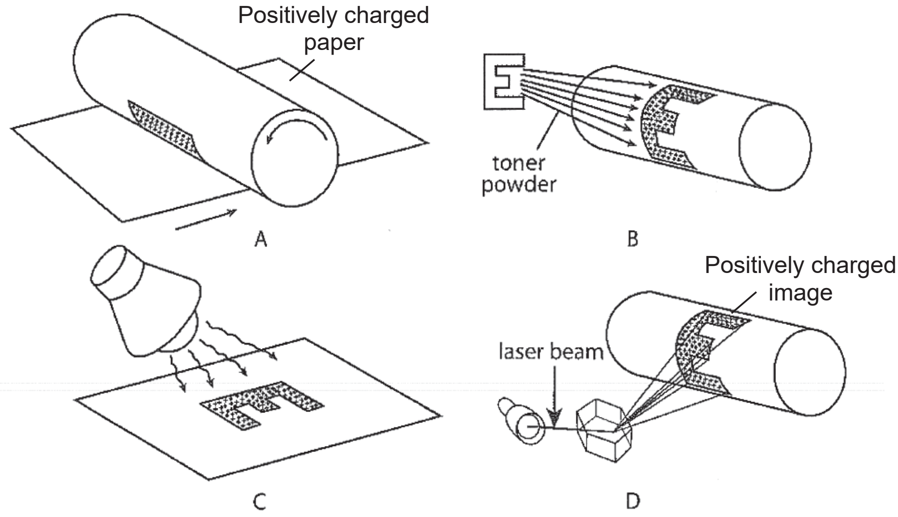
.... **[2]**

(c) In the following diagram, a second ray of blue light strikes the glass prism at **C**. This ray is parallel to the ray that strikes the glass prism at **A**. In this diagram, continue the path of the second ray through and out of the glass prism.



[2]

6 The diagram shows four stages on how a photocopier works.



The four stages are labelled from **A** to **D** but are not arranged in order.

The following table shows the first stage with a brief description on what happens during this stage within the photocopier.

Stage	Brief Description of the stage
D	Light is shone on a document and the white areas reflect light onto the drum which is positively charged. Areas on the drum that are struck by the light are discharged and leaves a positively charged image on the drum.

(a) Complete the table by

(i) arranging the other stages in correct order. **[1]**

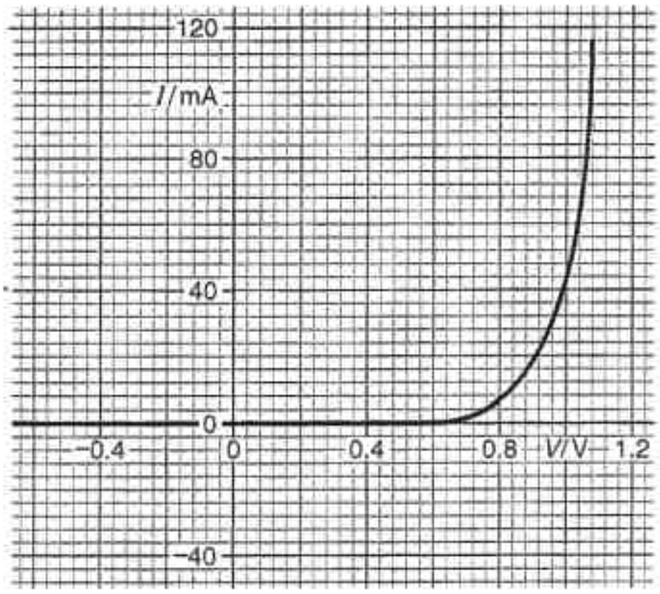
(ii) providing a brief description of each stage. **[3]**

(b) Explain why the paper in stage **A** is more positively charged than the image formed in stage **D**.

....

.... **[1]**

7 The graph shows how the current **I** in a diode varies with the potential difference **V** across it.



(a) Describe how **I** varies with **V** when

(i) **V** is negative,

.... **[1]**

(ii) **V** is positive.

....

.... **[2]**

(b) Calculate the resistance of the diode when **V** is 1.0 V.

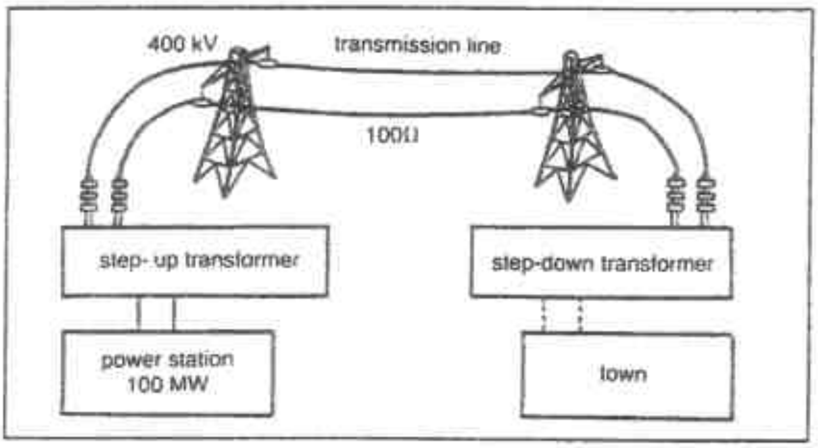
Resistance = ... **[2]**

(c) A student states "when **V** is negative, the resistance is zero". State with a reason whether you agree with the student.

....

.... **[1]**

8 The diagram shows a power station, which generates 100 MW of power.



The voltage is stepped up to 400 kV and the national grid transmits the power over a large distance. The voltage is then stepped down before the power is used by industries and homes in a town.

(a) Given that 100 MW is fed into the line at 400 kV, calculate the current flowing in the transmission line.

Current = ... **[2]**

(b) Calculate the power loss along the transmission line given that the total resistance of the line is 100 Ω.

Power = ... **[2]**

(c) How would you modify the circuit so that the power loss in the circuit can be reduced? Explain your answer.

....

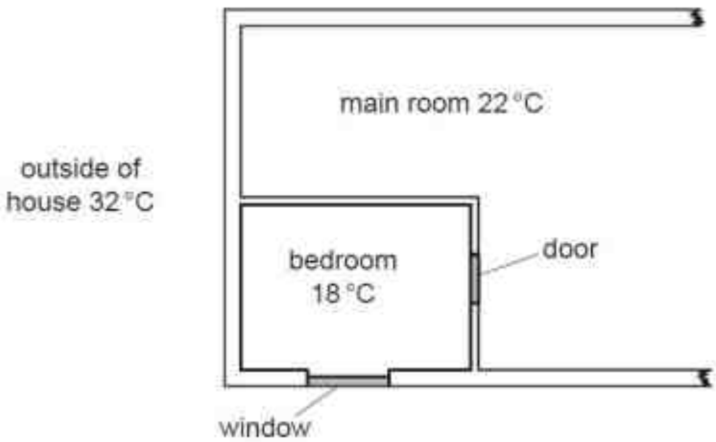
....

.... **[2]**

SECTION B : [30 marks]

Each question is worth **10 marks***. Answer* **ALL** *questions in this section.* **Question 11** *is an* **EITHER / OR QUESTION***.* ***SELECT ONLY ONE PART OF THIS QUESTION****. Show your working and write your answers in the spaces provided.*

9 The diagram shows the plan of a bedroom and part of the main room of a house. Other rooms are not shown.



The temperatures of the main room, the bedroom and the outside of the house are shown.

The following table shows all the thermal energy inputs to the bedroom in one hour.

Thermal energy input to bedroom	Energy / J
Through the door and walls from main room	4.5×10^4
Through the walls from outside of house	2.3×10^6
Through the window	1.1×10^6
From the person sleeping in bedroom	2.0×10^5

(a) Explain why more thermal energy enters the bedroom from the outside of the house than from the main room.

....

.... **[1]**

(b) An air conditioner keeps the temperature constant in the bedroom by removing energy.

Identify a suitable location of the air conditioner in the bedroom and explain how it cools the bedroom efficiently.

....

....

....

....

.... **[3]**

(c) The inside wall of the bedroom radiates thermal energy. Explain how the colour of the inside wall affects the amount of energy radiated.

....

....

....

.... **[2]**

(d) **(i)** What is the rate of thermal energy removed by the air conditioner if the temperature of the room is to be maintained at 18 ˚C?

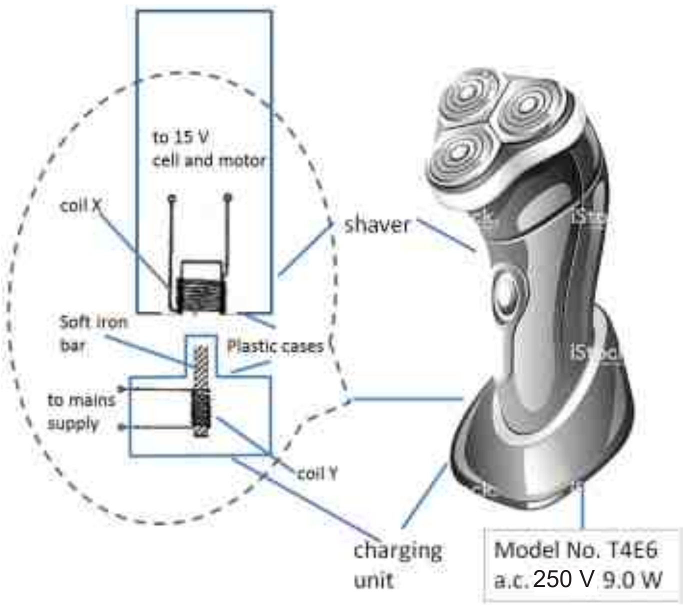
Rate = ... **[3]**

(ii) State an assumption made in the calculation for **d(i)**.

....

.... **[1]**

10 The diagram shows an electric shaver.



It consists of the shaver and a charging unit. Both the shaver and the charging unit are completely covered by plastic cases and there is no metal contact between them. Inside the shaver, there is a 15 V rechargeable cell for driving a motor.

(a) When the shaver is in operation, the current flowing through the motor is 0.36 A. Calculate the power consumed by the motor.

Power = ... **[2]**

(b) When the energy stored in the cell is used up, the shaver is placed on the charging unit to recharge the cell. The charging unit is connected to the mains supply and its label is shown in the diagram.

Calculate the energy, in joules, drawn by the charging unit from the mains supply in one hour.

Energy = ... **[2]**

(c) To charge the rechargeable cell, the shaver will be placed on the charging unit. At the bottom of the shaver is coil **X**, which is connected to the 15 V rechargeable cell. Another coil **Y** is located inside the charging unit with a soft-iron bar fixed inside it. When the shaver is placed on the charging unit, the soft-iron bar lies inside coil **X**.

(i) Explain how an electromotive force (e.m.f.) is produced in the shaver to recharge the cell.

....

....

....

....

.... **[3]**

(ii) An output voltage of 30 V a.c. is produced at coil **X** to charge the cell. Calculate the number of turns in coil **X** if there is 11000 turns in coil **Y**.

