Name:	Register Number:	Class:

4E 5N

BEDOK GREEN SECONDARY SCHOOL

4E 5N

Preliminary Examination 2018

SCIENCE (CHEMISTRY/BIOLOGY) 5078/01

Paper 1 Multiple Choice 21 August 2018

1 hour

Additional Material: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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

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

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this Question Booklet.
A copy of the Data Sheet is printed on page 16.
A copy of the Periodic Table is given on page 17.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **17** printed pages including the cover page.

[Turn Over

1 Which apparatus is most suitable to measure 21.20 cm^3 of hydrochloric acid?

A pipette

B burette

C measuring cylinder

D electronic top pan balance

2 Which method is suitable for obtaining pure ethanol from wine?

A filtration

B distillation

C crystallisation

D fractional distillation

3 An unknown white substance was found on a murdered victim's body. A crime scene investigator conducted a series of tests on the substance.

First, he dissolved the substance in water to form a colourless solution. Next, to a portion of the solution, he added aqueous sodium hydroxide dropwise. A white precipitate was formed. The precipitate did not dissolve when excess sodium hydroxide was added.

What is the white substance likely to be?

A zinc nitrate

B zinc sulfate

C calcium nitrate

D calcium sulfate

4 Which group of particles has eight electrons in their valence shells?

A Li^+, Na^+, Cl^-, S

B Li^+, Na^+, Cl^-, Ne

C H^+, Mg^{2+}, F^-, He

D S^{2-}, Na^+, O^{2-}, Ar

5 An element has the electronic configuration, 2.8.4. What is the identity of the element?

A sulfur

B silicon

C carbon

D nitrogen

6 Two elements react to form a compound with the chemical formula $\mathbf{X}_2\mathbf{Y}$.

This compound is able to conduct electricity when dissolved in water.

Which of the following pairs is most likely to be elements **X** and **Y**?

	X	**Y**
A	sodium	sulfur
B	magnesium	chlorine
C	oxygen	carbon
D	nitrogen	oxygen

7 Using the equation shown below, find the volume of oxygen needed to completely react with 36 dm^3 of CH_4 at room temperature and pressure.

$$CH_4\ (g) + 2O_2\ (g) \longrightarrow CO_2\ (g) + 2H_2O\ (g)$$

A 24 dm^3

B 36 dm^3

C 48 dm^3

D 72 dm^3

8 In a village, before using a cast iron wok, lemon juice is used to clean the surface of the wok. This is because

A the lemon juice is acidic and will react with iron surface to produce iron(II) salt.

B the lemon juice is acidic and will react with iron surface to produce iron(III) salt.

C the lemon juice is acidic and will remove the iron(III) oxide that is found on the surface.

D the lemon juice is acidic and will add on to the iron(III) oxide that is found on the surface.

9 Aluminium oxide can react with both acid and alkali to form a salt. What type of oxide is it?

A basic

B acidic

C neutral

D amphoteric

10 What result is obtained when liquid bromine is added to aqueous potassium chloride?

A A brown vapour forms.

B A silvery solid is formed.

C A green gas is produced.

D There is no visible reaction.

11 Element **Z** has the electronic configuration of 2.8.8.1. A scientist dropped a piece of element **Z** in cold water. What would his observation be?

A Element **Z** sinks to the bottom of the container and no bubbles was seen.

B Element **Z** floats on the surface of the water and some bubbles were seen.

C Element **Z** sinks to the bottom of the container and effervescence was seen.

D Element **Z** darts around the surface of the water, effervescence and sparks were seen.

12

The diagrams above show the results obtained when three different metallic discs of the same shape and size were dropped into dilute hydrochloric acid separately.

Which metal is likely to have been placed in each beaker?

	beaker 1	**beaker 2**	**beaker 3**
A	magnesium	copper	calcium
B	calcium	copper	magnesium
C	copper	magnesium	calcium
D	calcium	magnesium	copper

13 Nickel is between iron and lead in the reactivity series.

Which statement(s) can be deduced from its position in the reactivity series?

I Nickel forms effervescence with cold water.
II Nickel is obtained by heating nickel ore with carbon monoxide.
III Nickel reacts with dilute hydrochloric acid to produce hydrogen gas.

A **I** only

B **I** and **III**

C **II** and **III**

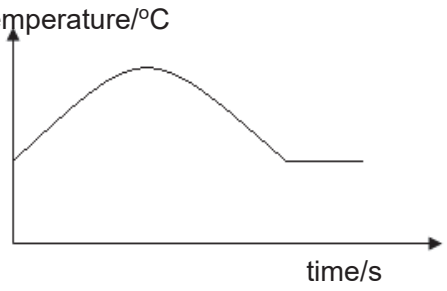
D **I**, **II** and **III**

14 Carbon monoxide, sulfur dioxide and oxides of nitrogen are all common pollutants of air. Which pollutant is shown with its correct source and its adverse effect on the environment?

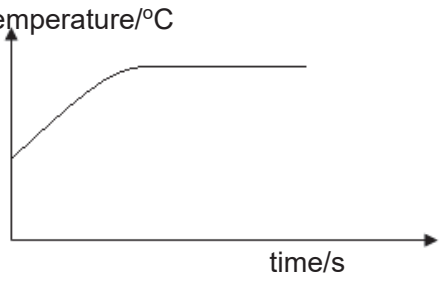
	pollutant	**source**	**effect on the environment**
A	carbon monoxide	combustion of fossil fuels	acid rain
B	carbon monoxide	lightning	global warming
C	oxides of nitrogen	lightning	acid rain
D	sulfur dioxide	volcanoes	global warming

15 Ammonium chloride was added to distilled water. Which graph correctly shows the change in temperature?

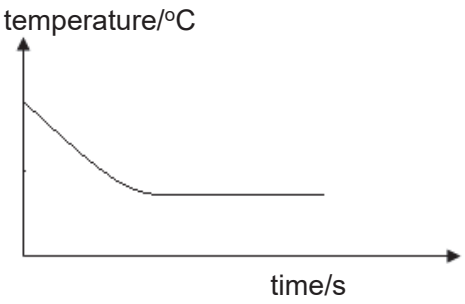
A



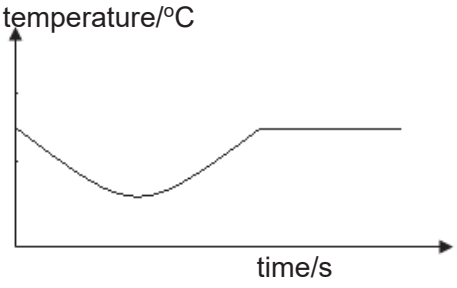
B



C



D



16 Acidified potassium manganate(VII) can be used to detect the presence of ethanol vapour in the breath of a person who has consumed alcohol.

If ethanol is present, a colour change is observed. What is the colour change observed?

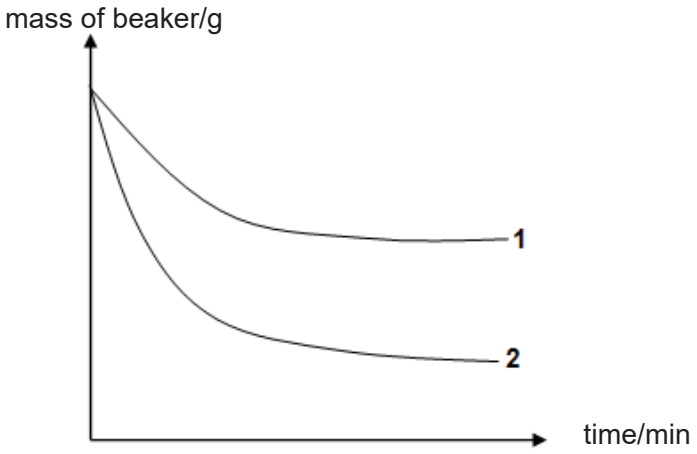
A colourless to brown

B purple to colourless

C colourless to purple

D brown to colourless

17 Excess magnesium was added to a beaker of dilute hydrochloric acid on an electronic mass balance. A graph of the mass of the beaker and contents was plotted against time (curve **1**).



What change in the experiment could give curve **2**?

I The same volume of a more concentrated solution of hydrochloric acid.
II The same mass of magnesium but in smaller pieces.
III A lower temperature.

A **I** only

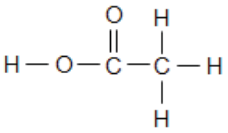
B **II** only

C **I** and **II** only

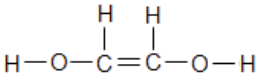
D **II** and **III** only

18 A compound with molecular formula $C_2H_4O_2$ dissolves readily in water to form an aqueous solution. When this aqueous solution reacts with magnesium and limestone respectively, bubbles of colourless gas are observed. What is the structural formula of this compound?

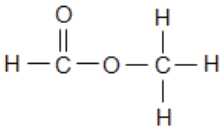
A



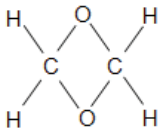
B



C

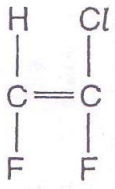


D



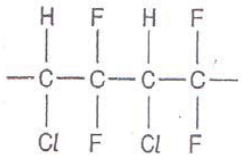
[Turn Over

19 The diagram shows the structure of a monomer.

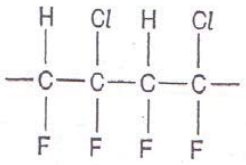


Which polymer can be made from this monomer?

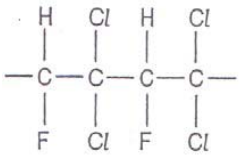
A



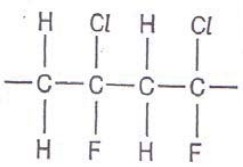
B



C

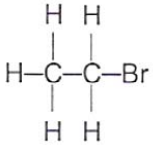


D

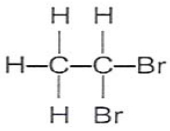


20 What is the structure of the product formed when ethene gas is passed through aqueous bromine?

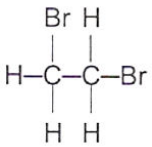
A



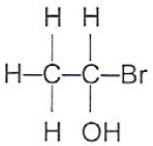
B



C



D



Name:	Register Number:	Class:

4E 5N

BEDOK GREEN SECONDARY SCHOOL

Preliminary Examination 2018

4E 5N

5076/03

5078/03

SCIENCE (CHEMISTRY)

Paper 3 Theory

15 August 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page 12.
A copy of the Periodic Table is printed on page 13.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A [45 marks]	
Section B [20 marks]	
Total [65 marks]	

This document consists of **13** printed pages.

[Turn Over

Section A

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

1 Fig. 1.1 shows the particles in six substances.

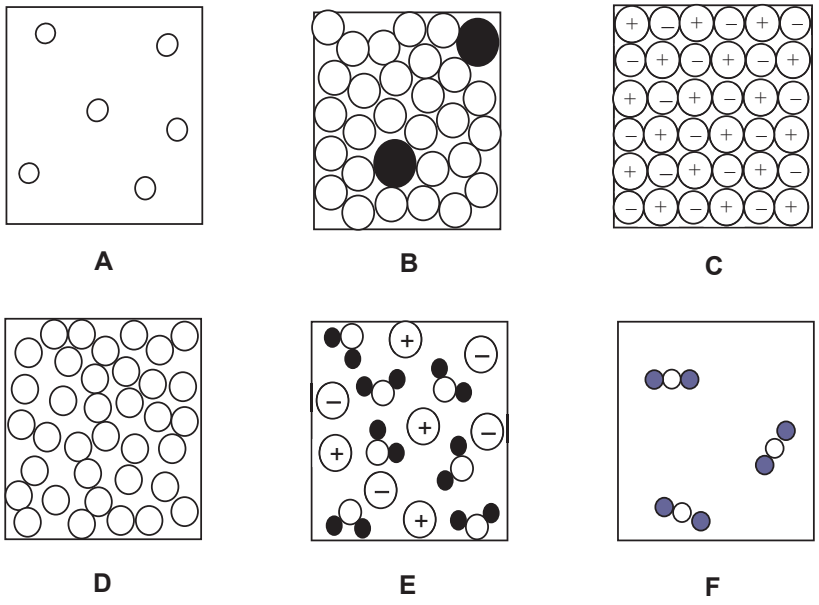


Fig 1.1

(a) Which diagram best represents

(i) carbon dioxide, ……..

(ii) molten copper, ……..

(iii) solid sodium chloride, ……..

(iv) helium, ……..

(v) brass. ……..

[5]

(b) Which of the above substances, **A** – **F**, represents an element?

……..……...[1]

[Turn Over

2 Table 2.1 gives some information on the component gases of clean air in the atmosphere.

Table 2.1

gas	melting point / °C	boiling point / °C
nitrogen	–210	–196
oxygen	–218	–183
argon	–189	–186
other noble gases		
carbon dioxide	sublimes at –78 °C	
water vapour	0	100

Separating air into its component gases is an important process in the industries. Air is first cooled to liquid at –200 °C before it is gradually warmed up and separated into its component gases, as illustrated in Fig. 2.1.

