SMILE Tutor
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2022

SECONDARY 4 COMBINED PHYSICS TEST PAPERS

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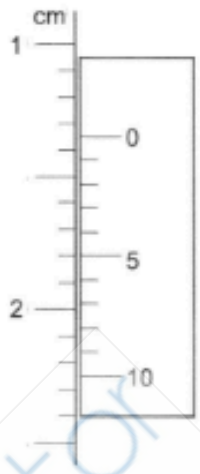
BUKIT BATOK SECONDARY SCHOOL PRELIM PAPER

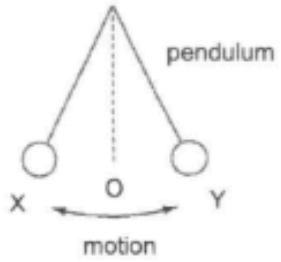
1 The diagram shows part of a vernier scale.



What is the correct reading of the vernier scale?

A 1.85 cm
B 1.58 cm
C 1.35 cm
D 1.05 cm

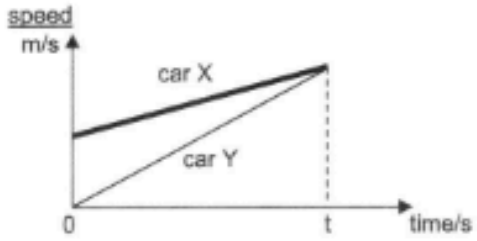
2 The diagram shows a simple pendulum. It swings between X and Y.



Which sequence should be timed to measure the period of the pendulum?

A $Y \rightarrow O$
B $X \rightarrow O \rightarrow Y$
C $O \rightarrow Y \rightarrow O \rightarrow X$
D $O \rightarrow X \rightarrow O \rightarrow Y \rightarrow O$

3 The diagram below shows how speed varies with time for two cars, X and Y.



Which of the following statements is correct?

A Both cars come to a stop at time t.

B Both cars travel at the same speed throughout the journey.

C The acceleration of car Y is greater than the acceleration of car X.

D The distance covered by car X and car Y is the same.

4 On Earth, two different balances show that an object has a mass of 2.0 kg and a weight of 20 N.

The same balances and object are taken to the Moon, where the gravitational field strength is less than on Earth.

Which row shows the weight and mass of the object on the moon as compared to on Earth?

	weight	mass
A	less	same
B	same	same
C	less	less
D	same	less

5 The densities of some liquids at 15 °C are shown below.

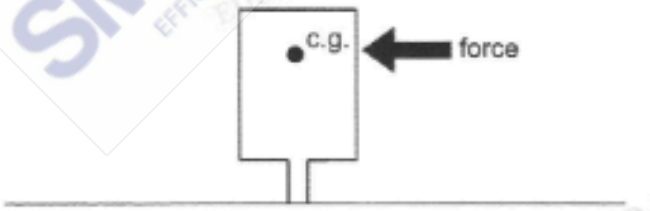
liquid	density kg/m^3
palm oil	914
rosin oil	980
naphtha	665
milk	1020

A solid cube with a mass of 1.3 kg and has sides of length 0.11 m.

What happens to the cube when it is placed in each of the liquids?

	milk	naphtha	palm oil	rosin oil
A	float	float	float	float
B	float	sink	float	float
C	float	sink	sink	float
D	sink	sink	sink	sink

6 The diagram shows an object placed on a level table. The centre of gravity (c.g.) of the object mark is shown on the object.



Why does the object topple easily?

A When tilted slightly left, the vertical line through the centre of gravity lies easily inside the base area and produces a clockwise moment.

B When tilted slightly left, the vertical line through the centre of gravity lies easily inside the base area and produces an anti-clockwise moment.

C When tilted slightly left, the vertical line through the centre of gravity lies easily outside the base area and produces a clockwise moment.

D When tilted slightly left, the vertical line through the centre of gravity lies easily outside the base area and produces an anti-clockwise moment.

7 An electric motor can lift a weight of 2000 N through a height of 10 m in 20 s.

What is the power of the motor?

A 10 W

B 1000 W

C 4000 W

D 400 000 W

8 A house, built in a country with a hot, sunny climate, stays cool during the day.

Which material for the wall and which outside colour keeps the house the coolest?

	wall material	outside colour
A	poor conductor	light
B	poor conductor	dark
C	good conductor	light
D	good conductor	dark

9 Which statement is correct about boiling and evaporation?

A Evaporation occurs throughout the entire liquid but boiling only occurs at the surface.

B Evaporation can only occur when the temperature of the liquid is at boiling point.

C Evaporation causes the temperature of a liquid to drop.

D When a liquid is boiling, its temperature continues to rise.

10 In view of the current Covid-19 situation, Singapore has placed thermal sensors to detect arriving visitors from overseas with high body temperatures.

What type of electromagnetic wave does the thermal sensors detect?

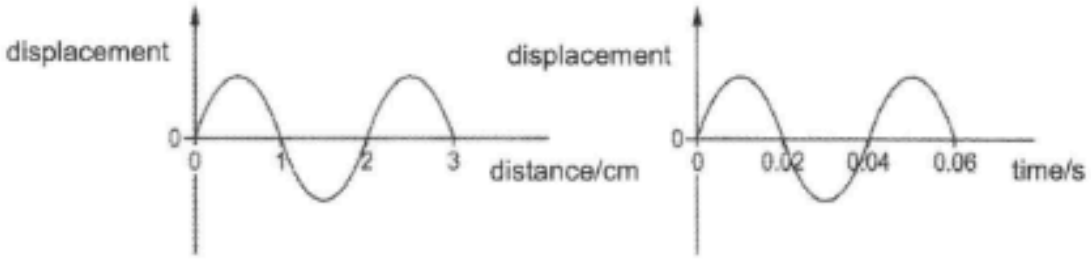
A gamma rays

B infra-red

C ultraviolet rays

D X-rays

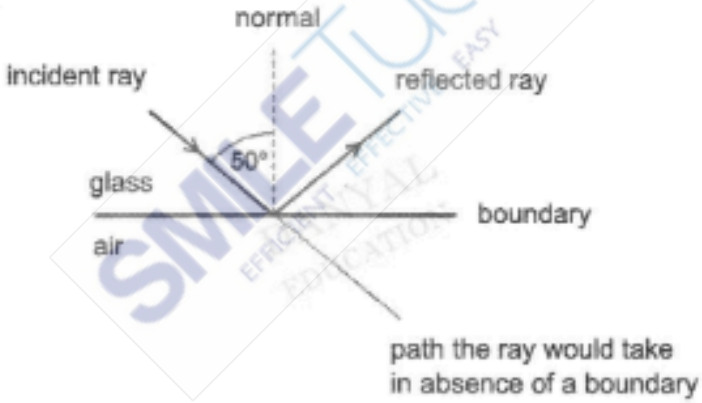
11 The displacement-distance and displacement-time graphs are shown for a water wave in a ripple tank.



What is the speed of the water wave?

A 0.02 cm/s **B** 0.08 cm/s **C** 25 cm/s **D** 50 cm/s

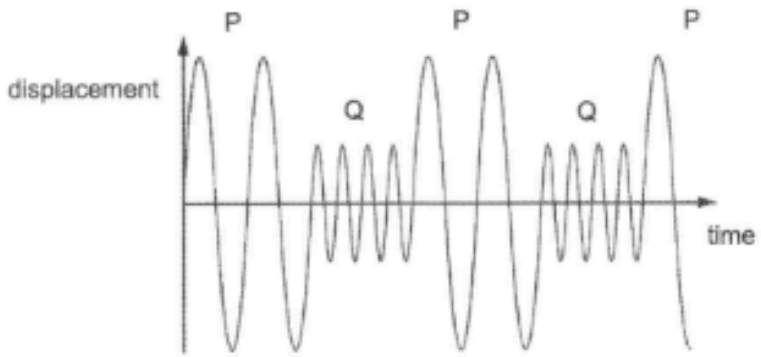
12 A ray of light travelling in a glass block will change direction when it reaches the edge of the block.



What is the angle between the reflected ray and the path the ray would take in absence of a boundary?

A 50 ° **B** 80 ° **C** 100 ° **D** 130 °

13 A police car siren emits two different sounds P and Q repeatedly.
The diagram represents the sounds emitted.

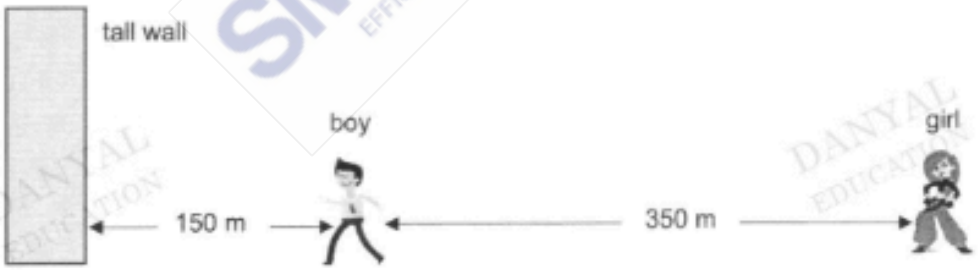


Which sound is louder and which has the lower pitch?

	louder	lower pitch
A	P	P
B	P	Q
C	Q	P
D	Q	Q

14 A boy stands 150 m in front of a tall wall. A girl stands 350 m from the boy.

The boy fires a starting pistol and girl hears two bangs.



Given that the speed of sound is 300 m/s, what is the time interval between the two bangs heard by the girl?

A 0.50 s

B 1.00 s

C 1.17 s

D 1.67 s

15 A small battery, when fully charged, is capable of supplying a current of 400 mA to a circuit for 1.0 hour before fully discharged.

For how long this battery will be able to supply a current of 2.0 A?

A 720 hours

B 200 hours

C 12 hours

D 0.20 hours

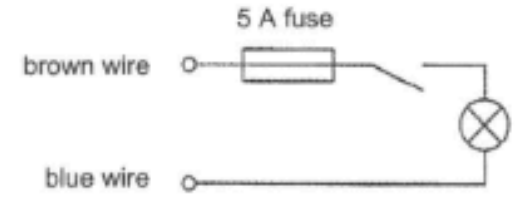
16 The resistance of a cylindrical P is 80 Ω. A second wire Q is made from the same material.
The cross-sectional area of Q is four times that of P.
The length of Q is twice the length of P.

What is the resistance of Q?

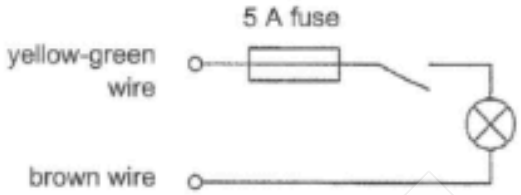
A 10 Ω **B** 40 Ω **C** 160 Ω **D** 640 Ω

17 Which circuit shows the correct colour of wire, position of fuse and fuse rating for an appliance that requires 4.0 A of current?

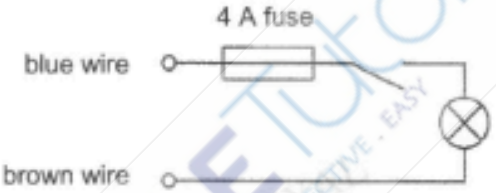
A



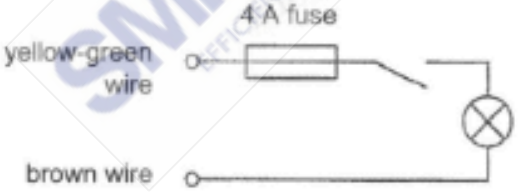
B



C



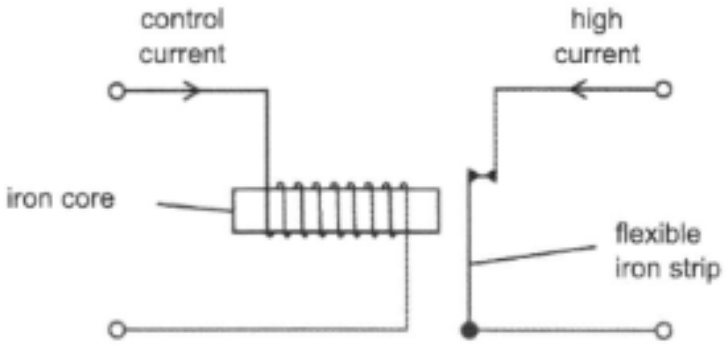
D



18 In which pair are both formulae correct?

A	$E = VIt$	$V = \frac{W}{Q}$
B	$E = VIt$	$V = WQ$
C	$E = \frac{VI}{t}$	$V = WQ$
D	$E = \frac{VI}{t}$	$V = \frac{W}{Q}$

19 A component of a simplified circuit breaker shows a control current is used to switch off a high current.



When the control current is switched on, the high current does not switch off.

Which change might switch off the high current?

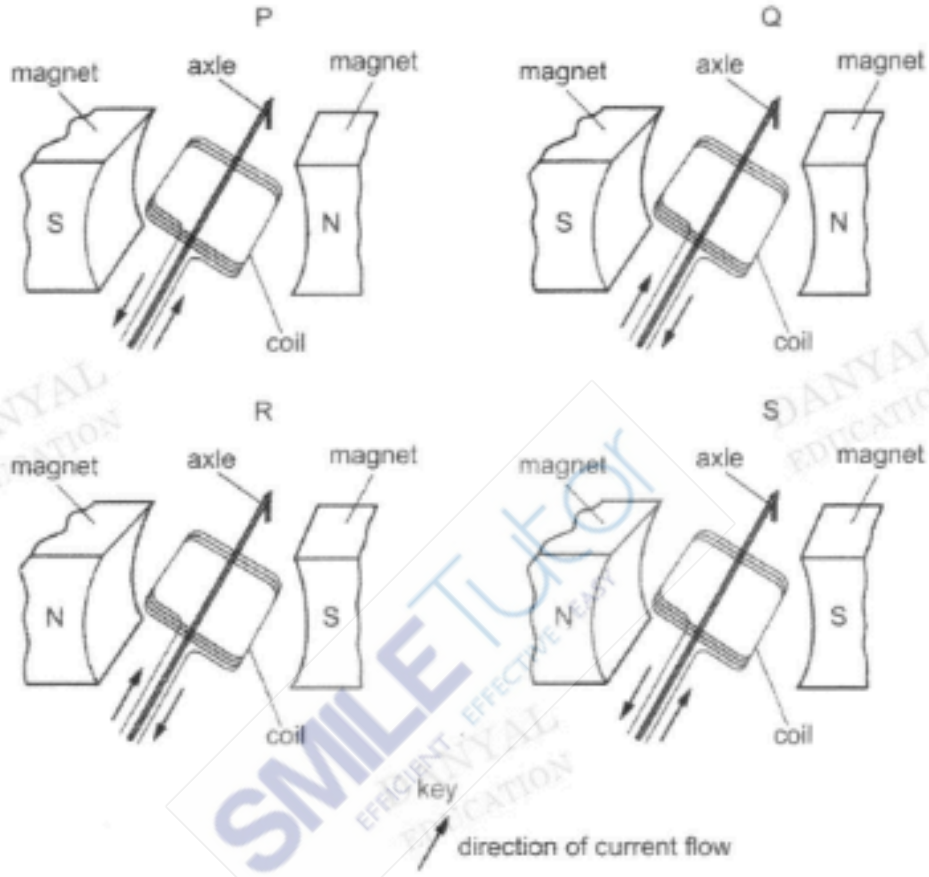
A moving the strip further from the iron core

B reducing the number of turns around the iron core

C replacing the iron core by a steel core

D using a larger control current

20 A current-carrying coil in a magnetic field experiences a turning effect which causes it to rotate.
The diagrams show the possible arrangements of field and current flow around the coil.



In which diagrams does the coil rotate in an anti-clockwise direction?

A P and Q
B P and R
C Q and R
D Q and S

Section A [45 marks]

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

1 Two forces of magnitude 10 N and 18 N act on an object, P as shown in Fig. 1.1.

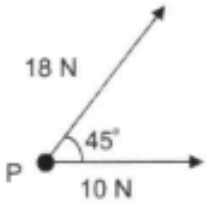


Fig. 1.1

An incomplete vector diagram for these forces is shown in Fig. 1.2.

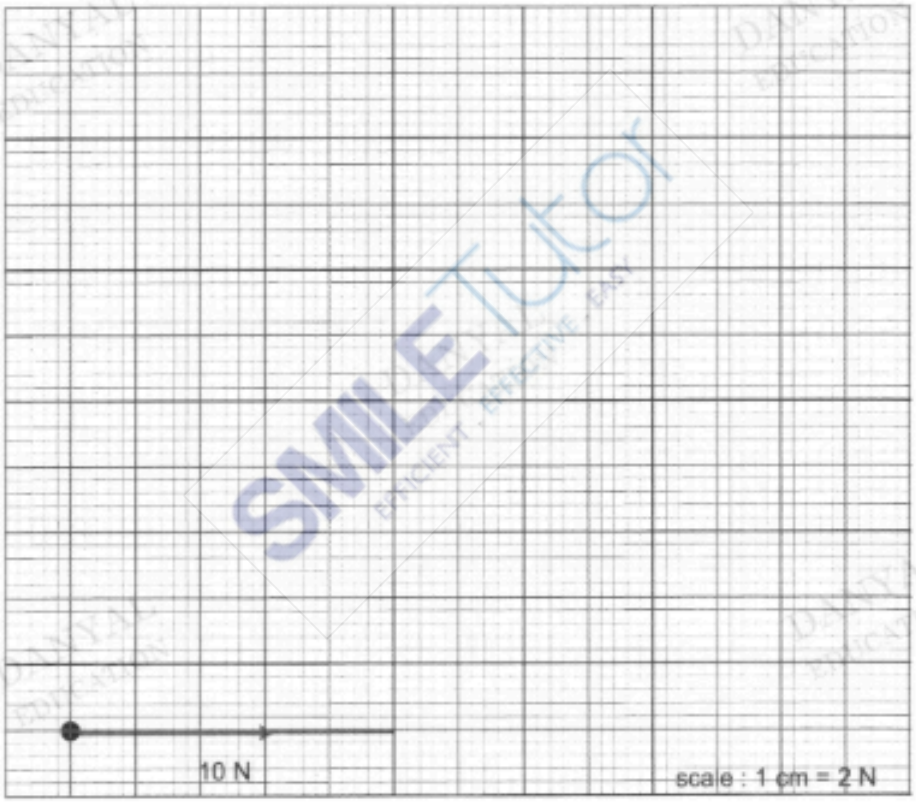


Fig. 2.2

Complete Fig. 1.2, using a scale of 1 cm to represent 2 N, to determine the magnitude of the resultant force and angle between resultant force and 10 N force.

resultant force = ... N

direction = ... [3]

2 A ball bearing is dropped into a long cylinder containing oil as shown in Fig. 2.1.

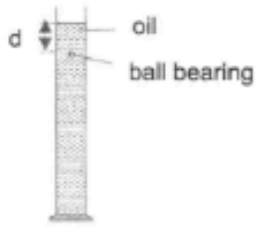


Fig. 2.1

The ball bearing moves down through the oil.
The distance, d, between the oil surface and the ball bearing is measured every second.
The results obtained are shown on Fig. 2.2.

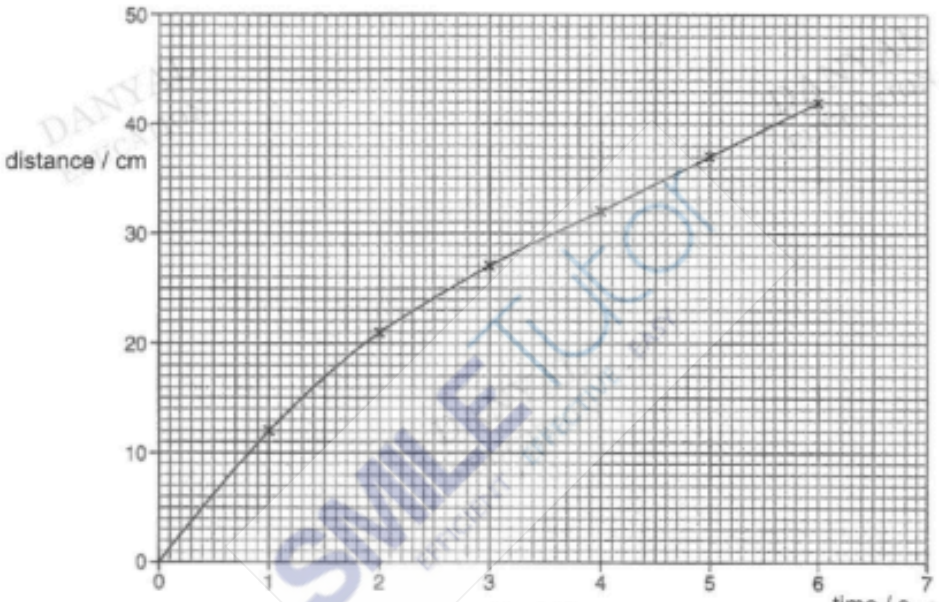


Fig. 2.2

(a) Calculate the speed of the ball bearing from 3.0 to 6.0 seconds.

speed =..... m/s [2]

(b) With reference to forces acting on the ball bearing, explain why the speed is constant between 3.0 to 6.0 seconds.

.....

.....

..... [2]

3 Water is contained in a syringe that has a cap over its nozzle, as shown in Fig. 3.1.

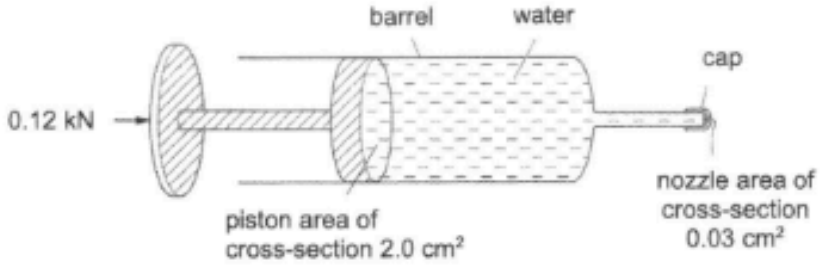


Fig. 3.1

The cross-sectional area of the piston of the syringe is 2.0 cm^2 and the cross-sectional area of the nozzle is 0.03 cm^2. A force of 0.12 kN is applied at the piston, as shown in Fig. 3.1. The pressure in the water is the same throughout the syringe.

(a) Calculate

(i) the pressure of the water in the syringe.

pressure = ... N / cm^2 [2]

(ii) the force on the cap.

force = ... N [1]

(b) The cap is removed from the syringe. As the piston is pushed in the direction shown, water is forced out of the nozzle. The volume of water leaving the barrel of the syringe per second is equal to the volume leaving the nozzle per second.

Suggest why the speed of the water leaving the nozzle is greater than the speed of the water in the barrel.

.....

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..... [3]

4 A gaseous substance at a temperature of 100 °C is cooled until it becomes a liquid. The variation with time of the temperature of the substance is shown in Fig. 4.1.

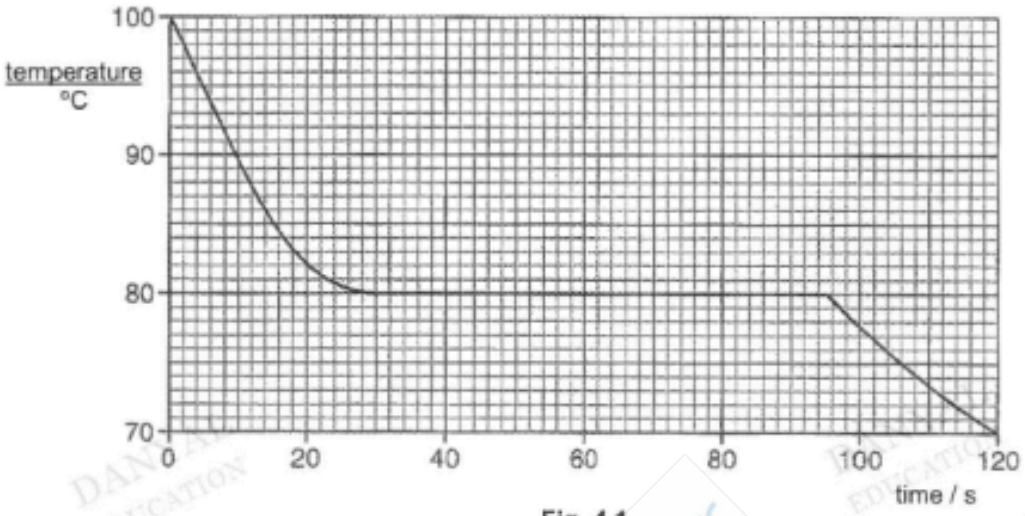


Fig. 4.1

(a) Describe how the motion of the molecules of the substance changes during the first 20 seconds of cooling.

.....

..... [1]

(b) Describe the molecular arrangement of the substance at 100th second.

.....

..... [1]

(c) The temperature of the substance remains constant for a period during cooling.

(i) Determine the duration when the temperature remains constant.

time = ... s [1]

(ii) Explain why the temperature remains constant during this period.

.....

.....

.....

..... [2]

5 Table 5.1 contains statements about electromagnetic waves and sound waves. Some of the statements are true and some are false.

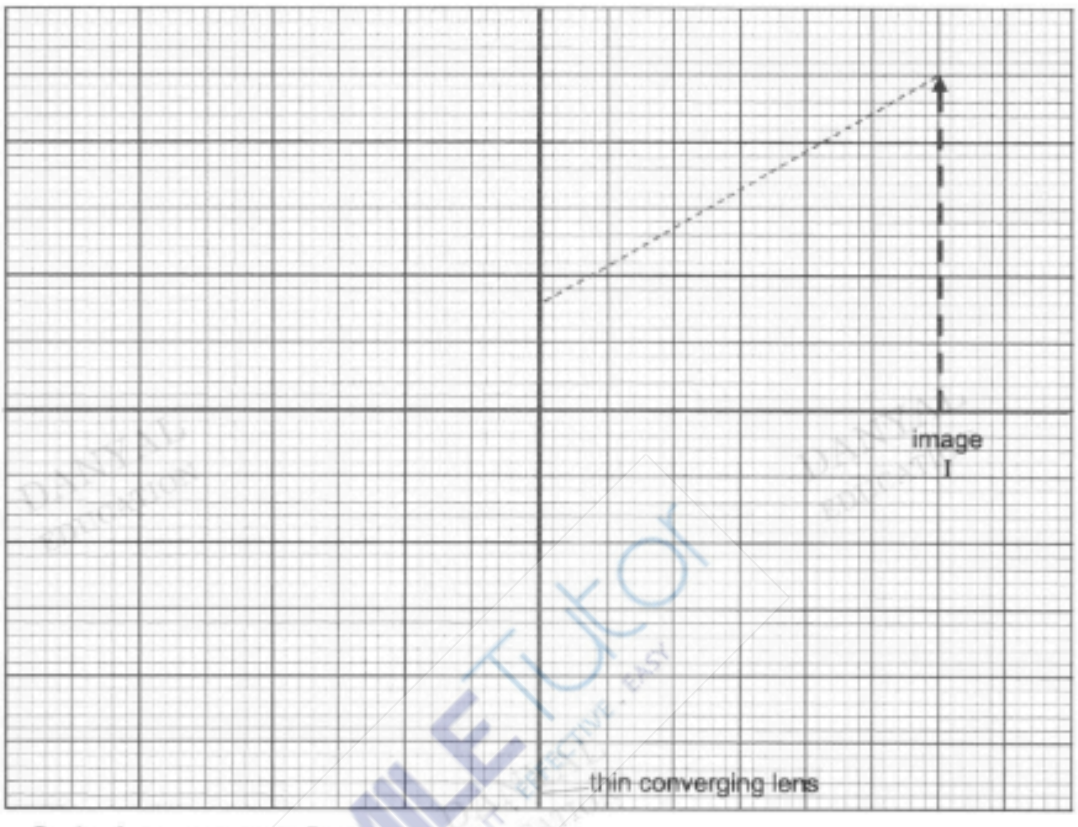
For each statement, state whether true or false.

Table 5.1

statement	true or false
Sound waves travel at the same speed in liquids as they do in solids.	
The speed of sound in a vacuum is approximately 330 m/s.	
Infrared waves travel at a different speed compared to gamma ray in vacuum.	
Light waves are transverse wave.	
Sound waves transfer sound energy, but electromagnetic waves do not transfer energy.	

[3]

6 An image I is formed 30 cm away from a thin converging lens as shown in Fig. 6.1.



Scale: 1 cm represents 5 cm

Fig. 6.1

The object, O, is not shown in Fig. 6.1. The diagram is drawn to a scale in which 1 cm represents 5 cm.

A light ray has been drawn from the top of the image to the lens.

On Fig. 6.1:

(a) Complete the existing ray and add additional ray through the lens to draw the object and label it as O. [2]

(b) Use the rays you have drawn to determine the actual focal length of the lens.

actual focal length = ... cm [2]

7 A student investigates the refraction of light when it travels from glass to air.

Fig. 7.1 shows the arrangement of the apparatus.

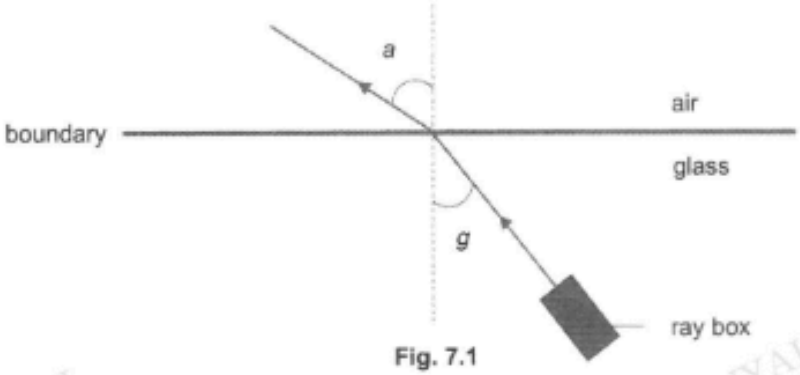


Fig. 7.1

The student measures the angle *a* in air and angle *g* in glass. She then changes the direction of light ray at the boundary and measures the new angle *g* in the glass.
Table 7.2 shows the result.

Table 7.2

angle *a* in the air	angle *g* in the glass
45 °	26 °
35 °	

(a) Use the data in Table 7.2, show that the refractive index of glass is 1.6 and hence calculate the missing value for the angle *g* in the glass.

angle *g* = ... ° [2]

(b) The critical angle for light at the glass air boundary is 39 °.

Describe how the direction of light at the boundary changes as the students increases angle *g* from 30 ° to 50 °.

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..... [4]

8 Fig. 8.1 shows the electric field lines between a positively charged strip and negatively charged strip placed close together.

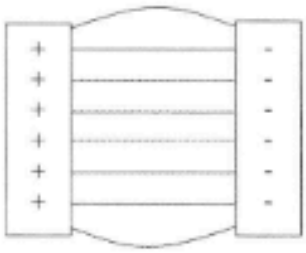

Fig. 8.1

(a) Draw an arrow on each field line to show the direction of the electric field. [1]

(b) State what is meant by electric field.

.....

.....

..... [1]

(c) Fig. 8.2 shows an unknown charged sphere, initially at rest, swings to the right when place near to the positively charged strip.

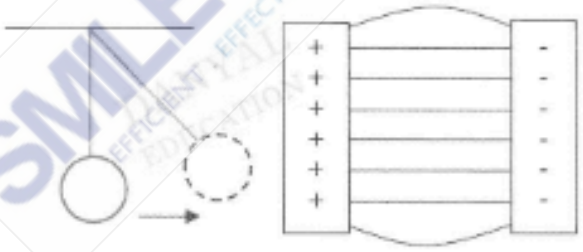

Fig. 8.2

State the charge of the sphere and the reason it swings to the right.

charge of sphere: ..... [1]

reason: .....

..... [1]

9 Four resistors W, X, Y and Z are connected to a battery, as shown in Fig. 9.1.

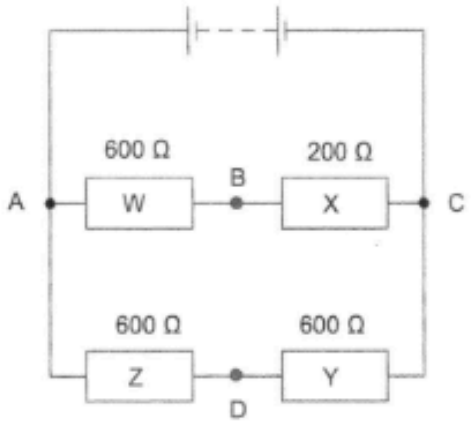

Fig. 9.1

(a) Calculate the effective resistance of the whole circuit.

effective resistance = ... Ω [2]

(b) The current in resistor W is 8.0 mA.

(i) Calculate the potential difference (p.d.) between points A and B.

p.d. = ... V [2]

(ii) Determine the p.d. between points B and D.

p.d. = ... V [2]

10 Fig. 10.1 shows four metal bars A, B, C and D.
The ends of the bars are labelled 1, 2, 3, 4, 5, 6, 7 and 8.

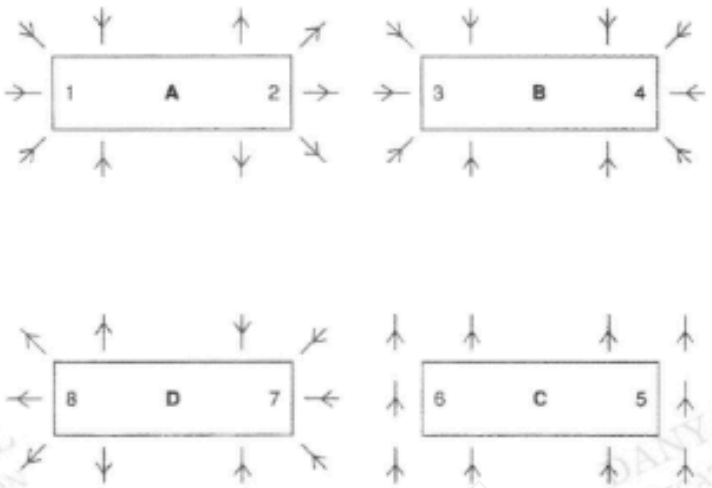

Fig. 10.1

A compass needle is placed at different positions near the end of each metal bar.
The directions in which the compass needle is pointing is shown in Fig. 10.1.

(a) State,

(i) which metal bar may be made of copper, ... [1]

(ii) **one** pair of labelled ends that will repel each other. ..... [1]

(b) Describe an electrical method to demagnetise a bar magnet.
You may include a diagram in your answer.

.....

.....

.....

..... [2]

Section B [20 marks]

Answer any **two** questions.

Write your answers in the spaces provided.

11 Fig. 11.1 shows a gymnast on a trampoline. At position A in Fig. 11.1a, the gymnast starts to rise. She passes through B in Fig. 11.1b and reaches her maximum height at C.

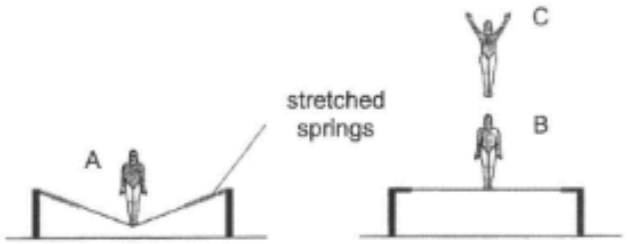

Fig. 11.1a **Fig. 11.1b**

(a) State the form of energy stored in the stretched springs shown in Fig. 11.1a.

..... [1]

(b) When the gymnast is at B, her kinetic energy is 1.9 kJ, its maximum value. The mass of the gymnast is 45 kg.

(i) Calculate the speed of the gymnast at B.

speed = ... [2]

(ii) Ignoring the effects of any friction, calculate the maximum height that the gymnast can rise to from B to C.
The gravitational field strength g is 10 N/kg.

height = ... m [2]

(c) A second gymnast weigh 600 N walks up a plank from point C to D in Fig. 11.2. The weight of the diving board is 300 N. This force acts at the centre of gravity C of the diving board, which is 0.90 m from P. The diving board is attached to the fixed base. The fixed base exerts a downwards force *F* on the diving board.

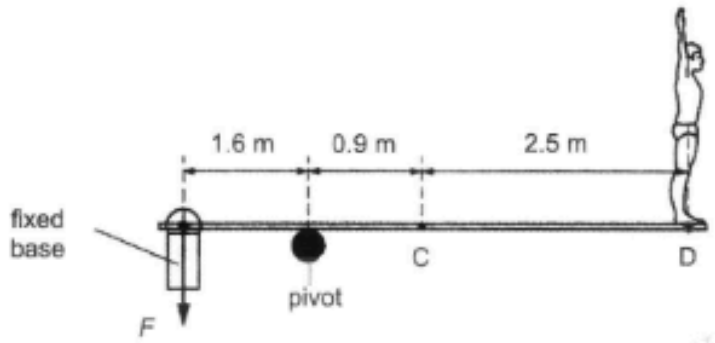

Fig. 11.2

(i) Calculate force F when the gymnast is at point D.

F = ... N [2]

(ii) The gymnast was not ready for his act and walks down the plank from point D to C.

Explain the effect, if any, to force *F*.

.....

.....

.....

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.....

.....

..... [3]

12 Typhoons create waves on the surface of the ocean.
Table 12.1 gives data on the speed and wavelength of some water waves.
The waves travel in deep water of depth 4000 m or in shallow water of depth 10 m.

Table 12.1

depth 4000 m	wavelength / m	10	40	100	200	300	400	500	600
	speed / m/s	4.0	7.9	12.5	17.7	21.6	25.0	27.9	30.6

depth 10 m	wavelength / m	10	40	100	200	300	400	500	600
	speed / m/s	4.0	7.6	9.3	9.7	9.8	9.9	9.9	9.9

(a) For the range of wavelengths in Table 12.1, state a difference between the speed of water waves in deep and shallow water.

.....

.....

..... [1]

(b) A typhoon 2000 km away from a stationary ship, forms quickly. It generates water waves for a short period of time.
The waves, with wavelengths between 10 m and 600 m, travels across an ocean of depth 4000 m to the ship.

(i) Calculate the time taken for the **first** wave to reach the ship.

time = ... s [2]

(ii) Calculate the frequency of the **first** wave to reach the ship.

frequency = ... Hz [2]

(iii) Determine, to the nearest 100 m, the wavelength of the wave that arrives 4 hours **after** the first wave.

wavelength = ... m [3]

(c) The stationary ship sounded its siren to alert a fisherman on a fishing boat nearby.

Describe how the sound of siren travels through the air to the fisherman.

.....

.....

.....

..... [2]

13 Water in a swimming pool is heated by solar powered pool heater panels.
Fig. 13.1a and Fig.13.1b show panel design A and panel design B respectively.

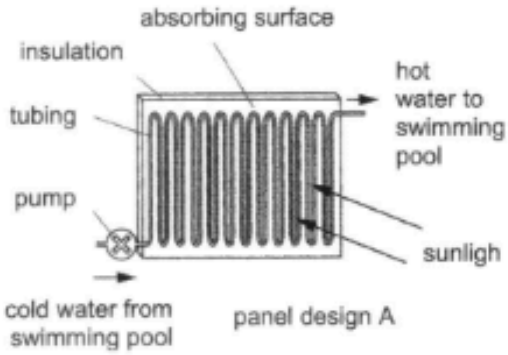


Fig. 13.1a

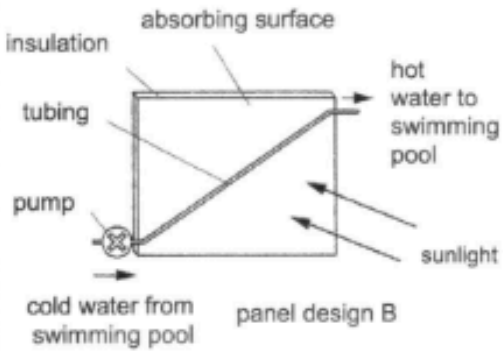


Fig. 13.1b

(a) Name the method of thermal energy transfer that takes place between the sun and the panel.

..... [1]

(b) Explain why panel design A is used rather than panel design B.

.....

.....

..... [2]

(c) Fig. 13.2 shows the side view of the swimming pool with four possible inlet pipe positions K, L, M and N.

Fig. 13.2

The hot water pipe leaving the heater panels can be attached to any of the inlet pipe.

State and describe which inlet pipe would be the best choice to heat the water in the swimming pool evenly.

.....

.....

.....

..... [3]

(d) Fig 13.3 shows a typical hot-water tank connected to a 240 V mains supply to heat up the water in the pool. The immersion heater has a power of 1.8 kW.

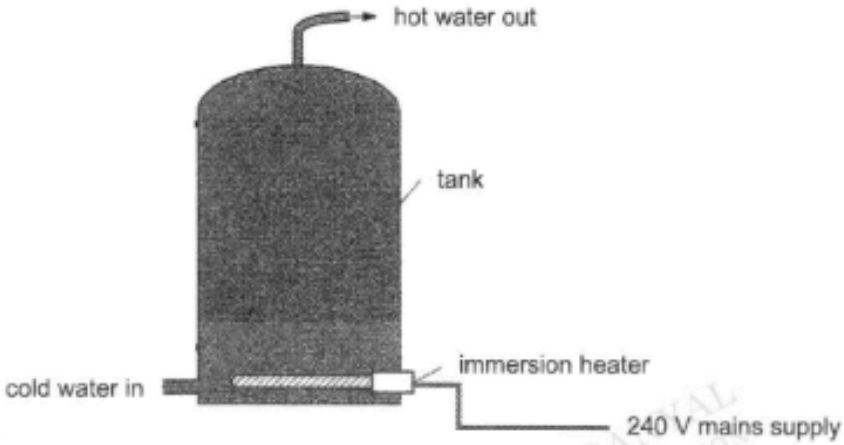


Fig. 13.3

Calculate

(i) the current through the immersion heater.

current = ... A [2]

(ii) the cost of using the hot water tank for 4 hours daily in one week.
The cost for 1.0 kWh is 25 cents.

cost = $ ..... [2]

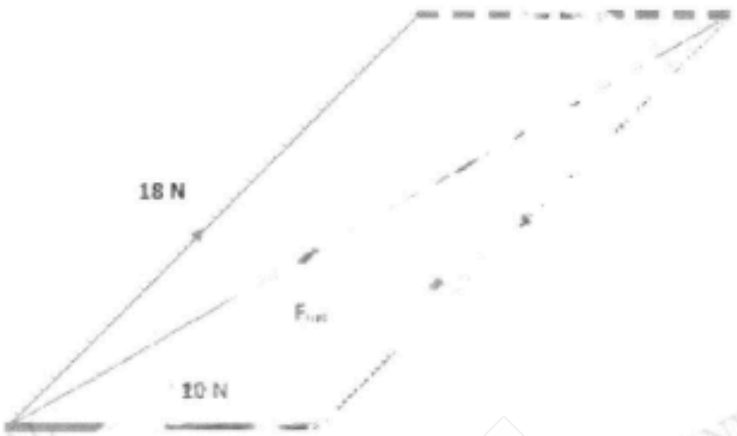
End of Paper

ANSWER SHEET

Paper 1

Qns	Ans
1	C
2	D
3	C
4	A
5	C
6	D
7	B
8	A
9	C
10	B
11	D
12	B
13	A
14	B
15	D
16	B
17	A
18	A
19	D
20	B

Marking Scheme BBSS Prelims 2022 Paper 2 with Marker's Report

Qns	Suggested Answer
1	 [1] correct **shape** and **drawing** (solid/dotted lines) of either tip to tail method or parallelogram + **correct** direction of arrows of 10 N, 18 N and F_{net} following 1cm: 2N scale [1] F_{net} = (25.8 – 26.6) N [1] direction : 30° +-1° from 10 N *Markers' comments:* *Majority of students have difficulty instating the direction which is the angle between resultant force and 10 N*

2a	**Concept** statement: **speed** from 3 to 6 seconds = **gradient of distance - time graph** $v = \frac{0.42-0.27}{6-3}$ (substitution) v = 0.050 m/s (2.s.f) (-1 m if student forget to convert distance from m to cm and ans as 5.0 m/s) *Markers' comments:* *Weaker students fail to convert cm to m.* *Insist student to write down the concept statement.*
2b	At 3 to 6 seconds, the **resistance** due to liquid on the ball bearing is **equal in magnitude but opposite in direction** to the **weight** of the ball bearing. Hence it will have **zero resultant force, zero acceleration thus moving at constant speed.** *Markers' comments:* *Students are not able to mention that weight of ball and the resistance the ball is facing due to the liquid is acting in opposite direction.*

	Students are not able to link the 3 concepts of, *$F_{resultant}$ = 0 N: acceleration = 0 m/s^2 : speed is constant* *Weaker students have misconceptopn and relates the concepts of energy, KE and GPE, in explaining the constant speed.*
3ai	**Conversion:** F = 0.12 kN = 120 N **Formula:** P = F / A P = F / A P = 120 / 2.0 P = 60 N/cm^2 *Markers' comments:* *Weaker students fail to convert 0.12 kN to 120* *Encourage students to write physics concept statement/formula before starting the calculation.*
3aii	**Concept statement:** Since pressure in the water is the same throughout the syringe, then: Pressure on cap = 60 N/cm^2 **Formula:** F = P x A Force on cap, F = pressure on cap x area of cap Force on cap, F = 60 x 0.03 Force on cap, F = = 1.8 N *Markers' comments:* *Generally well done*
3b	• Since Volume = cross section area x length. The cross-section area of nozzle is smaller than cross section area of piston. • Length of water column move in nozzle is more than length of water column move in barrel. • Since speed = length/ time, length of water column travelling past the nozzle per second is more than the length of water column travelling past the barrel per second hence higher speed at nozzle. *Markers' comments:* *No marks for contradiction.* *Majority of students compare and relates the cross sectional area to pressure at piston and nozzle - contradict* *Misconception 1: since P = F/A, and F is constant, small area at nozzle will lead to high pressure hence faster speed of water.* *Big area at piston will lead to low pressure hence low speed of water* *Misconception 2: high pressure relates to high speed*

4a	The gas molecules that initially move at high speed and at random, move at lower speed / less energetically / less vigorous *Markers' comments:* *Generally well done*
4b	The molecules of the substance are • **randomly arranged** and • **closely packed but not as closely packed as solid** *Markers' comments:* *Some students did not write down 1 of the 2 key phrases.* *Weaker students explain the motion rather than arrangements.* *Comparison to solid was commonly missing.*
4ci	Time = 95 – 30 = 65 s *Markers' comments:* *Students must show that they have read the final reading (to half of the smallest division) as 95 s.* *Importance of showing working: Give student benefit of doubt and accept answer, only if students show working: 95 – 28 = 67 s*
4cii	• During this period, internal potential energy decreases, forming of **stronger intermolecular forces of** attraction and thermal energy released to the surrounding • The **internal kinetic** energy remains **constant** hence the **temperature remains constant**. *Markers' comments:* *Many candidates could not give sufficient points to gain credit.*

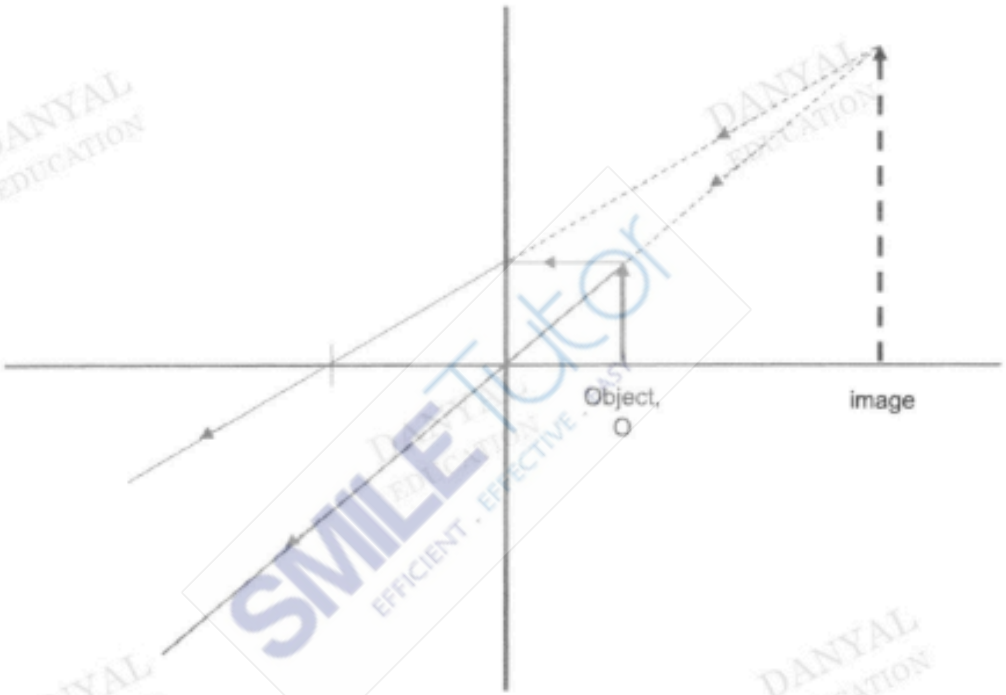
5	

statement	true or false
Sound waves travel at the same speed in liquids as they do in solids.	**false**
The speed of sound in a vacuum is approximately 330 m/s.	**false**
Infrared waves travel at a same speed compared to gamma ray in vacuum.	**true**
Light waves are transverse wave	**true**
Sound waves transfer sound energy, but electromagnetic waves do not transfer energy.	**false**

5 correct [3 marks]

	3 - 4 correct [2 marks] 2 correct [1 mark] 0 - 1 correct [0 mark] *Markers' comments:* *Students assume 330 m/s is correct but fail to see the word vacuum. There is no sound in vacuum hence 0 m/s.* *Students may have misconception that all EM wave travel in different speed.*

6a



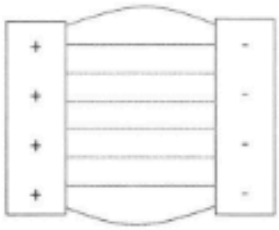
Correct dotted and solid lines with arrows [1]
Correct positioning of object with arrow head and label [1]

Markers' comments:
Poorly done.
Many candidates did not realise that the dotted image refers to a virtual image.
Many candidates tried to draw rays unsuccessfully.