Number of turns = ... **[2]**

(d) The charging unit is connected to the mains with a two-pin plug. State a reason that explains why it is safe to use a two-pin plug.

....

....

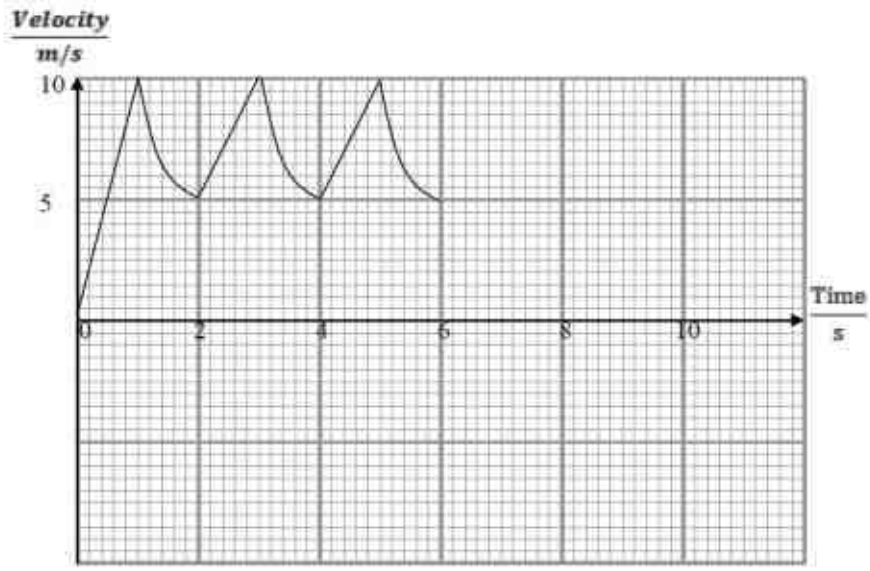
.... **[1]**

11 EITHER

The diagram shows a boy of mass 32 kg riding on a skate scooter.

He pushes off with his rear foot momentarily, cruises for a while and then pushes off with rear foot again. The cycle is repeated. There is presence of resistive forces.

The following graph shows how the velocity of the boy changes over the first 6.0 s of his journey.



(a) Describe the boy's acceleration over the first 2.0 s of his journey.

....

....

....

.... **[2]**

(b) Which part of the graph shows that there is presence of resistive forces? Explain your answer.

....

.... **[2]**

(c) At 0.50 s, calculate

(i) the total displacement of the boy,

Total displacement = ... **[1]**

(ii) the acceleration of the boy

Acceleration = ... **[1]**

(iii) the forward driving force applied by the boy if the total resistive force acting on him is 4.5 N.

Forward driving force = ... **[3]**

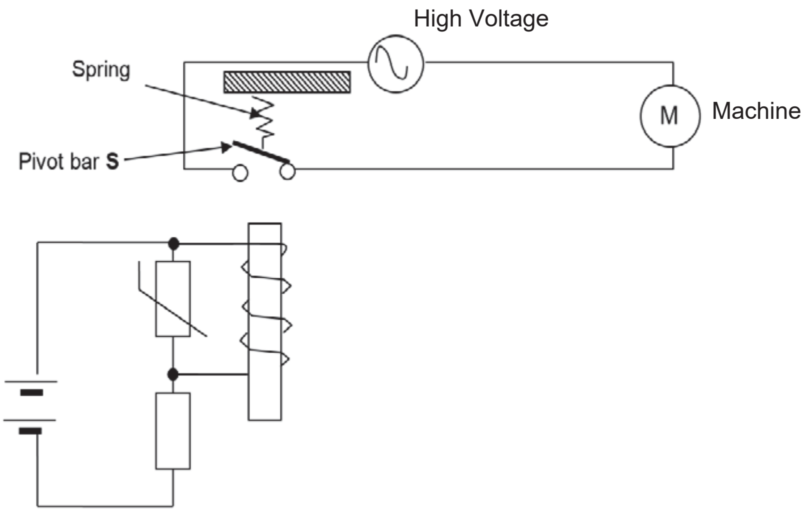
(d) State the other force that is part of an action-reaction pair with the forward driving force calculated in **c(iii)**.

....

.... **[1]**

11 OR

The diagram shows a magnetic relay used to operate the switch of a machine in a factory.



(a) Explain how the magnetic relay works when the temperature around the thermistor **decreases**.

....

....

....

....

.... **[3]**

(b) **(i)** In the diagram, indicate the **N-pole** of the electromagnet. **[1]**

(ii) Suggest a suitable material for the pivot bar **S**. Give a reason for your choice.

....

....

.... **[2]**

(c) **(i)** Explain clearly the advantage of using a magnetic relay to operate the machine

....

....

.... **[2]**

(ii) The machine operates at ‘1000 V, 5 A’ and runs an average of 12 hours daily. Calculate the cost of operating the machine in a month (30 days) if each unit of electricity costs $0.29.

Cost = ... **[2]**

END OF PAPER

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2018

SUBJECT : PHYSICS 6091 DATE : 20 AUG 2018 (P2)
11 SEPT 2018 (P1)

LEVEL : SECONDARY 4 EXPRESS DURATION :

PAPER 1 [40 marks] (DURATION: 1 HOUR)

1	2	3	4	5	6	7	8	9	10
C	**D**	**D**	**D**	**A**	**A**	**B**	**A**	**A**	**C**

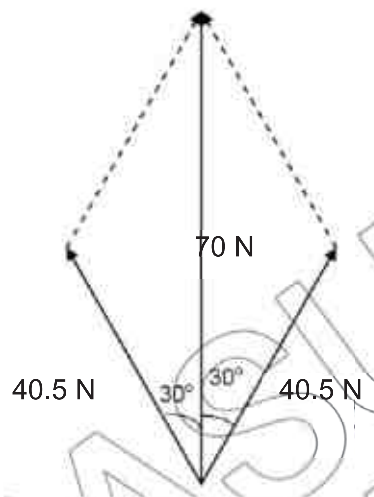
11	12	13	14	15	16	17	18	19	20
D	**D**	**D**	**A**	**C**	**D**	**C**	**B**	**B**	**C**

21	22	23	24	25	26	27	28	29	30
A	**B**	**B**	**A**	**A**	**C**	**C**	**C**	**B**	**C**

31	32	33	34	35	36	37	38	39	40
C	**D**	**D**	**A**	**C**	**C**	**A**	**D**	**C**	**C**

PAPER 2 (DURATION: 1 HOUR 45 MIN)

Section A [50 marks]

<table>
<tr><th>QN</th><th>Suggested Answers</th><th>Sub Ttl</th><th>Ttl</th></tr>
<tr><td>1a</td><td>

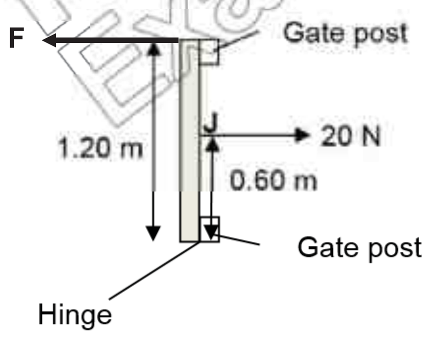
Suitable scale [1]
Shape of vector diagram [1]
Labelling forces [1]
Tension in cable JK = 40.5 ± 4.0 N [1]</td><td>4(M)</td><td>7</td></tr>
<tr><td>1bi</td><td>

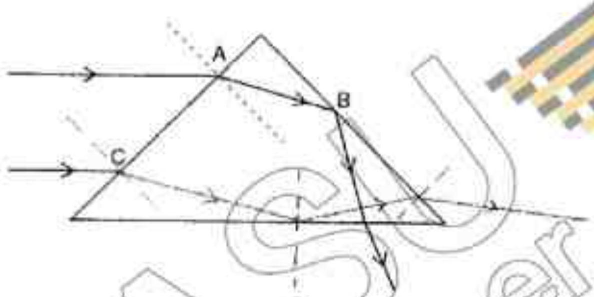
Diagram III</td><td>1(E)</td><td></td></tr>
<tr><td>1bii</td><td>Taking moments about hinge,

Total clockwise moments = Total anti-clockwise moments
20 × 0.60 = F × 1.20 [1]
F = 10 N [1]</td><td>2 (M)</td><td></td></tr>
</table>

QN	Suggested Answers	Sub Ttl	Ttl
2a	Work is the energy transferred [1] when a force moved an object over a distance in the direction of the force. Unit of work: Joules Symbol: J [1]	**2 (E)**	**7**
2bi	WD = Force × distance moved = (2 × 295) × 15 [1] [2 × 295] = 8850 J [1]	**2 (M)**	
2bii	WD against Friction = 8850 – 7400 = 1450 J [1] WD = Force × distance moved 1450 = F × 15 [1] F = 96.7 N [1] Average frictional forces = 96.7 N	**3 (D)**	

QN	Suggested Answers	Sub Ttl	Ttl
3ai	Solids have fixed shape as the molecules are vibrating about their fixed position. [1] Liquids do not have fixed shape as the molecules are able to slide past one another. [1]	**2 (M)**	**7**
3aii	The weak intermolecular force between the gas molecules.	**1 (E)**	
3b	The molecules are at constant random motion and they collide with [1] one another. At times, some molecules gained enough energy to break the intermolecular bonds [1] between them and escape to the surrounding as vapour.	**2 (E)**	
3c	During evaporation, some molecules with more energy escape from the surface of the liquid. The remaining molecules has less kinetic energy [1]. Thus the internal energy of the liquid will decrease [1].	**2 (M)**	

QN	Suggested Answers	Sub Ttl	Ttl
4a	A [1]	**1 (E)**	**6**
4bi	Radiowaves [1]	**1 (E)**	
4bii	$v = f\lambda$ $3 \times 10^8 = 5 \times 10^6 \times \lambda$ [1] [½ m for v and ½ for f] $\lambda = 60$ m [1]	**2 (M)**	
4c	X-rays are absorbed by the Earth's atmosphere. [1]	**1 (M)**	
4d	Any of the following: They are transverse waves. They travel at the same speed of 3×10^8 m/s in vacuum. They do not require a medium to travel. They do not carry any charge. They are not affected by electric field.	**1 (E)**	

QN	Suggested Answers	Sub Ttl	Ttl
5a	$\eta = \frac{\sin i}{\sin r}$ $= \frac{\sin 45°}{\sin 29°}$ [1] = 1.46 (3sf)[1]	**2 (E)**	**6**
5b	Light is travelling from optically denser medium (glass) to an optically less dense medium (air) and the angle of incidence is greater than the critical angle [1], total internal reflection takes place [1].	**2 (M)**	
5c	 Refraction at C with ray parallel to AB [1] TIR and refraction [1] Normal should be drawn at the surfaces [deduct ½ m if both not done]	**2 (D)**	