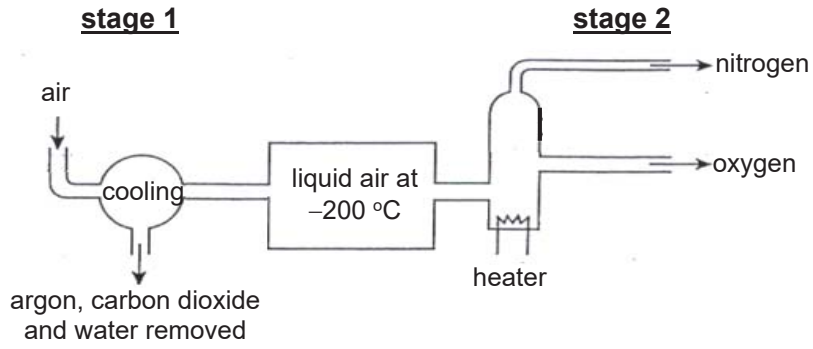


Fig. 2.1

(a) Describe the arrangement and movement of the particles in the liquid air.

……

……..…..[2]

(b) Explain why argon, carbon dioxide and water can be removed when air is compressed and cooled to –200 °C in **stage 1**.

……....[1]

(c) Name the method used to separate the components of liquid air in **stage 2**.

……....[1]

[Turn Over

(d) Which component will be collected last in **stage 2**? Explain your answer.

……...[2]

(e) Which component will have the largest volume collected in **stage 2**?

……[1]

3 **(a)** Sir James Jeans, who was a great populariser of science, once described an atom of carbon as being like six bees buzzing around a space the size of a football stadium.

(i) Suggest what were represented by the six bees in this description.

……...[1]

(ii) What is missing from Jeans' description when applied to an atom of carbon?

……[1]

(b) Carbon has two isotopes which have the symbols $^{12}_{6}C$ and $^{13}_{6}C$.

(i) State, in terms of atomic structure, the difference between the two isotopes of carbon.

……

……[1]

(ii) Draw a diagram to show the arrangement of electrons in an atom of the $^{12}_{6}C$ isotope.

[1]

[Turn Over

4 Chromatography is often used to solve crimes involving forgery.

In an investigation of a case which involves a bank cheque issued with a forged signature, the sample of ink from the forged signature was tested together with inks from the pens of five suspects **V**, **W**, **X**, **Y** and **Z**. Fig. 4.1 shows the chromatogram that was obtained with the use of an organic solvent.

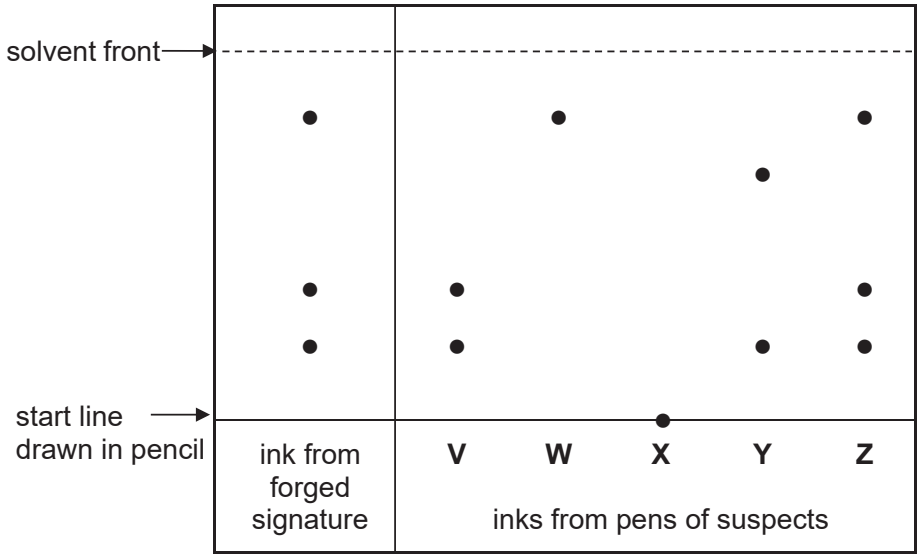


Fig. 4.1

(a) Which suspect is most likely to have forged the signature in the bank cheque?

……[1]

(b) Suggest why the ink from the pen of suspect **W** gives only one spot on the chromatogram.

……[1]

(c) Explain why the start line is drawn in pencil but not in pen.

……

……[2]

(d) Suggest a reason why water would probably **not** be a suitable solvent to use for this chromatography.

……[1]

[Turn Over

5 Haematite, a common ore used for the extraction of iron, contains the compound, iron(III) oxide. Iron is produced in the blast furnace by heating a mixture of iron(III) oxide, coke and limestone with air. Fig. 5.1 gives the outline of a blast furnace in which iron is extracted from its ore.

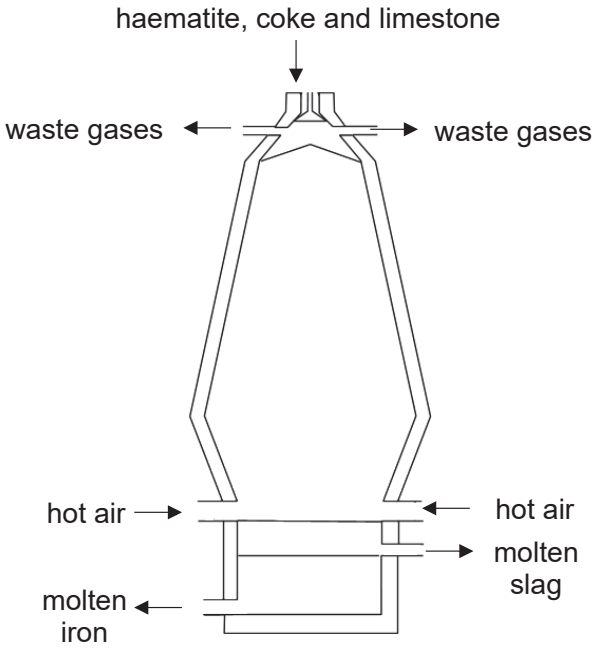


Fig. 5.1

(a) Describe how carbon dioxide is produced under high heat in the blast furnace.

……

……[2]

(b) The chemical equation for the production of iron in the blast furnace is shown.

$$Fe_2O_3\ (s) + 3CO\ (g) \rightarrow 2Fe\ (l) + 3CO_2\ (g)$$

(i) State the oxidation state of iron in iron(III) oxide.

……[1]

(ii) Explain, in terms of oxidation states, whether iron(III) oxide is oxidised or reduced.

……

……[2]

[Turn Over

6 **(a)** A 500 cm^3 aqueous sample contains 37.6 g of copper(II) nitrate. Calculate the concentration of the copper(II) nitrate solution in mol/dm^3.

[Relative atomic masses: A_r, Cu, 64; N, 14; O, 16]

concentration = ……mol/dm^3 [2]

(b) When a piece of zinc is added to the copper(II) nitrate solution, a reddish brown solid is formed. Explain the observation.

……

……

……[2]

7 Fig. 7.1 describes some of the properties and reactions of solution **Z**.

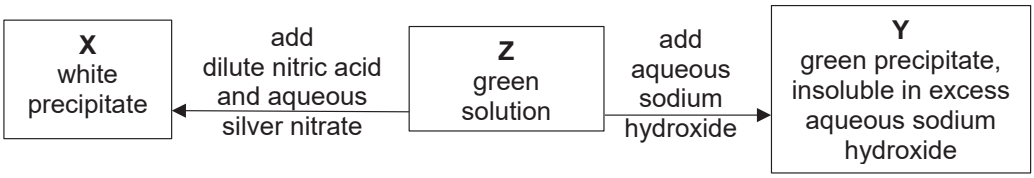


Fig. 7.1

(a) Give the identities of **X, Y** and **Z**.

X ……..

Y ……..

Z ……..

[3]

(b) Write a balanced chemical equation for any **one** of the reactions in Fig. 7.1.

……..…..[2]

8 **(a)** Complete Table 8.1 by filling in the **five** blanks.

Table 8.1

name of substance	chemical formula	solubility in water
sodium carbonate		soluble
calcium nitrate	$Ca(NO_3)_2$	soluble
	K_2SO_4	soluble
barium chloride		soluble
lead(II) chloride	$PbCl_2$	
iron(III) carbonate		insoluble

[5]

(b) **(i)** Give the names of the two reagents in Table 8.1 that can be used to prepare a white precipitate of calcium carbonate.

1…….

2…….

[1]

(ii) Describe the process of how you could prepare a pure dry sample of calcium carbonate from the two reagents you have given in **(b)(i)**.

……

……

……

……[3]

[Turn Over

Section B

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

Write your answers in the spaces provided.

9 Fluorine is an element found in Group VII. It would react vigorously with potassium, from Group I, to form potassium fluoride. It would also react with hydrogen gas to form hydrogen fluoride.

(a) Write a balanced chemical equation for the reaction of fluorine and potassium.

……...[2]

(b) Draw and label the electronic structures of potassium fluoride and hydrogen fluoride.

[Proton (atomic) numbers: H, 1 ;F, 9; K, 19]

potassium fluoride

hydrogen fluoride

[4]

(c) Use these structures to explain why, at room temperature and pressure, potassium fluoride is a solid and hydrogen fluoride is a gas.

……

……

……

……

……[4]

10 Alcohols form a homologous series.

(a) **(i)** Give **two** general properties of a homologous series.

……

……

……[2]

(ii) Write the general formula of the homologous series of alcohols.

……[1]

(b) **X** is an alcohol with two carbon atoms in its molecule.

(i) Complete Table 10.1 by naming and drawing the full structural formula of **X**.

Table 10.1

name of X	structural formula of X

[2]

(ii) Give the chemical formula of the organic substance that is formed when **X** reacts with atmospheric oxygen.

……[1]

(iii) A solution of **X** can be made by fermentation of glucose. Describe how this process is completed in the laboratory.

……

……

……

……[3]

(iv) **X** is commonly used in Brazil as a fuel for vehicles. Suggest a reason why **X** can be used for this purpose.

……[1]

11 When hydrochloric acid reacts with strips of magnesium, a gas is given off.

(a) Draw a diagram to show how you would investigate the speed of the reaction between hydrochloric acid and magnesium in an experiment. Describe how you would find the speed of the reaction based on the data collected in this experiment.

……

……

……

……

……[4]

(b) State and explain **one** way of increasing the speed of this reaction. Use your knowledge of reacting particles in your explanations.

……

……

……

……[3]

(c) Give the name of the gas given off in this reaction.

……[1]

(d) **G** is the next member in the same group that magnesium belongs to.

(i) State the chemical symbol of **G**.

……[1]

(ii) Explain why **G** is placed in the same group as magnesium.

……[1]

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

BEDOK GREEN SECONDARY SCHOOL
SCIENCE DEPARTMENT
MARKING SCHEME
YEAR (2018)

SUBJECT: **Science Chemistry 5076/5078 Paper 1**
SETTER: **Ms Nadiah** **EXAM: Prelim**
LEVEL: **4E5N**

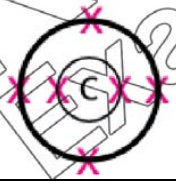
PAPER 1 (20 marks)

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

BEDOK GREEN SECONDARY SCHOOL
SCIENCE DEPARTMENT
MARKING SCHEME
YEAR (2018)

SUBJECT: Science Chemistry 5076/5078 Paper 3
SETTER: Tang Hui Boon **EXAM: Prelim**
LEVEL: 4E5N

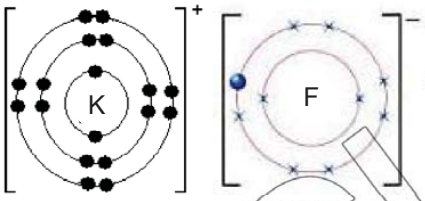
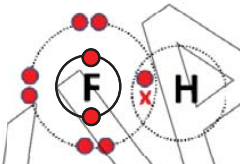
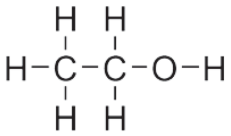
PAPER 3
Section A: 45 marks

Qn. No.			Scoring Points	Marks	Max. Marks
1	(a)	(i)	F	[1]	[5]
		(ii)	D	[1]	
		(iii)	C	[1]	
		(iv)	A	[1]	
		(v)	B	[1]	
	(b)		A and/or D	[1]	[1]
2	(a)		Particles are **closely packed but not orderly arranged**. Particles **move freely and slide past each other** throughout the liquid.	[1] [1]	[2]
	(b)		At –200°C, argon, carbon dioxide and water will be **removed as solids.**	[1]	[1]
	(c)		Fractional distillation	[1]	[1]
	(d)		Oxygen gas It has the **highest boiling point**.	[1] [1]	[2]
	(e)		Nitrogen gas	[1]	[1]
3	(a)	(i)	electrons	[1]	[1]
		(ii)	protons or neutrons or nucleus	[1]	[1]
	(b)	(i)	They have **different number of neutrons**. $^{12}_{6}C$ has **6 neutrons** whereas $^{13}_{6}C$ has **7 neutrons.**	[1]	[1]
		(ii)		[1]	[1]
4	(a)		Suspect **Z**	[1]	[1]
	(b)		The ink from the pen of **W** is probably made from **a pure substance.**	[1]	[1]
	(c)		Unlike ink from a pen, **pencil line will not dissolve in the solvent and will not interfere with the separation of the ink**. OR **Ink** from a pen is a mixture and it will **dissolve in the solvent** and will **get separated in the solvent** which will **interfere with the separation of the ink.**	[1] [1]	[2]
	(d)		The **ink** used for signing bank cheque would probably be **insoluble in water**.	[1]	[1]