6b 2.8 cm x 5 = 14 cm [2]
(allow e.c.f if they have drawn wrongly but understand the concept of focal length
(deduct 1 mark for those who put 2.4 x 5 = 12 cm)

Markers' comments:
Poorly done. Due to no diagram drawn.

7a	**Formula:** $n = \frac{\sin i \ (angle\ in\ optically\ less\ dense\ medium)}{\sin r \ (angle\ in\ optically\ denser\ medium)}$ $n = \frac{\sin 45}{\sin 26}$ n = 1.6 (shown) *(formula + substitution + final ans in 2.s.f) [1]* $\sin g = \frac{\sin i \ (angle\ in\ optically\ less\ dense\ medium)}{n}$ $g = \sin^{-1} [\frac{\sin i \ (angle\ in\ optically\ less\ dense\ medium)}{n}]$ $g = \sin^{-1} [\frac{\sin 35}{1.6}]$ g = 21 ° *(formula + substitution + final ans in 2.s.f) [1]* *Markers' comments:* *New trend of Qns (proving)* *Some students fail to show the working that the refractive index is 1.6.* *Weaker students reverse the value to be substituted in, n = sin i / sin r (typical mistake when light ray moves from optically denser to optically less dense medium)*
7b	1. When angle g **increases from 30 ° to below 39 °**, the light ray is refracted out of the glass-air boundary with an **increasing value of angle a**. 2. When **angle g = 39 °**, the light ray emerges at glass-air boundary **as angle a = 90 °** 3. When angle g **increases from** above 39 ° **to 50 °**, it undergoes total internal reflection 4. where **angle g = angle of** reflection *Markers' comments:* *Some students could not properly explain the segregation of the 3 different range of values clearly.* *1) At $30° \leq g < 39°$,* *2) At $g = 39°$,* *3) At $39° < g < 50°$* *Students did not gain credits due to missing key phrases like refracted ray, refracted angle, total internal reflection*

8a	 Direction of arrow: positive to negative Arrow must be at the line *Markers' comments:* *Generally ok.*

8b	An electric field is a region in which an electric charge experiences an electric force/electrostatic force. *Markers' comments:* *Generally ok.* *Weaker students, have missing keywords or wrong keywords*
8c	• negative. • As unlike charges attracts *Markers' comments:* *Generally ok.* *Weaker students mention wrong keywords : unlike poles repel instead of unlike charges repel*
9a	resistance W and X in series = 600 + 200 = 800 Ω resistance Z and Y in series = 600 + 600 = 1200 Ω effective resistance = $[\frac{1}{800} + \frac{1}{1200}]^{-1}$ = 480 Ω *Markers' comments:* *Generally ok.* *Weaker students did not show the correct technique of calculation*
9bi	**Conversion:** 8.0 mA = 8.0 x 10^{-3} **Formula:** V = RI V = 600 x 8.0 x 10^{-3} [1] for conversion V = 4.8 V *(formula + substitution + final ans in 2.s.f) [1]* *Markers' comments:* *Generally ok.* *Weaker students did not get the formula right*
9bii	V_{batt} = (600 + 200) x 8.0 x 10^{-3} V_{batt} = 6.4 V $V_{batt} = V_{ADC}$ V_{AD} = 6.4 / 2 = 3.2 V $V_{BD} = V_{AB} - V_{AD}$ V_B *Markers' comments:* *Poorly done.* *Students are not sure of how to interpret the diagram*
10ai	C *Markers' comments:* *Generally ok*

10aii	1 and 7 or 2 and 8 *Markers' comments:* *Generally ok* *Some students did not answer to the question requirement* *(a pair must have two entities)*
10b	Place a magnet inside a solenoid in the east - west direction Connect the solenoid to an alternating current Withdraw the magnet with the alternating current still flowing in the solenoid, until it is some distance away. *Markers' comments:* *Moderately done* *Missing keywords 'east-west' direction.* *Some students have a misconception; DC supply drawn/explain rather AC supply.*

Section B

Qns	Answer
11a	Elastic Potential Energy due to stretched springs *Markers' comments:* *Well done*
11bi	**Conversion:** 1.9 kJ = 1900 J *(1 mark conversion)* **Formula:** KE = ½ x m x v^2 1900 = ½ x 45 x v^2 v = 9.2 m/s *(final ans + 2 or 3 sf) [1]* *Markers' comments:* *Generally Well done.* *Weaker students have issues with conversion and/or mathematical manipulation.* *Many candidates forgot to write the units, losing marks.*
11bi	**Concept statement:** Loss in KE = Gain in GPE *(concept statement)* 1900 = m x g x h 1900 = 45 x 10 x h *(formula + substitution) [1]* h = 4.22 m *(final ans + 2 or 3 sf) [1]* *Markers' comments:* *Wrong / no concept statement (-1 mark)* *Some candidates wrote KE = GPE which is not acceptable conceptually.* *Students are supposed to write loss in KE = Gain in GPE.* *Weaker students did not understand the concept that 1.9kJ of energy of KE is converted to GPE, hence are unable to start on the question*

11ci	**Concept statement:** Applying principle of moment about pivot, sum of anticlockwise M = sum of clockwise M (concept statement) F x 1.6 = (300 x 0.9) + [600 x (0.9 + 2.5)] *(substitution) [1]* F = 1443.75 F = 1440 N *(final ans + 2 or 3 sf) [1]* *Markers' comments:* *Poorly done* *students have issues with the summation of clockwise moment and/or mathematical manipulation.*
11cii	As the gymnast walks from D to C, the **perpendicular distance from line of action of his weight to pivot decreases**. Hence **decreasing the total clockwise moment**. For sum of clockwise moment to equal sum of anticlockwise moment, the **sum of anticlockwise moment can be decreased** by **decreasing the force F,** for the same fixed distance of 1.6 m, *Markers' comments:* *Poorly done* *students understood that force F will decrease but could not use the appropriate keywords using the concepts of POM to explain the effect of the change.*

12	*Markers' comments:* *Fewer candidates chose this question.* *Perhaps due to the overwhelming data / comprehending the data*
12a	• The speed of waves in deep water continues to increase when wavelength increases from 400m to 600m. • Whereas in shallow water, the speed of the waves remains constant when wavelength increases from 400m to 600m.
12bi	For first wave to reach the ship, the first wave's speed must be the highest (i.e., 30.6m/s) **Formula:** time taken = distance / speed time taken = 2000 x 10^3 m / 30.6ms^{-1} time taken = 6.54 x 10^4 s *Markers' comments:* *Candidates must be able to comprehend the data and apply it to new situations*
12bii	**Formula:** Since v = $f\lambda$, f = v/λ f = 30.6/600 (formula + Substitution) [1] f = 0.051 Hz (final ans + 2 s.f + unit) [1]

12biii	4 hours = (4 x 60 x 60)s = 14400 s Total time elapsed = 4 hours + time for first wave to reach ship (i.e., answer to (b)(i)) = (14400 + 6.54 x 10^4)s = 79 800 s Speed = distance / time = 2 000 000m / 79 800s = 25.1 m/s Approximate wavelength = 400 m (check with respect to data) *Markers' comments:* *Candidates must be able to cross reference their answer to the data given. Similar type of question O level Nov 2014 Paper 2 Q10*
12c	• **air molecules vibrate parallel to the direction of travel of the sound wave**, from the ship to the fisherman **causing regions of compression** (where the molecules are closely packed) and **regions of rarefaction** (where the molecules are spaced out). • These **vibrations pass sound energy from molecule to molecule** without transferring the air molecule *Markers' comments:* *Many candidates could not give sufficient points to gain credit.*

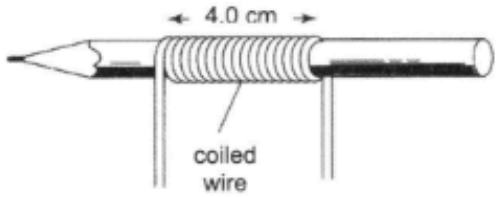
13a	Radiation (due to travelling through space where there are no particles)
13b	• Panel design A make use of more absorbing **surface, hence higher rate of thermal absorption**, as compared to panel design b. • The longer tubing in A allows the water to be **heated up longer and reach a higher temperature** compared to B *Markers' comments:* *Many candidates could not give sufficient points to gain credit. 2nd point was often missing in the explanation.*
13c	Inlet pipe N. Entering from pipe N, the bulk of hotter water having a **lower density** than cold water will **rise**. The bulk of **cold water which is denser, sinks and will displace the hot water**. This sets up a convection current and the cycle continues until it reaches thermal equilibrium. *Markers' comments:* *Many candidates could not give sufficient points to gain credit.* *Some candidates are not careful with their keywords and went on to mention that water molecules will expand. Some candidates forget to mention that the cycle repeats/continues to reach thermal equilibrium*

13di	**Conversion:** P = 1.8 kW = 1800 W **Formula:** I = P/V I = 1800 / 240 I = 7.5 A *Markers' comments:* *Generally Well done.*
13dii	**Formula:** E = P x t E = 1.8 x 4 x 7 E = 50.4 kWh (final ans + 2 s.f + unit) [1] Cost = E x rate Cost = 50.4 x 25 cents Cost = 1260 cents or $12.60 *Markers' comments:* *Generally Well done.* *Emphasise that time is in hours rather than seconds when involving calculation of electrical bills.*

CHRIST CHURCH SECONDARY SCHOOL PRELIM PAPER

1 The radius of a piece of copper wire is to be measured using a ruler. The wire is wound tightly round a pencil to make 18 turns. The length of the solenoid formed is then measured using a ruler.

The radius of the wire is _____.



A 0.11 cm **B** 0.22 cm **C** 2.22 cm **D** 4.5 cm

2 The swings of a simple pendulum (of fixed length) are 10° wide and each swing takes two second.

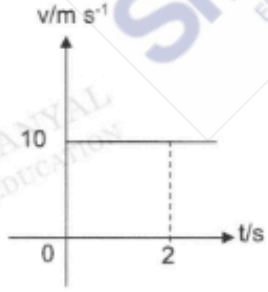
How long will each swing take if the width of the swing is reduced to 5°?

A 0.25 second **B** 0.50 second
C 1.00 second **D** 2.00 second

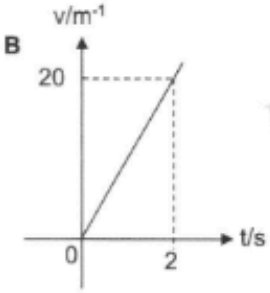
3 An iron ball falls through the air. The acceleration of free fall is 10 m/s^2. Air resistance can be ignored.

Which of the following graphs below best describes the motion of the iron ball during the first two seconds of its fall?

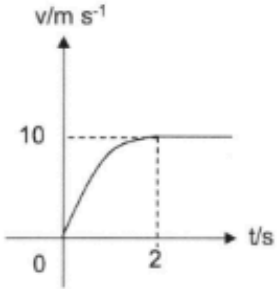
A



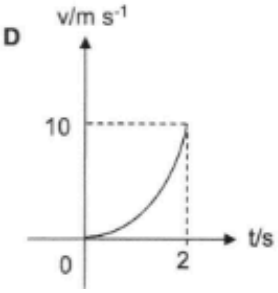
B



C



D

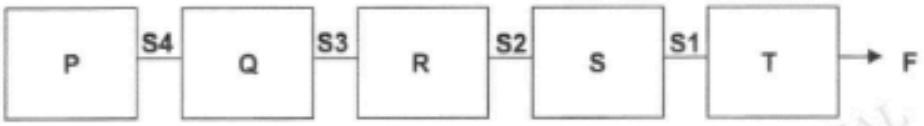


4 Two forces act on a ball. The magnitudes of the two forces are 8.0 N and 13.0 N.

Which of the following **cannot** be the resultant force acting of the ball?

A 4.0 N **B** 5.0 N **C** 14.0 N **D** 21.0 N

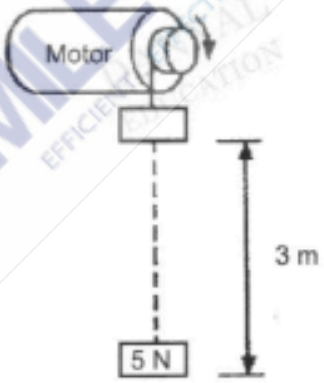
5 Five blocks **P**, **Q**, **R**, **S** and **T**, of different masses, are connected by four identical strings **S1**, **S2**, **S3** and **S4** as shown in the diagram below. They are pulled by a steadily increasing force **F**.



Which of the following strings is most likely to break?

A **S1** **B** **S2**
C **S3** **D** **S4**

6 An electric motor is used to lift a 5 N load through 3 m as shown in the diagram. The total amount of electrical energy used by the motor is 27 J.



What is the amount of energy wasted by the motor?

A 9 J **B** 12 J
C 15 J **D** 22 J

7 Andy is having difficulty in turning the nut using the spanner. He pulls with the same force in each case.

Which diagram below shows him producing the biggest turning effect?

A 

B 

C 

D 

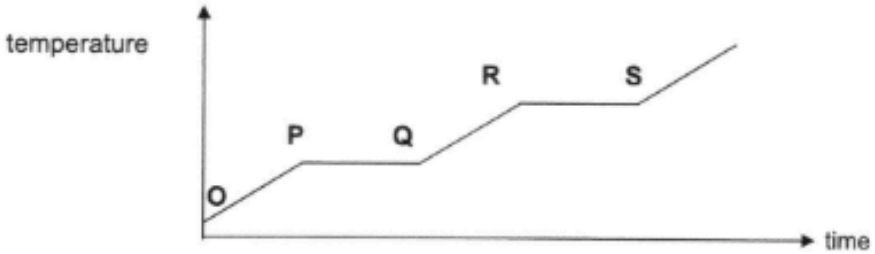
8 Heat transfer can occur by conduction, convection or radiation.

The best example of heat transfer by conduction is _____.

A from the boiler to the hot water storage tank in the domestic hot water system
B from the frying-pan to its contents
C from the Sun to the Earth
D through glass into a greenhouse

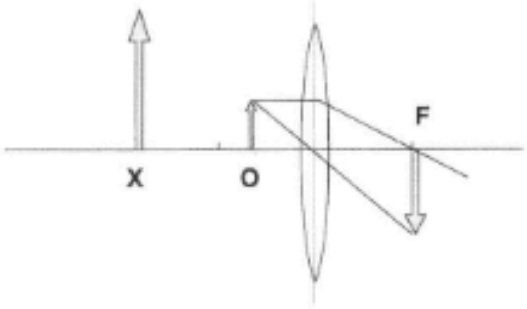
9 A solid substance in a boiling tube was heated steadily. The temperature-time graph of the substance is as shown below.

Which section of the graph indicates the substance being a mixture of solid and liquid?



A OP B PQ C QR D RS

10 A student starts to draw a ray diagram for an object at O, near a thin convex lens, but is not sure whether the image is formed at **X** or at **F**.



The correctly drawn image is _____.

A real and at F. **B** real and at X.
C virtual and at F. **D** virtual and at X.

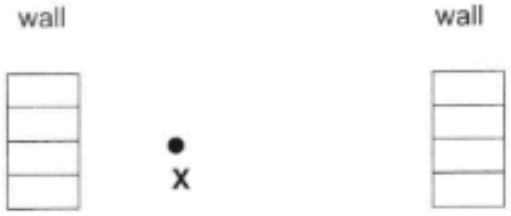
11 The table below represents the electromagnetic spectrum.

radio waves	X	infra-red rays	Y	ultraviolet rays	Z

What waves do **X**, **Y** and **Z** represent?

	X	Y	Z
A	microwaves	gamma rays	X rays
B	visible light	X rays	gamma rays
C	microwaves	visible light	X rays
D	visible light	microwaves	gamma rays

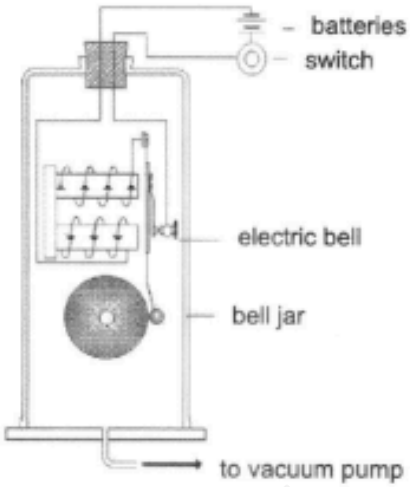
12 A man who is standing at point **X** between two parallel walls fires a pistol.



He hears echoes after 0.5 s and 0.8 s. A **further** echo is heard, after firing, at a time of _____.

A 1.1 s **B** 1.3 s **C** 2.2 s **D** 2.6 s

13 An electric bell is placed inside a bell jar and the air inside the bell jar is removed using a vacuum pump.



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

A When the switch is closed, a ringing sound is heard because the core becomes magnetized and attracts the armature.
B The bell will produce only one ringing sound every time the switch is closed.
C The frequency of sound waves produced by the bell is less than 20 Hz, making the ringing sound inaudible.
D No sound is heard even when the switch is closed because the sound waves cannot travel through vacuum.

14 A positively charged object attracts a suspended light conducting ball.

The light conducting ball can be _____.

I negatively charged
II neutral
III positively charged

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

15 A current of 5 mA flows in a circuit for 2 minutes.

Calculate the amount of charge that passes through the circuit.

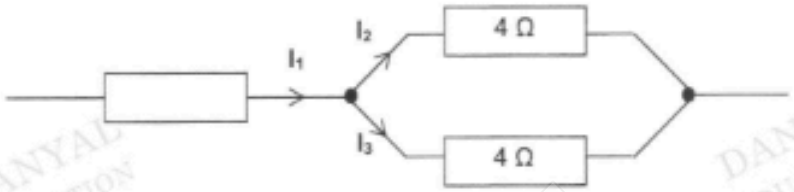
A 0.6 C
B 10 C
C 60 C
D 600 C

16 A wire of radius, ***r***, has a resistance of 20 Ω.

If another similar wire, twice the length but half the cross-sectional area is used, what is the new resistance of the wire?

A	5 Ω	**B**	10 Ω
C	40 Ω	**D**	80 Ω

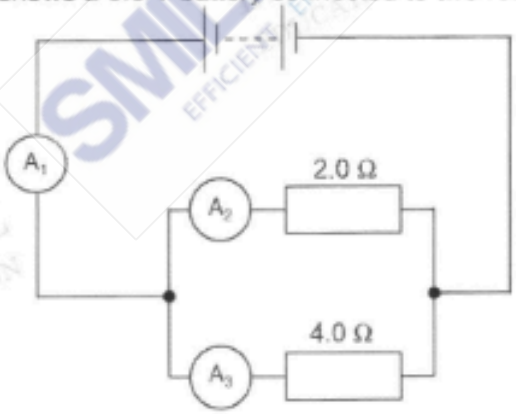
17 In the diagram below, I_1 is the current supplied by a source. I_2 and I_3 are the currents in each branch of the parallel arrangement shown.



Which of the following statements concerning I_1, I_2 and I_3 is correct?

A I_1 is equal to I_2 but greater than I_3.
B I_2 is greater than I_3 but smaller than I_1.
C I_3 is greater than I_2 but smaller than I_1.
D I_2 is equal to I_3 but smaller than I_1.

18 The diagram shows a 6.0 V battery connected to two resistors in parallel.



Which row shows the currents, in amperes, in the three ammeters?

	A_1	A_2	A_3
A	1.0	1.0	1.0
B	1.0	3.0	1.5
C	4.5	1.5	3.0
D	4.5	3.0	1.5

19 An electric heater is connected to a 3-pin socket. The current in the 'live' wire is 1 A. The potential difference between the 'live' and 'neutral' wire is 240 V.

Which of the following correctly describes the current and the potential difference between the 'neutral' and 'earth' wire?

	current in 'neutral' wire (A)	potential difference between 'earth' and 'neutral' wire (V)
A	0	0
B	1	0
C	1	240
D	0	240

20 The diagram below shows a beam of electrons about to enter a magnetic field. The direction of the field is into the page.

What will be the direction of the deflection, if any, as the beam passes through the magnetic field?

A towards the top of the page
B towards the bottom of the page
C out of the paper
D no deflection

Section A [45 marks]

Answer **all** the questions in the spaces provided.

1 A motorcycle is travelling towards an obstacle at a constant speed of 16 m/s as shown in Fig. 1.1. The motorcyclist only sees the obstacle when he is 120 m away, and applies the brake immediately. He takes 12.0 seconds to decelerate uniformly to a stop.

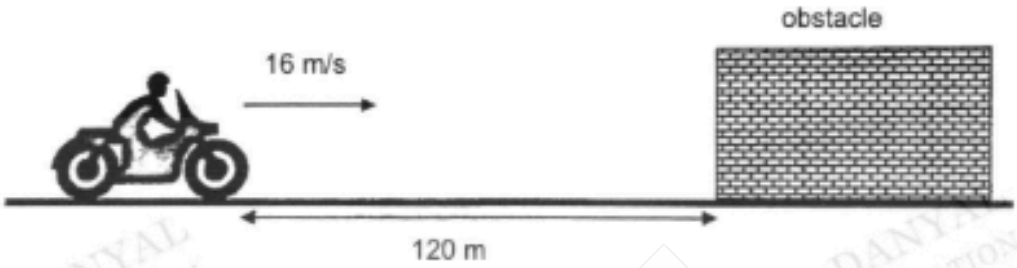
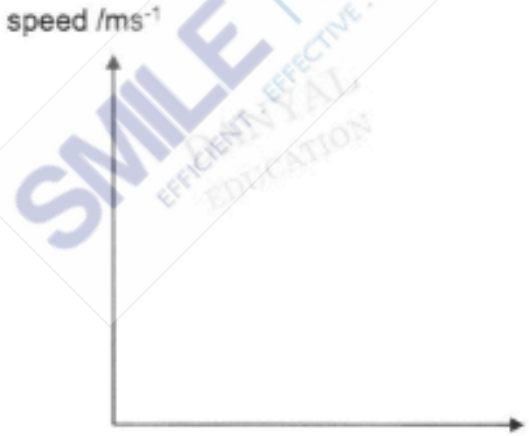


Fig. 1.1

(a) Sketch the speed-time graph of the motorcycle from the time when the motorcyclist first sees the obstacle to the time when the motorcycle comes to a stop. Indicate clearly the corresponding values of speed and time on the axes.



[2]

(b) **(i)** Calculate the deceleration of the motorcyclist.

deceleration = ... m/s^2 [2]

(ii) Showing the relevant calculations in the space below, determine whether the motorcyclist will hit the obstacle.

[2]

(c) If the motorcyclist carries an additional passenger, suggest and explain whether it is more or less likely for the motorcycle to hit the obstacle.

.....

.....

..... [1]

2 A tyre which is used on a large earth-moving vehicle is shown in Fig. 2.1. The vehicle has four of these tyres. When the vehicle is loaded, its mass is 10 000 kg.

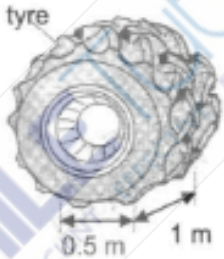


Fig. 2.1

(a) Calculate the total area of the four tyres, in m^2, in contact with the ground.

total area = ... m^2 [2]

(b) Calculate the pressure, in Pa, exerted on the ground by the tyres.

pressure = ... Pa [2]

3 Fig. 3.1 below shows an object **O** being pulled by two men using two ropes. Each man exerts a force of 50 N. The ropes are kept horizontal to the ground.

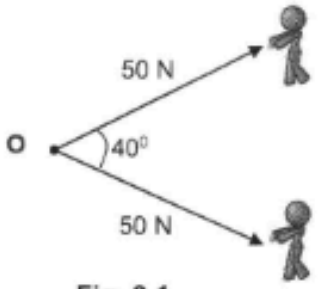


Fig. 3.1

Using a vector diagram, determine the resultant force on the object. State the scale used.

resultant force = ... N [3]

4 Fig. 4.1 shows a helicopter stationary in the air. Vertical lift forces are produced by the front and back rotors as shown in the figure.

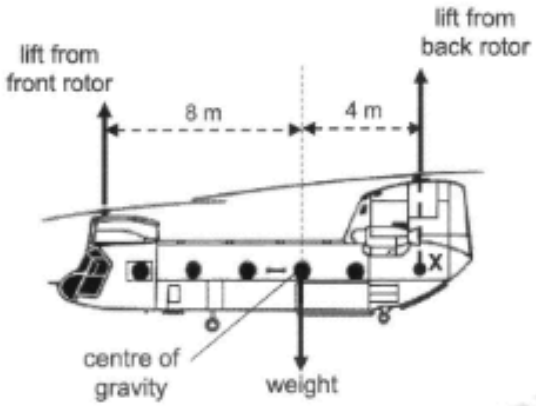


Fig. 4.1

The weight of the helicopter is 80 000 N.

(a) Calculate the mass of the helicopter. (Taking g = 10 N/kg)

mass = ... N [1]

(b) By taking moments about point **X**, calculate

(i) the moment due to the weight of the helicopter.

moment = ... Nm [2]

(ii) the lift force from the front rotor.

lift force = ... N [2]

(c) Using your answer in **(b) (ii)**, calculate the lift force from the back rotor.

lift force = ... N [1]

5 Fig. 5.1 shows a boy doing push-up exercise. He applies a force of 400 N as he pushes up a distance of 0.45 m. He completed 40 push-ups in 1 minute.

Fig. 5.1

Calculate the

(a) work done by the boy when he completed one push-up.

work done = ... J [1]

(b) power generated by the boy in 1 minute.

power = ... W [2]

6 Fig. 6.1 shows a computer chip fitted with a heat sink with black metal fins. The function of the heat sink is to keep the computer chip cool.

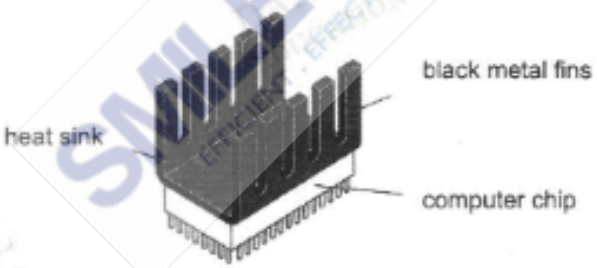


Fig. 6.1

Explain three features of the heat sink that allow the thermal energy to be transferred easily away from the chip. In your answer, state clearly the method(s) by which thermal energy is transferred.

.....

.....

.....

.....

..... [3]

7 A solid substance is placed in a beaker and heated with a 10 W heater. Fig. 7.1 shows how the temperature of the beaker and its contents changes with time.

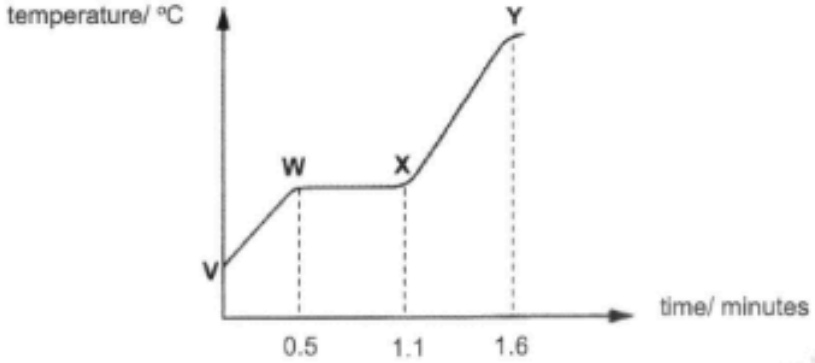


Fig. 7.1

(a) Compare the arrangement and forces of attraction between the molecules of the substance in the segments **VW** and **XY**.

arrangement of molecules:

.....

.....

.....

..... [1]

forces of attraction between molecules:

.....

.....

.....

..... [1]

(b) Explain why the temperature of the substance remains constant for the segment **WX** even when energy is continuously supplied.

.....

.....

..... [2]

(c) Calculate the amount of thermal energy supplied by the heater during the segment **WX**.

energy = ... J [2]

(d) Explain why the actual energy gained by the substance in the segment **WX** is less than the energy supplied by the heater calculated in part **(c)**.

.....

.....

..... [1]

8 Typical wavelengths of electromagnetic waves (E.M. waves) are given in Table 8.1 below, given that 1 nm = 1 x 10^{-9} m.

E.M. wave	gamma	X-rays	ultra-violet	visible light	infra-red	microwaves	radio
typical wavelength	0.001 nm	0.1 nm	10 nm	0.6 μm	100 μm	0.03 m	3 m

Table 8.1

(a) **(i)** State the speed of ultra-violet waves in a vacuum.

speed = ... m/s [1]

(ii) Calculate the frequency of ultra-violet waves of wavelength 10 nm.

frequency = ... Hz [2]

(b) State one use of ultra-violet waves.

..... [1]

(c) State one use of infra-red waves.

..... [1]

9 Fig. 9.1 shows a circuit with three 12 Ω resistors connected in series with a battery and an ammeter. An unknown resistor **X** is to be connected between any two of the four points **H**, **I**, **J**, **K**.

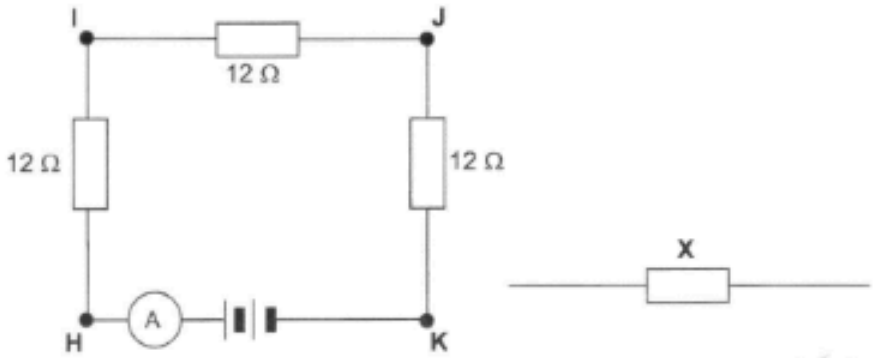


Fig. 9.1

(a) If the ammeter reads 0.25 A before resistor **X** is connected, calculate the electromotive force of the battery.

emf = ... V [2]

(b) If **X** is 9 Ω and is connected **in series** between **H** and **K**, calculate

(i) the effective resistance of the circuit,

effective resistance = ... Ω [1]

(ii) the current flowing through the ammeter

current = ... A [2]

(c) State and explain what happens to the current flowing through the ammeter if a wire of negligible resistance is connected in parallel across **I** and **J**.

.....

.....

..... [2]

Section B [20 marks]

Answer any **two** questions.

Write our answers in the spaces provided.

10 An electric convection oven with a top and bottom heating elements, which is able to provide more uniform heating to food placed in the toaster, is shown in Fig. 10.1.

The top and bottom heating elements are connected in **parallel**, and have resistances of 40 Ω and 80 Ω respectively.

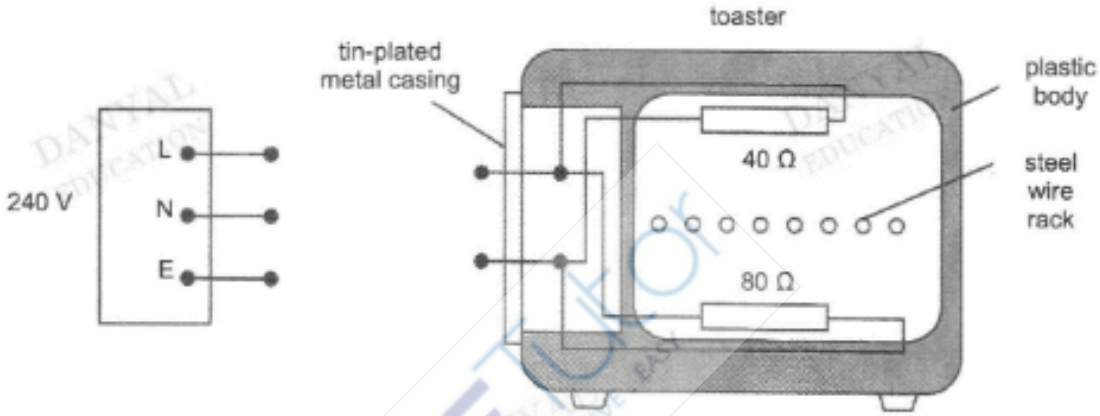


Fig. 10.1

(a) On the figure above, draw lines to show how the live, neutral and earth wires should be wired from the 240 V a.c. source to the toaster.

Include a fuse and a switch in your circuit diagram. [3]

(b) Calculate the current that is drawn when the toaster is working normally.

current = ... A [2]

(c) State the function of a fuse, and explain how it works in the circuit.

.....

.....

..... [2]

(d) Given the choice of 3 A, 5 A, 13 A or 20 A, state the fuse rating that should be used,

fuse rating = ... A [1]

(e) Find the cost, in cents, of using the toaster for 5 minutes if the cost is 27 cents per unit of electricity.

cost = ...cents [2]

11 (a) Fig. 11.1 shows a section of an optical fibre with the refractive index of n = 1.46. A ray of light from air is incident on the fibre and the angle of incidence at the air-fibre boundary is 30°.

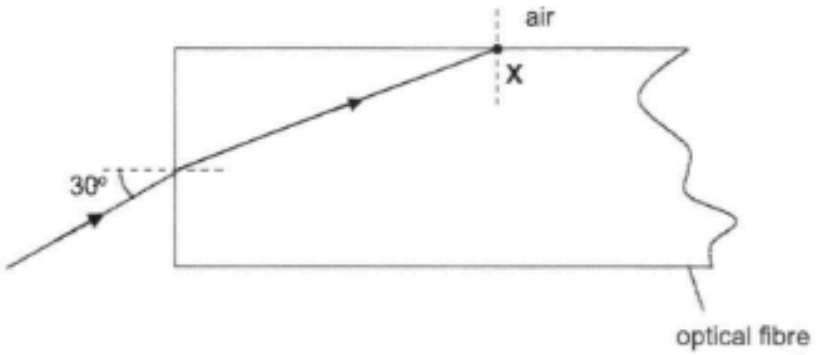


Fig. 11.1

(i) Calculate the angle of refraction at the air-fibre boundary.

angle of refraction = ...° [2]

(ii) Calculate the critical angle of the optical fibre.

critical angle = ...° [2]

(iii) Calculate the angle of incidence at the fibre-air boundary at **X**.

angle of incidence = ...° [1]

(iv) At the fibre-air boundary, **X**, will the ray of light emerge from the fibre into the air? Explain your answer.

.....

.....

.....

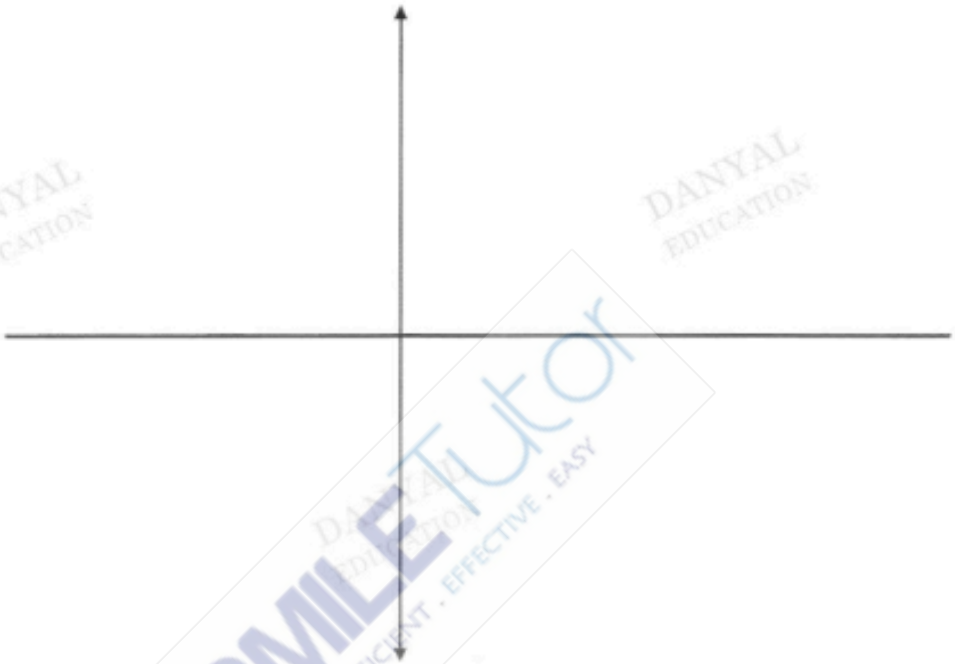
..... [2]

(b) An object of height 2.0 cm is placed 2.8 cm in front of a converging lens. A virtual image was produced and it was magnified by 1.5 times.

(i) State another characteristics of the image.

..... [1]

(ii) By means of a scale diagram below, determine the focal length of the lens used. The principle axis and lens have been drawn for you.



focal length = ... [2]

12 (a) Suggest a material that is used to make a permanent magnet

..... [1]

(b) When there are no other magnetic fields present, the needle of a plotting compass points due North in the Earth's magnetic field. This is shown in the fig. 12.1.

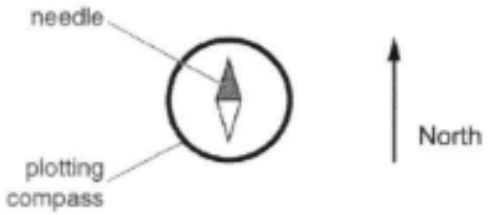


Fig. 12.1

The plotting compass is placed close to a permanent magnet, first at position A and then at position B, as shown in fig. 12.2.

Fig. 12.2

The magnetic field close to the permanent magnet is very much larger than the magnetic field of the Earth.

Draw needles in the two circles to show the direction in which the compass needle points when the compass is at A and at B. [2]

(c) **Figure 12.3** shows a coil which is wound on an iron core. It is placed near a permanent magnet.

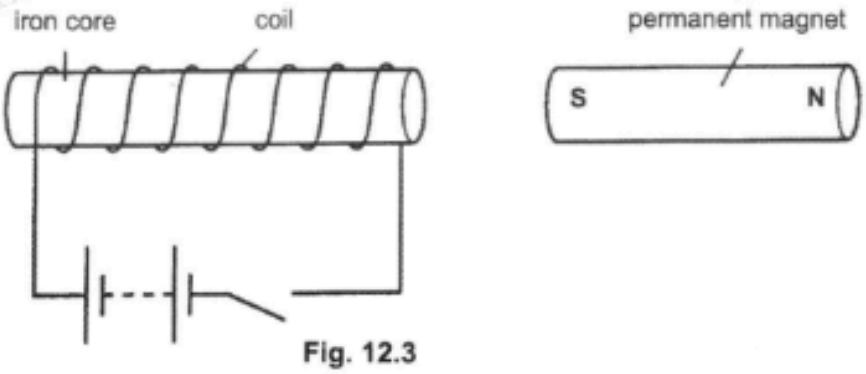


Fig. 12.3

(i) On fig. 12.3, label the direction in which the current flows, and identify the North and South poles on the iron core. [2]

(ii) What happens to the permanent magnet when it is placed near the coil? Explain your answer briefly.

.....

.....

.....

..... [2]

(iii) Suggest one way to increase the strength of the electromagnet.s

.....

.....

..... [1]

(d) Fig. 12.4 shows a permanent magnet and a current-carrying wire placed near it, with the current flowing into the plane of the paper. The wire experiences an induced force.