QN	Suggested Answers	Sub Ttl	Ttl
6ai	**DBAC**	**1 (M)**	**5**
6aii	B: Negatively charged toner particles are then attracted to [1] the positively charged image. A: The toner is transferred/attracted to [1] the paper when the drum rolls on the positively charged paper. C: Heat is applied to the toner powder [1] to fix the image onto the paper.	**3 (D)**	
6b	So that the negatively charged toner is attracted to the paper instead of sticking to the drum.	**1 (D)**	

QN	Suggested Answers	Sub Ttl	Ttl
7ai	When V is negative, the current I is zero. [1]	**1 (E)**	**6**
7aii	When V is between 0 V to 0.6 V, the current is zero. [1] When V is greater than 0.6 V, the current I varies from 0 mA to 116 mA. [1]	**2 (D)**	
7b	From the graph, when V is 1.00 V, I is 44 mA. Resistance of the diode, R = V/I $= 1.00 / 44 \times 10^{-3}$ [1] = 22.7 Ω [1]	**2 (M)**	
7c	No. When V is negative and I is zero, it means that the resistance must be very high [1] such that no current can pass through.	**1 (M)**	

QN	Suggested Answers	Sub Ttl	Ttl
8a	$I = \frac{P}{V}$ $= \frac{100,000,000}{400,000}$ [1] $= 250A$ [1]	**2 (E)**	**6**
8b	$P_{loss} = I^2R$ $= 250^2 \times 100$ [1] $= 6.25MW$ [1]	**2 (M)**	
8c	Step up the voltage to more than 400 kV [1] to reduce the current flowing through the transmission line. As power loss in the circuit is I^2R [1], with reduced current, power loss is reduced.	**2 (D)**	

Section B [30 marks]

QN	Suggested Answers	Sub Ttl	Ttl
9a	There is greater temperature difference of 14 °C between outside the house and the bedroom than that between the main room and the bedroom which is a temperature difference of 4 °C.	**1 (M)**	**10**
9b	It needs to be placed at the top [½] of the bedroom. The air around the air conditioner will be cooled, becomes more dense and sinks to the bottom of the room. [1] The warmer air, being less dense, will rise to the top of the room to be cooled. [1] A convection current is created [½] which helps to cool the room efficiently.	**3 (S)**	
9c	The inside wall of the bedroom should be painted white [1]. White is a poor emitter of radiant heat [1].	**2 (M)**	
9di	In 1 hour, total heat entering the bedroom $= 4.5 \times 10^4 + 2.3 \times 10^6 + 1.1 \times 10^6 + 2.0 \times 10^5$ [1] $= 4.05 \times 10^6$ J [1] Rate of thermal energy removed by the air conditioner $= 4.05 \times 10^6$ J / 60 s $= 6.75 \times 10^5$ W [1]	**3 (D)**	
9dii	Any reasonable assumption: • There is no heat entering the room other than what is stated. • The window and door is kept closed throughout. • The temperature outside the bedroom remains as stated.	**1 (D)**	

QN	Suggested Answers	Sub Ttl	Ttl
10a	Power consumed by the motor = VI = 15 × 0.36 [1] = 5.4 W [1]	**2 (E)**	**10**
10b	E = Pt = 9 × 1 × 60 × 60 [1] = 32400 J [1]	**2 (E)**	
10ci	When the charging unit is connected to the mains supply, an alternating current flows through coil Y [1]. This alternating current will produce a changing magnetic field [1]. According to Faraday's law, this changing magnetic field linking [1] coil X will produce an e.m.f. in coil X which will produce an induced current to recharge the cell.	**3 (D)**	
10cii	Vs / Vp = Ns / Np 30 / 250 = Ns / 11000 [1] Ns = 1430 turns [1]	**2 (M)**	
10d	The charging unit has double-insulation [1] or has completely insulated plastic.	**1 (S)**	

Either

QN	Suggested Answers	Sub Ttl	Ttl
11a	From 0 s to 1.0 s: Positive uniform/constant acceleration [1] From 1.0 s to 2.0 s: Negative and non-uniform acceleration. [1]	**2 (M)**	**10**
11b	From 1.0 s to 2.0 s, 3.0 s to 4.0 s and 5.0 s to 6.0s (the part when the boy is cruising) [1]. During these timings, the boy is slowing down [1] showing that there is presence of resistive forces like friction and air resistance to oppose his motion.	**2 (M)**	
11ci	Total displacement $= \frac{1}{2} \times 0.50 \times 5$ $= 1.25$ m [1]	**1 (M)**	
11cii	Acceleration $= (v - u)/t$ $= (5 - 0)/0.50$ $= 10$ m/s^2 [1]	**1 (M)**	
11cii	Resultant Force $= ma$ $= 32 \times 10$ $= 300$ N [1] $F - 4.5 = 300$ [1] $F = 304.5$ N $= 305$ N (to 3 sf) [1]	**3 (D)**	
11d	The force applied by the boy on the ground. [1]	**1 (M)**	

Or

QN	Suggested Answers	Sub Ttl	Ttl
11a	When the temperature of the thermistor decreases, its resistance increases. The voltage across the thermistor increases and causes a larger current to flow through the solenoid. The electromagnet becomes strongly magnetised and attracts S to close the switch.	**3 (M)**	**10**
11bi	Top of the iron core is N-pole. [1]	**1 (M)**	
11bii	Iron [1] It can be magnetised and demagnetised easily. [1]	**2 (E)**	
11ci	The magnetic relay prevents the user from direct contact with high voltage of power supply. [1] Hence, it prevents/minimises the risk of electric shock. [1]	**2 (M)**	
11cii	Total energy used $= 1000 \times 5 \div 1000 \times 12 \times 30$ $= 1800$ kWh [1] Cost of energy $= 1800 \times \$0.29$ $= \$522$ [1]	**2 (M)**	

Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY FOUR EXPRESS

PHYSICS 6091/01 **12 SEPTEMBER 2018**

PAPER 1 **1 HOUR**

Additional Materials : **Optical Answer Sheet**

READ THESE INSTRUCTIONS FIRST

1. This paper consists of **40** Multiple Choice Questions.
2. Answer all questions on the Optical Answer Sheet (**OAS**).
3. Write your name, class and shade your register number in the spaces on the **OAS**
4. Do not fold nor use any correction fluid on the **OAS**. Read the instructions on the **OAS** carefully.
5. The total mark for this paper is 40 marks.

This paper consists of **16** printed pages, including this cover page.

Section A

Answer **ALL** the questions in this section.

1 The diameter of a cylindrical pencil is measured using a micrometer screw gauge. A student initially takes the zero error reading (Diagram A) of the micrometer followed by the reading of the diameter (Diagram B).

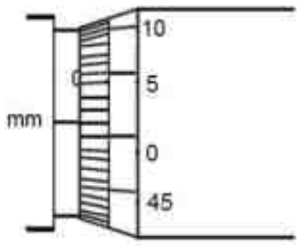


Diagram A

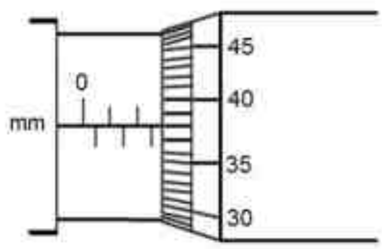


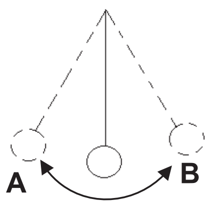
Diagram B

What is the actual diameter of the cylindrical pencil?

A 2.37 mm **B** 2.39 mm **C** 2.87 mm **D** 2.89 mm

2 The diagram shows a simple pendulum. It swings between **A** and **B**. The periods of oscillation for different lengths of pendulum are recorded in the table below.

length of pendulum / m	0.5	0.6	0.7	0.8
period of oscillation / s	1.429	1.565	1.689	1.805



If the length of the pendulum is 0.68 m, what is the approximate time taken for 20 oscillations?

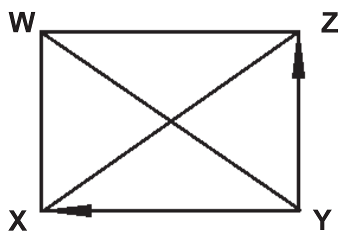
A 1.63 s

B 1.66 s

C 32.5 s

D 33.3 s

3 The figure below shows two forces acting at a point **Y** which are represented by **YX** and **YZ** respectively.



Which option represents a third force that is required to maintain equilibrium?

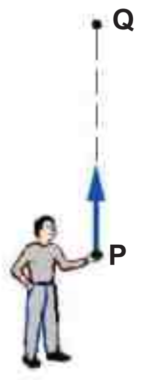
A **YW**

B **WY**

C **XZ**

D **ZX**

4 A ball is thrown vertically upwards from **P**. It reaches the greatest height at **Q** and then falls back to **P** where it is caught.



Neglecting air resistance, which of the following statements is **CORRECT**?

A Acceleration at **Q** is zero.

B The time of rise from **P** to **Q** is greater than the time of fall from **Q** to **P**.

C The total displacement of the ball is zero.

D The ball experiences a steady decreasing upward force when it rises from **P** to **Q**.

5 A car of a total mass of 800 kg is moving along a road at constant speed of 10 m/s. It suddenly brakes for 8 s before it comes to a stop in front of a traffic light.

Assuming that the braking force and the deceleration of the car are constants, what is the braking force exerted on the car?

A 80 N

B 100 N

C 640 N

D 1000 N

6 A 25 cm^3 molten copper of density 8.9 g/cm^3 is mixed thoroughly with 467 g of molten tin of density 7.3 g/cm^3 to form a bronze alloy.

What is the average density of the bronze alloy?

A 7.75 g/cm^3

B 7.92 g/cm^3

C 8.10 g/cm^3

D 8.33 g/cm^3

7 A 100 kg rock is being hung freely on the Moon. When an astronaut pushes the rock upwards, he will feel that ________________________.

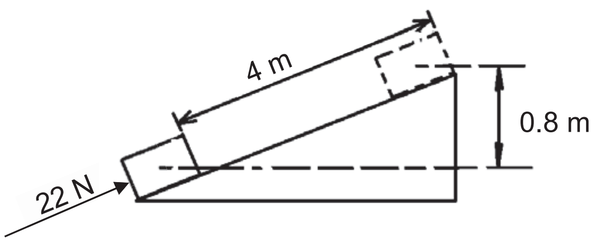
A the rock is easier to be pushed than on the Earth

B the rock is more difficult to be pushed than on the Earth

C the rock requires as much effort to be pushed as on the Earth

D the rock requires no effort to be pushed

8 A 22 N force is applied to push a 6 kg box along a 4 m ramp to reach a height of 0.8 m above its starting position. Assume gravitational field strength, g = 10 N/kg.



What is the work done against friction?

A 32 J

B 40 J

C 48 J

D 88 J

9 A 50 kg rectangular block of dimensions 2 m x 3 m x 5 m exerts pressure onto a hard ground. Assume gravitational field strength, g = 10 N/kg.

What is the **LEAST** pressure that the rectangular block can exert on the ground?