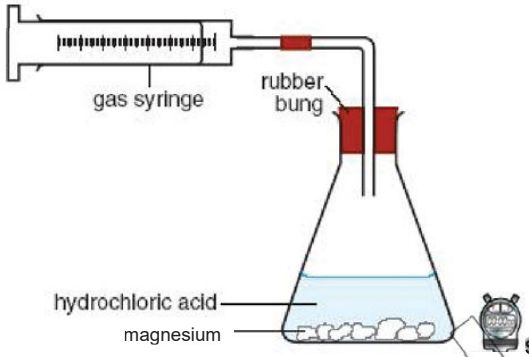
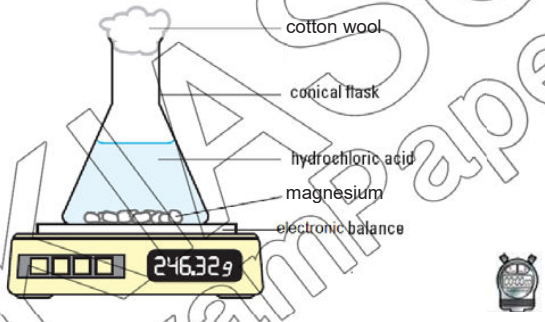
5	(a)	Carbon dioxide is formed when **coke is burnt in hot air** and when **limestone is decomposed at high temperature**. *(will not accept CO reducing Fe_2O_3 equation given in part (b). CO_2 is produced mainly by oxidation under this reaction.)*		[1] [1]	[2]
	(b)	(i)	+3	[1]	[1]
	(c)	(ii)	The **oxidation state** of iron has **decreased** and thus, it is **reduced.** Iron's oxidation state has decreased **from +3 in iron(III) oxide to 0 in iron**.	[1] [1]	[2]
6	(a)	Number of moles of $Cu(NO_3)_2 = \frac{37.6}{188} =$ **0.2** Concentration in mol / $dm^3 = \frac{0.2}{0.5} =$ **0.4 mol / dm^3**		[1] [1]	[2]
	(b)	**Zinc is more reactive than copper**. Zinc **displaces copper in copper(II) nitrate** to form **copper metal** which is the reddish brown solid.		[1] [1]	[2]
7	(a)	**X**: silver chloride / AgC*l* **Y**: iron(II) hydroxide / $Fe(OH)_2$ **Z**: iron(II) chloride / $FeCl_3$		[1] [1] [1]	[3]
	(b)	$FeCl_2 + 2AgNO_3 \rightarrow Fe(NO_3)_2 + 2AgCl$ OR $FeCl_2 + 2NaOH \rightarrow Fe(OH)_2 + 2NaCl$ correct formulae of reagents and products balanced equation		[1] [1]	[2]
8	(a)			[1] [1] [1] [1] [1]	[5]
	(b)	1. sodium carbonate 2. calcium nitrate		both [1]	[1]
	(c)	**Mix sodium carbonate and calcium nitrate solution** (or reagents stated in 8(b)(i) together. **Filter** the mixture and **collect the residue**. **Wash** the residue with **distilled water** and **dry between pieces of filter paper**.		[1] [1] [1]	[3]

name of substance	chemical formula	solubility in water
sodium carbonate	**Na_2CO_3**	soluble
calcium nitrate	$Ca(NO_3)_2$	soluble
potassium sulfate	K_2SO_4	soluble
barium chloride	**$BaCl_2$**	soluble
lead(II) chloride	$PbCl_2$	**insoluble**
iron(III) carbonate	**$Fe_2(CO_3)_3$**	insoluble

Section B: 30 marks

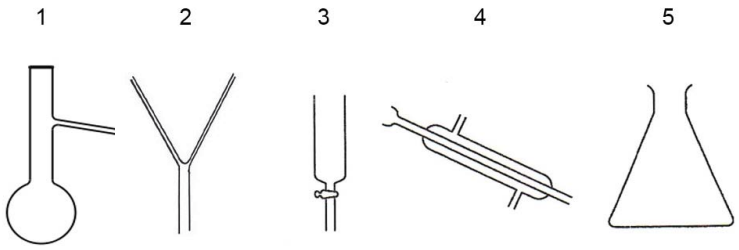
Qn. No.			Scoring Points	Marks	Max. Marks
9	(a)		$2K + F_2 \rightarrow 2KF$ correct formulae of reagents and product balanced equation	 [1] [1]	[2]
	(b)		 correct transfer of electron and charge correct number of electrons  correct number of shared electrons correct number of electrons in the molecule	 [1] [1] [1] [1]	[4]
	(c)		Potassium fluoride is an **ionic** compound with **strong electrostatic forces of attraction** between its oppositely charged **ions**, thus it **requires a large amount of energy to overcome** the attraction and has a **high melting and boiling point**. Hydrogen fluoride is a **covalent** compound with **weak intermolecular forces**. It **requires only a little amount of energy** to **overcome** the attraction, thus it has a **low melting and boiling point**.	[1] [1] [1] [1]	[4]
10	(a)	(i)	Member of the same homologous series have **similar chemical properties** and they display a **gradual change in their physical properties** as the number of carbon atoms increases in their molecules. *(will not accept same functional groups or general formula because question ask for properties and not structure.)*	[1] [1]	[2]
		(ii)	$C_nH_{2n+1}OH$	[1]	[1]
	(b)	(i)	**name of X**: **ethanol**; **structural formula of X**:  correct name correct structural formula	 [1] [1]	[2]
		(ii)	CH_3COOH	[1]	[1]
		(iii)	**Yeast** is added to a solution of glucose in a conical flask and placed in a water bath. **Temperature** of the mixture in the water bath needs to be kept at **37°C**.	[1] [1]	[3]

			The conical flask is connected through a delivery tube to a test tube with limewater **to prevent oxygen** in air from entering the conical flask. **please emphasize to students that a brief mention of the 3 conditions with no proper description of experiment will be penalised one mark in the exams because the question asked for description of process.*	[1]	
		(iv)	X can be **burnt** exothermically to **produce heat** to power the vehicles.	[1]	[1]

11	(a)	 OR  diagram label **Plot a graph of volume of gas** produced **against time**. OR **Plot a graph of mass of contents in flask against time**. relevant graph to the diagram drawn. (Students are not required to plot/sketch the graph) The speed of reaction can be determined by the **gradient of graph.** *(Stopwatch needs to be mentioned "once" either in diagram or description to be awarded mark either in diagram or description.*	[1] [1] [1] [1]	[4]
	(b)	**Increasing the temperature** of reaction mixture will **increase the kinetic energy / speed** of reacting **particles**. OR Use **powdered magnesium** instead of strips of magnesium **provides smaller particle size of magnesium** which **provide a larger surface area for collision**. OR	[1] [1] OR [1] [1] OR [1]	[3]

		Use a **higher concentration** of hydrochloric **acid provides more H^+ ions per unit volume for collision** with magnesium particles. either of the above answers **Higher frequency of effective collision between H^+ ions and magnesium particles increases the speed of reaction**. *Note: Students need to mention the reacting particles, magnesium and acid particles (H^+ ions) at least once in the answers.*		[1] [1]	
	(c)	hydrogen		[1]	[1]
	(d)	(i)	Ca	[1]	[1]
		(ii)	They have the **same number of valence electrons**. OR They both have **two valence electrons**.	[1]	[1]

21 The diagram shows some laboratory apparatus.



Which apparatus are needed to produce and collect pure water from seawater?

A 2 and 5 **B** 3 and 5

C 1, 2 and 4 **D** 1, 4 and 5

22 Which substance, **A** to **D** undergoes changes in physical states from room temperature to 0°C?

	Melting point/°C	**Boiling point / °C**
A	-2	65
B	-23	4
C	50	250
D	-187	-165

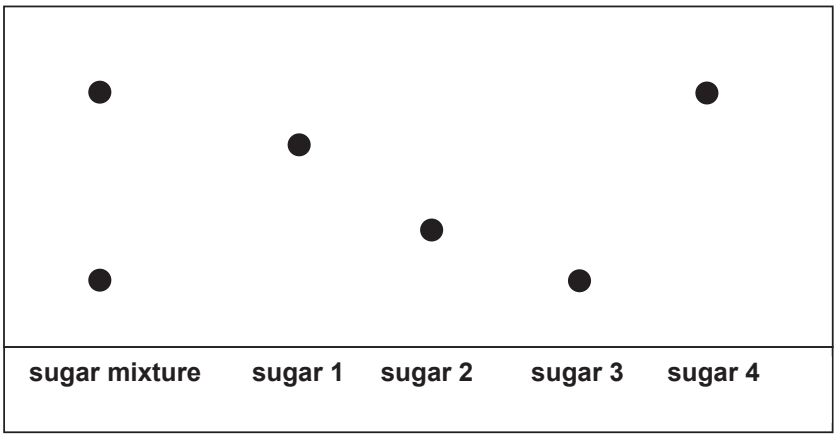
23 Which statements are true about compounds?

1 They can be made from another compound.
2 They can be made from metals alone.
3 They can be made from non-metals alone.
4 They can be made from a metal and a non-metal.

A 1, 2 and 3 **B** 1, 2 and 4

C 1, 3 and 4 **D** 2, 3 and 4

24 A sugar mixture was compared with four different simple sugars using chromatography. The results are shown in diagram below. What types of sugars does the mixture contain?



A sugar 1 and 2 **B** sugar 1 and 4

C sugar 2 and 3 **D** sugar 3 and 4

25 Which compound contains three atoms?

A H_2O **B** HC*l*

C $CaSO_4$ **D** NO

26 Which of the following compounds has the highest percentage of nitrogen by mass?

A NH_4NO_3 **B** $(NH_4)_2CO_3$

C $CO(NH_2)_2$ **D** NH_4Cl

27 A student dissolved 14.9g of potassium chloride, KCl, in 100 cm^3 of water. What is the concentration of the resulting potassium chloride solution in mol/dm^3?

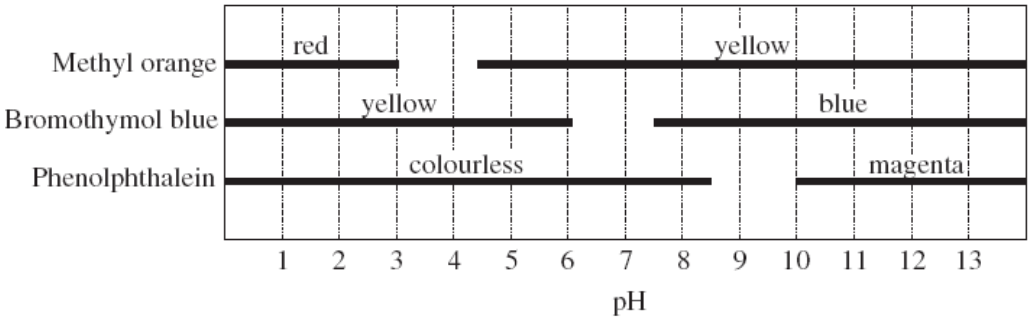
A 0.002 mol/dm^3

B 0.01 mol/dm^3

C 0.15 mol/dm^3

D 2.0 mol/dm^3

28 The graph below shows the colour ranges of the acid-base indicators methyl orange, bromothymol and phenolphthalein.



A solution, when placed in the three indicators separately, is yellow in methyl orange, yellow in bromothymol and colourless in phenolphthalein. What is the pH range of the solution?

A 2.5 to 3.5 **B** 4.5 to 5.5

C 7.5 to 8.5 **D** 9.5 to 10.5

29 Which of the following elements burns in air to produce a substance which can react with both hydrochloric acid and sodium hydroxide?

A lead **B** hydrogen

C iron **D** phosphorous

30 Which of the following reagents **cannot** be used to differentiate sodium hydroxide solution from sodium chloride solution?

A Aqueous iron(III) nitrate

B Aqueous copper(II) nitrate

C Aqueous lithium nitrate

D Aqueous ammonium nitrate

31 Separate samples of hydrogen peroxide are added to aqueous potassium iodide and to acidified potassium manganate(VII). It is known that hydrogen peroxide is both an oxidising agent and a reducing agent.

What colour changes are seen?

	aqueous potassium iodide	acidified potassium manganate(VII)
A	colourless to brown	purple to colourless
B	brown to colourless	purple to colourless
C	colourless to brown	orange to green
D	brown to colourless	orange to green

32 **X**, **Y** and **Z** are elements in the same period of the Periodic Table.