Fig. 12.4

On fig. 12.4, draw

(i) draw the magnetic field pattern due to the current on the wire, [1]
(ii) draw the direction of the induced force acting on the wire. [1]

END OF PAPER

ANSWER SHEET

Marking Scheme

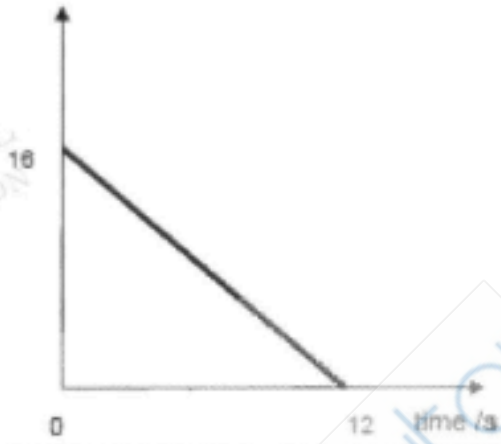
Section A (20 marks)

Question	Answer	Question	Answer	Question	Answer	Question	Answer
1	A	6	B	11	C	16	D
2	D	7	B	12	B	17	D
3	B	8	B	13	D	18	D
4	A	9	B	14	C	19	B
5	A	10	D	15	A	20	B

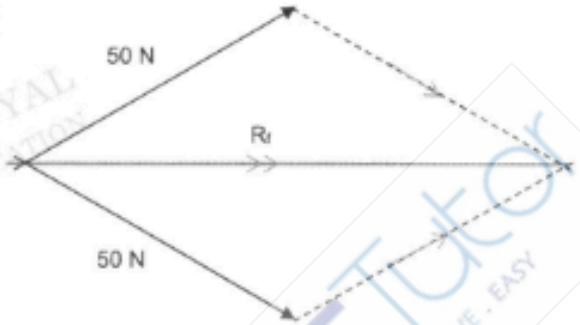
Paper 2 (65 marks)

- ½ mark awarded for correct relevant formula
- Minus ½ mark for answer with incorrect significant figures

Section A (45 marks)

Question		Answer	Marks
1	a	speed /ms^{-1}  	Correct shape of straight line [1] Correct label of values on axis [1]
	bi	a = (v-u)/t = (0-16)/12 = -1.33 ms^{-2} deceleration = 1.33 ms^{-2} [Do not award answer mark if answer is -1.33]	[1] [1]
	bii	total distance travelled = area under graph = (0.5 x 12 x 16) =96 m Since distance travelled < 120 m, he will not hit the obstacle	[1] [1]
	c	It is more likely for the motorcycle to hit the obstacle. With an extra passenger, there is greater mass, which means there is greater inertia. This will increase his stopping distance.	[1/2] [1/2]
			Total: 7 marks

2	a	total area = (4)(0.50 × 1.0) = 2 m^2 [Award 1m if only one tyre is calculated]	[1] [1]
	b	P = F / A = (10 000 × 10) / 2 = 50 000 Pa	[1] [1] allow ecf
			Total: 4 marks

3		Scale: 1 cm: 10 N  Resultant force = 9.4 cm X 10 N = 94 N ± 5 N [Minus 0.5 marks for no label and arrows]	Suitable scale [B1] Correct parallelogram drawn [B1] Correct value of resultant force according to parallelogram [B1]
			Total: 3 marks

4	a	mass = 80 000 / 10 = 8 000 kg	[1]
	bi	moment due to the weight = 80 000 × 4 = 320 000 Nm	[1] [1]
	bii	lift force from the front rotor = 320 000 / 12 = 26 700 N (corrected to 3 s.f.)	[1] [1]
	c	lift force from the back rotor = 80 000 – 26 700 = 53 300 N	[1] allow ecf
			Total: 6 marks

5	a	work done = 400 × 0.45 = 180 J	[1]
	b	power = (180 × 40) / 60 = 120 W [No method mark awarded if the time used is in min]	[1] [1]
			Total: 3 marks

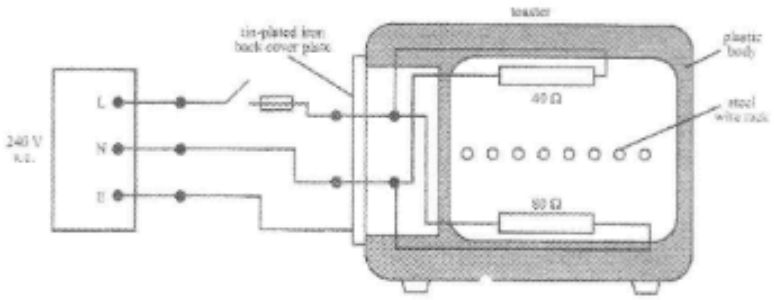
6		The heat sink is designed with fins so that it has large surface area. This feature helps to radiate thermal energy much faster as compared to a flat surface. (or increase thermal energy lost by radiation) The heat sink is made of metal which is a good thermal conductor. This increases transfer of thermal energy by conduction The heat sink is black in colour. Black is a good radiator of thermal energy.	[1] [1] [1]
			Total: 3 marks

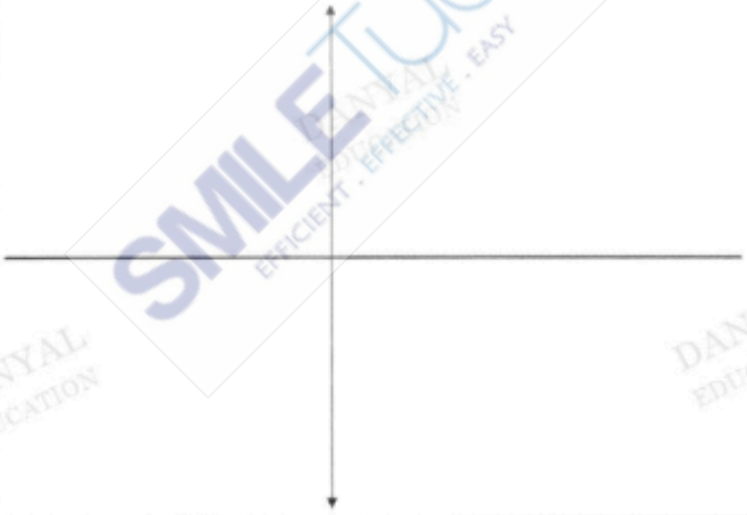
7	a	Arrangement of molecules: Molecules in VW are arranged in an orderly manner, while molecules in XY are arranged in a disorderly manner [Also accept Arrangement of molecules: Molecules in VW are close together, while molecules in XY are further apart. or Arrangement of molecules: Molecules in VW are arranged in a regular pattern, while molecules in XY are arranged in an irregular pattern.] Forces of attraction between the molecules: Forces of attraction between molecules in VW is stronger than that in XY.	[1] [1]
	b	Heat is absorbed to break/weaken bonds. The energy supplied is not to increase the K.E of the particles. Hence, temperature remains constant.	[1] [1]
	c	E = Pt = 10 × [(1.1 – 0.50) × 60) = 360 J	[1] [1]
	d	Some energy produced by the heater is lost to the surroundings / beaker.	[1]
			Total: 7 marks

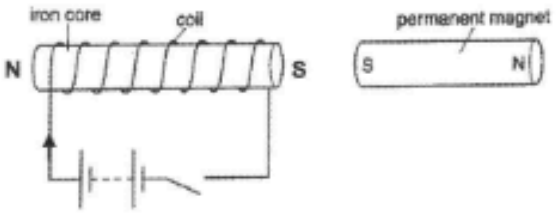
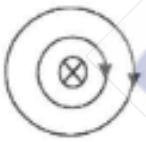
8	ai	speed = 3×10^8 m/s	[1]
	aii	f = v/λ = $(3 \times 10^8) / (10 \times 10^{-9})$ = 3×10^{16} Hz	[1] [1] allow ecf
	b	detection for forgery of fake notes [accept any possible answers]	[1]
	c	TV remote controller [accept any possible answers]	[1]
			Total: 5 marks

9	a	V = IR = 0.25 X 36 = 9 V	[1] [1]
	bi	12 + 12 + 12 + 9 = 45 Ω	[1]
	bii	I = V/ R = 9/45 = 0.2 A	[1] [1]
	c	The current will increase as total resistance drops to 24 Ω instead of 36 Ω due to short circuit.	[1] [1]
			Total: 7 marks

Section B (10 marks, 3 choose 2)

Question		Answer	Marks
10	a		
		Live, neutral and earth wires corrected wired [1 mark for 2 correct answers] [crossing of wires not allowed] Fuse and switch connected to live wire	[2] [1]
	b	1/R = 1/40 + 1/80 1/R = 3/80 R = 26.7 Ω I = V / R = 240 / 26.7 = 8.99 A [Award 1m if current is calculated based on incorrect resistance values] [Accept 2 or 3 s.f]	[1] [1]
	c	If the current exceeds the fuse rating, the fuse will become hot, melt and break the circuit. This stops the current from flowing in the circuit and hence protecting the appliance from damage.	[1/2] [1/2] [1/2] [1/2]
	d	fuse rating = 13 A	[1] allow ecf
	e	P = VI = (240)(8.99) = 2160 W = 2.16 kW E = Pt = (2.16)(5 / 60) = 0.18 kWh Cost = (0.180(27) = 4.86 cents (accept 5 cents)	[1/2] [1/2] [1] allow ecf
			Total: 10 marks

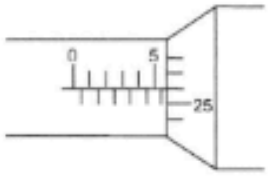
Question		Answer	Marks
11	ai	$n = \frac{\sin i}{\sin r}$ $\sin r = \frac{\sin 30}{1.46}$ $= 0.342$ $r = 20°$	[1] [1]
	aii	$n = \frac{1}{\sin c}$ $1.46 = \frac{1}{\sin c}$ $\sin c = \frac{1}{1.46}$ $c = 43.2°$	[1] [1] accept 43°
	aiii	i = 90 – 20 = 70°	[1]
	aiv	No. Because the angle of incidence is greater than critical angle.	[1] [1]
	bi	Upright	[1]
	bii		
		Correct ray diagram drawn, showing both object and image. Accurate dimension according to question. [Minus max 0.5 mark for following Bold or dotted lines not according to answer above, Missing arrows, etc.] Focal length = 7.5 cm (± 1.0)	[1] [1] allow ecf
			Total: 10 marks

Question		Answer	Marks
12	a	steel	[1]
	b	compass A points towards S-pole of magnet compass B points right, away from N-pole of magnet	[1] [1]
	ci	 Direction of current flow Label both N and S	[1] [1]
	cii	The permanent magnet will be repelled by the electromagnet because two like poles (South poles) are facing each other.	[1] [1]
	ciii	Any one of the following: Increase the current, Increases the number of turns of the solenoid,	[1]
	di	 Correct shape and direction.	[1]
	dii	 Downward force acting on wire.	[1]

THE END

CHUA CHU KANG SECONDARY SCHOOL PRELIM PAPER

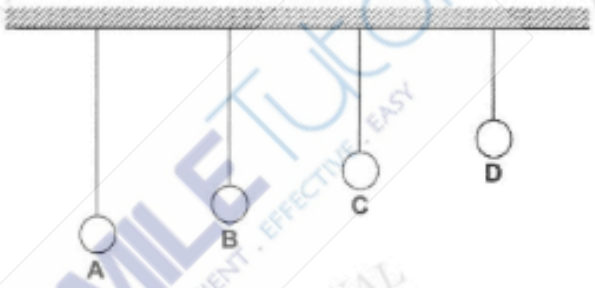
21 The diagram shows part of a micrometer screw gauge.



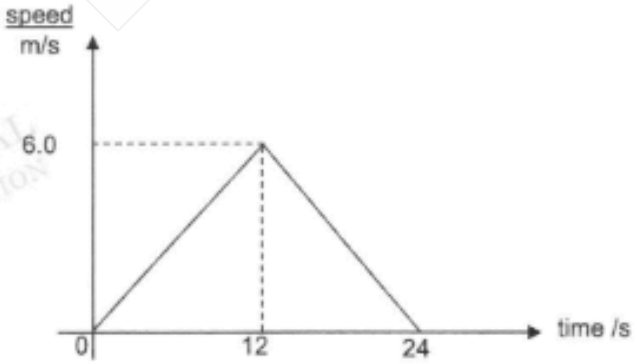
What is the reading shown?

A 5.126 mm
B 5.526 mm
C 5.76 mm
D 6.26 mm

22 Which simple pendulum has the highest frequency of oscillation?



23 The speed-time graph shows the motion of a car over a period of 24 s.



What is the deceleration of the car?

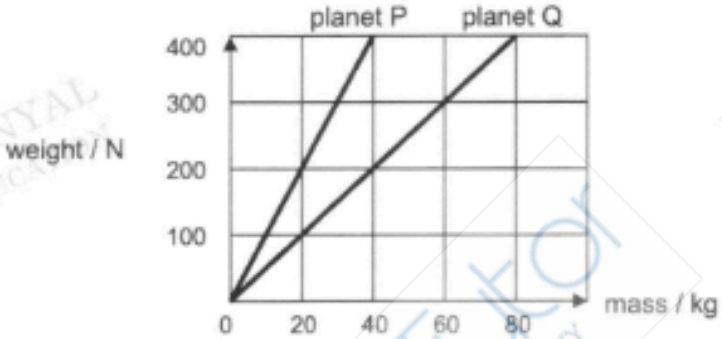
A $-0.50\ m/s^2$
B $0\ m/s^2$
C $0.50\ m/s^2$
D $72\ m/s^2$

24 A trolley is pushed from rest across a frictionless horizontal surface with a constant force.

If the pushing force is removed, what will happen to the box?

A The box will continue to move at a constant speed.
B The box will continue to move with its speed increasing at a constant rate for a while and then slow down.
C The box will start to slow down to a stop.
D The box will stop immediately.

25 The graph shows how weight varies with mass on planet P and planet Q.



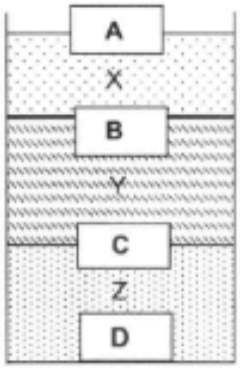
An object weighs 400 N on planet P. The object is taken to planet Q.

What is the mass and weight of the object on planet Q?

	mass of object on planet Q / kg	weight of object on planet Q / N
A	40	200
B	40	400
C	80	200
D	80	400

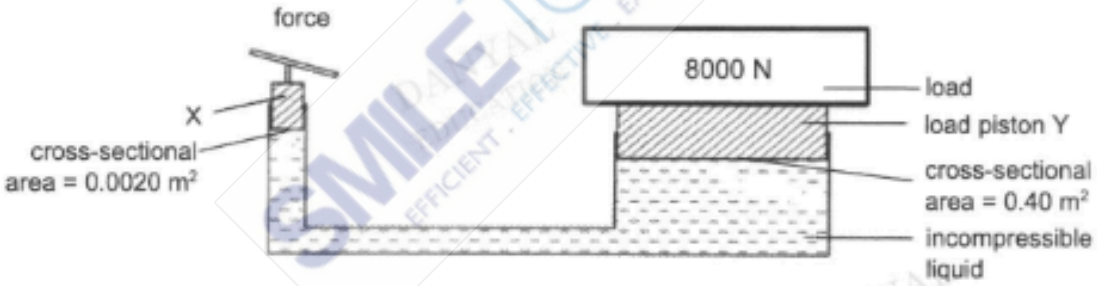
26 The diagram shows a beaker containing three immiscible liquids, X, Y and Z, with varying densities. A solid object which is less dense than Z but denser than X and Y is placed in the beaker.

Where would the position of the object be?



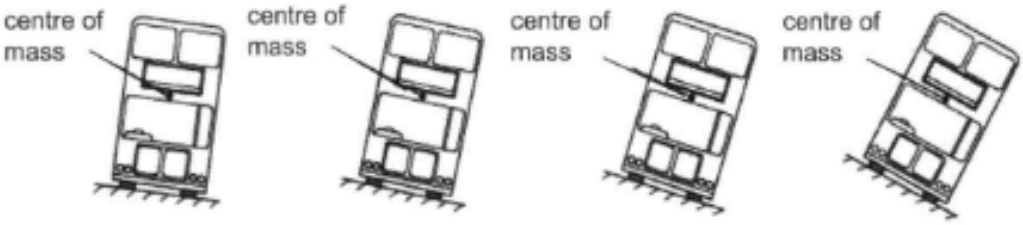
27 The diagram shows a hydraulic jack. The pressure at both cross-sectional areas is the same.

What is the force required at piston X to lift a load of 8000 N at piston Y?



A 40 N **B** 320 N
C 80 000 N **D** 1 600 000 N

28 The diagram shows four similar buses placed on different ramps tilted at different angles.



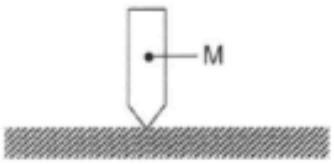
How many bus(es) will fall over?

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

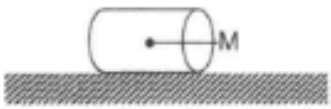
29 The diagrams show how four objects are placed on the ground. Point M indicates the respective centre of gravity for each object. The ground is shown as the shaded region.

Which object is in neutral equilibrium?

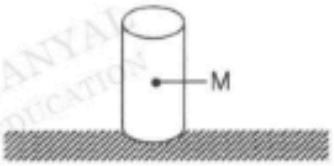
A



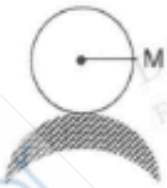
B



C



D



30 When a 200 N force is applied to a box weighing 300N, the box moves 4.0 m horizontally in 20 s.

What is the average power used when the box is moved?

A	40 W	**B**	60 W
C	100 W	**D**	16 000 W

31 Which statement about solids, liquids and gases is correct?

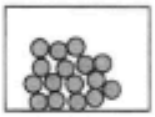
A In a gas, particles move slowly downwards due to the force of gravity.
B In a liquid, particles move slowly in some directions only.
C In a solid, particles vibrate about their fixed positions.
D Liquids and gases can be easily compressed.

32 The melting and boiling points of mercury are −39 °C and 357 °C respectively.

Which diagram shows the arrangement of mercury atoms at 0 °C?

A

B



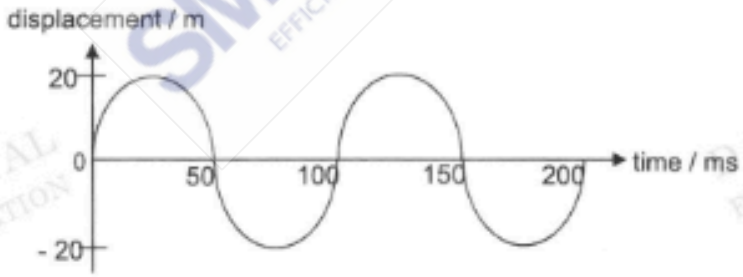
C

D

33 Which statement correctly describes what happens when a substance is boiling?

A The boiling substance changes from a gas to a liquid.
B The boiling substance gains thermal energy and therefore its temperature increases.
C The forces of attraction between the particles become weaker.
D There is no transfer of thermal energy and therefore the temperature of the substance remains constant.

34 The graph shows how the displacement of a particle in a wave varies with time.

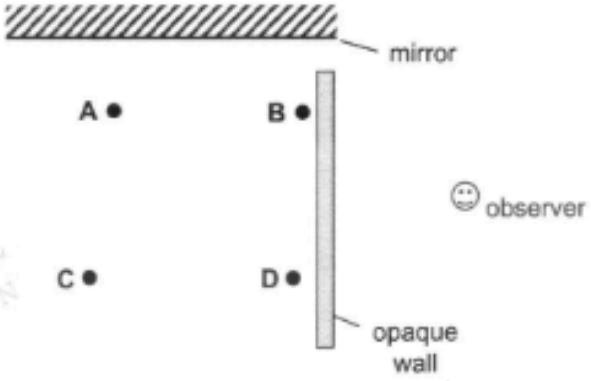


What is the amplitude of the wave?

A 0 m
B 20 m
C 40 m
D 100 m

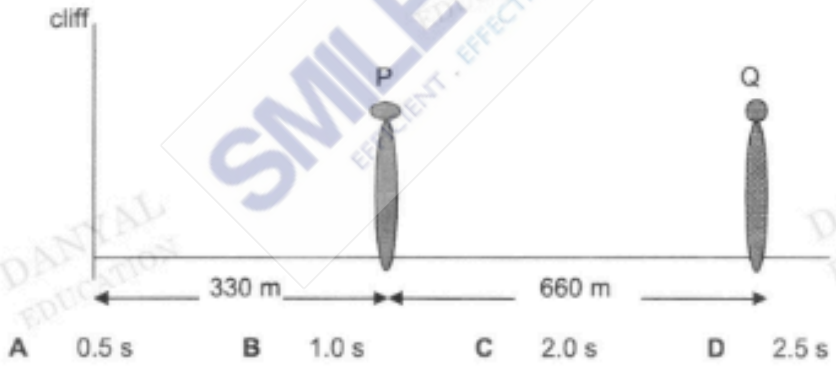
35 Four objects are blocked by an opaque wall.

Which object can be seen by the observer on the mirror?



36 Two people, P and Q stood in front of a vertical cliff. P fired a pistol. The time for the sound to travel directly from P to Q was t_1 seconds and the time for the echo to reach Q was t_2 seconds. Both timings were measured from the instant the pistol was fired.

If the speed of sound in air is 330 m/s, what was the value of $(t_2 - t_1)$?



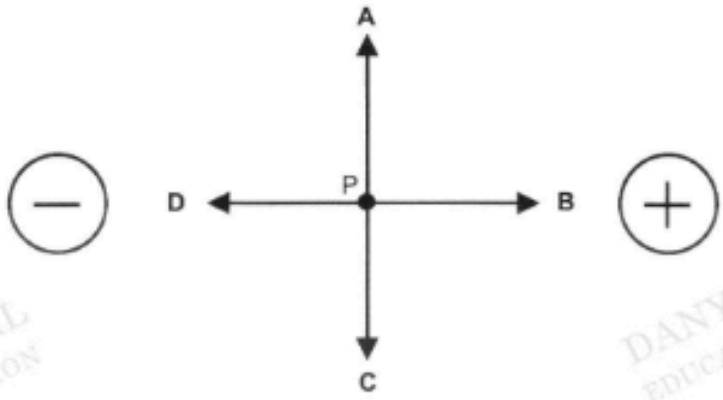
37 The table shows the lengths and diameters of four copper wires.

Which wire has the highest resistance?

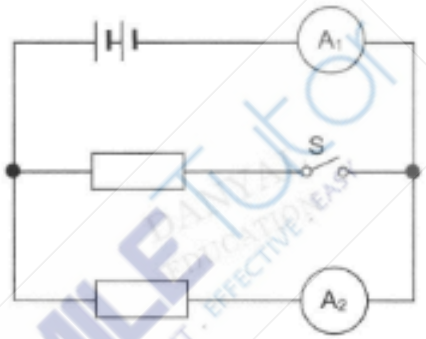
	length / m	diameter / mm
A	0.50	1.0
B	0.50	2.5
C	0.75	1.0
D	0.75	2.5

38 The diagram shows two oppositely-charged particles.

In which direction does the electric field act at the point P between the two charges shown?



39 Two identical resistors are connected as shown in the circuit.



How would the readings of ammeters A_1 and A_2 change when switch S is closed?

	reading of A_1	reading of A_2
A	increases	increases
B	increases	no change
C	no change	decreases
D	no change	no change

40 The cost of a unit of electricity is 26 cents.

What is the cost, to the nearest cent, if a student uses a 500 W computer for 40 minutes?

A \$0.09 **B** \$5.20
C \$52.00 **D** \$86.67

End of Paper 1

Section A

Answer **all** the questions in the spaces provided.

1 A mass of 50 kg is raised vertically by a wire attached to it.

(a) Draw a free body diagram of the mass showing all the vertical forces acting on it. Label all the vertical forces clearly.

[1]

(b) Calculate the tension in the wire if the mass accelerates upwards at 2.0 m/s^2.

tension = ... N [2]

2 Fig. 2.1 shows a windsurfer in equilibrium with a wind force acting on the sail of his board. The weight of the windsurfer is 600 N.

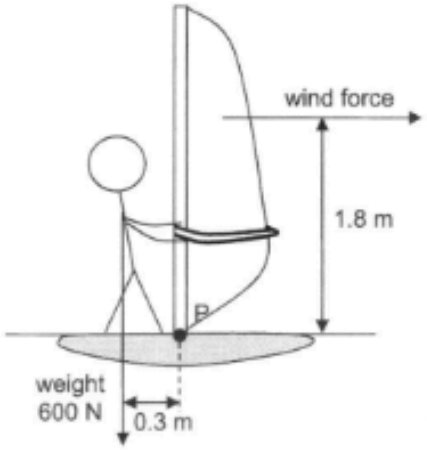


Fig. 2.1

(a) (i) Taking moment about pivot P, calculate the moment due to the weight of the windsurfer.

moment = ... Nm [1]

(ii) Hence, determine the force of the wind on the sail.

force = ... N [2]

(b) Explain why the windsurfer needs to lean back more if the wind speed increases in order to balance on his board.

.....

.....

.....[2]

3 Fig. 3.1 shows a ball being dropped from rest from a height of 5.0 m. Assume there is negligible air resistance.

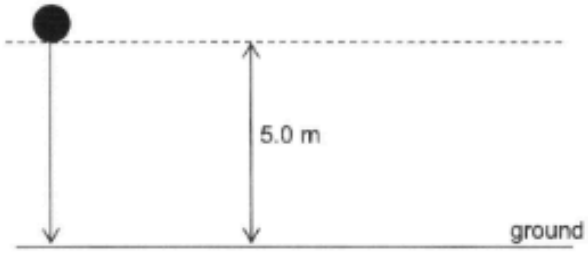


Fig. 3.1

(a) Calculate the speed of the ball just before hitting the ground.

speed = ...m/s [2]

(b) Using the graph provided, sketch a speed-time graph to represent the motion of the ball from the moment it drops till it just hits the ground.

[1]

(c) Calculate the time taken for the ball to reach the ground.

time = ...s [2]

4 Fig. 4.1 shows two ventilation shafts, A and B, built to provide fresh air for the miners in an underground tin mine.

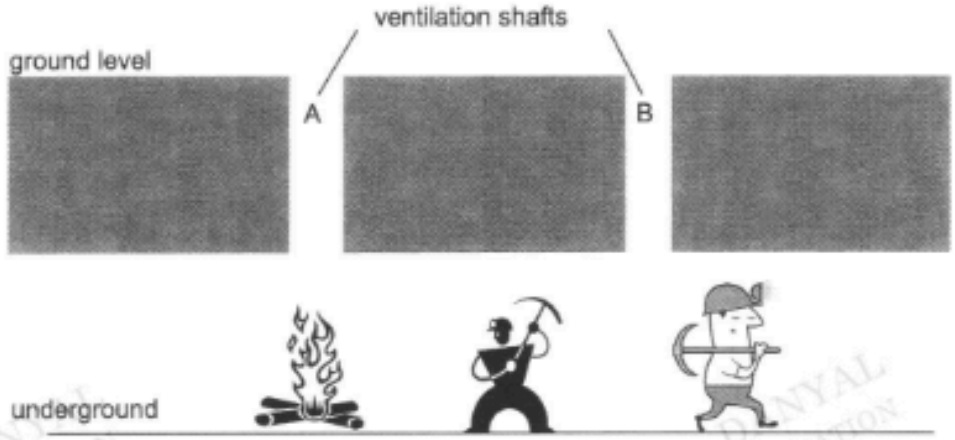


Fig. 4.1

(a) To improve the flow of air, a fire was lit at the bottom of one of the shafts.

Explain how this improves the air flow.

.....

.....

.....[2]

(b) To further improve the ventilation, a miner suggests to light fires at the bottom of both shafts.

Comment whether the miner's idea can further improve ventilation.

.....

.....[1]

5 Fig. 5.1 shows a block of transparent plastic. Light from O reaches the top surface of the transparent plastic at points X, Y and Z. The refractive index of the transparent plastic is 1.6.

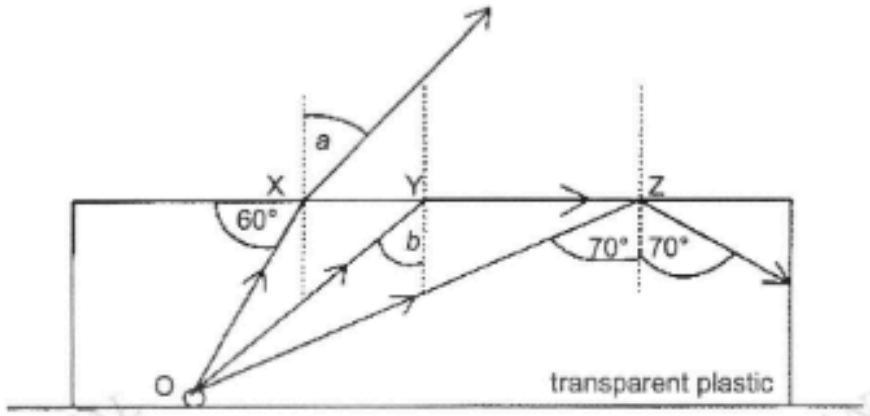


Fig. 5.1

(a) Calculate the value of angle *a*.

angle a = ...° [2]

(b) Calculate the value of angle *b*.

angle b = ...° [2]

(c) Another phenomenon occurs at Z.

State **one** condition required for this phenomenon to take place.

.....

.....[1]

6 Fig. 6.1 shows the side view of a water wave in a ripple tank.

Fig. 6.1 *(not drawn to scale)*

Fig. 6.2 is a scaled diagram of the ripple tank, viewed from the top.

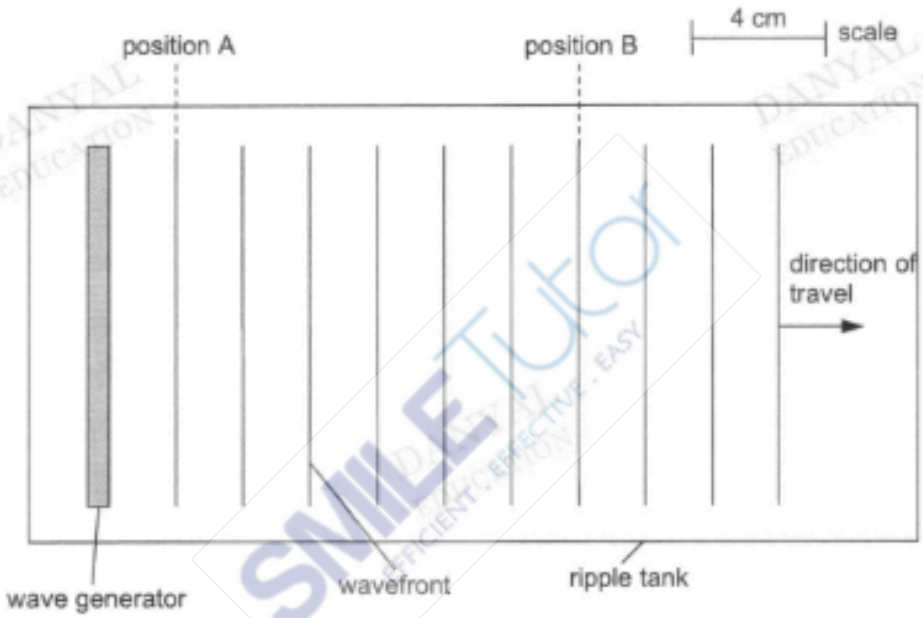


Fig. **6.2** *(drawn to scale)*

(a) State what is meant by the term *wavefront*?

.....

.....[1]

(b) Describe how the water in the ripple tank provides an example of *transverse wave* motion.

.....

.....

.....[1]

(c) The wavefront shown at position A in Fig. 6.2 takes 4.0 s to travel to position B.

Determine

(i) the wavelength,

wavelength = ... cm [1]

(ii) the speed,

speed = ... cm/s [2]

(iii) the frequency of the wave.

frequency = ... Hz [1]

7 Table 7.1 shows the typical frequencies of three types of electromagnetic (EM) waves S, T and U.

Table 7.1

EM Wave	typical frequency	use
S	1.0×10^{10} Hz	mobile communication
T	3.0×10^{12} Hz	intruder alarm, remote control
U	3.0×10^{16} Hz	detect counterfeit notes

(a) Which wave could be ultraviolet ray?

EM wave ..... [1]

(b) State **one** difference between an EM wave and a sound wave of the same wavelength.

.....

.....[1]

8 Fig 8.1 illustrates a sound wave travelling through air. X represents one particular air particle.

Fig. 8.1

(a) On Fig 8.1, mark clearly

(i) how particle X moves, [1]

(ii) the wavelength of this sound wave. Label this as L. [1]

(b) The pitch of the sound wave is raised.

State and explain how, if any, (a)(ii) would be affected.

.....

.....

.....[2]

9 Fig. 9.1 shows one method of painting a metal panel using electrostatic charges. The paint spray produces paint droplets which are positively-charged, and the metal panel is negatively-charged.

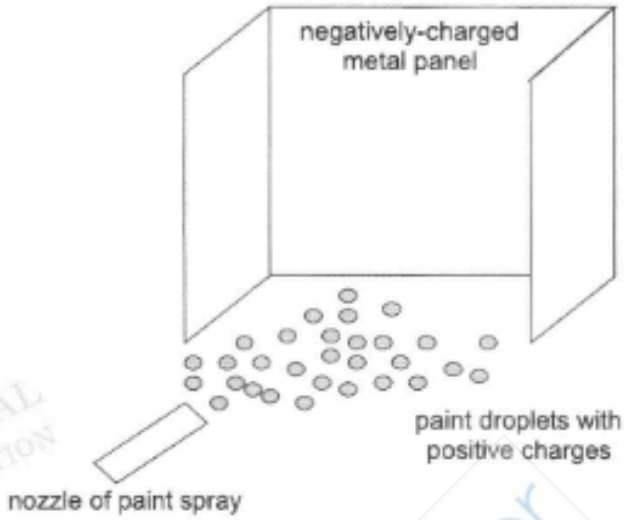


Fig. 9.1

(a) Explain why the paint droplets spread out as they leave the nozzle.

.....

.....

.....[2]

(b) Explain why the metal panel needs to be charged negatively.

.....

.....[1]

10 Fig. 10.1 shows an electrical circuit set up by a student using two similar light bulbs, a 12.0 V battery, a switch, a voltmeter, an ammeter and an unknown component Z.

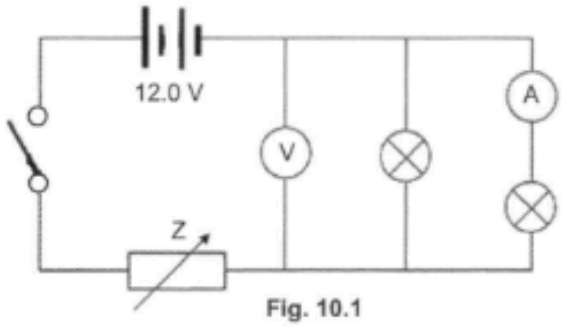


Fig. 10.1

The ammeter reading is 2.0 A when the voltmeter reading is 5.0 V.

Calculate

(a) **(i)** the resistance of one lamp,

resistance = ...Ω [2]

(ii) the potential difference across component Z,

potential difference = ... V [1]

(iii) the current that flows through Z.

current = ... A [1]

(b) Name component Z.

.....[1]

11 An experiment was conducted to test the ability of a vertically held soft iron bar to attract magnetic tacks. All the magnetic tacks were attracted to the soft iron in the presence of a magnet as shown in Fig. 11.1.

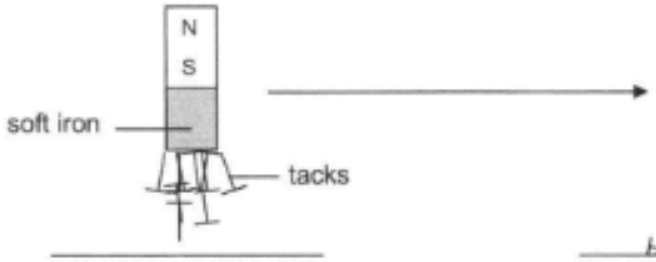


Fig. 11.1

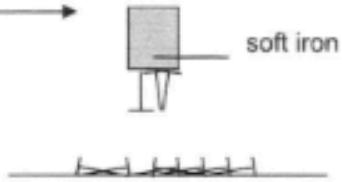


Fig. 11.2

As soon as the bar magnet was removed from the soft iron, most of the tacks that were attracted to the soft iron dropped. Three of the tacks remained attracted to the soft iron even after one hour had passed as shown in Fig. 11.2.

(a) (i) Explain why most of the tacks dropped once the magnet was removed.

.....

.....[1]

(ii) Suggest a material that these fallen tacks are made of.

.....[1]

(b) (i) Explain why some of the tacks remained attracted to the soft iron even after the magnet was removed.

.....

.....[1]

(ii) Suggest a material that these tacks that remained attracted are made of.

.....[1]

Section B

Answer any **two** questions from this section in the spaces provided.

12 A 50 W immersion heater was used to heat up some water.
The temperature of the water was taken at regular intervals.

Fig. 12.1 shows how the temperature of the water varied with time.

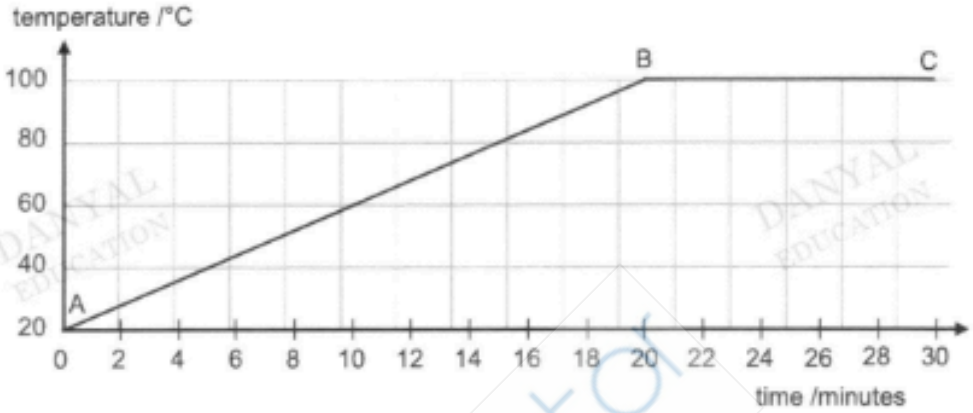


Fig. 12.1

(a) Describe the average speed and average separation of the water molecules

(i) between A and B,

.....

.....

.....[2]

(ii) between B and C.

.....

.....

.....[2]

(b) **(i)** Between B and C, the mass of water in the beaker decreases by 10 g.

Calculate how much energy is needed to boil 10 g of water at 100 °C.

energy = ... [2]

(ii) The amount of heat energy needed to change 10 g of water at 100 °C to steam should be 22600 J.

Explain why this is different from your calculated answer in **(b)(i)**.

.....

.....

.....[1]

(c) The immersion heater was connected to a 240 V power supply.

Calculate the current produced by the heater and hence explain whether a 13 A fuse is suitable for the immersion heater.

current = ...

.....

.....

.....[3]

13 (a) An object is placed 6.0 cm away in front of a thin converging lens. The image formed is real, inverted and the same size as the object.

(i) State the focal length of the lens.

focal length = ... [1]

(ii) Describe how the image changes as the object is moved slowly towards the lens until it is approximately 1 cm from the lens.

.....

.....

.....

.....

.....[4]

(b) A ray of blue light travelling in a vacuum enters a glass block of refractive index 1.5.

(i) State the speed of blue light travelling in vacuum.

speed of blue light in vacuum = ... [1]

(ii) Calculate the speed of blue light in glass.

speed of blue light in glass = ... [2]

(iii) State, giving a reason, how the speed of red light compares with the speed of blue light in a vacuum.

.....

.....[2]

14 A car and its passengers have a combined mass of 900 kg.
It starts from rest and moves with a constant acceleration of 2.0 m/s^2 until t = 10 s.
The car then travels at constant speed for the next 10 s.
It then decelerates at a constant rate for 4.0 s until it is at rest.
The opposing force acting on the car during the journey is 2000 N.

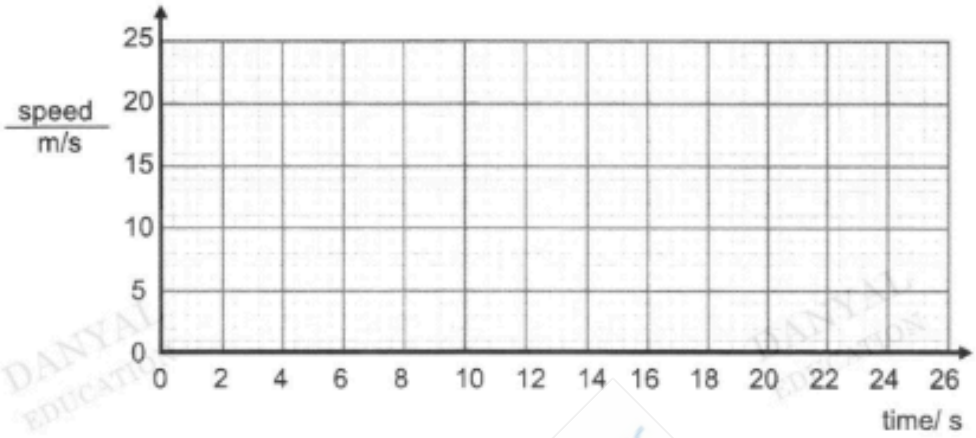


Fig. 14.1

(a) On the grid in Fig. 14.1, plot a graph to show how the speed of the car changes with time. [3]

(b) Calculate

(i) the distance travelled in the first 10 s.

distance = ... [2]

(ii) the energy gained by the car during the first 10 s.

work done = ... [2]

(c) State the driving force when t = 12 s.

driving force = ... [1]

(d) Describe how you would calculate the constant braking force acting on the car in the final 4.0 s of the journey.

.....

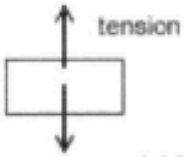
.....[2]

End of Paper 2

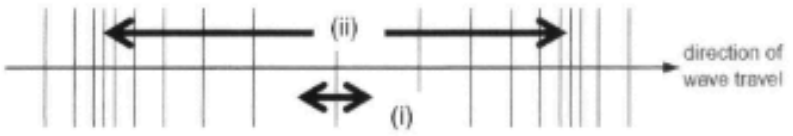
ANSWER SHEET

4E Sci Phy Prelim 2022

21	C	22	D	23	C	24	A	25	A	26	C	27	A	28	A	29	B	30	A
31	C	32	B	33	C	34	B	35	C	36	C	37	C	38	D	39	B	40	A

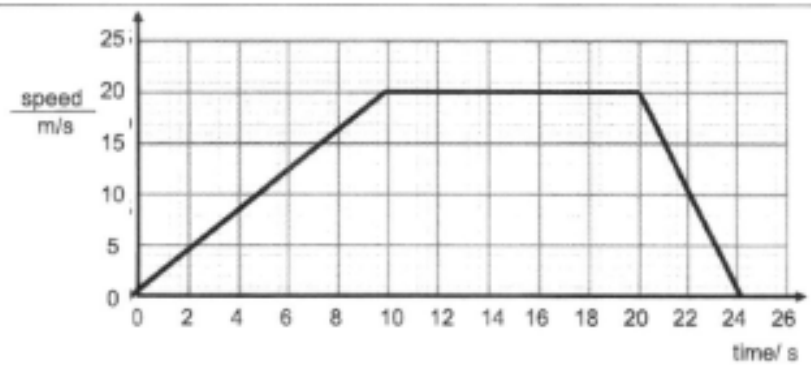
1	a		 Both forces correctly labelled and in correct directions. Many do not know the terminology 'tension'.	[1]
	b		Resultant force, F = ma T – W = 50 x 2 T – 50(10) = 100 T = 600 N Correct substitution of m a give 1m Many just thought the resultant force F is the heavier item.	[1] [1]
2	a	i	moments = F x d = 600 N x 0.3 m = 180 Nm Well done, except for a few who cannot remember the formula	[1]
		ii	Acw=cw 180 = 1.8F F = 100 N Well done, except for a few who cannot remember the concept of Principle of moments	[1] [1]
	b		There is greater force on the sail creating a greater clockwise moment Therefore, the person leans back to increase the distance between his CG and the pivot to obtain a greater anticlockwise moment Quite okie. But shld get students to describe acw, cw instead of saying to balance the moment	[1] [1]
3	a		m(10)(5.0) = ½ mv² [1] v= 10m/s [1] Many used d= sxt formula. Where they somehow use t = 1s.	[1] [1]

			Not many realised this is a Conservation of Energy question.	
	b		1m for a straight line drawn correctly value (10) is not needed , speed m/s 10 time / s Many students didn't realise that it was dropped from rest (fail to read the question properly)	[1]
	c		Area under graph = 5 = ½ (t)(10) [1] t = 1.0 s Badly done Many used d= sxt formula. which can only be used when acceleration = 0 However in this question acceleration is equal to 10 m/s^2	[1] [1]
4	a		The hot air above the fire will rise (as the hot air is less dense) through shaft A. OR Cooler air being denser will move into the mine from the other shaft, shaft B. This set up a convection current which improves the ventilation. Many omitted the mention of density Common mistake: molecules expand / molecules less dense	[1] [1]
	b		This will not work as hot air will rise from both shafts and there is no inlet for the cooler fresh air. Majority could do this	[1]
5	a		a = $\sin^{-1}$(1.6 x sin (90°-60°)) = 53.1° Many thought the angle of incidence is 60° which is wrong Give 1 m if students show understanding that there is angle of incident is 30°	[1] [1]
	b		b = $\sin^{-1}$(1 / 1.6) = 38.7°	[1] [1]

			Quite okie	
	c		From optically denser to less dense medium OR Incident angle is greater than critical angle Quite okie	[1]
6	a		A wavefront is an imaginary line joining adjacent points that are in phase . Many cannot recall the definition	[1]
	b		The water particles in the ripple tank travels in a direction perpendicular to the direction of the wave. Many cannot recall the definition and describe the transverse wave in relation to the question	[1]
	c	i	2.0 cm	[1]
		ii	speed = distance/time = (6 x 2)/4 OR 2/(4/6) = 3.0 cm/s (allow **ecf** from (c)(i)) Or Speed = distance/time = 12/4 =3.0 cm/s Many do not understand the idea of a scaled-drawing.	[1] [1]
		iii	f = v/λ = 3/2 = 1.5 Hz (allow **ecf** from (c)(i) and (ii))	[1]
7	a		U	[1]
	b		Sound wave *requires a medium* while electromagnetic wave does not require a medium for transfer of energy. OR Sound wave is *longitudinal wave* while electromagnetic wave is transverse wave.	[1]
8	a	i ii	 (i) Particles are moving parallel to the direction of wave travel. (double arrow to show) (ii) wavelength from compression to compression	[1] [1]

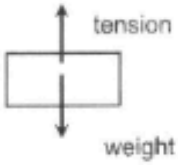
	b		The wavelength of the sound wave will be shorter Since v=fλ and the speed of sound remains the same, when frequency increases, wavelength is shorter.	[1] [1]
9	a		They all have the same charge. Like charges repel.	[1] [1]
	b		This is so that it can attract the positively-charged paint droplets. Unlike charges attract.	[1]
10	a	i	$R=\frac{V}{I}$ $=\frac{5}{2}$ $=2.5\ \Omega$	 [1] [1]
		ii	V=12-5=7.0 V	[1]
	c	iii	4.0 A	[1]
	b		variable resistor / rheostat	[1]
11	a	i	The soft iron and the tacks lose their induced magnetism. Most students could do this	[1]
		ii	Iron. *Will give BOD for answer like nickel and cobalt, but pls warn student that in their syllabus there are only iron (soft magnetic material) and steel (hard magnetic material)*	[1]
	b	i	The tacks retains the magnetism and attracts the soft iron by induction. Most students could do this	[1]
		ii	Steel Most students could do this	[1]
12	a	i	The average speed of the water molecules increases (as the average kinetic energy of the molecules increases due to the increase in temperature) The average separation of the water molecules remains the same	[1] [1]
		ii	The average speed of the water molecules remains the same as temperature remains constant The average separation of the water molecules increases greatly as liquid water changes to the gaseous state	[1] [1]
	b	i	E = Pt = 50 x (10 x 60) = 30000 J	[1] [1]

		ii	Some heat energy is lost to the surrounding instead of being used to heat up the water Thus, more energy is required in reality to change the water into steam .	[1]
	c		Rated current of the heater is I = P/V = 50/240 [1] = 0.208 A [1]. Hence a 13 A fuse might allow excessive current to flow and damage the heater, but it will not blow Or Wire may overheat and catches fire. *(Do not accept if just mention rating is too high)*	[1] [1] [1]
13	a	i	3.0 cm	[1]
		ii	As the object is moved nearer to the lens, the image becomes magnified until it is 3 cm from the lens And/or When it is less than 3 cm from the lens, the image becomes virtual and upright And/or and magnified. and/or the image becomes on the same side of the lens as the object. Any of the 4 underlined: award 4m (the position of the object must be correct for the characteristic mentioned)	[1] [1] [1] [1] [1]
	b	i	3.0×10^8 m/s	[1]
		ii	n = c/v $1.5 = (3 \times 10^8)/v$ $v = 2.0 \times 10^8$ m/s	 [1] [1]
		iii	The speed of red light is the same as the speed of blue light as they are all EM waves which travel at the same speed in vacuum.	[1] [1]

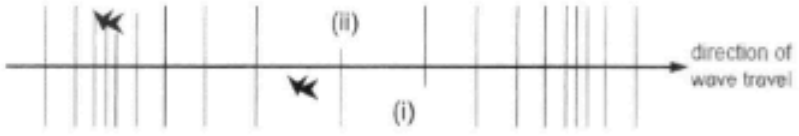
14	a		 Straight line from (0,0) to (10, 20) [1] Horizontal line from end of first line for 10 s [1] Straight line from (20, 20) to (24,0) [1]	[3]
	b	i	distance = area under graph = ½ x 10 x 20 = 100 m	[1] [1]
		ii	gain in KE = 1/2 mv^2 = ½ x 900 x 20^2 = 180 000 J	[1] [1]
	c		2000 N	[1]
	d		Calculate the acceleration (or deceleration) multiplied by the mass of the car, in order to calculate ma As the breaking force + "other opposing forces" = ma Subtract 2000 from ma to find the magnitude of breaking force	[1] [1]