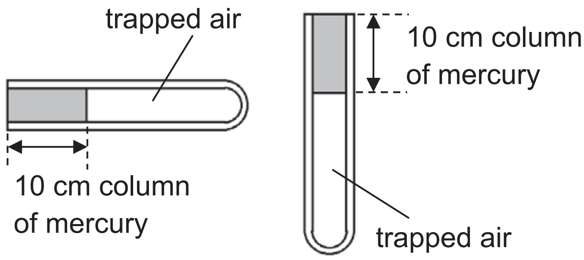
A 8.33 Pa

B 16.7 Pa

C 33.3 Pa

D 83.3 Pa

10 The diagrams below show air trapped in two capillary tubes **A** and **B** by a small column of mercury as shown. The length of the mercury column is 10 cm. The atmospheric pressure is 76 cm Hg.

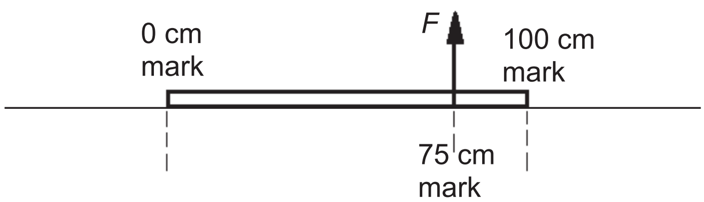


capillary tube **A** capillary tube **B**

What is the pressure of the trapped air in capillary tubes **A** and **B**?

	air pressure in capillary tube A	**air pressure in capillary tube B**
A	76 cm Hg	76 cm Hg
B	76 cm Hg	86 cm Hg
C	86 cm Hg	76 cm Hg
D	86 cm Hg	86 cm Hg

11 A 1 m uniform wooden rule weighing 20 N is being lifted vertically up by a force F at the 75 cm mark as shown.

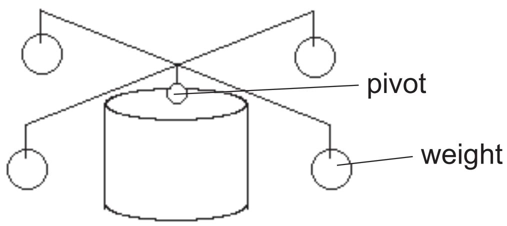


What is the **MINIMUM** force F required to lift the rule?

A 13.3 N **B** 26.6 N

C 40.0 N **D** 80.0 N

12 The diagram shows a balancing toy pivoted on a stand. If the toy is tilted slightly, it does not topple but returns to its original position.



Where is the position of the centre of gravity of the toy?

A above the pivot

B below the pivot

C exactly at the pivot

D inside the weight

13 A gas of the same volume as a liquid expands faster when heated?

Which of the following reasons is **CORRECT**?

A The gas molecules are bigger.

B The gas molecules expand faster.

C The forces between gas molecules are weaker than those between the liquid molecules.

D The gas molecules collide more frequently with each other.

14 In the Brownian motion experiment involving smoke particles, heavy particles settle quickly but very small particles remain suspended for long periods of time.

Which of the following reasons is **CORRECT**?

A The air pressure has a greater effect on very small particles.

B Very small particles have low inertia and are easily affected by the bombardments of the air particles.

C The Earth's gravitational field does not act on the very small particles.

D The very small smoke particles has the same density as the air.

15 A liquid-in-glass thermometer has a mercury level of 3.0 cm at – 5 °C and a mercury level of 11.0 cm at 115 °C.

What is the mercury level when the temperature is 105 °C.

A 8.3 cm **B** 9.8 cm

C 10.1 cm **D** 10.3 cm

16 The thermocouple is able to measure a temperature as high as 2500 °C.

Which of the following reason(s) is/are **CORRECT**?

(1) high specific heat capacity

(2) low heat capacity

(3) high melting point

A 1 only

B 3 only

C 1 and 2 only

D 1 and 3 only

17 Which of the following statements about the vacuum flask is **INCORRECT**?

A Heat loss by radiation is minimised by keeping the hot water in a double-walled container.

B Heat loss is minimised by placing a cork or plastic stopper to close up the neck of the container.

C The vacuum in the doubled-wall container effectively prevents conduction and convection.

D The walls of the container are silvered to reduce radiation.

18 Which of the following statement(s) is / are **CORRECT**?

(1) Electrical conductors are usually good conductors of heat.

(2) Conductors of heat have free electrons to transmit heat quickly.

(3) Electromagnetic waves need electrons to transmit energy.

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

19 The specific heat capacity for ice and water is given as 2.1 kJ/kg °C and 4.2 kJ/kg °C respectively. The specific latent heat of fusion of water is given to be 340 kJ/kg.

What is the total amount of energy needed to raise 1.5 kg of ice from –15 °C to 40 °C?

A 173 kJ

B 346 kJ

C 809 kJ

D 28600 kJ

20 Evaporation is always accompanied by cooling.

Which of the following reasons is **CORRECT**?

A The air molecules cool the liquid surface.

B The more energetic molecules leave the liquid.

C There are fewer molecules left in the liquid.

D The escaped molecules returned to the liquid.

21 X-rays, visible light and ultraviolet radiation are all part of the electromagnetic spectrum.

Which of the following describes the **CORRECT** order in increasing wavelength?

A X-rays, visible light and ultraviolet radiation

B X-rays, ultraviolet radiation and visible light

C visible light, X-rays and ultraviolet radiation

D ultraviolet radiation, X-rays and visible light

22 What are the **CORRECT** changes to the frequency, wavelength and speed of the water waves when they move from shallow waters to deep waters?

	frequency	**wavelength**	**speed**
A	increases	remains the same	increases
B	remains the same	decreases	decreases
C	remains the same	increases	increases
D	decreases	remains the same	decreases

23 An insect makes a sound that is higher than the maximum audible frequency of a normal person.

Given that the speed of the sound in air is 300 m/s, which of these wavelengths of the sound is made by the insect?

A 0.012 m

B 0.068 m

C 15 m

D 68 m

24 In an experiment to measure the speed of sound in air, a girl stands 60 m away from a wall and claps her hands together to produce a sound. At the instant when she hears an echo, she claps her hands again. She does this for 50 claps. The total time taken for 50 claps is 15 s.

Which of these calculations gives the speed of sound in air?

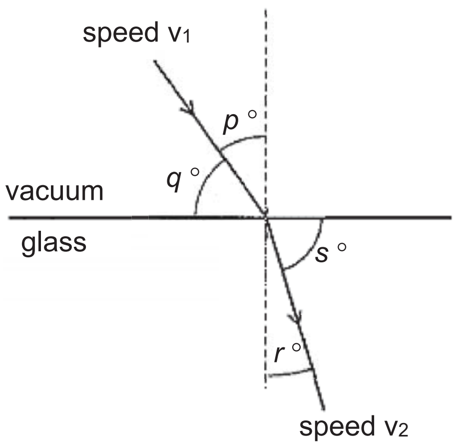
A $\frac{15}{60\times50}$

B $\frac{60\times50}{15}$

C $\frac{60\times2\times50}{15}$

D $\frac{60\times2\times15}{50}$

25 A ray of light travels from vacuum into glass.



What is the refractive index of the glass?

A sin(p °)/sin(s °)

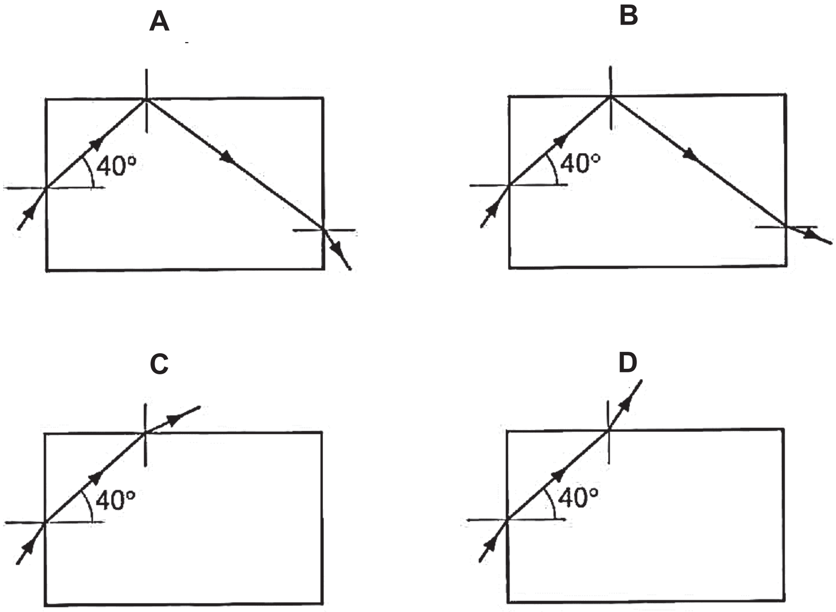
B sin(q °)/sin(r °)

C v_1/ v_2

D v_2/ v_1

26 A ray of light is incident on one side of a rectangle glass block. The angle of refraction is 40 ° in the glass. The critical angle for light in glass is 42 °.

Which diagram shows the path of this ray?



27 When the object is placed at 19 cm from the optical centre of a converging lens, the image formed is real, inverted and magnified. When the object is placed at 21 cm from the optical centre of the same converging lens, the image formed is real, inverted and diminished.

What is the focal length of the converging lens?

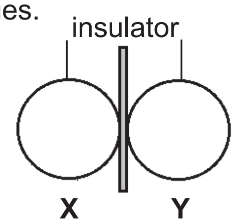
A 10 cm

B 20 cm

C 40 cm

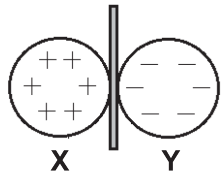
D cannot be determined

28 Two neutral conducting balls **X** and **Y** are suspended by insulating threads from the ceiling as shown. They are separated by a sheet of insulator. **X** is touched by a rod which carries positive charges.

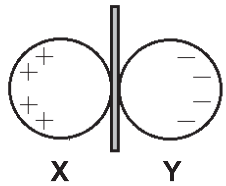


Which of the following diagrams best represents the charge distribution on them?

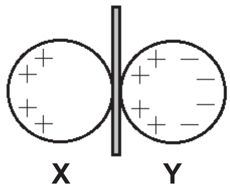
A



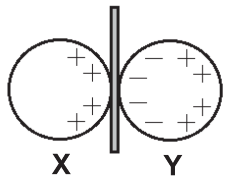
B



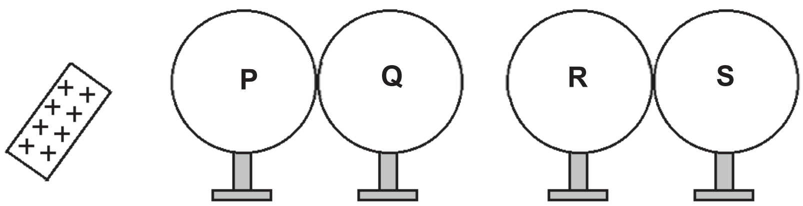
C



D



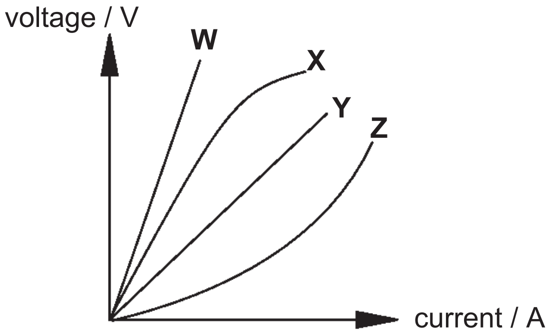
29 **P**, **Q**, **R** and **S** are four identical insulated metal spheres. They are arranged as shown below. A positively charged rod is brought near to **P**. Sphere **S** is earthed momentarily.