X forms an acidic oxide, **Y** forms a basic oxide and **Z** forms an amphoteric oxide.

If **X**, **Y** and **Z** are placed in increasing order of atomic number (lowest atomic number first), which order is correct?

A **X**, **Y**, **Z** **B** **Y**, **Z**, **X**

C **Y**, **X**, **Z** **D** **X**, **Z**, **Y**

33 Rubidium is in the same group as sodium in the Periodic Table. What is a likely property of rubidium?

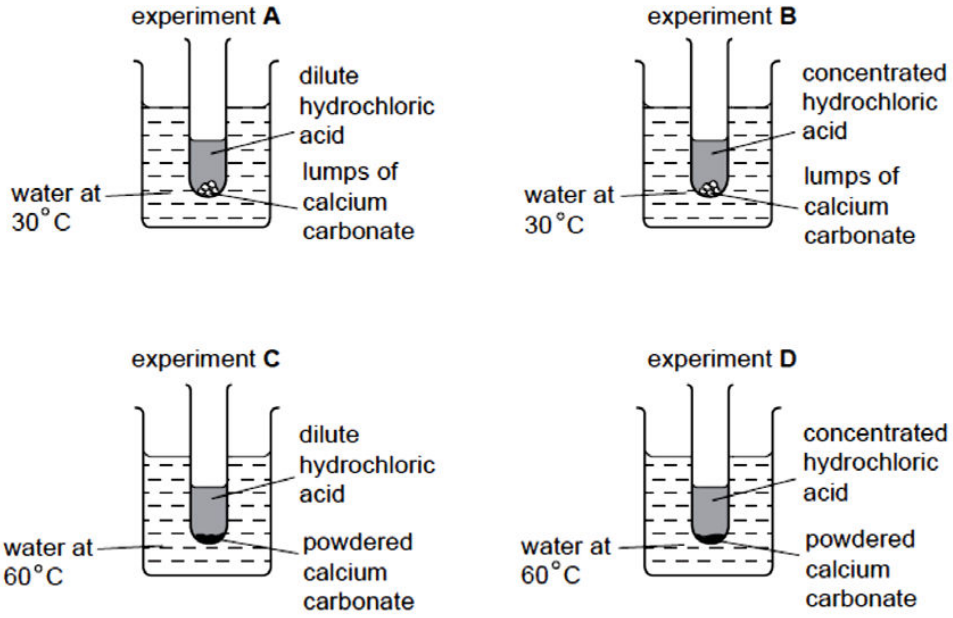
A It reacts with water to form hydrogen gas.

B It cannot be cut by knife.

C It reacts with chlorine gas to form a salt with the formula $RbCl_2$.

D It does not conduct electricity in the molten state.

34 Which of the following experiment will have the fastest speed of reaction?

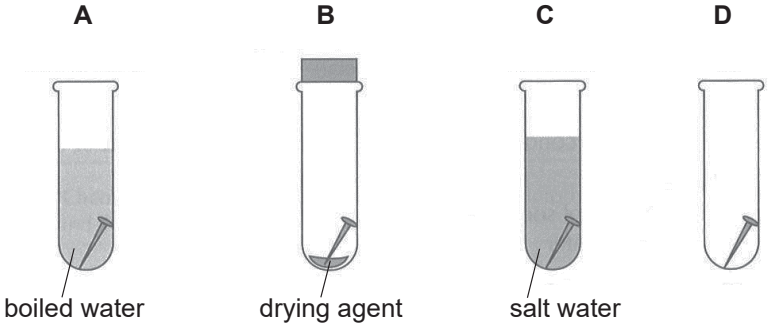


35 The element chromium produces hydrogen from dilute hydrochloric acid but it does not react with cold water. When a piece of chromium is placed in lead(II) nitrate solution, solid of lead appear.

What is the order of **decreasing** reactivity of the metals lead, calcium and chromium?

A	calcium, chromium, lead	**B**	calcium, lead, chromium
C	chromium, calcium, lead	**D**	lead, chromium, calcium

36 In which tube is the iron nail **not** likely to rust?



37 Which of the following shows the correct percentage composition of oxygen, nitrogen and carbon dioxide found in dry unpolluted air?

	Oxygen	Nitrogen	Carbon dioxide
A	78	21	1
B	1	78	21
C	21	78	1
D	78	21	78

38 Which of the following shows the correct use of the different fractions of petroleum?

	Fraction	**Uses**
A	Petrol	used for making chemical feedstock
B	Bitumen	used for lubricating machine parts
C	Kerosene	used as fuel for aircraft
D	naphtha	used to pave road

39 Which of the following hydrocarbon undergoes substitution reaction?

A C_2H_4 **B** C_2H_6

C C_2H_5COOH **D** C_2H_5OH

40 Which of the following is the same for both ethanol and ethanoic acid?

A empirical formula

B functional group

C number of carbon

D homologous series

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number / atomic symbol / name / relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

BEDOK SOUTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2018

4E/5NA

CANDIDATE NAME

CLASS

REGISTER NUMBER

SCIENCE (CHEMISTRY)

Paper 3 Chemistry

5076/03 & 5078/03

31 July 2018

Candidates answer on the Question Paper.
No additional materials are required.

1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all work you hand in.
You may use an 2B pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use staples, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate unites.

Section A (45 marks)
Answer **all** questions.
Write your answers in the space provided on the question paper.

Section B (20 marks)
Answer any **two** questions.
Write your answers in the space provided on the question paper.

A copy of Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.

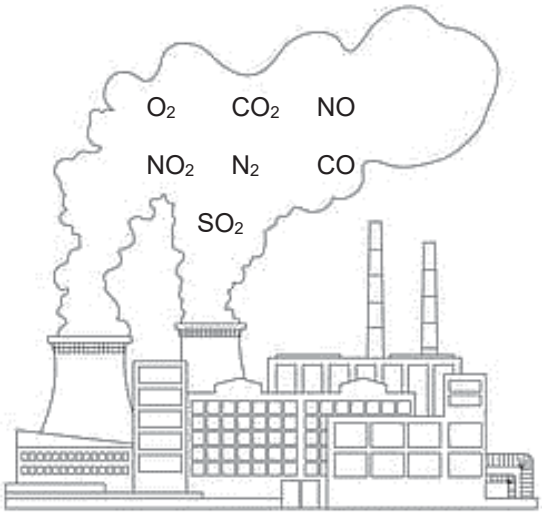
At the end of the exam, fasten all your work securely together.
The number of marks in given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Section C	
Total	

Setter: Ms Cynthia Chong

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

A1 The diagram below shows the formulae of some gases found in polluted air.



Choose formulae from the diagram to answer the following questions **(a)** to **(d)**. Each may be use once, more than once or not at all.

(a) Give the formula of a gas that is produced by incomplete combustion of fuels. State the harmful health effect of this gas.

……..
……... [2]

(b) Give the formulae of two gases that are produced by reactions in catalytic converters.

…… and ……... [1]

(c) Give the formulae of two gases that are involved in both respiration and photosynthesis.

…… and ……... [1]

(d) Give the formulae of two gases that produce acid rain.

…… and ……... [1]

[Total: 5 marks]

A2 Sulfur and sulfur compounds are common in the environment.

(a) A sample of sulfur from a volcano contained two different types of sulfur isotopes: sulfur-32 and sulfur-34.

(i) Complete the table below to show the atomic structure of each isotope of sulfur.

Isotope	Number of		
	Proton	Neutron	Electron
Sulfur-32			
Sulfur-34			

[2]

(ii) The relative atomic mass of sulfur is 32.2. Explain why does the relative atomic mass of sulfur is not a whole number.

……...

……..… [2]

(b) One of the gases produced during volcanic eruptions is hydrogen sulfide. H_2S. Hydrogen sulfide is a poisonous, colourless gas which smells of rotten eggs.

(i) Draw a dot-and-cross diagram to represent the bonding in a hydrogen sulfide molecule. Show outer electrons only.

[2]

(ii) Explain, in terms of bonding and structure, why hydrogen sulfide gas does not conduct electricity.

……

…….. [2]

[Total: 8 marks]

A3 The table below shows some salts and products that contain them.

Salt	product
Silver chloride	Photographic film
Potassium nitrate	fertiliser
Zinc sulfate	Health supplement

(a) **(i)** Which salt in the table can be made by **precipitation**?
Explain your reasoning.

Salt: ……

Reason: …… [2]

(**ii**) Which salt in the table can be made by **titration**? Suggest two reagents needed to make this salt.

Salt: ……

Reagent 1: …… Reagent 2: …… [2]

(b) Other substances are used to make a range of useful products.

Put a tick (√) in one box in each row to show a correct use of each substance.

Substance	Use			
	to make car battery	**to make road surface**	**to reduce acidity in soil**	**to fill filament bulb**
Calcium silicate				
Calcium hydroxide				
Argon				
Sulfuric acid				

[2]

[Total: 6 marks]

A4 In an oil refinery petroleum is separated into useful fractions by fractional distillation.

(a) What is the physical property that allows the various fractions in crude oil to be separated?

…….. [1]

(b) To meet the world's demand for petrol, heavier fraction such as diesel undergoes cracking to produce lighter fractions as shown in the equation below.

$C_{12}H_{26}$ → C_6H_{14} + C_2H_4 product **P**

Give the chemical name and formula of the product **P**.

Chemical name: …….

Chemical formula: ……. [2]

[Total: 3 marks]

A5 The Thermit reaction is used to weld railway rails together.

In Thermit reaction, aluminium powder reacts with iron(III) oxide to make small amounts of molten iron which runs into the gaps between the rails. Solid aluminium oxide is made at the same time.

(a) Complete the equation for the reaction by filling in missing state symbols.

2 Al (……..) + Fe_2O_3 (……..) → 2Fe (……..) + Al_2O_3 (……..) [1]

(b) **(i)** The table shows some information about oxidation state changes during the reaction. Complete the table.

Element	Oxidation state at the start	Oxidation state at the end	Oxidised or reduced?
Oxygen	-2	-2	unchanged
Aluminium			
iron			

[2]

(ii) Hence, or otherwise, explain why Thermit reaction is a redox reaction.

…….

……. [1]

(c) Is Thermit reaction an endothermic or exothermic reaction? Explain your answer.

……

…… [2]

(d) Predict if the melting point of aluminium oxide is high or low. Explain your answer in terms of structure and bonding.

……

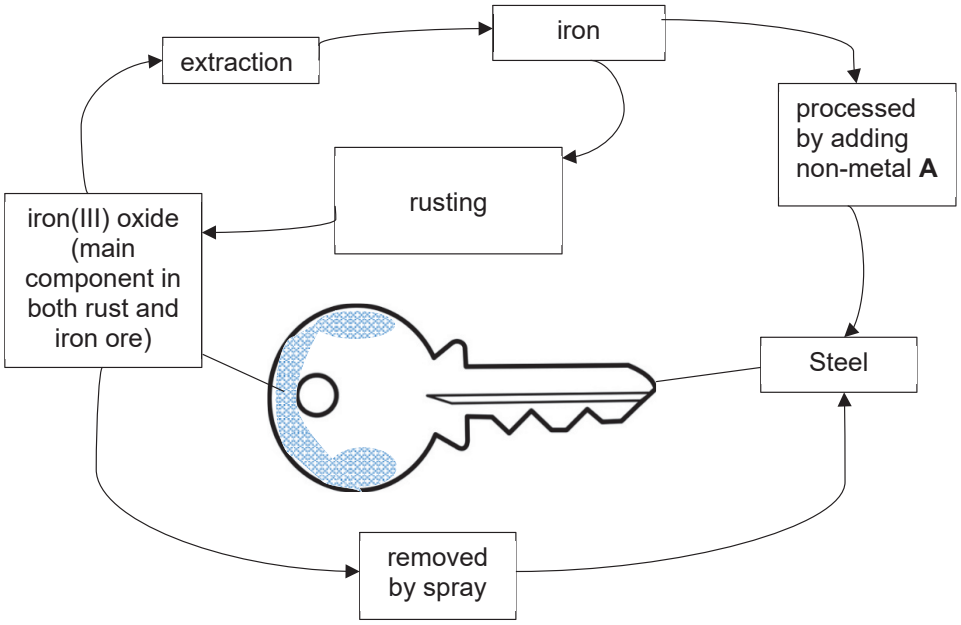
……

……

…… [2]

[Total: 8 marks]

A6 Common keys are made from steel. One problem with using steel is that the iron in steel will rust. The diagram shows the cycle of changes that happens when iron in a steel key rust and then extracted.



(a) **(i)** Identify non-metal **A**. …… [1]

(ii) Explain the importance of adding **A** to iron in making steel key.

……

……

…….. [2]

(b) A shop sells a spray-on rust treatment. The spray contains particles of zinc. Explain how zinc prevents rust from forming.

……...

……

……..… [2]

(c) Write a balanced chemical equation for the extraction of iron in the blast furnace.