ANS for
4E Sci Phy Prelim 2022

21 C	22 D	23 C	24 A	25 A	26 C	27 A	28 A	29 B	30 A
31 C	32 B	33 C	34 B	35 C	36 C	37 C	38 D	39 B	40 A

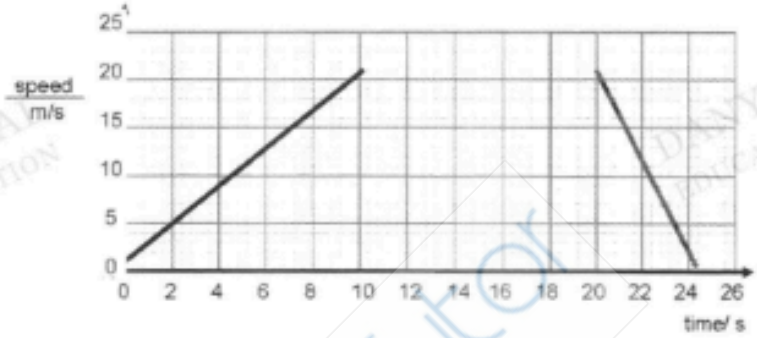
1	a		 Both forces correctly labelled and in correct directions Can accept: Many do not know the terminology "tension" Many also cited (wrongly) air resistance, gravity.	[1]
	b		Resultant force, F = ma T – W = 50 x 2 T – 50(10) = 100 T = 600 N Correct substitution of m,a give 1m Many just thought the resultant force F is the tension itself	[1] [1]
2	a	i	moments = F x d = 600 N x 0.3 m = 180 Nm Well done, except for a few who cannot remember the formula	[1]
		ii	Acw=cw 180 = 1.8F F = 100 N Well done, except for a few who cannot remember the concept of Principle of moment	[1] [1]
	b		There is greater force on the sail creating a greater (clockwise) moment. Therefore, the person leans back to <u>increase the distance between his CG and the pivot</u> to obtain a <u>greater anticlockwise moment</u> Quite okie. But shld get students to describe acw, cw instead of saying to balance the moment	[1] [1]

3	a		m(10)(5.0) = ½ mv² [1] v= 10m/s [1] Many used d= sxt formula. Where they somehow use t = 1s. Not many realised this is a Conservation of Energy question.	[1] [1]
	b		1m for a straight line drawn correctly value (10) is not needed , speed m/s  Many students didn't realise that it was dropped from rest (fail to read the question properly)	[1]
	c		Area under graph = 5 = ½ (t)(10) [1] t = 1.0 s Badly done Many used d= sxt formula. Which can only be used when acceleration = 0 However in this question acceleration is equal to 10 m/s²	[1] [1]
4	a		Hot air expands OR The hot air above the fire will rise (as the hot air is less dense) through shaft A. OR Cooler air being denser will move into the mine from the other shaft, shaft B. This set up a convection current which improves the ventilation. Many omitted the mention of density Common mistake: molecules expand / molecules less dense	[1] [1]
	b		This will not work as hot air will rise from both shafts and there is no inlet for the cooler fresh air. Majority could do this	[1]
5	a		a = $\sin^{-1}$(1.6 x sin (90°-60°)) = 53.1° Many thought the angle of incidence is 60° which is wrong Give 1 m if students show understanding that there is angle of incident is 30° formula , n = sin r/ sin i, also can give 1 m	[1] [1]
	b		b = $\sin^{-1}$(1 / 1.6)	[1]

			= 38.7° Quite okie	[1]
	c		From optically denser to less dense medium OR Incident angle is greater than critical angle Many forgot the conditions for TIR to occur	[1]
6	a		A wavefront is an imaginary line joining adjacent points that are in phase . Many cannot recall the definition	[1]
	b		The water particles in the ripple tank travels in a direction perpendicular to the direction of the wave. Many cannot recall the definition and describe the transverse wave in relation to the question	[1]
	c	i	2.0 cm	[1]
		ii	speed = distance/time = (6 x 2)/4 OR 2/(4/6) = 3.0 cm/s (allow ecf from (c)(i)) Or Speed = distance/time = 12/4 =3.0 cm/s Many do not understand the idea of a scaled-drawing.	[1] [1]
		iii	f = v/λ = 3/2 = 1.5 Hz (allow ecf from (c)(i) and (ii))	[1]
7	a		U	[1]
	b		Sound wave *requires a medium* while electromagnetic wave does not require a medium for transfer of energy. OR Sound wave is *longitudinal wave* while electromagnetic wave is transverse wave.	[1]
8	a	i ii	 (i) Particles are moving parallel to the direction of wave travel. (double arrow to show) Many students just give arrow in one direction. (give mark this time, but warn them in O level the need to have bidirection arrow) (ii) wavelength from compression to compression, must give exact position of middle of compression to middle of next compression	[1] [1]

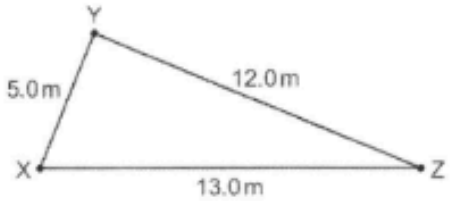
	b		The wavelength of the sound wave will be shorter Since v=fλ and (the speed of sound remains the same,) when frequency increases, wavelength is shorter. Many students scored one mark only and missed out the second point.	[1] [1]
9	a		They all have the same charge. Like charges repel. Mostly well done	[1] [1]
	b		This is so that it can attract the positively-charged paint droplets. Unlike charges attract. Mostly well done	[1]
10	a	i	$R = \frac{V}{I}$ $= \frac{5}{2}$ $= 2.5\ \Omega$ Some students left this answer in fraction. They cannot tell if the circuit is series or parallel.	[1] [1]
		ii	$V = 12 - 5 = 7.0\ V$ Some students just used 12V as the answer.	[1]
	c	iii	4.0 A Many students just gave 2A as the answer or calculated wrongly	[1]
	b		variable resistor / rheostat	[1]
11	a	i	The soft iron and the tacks lose their induced magnetism. Most students could do this	[1]
		ii	Iron. *Will give BOD for answer like nickel and cobalt, but pls warn student that in their syllabus there are only iron (soft magnetic material) and steel (hard magnetic material)*	[1]
	b	i	The tacks retains the magnetism and attracts the soft iron by induction. Most students could do this	[1]
		ii	Steel Most students could do this	[1]
12	a	i	The average speed of the water molecules increases (as the average kinetic energy of the molecules increases due to the increase in temperature) The average separation of the water molecules remains the same Many students stated that the ave separation increased (can accept also)	[1] [1]
		ii	The average speed of the water molecules remains the same as temperature remains constant	[1]

			Many students stated that the average speed increases The average separation of the water molecules increases greatly as liquid water changes to the gaseous state	[1]
	b	i	E = Pt = 50 x (10 x 60) = 30000 J Some students forgot to convert minutes to seconds. Some students did not recognise that the 50W was provided in the question.	[1] [1]
		ii	Some heat energy is lost to the surrounding instead of being used to heat up the water Thus, more energy is required in reality to change the water into steam Most could answer this	[1]
	c		Rated current of the heater is I = P/V = 50/240 [1] = 0.208 A [1]. Hence a 13 A fuse might allow excessive current to flow and damage the heater, but it will not blow Or Wire may overheat and catches fire. *(Accept also if just mention rating is too high), BUT pls caution the student to explain why too high is dangerous, it shld be explained as well* *Most students stated this and thus did not get the mark*	[1] [1] [1]
13	a	i	3.0 cm Many students stated 6 cm as the answer	[1]
		ii	As the object is moved nearer to the lens, the image becomes magnified until it is 3 cm from the lens And/or When it is less than 3 cm from the lens, the image becomes virtual and upright And/or and magnified. and/or the image becomes on the same side of the lens as the object. Any of the 4 underlined: award 4m (the position of the object must be correct for the characteristic mentioned) This was mostly well done	[1] [1] [1] [1] [1]
	b	i	3.0×10^8 m/s Many students left out the unit	[1]
		ii	n = c/v	

			1.5 = (3 x 10^8)/v v = 2.0 x 10^8 m/s Many students left out the unit	[1] [1]
		iii	The speed of red light is the same as the speed of blue light as they are all EM waves/ all light which travel at the same speed in vacuum. Many students left out the second part and so scored just one mark	[1] [1]
14	a		 Straight line from (0,0) to (10, 20) [1] Horizontal line from end of first line for 10 s [1] Straight line from (20, 20) to (24,0) [1] Quite well done, although some students ended at 26 s instead of 24 s	[3]
	b	i	distance = area under graph = ½ x 10 x 20 = 100 m Mostly well done	[1] [1]
		ii	gain in KE = 1/2 mv^2 = ½ x 900 x 20^2 = 180 000 J Poorly done. Many students still cannot use PCE/ COE to solve this.	[1] [1]
	c		2000 N Quite well done. However, some students just put the answer as 0 N as they thought the question was asking for the resultant force.	[1]
	d		Calculate the acceleration (or deceleration) multiplied by the mass of the car, in order to calculate ma As the breaking force + "other opposing forces" = ma Subtract 2000 from ma to find the magnitude of breaking force Many students left out the second part and so scored just one mark	[1] [1]

EDGEFIELD SECONDARY SCHOOL PRELIM PAPER

1 Paths are laid as shown between X, Y and Z.

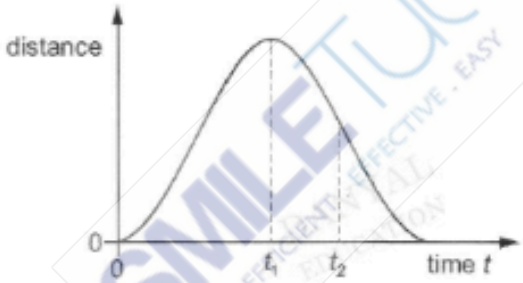


A person walks along the paths from X to Y to Z and then back to X.

What is the value of the total displacement and of the total distance travelled?

	total displacement / m	total distance travelled / m
A	0	0
B	0	30
C	30	0
D	30	30

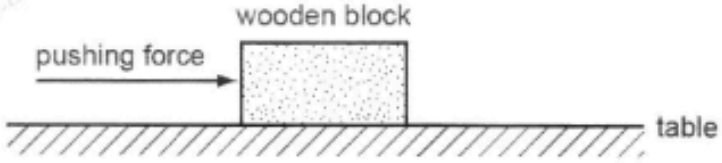
2 A train sets off from a station at time t = 0. The graph shows how the distance between the train and the station varies with time.



Which statement about the motion of the train between t_1 and t_2 is correct?

A Its speed is decreasing and it is moving away from the station.
B Its speed is decreasing and it is moving towards the station.
C Its speed is increasing and it is moving away from the station.
D Its speed is increasing and it is moving towards the station.

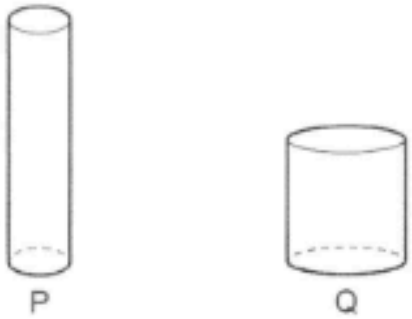
3 A wooden block is pushed across a table at constant speed.



Which statement is correct?

A The frictional force increases as the block moves at constant speed.
B The frictional force is equal and opposite to the pushing force.
C The frictional force is greater than the pushing force.
D The frictional force is less than the pushing force.

4 Two cylinders P and Q are made of copper.

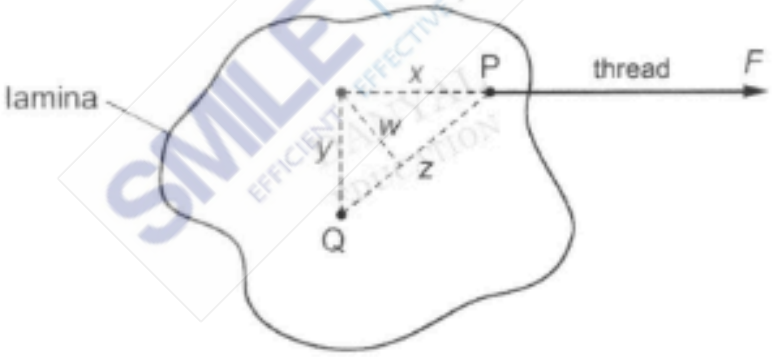


The height of P is twice that height of Q. The diameter of P is half the diameter of Q.

Which statement is correct?

A The density of cylinder P is four times that of cylinder Q.
B The density of cylinder P is twice that of cylinder Q.
C The density of cylinder P is equal to that of cylinder Q.
D The density of cylinder P is half that of cylinder Q.

5 A length of thread is attached to a lamina at point P, as shown in the diagram.



The lamina is free to rotate about point Q.

The tension in the thread is *F*.

What is the moment of *F* about Q?

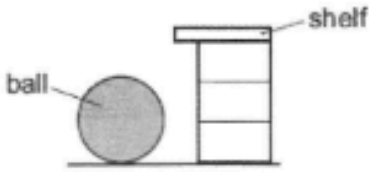
A *Fw** **B** *Fx** **C** *Fy** **D** *Fz*

6 A weightlifter picks up a stone ball and places it on a shelf.

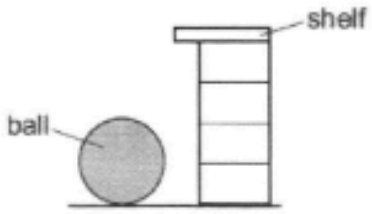
Each lift takes the same time.

Which situation requires the greatest power?

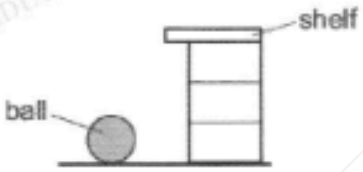
A



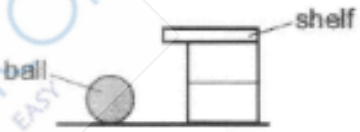
B



C



D



7 A rectangular block of metal has weight 6.0 N and measures 3.0 cm x 4.0 cm x 5.0 cm.

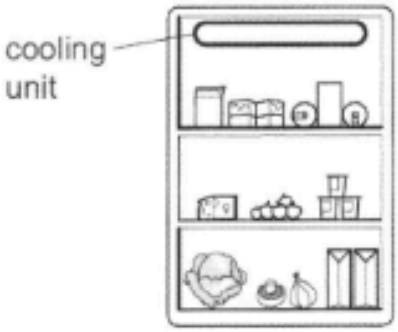
What is the smallest pressure that it can exert when resting on a horizontal surface?

A 0.10 N / cm^2 **B** 0.30 N / cm^2 **C** 0.40 N / cm^2 **D** 0.50 N / cm^2

8 Which statement about water is correct?

A At the boiling point, water vapour molecules have the same kinetic energy as liquid water molecules.
B Evaporation occurs only at boiling point.
C Water molecules become heavier when water freezes.
D Water molecules lose all of their kinetic energy when water freezes.

9 The diagram shows the inside of a refrigerator.



When the refrigerator is first switched on, what happens to the air near the cooling unit?

	air molecules	density of the air
A	become smaller	decreases
B	become smaller	increases
C	move closer together	decreases
D	move closer together	increases

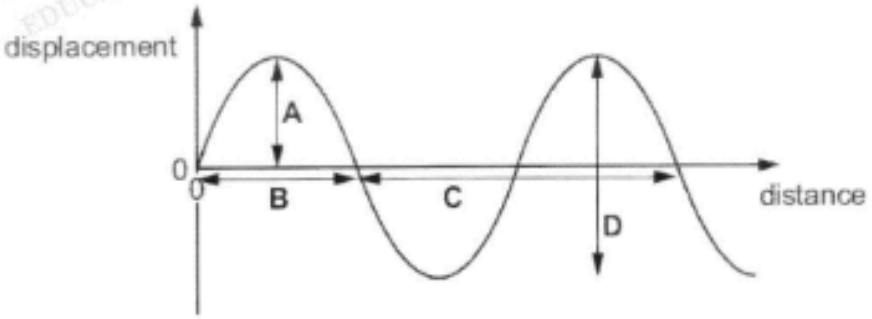
10 The temperature of the water in four beakers are different and areas of the surfaces of the water are also different.

In which beaker is the rate of evaporation of the water greatest?

	temperature of water / °C	surface area of water / cm^2
A	20	50
B	20	100
C	25	50
D	25	100

11 The diagram shows the displacement-distance graph of the particles in a wave.

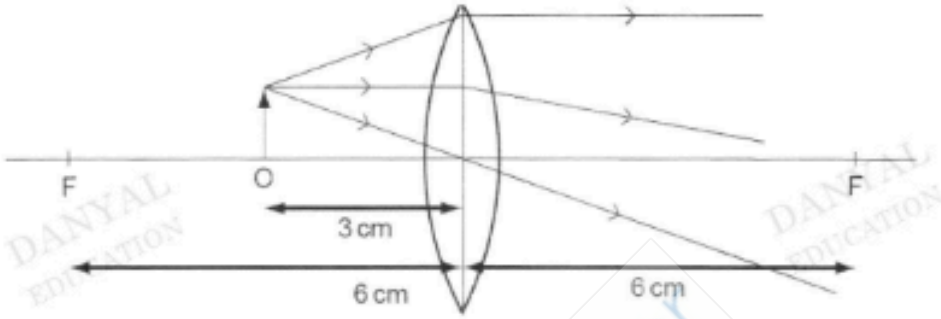
Which value is multiplied by the frequency to give the speed of the wave.



12 Which statement about radio waves is correct?

A Radio waves are sound waves.
B Radio waves are used to kill cancerous cells.
C Radio waves are used in television communications.
D Radio waves have frequencies higher than those of visible light.

13 The diagram shows an object O placed 3 cm away from a converging lens of focal length 6 cm.



What type of image is produced?

A real, erect and diminished
B real, inverted and magnified
C virtual, erect and magnified
D virtual, inverted and diminished

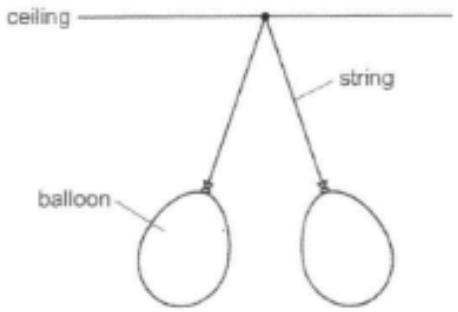
14 A longitudinal wave passes along a spring. The coils of the spring vibrate from side to side.

The diagram shows the positions of the coils at one particular time.

Which positions are one wavelength apart?

A W and X **B** W and Z **C** X and Z **D** Y and Z

15 Two balloons are suspended from the ceiling by string and have moved apart as shown.



Which statement is correct?

A One is charged and the other is uncharged.
B They are uncharged.
C They have like charges.
D They have unlike charges.

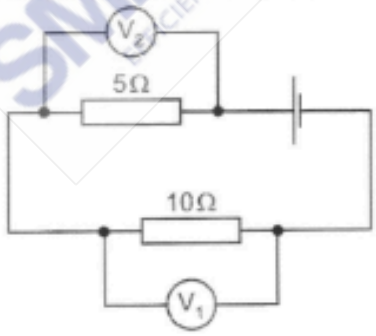
16 A wire of length 0.50 m and cross-sectional area 1.0×10^{-6} m^2 has a resistance of 0.75 Ω.

Another wire of the same material has a length of 2.0 m and a cross-sectional area of 0.50×10^{-6} m^2.

What is the resistance of the longer wire?

A 0.094 Ω **B** 0.38 Ω **C** 1.5 Ω **D** 6.0 Ω

17 Two resistors are connected in a circuit as shown.



The reading on the voltmeter V_1 is 2V.

Which statement is correct?

A The current in the 5 Ω resistor is greater than the current in the 10 Ω resistor.
B The current in the 10 Ω resistor is 20 A.
C The electromotive force of the cell is 3 V.
D The reading of the voltmeter V_2 is 4 V.

18 In a household electrical circuit, why are fuses and switches always placed in the live lead?

A A break in the live wire cuts off the appliance from the voltage supply.
B A break in the neutral wire would not stop current in the circuit.
C The live wire carries a greater current.
D The neutral wire carries no current.

19 Five electrical appliances are connected to the same socket and there is a very large current.

Why is this dangerous?

A The fuses blow in the appliances.
B There is a greater risk of an electrical shock.
C There is overheating in each appliance.
D There is overheating in the socket.

20 Which diagram shows the magnetic field pattern in the region between the N-poles of the two bar magnets?

A

B

C

D

Section A

Answer **all** the questions in the spaces provided.

1 A microphone in a recording studio has a weight W of 5.0 N.

(a) The microphone is suspended from the ceiling by a cord attached to a small ring. Fig. 1.1 shows the microphone pulled to one side and kept stationary by a horizontal thread.

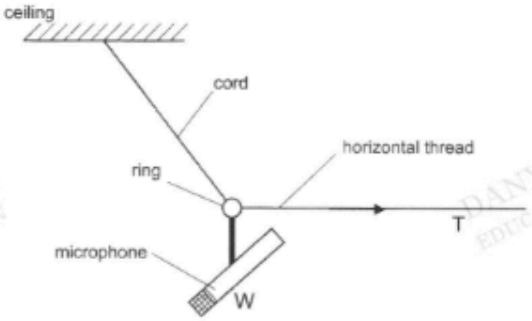


Fig. 1.1 (not to scale)

The tension T in the horizontal thread is 8.0 N.

Determine graphically the magnitude and the direction, relative to the vertical, of the resultant of forces W and T.

magnitude of resultant force = ... N [2]

direction of resultant force = ... [1]

(b) State how the magnitude and direction of the resultant in **(a)** compares with the force on the ring due to the tension in the cord.

(1) magnitude : .....

(2) direction of force on the ring by the cord compared to resultant in **(a)**

..... [1]

2 Fig. 2.1 shows an early water-powered device used to raise a heavy load. The heavy load rests on piston B.

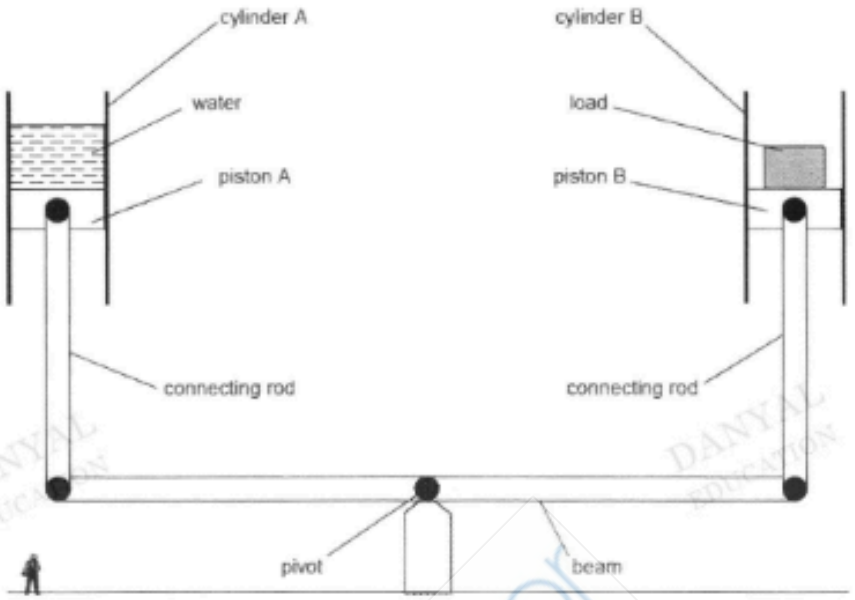


Fig. 2.1

Initially, a large weight of water in cylinder A pushes piston A down. This causes the left-hand end of the beam to move down and the right-hand end of the beam to move up. Piston B rises, lifting the heavy load.

(a) The weight of water in cylinder A is 80 kN.

Calculate the mass of water in cylinder A.

mass of water = ... kg [1]

(b) The density of water is 1000 kg / m^3.

Calculate the volume of water in cylinder A.

volume of water = ... m^3 [1]

(c) Piston A moves down a distance of 4.0 m.

Calculate the gravitational potential energy lost by the water.

gravitational potential energy = ... J [1]

(d) The heavy load lifted by piston B gains 96 kJ of gravitational potential energy.

Given that efficiency = [useful output energy / total input energy] x 100%

Calculate the efficiency of the device in percentage.

efficiency = ... % [1]

3 Fig. 3.1 shows a wooden bench of weight 2000 N.

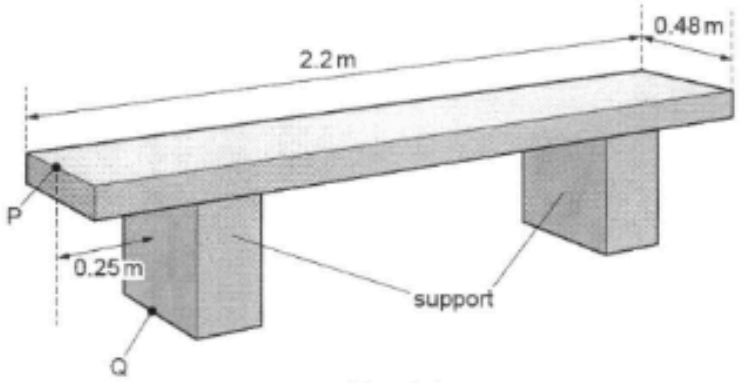


Fig. 3.1

(a) Each of the two supports has an area of 0.040 m^2 in contact with the ground.

Calculate the pressure on the ground due to the bench.

pressure = ... Pa [2]

(b) Given that the wood used to make the bench is uniform with same density.

Explain why this wooden bench is stable and will not topple?

.....

.....

.....[1]

(c) There is a force exerted vertically downwards from point P shown in Fig. 3.1.

Calculate the maximum force that can be exerted vertically downwards at P without the bench rotating about the point Q shown in Fig. 3.1.

maximum force = ... N [2]

4 Fig 4.1 shows a water wave passing a floating log. The log is stationary.

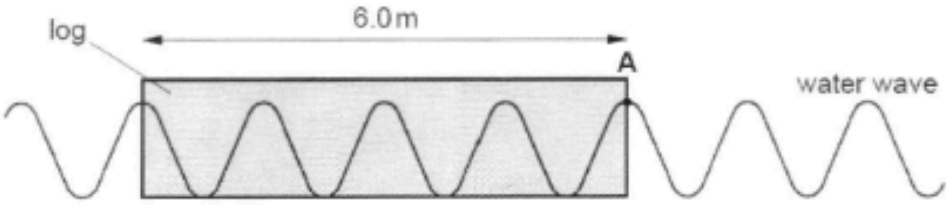


Fig. 4.1

The log is 6.0 m long and 5 complete waves take 10 seconds to pass point A.

Determine

(a) the wavelength of the water waves,

wavelength = ... m [1]

(b) The period of the water waves,

period = ... s [1]

(c) the frequency of the water waves,

frequency = ... Hz [1]

(d) the speed of the water waves.

speed = ... m / s [1]

5 Fig 5.1 shows a light ray in air, incident on the side of a rectangular glass block at an angle of 60°.

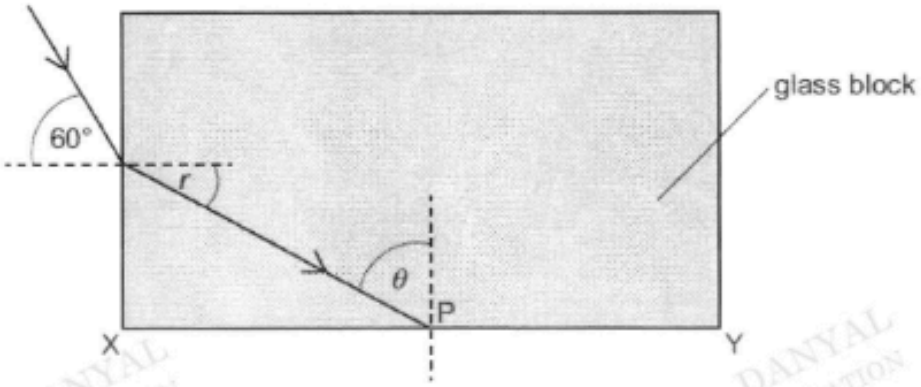


Fig. 5.1

The refractive index of the glass is 1.5. The light travels in the glass and is incident on side XY at P.

(a) State a similarity and a difference between light and sound waves.

similarity :
.....
..... [1]

difference : .....
..... [1]

(b) At the point where the light enters the glass, the angle of refraction is *r*.

Calculate angle *r*.

r = ...° [1]

(c) **(i)** Calculate the critical angle *c* for light travelling in the block.

critical angle *c* = ...° [1]

(ii) At P, the angle Θ between the ray and the normal is given by Θ = 90° – r.

State and explain what happens to the light when it is incident on side XY.

.....

.....

..... [2]

(d) Given the speed of light in the air is 3.0×10^8 m / s.

Calculate the speed of light in the glass block.

speed of light in glass = ... m / s [1]

6 A plastic rod is rubbed with a cloth and becomes negatively charged as shown in Fig. 6.1.

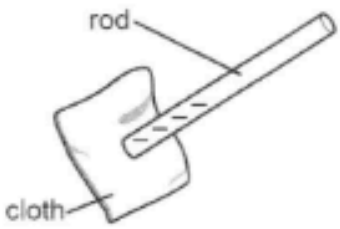


Fig. 6.1

(a) Explain how the rod becomes negatively charged when rubbed with a cloth.

.....

..... [2]

(b) An uncharged metal-coated sphere hangs from an insulating thread. The negatively-charged rod is brought near the sphere. The sphere is attracted to the rod, as shown in Fig. 6.1.

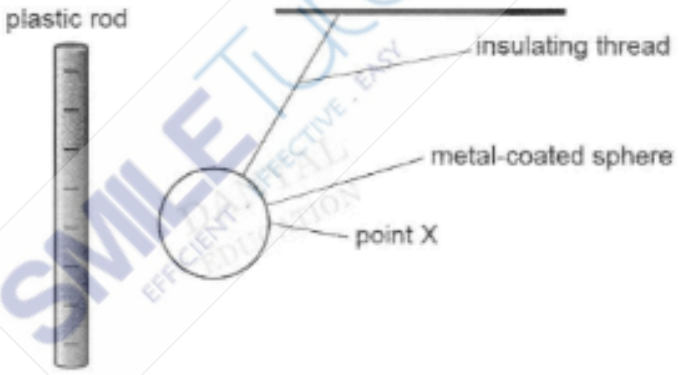


Fig. 6.2

(i) Draw on Fig. 6.2 how charge is distributed on the sphere when the negatively-charged rod is near. [1]

(ii) Describe and explain why the uncharged sphere is attracted to the negatively-charged rod.

.....

.....

..... [2]

(c) With the charged rod still close to the sphere, point X on the metal-coated sphere is earthed by connecting the sphere with a copper wire to the ground.

Describe and explain what happens to the charges in the metal-coated sphere as it is earthed and what is the net charge on the sphere.

.....

.....

..... [2]

7 A student sets up the circuit shown in Fig. 7.1.

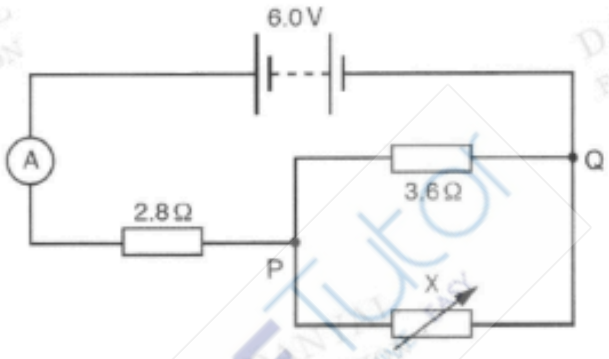


Fig. 7.1

The electromotive force (e.m.f) of the battery is 6.0 V.

(a) The resistance of the variable resistor X is set to 1.8 Ω

Determine

(i) the total resistance of the circuit,

resistance = ... Ω [2]

(ii) the current measured by the ammeter.

current = ... A [2]

(b) The resistance of X is increased.

Explain why the p.d. across the 2.8 Ω resistor changes.

.....

.....

..... [2]

(c) A a piece of copper wire of negligible resistance is connected to point P and Q. Determine the current measured by the ammeter.

current = ... A [1]

8 Fig. 8.1 is the view from above a small compass on a laboratory bench.

Fig. 8.1

Fig. 8.2 is the view from above of a stationary magnet on the same laboratory bench with three small compasses placed around the magnet.

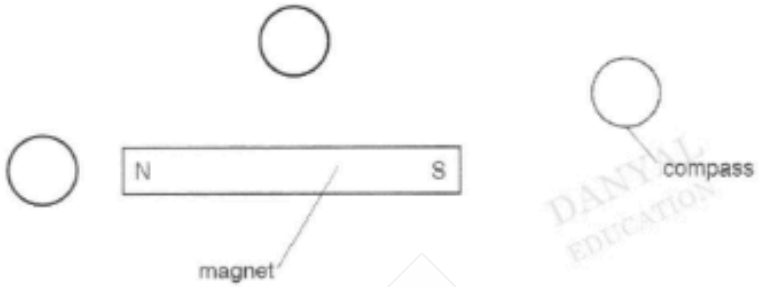


Fig. 8.2

(a) State the material from which the compass needle in Fig. 8.1 is made.

..... [1]

(b) On Fig. 8.2, the compasses are placed within the magnetic field of the magnet. Sketch the positions of the compass needles. [2]

(c) An unmagnetized iron bar PQ is placed near to the magnet on the laboratory bench.

Fig. 8.3 shows the two poles of the magnet and PQ.

Fig. 8.3

The iron bar is initially at rest and the magnet is moved to the right very slowly. When the magnet is at a short distance from the iron bar, the iron bar moves very quickly to the left towards it.

Explain why the iron bar is attracted to the magnet.

.....

.....

.....[1]

9 Fig 9.1 shows a horizontal, current carrying wire PQ in the gap between the permanent magnet.

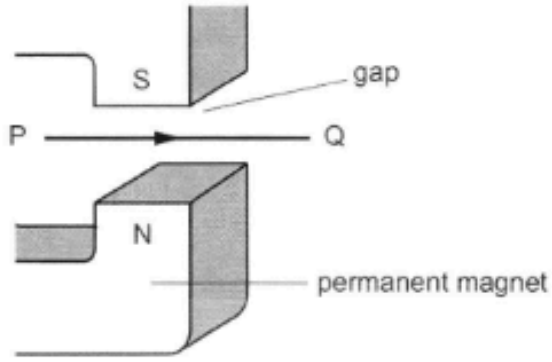


Fig. 9.1

(a) There is a magnetic field in the gap between the N pole and the S pole.

The current in PQ is from left to right.

Indicate on Fig 9.1, with an arrow, the direction of the force acting on the wire PQ. [1]

(b) State the effect on wire PQ of increasing the strength of the magnetic field in the gap by using stronger magnet.

.....

..... [1]

(c) State one modification that can be made to reverse the direction of the force.

.....

..... [1]

Section B

Answer any **two** questions from this section in the spaces provided.

10 When a car driver sees an emergency ahead, he applies the brakes. During his reaction time the car travels at a steady speed and covers a distance known as the thinking distance. The braking distance is the distance travelled by the car after the brakes are applied.

Fig. 10.1 shows the speed-time graph of the car.

The driver sees the emergency at time t = 0.
The total mass of the car is 800 kg.

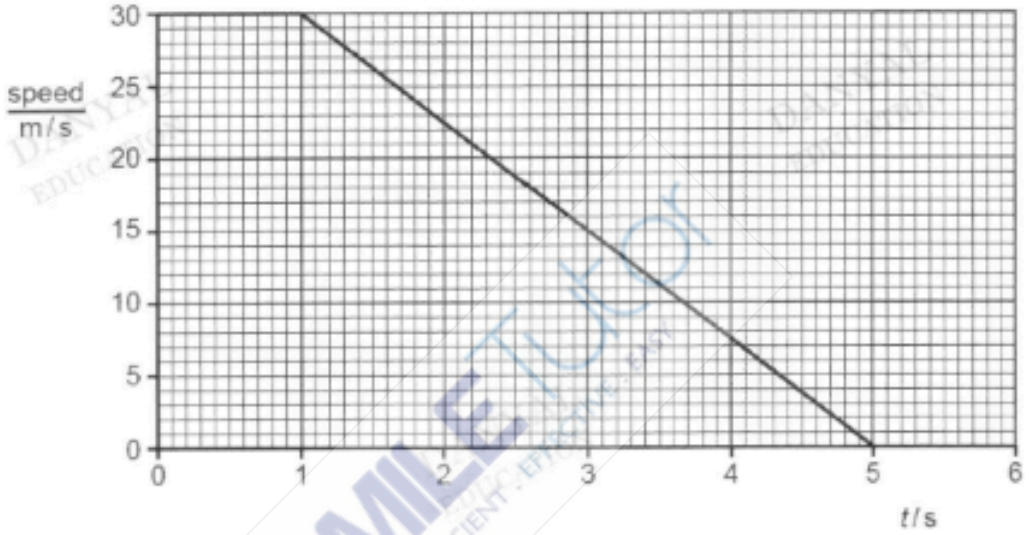


Fig. 10.1

(a) State the energy change that occurs as the car brakes.

..... [1]

(b) Determine

(i) the thinking distance,

thinking distance = ... m [1]

(ii) the braking distance,

braking distance = ... m [1]

(iii) the total stopping distance,

stopping distance = ... m [1]

(iv) the deceleration of the car during braking,

deceleration = ... $m\ s^{-2}$ [2]

(v) the force provided by the brakes.

force = ... N [2]

(c) Using ideas about friction and deceleration, state and explain how the braking distance is affected by

(i) using new tyres rather than badly worn tyres,

.....

..... [1]

(ii) the car carrying a heavy load of passengers.

.....

.....

..... [1]

11 A student places a small electrical heater inside a cup of water, as shown in Fig. 11.1.

Fig. 11.1

(a) The student determines the electrical power of the heater

On the space above the cup in Fig. 11.1, draw the electrical circuit that the student uses. Include an *ammeter* to measure the current through the heater, a *voltmeter* to measure the potential difference across the heater and a *power supply*. [2]

(b) The voltage of the power supply is 12 V and the current is 4.2 A.

(i) Calculate the electrical power input to the heater.

power = ... W [1]

(ii) Calculate the energy input to the heater in 120 minutes. Give your answer in kWh.

energy = ... kWh [2]

(iii) Given that the cost per unit of electrical energy is $0.28. Calculate the cost of operating this heater for 120 minutes.

cost = ... [1]

(c) During heating, the students notices that some water evaporates from the cup.

(i) Describe, using ideas about molecules of water, what happens during evaporation.

.....

.....

..... [1]

(ii) The student finds that the amount of evaporation increases when the temperature of the water is higher.

State one other factor that increases the amount of evaporation.

..... [1]

(d) The student turns off the power supply and the water cools.

Describe and explain how convection in the air causes the water to cool.

.....

.....

..... [2]

12 Fig. 12.1 shows an alarm system in which the switch is shown closed.

The top circuit is arranged so that the electromagnet is positioned over the soft iron contact.

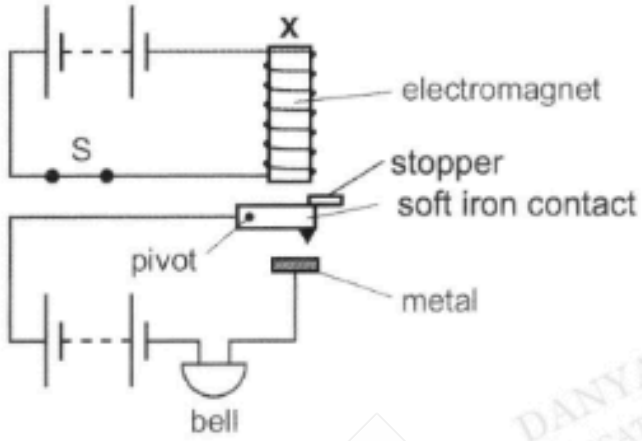


Fig. 12.1

(a) When the switch is closed as shown in Fig. 12.1, indicate the pole at the top of the electromagnet, **X**.

pole at **X** = ... [1]

(b) Describe and explain what happens when the switch S is opened.

.....

.....

..... [2]

(c) If when S is closed and the electromagnet is not strong enough to maintain the position of the iron contact as shown in Fig. 12.1, suggest **one** modification that can be made to the circuit.

.....

..... [1]

(d) Fig. 12.2 shows the enlarged view of the uniform iron contact.

Given that the mass of the iron contact is 100 g.

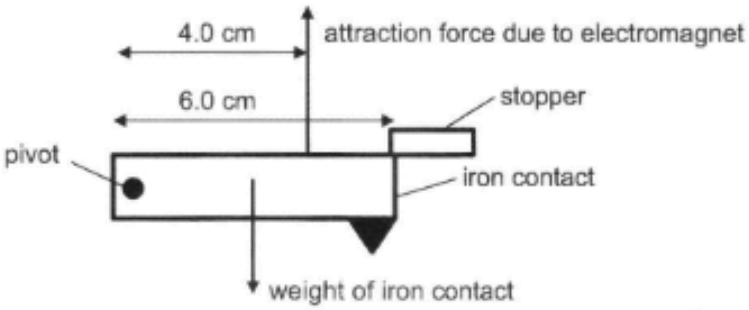


Fig. 12.2

(i) Calculate the weight of the iron contact. Take g = 10 N / kg.

weight = ... [1]

(ii) Indicate with an arrow and label F_s on Fig. 12.2, the force acting on iron contact by the stopper. [1]

(iii) Given that the attraction force due to the electromagnet is 5.0 N, calculate the force acting on the iron contact by the stopper F_s.

force F_s = ... [2]

(e) If a technician accidentally replaced the iron contact with a steel contact, will the system work? Explain.

.....

.....

..... [2]

End of paper

ANSWER SHEET

MCQ [20 marks]

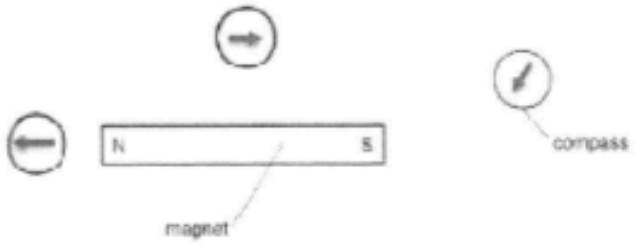
	1	2	3	4	5	6	7	8	9	10
Answer	B	D	B	C	C	B	B	A	D	D
Question	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Answer	C	C	C	D	C	D	C	A	D	B

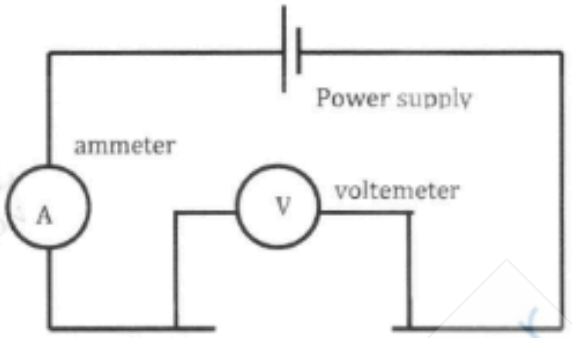
SECTION A [65 marks]

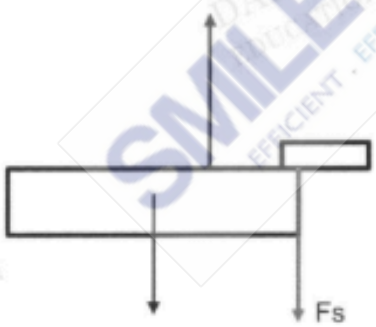
Q No.	Solutions	Marks	Remarks
1a	Scale: 1 cm : 1 N Magnitude of resultant = 9.3 N to 9.6 N Direction of resultant force = 38.7° from 8 N (36 to 40°) OR = 52° from 5N (50 to 53° 	1 1 1	1 m for resultant 1 m for vector diagram
b	1. Magnitude = same constant 2. Opposite to resultant	1	
2a	W = mg 80 000 = m x 10 m = 8000 kg	1	
b	D = m/V 1000 = 8000 / V V = 8.0 m^3	1	
c	Lost in PGE = mgh = 8000 x 10 x 4 = 320 000 J	1	
d	Efficiency = (96 / 320) x 100 = 30%	1	
3a	P = F/A = 2000 / 2(0.040) = 25 000 Pa	2	

b	So that the weight of the bench which acts vertically down from the centre of gravity is within the area of base, so won't topple / will be stable OR So that the CG is within the area of base, so won't topple / will be stable	1	
c	Using POM Ma = Mc P x 0.25 = 2000 x 0.85 P = 6800 N	 1 1	
4a	Wavelength = 6.0 / 4 = 1.5 m	1	
b	Period T = 10 / 5 = 2.0 s	1	
c	f = 1/T = ½ = 0.50 Hz	1	
d	V = f x wavelength = 0.5 x 1.5 = 0.75 m/s	1	
5a	Similar: both carries energy from one place to another / both obey wave equation etc Difference: light is a transverse wave while sound is a longitudinal wave / light can pass through vacuum while sound cannot transmit in vacuum / it requires a medium / speed of light is much faster than sound in air.	1 1	
b	n = sin i/sin r 1.5 = sin 60 / sin r r = 35.26 = 35.3° or 35°	1	
ci	n = 1 / sin c 1.5 = 1 / sin c c = 41.81 = 41.8° or 42°	1	
ii	Total internal reflection occurs. As i > c and light is travelling from an optical denser medium (glass) towards an optical less dense medium (air)	1 1	
d	n = c / v 1.5 = 3.0x10^8 / v v = 2.0 x 10^8 m/s	1	

6a	Due to charging by friction, there is a transfer of electrons from cloth to rod. The rod gains electrons and have excess electrons, hence net negatively charged.	1 1	
bi	Clear + and – signs on the sphere left and right surface. Left surface is positively charged Right surface is negatively charged Equal no of positive and negative charges	1	
ii	When the negatively rod is brough near the sphere, some electrons in the sphere are repelled to right hand side as like charges repel. The right hand side will be induced negatively while the left hand side will be induced positively. (induction) Since the attraction force due to unlike charges is greater than the repulsion due to like charges, there is a net attraction force, hence sphere is attracted to the rod.	1 1	
c	When the wire is connected to the sphere, the excess electrons on the right hand side will move down the wire into the ground. The sphere will now have net positive charge.	1 1	
7ai	$R = 2.8 + (1/3.6 + 1/1.8)^{-1}$ $= 2.8 + 6/5 = 4.0\ \Omega$	1 1	
ii	$I = V/R = 6.0 / 4.0$ $= 1.5\ A$	1 1	
b	As X increases, the total resistance across PQ increases, the total resistance of the circuit increases. Hence current in through 2.8 Ω resistor decreases. As V = IR, hence p.d across it decreases.	1 1	
c	$I = V/R = 6.0 / 2.8 = 2.14\ A$	1	

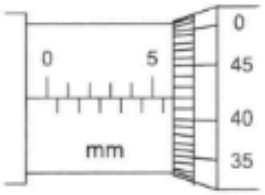
8a	Steel	1	
b		2	
c	Due to magnetic induction, the iron bar becomes an induced magnet and the side P will be induced north. Since unlike poles attract, the iron bar is attracted to the magnet. (since the attraction force due to unlike poles is greater than the repulsion force due to like poles, there is a net attraction force)	1	
9a	Arrow drawn out of paper		
b	Greater force / PQ moves further out	1	
c	Reverse the current by swopping the terminals Reverse the direction of magnetic field by swopping the poles (any one)	1	
	SECTION B [20 marks]		
10a	Kinetic energy of the car to heat and sound energy	1	
bi	Thinking distance = 30 x 1 = 30 m	1	
ii	Braking distance = ½ x 4 x 30 = 60 m	1	
iii	Stopping distance = 60 + 30 = 90 m	1	
iv	$a = (v-u)/t = (0 - 30)/4 = -7.5\ ms^{-2}$ Deceleration $= 7.5\ ms^{-2}$	1 1	
v	F = ma = 800 x 7.5 = 6000 N	1 1	
ci	New tyres have more friction, so braking force and the deceleration will be greater and car stops in a shorter	1	

	distance.		
ii	With more passengers, there is more mass. F = ma, the deceleration will be smaller, hence longer stopping distance. OR More mass, more interia, so takes a longer distance to stop.	1	
11a		2	
bi	P = IV = 4.2 x 12 = 50.4 W	1	
ii	E = Pt = 0.0504 x 2 hr = 0.1008 kWh = 0.10 kWh	1 1	
iii	Cost = 0.1008 x $0.28 = $0.028224 = $0.028	1	
ci	Water molecules are in random and continuous motion. Those water molecules which at the surface and have enough kinetic energy to break the intermolecular forces is able to escape into the atmosphere.	1	
ii	Motion of air (wind) Higher temperature of water Lower atmosphere pressure Use a cup with bigger exposed surface area.	1	

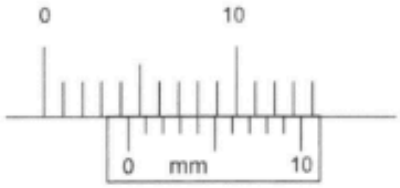
d	Thermal energy is transferred from the water to the air at the surface. The air around the surface of water gets heated up, expands, becomes less dense and rises. The cooler denser air comes in from the side to replace the rising warm air. This creates a convection current and the water cools down.	1 1	
12a	Pole at X = South pole	1	
b	When the switch is open, current is cut off and the electromagnet demagnetised. The iron contact will fall/rotate clockwise due to its weight. The iron contact will touch the metal and the circuit is closed and the bell rings.	1 1	
c	Increase number of turns in the solenoid. Increase the size of the current through electromagnet by increasing the emf of cells Shift the lower circuit higher / iron contact higher	1	
di	W = mg = 0.1 x 10 = 1.0 N	1	
ii		1	
iii	Ma = Mc 5 x 4.0 = 1 x 3 + Fs x 6 Fs = 2.83 N	2	
e	Steel is a hard magnetic material. When it magnetised by the electromagnet, it retains its magnetism. So when the switch S is open, the iron contact will still be attracted by the electromagnet due to magnetic induction. Hence the bell circuit will still be open and the bell will not ring.	1 1	

COMPASSVALE SECONDARY SCHOOL PRELIM PAPER

1 The diagrams show part of a micrometer screw gauge and a vernier scale.



micrometer screw gauge



vernier caliper

What are the readings shown?