If the rod is removed, what would be the charge on spheres **R** and **S**?

	R	S
A	positive	positive
B	positive	negative
C	negative	positive
D	negative	negative

30 The graph below shows the relationships between the potential difference and the current of four different conductors, **W**, **X**, **Y** and **Z**.



Which conductor has the highest resistance??

A **W**

B **X**

C **Y**

D **Z**

31 What is the e.m.f. of the cell in an electrical circuit if it uses 1kJ of energy to send 3A of current around the circuit for 2 minutes?

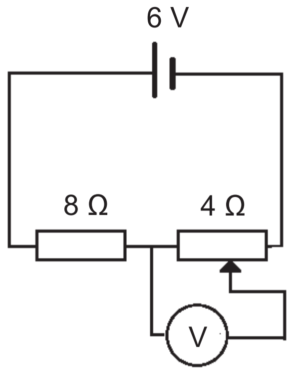
A 2.78 V

B 6.00 V

C 167 V

D 360 V

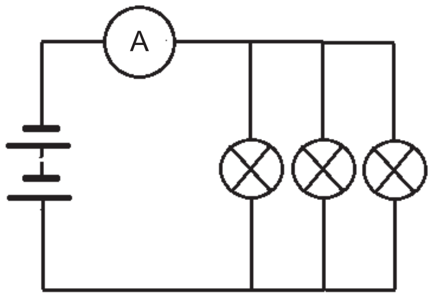
32 The diagram shows a circuit with a potential divider joined in series with a fixed resistor.



What are the minimum and maximum readings which can be obtained on the voltmeter?

	minimum voltage/ V	**maximum voltage/ V**
A	0	2
B	0	4
C	2	4
D	2	6

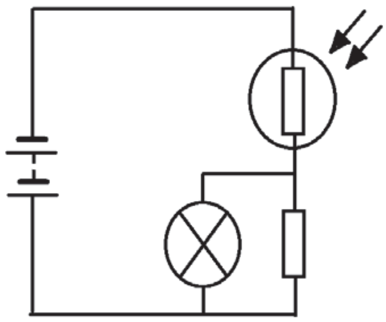
33 Three identical filament bulbs are connected to a d.c. supply as shown in the figure below. Each bulb operates at normal brightness and the ammeter registers a steady current. Filament in one of the bulbs in the circuit breaks.



What happens to the ammeter reading and the brightness of the remaining bulbs?

	ammeter reading / A	**brightness/ V**
A	increases	increases
B	increases	unchanged
C	decreases	increases
D	decreases	unchanged

34 Some electronic components are connected as shown in the circuit.



Which of these circumstances will light up the lamp in the circuit?

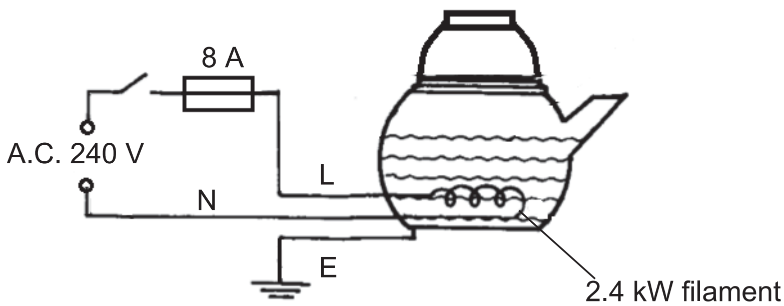
A Circuit placed under a bright light

B Circuit placed in a dark room

C On a cold day

D On a hot day

35 The figure below shows the connection of a metal-cased electric kettle to the a.c. mains.



Which of the following statements about the arrangement is **<u>TRUE</u>**?

A The switch should be placed along the neutral wire.

B The rating of the fuse is too small.

C The fuse should be placed along the neutral wire.

D The Earth wire should not be connected to the casing.

36 End **X** of a metal rod attracts the N-pole of a compass needle. What does this show about the rod?

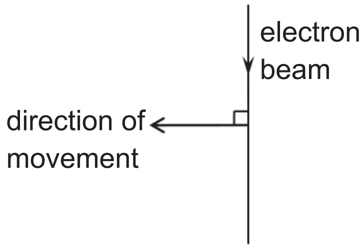
A It could be made of copper but is not permanently magnetised.

B It could be made of copper with a S-pole at **X**.

C It could be made of steel but is not magnetised.

D It could be made of steel with a N-pole at **X**.

37 A beam of electrons travels between the poles of a magnet. The beam starts to move in the direction shown.



Which is the most likely direction of the magnetic field?

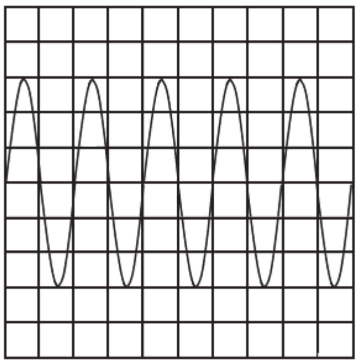
A into the paper

B out of paper

C to the right

D to the left

38 A 20 Hz signal is displayed on a C.R.O. screen as shown.



What is the setting of the time base of the C.R.O.?

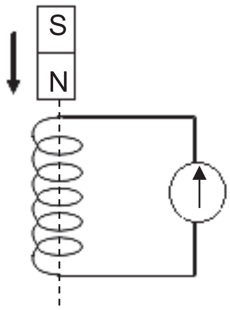
A 20 ms / div

B 25 ms / div

C 200 ms / div

D 250 ms / div

39 A small coil is connected to a sensitive galvanometer. When the magnet is allowed to fall towards the coil, the galvanometer needle moves quickly to the right of the zero position. The magnet moves through the coil.



How does the galvanometer needle move as the magnet falls away from the coil?

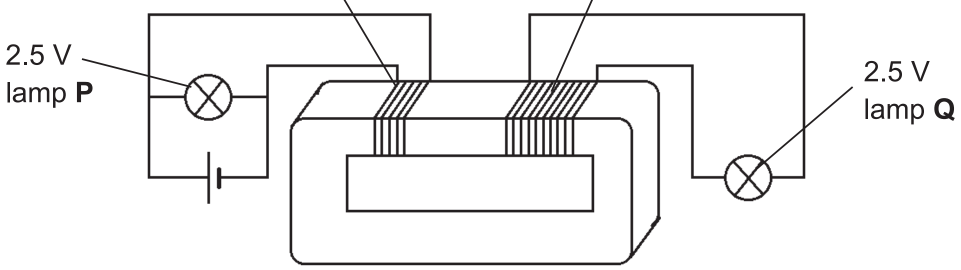
A It does not move.

B It gives a steady reading to the right.

C It moves quickly to the left of the zero position and then returns to zero

D It moves quickly to the right of the zero position and then returns to zero.

40 A pupil sets up a model transformer as shown. It is connected to a 2.5 V d.c. supply. Both lamps have a voltage of 2.5 V.



What does the pupil notice about the lamps?

	lamp P	lamp Q
A	normal brightness	not lit
B	very bright	dim
C	dim	very bright
D	decreases	unchanged

END OF PAPER

Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY FOUR EXPRESS

PHYSICS 6091/02 **12 SEPTEMBER 2018**

PAPER 2 **1 HOUR 45 MINUTES**

Additional Materials : NIL

READ THESE INSTRUCTIONS FIRST

1. Answer **ALL** questions in Section **A** on the question paper.
2. In **Section B**, answer Questions **9** and **10**, and ***either part*** of Question **11**. Write your answers in the spaces provided on the question paper.
3. All workings and constructions must be shown clearly. **Omission of essential working will result in loss of marks**
4. The number of marks is given in brackets [ ] at the end of each question or part question.
5. You are expected to use an electronic calculator to evaluate explicit numerical expression.
6. The total mark for this paper is 80 marks.

This paper consists of **17** printed pages, including this cover page.

Section A [50 Marks]

Answer **ALL** the questions in this section. Write your answers in the spaces provided on the question paper.

1 In a Singapore F1 night race, a race car driver approaches a S-shaped bend carefully at the beginning of the race as follows:

(i) The race car approaches the first bend at 100 km/h at t = 0 s.

(ii) The race car slows down with decreasing deceleration to 40 km/h to navigate the first bend from t = 0 s till t = 4 s.

(iii) The race car continues at 40 km/h to navigate the second bend from t = 4 s till t = 8 s.

(iv) The race car speeds up along a straight road with increasing acceleration to 200 km/h after the bend from t = 8 s till t = 16 s.

(a) State what is meant by uniform acceleration.

………

……… [1]

(b) Using the information from **(i)** to **(iv)**, sketch the speed-time graph of the race car from t= 0 s till t =16 s. Label your graph. [4]

2 Fig. 2.1 below represents a force-time graph of the force applied to a stationary 2 kg box to push it over a rough surface. The box accelerates uniformly at 0.25 m/s^2 during t = 0 s to t = 3 s. Assume the frictional force is constant throughout the motion of the box.

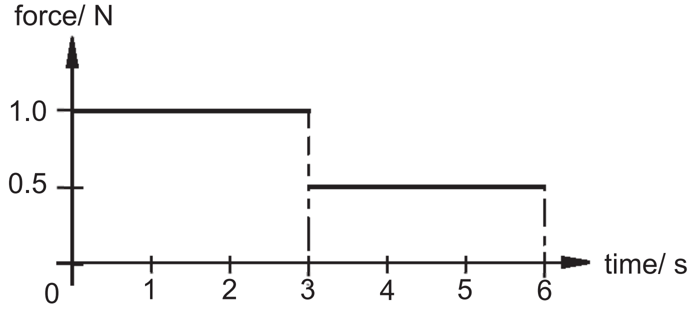


Fig. 2.1

(a) Calculate the frictional force acting on the 2 kg box.

frictional force = ... [2]

(b) Determine the acceleration from t = 3 s to t = 6 s.

acceleration = ... [1]

(c) After 6 seconds, a braking force is being applied to the box to slow it down.

Determine the average braking force applied from t = 6 s to stop it at t = 8 s.

average braking force = ... [3]

3 A uniform rod **PQ** of length 100.0 cm and weight 5.0 N is hung as shown in the Fig. 3.1. Two spring balances, **A** and **B** are attached to points **P** and **Q** of the rod respectively. A load of 15.0 N is placed 20.0 cm from the spring balance **A**.