……..…….. [1]

(d) Though the extraction of iron from blast furnace is a relatively cheap process, steels are still widely recycled.

Explain the importance of recycling of metals such as iron.

……...

……..… [1]

[Total: 7 marks]

A7 **(a)** Propane burns completely in oxygen to form carbon dioxide and water.

The equation for the reaction is

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

(i) Calculate the number of moles in 44 g of propane.

[1]

(ii) Hence, calculate the volume of carbon dioxide that is produced from 44 g of propane at room temperature and pressure.

[2]

(b) **(i)** State why propene can be made into polymer but propane cannot.

……

…… [1]

(ii) Describe a test to distinguish between propene and propane.

……

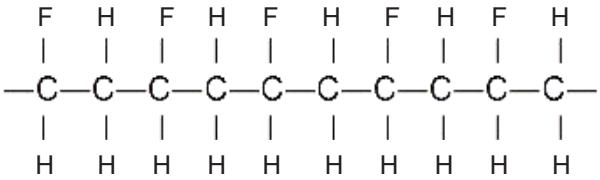
…… [2]

(iii) State one harmful effect of polymer to the environment.

…… ……

…… [1]

(c) The figure below shows the structure formula of part of an addition polymer.



Deduce and draw the structural formula of the **monomer** from which this polymer is made.

[1]

[Total: 8 marks]

Section B

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

B8 **(a)** Explain why sulfuric acid can act as an acid and why potassium hydroxide can act as an alkali. Give examples of chemical reaction that sulfuric acid and potassium hydroxide undergo.

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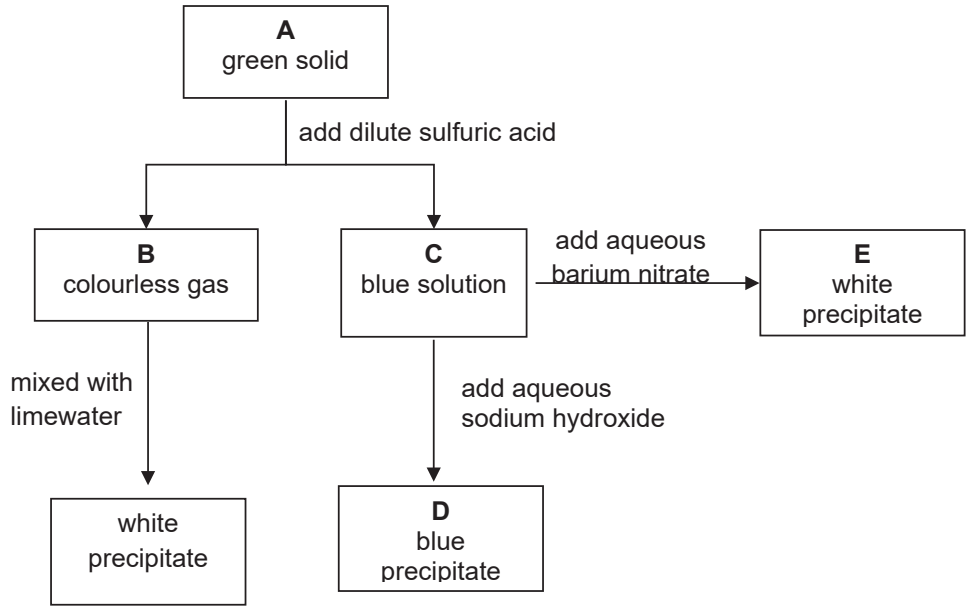
..... [4]

(b) Write the ionic equation that describes the reaction of an acid with an alkali

..... [1]

(c) The diagram below shows some of the properties and reactions of the substances **A**, **B**, **C**, **D** and **E**.



Identify these substances.

(i) green solid **A**, …….

(ii) colourless gas **B**, …….

(iii) blue solution **C**, …….

(iv) blue precipitate **D**. ……. [4]

(d) The formation of white precipitate **E** shows the presence of sulfate ions.

Why does this **not** prove that sulfate ions are present in solid **A**?

……

…… [1]

[Total: 10 marks]

B9 **(a)** The speed of a chemical reaction can be changed by

- increasing the temperature of the reaction,
- decreasing the concentrations of reacting solutions.

(i) State the effect that each of these has on the speed of a reaction.

(ii) Use your knowledge of reacting particles to explain your answer to **(a)(i)**.

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..... [5]

(b) A student carried out an experiment to investigate how the speed of reaction between magnesium and hydrochloric acid will change with time.

(i) Draw a labelled diagram to show the experiment setup that the student use.

(ii) Describe how the student will carry out the experiment, clearly stating the physical quantity he will measure.

(iii) Describe how the speed of this reaction would change with time.

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…… [5]

[Total: 10 marks]

B10 **(a)** What is the common name given to elements in Group VII?

…… [1]

(b) Give the electronic structures of fluorine and chlorine and use these to explain why they are placed in Group VII.

……

……

…… [2]

(c) Chlorine was discovered by Carl William Scheele in 1774 at Sweden. The origin of the name came from the Greek word "chloros" meaning "pale green".

In 1886, a new element was discovered. Based on its electronic structure, colour and its reaction with zinc chloride, this new element was placed above chlorine in Group VII of the Periodic Table and given the name fluorine.

(i) Predict the colour of fluorine.

…… [1]

(ii) Suggest how the colour of fluorine could help explain its position in the Periodic Table.

…… [1]

(iii) Describe what would be observed when fluorine is bubbled into a solution of potassium bromide. Explain your observation.

……

……

…… [2]

(d) The element with an atomic number of 85 is so unstable that it has never been seen by the naked human eye.

(i) Consider the properties of other elements in the same group as this element, predict **one** physical and **one** chemical property of the element with atomic number 85.

……

……

……

…… [2]

(ii) Give the chemical formula of the compound formed between magnesium and the element with atomic number 85.

…… [1]

[Total: 10 marks]

End of Paper

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group																	
I	II										III	IV	V	VI	VII	0
						1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9										5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24										13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

2018 Bedok South Secondary School Secondary 4
Science(Chemistry) PRELIM Marking Scheme

Paper 1: 30 Marks

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

Answer

A1 **(a)** CO
Prevents blood from absorbing oxygen which causes headaches, giddiness or may lead to death. — 1, 1

(b) N_2 and CO_2 (both must be correct) — 1

(c) CO_2 and O_2 (both must be correct) — 1

(d) NO_2 and SO_2 (both must be correct) — 1

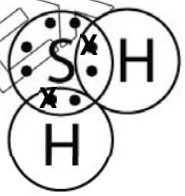
[Total: 5 marks]

A2 **(ai)**

Isotope	Number of		
	Proton	Neutron	Electron
Sulfur-32	16	32 - 16 = 16	16
Sulfur-34	16	34 - 16 = 18	16

1, 1

(aii) Each sulfur isotope has different **relative abundance/ percentage/ amount**. — 1
When the **average** of the masses of the 2 sulfur isotope is taken, there is decimal. (any phrase to the effect) — 1

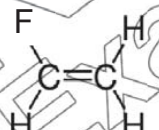
(bi) 

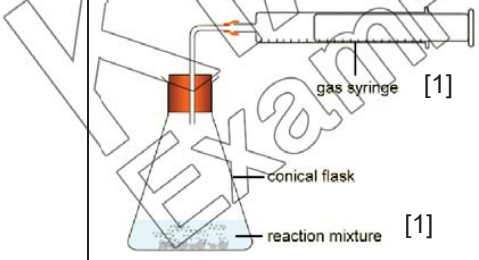
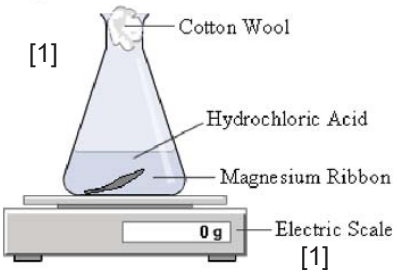
Correct valence electron for sulfur and hydrogen — 1
Correct number of shared electrons (2 single bond) — 1

(bii) [structure] hydrogen sulfide is a **simple covalent molecule/compound** — 1
[charge carrier] there are **no free moving electrons/charge carrier** to conduct electricity. [bonding] — 1

[Total: 8 marks]

<table>
<tr><td>A3 (salt pre)</td><td>(ai)</td><td>Salt: Silver chloride
Reason: It is an <u>insoluble</u> salt.</td><td>1
1</td></tr>
<tr><td></td><td>(aii)</td><td>Salt: Potassium nitrate (SPA – titration (neutralisation))
Reagent 1: <u>potassium hydroxide</u> Reagent 2: <u>nitric acid</u> (both correct)</td><td>1
1</td></tr>
<tr><td></td><td>(b)</td><td>
<table>
<tr><th rowspan="2">Substance</th><th colspan="4">Use</th></tr>
<tr><th>to make car battery</th><th>to make road surface</th><th>to reduce acidity in soil</th><th>to fill filament bulb</th></tr>
<tr><td>Calcium silicate (SLAG)</td><td></td><td>√</td><td></td><td></td></tr>
<tr><td>Calcium hydroxide(slaked lime)</td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>Argon</td><td></td><td></td><td></td><td>√</td></tr>
<tr><td>Sulfuric acid</td><td>√</td><td></td><td></td><td></td></tr>
</table>
All correct – 2 marks 3/2 correct – 1 mark 1 correct – 0 marks</td><td>2</td></tr>
<tr><td></td><td></td><td>[Total: 6 marks]</td><td></td></tr>
<tr><td>A4</td><td>(a)</td><td>Difference in boiling point</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>Name: <u>Butene</u>
formula: <u>C_4H_8</u></td><td>1
1</td></tr>
<tr><td></td><td></td><td>[Total: 3 marks]</td><td></td></tr>
<tr><td>A5</td><td>(a)</td><td>2 Al (<u>s</u>) + Fe_2O_3 (<u>s</u>) → 2Fe (<u>l</u>) + Al_2O_3 (<u>s</u>) (all must be correct)</td><td>1</td></tr>
<tr><td></td><td>(bi)</td><td>
<table>
<tr><th>Element</th><th>Oxidation state at the start</th><th>Oxidation state at the end</th><th>Oxidised or reduced?</th></tr>
<tr><td>Oxygen</td><td>-2</td><td>-2</td><td>unchanged</td></tr>
<tr><td>Aluminium</td><td>0</td><td>+3</td><td>Oxidised</td></tr>
<tr><td>iron</td><td>+3</td><td>0</td><td>reduced</td></tr>
</table>
</td><td>1
1</td></tr>
<tr><td></td><td>(bii)</td><td>Aluminium is oxidised while iron is reduced, since oxidation and reduction occur <u>simultaneously</u>, Thermit reaction is a redox reaction.</td><td>1</td></tr>
<tr><td></td><td>(c)</td><td>Exothermic reaction. (heat given out , hot)
Temperature must be high for iron to be in liquid state. (any phrasing to the effect)</td><td>1
1</td></tr>
<tr><td></td><td>(d)</td><td>[P1] Aluminium oxide has a <u>high</u> melting point
[P2] Aluminium oxide is an <u>ionic</u> compound/ has <u>giant lattice</u> structure,
[P3] <u>large amount of heat</u> is needed to overcome the <u>strong electrostatic forces of attraction</u> between the oppositely-charged ions. (bonding)</td><td>3 pt – 2 M
2 pt – 1M</td></tr>
<tr><td></td><td></td><td>[Total: 8 marks]</td><td></td></tr>
<tr><td>A6</td><td>(ai)</td><td>carbon</td><td>1</td></tr>
</table>