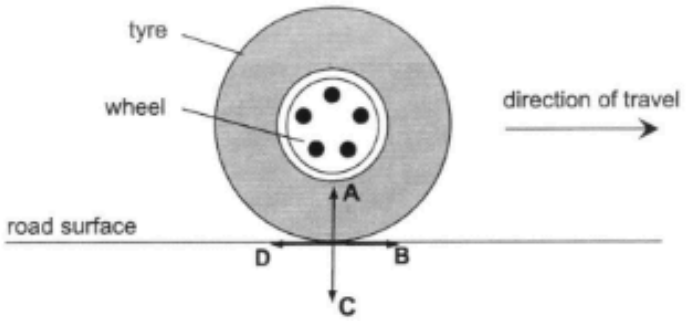
	micrometer scale reading / mm	vernier scale reading / mm
A	5.42	3.4
B	5.42	4.4
C	5.92	3.4
D	5.92	4.4

2 What is the order of magnitude for the diameter of an atom and for the diameter of the Earth?

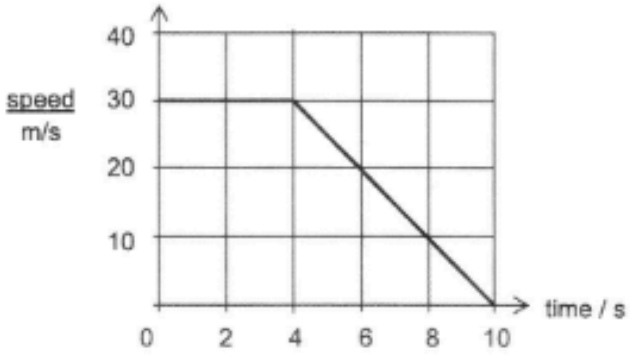
	diameter of atom	diameter of Earth
A	0.1 nanometres	10 megametres
B	0.1 nanometres	10 gigametres
C	0.1 micrometres	10 megametres
D	0.1 micrometres	10 gigametres

3 A car is accelerating along a road in the direction shown. The wheel shown is connected to the engine.

In which direction is the force of friction exerted by the road on the car tyre?



4 The speed-time graph shows a motorcycle travelling at a steady speed before decelerating uniformly to a stop.



What is the average speed of the motorcycle over the 10 s?

A 15 m/s
B 21 m/s
C 30 m/s
D 210 m/s

5 A brick is brought from Earth to the surface of the Moon.

Given that the gravitational field strength of the Moon is 1.6 N/kg, how will the properties of the brick change?

	inertia	weight	density
A	decreases	increases	remains unchanged
B	decreases	increases	increases
C	remains unchanged	decreases	decreases
D	remains unchanged	decreases	remains unchanged

6 Student A lifts a box weighing 40 N from the floor to a height of 0.80 m in 4.0 s.
Student B lifts another box weighing 60 N from the floor to a height of 0.50 m in 2.0 s.

Compared to student A, student B does

A less work but exerts more power.
B more work but exerts less power.
C the same work but exerts more power.
D the same work but exerts less power.

7 Which statement is correct?

A In a gas, the kinetic energy of the molecules increases with decreasing temperature.
B In a liquid, the molecules move around one another.
C The molecules in a liquid are further apart than in a gas.
D The molecules in a liquid are closer together than in a solid.

8 Boiling and evaporation are different processes.

Which statement is **not** correct?

A Boiling occurs throughout the entire liquid but evaporation only occurs at the surface.
B Evaporation can only occur when the temperature of the liquid is high enough.
C Evaporation causes the temperature of a liquid to fall.
D When a boiling liquid is heated its temperature remains constant.

9 What is meant by the amplitude of a wave?

A the average displacement from the equilibrium position
B the instantaneous displacement from the equilibrium position
C the maximum displacement from the equilibrium position
D the minimum displacement from the equilibrium position

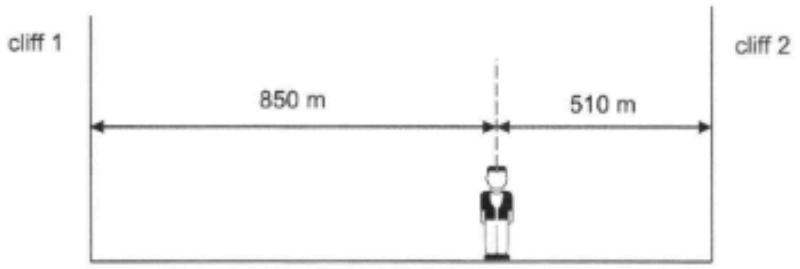
10 Which row correctly lists the applications of parts of the electromagnetic spectrum?

	microwaves	infra-red radiation	gamma rays
A	cooking	cancer treatment	television controller
B	sunbed	television controller	sterilisation
C	satellite television	toaster	cancer treatment
D	telecommunications	sterilisation	security inspections

11 Which statement about microwaves and ultra-violet radiation is correct?

A They travel at about 330 m/s in air.
B They travel as longitudinal waves in air.
C Ultra-violet radiation does not obey the law of reflection but microwaves do.
D Ultra-violet radiation has a higher frequency than microwaves.

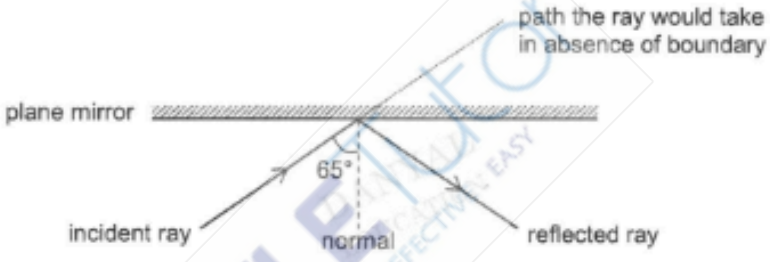
12 A man stands between 2 cliffs as shown in the diagram and claps his hands once.



Assuming that the velocity of sound in air is 340 m/s, what will be the time interval between the 2 loudest echoes?

A 0.17 s **B** 0.33 s **C** 1.0 s **D** 2.0 s

13 A ray of light incident on a plane mirror will change direction when it is reflected.



What is the change in direction of the ray?

A 50°
B 65°
C 130°
D 155°

14 When a plastic rod is rubbed with a duster, the plastic rod becomes negatively charged and the duster positively charged.

Which of the following correctly explains the charges on the plastic rod and the duster?

	plastic rod	duster
A	gained electrons	lost electrons
B	lost protons	gained protons
C	lost electrons	gained electrons
D	lost protons	lost electrons

15 The diagram shows a negatively charged polythene strip and a positively charged acetate strip that are freely suspended.

polythene strip acetate strip

Two rods X and Y are brought in turn to these two strips.
Rod X attracts both the polythene strip and the acetate strip.
Rod Y attracts the polythene strip but repels the acetate strip.

Which type of charge is on each rod?

	rod X	rod Y
A	negative	positive
B	positive	negative
C	uncharged	negative
D	uncharged	positive

16 A charge of 150 C flows through an electric appliance in 2.0 minutes.

What is the average current in the appliance?

A 0.013 A
B 1.25 A
C 75 A
D 300 A

17 A wire of length 1.8 m and a cross-section of 3.0×10^{-6} m^2 has a resistance of 1.2 Ω. Another wire of the same material has a length of 0.90 m and a cross-sectional area of 1.0×10^{-6} m^2.

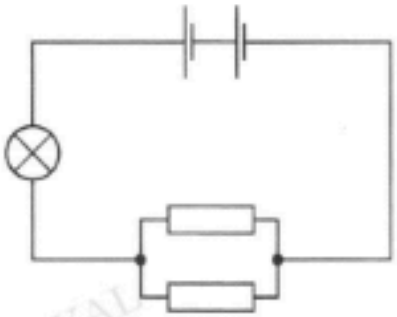
What is the resistance of the shorter wire?

A 0.20 Ω
B 0.80 Ω
C 1.8 Ω
D 7.2 Ω

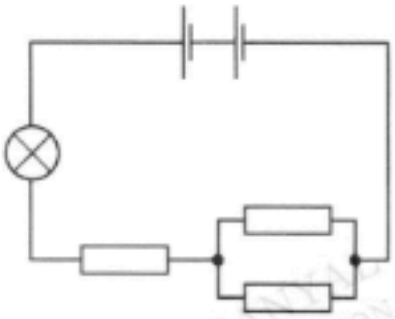
18 A lamp is connected in four circuits, each using identical batteries. The resistors are all identical.

In which circuit will the lamp be brightest?

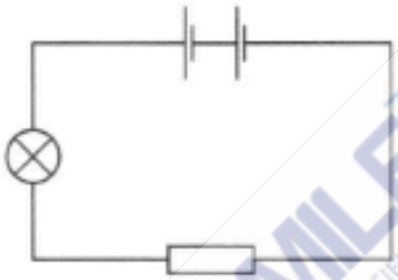
A



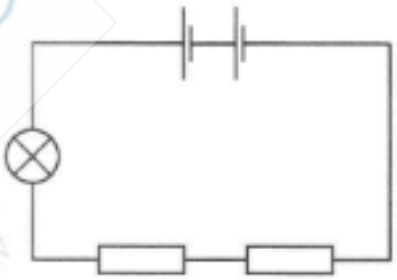
B



C



D



19 A kitchen hood is controlled by one switch. The unit contains a 0.80 kW fan and a 50 W lamp.

In one week, the lamp uses 0.60 kWh of electrical energy.

How much electricity is used by the fan alone?

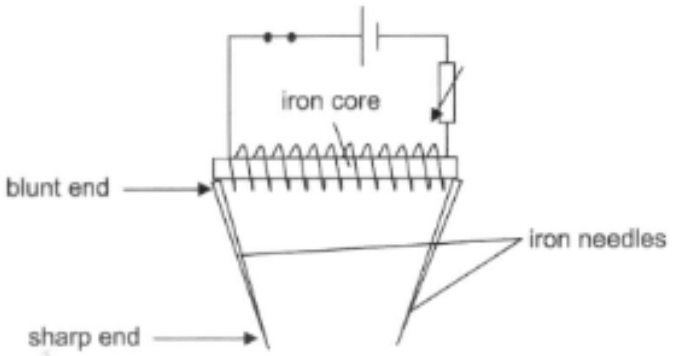
A 0.063 kWh

B 0.80 kWh

C 9.6 kWh

D 12 kWh

20 The figure shows a coil of insulated wire around an iron core.
Two iron needles hang from the ends of the iron core and are inclined towards each other as shown.



Which statement is correct?

A The blunt ends of both needles are north poles.
B The needles have become permanently magnetised.
C The needles are induced magnets.
D The sharp ends of both needles are north poles.

21 Which apparatus is most suitable for collecting 25.0 cm^3 of fluorine at room temperature?

A burette
B gas syringe
C measuring cylinder
D pipette

22 The melting and boiling points of two substances X and Y are shown.
Substances X and Y are miscible liquids.

substance	melting point / °C	boiling point / °C
X	5.5	80
Y	–95	110

Which method is most suitable to separate substances X and Y?

A crystallisation
B filtration
C fractional distillation
D simple distillation

23 Which statements about the Kinetic Particle Theory are correct?

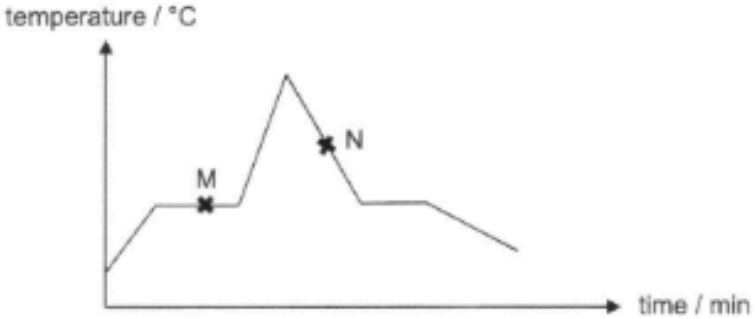
1 In gaseous state, particles are far apart and moving in random directions.

2 Particles in solid state have lower kinetic energy than particles in liquid state.

3 During boiling, particles gain energy and break free from their fixed positions.

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

24 A solid substance is heated to melt and cooled as shown in the diagram.



What are the physical states of the substance at M and N?

	M	N
A	liquid	liquid + solid
B	liquid + solid	liquid
C	liquid + solid	solid
D	solid	liquid + solid

25 A solution of lead(II) nitrate is tested with different reagents.

Which row gives the correct observation?

	test	observation
A	aqueous ammonia added	white precipitate formed, soluble in excess
B	aqueous sodium hydroxide added	white precipitate formed, soluble in excess
C	aqueous sodium hydroxide added	effervescence observed
D	dilute nitric acid added	effervescence observed

26 An element X forms an ion X^{2-}.

Which group of the Periodic Table is this element found in?

A Group I
B Group II
C Group VI
D Group VII

27 The chemical formula of the compound formed by P and Q is PQ_2.

Both P and Q are non-metals.

What is the correct electronic configuration of P and Q?

	P	Q
A	2.2	2.7
B	2.4	2.6
C	2.8.1	2.6
D	2.8.6	2.1

28 Potassium chlorate has the formula $KClO_3$.

What is the chemical formula of copper(II) chlorate?

A $CuClO_3$
B Cu_2ClO_3
C $Cu_3(ClO_3)_2$
D $Cu(ClO_3)_2$

29 A solution of nitric acid is made by dissolving 31.5 g of HNO_3 in 200 cm^3 of water.

What is the concentration, in mol/dm^3, of this solution?

A 0.0025 mol/dm^3
B 0.1575 mol/dm^3
C 2.5 mol/dm^3
D 157.5 mol/dm^3

30 A student adds an aqueous solution of sodium hydroxide to a solution of dilute hydrochloric acid. The reaction is exothermic.

Which row shows the direction of heat flow and the change in temperature for this reaction?

	temperature change	direction of heat flow
A	fall	from surroundings
B	fall	to surroundings
C	rise	from surroundings
D	rise	to surroundings

31 Copper(II) oxide is added to excess dilute nitric acid.

The equation for the reaction is shown.

$$CuO(s) + 2HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + H_2O(l)$$

Which change in the conditions will increase the speed of reaction?

A decrease the concentration of nitric acid
B decrease the volume of nitric acid
C increase the particle size of copper(II) oxide
D increase the temperature

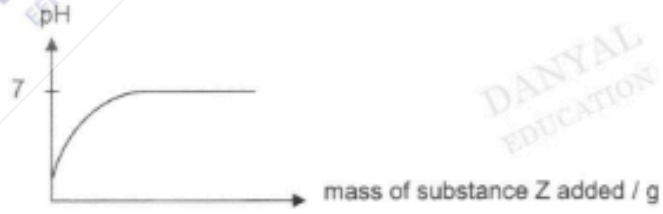
32 Part of some chemical reactions are shown.

Which reaction represents reduction?

A $2Cl^- \rightarrow Cl_2 + 2e^-$
B $H^+ + OH^- \rightarrow H_2O$
C $Na^+ + Cl^- \rightarrow NaCl$
D $Fe^{3+} + e^- \rightarrow Fe^{2+}$

33 Substance Z is an insoluble solid. Excess substance Z is added into a beaker of dilute hydrochloric acid.

The pH of the reaction mixture is measured and shown.



What is substance Z?

A calcium hydroxide
B magnesium carbonate
C potassium oxide
D silver chloride

34 Some information about oxides of T and U are given.

	reacts with acid to form salt and water	reacts with base to form salt and water
oxide of T	✓	×
oxide of U	×	×

What type of oxides are oxides of T and U?

	T	U
A	acidic	amphoteric
B	amphoteric	acidic
C	basic	neutral
D	neutral	basic

35 Which salt requires pipette and burette in its preparation?

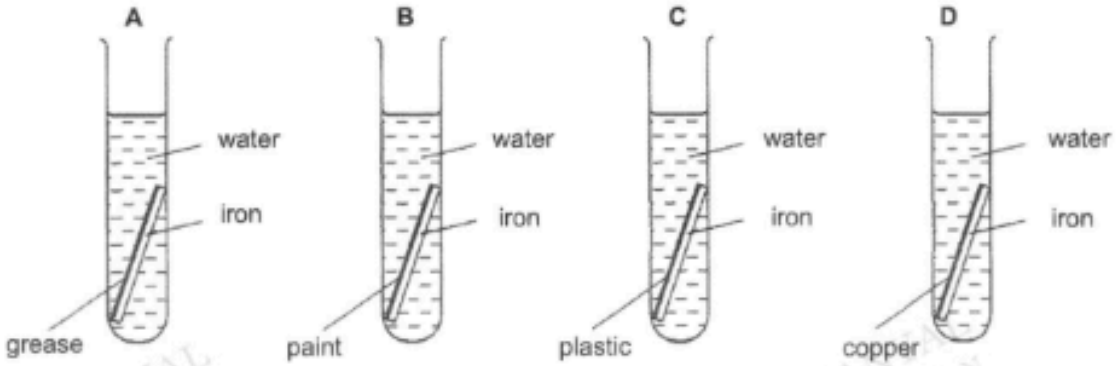
A ammonium chloride
B barium sulfate
C lead(II) chloride
D zinc nitrate

36 Which row about bromine is correct?

	state at room temperature	colour	displacement reactions
A	liquid	red-brown	displaces chlorine from chlorides
B	liquid	red-brown	displaces iodine from iodides
C	solid	brown	displaces chlorine from chlorides
D	solid	brown	displaces iodine from iodides

37 Identical pieces of iron are placed in four different test-tubes.

In which test-tube will the iron rust?



38 Two statements were made about acid rain.

Statement 1: The burning of fossil fuels containing sulfur is a cause of 'acid rain'.

Statement 2: Acid rain is formed from sulfur dioxide which is produced when sulfur compounds burn.

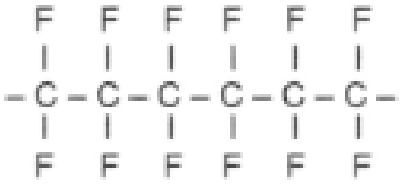
Which of the following is true?

A Both statements are correct and statement 2 explains statement 1.
B Both statements are correct but statement 2 does not explain statement 1.
C Statement 1 is correct but statement 2 is incorrect.
D Statement 2 is correct but statement 1 is incorrect.

39 Which petroleum fraction is used as a material for road surfaces?

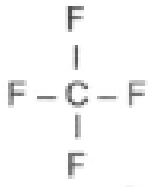
A bitumen
B diesel
C lubricating oil
D naphtha

40 The diagram shows part of the structure of an addition polymer.



Which monomer is used to make this polymer?

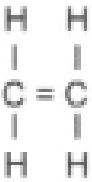
A



B

C

D



Section A (45 marks)

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

1 A ship is being pulled by two tugs, as shown in Fig. 1.1.
The tugs pull with forces of 8500 N and 5000 N respectively, as shown in the diagram.

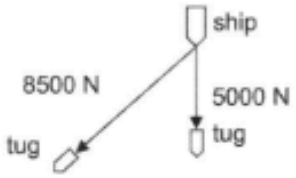


Fig. 1.1

An incomplete vector diagram for these forces is shown in Fig. 1.2.

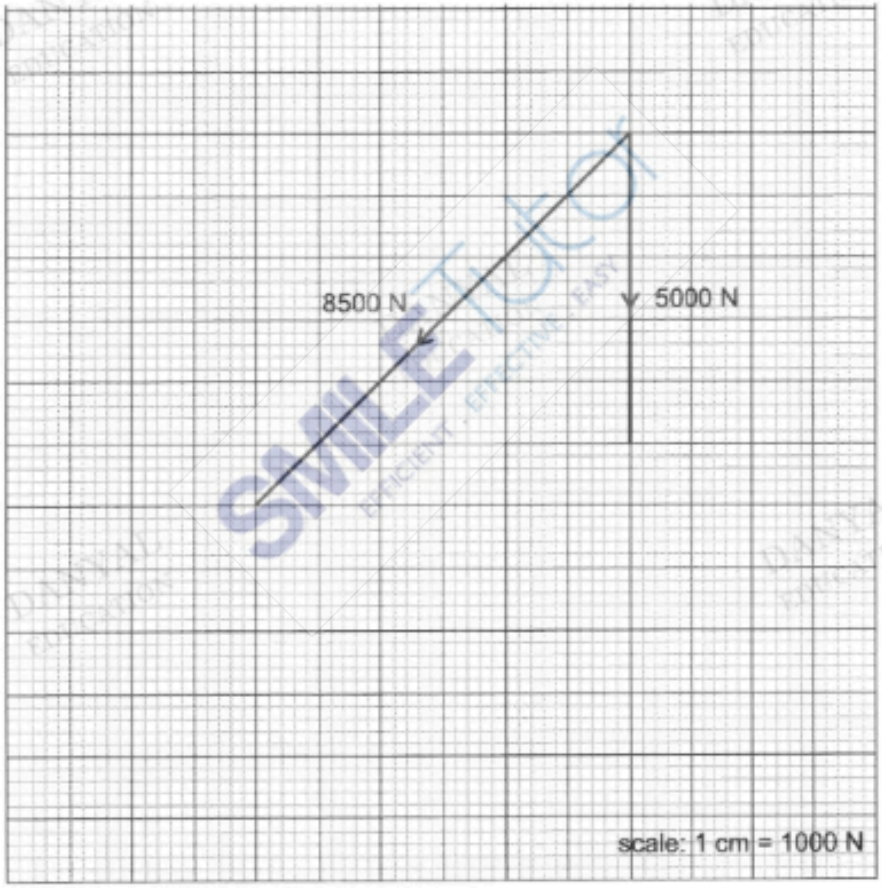


Fig. 1.2

Complete Fig. 1.2, using a scale of 1 cm to represent 1000 N to determine the resultant force that the tugs exert on the ship.

resultant force = ... N [3]

2 Fig. 2.1 shows the motion of a car along a straight road. As the car approaches a small town, it slows down. The car travels at a constant speed from the start of the town to the end of the town. After passing through the town, the car speeds up.

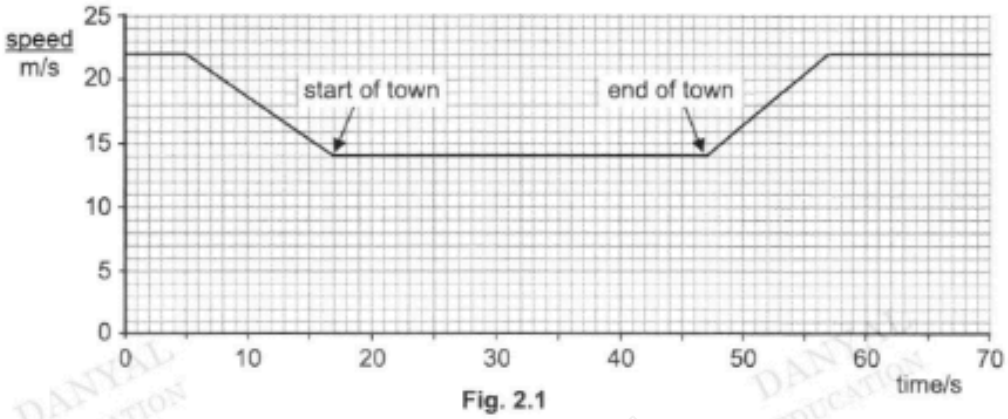


Fig. 2.1

(a) The car motor is providing a constant force to maintain a constant speed as the car travels through the town.

Explain why the speed remains constant even though the motor is applying a force.

.....

.....

..... [2]

(b) Calculate the deceleration of the car.

deceleration = ... m/s^2 [2]

(c) Calculate the distance travelled by the car **for the duration of its acceleration** after passing the town.

distance = ... m [2]

3 A reverse bungee ride involves a passenger cradle hurled vertically up into the air by the release of stretched elastic ropes as shown in Fig. 3.1.

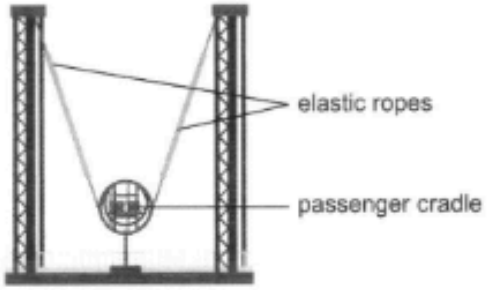


Fig. 3.1

The elastic ropes are pulled down a distance of 8.0 m using an average force of 50 kN.
The passenger cradle has a mass of 600 kg.
Energy is transmitted to the passenger cradle when the elastic ropes are released.
(gravitational field strength, g = 10 N/kg)

Ignoring any effects of friction, calculate

(a) the work done in pulling back the elastic ropes,

work done = ... J [2]

(b) the speed at which the passenger cradle launches from the ground,

speed = ... m/s [2]

(c) the maximum height reached by the passenger cradle.

height = ... m [2]

4 **(a)** Light travelling from water to air is incident on the surface at an angle of 49°, as shown in Fig. 4.1.

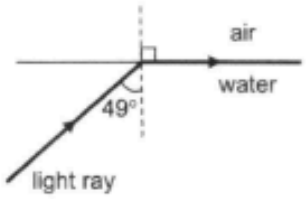


Fig. 4.1

Calculate the refractive index of water for this light.

refractive index = ... [2]

(b) Fig. 4.2 shows the side view of a water-filled aquarium **PQRS**. An electric lamp, placed in a box with a narrow slit, is immersed in one corner of the aquarium at **S**. The path of a light ray from the lamp passing through the water is drawn.

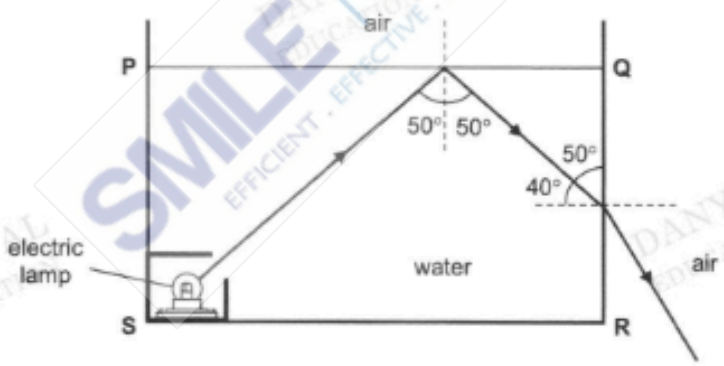


Fig. 4.2

The ray emerges out of the aquarium at surface **QR**.

Explain why the ray will emerge from surface **QR** but not surface **PQ**.

.....

.....

.....

..... [2]

5 A man is holding a load of weight F in his hand as shown in Fig. 5.1.

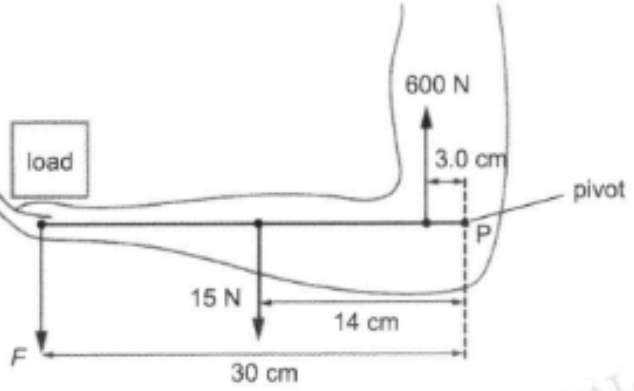


Fig. 5.1

The arm is pivoted at the elbow. The weight of the forearm is 15 N and it passes through its centre of mass. The muscle of the upper arm exerts a force of 600 N. P is the point in the elbow at which the arm pivots. The perpendicular distances of the line of action of forces from point P are shown in Fig. 5.1.

(a) Calculate the clockwise moment of the force exerted by the muscle of the upper arm.

clockwise moment = ... Ncm [2]

(b) Hence, calculate F, the maximum weight that can be supported by the hand.

weight = ... N [2]

(c) Explain why a load such as a bag will be easier to carry when the handle is placed near to the elbow.

.....

.....

..... [1]

6 Fig. 6.1 shows a bottle filled with two liquids A and B. The two liquids do not mix.

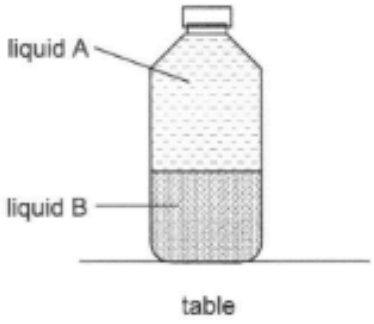


Fig. 6.1

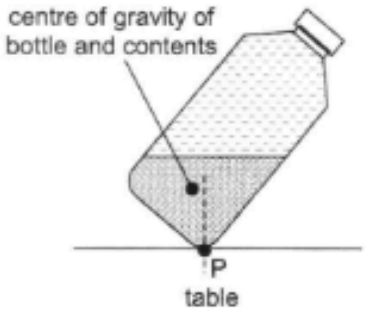


Fig. 6.2

(a) The volume of the bottle is 330 cm^3 and the volume of liquid A is 220 cm^3. The density of liquid A is 0.85 g/cm^3 and density of liquid B is 1.7 g/cm^3.

Determine the average density of contents of the bottle (liquids A and B)

average density = ... g/cm^3 [2]

(b) The bottle is tilted about P and held in position as shown in Fig. 6.2.

Explain what happens to the bottle when it is released.

.....

.....

.....

..... [2]

7 Fig. 7.1 shows the structure of a water cooler that is used to supply cold water in an office.

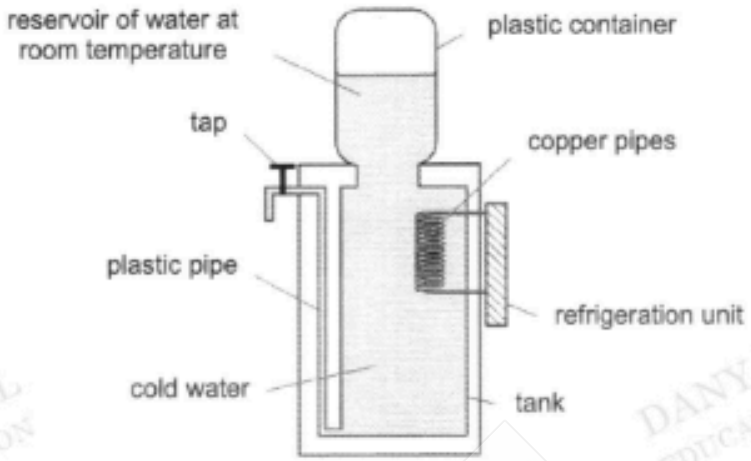


Fig. 7.1

When the tap is opened, water at room temperature from the reservoir in the plastic container flows down into the tank. Cold water from the tank flows through the plastic pipe and out of the tap.
Cold liquid from the refrigeration unit is pumped through the copper pipes and thermal energy passes through the copper to this liquid.

(a) Suggest why this pipe is made from copper.

.....

.....

..... [1]

(b) Describe the process by which all the water in the tank is cooled by the copper pipe.

.....

.....

.....

..... [2]

8 Fig. 8.1 shows a thin converging lens that is used to form a real image **I** from an object **O** (not shown). The horizontal line represents the principal axis.

The focal length of the lens is 2.0 cm.

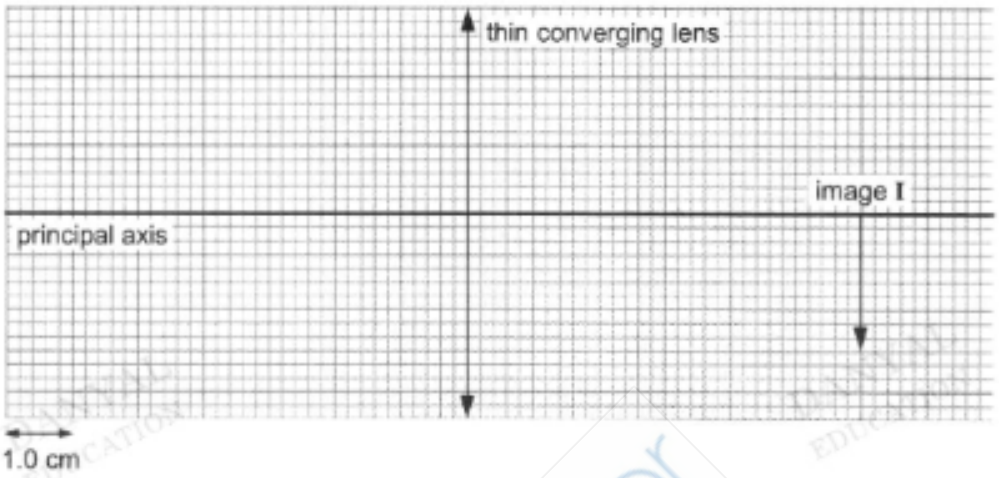


Fig. 8.1

Complete the ray diagram with 2 rays to locate and draw the object on Fig. 8.1.

Label the object **O** clearly on the diagram. [2]

9 A circuit containing four resistors and a battery of e.m.f. 12 V is connected, as shown in Fig. 9.1.

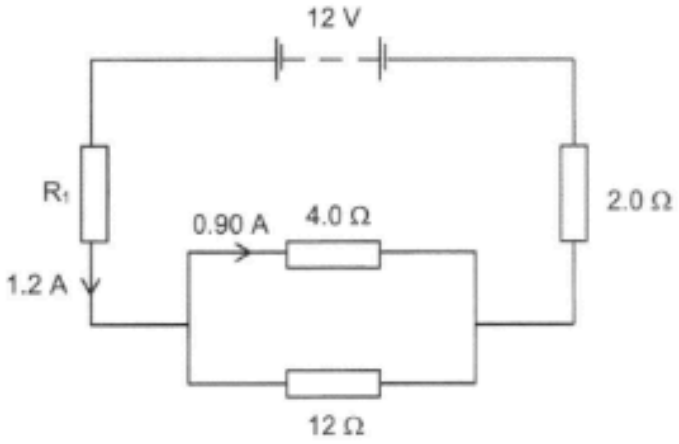


Fig. 9.1

(a) Calculate the potential difference across the 4.0 Ω resistor.

potential difference = ... V [1]

(b) Calculate the potential difference across resistor R_1.

potential difference = ... V [2]

10 Fig.10.1 shows a heating and lighting circuit in a typical house. They are connected to a 240 V mains supply.
The storage water heater has a metal case. The light bulbs are rated at 40 W, 240 V each.

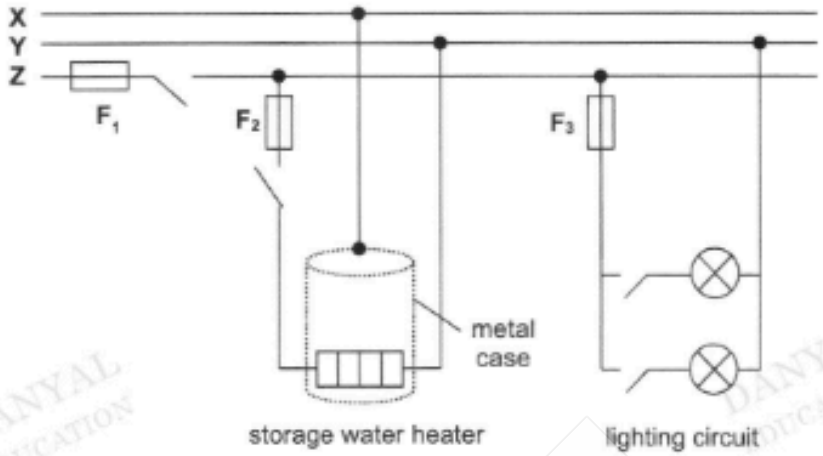


Fig. 10.1

(a) Wire **X** is connected to a part of the storage water heater but not to the lighting circuit.
Describe the function of wire **X**.

.....

.....

.....

..... [2]

(b) All the switches are closed.
The user wishes to use a fuse of 10 A for F_3. Discuss, using suitable calculations, whether this would be a good idea.

.....

.....

.....

.....

..... [3]

11 Fig. 11.1 shows a coil of wire **ABCD** connected to a battery and held between the poles of a magnet.

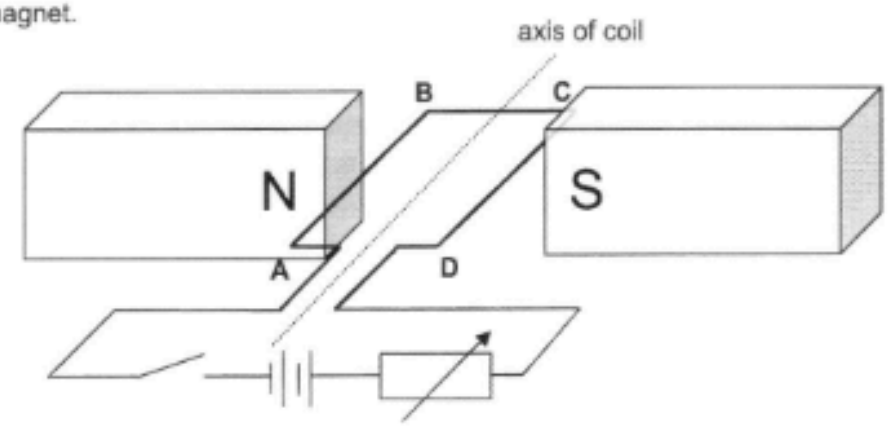


Fig. 11.1

(a) On Fig. 11.1, draw an arrow on the side **BC** of the coil to show the direction of the conventional current. [1]

(b) By considering the direction of current and the forces on coil **ABCD**, explain why there is a turning effect on the coil.

.....

.....

.....

.....

..... [3]

Section B (20 marks)

Answer any **two** questions from this section.

12 Fig. 12.1 shows a hydraulic device that is used to compress paper in a waste disposal site. When a jack is used, a force F_1 is exerted at the handle. This causes piston **A** to exert a force F_2 on the liquid, producing pressure in the liquid. The liquid transmits this pressure to piston **B** which then causes a force to be exerted on the paper.

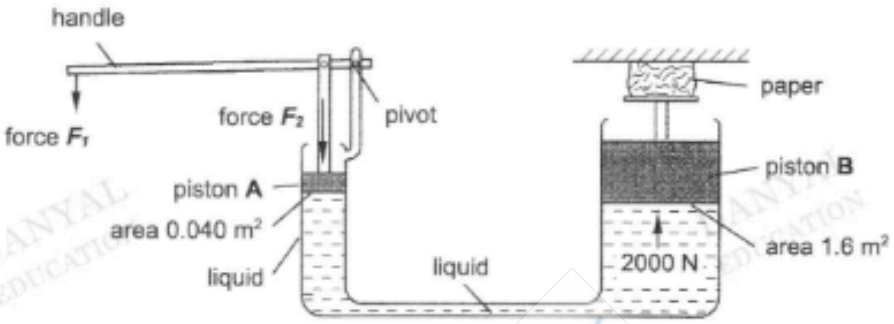


Fig. 12.1

(a) State and explain **two** reasons why the force exerted on the paper is greater than force F_1.

.....

.....

.....

.....

.....

..... [4]

(b) A force of 2000 N is exerted on piston **B**. The area of piston **A** is 0.040 m². The area of piston **B** is 1.6 m². Calculate

(i) the pressure exerted at piston **B**,

pressure = ... [2]

13 A small glass measuring cylinder containing oil is placed inside a freezer where the temperature is -18 °C. Fig. 13.1 shows how the temperature of the oil varies with time *t*.

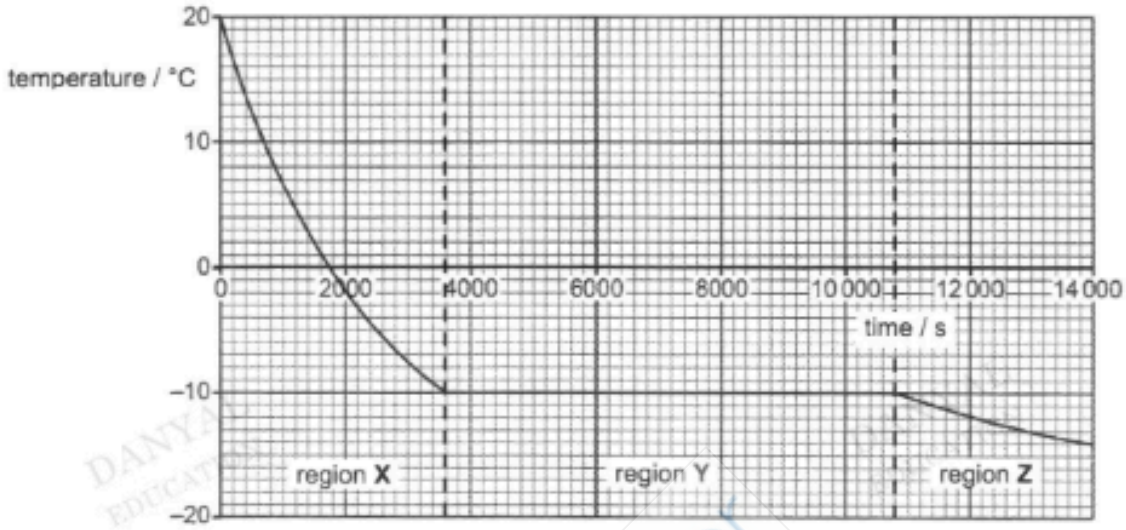


Fig. 13.1

(a) Explain why the oil temperature remains constant in region **Y**.

.....

.....

..... [2]

(b) Describe the changes, if any, that occur to the arrangement and to the motion of the molecules of oil as it cools from -11 °C to -14 °C in region **Z**.

arrangement of molecules .....

.....

.....

motion of molecules .....

.....

..... [2]

(ii) the force F_2 exerted on piston **A**.

force = ... [2]

(c) Suggest, with explanation, how the distance moved by piston **B** compares with the distance moved by piston **A**.

.....

.....

.....

..... [2]

(c) The freezer has a power of 80 W. Use this information and Fig. 13.1 to calculate the energy used by the freezer in region **Y**.

energy = ... [2]

(d) In the cooling system of the refrigerator, a liquid that is very easy to evaporate is pumped through metal pipes inside and outside the food compartment.

The vapour from the freezing compartment is pumped to the outside of the refrigerator where it is compressed back into a liquid, causing the liquid to be heated. The hot liquid passes along a metal tube which are attached with blackened metal plates. The metal plates are in the air, as shown in Fig. 13.2.

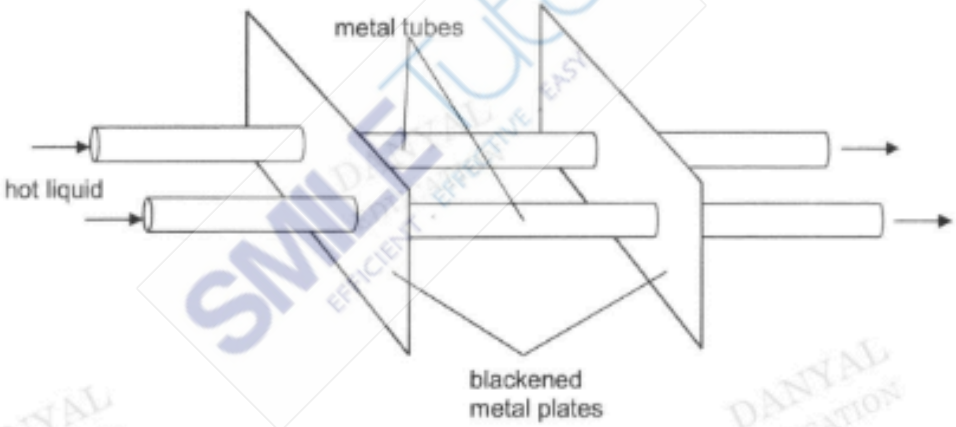


Fig. 13.2

Using ideas of thermal energy transfer, explain how energy is transferred as rapidly as possible from the hot liquid in the tube to the outside air.