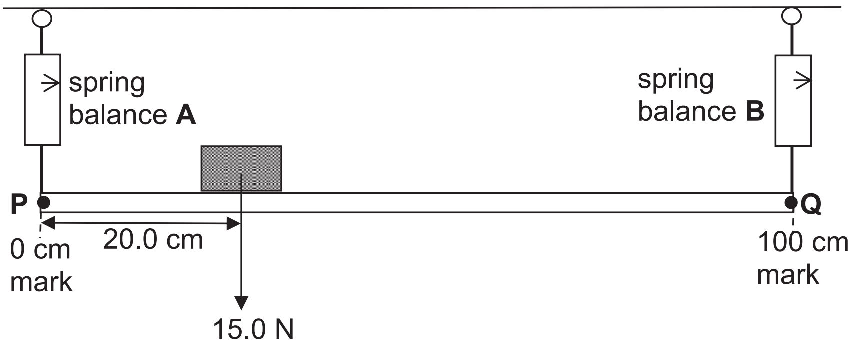


Fig. 3.1

(a) On Fig. 3.1, mark and label the position of the weight of the rod. [1]

(b) Taking moments about point **Q**, calculate the reading on the spring balance **A** in order for the rod to balance horizontally.

reading = ... [2]

(c) Hence or otherwise, determine the reading on the spring balance **B** in order for the rod to balance horizontally.

reading = ... [2]

(d) If the 15.0 N weight is gradually moved along the rod towards point **P**, while the rod is being kept in equilibrium.

State and explain the change in the reading of the spring balance **B**.

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……………………………………………………………..……………………......

……………………………………………………………..……………………....[2]

4 Fig. 4.1 shows a type of manometer used to measure the pressure difference between the pressure exerted by the force of 60 N on a platform area of 0.5 m^2 and a gas within a gas vessel. The volume of gas is 0.0122 m^3. Given that the density of water is 1000 kg/m^3 and the gravitational constant is g = 10 N/kg.

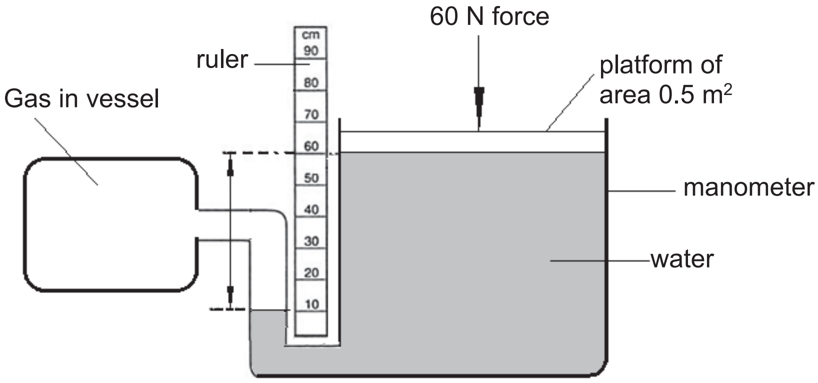


Fig. 4.1

(a) Label in Fig. 4.1 with '**A**' the location with the highest pressure. [1]

(b) Determine the pressure exerted by the force on the platform.

pressure = ... [1]

(c) Determine the gas pressure exerted by the gas in the vessel.

gas pressure = ... [2]

(d) After the removal of the 60 N force on the platform, the gas expands to a new volume of 0013 m^3.

Assume that the temperature remains constant throughout the expansion of the gas, determine the new gas pressure exerted by the gas.

new gas pressure = ... [2]

5 A teacher demonstrates the sound produced by a loudspeaker by connecting a microphone to a cathode ray oscilloscope (C.R.O.). The teacher initially obtains the C.R.O. trace shown in Fig. 5.1.

Fig. 5.1

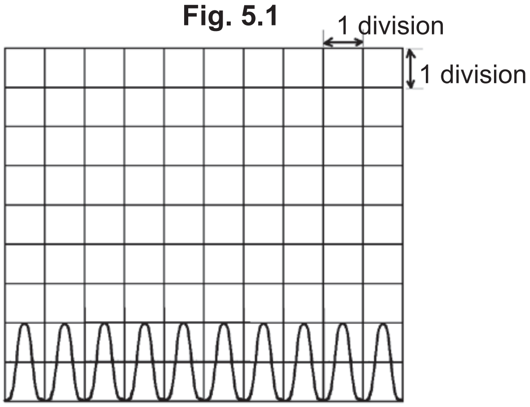
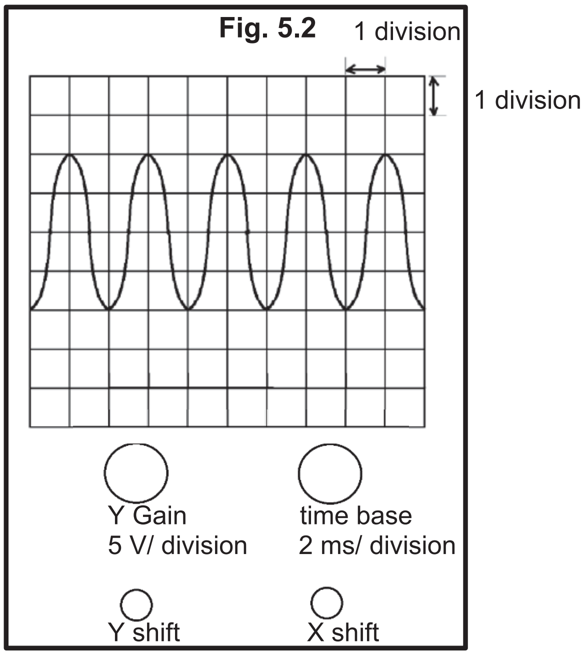


Fig. 5.2



The teacher then adjusts the controls to obtain the C.R.O. trace shown in Fig. 5.2.

(a) State and briefly explain the adjustments the teacher make to the controls to obtain trace on Fig. 5.2.

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

……………………………………………………………………………………………… [3]

(b) The time base shown in Fig. 5.2 is set to 2 ms / division.

Determine the frequency emitted by the loudspeaker.

frequency = ………………………... [2]

(c) The loudspeaker was adjusted to produce louder sound of a lower pitch.

Describe and explain what happens to the trace on the C.R.O. screen.

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

……………………………………………………………………………………………… [2]

6 Fig. 6.1 shows a positively charged rod, an uncharged metal sphere on an insulated stand and a connection to earth.

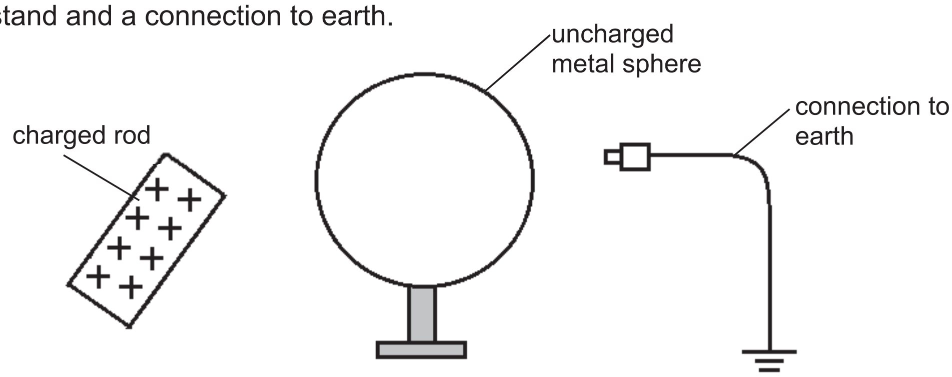


Fig. 6.1

(a) Describe how this apparatus is used to give the metal sphere a negative charge by induction.

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…………………………………………………………………………………………………

………………………………………………………………………………………………… [3]

(b) State and explain what happens to the free electrons in the metal sphere during the charging process.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [2]

(c) At the end of the charging process, the metal sphere has a negative charge of 1.2 nC. The charging process took 2.5 s.

Calculate the average current during this time.

current = ………………………………….. [1]

7 The Senoko power station generates electrical energy at 30 kV and 12 kA. The generator in the power station is connected to the primary coil of an ideal transformer. The transformer changes the voltage before the electrical energy is transmitted across the country through transmission cables at 450 kV.

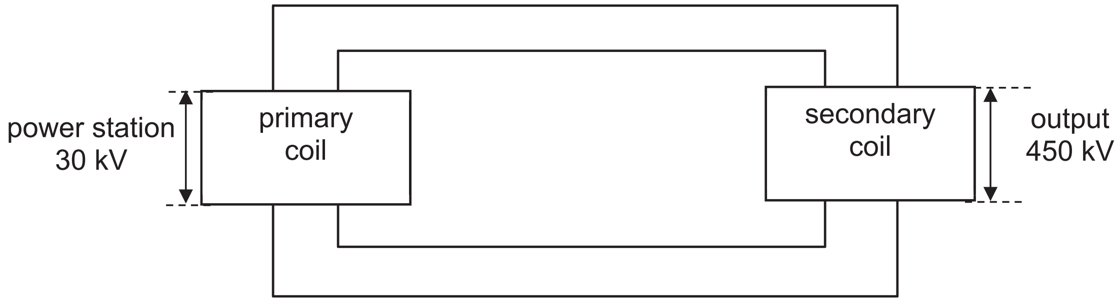

Fig. 7.1

(a) Explain how the current in the primary coil can produce an output voltage in the secondary coil.

....

....

....

....

.... [3]

(b) Calculate the ratio of the number of turns in the primary coil to the number of turns in the secondary coil.

ratio = ... [2]

(c) The total resistance of the transmission cables is 1500 Ω and the electrical power transmitted through the transmission cables is 2.0×10^3 W.

Determine the power loss in the transmission cable.

power loss = ... [2]

8 Fig. 8.1 is drawn to full scale. An object **O** is placed in front of a converging lens **L**. The lens forms an image of the object **O**.

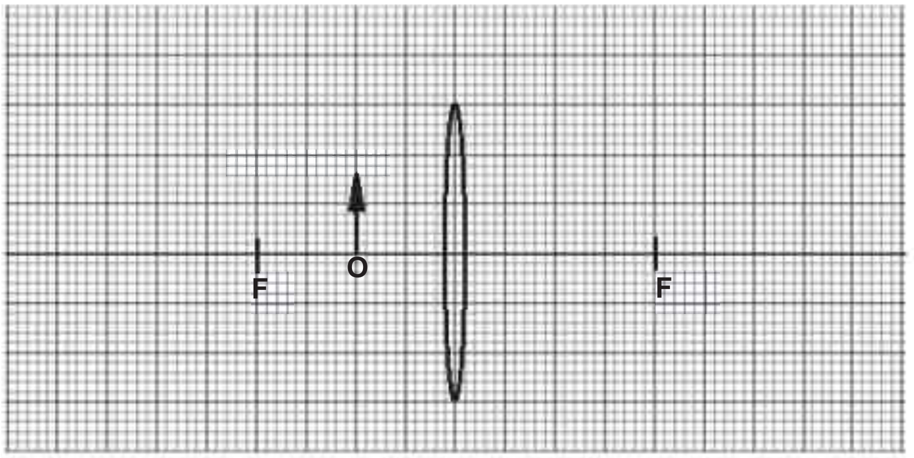

Fig. 8.1

(a) On Fig. 8.1,

(i) draw two rays from the top of the object to locate the top of image. [2]

(ii) draw and label the image **I**. [1]

(b) State how the rays show that the image is virtual.