	(aii)	[P1] Carbon will **disrupt the orderly** arrangement of iron, (ALLOY) [P2] making it more **difficult** for the iron atoms to slide past each other, [P3] thus **increasing the strength** of iron. (any phrasing to the effect)	3 pt – 2 M 2 pt – 1M
	(b)	[P1] zinc is **more reactive** than iron / zinc has higher tendency to lose its electrons, [P2] zinc will preferentially **corrode in place of iron**.	1 1
	(c)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	1
	(d)	The earth's mineral ores are limited and are non-renewable. Recycling helps to conserve the limited resources in our earth and make them last longer. With a decrease of mining for ores, land will be free for other uses eg, agriculture. Recycling means saves the environment from pollution as unsightly scrap metals is removed from the environment. [any one, reject any answer about saving cost]	1
		[Total: 7 marks]	
A7	**(ai)**	Number of moles of propane: 44/44 = 1 mole	1
	(aii)	Number of moles of CO_2: 3 moles Volume of CO_2: 3 x 24 = 72 dm^3 (must include correct units, no ecf)	1 1
	(bi)	Propene is **unsaturated/ contains C=C double bond**, thus it is able to undergo **addition reaction**. OR Propane is saturated, contains all single covalent bond, thus unable to undergo addition reaction. (any phrasing with similar meaning)	1
	(bii)	[test] Add (aqueous) bromine solution to propane and propene. [result] reddish brown colour of bromine will become colourless in propene but remains unchanged in propane.	1 1
	(biii)	Polymer is non-biodegradable and thus will [effect] remain in the environment for a long time, thus causing land pollution/ constantly in need to find land to bury them. Polymer, when burnt, will release toxic gases to the environment thus, causing air pollution. [any one]	1
	(c)	 **monomer (alkene)**	1
		[Total: 8 marks]	
B8	**(a)**	[P1] An acid is a substance which produces **hydrogen ions** when it is dissolved in **water**. [P2] Example: Sulfuric acid reacts with reactive metal to produce salt and hydrogen gas/ sulfuric acid reacts with carbonates to produce salt,	1 Any

		water and carbon dioxide gas. Sulfuric acid react with base/alkali to produce salt and water. [P3] An alkali is a substance which produces **hydroxide** ions when it is dissolved in **water**. [P4] Example: sodium hydroxide reacts with ammonium salt to form salt, water and ammonia gas. (full credit if formulae/ chemical equation given)	one 1 1 1
	(b)	H^+ (aq) + OH^- (aq) → H_2O (l)	1
	(c)	Green solid **A**: **copper(II) carbonate** colourless gas **B**: **carbon dioxide** blue solution **C**: **Copper(II) sulfate** blue precipitate **D**: **copper(II) hydroxide**	1 1 1 1
	(d)	Sulfuric acid was added to the green solid, thus the sulfate ion might have come from sulfuric acid instead.	1
		[Total: 10 marks]	
B9	**(a)**	[Etemp] when temperature is increases, speed of chemical reaction **increases**. [Econc] when concentration decreases, speed of chemical reaction **decreases**. [Rtemp] when temperature increases, particles gains kinetic energy and **move faster.** Frequency of effective collision will increases. [Rconc] when concentration decreases, **number of particles per unit volume decrease**. Frequency of effective collision will decreases. [collision theory – 1 mark]	1 1 1 1 1
	(b)	Measurement of volume of hydrogen gas  [1] [1] Student will record the **volume of hydrogen gas** [1] produced **at regular interval**. [1] Measurement of decrease in mass  [1] [1] Student will record the decrease in **mass of reaction mixture** [1] at **regular interval** [1]. Speed of reaction will decrease with time.	Apparatus 1M Set up 1M 2 1

		[Total: 10 marks]	
B10	**(a)**	halogen	1
	(b)	[electronic configuration] E.C of Fluorine: 2.7, E.C of chlorine is 2.8.7 (state both to get 1 mark) Since they both have **7 valence electron**, thus they are placed in group VII.	1 1
	(ci)	Yellow	1
	(cii)	It is **lighter** in colour than chlorine, thus Fluorine is placed **above chlorine** in group VII.	1
	(ciii)	[observation] colourless solution turns reddish brown. [explanation] fluorine is **more reactive** than bromine, thus it will **displace** bromine from potassium bromide and **produce bromine**.	1 1
	(di)	[physical] cannot conduct electricity/ black colour/ solid at room temperature [any one] (do NOT write "high/low" melting point) [chemical] gain 1 electron to form anion/ least reactive in group VII/ reacts wth metal to form ionic compound/ reacts with non-metal to form covalent compounds. [any one]	1 1
	(dii)	$MgAt_2$	1
		[Total: 10 marks]	

Register No.	Class

Name ______________________________

BENDEMEER SECONDARY SCHOOL
2018 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (PHYSICS, CHEMISTRY) PAPER 1
5076/01

DATE : **29th August 2018**
DURATION : **1 hour**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number on the work you hand in.
Do not use paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in 2B pencil on the OTAS sheet.

Read the instructions on the OTAS sheet very carefully.

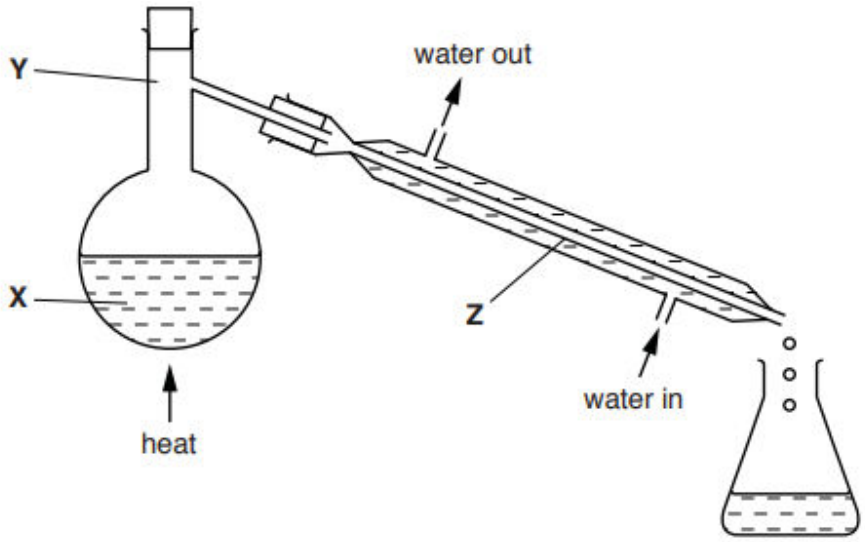
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.
A copy of the Data Sheet is printed on page 20.
A copy of the Periodic Table is printed on page 21.
The use of an approved scientific calculator is expected, where appropriate.

/ 40

This document consists of **21** printed pages.

[Turn over

21 The diagram shows the apparatus used to distil seawater.

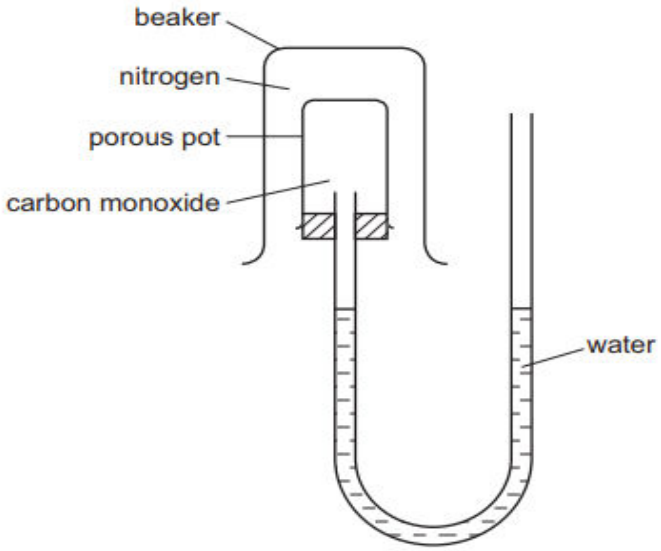


While water is being collected, at which point(s) is the temperature 100°C?

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

[Turn over

22 Gases can diffuse through porous pots. The diagram shows a beaker full of nitrogen inverted over a porous pot containing carbon monoxide.



The water level does not move.

Which statement explains this?

A Both gases have two atoms in a molecule.

B Neither gas is soluble in water.

C Nitrogen is almost inert.

D The two gases have equal molecular masses.

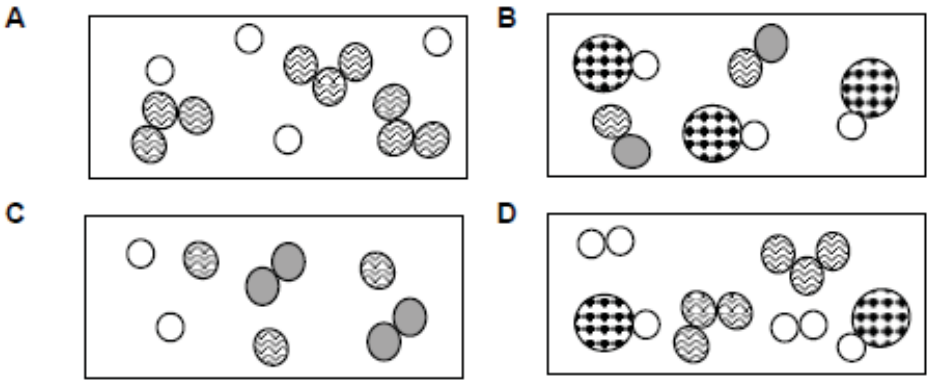
23 Which statement(s) best explain(s) that air is a mixture, not a compound?

I Air does not have a fixed composition.
II It is a colourless and odourless gas.
III It is made up of more than two elements.
IV The gases making up air can be separated by fractional distillation.

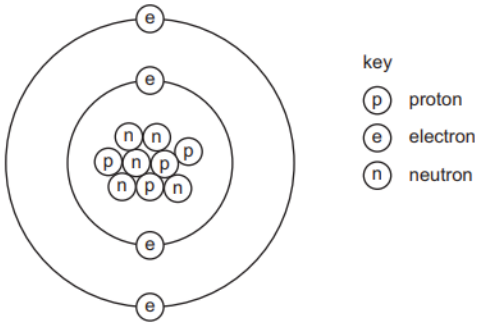
A I only **B** II only **C** I and IV **D** III and IV

[Turn over

24 Which diagram correctly represents a mixture of element(s) and compound(s)?



25 The diagram shows the atomic structure of an element X.



What is X?

A aluminium

B beryllium

C boron

D fluorine

26 What happens when a bond is formed between a green gaseous element and a soft metallic element?

A The gaseous atoms gain an electron.

B The gaseous atoms lose an electron.

C The metal atoms gain an electron.

D The two elements share a pair of electrons.

[Turn over

27 Which salt can be prepared by an acid-alkali titration method?

A aluminium carbonate

B ammonium chloride

C calcium nitrate

D iron(II) sulfate

28 The oxide of element X dissolves in water to form a solution which when tested with Universal Indicator paper gives a pH of 14. The oxide does not react with potassium hydroxide. Where is X mostly likely to be found in the Periodic Table?

A Group I

B Group VI

C Group VII

D Group 0

29 25 cm^3 of 0.1 mol / dm^3 hydrochloric acid exactly neutralise 20 cm^3 of aqueous sodium hydroxide. The equation for this reaction is:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

What is the concentration of the sodium hydroxide solution?

A 0.080 mol / dm^3

B 0.125 mol / dm^3

C 0.800 mol / dm^3

D 1.250 mol / dm^3

[Turn over

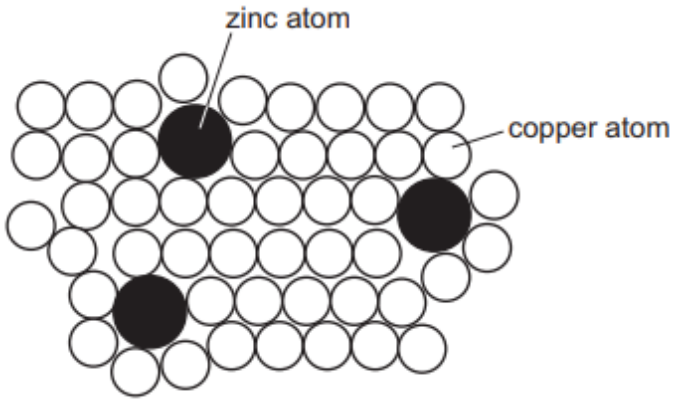
30 W, X and Y are metals, one of which is copper and one of which is iron.

- W has a coloured oxide which can be reduced by carbon.
- X has a black oxide and is also found in nature as a pure metal.
- Y has an oxide which cannot be reduced by carbon.

Which metal is the most reactive and what is the possible identity of W?

	most reactive metal	possible identity of W
A	X	Cu
B	X	Fe
C	Y	Cu
D	Y	Fe

31 The diagram shows the structure of brass.



Why is brass harder than pure copper?

A The zinc atoms form strong covalent bonds with copper atoms.

B The zinc atoms have more electrons than the copper atoms.

C The zinc atoms prevent the 'sea of electrons' from moving freely in the solid.

D The zinc atoms prevent the layers of copper atoms from sliding over each other.

[Turn over

32 The following statements are about elements in the Periodic Table.

I Their atoms have a full outer shell of electrons.
II They are found in Group 0.
III They are present in small quantities in the air.
IV They form basic oxides.

Which statements are correct for the noble gases?

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

33 The labels on two bottles fell off. One bottle was known to contain sodium chloride solution and the other bottle contained sodium nitrate solution.

Which test would most likely identify the solutions?

A addition of aqueous ammonia

B addition of aqueous silver nitrate

C addition of blue litmus paper

D addition of dilute sulfuric acid

34 Which reagent when reacted with ammonium sulfate, liberates ammonia?

A acidified potassium dichromate(VI)

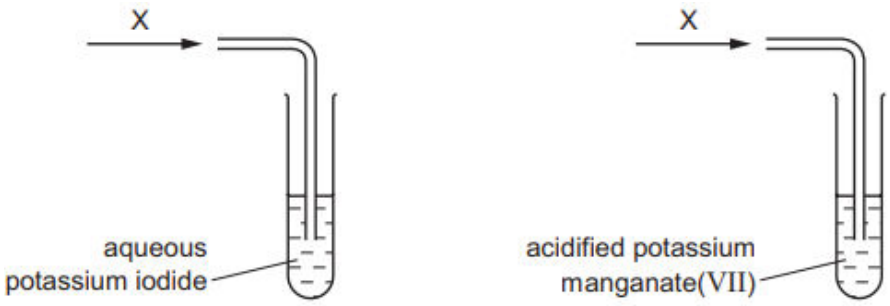
B aqueous bromine

C dilute hydrochloric acid

D limewater

[Turn over

35 Gaseous compound X is an oxidising agent. X is bubbled through separate solutions of aqueous potassium iodide and acidified potassium manganate(VII).