.....

.....

.....

.....

.....

..... [4]

14 **(a)** Fig. 14.1 shows a coil of wire wound around a rectangular tube.
Two iron rods are placed next to each other at the bottom of the tube.

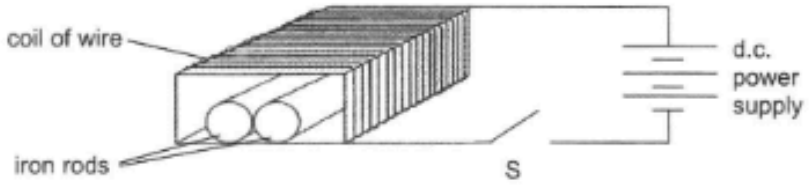


Fig. 14.1

Describe and explain what happens to the iron rods when switch S is closed.

.....

.....

..... [2]

(b) The voltage of a power supply **P** varies with time as shown in Fig. 14.2.
The direction of the voltage changes with 0.01 s.

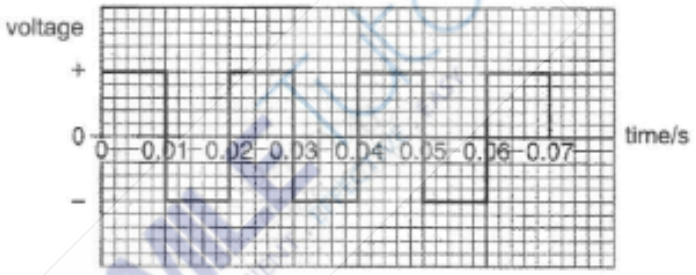


Fig. 14.2

Fig. 14.3 shows the d.c. supply of the coil of wire replaced by power supply **P**.

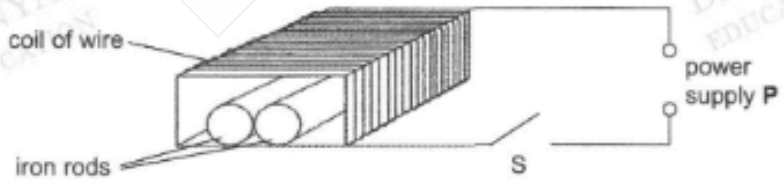


Fig. 14.3

Power supply P is switched on.
Describe and explain what happens to the iron rods when switch S is closed.

.....

.....

..... [2]

(c) The iron rods are replaced by an iron core and it is brought near to a bar magnet attached to a cone of paper to make a simple loudspeaker, as shown in Fig. 14.4.

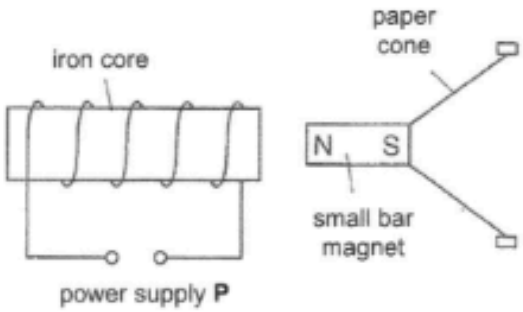


Fig. 14.4

The magnet causes the paper cone to vibrate forwards and backwards, producing a sound wave in the air.

(i) Use Fig. 14.2 to calculate the frequency of the sound wave.

frequency = ... [1]

(ii) Power supply P is adjusted to produce a sound wave of frequency of 210 Hz.
Assuming the speed of sound is 340 m/s, calculate the wavelength of this new sound wave and explain the effect on the sound produced.

wavelength = ...

explanation .....

.....

..... [3]

(iii) Describe **two** ways to increase the loudness of the sound produced by the paper cone.

.....

.....

.....

..... [2]

- End of Paper -

ANSWER SHEET

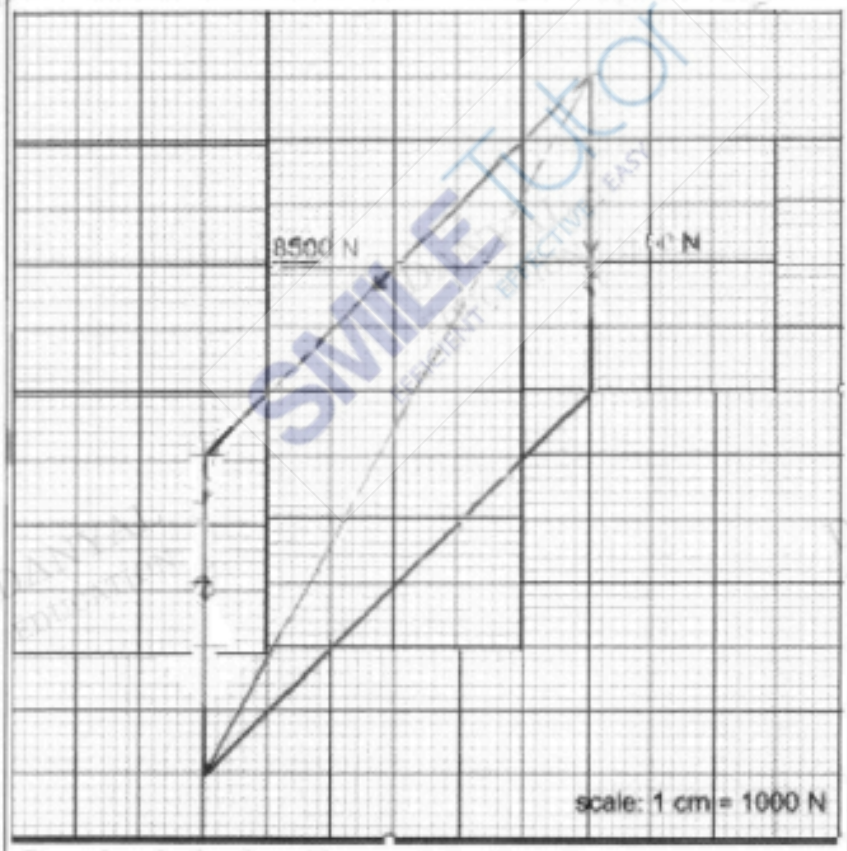
Paper 1

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
D	A	B	B	D	A	B	B	C	C
11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
D	D	A	A	D	B	C	A	C	C

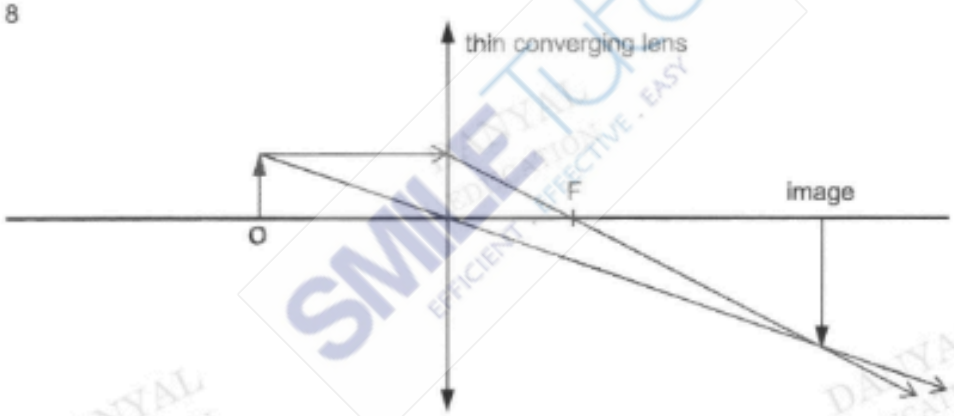
A: 5 B: 5 C: 5 D: 5

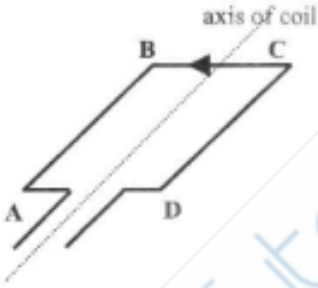
Paper 2

[1] penalty for missing/wrong unit in Section B to a maximum of [1] per question (Q12-14).

Qn	Answer	Marks
1		penalise if resultant is dotted line annotate but no penalty if single or no arrow for Fnet
	Correct scale drawing with correct direction of arrows	[1]
	Resultant force = 12500 N (12200 N - 12800 N)	[1]
	Resultant force at 29° (28° – 30°) to 5000 N force	[1]

2a	There are resistive forces (accept friction, air resistance) acting in the opposite direction to motion which are equal to the forward force/pushing force by the car motor. The resultant force is zero and since F = ma, acceleration is zero and the speed remains constant. Or resultant force is zero so by Newton's first law, the car continues in its state of constant speed.	[1] [1]
2b	a = (v – u) / t = (14 – 22) / (17-5) (*or other points from graph to find gradient*) = -0.67 m/s^2 (2 sf) (accept -0.667 m/s^2) Therefore deceleration = 0.67 m/s^2	[1] [1]
2c	Distance travelled = area under v-t graph = ½ (14+22) x 10 = 180 m	 [1] [1]
3a	Work done = F x s = 50 000 x 8.0 = 400 000 J or 4.0 x 10^5 J	 [1] [1]
3b	KE of cradle = Work done ½ x 600 x v^2 = 400 000 (allow for e.c.f.) v^2 = 1333.33 v = 37 m/s (2 sf) (accept 36.5 m/s	 [1] [1]
3c	GPE gained = KE lost mgh = 400 000 (allow for e.c.f.) 600 x 10 x h = 400 000 h = 67 m (2 sf) (accept 66.7 m)	 [1] [1]
4a	n = 1 / sin c = 1 / sin 49 = 1.3 (2 sf) (accept 1.33)	 [1] [1]
4b	(As the light ray is travelling from an optically denser medium to less dense medium,) the angle of incidence of 50° is greater than the critical angle of 49°, therefore total internal reflection occurs at PQ. At QR the angle of incidence of 40° is smaller than the critical angle of 49°, therefore total internal reflection does not occur and the light ray refracts out of the aquarium.	 [1] [1]
5a	Moment = F x d = 600 x 3.0 = 1800 Ncm	 [1] [1]
5b	By the principle of moments, Total anticlockwise moments = Total clockwise moments 1800 = (15x14) + (Fx30) 30F = 1800 – 210 F = 53 N	 [1] [1]
5c	When the load is placed nearer to the elbow (pivot), the perpendicular distance is decreased and hence less force is required to obtain the same turning effect/moment is decreased.	 [1]

6a	Volume of liquid B = 330 – 220 = 110 cm^3 <ρ> = m_{total} / v_{total} = (220 x 0.85 + 110 x 1.7) / 330 = 1.1 g/cm^3 or 1.13 g/cm^3	[1] for correct working for M_A or M_B [1]
6b	The centre of gravity/line of action of the weight of the bottle remains within the base, anticlockwise moment due to the weight causes bottle to return to original position.	[1] [1]
7a	Copper is a good thermal conductor/conductor of thermal energy. This allows the thermal energy from the water to be conducted through the copper to the liquid inside.	[1]
7b	As the water near the copper pipe cools, it contracts, becomes denser and sinks. The cooler, denser water displaces the water from the bottom of the tank upwards to be cooled and sets up a convection current, causing the water near the copper pipe to mix with the rest of the water in the tank.	[1] [1]
8	 [1] – either light ray passing optical centre or light ray passing focal point [1] – both light rays and object drawn correctly	
9a	V = I R = 0.90 x 4.0 = 3.6 V	[1]
9b	p.d. across 2.0 Ω resistor = I R = 1.2 x 2.0 = 2.4 V p.d. across R_1 = 12 – 3.6 – 2.4 = 6.0 V (allow ecf for 3.6 V from part (a), no ecf for 2.4 V)	[1] [1]
10a	Wire X is the Earth and it is connected to the metal case of the storage water heater.	

	When an electrical fault occurs and the casing becomes live (high voltage), the earth wire directs the current away/into the earth. The resulting large current blows the fuse (F_2), disconnecting the appliance from high voltage.	[1] [1]
10b	I = P / V = (40 / 240) x 2 = 0.33 A OR 0.333 A A 10 A would not be suitable as this rating is too high. The fuse would not blow even if the current exceeds the normal operating current / The current would need to exceed the normal operating current by a large amount for the fuse to blow.	[1] [1] [1]
11a		[1]
11b	As current flows from D to C, the interaction between the magnetic field of the current-carrying wire and the magnetic field of the permanent magnets produces a force. By Fleming's left hand rule, the force on AB points downwards. Current then flows from B to A and an upward force is produced on the side CD, by Fleming's left hand rule. The forces in opposite directions produce a turning effect about the axis of the coil.	Interaction of mag field [1] Fleming's LHR correct for AB, CD [1] Forces in opp dir^n → turning effect [1]
12a	The moment due to force F_1 about pivot = moment due to force F_2. Since the perpendicular distance from F_1 to the pivot is much larger than the perpendicular distance from F_2 to the pivot, the force F_2 is much greater than F_1. The pressure on piston A is equal to the pressure on piston B. Since P = F/A and the area of piston B is much larger than the area of piston A, the force at piston B is greater than force at piston A. (Since the force at piston B is larger than F_2 and F_2 is greater than force F_1, the force exerted on the paper will be greater than force F_1.)	[1] [1] [1] [1]

12bi	P = F/A = 2000 / 1.6 = 1250 or 1300 Pa or N/m^2	[1] [1]
12bii	Pressure exerted at piston A = Pressure exerted at piston B F_2 / 0.040 = 1250 F_2 = 50 N	[1] [1]
12c	The distance moved by piston B is smaller than the distance moved by piston A since by conservation of energy, the work done by the smaller force, F_A at piston A over a distance, d_A must be equal to the work done by the larger force F_B at piston B over a smaller distance. $F_A \times d_A = F_B \times d_B$ OR The distance moved by piston B is smaller than the distance moved by piston A since liquids are incompressible and the volume of liquid moving in cylinder A with a smaller area must be equal to the volume of liquid moving in cylinder B with a larger area. $A_A \times d_A = A_B \times d_B$	[1] distance B < distance A [1] explanation - either qualitative or mathematical
13a	The thermal energy is released by the oil as the molecules form intermolecular bonds to change state from liquid to solid or undergo freezing/solidification.	[1] [1]
13b	**arrangement of molecules** There is no change in the arrangement of the molecules as they remain closely packed together in an orderly/regular pattern/arrangement. **motion of molecules** The molecules continue to vibrate about their fixed positions but at a slower speed.	[1] [1]
13c	E = P t = 80 x (10800 – 3600) = 576 000 J or 580 000 J (2 sf) or equivalent	[1] [1]
13d	Thermal energy from the hot liquid is transferred through the metal tubes to the surrounding air by conduction since metals are good conductors of heat. This thermal energy from the hot liquid to the metal tubes is also transferred rapidly to the blackened metal plates by conduction since both are good conductors of heat. The thermal energy is then transferred to the surrounding air by radiation since black surfaces are good emitters of radiation and the increased surface area of the metal plates also increase the amount of heat transferred to the surrounding air by radiation.	[1] [1] [1] [1]

14a	The irons rods move away from each other when the switch S is closed. They are magnetised with the same poles at the same ends and they repel each other since like poles repel.	[1] [1]
14b	The irons rods still move away from each other when the switch S is closed. (accept similar statements e.g. they remain apart or no change from (a)) Although the polarities change many times each second, the rods are still magnetised with the same poles at the same ends and they repel each other since like poles repel.	[1] [1]
14ci	f = 1 / T = 1 / 0.02 = 50 Hz	 [1]
14cii	v = f / λ 340 = 210 / λ λ = 0.62 or 0.618 m The sound produced will have a higher pitch since the frequency is higher.	[1] [1] [1]
14ciii	To increase the loudness of the sound, the e.m.f. (or current) of the power source can be increased, the number of turns (per unit length) of the coil can be increased or a stronger bar magnet can be used.	Any two

Paper 5

Qn	Answer	Marks
(i)	5 correct readings of U_A1, U_A2, U_B1 and U_B2.	[1] (see attached)
	Values of U_A and U_B correctly expressed to 1 d.p.	[1]
	Values of $U_{A(avg)}$ and $\frac{1}{U_{A(avg)}}$ correctly calculated. (Allow one error in calculation)	[1]
	Value of $U_{B(avg)}$ and $\frac{1}{U_{B(avg)}}$ correctly calculated. (Allow one error in calculation)	[1]
	Values of $\frac{1}{U_{A(avg)}}$ and $\frac{1}{U_{B(avg)}}$ correctly expressed to 2/3 s.f.	[1]

(j)	Axes labelled correctly Appropriate scale covering at least half the graph paper (with correct starting values) All points plotted correctly (allow for 1 error in plotting) Line of best fit drawn	[1] [1] [1] [1]
(k)	*y*-intercept correctly read from the graph (as reference, teacher's value is 0.0531)	[1]
(l)	Gradient calculation shown Gradient calculated correctly using values from students' graphs	[1] [1]
(m)	Working shown Value of f calculated within ±10% of teacher's values. Focal length = 15.3 cm (accept 13.8 cm to 16.8 cm)	M1 A1 (no A1 awarded if students' previous parts wrong)
(n)	Source of error correctly stated. e.g. difficult to determine a consistently sharp image, hence affecting readings of U_A and/or U_B.	[1]

MARSILING SECONDARY SCHOOL PRELIM PAPER

1 A pendulum clock is swinging too fast.

What has to be done to make the clock move slower?

A Decrease the amplitude of oscillation.
B Decrease the length of the pendulum.
C Increase the amplitude of oscillation.
D Increase the length of the pendulum.

2 Which of the following motion(s) is/are possible?

1 moving with constant speed and non-zero acceleration
2 moving with zero-velocity initially and non-zero acceleration
3 moving with constant velocity and zero acceleration

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

3 A stone is thrown upwards.

Which row describes the acceleration and the velocity of the stone when it reaches maximum height?

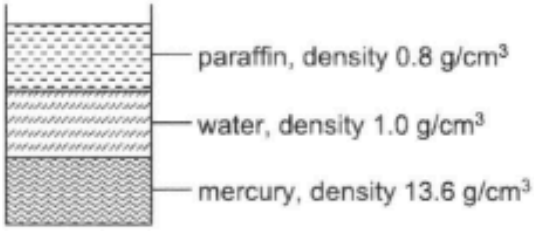
	acceleration / m/s^2	velocity/ m/s
A	0	0
B	0	10
C	10	0
D	10	10

4 Only two forces act on an object. If the object is in equilibrium, which of the following conditions are required?

1 The two forces have the same magnitude.
2 The two forces are opposite in direction.
3 The two forces are in the same direction.
4 The two forces are of the same type.

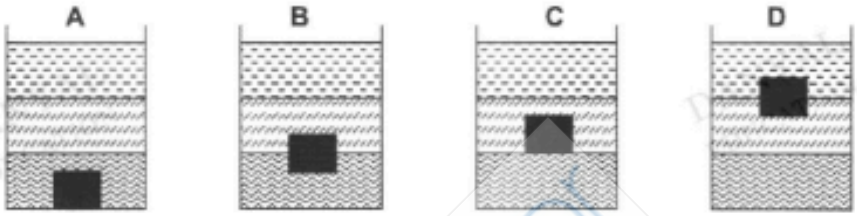
A 1 and 2 only
B 1 and 3 only
C 3 and 4 only
D 1, 2 and 4 only

5 The diagram shows a beaker containing three liquids which do not mix.



An ice cube of density 0.92 g/cm³ is dropped into the beaker.

Which figure shows the final position of the ice cube?

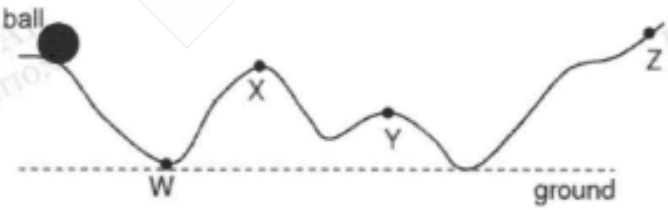


6 An object is slightly displaced by an external force. When the external force is removed, the object returns to its original position.

What state of equilibrium is the object in?

A neutral
B rotational
C stable
D unstable

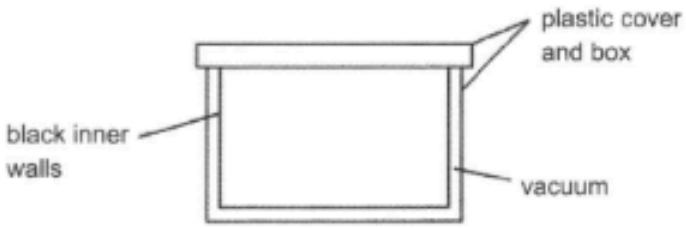
7 A ball is released from rest on a smooth surface. Air resistance is negligible.



Which statement is correct?

A The ball will move past point Z.
B The kinetic energy of the ball at Y is greater than X.
C The kinetic energy of the ball at W is the lowest compared to X, Y and Z.
D The gravitational potential energy of the ball at X is smaller than Y.

8 The diagram shows a container used to keep food warm for delivery.



Which of the following explanation is incorrect?

A Plastic is a poor conductor of heat, hence heat loss will be reduced through conduction.
B Plastic cover reduces the formation of convection current, preventing the cooling of food contents in the container.
C Vacuum reduces heat loss due to conduction as it does not have a medium to transfer the heat.
D Black inner wall is a poor absorber of infrared radiation, hence does not absorb heat from the food.

9 Which diagram represents the change in arrangement of the particles of water when it freezes?

A 

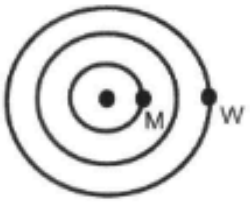
B 

C 

D 

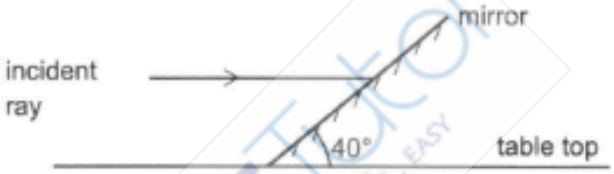
10 A pebble is dropped into still water so that the circular wavefronts are seen to travel outwards with a speed of v.

If the wavelength is λ, what is the time taken for the disturbance at M to reach W?



A λ / 2v
B λ / v
C 3λ / 2v
D 2λ / v

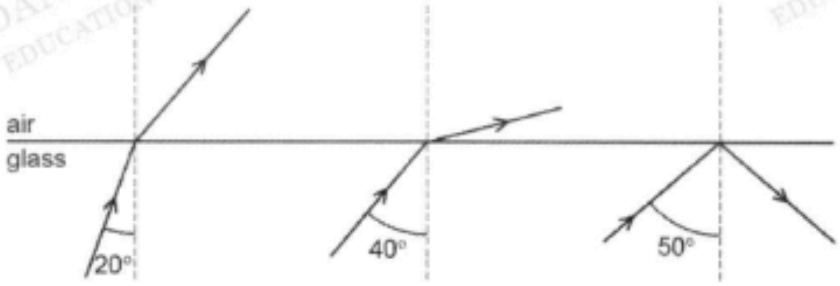
11 A plane mirror is inclined at 40° to the table-top. An incident ray parallel to the table-top strikes the mirror and a reflected ray is formed.



What is the angle of reflection?

A 20°
B 40°
C 50°
D 100°

12 Three rays of light are incident between a glass block and air. The diagram is not drawn to scale.



Which of the following is most likely to be the critical angle of the glass?

A 25°
B 35°
C 45°
D 55°

13 Which of the following is **not** an application of infrared radiation?

A ear thermometer
B night vision goggles
C remote control
D sunbeds used for skin tanning

14 A man fired a pistol at the starting line of a race and he heard an echo from the wall 0.5 s later. The speed of sound in air is 330 m/s.

What is the distance between the man and the wall?

A 82.5 m
B 165 m
C 330 m
D 660 m

15 Two identical conducting balls are suspended freely and placed close to one another.

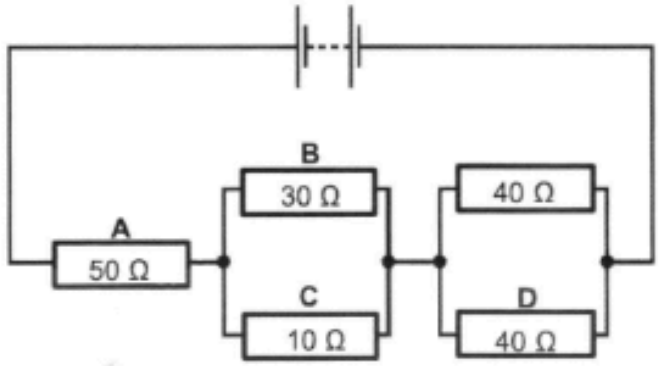
What could be the charge on the conducting balls?

1 Both of them have positive charges.
2 Both of them have negative charges.
3 They have opposite charges.

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

16 The diagram shows a circuit containing five resistors connected to a battery.

In which resistor is the current the smallest?



17 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

18 When a 9.0 V battery is connected to a filament lamp, the current flowing through it is 3.0 A.

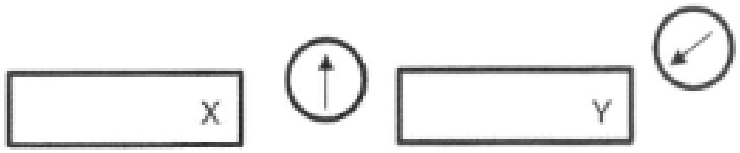
If the filament lamp converts 25% of the electrical energy into light and the rest is lost as heat, what is the amount of heat produced by the lamp in 6.0 minutes?

A 1.2×10^2 J
B 1.6×10^2 J
C 2.4×10^3 J
D 7.3×10^3 J

19 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.

20 The diagram shows the direction of the compass needle when placed near two bar magnets.



What are 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

Section A (45 marks)
Answer **all** the questions in the spaces provided.

1 **(a)** The table shows some instruments used in scientific measurements.

Write down the physical quantities measured and their respective SI units.

Instrument	Physical quantity	SI Unit
metre rule	length	metre
spring balance		
electronic balance		
stopwatch		
measuring cylinder		

[4]

(b) Fig. 1.1 shows a simple pendulum swinging from P to R and back to P repeatedly.

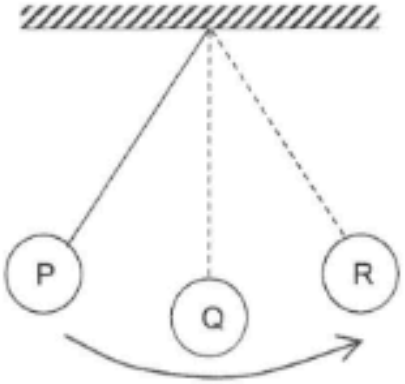


Fig. 1.1

An experiment was done to determine the periodic time of a pendulum. The time taken, t, for the pendulum to complete 20 oscillations are recorded below.

23.75 s , 25.11 s , 24.01 s , 23.13 s

(i) Determine the periodic time of the pendulum.

period = ... s [2]

(ii) What is the time taken for the pendulum to move from P to Q?

time = ... s [1]

2 A uniform beam, with mass 2.0 kg, is supported at 0.20 m from the centre by a pivot P. Two objects, of mass 4.0 kg and 8.0 kg respectively, are balanced on the beam as shown in Fig. 2.1 below.

Take acceleration due to gravity to be 10 m/s^2.

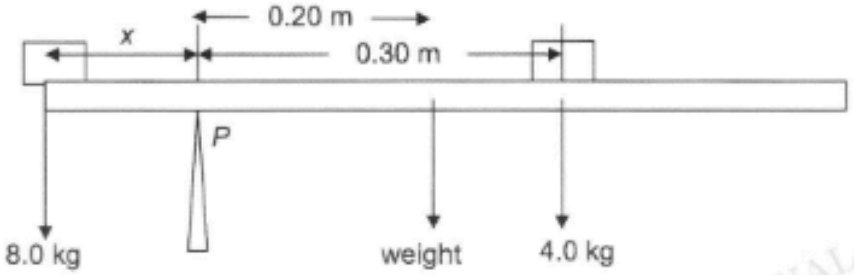


Fig. 2.1

(a) Calculate the weight of the beam.

weight = ... N [1]

(b) Determine the turning effect due to the weight of the beam.

turning effect = ... Nm [2]

(c) State the principle of moment.

.....

..... [2]

(d) Find the distance between the 8.0 kg mass and the pivot.

distance = ... m [2]

3 A bullet of mass 2.5 g, travelling at a velocity of 100 m/s is brought to rest in a bag of sand in 0.10 s.

Assuming that the deceleration is uniform, find

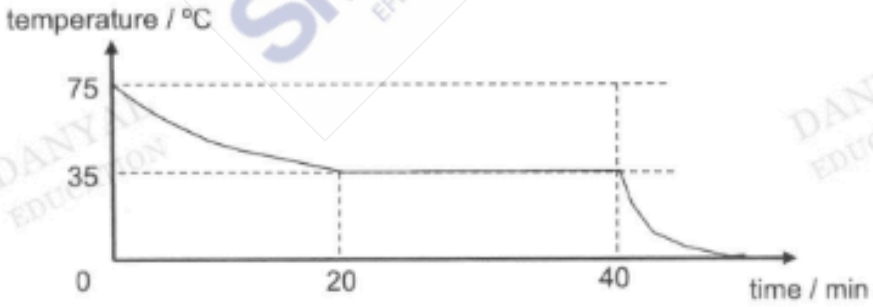
(a) the deceleration of the bullet,

deceleration = ... m/s^2 [2]

(b) the average retarding force.

average retarding force = ... N [2]

4 A substance in the liquid state is cooled down. The graph below shows how the temperature of substance changes with time.



(a) Fill in the blank with an appropriate word.

"35 °C is known as the ..... point of the solid." [1]

(b) From 20th to 40th min, the temperature of the substance did not decrease. Explain why.

.....

..... [2]

5 **(a)** Using the kinetic theory of matter, discuss why

(i) solids have a fixed volume,

.....

..... [2]

(ii) liquids have no fixed shape.

.....

.....

..... [1]

(b) Fig. 5.1 shows a metal pot containing water and placed on a hot plate.

Fig. 5.1

Explain how heat is transmitted from the hot plate to all the water in the pot.

.....

.....

.....

.....

.....

..... [3]

6 A loudspeaker and its microphone are set up facing each other such that the distance between them is 6.8 m. When the cone of the loudspeaker vibrates at a frequency of 200 Hz, there are exactly 4 complete waves in the air between the loudspeaker and microphone as shown in Fig. 6.1.

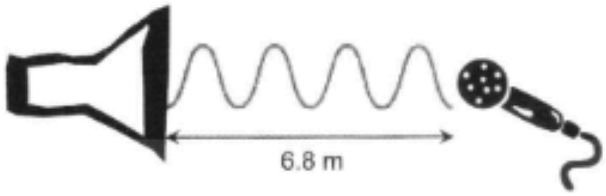


Fig. 6.1

(a) Calculate the speed of sound as it travels in the air between the loudspeaker and the microphone.

speed of sound = ... m/s [2]

(b) Determine the number of waves between the loudspeaker and the microphone when the frequency is 2.5 kHz.

no. of waves = ... [2]

7 **(a)** Two resistors, 4 Ω and 12 Ω are arranged in parallel to a cell of 5 V as shown in Fig. 7.1.

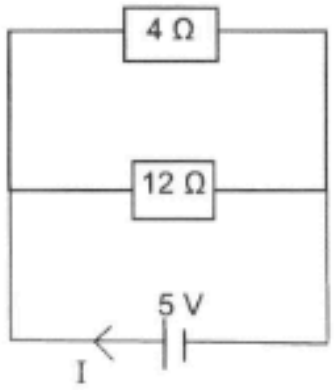


Fig. 7.1

(i) What is the total resistance of the circuit?

total resistance = ... Ω [2]

(ii) What is the total current, I, flowing from the cell?

I = ... A [2]

(b) Fig. 7.2 shows a coil in a magnetic field. The coil is able to rotate about the axis. The coil is connected to a d.c. power supply.

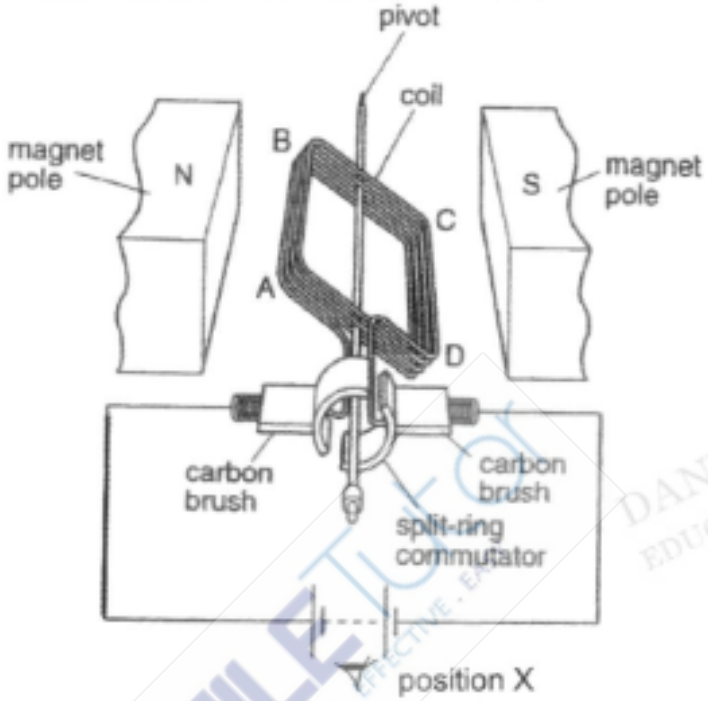


Fig. 7.2

(i) On Fig. 7.2, indicate the direction of current flow on wire AB. [1]

(ii) State the direction of rotation of the coil observed from position X.

.....[1]

8 The table lamp shown in Fig. 8.1 is made from plastic. It has only two wires in the cable. The lamp has a power rating of 150 W and is used on a 230 V supply.

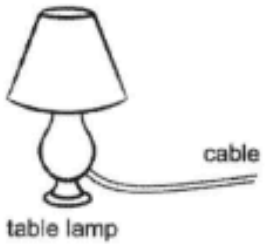


Fig. 8.1

(a) (i) Identify the two wires in the cable.

.....

..... [1]

(ii) Explain why the lamp is safe to use even though it has only two wires.

.....

..... [1]

(b) Calculate the current flow through the lamp when it is connected to the 230 V supply.

current = ... A [2]

(c) Calculate the electrical energy supplied to the lamp in 4.5 hours.

energy = ... J [2]

(d) The lamp is switched on for 4.5 hours each day. Given that the cost of electricity is 23 cents per kWh, calculate the total cost of using the lamp for 30 days.

total cost = $ ..... [2]

Section B (20 Marks)

Answer any **two** questions in this section in the spaces provided.

9 **(a)** Fig. 9.1 shows a piling hammer used to drive piles into the ground for high rise construction. The hammer is raised to a height of 20.0 m before releasing to drive the pile 2.0 m into the ground.

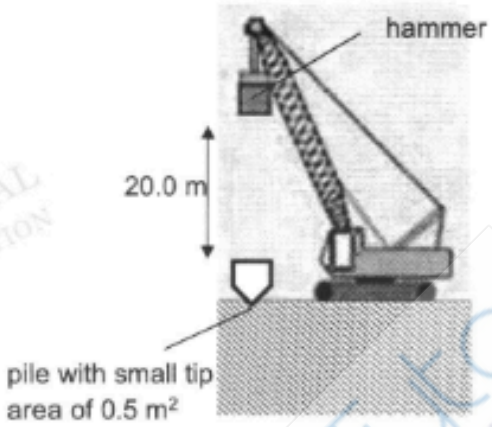


Fig. 9.1

(i) What is the pressure that the pile is acting on the ground, given that the mass of hammer is 250 kg?

pressure = ... [2]

(ii) Calculate the kinetic energy of the hammer just before it hits the pile.

kinetic energy = ... [2]

(iii) Given that the energy transferred to the pile is 40 kJ, calculate how much energy is transferred into other forms.

energy = ... [1]

(iv) State the form(s) of energy calculated in **(iii)**.

.....

..... [1]

(b) The hammer is held in equilibrium by 2 strings as shown in Fig. 9.2 (not drawn to scale) when it is not in use. The forces exerted by the 2 strings are T N and 1800 N respectively.

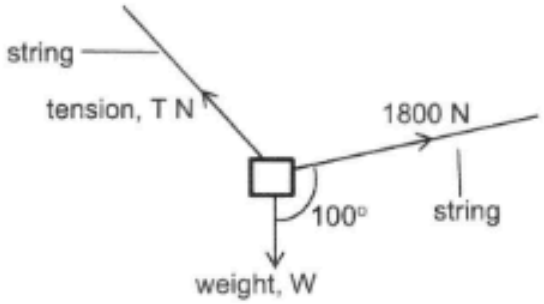


Fig. 9.2

By using a suitable scale diagram, determine the tension, T of the string.

tension, T = ... [4]

10 (a) A ray of light is passed through a regular triangular glass block, PQR with a refractive index of 1.5. The ray strikes the surface PQ at S at an angle of 35° and gets refracted as shown in Fig. 10.1.

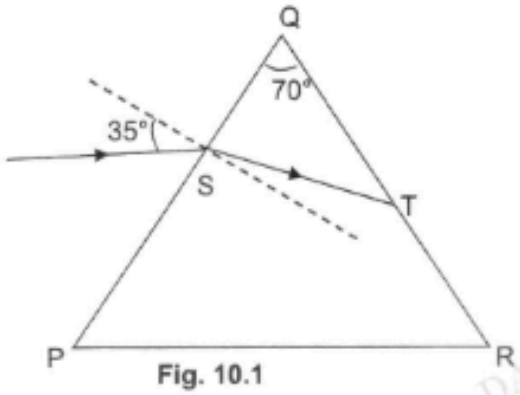


Fig. 10.1

(i) Calculate the critical angle of this medium.

critical angle = ... [2]

(ii) Calculate the angle of refraction at S.

angle of refraction at S = ... [2]

(iii) Calculate the angle of incidence at T.

angle of incidence at T = ... [1]

(iv) On Fig. 10.1, draw the path of the light ray right after it strikes the surface QR. [1]

(b) Fig. 10.2 shows the position of an object O and image I after light rays from the object pass through a thin converging lens.

On Fig. 10.2,

(i) complete the ray diagram to show how the image is formed, [2]
(ii) mark out the position of the lens, [1]
(iii) mark out the focal point of the lens. [1]

Fig. 10.2

11 Fig. 11.1 shows a circuit used in a doorbell.

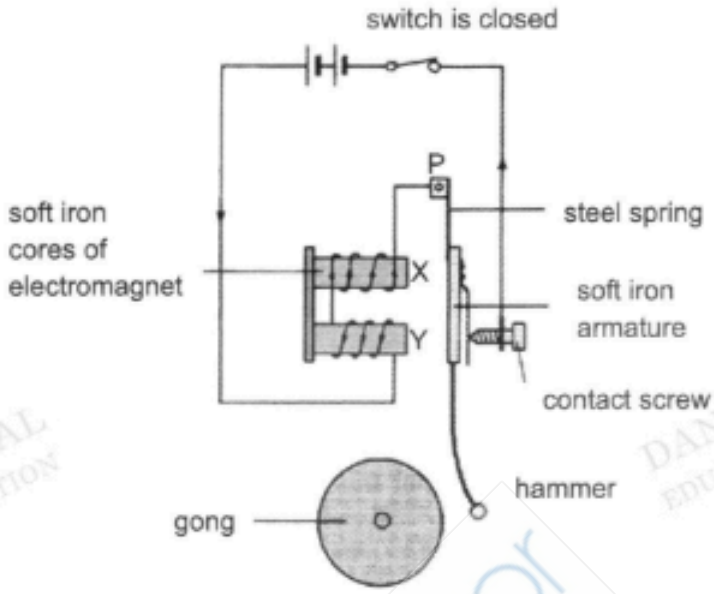


Fig. 11.1

(a) Explain how a ringing sound is produced when the switch is closed.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Suggest **two** changes that can be made to the set-up to produce a louder ringing sound.

Change 1:

.....

.....

Change 2:

.....

.....

[2]

(c) What are the poles of the 2 iron cores at X and Y when the switch is closed?

X: .....

Y: ..... [1]

(d) Explain how the following changes will affect the use of this doorbell.

Replace the iron core with

(i) a steel core.

.....

.....

(ii) a copper core.

.....

..... [3]

End of Paper

ANSWER SHEET

ANSWER SHEET

[20 marks]

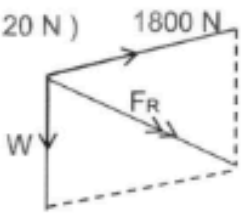
1	D	2	D	3	C	4	A	5	D	6	C	7	B	8	D	9	D	10	D
11	C	12	C	13	D	14	A	15	B	16	B	17	C	18	D	19	D	20	A

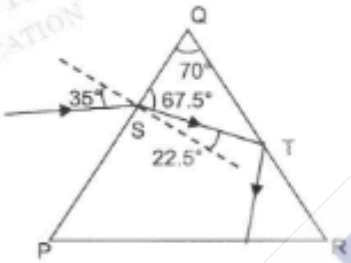
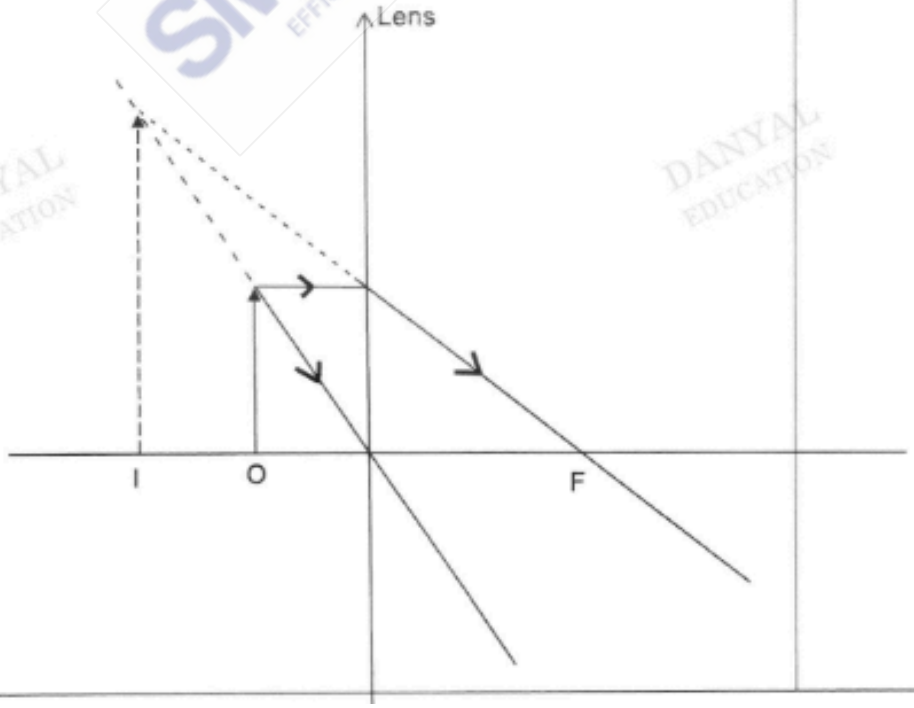
Section A [45 marks]

1	a	<table><tr><th>Instrument</th><th>Physical quantity</th><th>SI Unit</th></tr><tr><td>Metre rule</td><td>Length</td><td>Metre</td></tr><tr><td>Spring balance</td><td>Force/ Weight</td><td>Newton</td></tr><tr><td>Electronic balance</td><td>Mass</td><td>kilogram</td></tr><tr><td>Stopwatch</td><td>Time</td><td>Second</td></tr><tr><td>Measuring cylinder</td><td>Volume</td><td>Cubic metre</td></tr></table>	[1] [1] [1] [1]
	b	(i) (23.75 + 25.11 + 24.01 + 23.13)/4 = 24 s 24/20 = 1.2 s	[1] [1]
	b	(ii) 1.2/4 = 0.3 s	[1]
2	a	W = mg = 20 N	[1]
	b	Moment = F × d = 20 × 0.20 = 4 Nm	[1] [1]
	c	When an object is **balanced**, the sum of clockwise moments about a pivot is **equal** to the sum of anticlockwise moments about the **same** pivot.	[1] [1]
	d	by POM, 80 × x = 40 × 0.3 + 4 x = 0.20 m	[1] [1]
3	a	Deceleration = (100-0)/0.1 =1000 m/s^2	[1] [1]
	b	F = ma = 0.0025 × 1000 = 2.5N	[1] [1]
4	a	Melting/freezing	[1]
	b	The liquid particles are losing potential energy (energy is given out) to settle down in a regular arrangement (to strengthen forces of attraction)	[1] [1]
5	ai	Solids have a fixed volume because the molecules are closely packed with negligible space in between, Not possible to compress any further.	[1] [1]
	ii	However, because the molecules within a liquid can slide over one another throughout the liquid, liquids have no fixed shape.	[1]
	b	Water at the bottom of the pot gets heated up first, expands and becomes less dense and rises. (compare density,) Cooler, denser water at the top sinks to take its place to get heated up and rise. (rise/sink) Convection currents are set up to heat up all the water.	[1] [1] [1]
6	a	$v = f\lambda$ $= 200 \times \frac{6.8}{4}$ = 340 m/s	[1] [1]
	b	$\lambda = \frac{v}{f}$ $= \frac{340}{2500}$ =0.136 m $no.\ of\ waves = \frac{6.8}{0.136} = 50$	[1] [1]

7	ai	$\frac{1}{R}=\frac{1}{4}+\frac{1}{12}$ R = 3 Ω	[1] [1]
	aii	$I=\frac{V}{R}$ = 1.67 A	[1] [1]
	b	(i) A to B	[1]
		(ii) anticlockwise	[1]
8	ai ii	Live and Neutral wires in the cable. Double insulation (or plastic casing) of lamp prevents the user from electric shock and is safe to use.	[1] [1]
	b	P = IV 150 = 230 I I = 0.652 A	[1] [1]
	c	E = Pt = (150 W) (4.5 x 60 x 60 s) = 2.43 x 10^6 J (2.43 MJ)	[1] [1]
	d	Cost = energy (kWh) x unit cost of electricity = (0.150 kW) (4.5 h x 30) ($0.23) = $4.6575 = $4.66	[1] [1]

Section B [20 out of 30 marks]

9	ai	Pressure = Force / area = (250 x 10) / 0.5 = 5 000 Pa	[1] [1]
	aii	Using the conservation of energy, Gain in KE = loss in PE = mgh = 250 x 10 x 20 = 50 000 J	 [1] [1]
	iii	Energy transferred to other forms = 50 000 – 40 000 = 10 000 J	[1]
	iv	Thermal and sound energy	[1]
	b	Scale: 1 cm rep. 200 N (at least) diagram with arrows correct magnitude of T (2234 ± 20 N) 	[1] [1] [1] [1]

10	ai	$n = \frac{1}{\sin C}$ $1.5 = \frac{1}{\sin C}$ $C = \sin^{-1}\left(\frac{1}{1.5}\right)$ C = 41.8°	[1] [1]
	aii	$n = \frac{\sin i}{\sin r}$ $1.5 = \frac{\sin 35}{\sin r}$ $r = \sin^{-1}\left(\frac{\sin 35}{1.5}\right)$ r = 22.5°	[1] [1]
	aiii	angle STQ = 42.5° angle of incidence at T = 47.5°	[1]
	aiv		[1] total internal reflection. if biii <C, then refraction accepted (ECF)
	b	(i) The position of the lens (ii) The focal point of the lens (iii) Complete the ray diagram to show how the image is formed. 	[1] [1] [2]

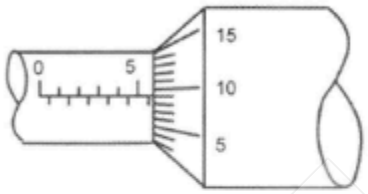
11	a	When switch is closed, the current in the solenoid causes the iron cores to become a strong electromagnet. The iron cores (electromagnet) cause the soft iron armature to become an induced magnet and is attracted towards the iron cores. When the armature turns clockwise about pivot P and the hammer hits the gong, a sound is produced. The circuit is now opened, iron cores lose magnetism and spring returns the armature to original position to get magnetised. The process repeated and the hammer repeatedly hits the gong creating a ringing sound.	[1] [1] [1] [1]
	b	Use a power supply with a higher e.m.f. // more turns on the solenoid/ Place iron core + solenoid nearer to metal rod./Move pivot P nearer to the top of the metal rod that hits the bell.	[1] [1]
	c	X: S Y: N	[1]
	d	(i) Steel core remains magentised, armature will not return to original position. Gong will only have one ding sound (ii) There will be no sound as copper is not a magnetic material, cannot attract the armature.	[1] [1] [1]

SERANGOON SECONDARY SCHOOL PRELIM PAPER

1 Which list contains **only** scalar quantities?

A acceleration, distance, kinetic energy, length
B distance, temperature, volume, weight
C mass, deceleration, density, kinetic energy
D mass, speed, kinetic energy, volume

2 A micrometer screw gauge is used to measure the diameter of a copper wire.



What is the diameter of the wire?