....

....

.... [1]

(c) The object is move slightly away from the converging lens. State two changes that this will cause to the image.

1. ....

....

2. ....

....[2]

Section B [30 Marks]

Answer all questions in this section. Answer only one of the two alternative questions in **Question 11**. Write your answers in the spaces provided on the question paper.

9 In an experiment to find out the cooling effect of moving air, 2 kg of water was gently heated and left to cool. When the water reached a temperature of 40 °C, its temperature at each minute was measured and recorded for the next 5 min.

In the first run, there was no wind. In the second run, the water was placed in front of a fan which was switched to low speed. In the third and fourth runs, the fan was subsequently switched to medium and high speeds respectively. The results of the experiment are shown in the table below.

Wind speed	Water temperature/ °C				
	1 min	2 min	3 min	4 min	5 min
No wind	37	35	34	33	32
Low speed	36	34	33	32	31
Medium speed	35	32	30	28	27
High speed	34	30	28	26	25

(a) Explain why the temperatures need to be recorded when there is no wind.

……………………………………………………………………………………..……………….

……………………………………………………………………………………………….….. [1]

(b) It takes 4200 J of energy to increase or decrease the temperature of 1 kg of water by 1.0 °C.

Thus, calculate the drop in the temperature and the heat transferred from the 2 kg of water to the surrounding air over the period of 5 minutes. Record your answers in the table below. [4]

Wind speed	Temperature drop over 5 min/ °C	Heat transferred from water to air/ J
No wind		
Low speed		
Medium speed		
High speed		

(c) When the fan was switched to high speed, calculate how much more heat is lost over the 5 minutes period due to the moving air as compared to no wind for 2 kg of water.

heat lost = ... [1]

(d) Assume the speed of the moving air at high speed is 10 km/h.

Using the information from the experiment, estimate the total heat loss by the water in an hour if the wind speed is increased to 20 km/h.

heat lost = ... [2]

(e) State whether the heat loss calculated in **9(d)** is an overestimate or an underestimate and briefly explain the reason(s).

....

....

....

....

.... [2]

10 Fig. 10.1 shows a blower unit connected to a thermistor and a d.c. power source. The blower unit has a constant resistance of 480 Ω. The resistance of the thermistor is shown in the graph in Fig. 10.2.

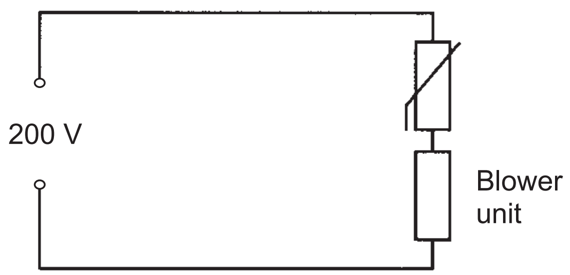

Fig. 10.1

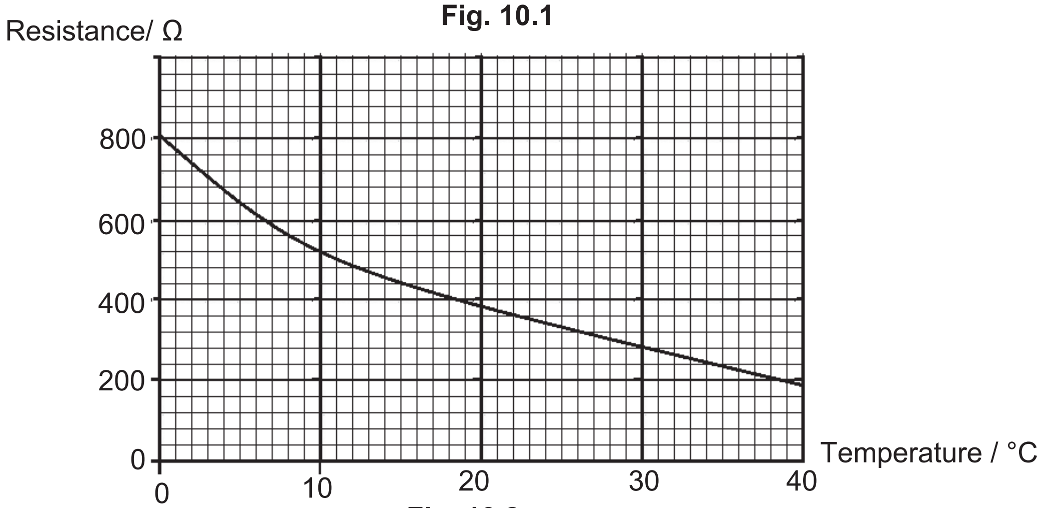

Fig. 10.2

(a) Use the graph to determine the resistance of the thermistor when the room temperature is at 20 °C.

……………………………………………………………………………………………….…………. [1]

(b) Calculate the current through the blower unit when the room temperature is at 30 °C.

current through the blower unit = ... [2]

(c) Explain how the speed of the blower unit changes when the room temperature increases.

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………………………………………………………………………………………………… [2]

(d) The blower unit needs a minimum of potential difference of 120 V to operate.

Determine the minimum room temperature that the blower unit will start to operate.

minimum temperature = ... [2]

(e) Explain how this circuit is suitable in operating an outdoor blower unit for both day and night operations.

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………………………………………………………………………………………………… [3]

11 EITHER

Fig. 11.1 shows a coil in a magnetic field. The coil is able to rotate about the axis. The ends **X** and **Y** of the coil is connected directly to a d.c. power supply. The arrows on the sides of the coil shows the direction of the current in the coil.

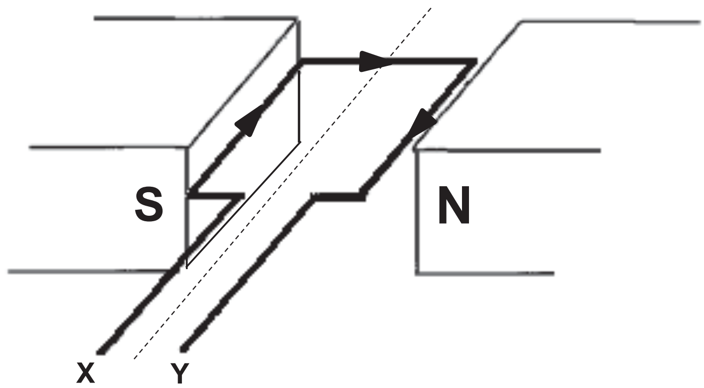

Fig. 11.1

(a) On Fig. 11.1, draw arrows to show the directions of the forces acting on both sides of the coil. [1]

(b) Describe the motion of the coil until it comes to rest.

....

....

....

.... [2]

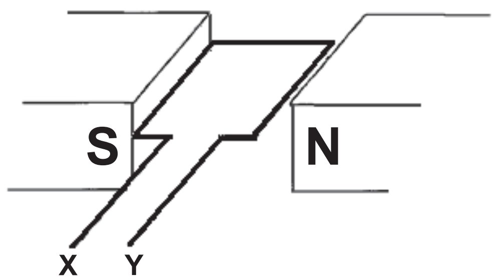

Fig. 11.2

(c) On Fig. 11.2, draw a split ring commutator and brushes connected to **X** and **Y**. Complete the diagram to show an electric circuit using symbols which include a direct current supply and a switch. [3]

(d) Explain why the coil rotates continuously when the split ring commutator is used.

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……………………………………………………………………………………………………[4]

11 OR

Fig. 11.3 shows a magnet, two compasses and two nails.

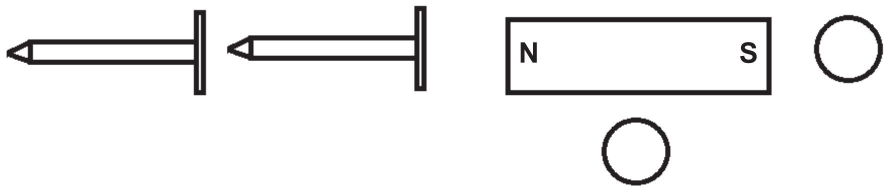


Fig. 11.3

(a) On Fig. 11.3, draw an arrow in each compass to show the direction of the magnetic field of the magnetic field in two positions. [2]

(b) The magnet causes the nails to become magnetised by induction. Both ends of each nail becomes magnetic poles.

On Fig. 11.3, mark **N** or **S** to both ends of each nail to show the magnetic poles. [2]

(c) When the magnet is removed, the nails are still magnetised.

Describe a method to test whether the nails are still magnetised when they are away from the magnet.

....

....

....

.... [1]

Fig. 11.4 shows a solenoid carrying a current. The current in the solenoid create a magnetic field.

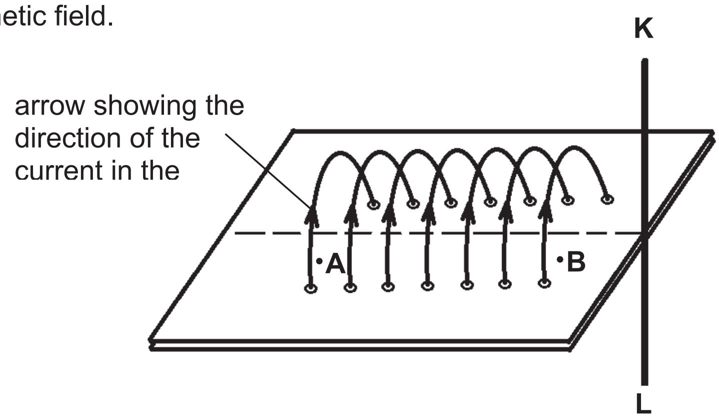


Fig. 11.4

(d) A magnetic field line passes through **A** and **B**.

On Fig. 11.4, draw this magnetic field line both inside and outside the solenoid. Draw an arrow on the line to show the direction of the magnetic field. [2]

(e) State how the pattern of the magnetic field lines inside the solenoid changes when the strength of the magnetic field increases.

....

....

....

.... [1]

(f) Fig. 11.4 shows a vertical wire **KL** next to the end of the solenoid. The wire is connected to a circuit and there is current downwards in the wire, from **K** to **L**. The current in the solenoid is shown in Fig. 11.4.

Describe how the direction of the force on wire **KL** can be determined.

....

....

....

....

....

....