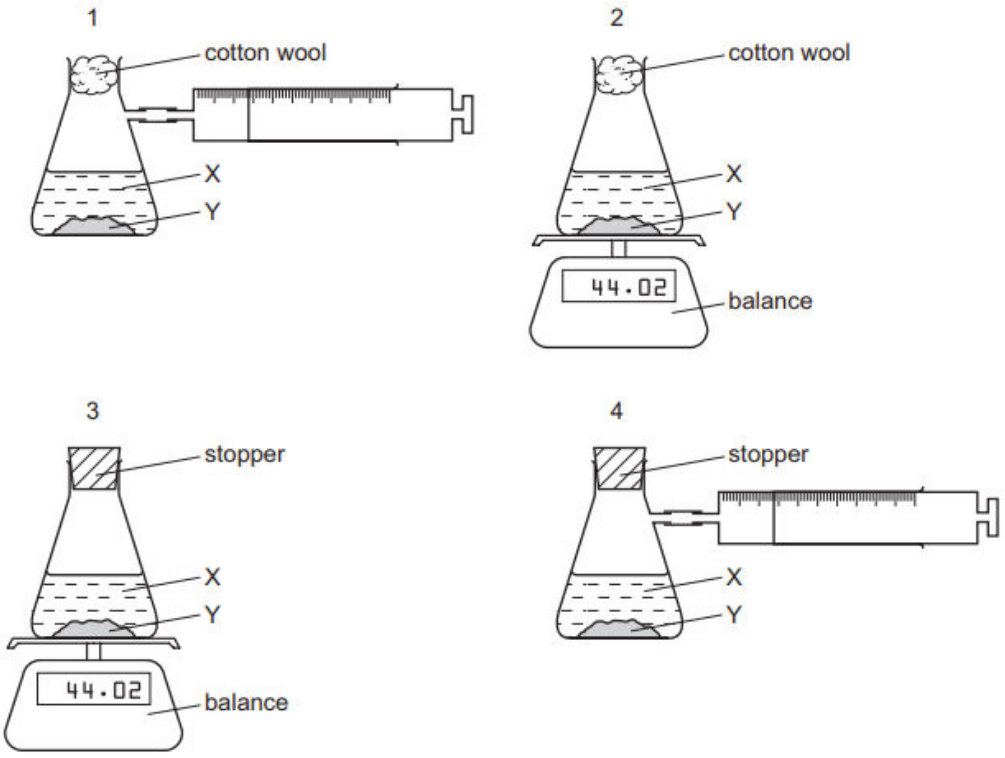
Which row shows the colour changes when X is bubbled through these two solutions?

	aqueous potassium iodide	acidified potassium manganate(VII)
A	brown to colourless	no change
B	brown to colourless	purple to colourless
C	colourless to brown	no change
D	colourless to brown	purple to colourless

[Turn over

36 A liquid X reacts with solid Y to form a gas.

Which two diagrams show suitable methods for investigating the rate (speed) of the reaction?



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

37 A thermometer is placed in water and the temperature is measured to be 43.0 °C. An endothermic change takes place as a solid is dissolved in the water. The temperature changes by 4.5 °C.

What is the thermometer reading now?

A 38 °C **B** 38.5 °C **C** 47 °C **D** 47.5 °C

[Turn over

38 A new planet has been discovered and its atmosphere has been analysed.

The table shows the composition of its atmosphere.

gas	percentage by volume / %
carbon dioxide	4
nitrogen	72
oxygen	24

Which gases present in the atmosphere of the new planet are in a higher percentage than they are in the Earth's atmosphere?

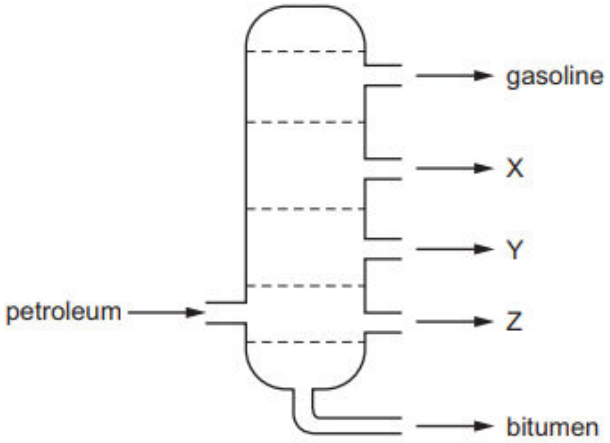
A carbon dioxide and nitrogen

B carbon dioxide and oxygen

C carbon dioxide, nitrogen and oxygen

D nitrogen and oxygen

39 The diagram shows the separation of petroleum into fractions.

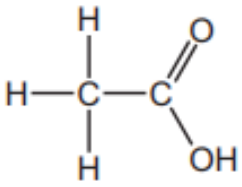


What could X, Y and Z represent?

	X	Y	Z
A	diesel oil	lubricating fraction	paraffin
B	lubricating fraction	diesel oil	paraffin
C	paraffin	lubricating fraction	diesel oil
D	paraffin	diesel oil	lubricating fraction

[Turn over

40 The diagram shows a molecule of an organic compound W.



Which statement is not correct?

A A solution of W in water has a pH greater than 7.

B A solution of W in water reacts with sodium hydroxide solution.

C When copper(II) carbonate is added to a solution of W, a gas is produced.

D When magnesium is added to a solution of W, a gas is produced.

[Turn over

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

[Turn over

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name		Register No.	Class

BENDEMEER SECONDARY SCHOOL
2018 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (CHEMISTRY) PAPER 3
5076/03, 5078/03

DATE : **20th August 2018**
DURATION : **1 hour 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
You may use a 2B pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page 14.
A copy of the Periodic Table is printed on page 15.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

65

This document consists of **15** printed pages.

[Turn over]

Section A

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

1 The structures of some substances containing chlorine are shown in Fig. 1.1.

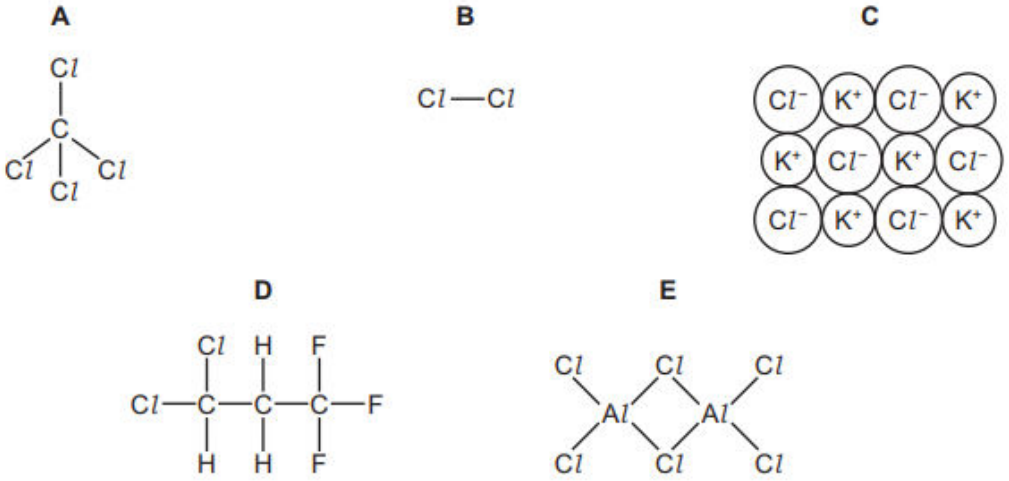


Fig. 1.1

Answer the following questions about these substances. Each of these letters A to E can be used once, more than once or not at all.

(a) Which substance conducts electricity in molten or aqueous state only?

…… [1]

(b) Which substance is a diatomic molecule?

…… [1]

(c) Which substance is an element?

Explain your answer.

……

…… [2]

(d) Which substance is the product of substitution of methane?

…… [1]

[Turn over]

2 Table 2.1 gives the composition of three particles.

Table 2.1

particle	number of protons	number of electrons	number of neutrons
A	15	15	16
B	15	18	16
C	15	15	17

(a) What is the evidence in Table 2.1 for each of the following?

(i) Particle A is an atom.

……..

…….. [1]

(ii) A, B and C are all particles of the same element.

……..

…….. [1]

(iii) Particles A and C are isotopes of the same element.

……..

……..

…….. [2]

(b) **(i)** What is the electronic structure of particle C?

…….. [1]

(ii) Is element C a metal or a non-metal? Give a reason for your choice.

……..

…….. [1]

[Turn over]

3 Coal-burning power stations generate a large amount of heat from the combustion of coal to convert steam which in turn drives turbine generators to produce electricity. Flue gas that is produced contains sulfur dioxide and oxides of nitrogen. These two gases cause acid rain.

(a) Oxides of nitrogen generally consist of a mixture of nitrogen monoxide and nitrogen dioxide. In flue gas, nitrogen monoxide is the main component in the oxides of nitrogen produced.

Explain how nitrogen monoxide causes acid rain even though it is a neutral oxide.

……

……

…… [2]

(b) Acid rain impacts farming greatly as it often causes the soil to be overly acidic and results in leaching of nutrients. In order to alleviate the effects of acid rain, a farmer has been advised to treat the soil to reduce the acidity.

Table 3.1 gives the solubility of some calcium compounds.

Table 3.1

	calcium hydroxide	calcium oxide	calcium carbonate
solubility in water (g per 100 ml of water)	0.173	immediately reacts with water on contact to form an alkaline solution	6.17×10^{-4}

Using the information in Table 3.1, suggest why calcium carbonate is less effective at reducing acidity than calcium hydroxide and calcium oxide.

……..

……..

…….. [2]

(c) Another source of oxides of nitrogen is from car engines.

Explain how the oxides of nitrogen are formed in car engines.

……..

……..

…….. [2]

[Turn over]

(d) Besides acid rain, name two other harmful effects of oxides of nitrogen and sulfur dioxide.

……..

…….. [2]

4 Soluble salts can be made by using a base and an acid.

(a) Complete this method of preparing dry crystals of the soluble salt cobalt(II) chloride from the insoluble base cobalt(II) carbonate.

step 1
Add an excess of cobalt(II) carbonate to hot dilute hydrochloric acid.

step 2

…….

step 3

…….

step 4

…….

step 5

……. [3]

(b) 5.95 g of solid cobalt(II) carbonate is added to 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3.

(i) Write a balanced chemical equation, including state symbols, for the above reaction.

……. [2]

(ii) Show that the cobalt(II) carbonate is added in excess.

[3]

5 The reactivity of different metal oxides was compared by heating them with metals in a crucible. This is shown in Fig. 5.1.

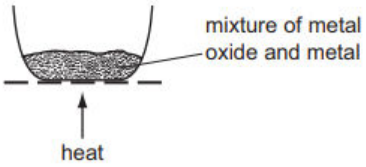


Fig. 5.1

The results are shown in Table 5.2.

Table 5.2

mixture	observations
iron(III) oxide + metal X	reacts
lead(II) oxide + iron	reacts
magnesium oxide + metal X	no reaction

(a) Use the results in Table 5.2 to suggest the order of reactivity of the metals iron, lead, magnesium and X, starting with the most reactive metal.

……..... [1]

(b) Predict whether iron will react with zinc oxide.

Explain your answer.

……..... [1]

(c) Write down two observations when lead(II) oxide reacts with iron.

……...

……..... [2]

(d) In the mixture, iron(III) oxide reacts with metal X.

Which element is reduced in the reaction? Use ideas about oxidation state to explain your answer.

……...