A 5.45 mm
B 5.59 mm
C 5.73 mm
D 6.23 mm

3 The diagram shows a simple pendulum oscillating between positions **X** and **Z**.

Which sequence should be timed to measure the period of the pendulum?

A X → Y
B X → Z
C X → Z → Y
D X → Z → X

4 An object falls from rest through a great height in air. Which row describes the acceleration and the velocity of the object before it reaches terminal velocity?

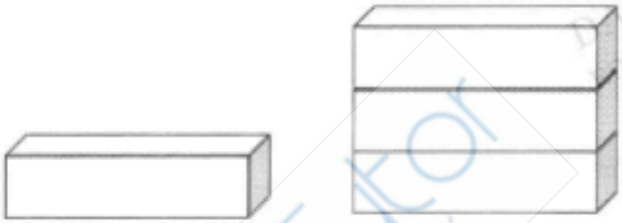
	acceleration	velocity
A	constant	constant
B	constant	increasing
C	decreasing	increasing
D	decreasing	decreasing

5 A force is applied to an object on a frictionless surface. It produces an acceleration of 3.5 m/s².

What are possible values for the applied force and for the mass of the object?

	force / N	mass / kg
A	2.0	1.5
B	2.0	7.0
C	7.0	0.5
D	7.0	2.0

6 The diagram shows a single brick and a pile of three bricks. All the bricks are identical.



Which statement about the bricks is correct?

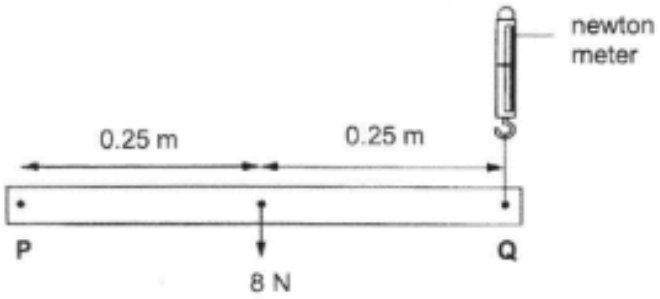
A The pile of bricks has the same density as the single brick, but three times the volume and mass.

B The pile of bricks has the same mass as the single brick, but three times the density and volume.

C The pile of bricks has the same volume as the single brick, but three times the density and mass.

D The pile of bricks has three times the mass, volume and density compared to the single brick.

7 A metal bar, PQ, has a weight of 8 N and is pivoted at P. It is prevented from turning by a newton meter acting at Q.



What is the reading on the newton meter?

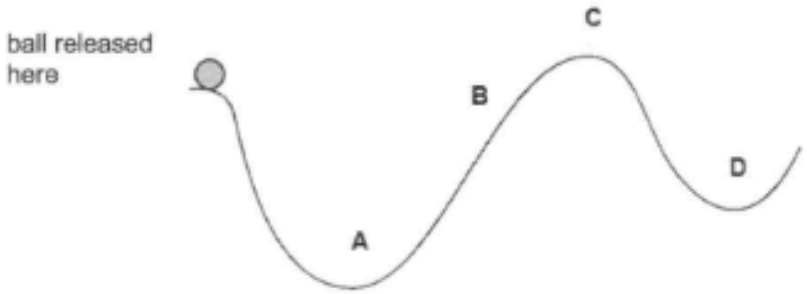
A 4.0 N
B 8.0 N
C 12.8 N
D 16 N

8 The diagram shows a wine bottle placed in a wooden holder. The bottle and the holder are in equilibrium.

Which statement is true about the set-up?

A The centre of gravity of the bottle is directly above the base of the wooden holder.
B The centre of gravity of the bottle and that of the wooden holder are at the same point.
C The centre of gravity of the wooden holder is directly above the base of the wooden holder.
D The centre of gravity of the bottle and the wooden holder is directly above the base of the wooden holder.

9 A ball is released from rest and rolls down a track from the position shown.
What is the furthest position the ball could possibly reach?

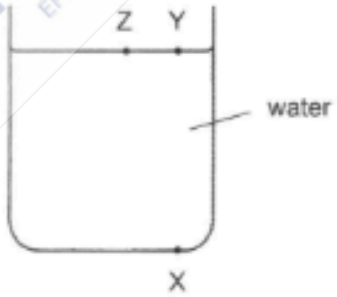


10 A box weighing 50 N is being pushed horizontally on a smooth surface by a 10 N force for 6 m in 3 s.

What is the average power?

A 20 W
B 60 W
C 100 W
D 300 W

11 A student has a large tank of water in which he wants to set up a convection current.



Which position is the most suitable to setup a convection current?

A cooling at X
B heating at X
C heating at Y
D heating at Z

12 Liquid evaporates from a beaker.
What happens to the temperature of the remaining liquid and how does this temperature change affect the rate of evaporation?

	temperature	rate of evaporation
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

13 It takes 0.20 s to generate one complete wave in a ripple tank. The wavelength of each wave produced is 4.0 cm.

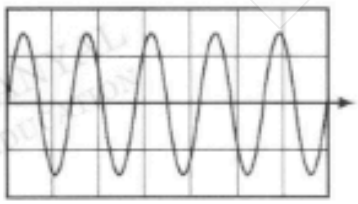
What is the speed of the wave?

A 0.80 cm/s
B 1.3 cm/s
C 5.0 cm/s
D 20 cm/s

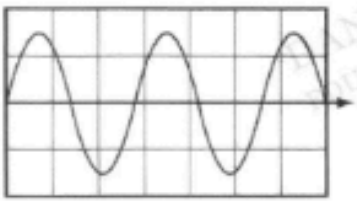
14 Which of the following sets of electromagnetic waves have higher wavelengths than visible light?

A radio waves, infrared radiation, ultraviolet radiation
B radio waves, microwaves, infrared radiation
C X-rays, gamma rays, ultraviolet radiation
D X-rays, microwaves, infrared radiation

15 The diagrams show the wave shapes of two different sounds. The scales are the same in each diagram.



sound 1

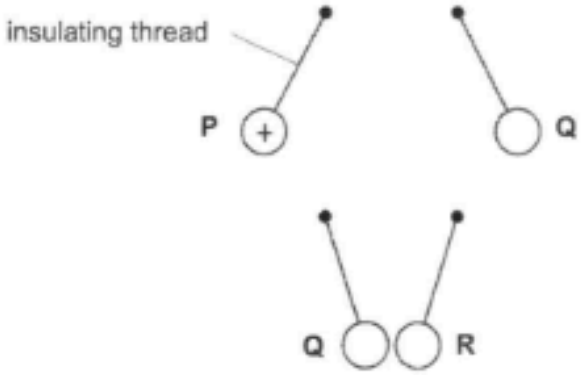


sound 2

How does sound 2 compare with sound 1?

A Sound 2 is louder than sound 1.
B Sound 2 is quieter than sound 1.
C Sound 2 has a lower pitch than sound 1.
D Sound 2 has a higher pitch than sound 1.

16 Three charged balls, **P**, **Q** and **R**, are suspended by insulated threads. Ball **P** is positively charged.



What are the charges on **Q** and **R**?

	charge on **Q**	charge on **R**
A	negative	negative
B	negative	positive
C	positive	negative
D	positive	positive

17 An electric oven is connected to the mains supply using insulated copper wires. The wires become very warm.

What can be done to reduce the resistance in the insulated copper wires?

A use thicker copper wires

B use thicker insulation

C use thinner copper wires

D use thinner insulation

18 Which statement describes an example of induced magnetism?

A A bar magnet attracts another bar magnet.

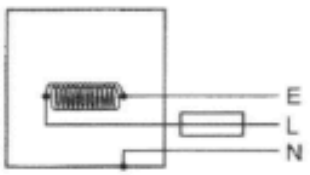
B A bar magnet, swinging freely, comes to rest pointing North-South.

C A bar magnet attracts a steel ball bearing.

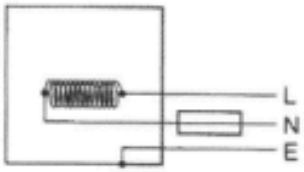
D A compass needle points to S-pole of a bar magnet.

19 The diagrams show the wiring to a heating element in a toaster oven. Which one shows the correct arrangement of wires?

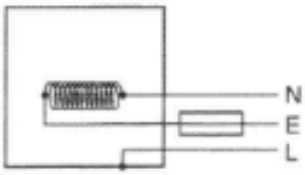
A



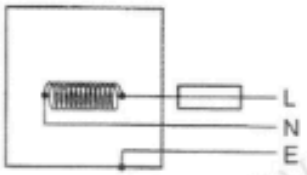
C



B

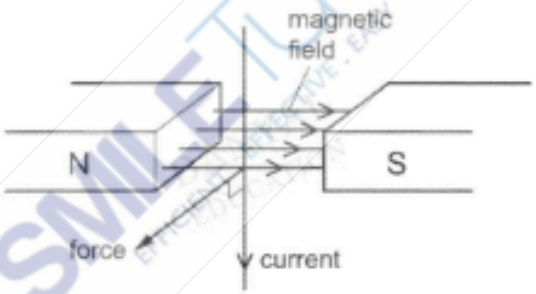


D



20 A wire in a magnetic field carries a current. The wire experiences a force due to the magnetic field.

The diagram shows the directions of the magnetic field, the current and the force.



The direction of the current and the direction of the magnetic field are both reversed. In which direction does the force act now?

A in the opposite direction from before the change

B in the same direction as before the change

C towards the north pole

D towards the south pole

END OF PAPER

Section A [45 marks]
Answer **all** questions.

1 Fig. 1.1 (not drawn to scale) shows a load held in position by two wires A and B. There is a tension of 50 N in each wire, with an angle of 160° between them.

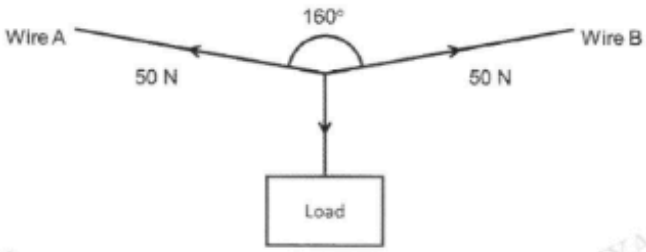


Fig. 1.1

(a) Using an appropriate scale, draw a vector diagram in the space below to determine the weight of the load.

weight = ... N [2]

(b) Calculate the mass of the load. [g = 10 N/kg]

mass = ... g [2]

2 A cyclist was travelling along a straight path. Fig. 2.1 shows the distance travelled by the cyclist with respect to time.

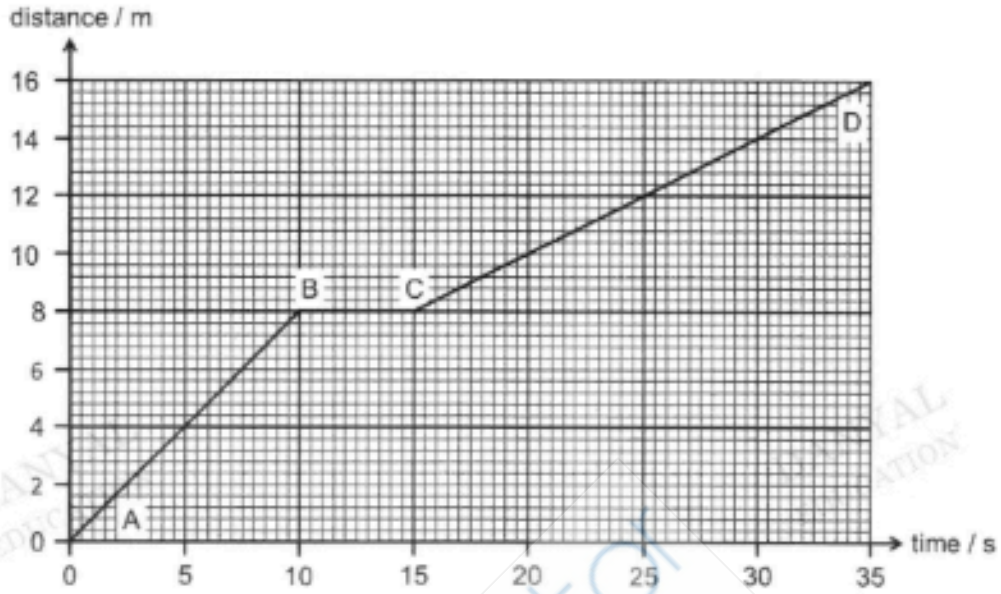


Fig. 2.1

(a) Calculate the speed of the cyclist from $t = 0$ s to $t = 10$ s.

speed = ... m/s [2]

(b) Describe the motion of the cyclist from $t = 10$ s to $t = 35$ s.

.....

.....

.....

.....

..... [2]

3 Fig. 3.1 shows a digger used to remove 3000 N of soil from the ground.

The centre of gravity of the soil has a perpendicular distance of 2.0 m away from the front edge A of the tracks in contact with the ground. The gravitational field strength on Earth is 10 N/kg.

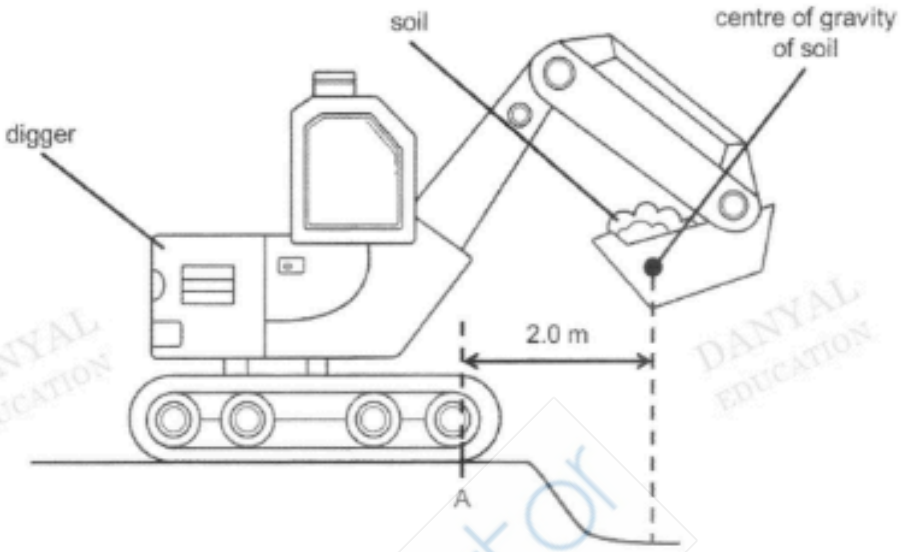


Fig. 3.1

(a) Calculate the moment of the weight of the soil about A.

moment of the weight of soil = ... Nm [1]

(b) The digger is moved forward such that the centre of gravity of the digger is directly above point B. Fig. 3.2 shows the digger at rest in that position without falling over.

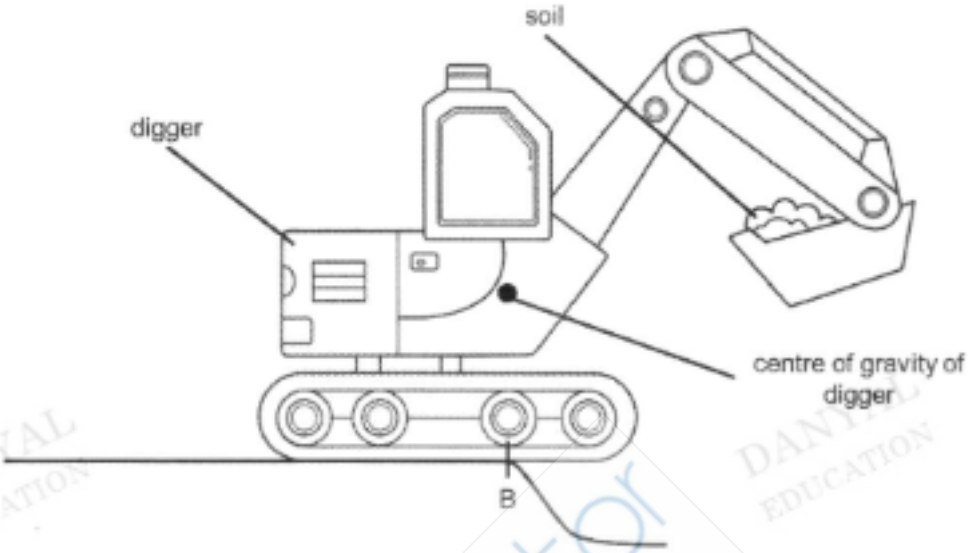


Fig. 3.2

Explain why the digger will fall over if it continues to move forward any further.

.....

.....

.....

.....

..... [2]

4 Fig. 4.1 shows a gymnast on a trampoline at point A with stretched springs on the side. The gymnast starts to rise and passes through point B. Fig. 4.2 shows the maximum height attained by the gymnast at point C.

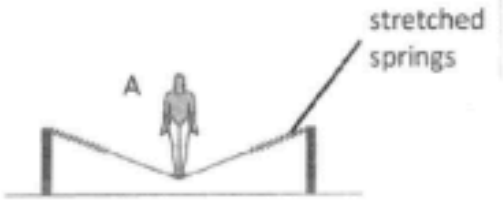


Fig. 4.1

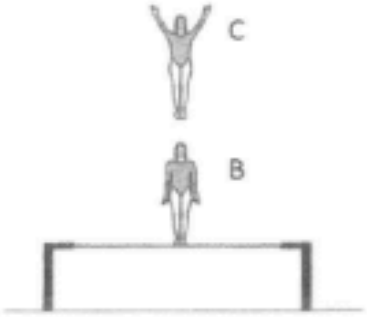


Fig. 4.2

(a) The gymnast has a mass of 50 kg and travelled 0.50 m from point A to B.

Calculate the amount of work done against gravity as the gymnast travelled from point A to B. [g = 10 N/kg]

work done = ... J [2]

(b) State the type of energy gained by the gymnast when rising from point B to C.

.....

..... [1]

(c) When the gymnast is at point B, there is a total kinetic energy of 1750 J.

Ignoring the effects of resistive forces, calculate the maximum height that the gymnast can reach.

maximum height = ... m [2]

5 Fig. 5.1 shows two identical glass cylinders containing equal volumes of water at the same initial temperature of 30°C. Two identical electric heaters were placed in the cylinders, one near the top in cylinder **A** and the other near the bottom in cylinder **B**.

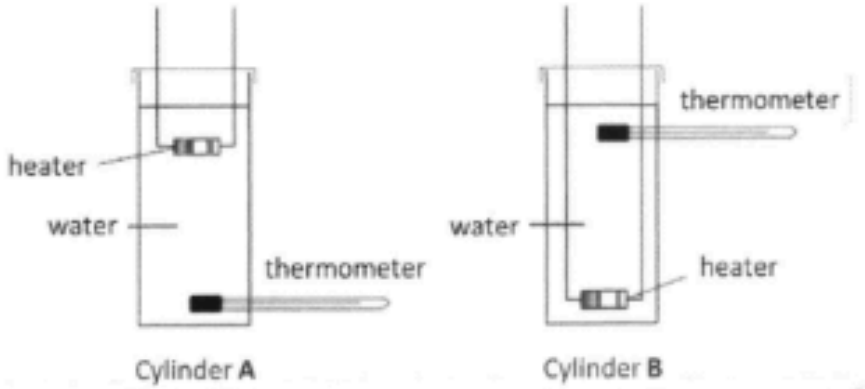


Fig. 5.1

(a) State the method(s) of transfer of thermal energy present in both cylinders.

.....[1]

(b) Describe the main method of heat transfer in which all the water is heated up in cylinder **B**.

.....

.....

.....

.....

.....

.....

.....[3]

(c) Both heaters are switched on at the same time. Explain why the thermometer reading in cylinder **A** increases much slower than the one in cylinder **B**.

.....

.....[1]

6 Fig. 6.1 shows the cooling curve of substance X. The temperature of substance X was brought down from an initial temperature of 45 °C using a cooling unit with a power rating of 800 W.

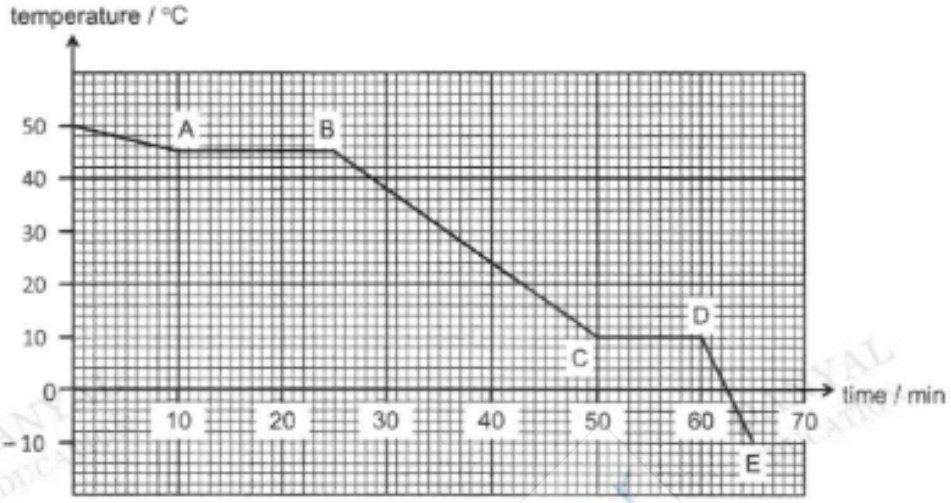


Fig. 6.1

(a) Calculate the amount of energy consumed by the cooling unit to change substance X from liquid to solid state.

amount of energy = ... J [2]

(b) Explain why the temperature of substance X remains constant from point A to B.

.....

.....

.....

.....

..... [2]

(c) Calculate the resistance of the cooling unit given that the normal operating current is 4.0 A.

resistance = ... Ω [2]

7 Fig. 7.1 shows a light ray incident on an air-to-glass boundary at an angle of 75°. The light ray is then reflected from the surface of a plane mirror, placed below the glass layer. The refractive index of the glass is 1.50.

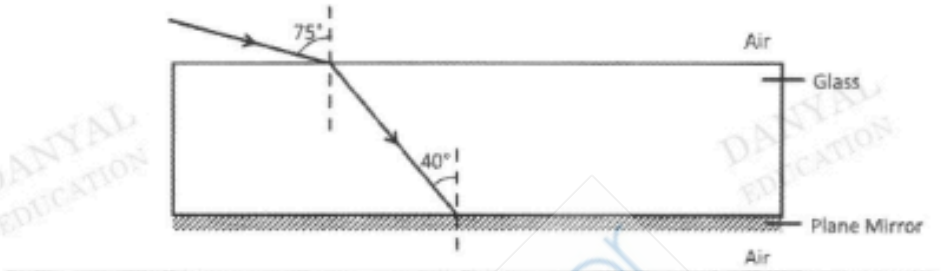


Fig. 7.1

(a) In the space above, complete the ray diagram as the light ray emerges from the glass layer back into the air. [1]

(b) **(i)** Calculate the critical angle of the glass if its refractive index is increased to 1.60.

critical angle = ...° [1]

(ii) Hence, explain what would happen to the light ray if the plane mirror is removed and the refractive index of the glass layer is increased to 1.60.

.....

.....

.....

.....

..... [2]

8 (a) Fig. 8.1 shows some short metal threads attached to a metal ball. The metal ball is supported by an insulating stand. The metal ball and threads contain negative charges that are free to move throughout the metal surface and positive charges that are not free to move. The metal ball and threads have no overall charge.

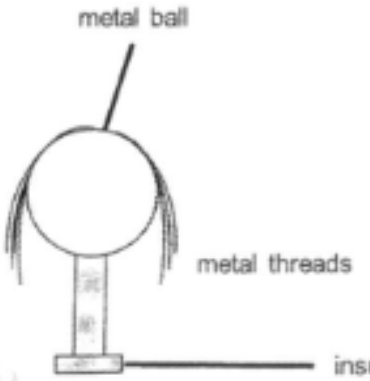


Fig. 8.1

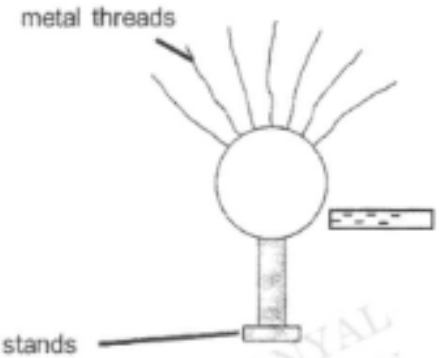


Fig. 8.2

Fig. 8.2 shows a negatively charged rod placed near the right side of the metal ball and the metal threads start to "stand" and move away from one another.

Explain why the metal threads would "stand" and move away from one another in Fig. 8.2.

.....

.....

.....

.....

..... [2]

(b) Fig. 8.3 shows an electrical circuit which consists of a 9 V cell, a 4.0 Ω resistor and 3 light bulbs of the same resistance. The potential difference across lamp Z is measured to be 3 V.

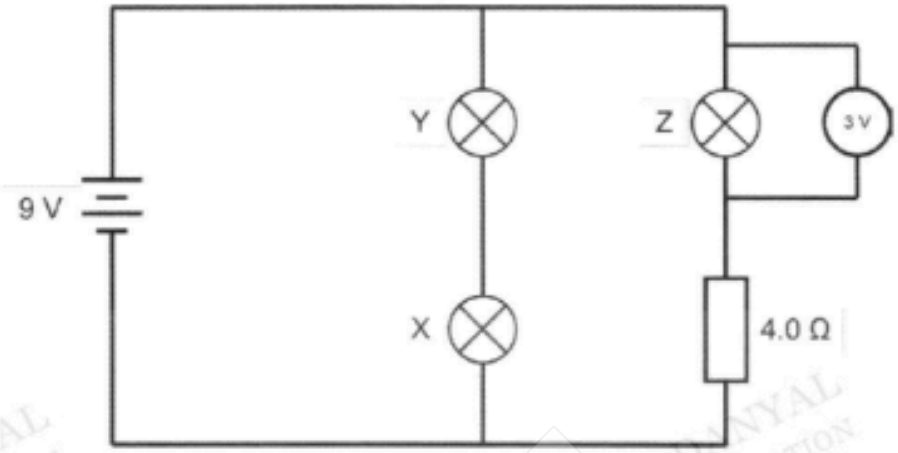


Fig. 8.3

(i) Calculate the current flowing in the 4.0 Ω resistor.

current = ... A [2]

(ii) Calculate the resistance of lamp Z.

resistance = ... Ω [1]

(iii) Calculate the total resistance of the circuit.

resistance = ... Ω [2]

9 (a) Fig. 9.1 shows two identical rods A and B placed in a solenoid which is placed on a horizontal flat surface and is connected to some batteries and switch S. Both rods are made of iron.

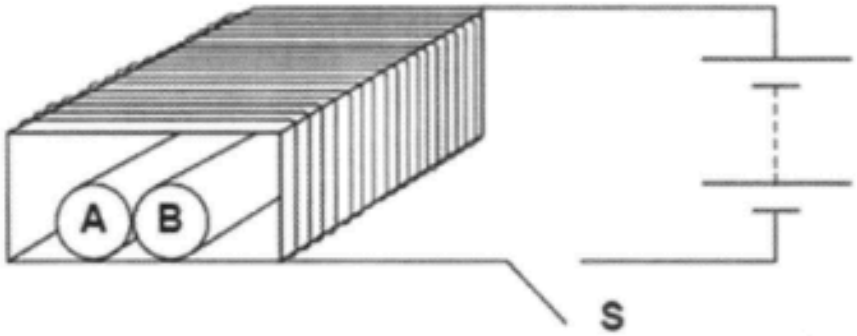


Fig. 9.1

(i) When switch S is closed, explain why the iron rods will roll away from each other.

.....

.....

.....

.....

..... [2]

(ii) Switch S is then opened after some time. Explain why the rods will roll towards each other if rod A is made of iron while rod B is made of steel.

.....

.....

.....

.....

..... [2]

(b) Fig. 9.2 shows a rigid wire held between the poles of a U-shaped magnet. When the switch is closed, there is an upward force on the wire as indicated.

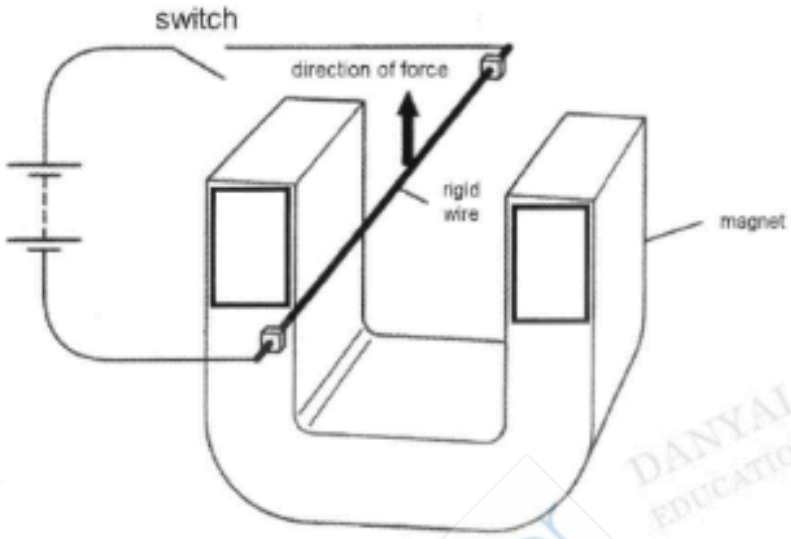


Fig. 9.2

(i) In the boxes provided in Fig. 9.2, label the north pole "N" and south pole "S" of the U-shaped magnet. [1]

(ii) State the changes that can be made to the set-up to cause a bigger downward force to act on the wire.

.....

.....

.....

.....

..... [2]

Section B [20 marks]
Answer any **two** questions from this section.

10 **(a)** Fig. 10.1 shows how the speed of a moving car varies with respect to time.

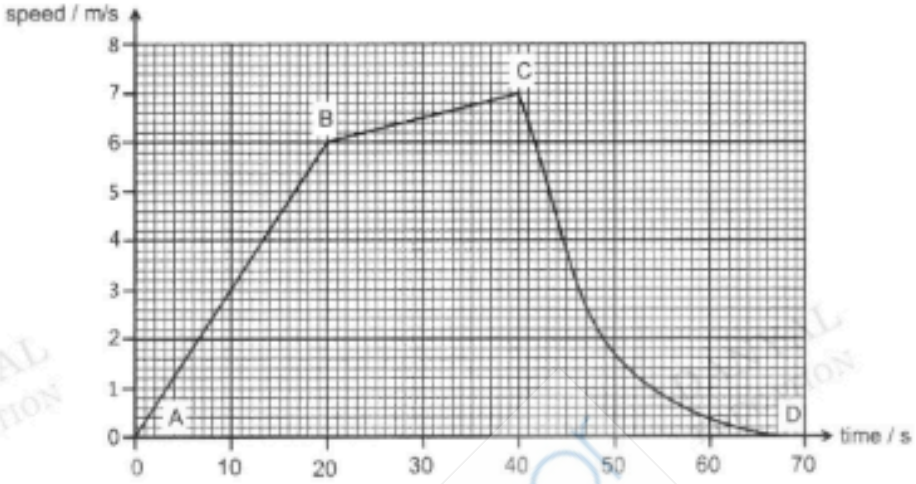


Fig. 10.1

(i) Calculate the average speed of the car for the first 40 seconds.

average speed = ... [2]

(ii) Assuming that the engine force remains constant throughout the whole journey, state whether the car was subject to any change in resistive forces between C and D. Explain your answer.

.....

.....

..... [2]

(b) Fig. 10.2 shows a uniform box held in equilibrium about the pivot P by a force F. The mass of the box is 4.0 kg. [g = 10 N/kg]

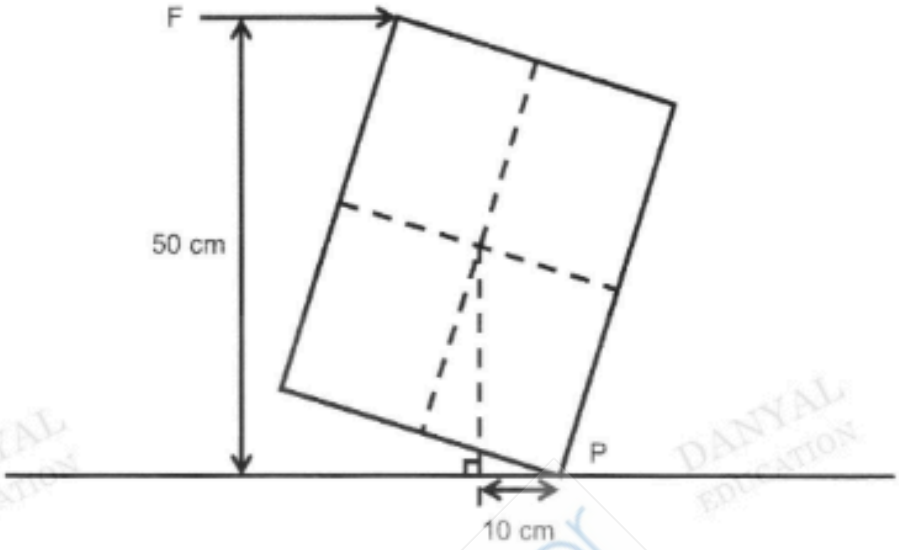


Fig. 10.2

(i) Calculate the weight of the box.

weight = ... [2]

(ii) Calculate the moment due to the weight of the box about point P.

moment = ... [2]

(iii) Hence, calculate the magnitude of force F.

force F = ... [2]

11 **(a)** Fig. 11.1 shows part of a hydraulic braking system of a motor car which uses oil as the brake fluid. When a force is applied on the brake pedal, pressure is exerted on the piston in the master cylinder. The exerted pressure is constant throughout the entire brake fluid which causes the piston in the slave cylinder to move up.

The contact area of the piston in the master cylinder is 20.0 cm^2 and the contact area of the piston in the slave cylinder is 5.0 cm^2.

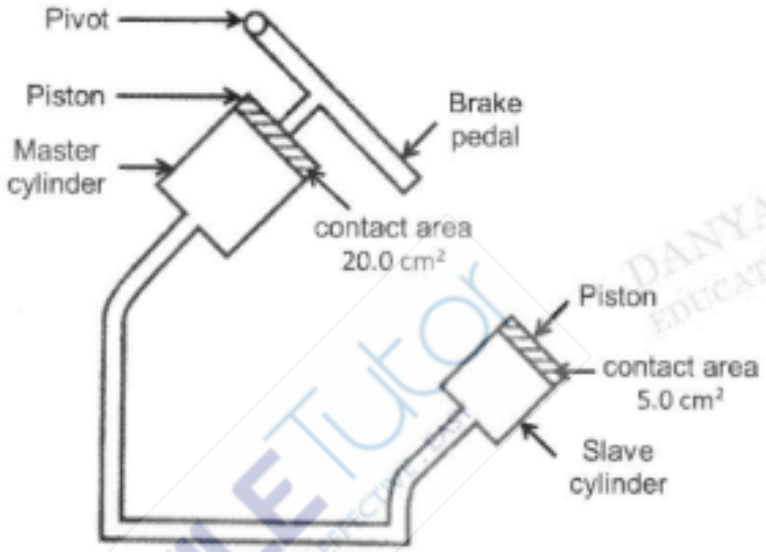


Fig. 11.1

(i) Calculate the pressure exerted on the brake fluid when a 250 N force is applied on the brake pedal.

pressure = ... [2]

(ii) Hence, calculate the force exerted on the piston in the slave cylinder.

force = ... [2]

(iii) Explain why oil is used as the brake fluid instead of air.

.....

.....

..... [2]

(b) The depth of the seabed can be measured by emitting sound waves and measuring the time taken for the reflected sound to return.

Fig. 11.2 shows the displacement-distance graph of the sound waves emitted. The sound waves travel at a speed of 1500 m/s in water.

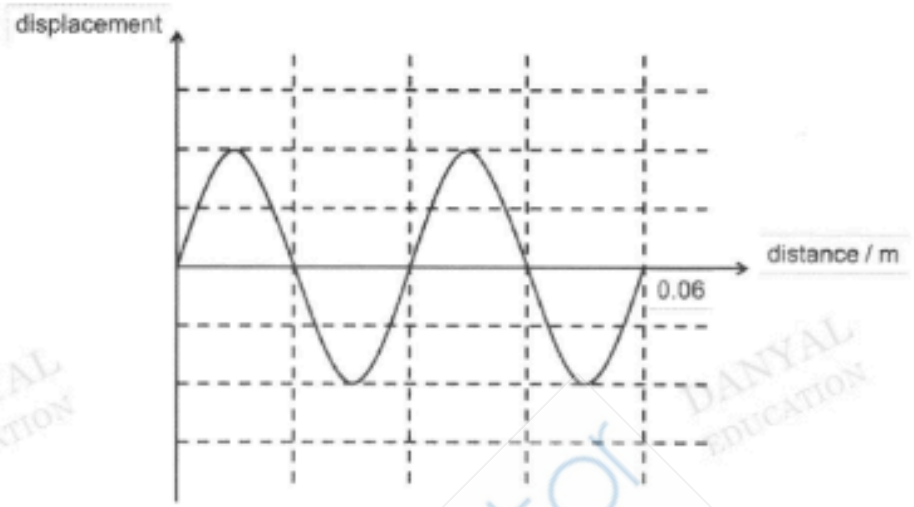


Fig. 11.2

(i) Calculate the frequency of the sound waves in water.

frequency = ... [2]

(ii) In the space above, draw the graph of a new sound wave that has half the loudness and double the pitch of the original sound wave. [2]

12 (a) Fig. 12.1 shows an electrical circuit of some household appliances. The whole circuit is protected by fuse Z and has a supply voltage of 240 V.

Two identical lamps A and B, marked '60 W 240 V', are connected to the live wire through fuse X.

An electric kettle, marked '1500 W 240 V', is connected to the live wire through fuse Y. It has a metal case which is connected to the Earth wire.

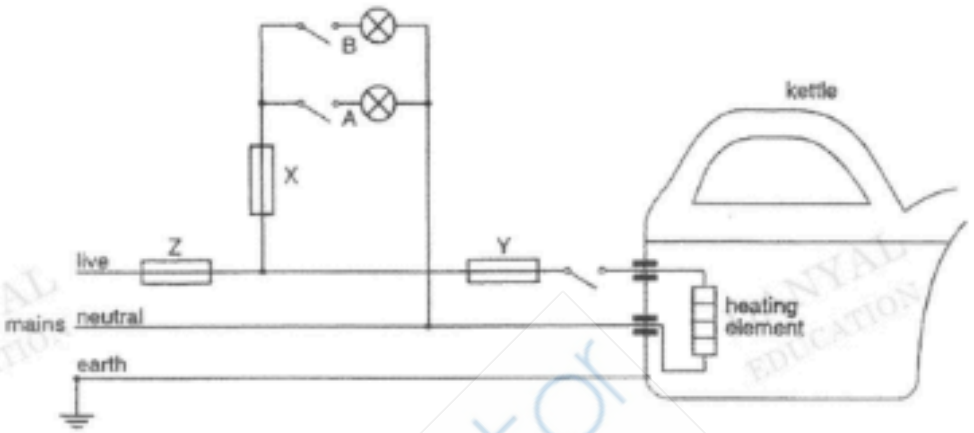


Fig. 12.1

When all the switches are closed,

(i) calculate the current in the electric kettle, and

current in electric kettle = ... [1]

(ii) calculate the total current of the circuit.

total current of circuit = ... [3]

(iii) All three appliances are used for 10 min daily. Calculate the total energy consumption of all three appliances for a month of 30 days. Leave your answer in kWh.

total energy consumption = ... [2]

(iv) Given that 1 kWh of energy costs 20 cents, calculate the total cost of using all three appliances for a month of 30 days.

total cost = ... [2]

(b) Fig. 12.2 shows the circuit of a simple electrical circuit breaker.

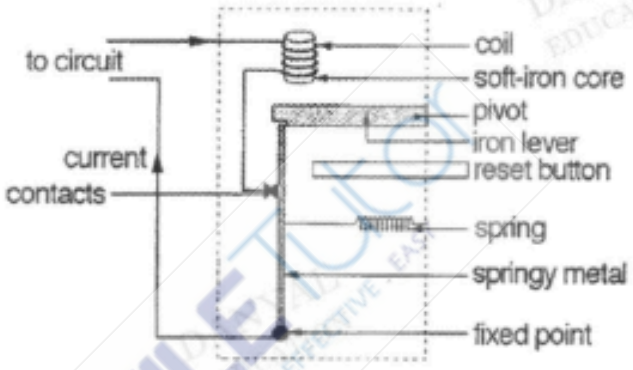


Fig. 12.2

In the event of an electrical fault, the current in the circuit will become very high and the circuit breaker will be activated.

Describe what happens to the soft-iron core, iron lever, spring and contacts in the circuit breaker when it is in operation.

.....

.....

..... [2]

END OF PAPER

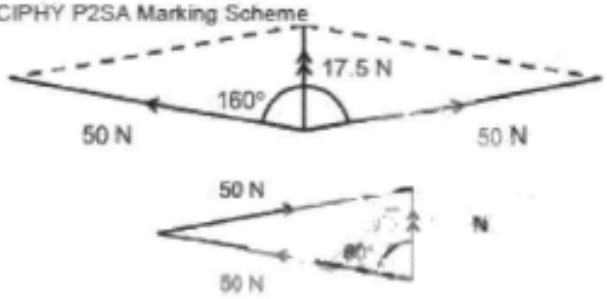
ANSWER SHEET

SSS 2022 4E5N Sci Physics Prelim Paper 1 Mark Scheme [20 marks]

1. D	11. B
2. B	12. B
3. D	13. D
4. C	14. B
5. D	15. C
6. A	16. C
7. A	17. A
8. D	18. C
9. B	19. D
10. A	20. B

2022 SSS 4E5N Prelim SCIPHY P2SA Marking Scheme

1 (a)



OR

1m — correct parallelogram / tip to tail method with resultant force shown
1m — W = 17.5 N (accept 16.0 N to 19.0 N)

Deduct 1m if no / inappropriate scale written: 1 cm to 5N
Deduct 1m if no / wrong arrowheads / wrong arrowhead direction
(1 arrowhead for tension & 2 arrowheads for resultant force) [2]

(b) $W = mg$

$m = \frac{W}{g} = \frac{17.5}{10}$ — M1

$m = 1.75\ kg = 1750\ g$ — A1

ECF given for "(a) divide by 10" [2]

2 (a) $speed = \frac{distance}{time} = \frac{8}{20}$ (gradient of d-t graph) — M1

$speed = 0.80$ m/s — A1 [2]

(b) 1m — From t = 10 s to t = 15 s, the cyclist was stationary / not moving.
1m — From t = 15 s to t = 35 s, the cyclist was travelling at a constant speed of 0.40 m/s. ($\frac{8}{20} = 0.40$) [2]

3 (a) $M = F \times d = 3000 \times 2.0 = 6000$ Nm — B1 [1]

(b) 1m — If the digger moves forward any further, the line of action of the weight of the digger will lie outside the base area of the digger.
DNA: "line of action of centre of gravity" / "centre of gravity or weight lie outside the base area"

1m — This will result in a resultant clockwise moment about point B (the clockwise moment about point B will be more than the anticlockwise moment about point B), causing the digger to fall over.
DNA: "sum of CWM not equal to sum of ACWM" [2]

4 (a) $WD = F \times d = (50)(10)(0.50)$ — M1
$WD = 250$ J — A1 [2]

(b) 1m — Gravitational potential energy [1]

(c) KE loss = GPE gain
$1750 = mgh = (50)(10)(h)$
$h = \frac{1750}{(50)(10)}$ — M1
$h = 3.5$ m — A1 [2]

5 **(a)** 1m – conduction and convection [1]

(b) 1m – The heater will heat up the **water at the bottom** of cylinder B and cause it to expand, **becomes less dense and rise**.

1m – The **cooler and denser water at the top** of the cylinder **will sink** to replace the water at the bottom.