……………………………………………………………………………………………………......[2]

***** End of Paper *****

Sec 4E Express (Physics) Prelim Exam Marking Scheme 2018

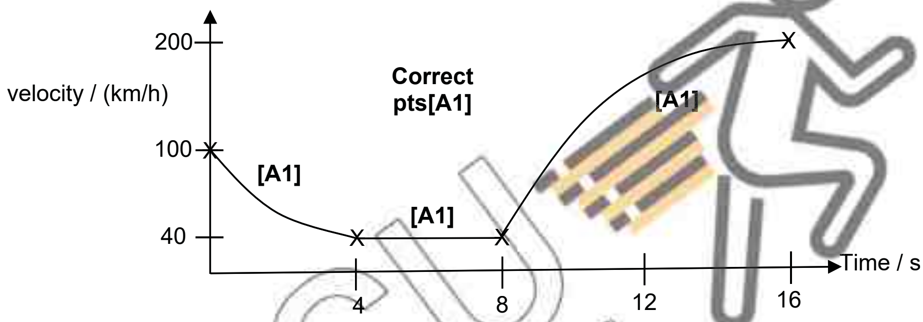
P1 MCQ:

Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans
1	**C**	6	**A**	11	**A**	16	**B**	21	**B**	26	**A**	31	**A**	36	**C**
2	**D**	7	**A**	12	**B**	17	**A**	22	**C**	27	**A**	32	**A**	37	**A**
3	**B**	8	**B**	13	**C**	18	**B**	23	**A**	28	**D**	33	**D**	38	**B**
4	**C**	9	**C**	14	**B**	19	**C**	24	**C**	29	**D**	34	**A**	39	**C**
5	**D**	10	**B**	15	**D**	20	**B**	25	**C**	30	**A**	35	**B**	40	**A**

P2 Section A:

1(a) constant rate of change of velocity or constant change of velocity per unit time **[A1]**

1(b)



2(a) F = ma = 2 x 0.25 = 0.5 N [A1]
Friction from 0-3 s = 1 - 0.5 = 0.5 N [A1]

2(b) F net = 0.5 – 0.5 = 0 N, no net force so no acceleration, 0 m/s^2 **[B1]**

2(c) speed of box at t = 3 s, = 3 x 0.25 = 0.75 m/s **[A1]**
Acceleration = (0 - 0.75)/2 = -0.375 m/s^2
Braking force + friction = 0.375 x 2 = 0.75 N **[A1]**
Braking force = 0.75 – 0.5 = 0.25 N **[A1]**

3(a) 5.0 N at 50 cm mark on figure**[A1]**
3(b) Using principle of moments about point Q,
Sum of anticlockwise moments = sum of clockwise moments
15.0 N x 0.8 m + 5.0 N x 0.5 m = F_A x1 m **[A1]**
F_A = 12+2.5 = 14.5 N**[A1]**
3(c) 20 – 14.5 = 5.5 N**[A1] ecf 3b**
3(d) The spring force at B will decrease.**[A1]** Clockwise moment about point P caused by the 15 N moving towards P decreases with a lesser moment arm. The anti-clockwise moment produced by the spring force to balance the rod will also decrease. **[A1]**

4(a) Point A is located any where along the base of the tank in figure**[A1]**
4(b) 60/0.5 = 120 Pa **[A1]**
4(c) hρg = 0.5 x 10 x 1000 = 5000 Pa **[A1]**
Total pressure = **120** + 5000 = 5120 Pa **[A1] ecf 4b**

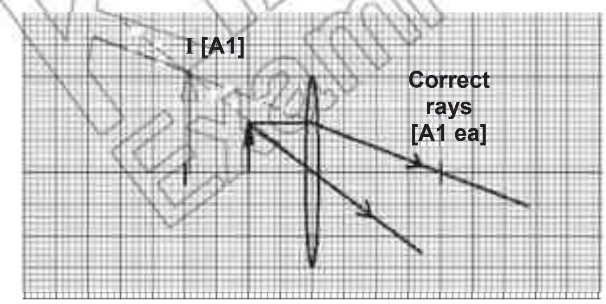
4(d) $P_1 V_1 = P_2 V_2$
$(5120)(0.0122) = P_2 (0.013)$ **[A1]**
P_2 = 4800 Pa **[A1]**3sf

5(a) Teacher uses Y shift to move the trace 4 divisions from the bottom of screen to the middle of screen.**[A1]**
Teacher adjust the Y gain from 10 V/ div to 5 V/div to stretch the wave in the vertical direction.**[A1]**
Teacher adjust the time base 4 ms/ div to 2 ms/div to stretch the wave in horizontal direction. **[A1]**
5(b) period T = 2 division x 2 ms /div = 4 ms **[A1]**
f = 1/0.004 = 250 Hz **[A1]**
5(c) The amplitude of the sound on CRO screen will increase. **[A1]**
The frequency will decrease (less frequent) as pitch lower **[A1]**

6(a) Charge rod brought near to uncharged metal sphere but not touching it. **[A1]**
The connection to earth is connected to the opposite end of the metal sphere and it is then removed. **[A1]** The charged rod is now removed, the metal sphere becomes negatively charged. **[A1]**

6(b) The free electrons are initially attracted by the positively charged rod when it is brought near to the metal sphere. **[A1]** When the connection to earth is connected, the electrons will move from the earth to the metal sphere, resulting in excess electrons on the metal sphere. **[A1]** The metal sphere remains negatively charged after all connection and rod are sequentially removed.
6(c) Charge = 1.2×10^{-9} C, time = 2.5 s
Q = I t => I = 1.2×10^{-9} / 2.5 [A1] = 4.8×10^{-10} A **[A1]**

7(a) The alternating current generated by the power station at the primary coils.**[A1]**
This will induce an increasing magnetic field in the primary coil.[A1]
The increasing and changing magnetic field induces e.m.f. and a current in the secondary coils, giving 450000 V **[A1]**
7(b) ratio =Np/Ns = Vp/Vs = 30000: 450000 = 1:15**[A1]**
7(c) I= P/V = 2×10^3/450000 = 0.00444 A **[A1]** ,
Power loss = I^2R = $(0.00444)^2 \times 1500$ = 0.0296 W **[A1]**

8(a)


8(b) The rays diverge and cannot converge to form an image. **[A1]**
8(c) The image will be larger **[A1]** The image will shift its position even further away from the object and the converging lens. **[A1]**

Section B

9(a) This is to determine the minimum amount of heat loss/ cooling effect/ change in temperature when there is no wind. **[A1]**

9(b)

Temp drop/ °C	Heat transferred/ J
8	67200
9	75600
13	109200
15	126000

[A1 per row]

9(c) 126000 – 67200 = 58800 J **[A1]**

9(d) Assuming the cooling effect is double for 20 km/h, the amount of heat lost in 5 min = 58800 x 2 = 117 600 due to wind and 117 600 x 12 = 1 411 200 J for 1 hour **[A1]** 67200 x 12 = 806 400 due to no wind. Total heat lost = 1 411 200 + 806 400 = 2 220 000 J **[A1]**

9(e) This is an overestimate as actual heat lost by water is less. **[A1]** The moving air might not be blowing over the water at an even manner and therefore it is not 100% efficient cooling system **[A1]** Can also say that the temperature difference between water and environment become less as more cooling takes place, thereby the rate of cooling is also greatly reduced.

10(a) 380 Ω**[A1]**

10(b) At 30 °C, thermistor R = 280 Ω.
Voltage across thermistor = 200 x (280)/(280+480) = 73.7 V **[A1]**
Current = 73.7 / 280 = 0.263 A **[A1]**

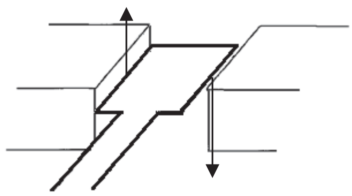
10(c) When the surrounding temperature increases, the resistance of the thermistor drops further. **[A1]** According to the potential divider rule, the blower unit will have a higher potential difference across it, resulting in a higher current and a higher speed. **[A1]**
Also accept overall resistance decreases thereby overall current increases.

10(d) When blower is at 120 V, thermistor has a potential difference of 80 V across.
Resistance of thermistor:- R/(R+480) x 200 = 80
R = 0.4 R + 192
R = 320 Ω**[A1]**, According to graph, that occurs at 26 °C **[A1]**

10(e) At day when temperature is higher, resistance of the thermistor is lower. The potential difference across blower unit is higher, thereby increasing blower speed.**[A1]**

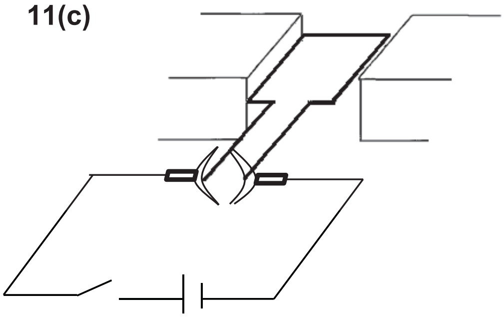
At night, when temperature is lower and fall below 26°C, the resistance of the thermistor increases beyond 320 Ω and potential difference across it rises above 80 V **[A1]**. The potential difference across the blower unit falls below operating voltage of 120 V **[A1]**, blower is not operating.

11 EITHER
11(a) [A1]



11(b) The coil rotates in a clockwise direction about its axis**[A1]** for about a maximum of 90 °. As the current is not reversed at this juncture, the coil continues to stay in the vertical position.**[A1]**

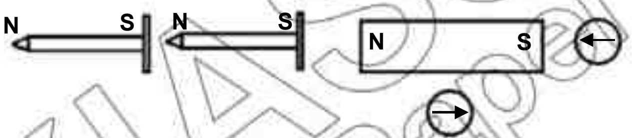
11(c)



Correct shape of Commutator and brushes **[A1]**, circuit, battery and switch **[A1],** electrical connections (armature link correctly to commutator) **[A1]**

11(d) The split ring commutator changes the direction of the current every half a revolution **[A1]** A section of the coil rotates upwards due to an upward force caused by the magnetic field and the current. When the coil is at the vertical position, the current is instantaneously cut off as the split ring commutator is not in contact with the carbon brushes **[A1]**. The momentum carries the coil past the vertical position, the split ring commutator now contacts the carbon brushes on the other side and reverses the current direction. **[A1]** Using the Fleming's Left hand rule, there will be a downward force on the coil causing the coil to rotate about its axis continuously. **[A1]**

11 OR
(a & b)

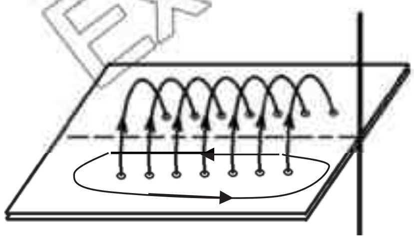


[A1 ea] 2 nail magnets and 2 compass directions

11(c) Place a non-magnetized iron filings/ iron paper clips near to the nail. When there is attraction, the nail is still magnetized **[A1]** or place a magnet near to the nail. And test both north and south poles towards the nail. If any of the poles is being repelled, the nail is magnetised.

Do not accept using nails themselves to test each other.

11(d)



[A1 ea an arrow and line inside and outside]

11(e) The number of magnetic field lines increases and the field lines becomes closer to one another **[A1]**

11(f) Using Fleming's Left hand rule, the direction of the magnetic field (represented by the index finger) is perpendicular to the current flow (represented by the middle finger) **[A1]**, the force generated as represented by the thumb is perpendicular to both the direction of the magnetic field and the current. **[A1]**