1m – This cycle will repeat to **form convection currents** until all the water is heated up in cylinder B. [3]

(c) 1m – water is a **poor conductor of heat** / **convection currents are near the top and take a longer time** to reach the thermometer. [1]

6 **(a)** E = P x t = (800)(10 x 60) --- M1
E = 480000 J --- A1 [2]

(b) Substance X is changing from gaseous state to liquid state / undergoing condensation.
1m --- The particles are **losing internal potential energy as the intermolecular forces become stronger / the particles become closer together**.
1m --- Since there is **no change in the internal kinetic energy**, there is no change in temperature / temperature remains constant. [2]

(c) Method 1:

$P = I^2R$

$R = \frac{P}{I^2} = \frac{800}{4.0^2}$ --- M1

$R = 50\ \Omega$ --- A1

Method 2:

$P = IV$

$V = \frac{P}{I} = \frac{800}{4.0} = 200\ V$ --- M1

$R = \frac{V}{I} = \frac{200}{4.0} = 50\ \Omega$ --- A1 [2]

7 **(a)**

1m for correct light rays (1 in glass layer, 1 in air with normal)
-1m for missing arrowheads / wrong direction
-1m for wrong angle of reflection at mirror (40°) / angle of refraction in air (75°)
-1m for missing / wrong normal [1]

(b) **(i)** $\sin c = \frac{1}{n} = \frac{1}{1.6}$

$c = \sin^{-1}\frac{1}{1.6} = 38.682° = 38.7°$ (1 d.p.) --- 1m [1]

(ii) 1m – The light ray will **undergo total internal reflection** as
1m – the **angle of incidence (40°) is more than the critical angle (38.7°)** and it is **travelling from an optically denser medium to an optically less dense medium**. [2]

8 **(a)** 1m --- When the negatively charged rod is brought near the right side of the metal ball, **the free moving negative charges in the metal ball will be repelled and move to the other end of the metal threads**.
1m --- Since the other end of the metal threads are negatively charged, they will move away from one another as **like charges repel**. [2]

(b) **(i)** V = I x R
$I = \frac{V}{R} = \frac{6}{4}$ --- M1
I = 1.50 A (3 s.f.) --- A1 [2]

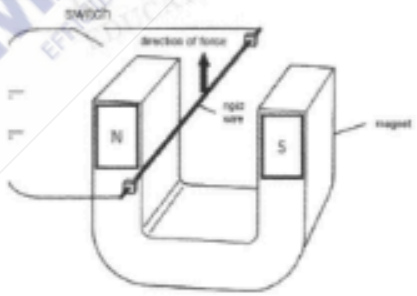
(ii) $R = \frac{V}{I} = \frac{3}{1.5} = 2.00\ \Omega$ (3 s.f.) --- B1
ECF given for "3 / (i)" [1]

(iii) $R_T = \left(\frac{1}{R_{X+Y}} + \frac{1}{R_{Z+10}}\right)^{-1} = \left(\frac{1}{2+2} + \frac{1}{2+4}\right)^{-1} = \left(\frac{1}{4} + \frac{1}{6}\right)^{-1}$ --- M1
$R_T = 2.40\ \Omega$ (3 s.f.) --- A1 [2]

9 **(a)** **(i)** 1m --- When switch S is closed, both **iron rods will be magnetized by direct current / become induced magnets / become electromagnets**.
1m --- The **same** end of the rods will be induced with the same **poles. Since like poles repel, the rods will roll away from each other.** [2]

(ii) 1m --- When switch S is opened, the **iron rod will lose its magnetism** as it is a soft magnetic material, and the **steel rod will retain its magnetism** as it is a hard magnetic material.
1m --- The **iron rod will be magnetized by induction / become an induced magnet by the steel rod with unlike poles next to the steel rod. Since unlike poles attract, the rods will move towards each other.** [2]

(b) (i)



[1]

(ii) 1m --- For a bigger force: **increase the current** flowing through the wire / **use a stronger magnet** / **increase magnetic field strength**
DNA: "add more batteries" without mentioning "increase current"

1m --- For downward force: **reverse the direction of flow of current** / **polarity of the magnet** [2]

2022 SSS 4E5N Prelim SCIPHY P2SB Marking Scheme

10 (a) (i) Average speed

$= \frac{total\ distance}{total\ time}$

$= \frac{\left(\frac{1}{2}\times 6\times 20\right)+\left(\frac{1}{2}(6+7)20\right)}{40}$ --- M1 for finding correct total distance

$= \frac{190}{40}$

= 4.75 m/s --- A1 for finding correct average speed [2]

(ii) 1m --- There is an **increase in the resistive forces**.

1m --- The **acceleration** (of the moving car between C and D) **is decreasing**. Hence, the **resultant force is decreasing**.

$F_R(decrease) = F_{engine}(constant) - f(increase)$ [2]

(b) (i) W = mg = (4.0)(10) --- M1

W = 40 N --- A1 [2]

(ii) M = F x d = (40)(0.1) --- M1

M = 4.0 Nm --- A1 [2]

(iii) About P,

Sum of clockwise moments = Sum of anticlockwise moments

F x 0.5 = 4 --- M1

F = 8.0 N --- A1 [2]

11 (a) (i) $P = \frac{F}{A} = \frac{250}{20\times 10^{-4}}$ --- M1

P = 125000 Pa or 1.25 x 10^5 Pa --- A1 [2]

(ii) F = P x A = 125000 x (5 x 10^{-4}) --- M1

F = 62.5 N --- A1 [2]

(iii) 1m --- Oil is not compressible / air can be compressed.

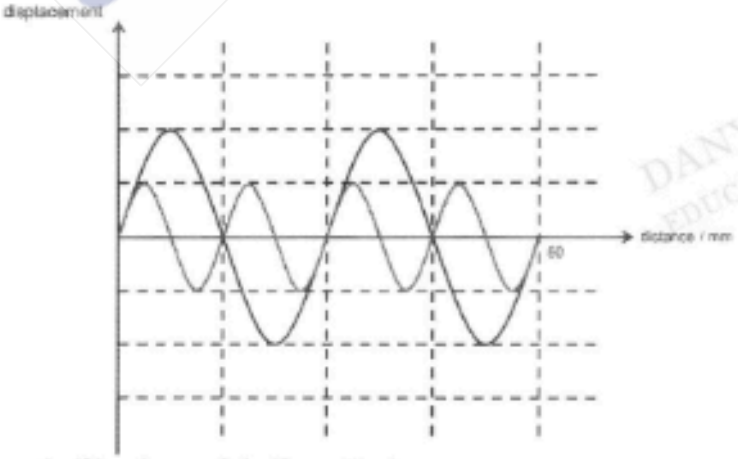
1m --- This maintains the **pressure to be constant throughout the whole brake fluid.** (Higher efficiency of transmission of pressure through the fluid) [2]

(b) (i) $v = f\lambda$ (wavelength value taken from graph)

$f = \frac{v}{\lambda} = \frac{1500}{30\times 10^{-3}}$ --- M1

f = 50000 Hz --- A1 [2]

(ii)



1m – half loudness → half amplitude

1m – double pitch → double frequency → half wavelength [2]

12 **(a)** **(i)** $P = IV$

$I = \frac{P}{V} = \frac{1500}{240} = 6.25$ A --- B1 [1]

(ii) Current in each lamp = $\frac{60}{240} = 0.25$ A --- M1

Current in both lamps = current in each lamp x 2

$I = 0.25 \times 2$ --- M1

$I = 0.5$ A

Total current of circuit = 0.5 + 6.25 = 6.75 A --- A1 [3]

(iii) $E = Pt = \left(\frac{60+60+1500}{1000}\right)\left(\frac{10}{60} \times 30\right)$ --- M1

$E = (1.62)(5) = 8.1$ kWh --- A1 [2]

(iv) Total cost = 8.1 x \$0.20 --- M1

= \$1.62 --- A1 [2]

(b) 1m --- When the current is very high, the soft-iron core will be magnetized and become strong enough to attract the iron lever upwards.

1m --- Without the iron lever to hold the springy metal in place, the spring will pull the springy metal to the right and the contacts will be broken, thus breaking the circuit. [2]

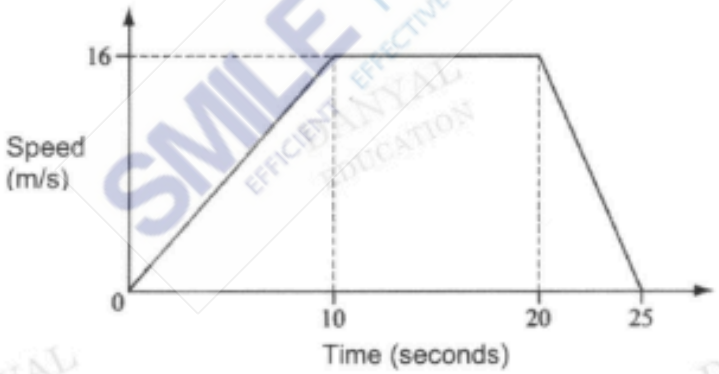
YUYING SECONDARY SCHOOL PRELIM PAPER

1. The time taken for a pendulum to swing from P to Q is shown in the stopwatch.

What is the period of the pendulum?

A 5.07 s
B 10.14 s
C 5 min 07 s
D 10 min 14 s

2. A speed-time graph of an object moving in a straight line is shown below.



What is the average speed of the object over 25 seconds?

A 11.2 m/s
B 13.5 m/s
C 16.0 m/s
D 22.4 m/s

3. A 4 kg object is moving with constant speed along a flat ground when the applied force is 6 N.

Which of the following describes its motion correctly when the applied force increased to 10 N?

A The object continues to move with the same constant speed.
B The object moves with a higher constant speed.
C The object moves with a constant acceleration of 1 m/s^2.
D The object moves with a constant acceleration of 2.5 m/s^2.

4. The diagram shows a single brick and a pile of 2 bricks.
All the bricks are identical.

Compared to the single brick, the pile of bricks has

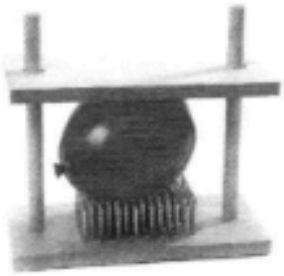
A the same density but two times the mass and volume.
B the same volume but two times the mass and density.
C the same mass but two times the volume and density.
D two times the mass, volume and density.

5. A tumbler toy is one that can be toppled over and then straighten up by itself.

What are the key design features for such a toy?

A heavy top to produce a low centre of gravity
B heavy bottom to produce a low centre of gravity
C light bottom to produce a high centre of gravity
D light top to produce a high centre of gravity

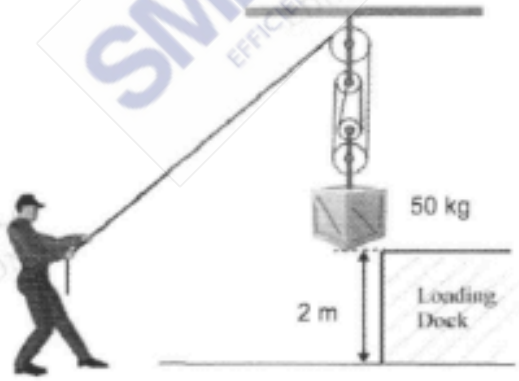
6. A balloon can be burst easily by a single nail but it does not burst when pressed against a bed of nails.



Which of the following best explains why?

A The pressure is spread over a larger contact area which reduces the applied force.
B The pressure is spread over a smaller contact area which increases the applied force.
C The applied force is spread over a smaller contact area which increases the pressure.
D The applied force is spread over a larger contact area which reduces the pressure.

7. A worker raises a 50 kg load up by 2 m above ground in 5 seconds. The gravitational field strength, g is 10 N/kg.



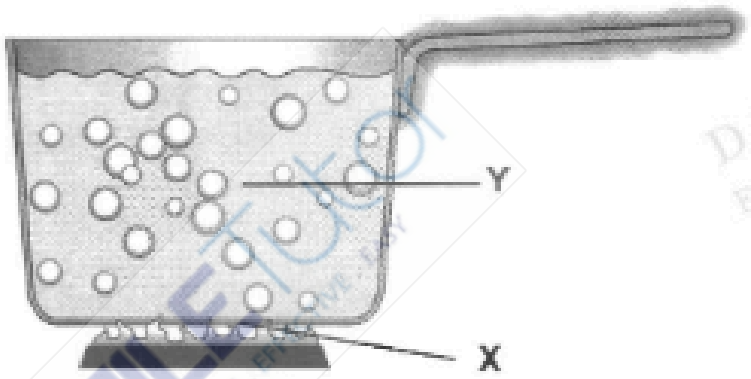
What is the useful power during the lifting operation?

A 20 W
B 50 W
C 200 W
D 500 W

8. A solid is heated.
Which statement about the molecules in the solid is **not** correct?

A They gain energy.
B They expand.
C They vibrate faster.
D They occupy more space.

9. A pot is used to boil water as shown in the diagram.



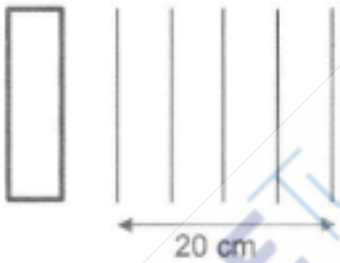
Which of the following is the main method of heat transfer in the region marked by X and Y?

	X	Y
A	conduction	convection
B	conduction	radiation
C	radiation	convection
D	convection	conduction

10. Which of the following comparison between boiling and evaporation is **not** correct?

A Boiling occurs throughout the entire liquid but evaporation only occurs at the surface.
B Boiling is a quick process but evaporation is a slow process.
C Boiling absorbs heat from surrounding but evaporation requires a constant heating source
D Bubbles are seen during boiling but not during evaporation.

11. A wave generator produces 10 oscillations in one second to form the following wave pattern. The distance between two crests shown is 20 cm.



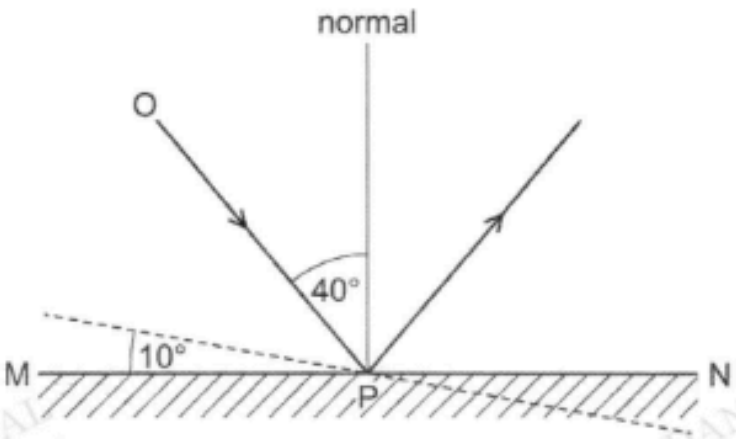
What is the speed of the wave?

A 0.2 m/s
B 0.5 m/s
C 1.0 m/s
D 2.0 m/s

12. Medium X has a refractive index of 1.25.
What is the speed of light in medium X?

A 3.75×10^8 m/s
B 3.00×10^8 m/s
C 2.40×10^8 m/s
D 0.75×10^8 m/s

13. The angle of incidence of ray OP on the plane mirror MN is 40°.



The mirror is rotated through 10°, as shown by the dashed line.
The direction of the incident ray OP does not change.

What is the new angle of incidence?

A 30°
B 40°
C 50°
D 60°

14. Which of the following shows part of the electromagnetic spectrum, arranged in the order of decreasing frequency?

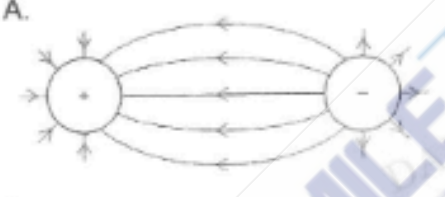
A ultraviolet rays, gamma rays, X-ray
B gamma rays, microwave, infra-red radiation
C radio wave, ultraviolet rays, microwave
D X-ray, microwave, radio wave

15. A sound was produced by a flute. Another louder sound of a lower pitch was produced by a tuba.
Which of the following is correct when we compare the sound from the flute to the sound from the tuba?

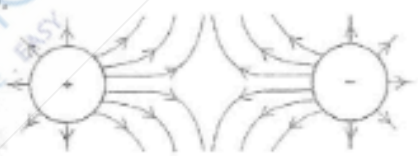
	amplitude of sound from flute	frequency of sound from flute
A	higher	higher
B	lower	higher
C	higher	lower
D	lower	lower

16. Which of the following diagrams show the electric field pattern between two charged spheres?

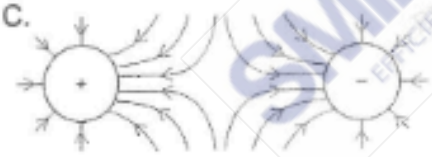
A.



B.



C.



D.

17. A wire of length 1.0 m and a cross-sectional area of 0.5×10^{-6} m^2 has a resistance of 2.0 Ω. Another wire of the same material has a length of 3.0 m and a cross-sectional area of 1.5×10^{-6} m^2.

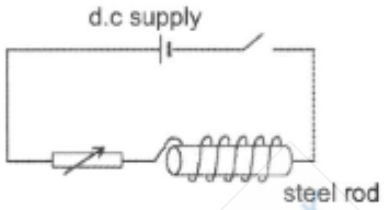
What is the resistance of the longer wire?

A 2.0 Ω
B 3.0 Ω
C 6.0 Ω
D 9.0 Ω

18. An electric heater takes a current of 5 A from a 240 V supply when operating normally. How long would it take for the heater to convert 4.8 MJ of electrical energy?

A 400 s
B 1000 s
C 4000 s
D 100,000 s

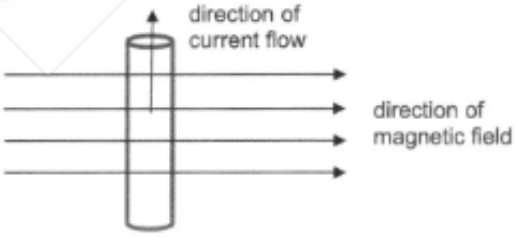
19. The diagram shows a circuit used to magnetise a steel rod.



Which statement describes how the steel rod can be **demagnetised**?

A Reverse the d.c supply and gradually increase the current in the circuit.
B Reverse the d.c supply and gradually decrease the current in the circuit.
C Use an a.c supply and gradually increase the current in the circuit.
D Use an a.c supply and gradually decrease the current in the circuit.

20. A current-carrying conductor is in a magnetic field. The directions of current flow and magnetic field are shown.



What is the direction of the force on the wire?

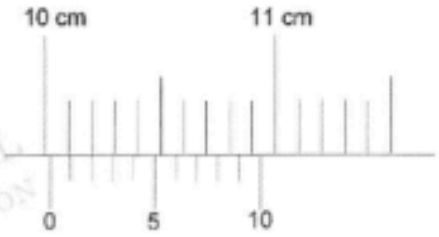
A out of the paper
B into the paper
C to the right of the paper
D to the left of the paper

Section A

Answer **all** questions in this section.
The total mark for this section is 45.

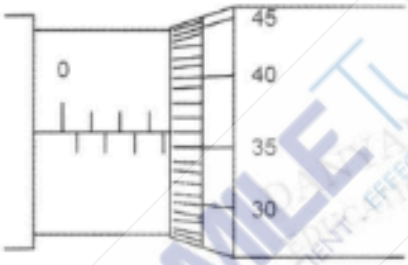
1. The following diagrams show the scales of some measuring instrument. Write down the readings for each instrument.

a) Vernier Caliper



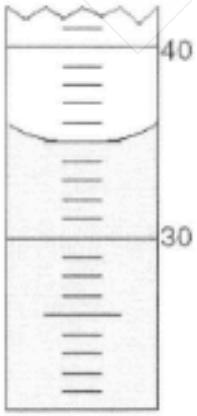
reading: ..... cm [1]

b) Micrometer Screw Gauge



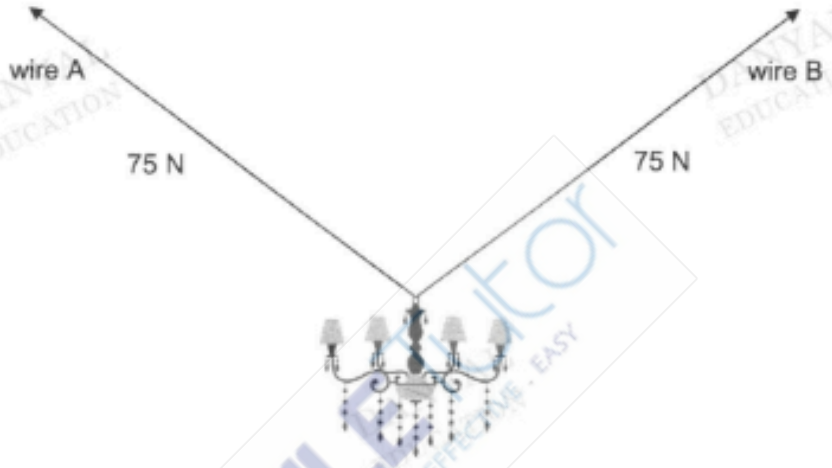
reading: ..... mm [1]

c) Measuring cylinder



reading: ..... cm^3 [1]

2. A chandelier is supported by two wires A and B as shown in the following diagram.



The tension in each wire is 75 N.
The above diagram is drawn to scale.
Complete the above diagram to determine the weight of the chandelier.
State the scale of the diagram.

scale = ... [1]

weight of chandelier = ... N [2]

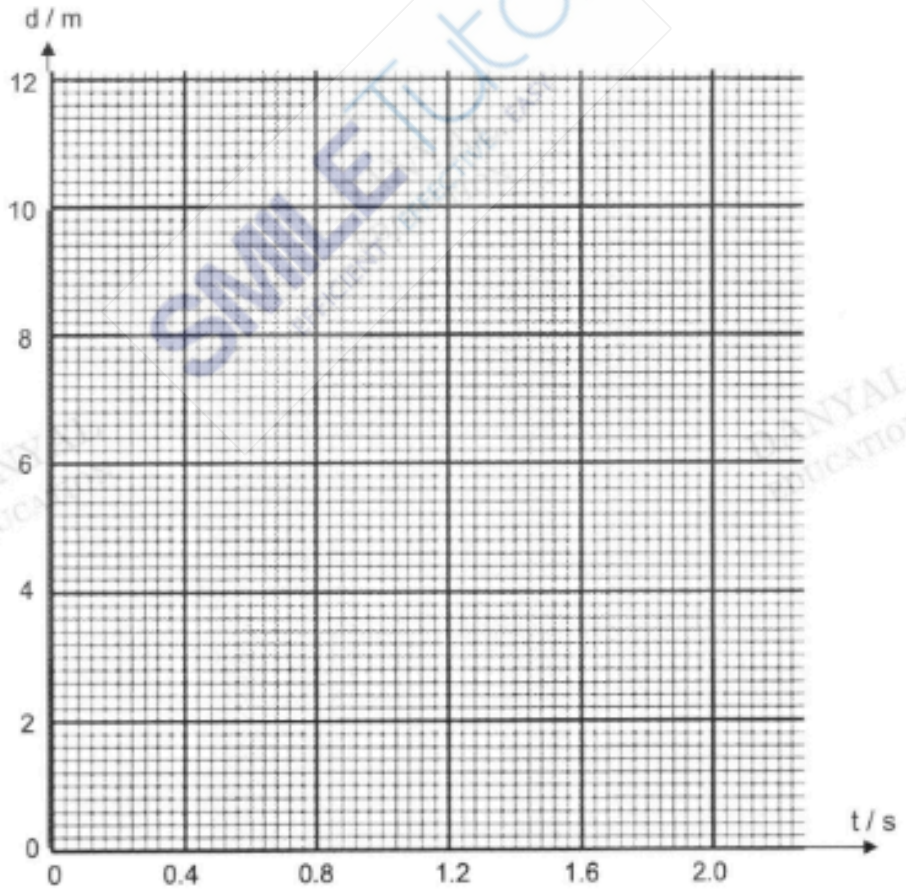
3. A badminton shuttlecock is a light, cone-shaped object with a large surface area. In an experiment using electronic apparatus, a shuttlecock is released from rest and the distance d fallen is measured at different time t.

The results obtained are shown in the table.

t /s	d /m
0	0
0.40	0.60
0.80	2.20
1.20	4.20
1.60	6.70
2.00	9.20

a) On the grid provided, plot these results, marking each point with a cross (x). [1]

b) Draw a curve line of best fit taking into account all the plotted points. [1]



c) From your graph, determine the uniform speed of the shuttlecock.

uniform speed = ... m/s [2]

d) Explain, in terms of forces acting on the shuttlecock, why it reaches a uniform speed.

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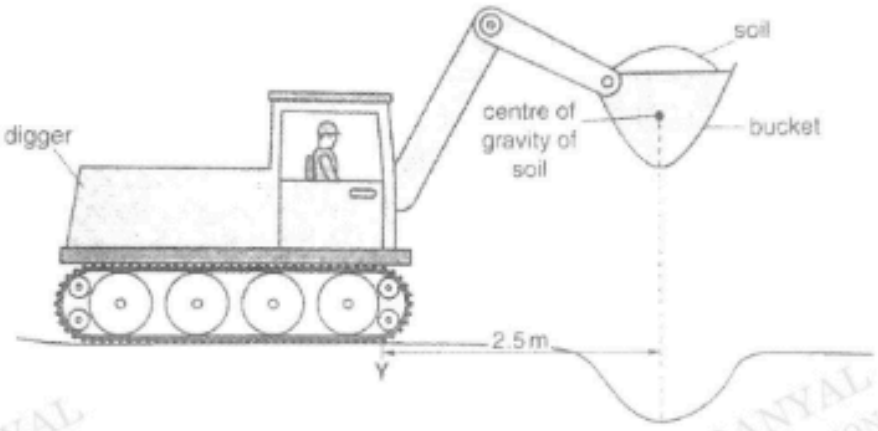
.....[2]

4. The diagram shows a mechanical digger which is used to remove soil from the ground.



The bucket of the digger contains 1.2×10^6 cm^3 of soil.
The density of the soil is 2.5 g/cm^3.
The gravitational field strength is 10 N/kg.

a) Calculate the mass of the soil.

mass of soil = ... kg [2]

b) The centre of gravity of the soil is a horizontal distance 2.5 m from the front edge Y of the tracks in contact with the ground.
Calculate the moment of the soil about Y.

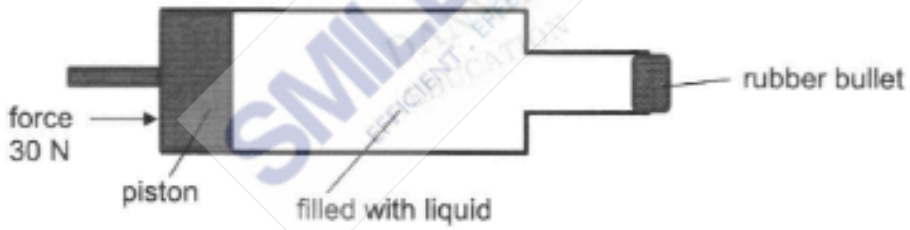
moment about Y = ... Nm [3]

c) The centre of gravity of the digger is located at a horizontal distance of 1.5 m away from Y.

Calculate the minimum weight of the digger needed to prevent it from toppling at the current position.

minimum weight of digger = ... N [2]

5. A toy consists of a piston designed to fire a rubber bullet using liquid pressure.



The cross-sectional area of the piston is 15 cm^2.
The cross-sectional area of the nozzle with the rubber bullet is 5 cm^2.

a) Calculate the pressure exerted by the piston on the liquid when the applied force is 30 N.

pressure = ...N/cm^2 [2]

b) For safety reason, the force pushing out the rubber bullet should be smaller than the applied force.
Explain how this is achieved in the toy.

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..... [2]

6. At a sharp corner on a racing circuit there is an escape lane, as shown in the following diagram.

The escape lane is a bed of small stones. A car of mass 700 kg approaches at a speed of 40 m/s. The brake fails and the car stops in the escape lane.

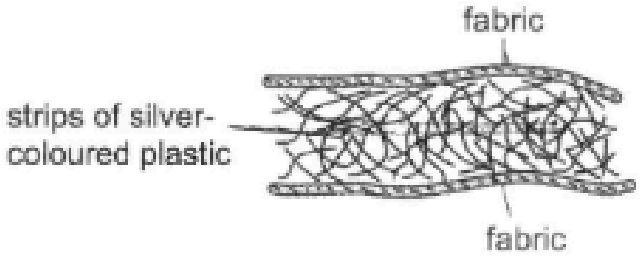
a) Calculate the kinetic energy of the car as it approaches the corner.

kinetic energy = ... J [2]

b) The car comes to rest 80 m along the escape lane.
Calculate the average frictional force on the car in the escape lane.

frictional force = ... N [2]

7. The following diagram shows the design of a type of insulating material used for making coats in cold countries. It consists of a layer of silver-coloured thin plastic strips inserted between two layers of fabric. The plastic strips trap small pockets of air between them.



Explain why the layer of plastic strips reduces loss of thermal energy by

a) conduction, ...

.....

.....

.....[2]

b) convection, ...

.....

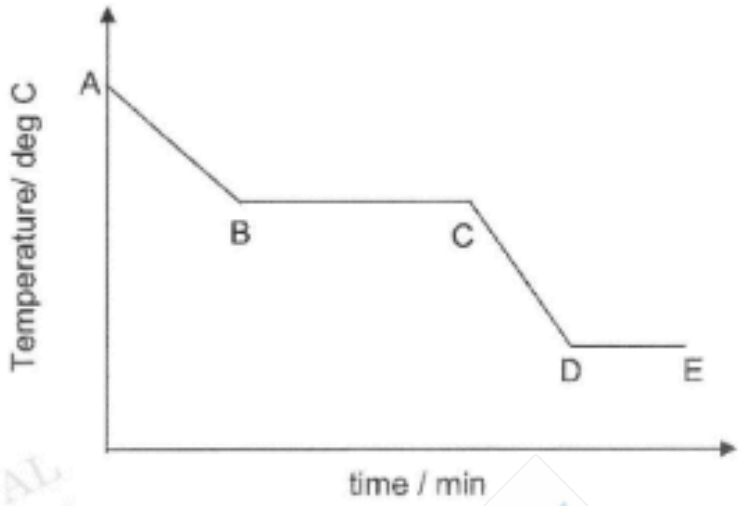
.....[1]

c) radiation, ...

.....

.....[1]

8. The graph shows the cooling curve of liquid P.



a) State the process occurring along BC: ..... [1]

b) Explain why the temperature remains constant along BC.

.....

.....

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.....[2]

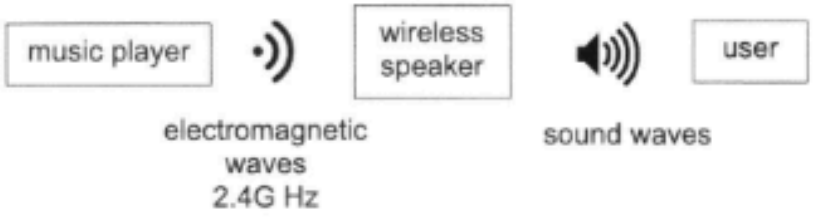
c) Explain why the temperature remains constant along DE.

.....

.....[1]

9. Electromagnetic waves are used in many applications in our lives.

A wireless speaker receives signals from the music player via electromagnetic waves. It converts the signals into sound and project the music to the users as sound waves.



a) State **two** differences between electromagnetic waves and sound waves.

.....

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.....

.....

.....[2]

b) Calculate the wavelength of the electromagnetic waves signal between the music player and the wireless speaker.

wavelength = ... m [2]

c) State the type of electromagnetic waves for the following applications.

intruder alarm : .....

satellite communications : ..... [2]

10. A battery has an output potential difference of 6.0 V and is connected to a lamp. The current in the lamp is 2.5 A.

a) Calculate the amount of charge passing through the lamp in 5 minutes.

charge = ... C [2]

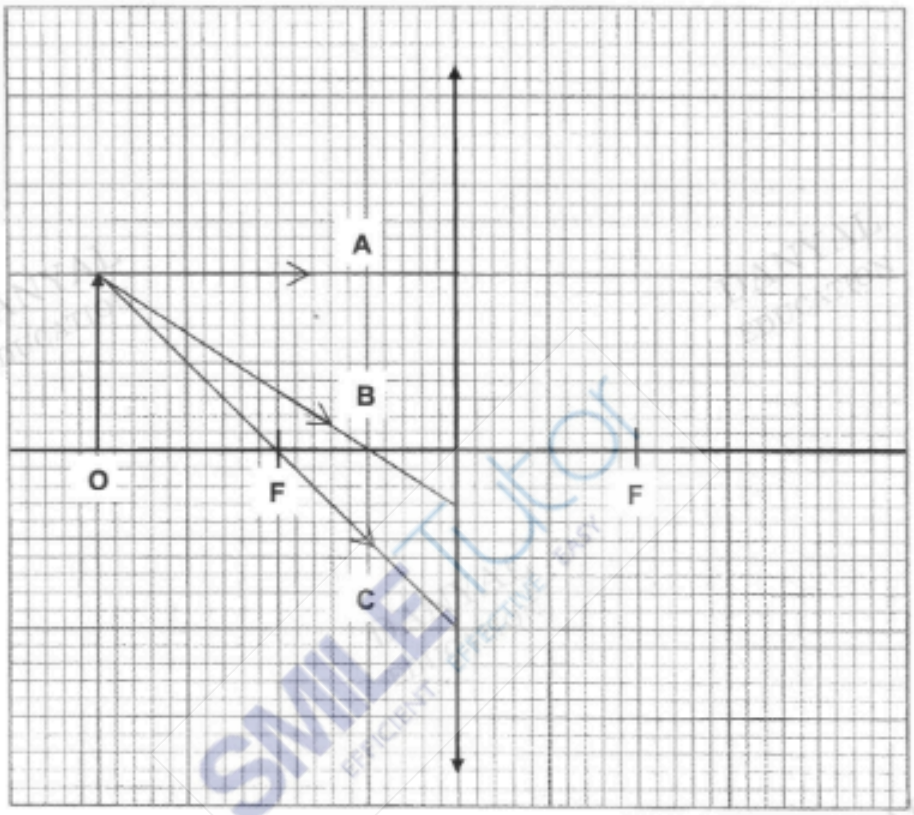
b) Calculate the electrical energy delivered to the lamp in 5 minutes.

energy = ... J [2]

Section B

Answer any **two** questions from this section in the spaces provided.
The total mark for this section is 20.

11. An object is placed 20 cm away from the thin converging lens, as shown below.



F is the principal focus of the lens.

a) Use light ray A and C to locate the position of the image.
Draw an arrow to represent the image. [2]

b) Use the image to complete the path of light ray B after passing the lens. [1]

c) Describe the **three** characteristics of the image formed.

.....[1]

d) The phenomenon of light rays changing directions after passing through a medium is known as the refraction of light.
Under certain conditions, total internal reflection will occur instead of refraction.

State the two conditions necessary for total internal reflection to occur.

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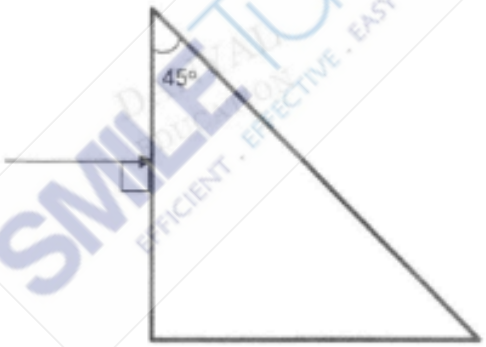
.....[2]

e) A light ray is incident normally on one face of the glass prism as shown.

The refractive index of the glass prism is 1.50.

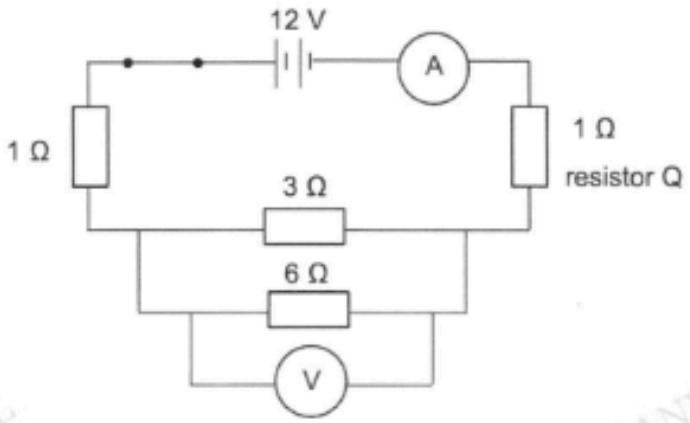


(i) Calculate the critical angle.

critical angle = ...° [2]

(ii) Complete the diagram to show the path of the light ray in the prism and in the air beyond the prism. Label all the relevant angles clearly in the drawing. [2]

12. An electric circuit is set up as shown in the following diagram.



a) Calculate the total resistance of the circuit.

total resistance = ... Ω [2]

b) Determine the reading of the ammeter.

ammeter reading = ...A [2]

c) Determine the reading of the voltmeter.

voltmeter reading = ... V [2]

d) Calculate the power dissipated in resistor Q.

power = ... W [2]

e) The 3 Ω resistor is subsequently removed from the circuit.
Explain the change in the voltmeter reading across the 6 Ω resistor.

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.....[2]

13. An electric grass cutter has a power of 1250 W and it operates with a 240 V mains electric supply.

a) A fuse is used to protect the grass cutter when a fault develops. Explain why a 3 A fuse would not be suitable to protect the grass cutter.

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.....[2]

b) In some circuits, a circuit breaker is used to do the same job as a fuse. Fig 13.1 shows a circuit breaker with the contacts closed.

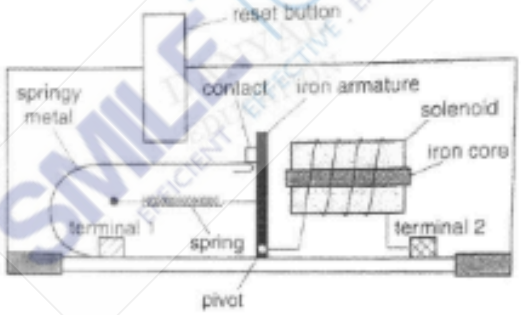

Fig. 13.1

Fig. 13.2 shows the circuit breaker after a large current has passed through the circuit.

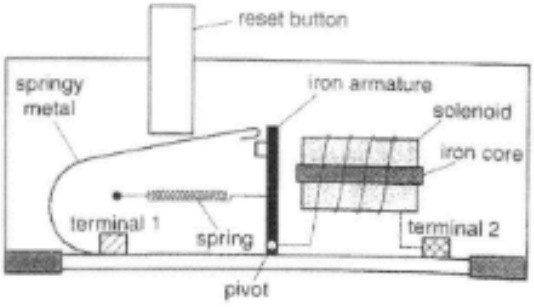

Fig. 13.2

Describe what happens in the circuit breaker when large current above its rating enters the circuit breaker.

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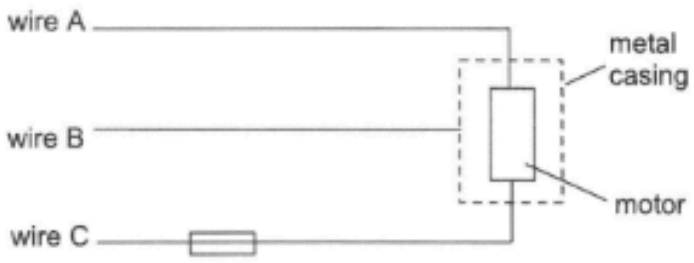
.....[3]

c) The grass cutter operates an average of 30 hours per month.
The cost of electrical energy is 26 cents per kWh.
Calculate the average cost of using the grass cutter per month.

cost = $..... [2]

d) There are 3 wires from the mains connected to the grass cutter.



i. Identify the wires and their colours by completing the following table.

wire	name of wire
A	
B	
C	

[1]

ii. Explain why the fuse is connected on wire C?

.....

.....

.....[1]

iii. Explain how wire B can protect the user?

.....

.....

.....[1]

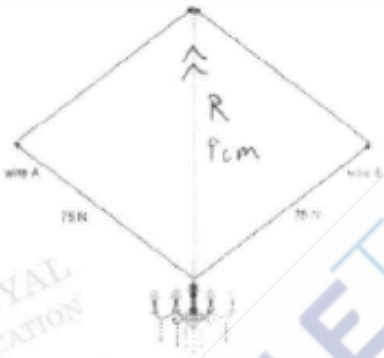
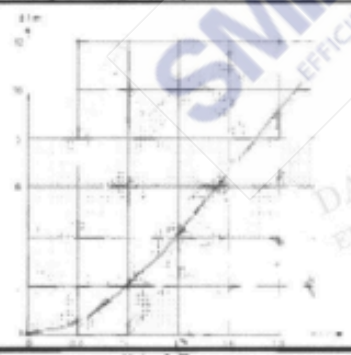
END OF PAPER

ANSWER SHEET

Paper 1

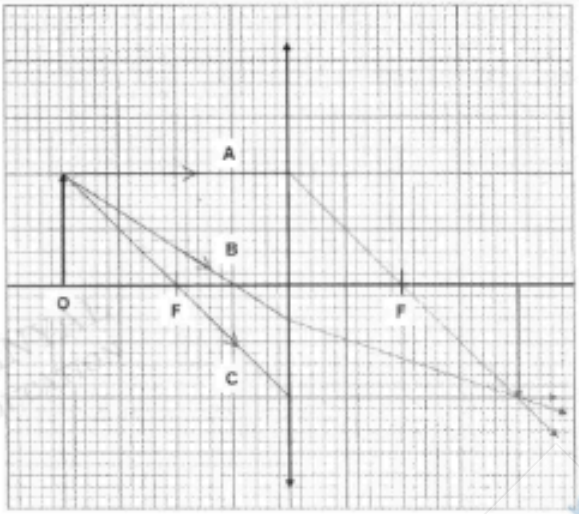
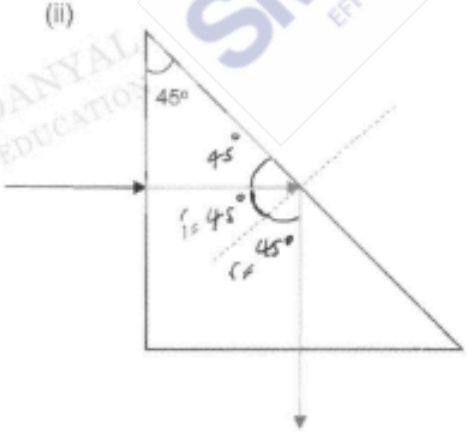
1	2	3	4	5	6	7	8	9	10
B	A	C	A	B	D	C	B	A	C
11	12	13	14	15	16	17	18	19	20
B	C	C	D	B	D	A	C	D	B

Section A

Qn	Solutions	Remarks
1a	10.02	
1b	3.86	
1c	35	
2	 [1] Scale = 1: 10 [1] Weight = 90 N [1]	Completion of vector diagram [1] Correct scale [1] Correct resultant [1] (allows range 88 – 92 N)
3a/b		Correct data points [1] Draw best fit curve [1]
3c	Gradient = $\frac{(9.2-4.2)}{(2.1-1.2)}$ = 6.25 m/s	M1 A1
3d	The weight and the air resistance are equal. The resultant force is zero so acceleration is zero and speed is uniform.	Weight = air resistance [1] (if students stated forces are balanced but did not highlight air resistance and weight, award [A0.5]) Resultant force = 0 N [A0.5] a = 0 m/s^2 [A0.5]

4a	Mass of soil = density x vol = 2.5 x 1.2 x10^6 = 3,000,000 g = 3000 kg	M1 A1
4b	Weight = 3000 x 10 = 30,000 N Moment = weight x distance = 30,000 x 2.5 = 75,000 Nm	A1 M1 A1 Allows for ecf from 4a
4c	Clockwise moment = anticlockwise moment W x 1.5 = 75,000 W = 50,000 N	M1 A1 Allows for ecf from 4a,b
5a	Pressure = force ÷ area = 30 ÷ 15 = 2 N/cm^2	M1 A1
5b	The pressure is consistent throughout the liquid. (pressure exerted by the liquid on the rubber bullet is equal to the pressure exerted on the liquid by the applied force) With a smaller cross-sectional area at the nozzle, the force pushing the rubber bullet will also be smaller.	A1 A1
6a	KE = 0.5 x m x v^2 = 0.5 (700) (40 x 40) = 560,000 J	 M1 A1
6b	Work done = KE F x 80 = 560,000 F = 7000 N	 M1 A1
7a	Plastic is a poor conductor of heat. The strips created many pockets of air and air is also a poor conductor of heat.	A1 A1
7b	The pockets of air cannot move freely to create a convection current for heat transfer.	A1

Section B

Qn	Solutions	Remarks
11ab		Complete ray A and C – A1 each Draw image – A1 Complete ray B – A1
11c	Real, inverted, same size	A1 (no 0.5)
11d	Light must be travelling from an optically denser medium towards an optically less dense medium. The angle of incidence must be greater than the critical angle.	A1 A1
11e	(i) $\sin c = 1 \div n$ $c = \sin^{-1}(1 \div 1.50)$ $c = 41.8°$ (ii) 	M1 A1 indicate i – A0.5 indicate r – A0.5 horizontal ray within prism – A0.5 vertical ray out of prism – A0.5

12a	Total resistance = $1 + 1 + (\frac{1}{6} + \frac{1}{3})^{-1}$ = 4 Ω	M1 A1
12b	I = emf ÷ R = 12 ÷ 4 = 3 A	M1 A1 Allows ecf for resistance in 12a
12c	pd across parallel resistors = emf – pd of two 1Ω = 12 – 3 (1) – 3(1) = 6 V Alt method includes using ohm's law on parallel group resistors (R = 2 Ω, V = 3 x 2 = 6 V)	M1 A1 Allows ecf for current in 12b
12d	P = VI = (3 x1) x 3 = 9 W	M1 A1 Allows ecf for current in 12b
12e	The total resistance increases. Circuit current decreases. Potential differences across the 1 Ω resistors drops. The potential difference across the 6 Ω resistor will be higher than before so voltmeter reading increases.	A0.5 A0.5 A0.5 A0.5
13a	I = P ÷ V = 1250 ÷ 240 = 5.21 A Operating current is greater than 3 A. The 3 A fuse will always melt and break the circuit so not suitable.	Calculate operating current – A1 Conclude – A1
13b	When large current enters, the iron core will become a stronger magnet. It can pull the iron armature towards the iron core. This will break the contact point with the springy metal. The circuit is opened and current will stop flowing. The iron core demagnetised. The iron armature is pulled back to its upright position by the spring.	A0.5 A0.5 A0.5 A0.5 A0.5 A0.5
13c	Cost = (1250 ÷1000) x (30) x ($0.26) = $9.75	M1 A1

13di	<table><tr><th>Wire</th><th>Name of wire</th></tr><tr><td>A</td><td>neutral</td></tr><tr><td>B</td><td>Earth</td></tr><tr><td>C</td><td>Live</td></tr></table>	A1 for all correct ans
13dii	So that when the fuse breaks the circuit, the appliance will not be connected to the live potential.	A1
13diii	The current will flow to the ground through wire B instead of the user if the metal casing becomes live during an electrical fault.	A1