……..... [2]

[Turn over]

6 Fig. 6.1 shows how the ions present in solution A are separated.

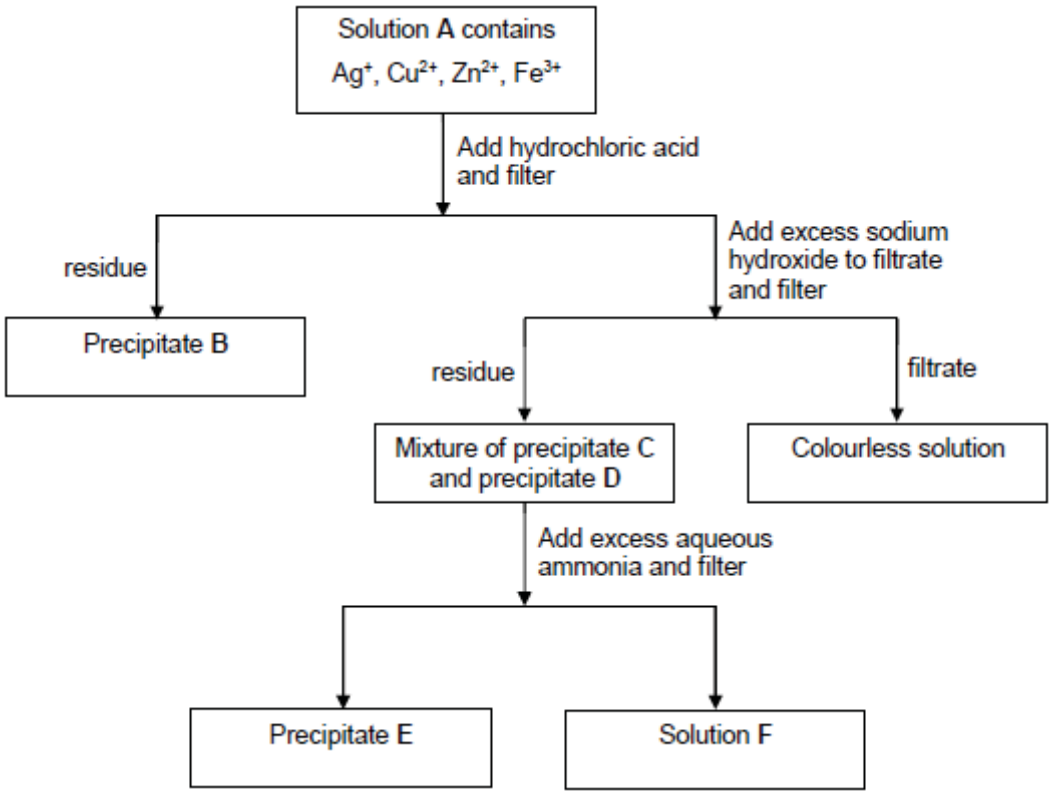


Fig. 6.1

(a) **(i)** It is known that solution A contains one anion. Suggest the identity of this anion. Give a reason for your answer.

……

……

…… [2]

(ii) Describe a test to confirm the anion named in **(a)(i).**

……

…… [1]

(b) Suggest the identity of substances B and C.

B ……..

C …….. [2]

[Turn over]

(c) Describe the movement and arrangement of particles in precipitate E which has been dried.

……

……

…… [2]

7 Fig. 7.1 shows a molecule of cyclohexane, C_6H_{12}, which is a cycloalkane and a saturated hydrocarbon. Cycloalkanes react in a similar way to alkanes.

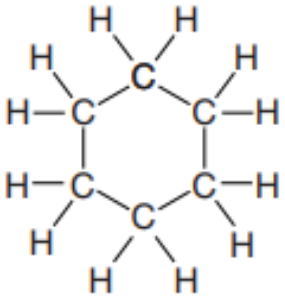


Fig. 7.1

(a) **(i)** Define the term saturated.

…… [1]

(ii) Define the term hydrocarbon.

……

…… [1]

(b) Construct the equation for the complete combustion of cyclohexane.

…… [1]

(c) Cyclohexane reacts with chlorine in the presence of ultraviolet light. This is a substitution reaction. Write the molecular formulae of two products of this reaction.

…… [2]

[Turn over]

Section B

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

8 Metals undergo different chemical reactions to produce different products.

(a) The rate of reaction between a metal and an acid is investigated.

A piece of zinc foil is added to 50 cm^3 of hydrochloric acid, of concentration 2.0 mol / dm^3. The acid is in excess. The hydrogen evolved is collected in the gas syringe and its volume measured every minute. The results are plotted and labelled as graph 1. This is shown in Fig. 8.1.

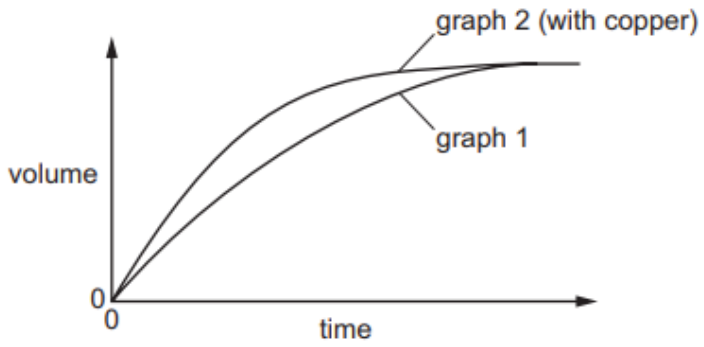


Fig. 8.1

The experiment is repeated to show that the reaction between zinc metal and hydrochloric acid is catalysed by copper. A small volume of aqueous copper(II) chloride is added to the acid before the zinc is added. The results of this experiment are plotted on the same grid and labelled as graph 2 in Fig. 8.1.

(a) **(i)** Explain why the reaction mixture in the second experiment contains copper metal. Include an equation in your explanation.

……

……

…… [2]

[Turn over]

(ii) If the first experiment is repeated using ethanoic acid, CH_3COOH, instead of hydrochloric acid, explain how and why the graph would be different from graph 1. Indicate the speed of this reaction on Fig. 8.1 and label it as graph 3.

……

……

…… [3]

(b) When lithium reacts with water, it moves about on the surface of the water. Bubbles are seen and the lithium disappears slowly.

Predict how the reaction of potassium with water compares with the reaction of lithium with water.

In your answer, include

- any three differences in observations,
- the names of the products formed when lithium and potassium react with water.

……

……

……

……

……

…….. [5]

9 In the laboratory, scientists are always doing research and conducting experiments to make useful products for mankind.

(a) One such useful product is phosphine, PH_3, which is used as a fumigant. It has the smell of garlic and is effective in pest control.

(i) Predict two physical properties of phosphine at room conditions.

Explain your answer.

……..

……..

……..

……..

……..

…….. [5]

(ii) Draw the electronic structure of phosphine. Show outer electrons only.

[2]

(b) Scientists also make margarine from vegetable oils. List the conditions and explain how vegetable oils are used to make margarine for use in foods.

……

……

……

……

…… [3]

[Turn over]

10 Thermal decomposition of compounds breaks them down into smaller substances when sufficient heat is applied.

(a) Air bags are used to protect passengers in a car during an accident. When the crash sensor detects an impact, it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag. This is shown in Fig. 10.1.

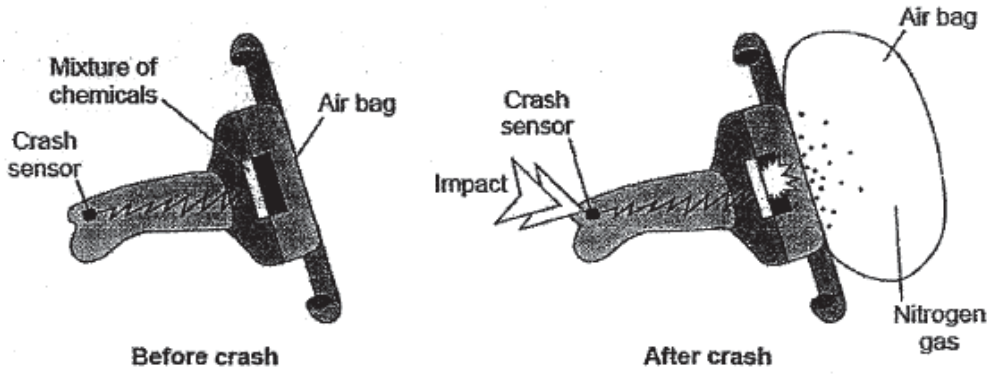


Fig. 10.1

The mixture of chemicals contains solid sodium azide, NaN_3 which decomposes to form sodium and nitrogen as follows.

…… NaN_3 (…….) → ……Na (…….) + …..N_2 (…….)

(i) Balance the chemical equation and complete the state symbols in the chemical equation above. [2]

(ii) Draw the electronic structure of nitrogen gas. Show outer electrons only.

[2]

(iii) An air bag consists of 130 g of sodium azide. When the sodium azide decomposed, 60 dm^3 of nitrogen was obtained at room temperature and pressure.

Show, using calculations, if the thermal decomposition of sodium azide has been efficient in producing nitrogen to fill up the air bag.

[3]

(b) A student used the apparatus in Fig. 10.2 to investigate what happens when liquid paraffin is heated to a high temperature.

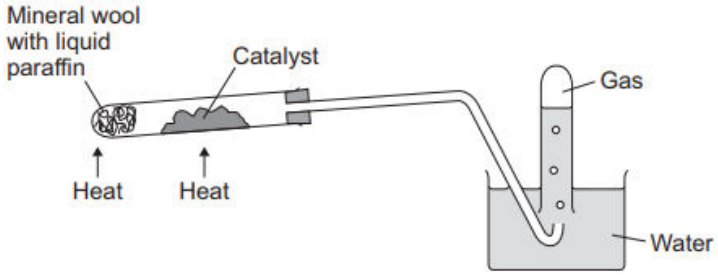


Fig. 10.2

Liquid paraffin contains alkanes. The most abundant alkane has a chemical formula of $C_{20}H_{42}$.

Name the reaction shown in Fig. 10.2. Describe, with the aid of a chemical equation, what happens to the alkane molecules in the reaction.

.....

.....

.....

..... [3]

END OF PAPER

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Prelim Exam 2018
4E/5N Sc(Chem)
Marking Scheme

Section A [1 mark each; 20 marks total]

1	2	3	4	5	6	7	8	9	10
B	D	C	D	B	A	B	A	B	D

11	12	13	14	15	16	17	18	19	20
D	A	B	D	C	D	B	B	D	A

Section B [45 marks total]

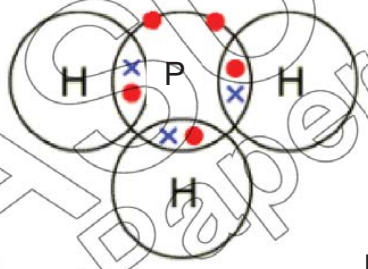
1	**(a)**	C	[1]
	(b)	B	[1]
	(c)	B [1] It has only one type of atom. [1]	[2]
	(d)	A	[1]
2	**(a)**	**(i)** It has the same number of protons and electrons; 15 each.	[1]
		(ii) All have the same number of protons (15) / same proton number / same atomic number	[1]
		(iii) same number of protons (15) / same proton number / same atomic number [1]; Different number of neutrons / different nucleon number / different mass number [1]	[2]
	(b)	**(i)** 2.8.5 / 2,8,5 [1] **(ii)** non-metal because it accepts electrons / needs 3 electrons to complete valence electron shell / because it is in Group V or 5 electrons in valence shell [1] Note: need both non-metal and reason for one mark	[2]

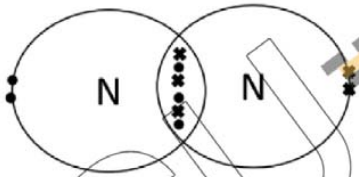
3	**(a)**	NO will be oxidised by oxygen in air to form nitrogen dioxide. [1] Nitrogen dioxide will then dissolve in rainwater to form nitric acid which caused acid rain. [1]	[2]
	(b)	Calcium carbonate is very much less soluble than calcium hydroxide and calcium oxide. [1] Thus, $CaCO_3$ reacts slowly with acid / effective only in reducing acidity of soil / surface in contact / cannot penetrate soil to neutralize acid deeper down. [1]	[2]
	(c)	The high temperatures of the car engines causes[1] nitrogen in the air to react with oxygen in the air producing oxides of nitrogen. [1]	[2]
	(d)	➢ irritates the eyes and lungs and cause breathing difficulties [1] ➢ high levels lead to inflammation of the lungs (bronchitis) [1]	[2]
4	**(a)**	Step 2 Filter to remove excess cobalt(II) carbonate; [1] Step 3 Heat the filtrate till saturation; [1] Step 4 Cool to allow crystals to form; [0.5] Step 5 Rinse crystals with a little distilled water to remove impurities and dry between sheets of filter paper; [0.5]	[3]
	(b)	**(i)** $CoCO_3$ (s) + 2HCl (aq) → $CoCl_2$ (aq) + CO_2 (g) + H_2O (l) State symbols [1]; balanced chemical equation [1]	[2]
		(ii) no of moles of HCl = cv = 2 * (40/1000) = 0.08 mol [1] Mole ratio $CoCO_3$: HCl Fm eqn 1 : 2 Fm data 0.04 : 0.08 [1] Mass of $CoCO_3$ = mol * molar mass = 0.04 * (59+12+48) = 0.04 * 119 = 4.76 g [1] 4.76 g of $CoCO_3$ needed but 5.95 g was used. Hence, $CoCO_3$ was in excess.	[3]

5	**(a)**	magnesium → X → iron → lead / Mg > X > Fe > Pb	[1]
	(b)	no / it will not react **and** zinc is more reactive / iron is less reactive; [1] ignore: zinc is reactive / iron is unreactive	[1]
	(c)	A greenish ppt/solid [1] and a grey/silver solid are formed. [1]	[2]
	(d)	Iron is reduced.[1] The oxidation state of iron decreases from +3 in iron(III) oxide to 0 in iron. [1]	[2]
6	**(a)**	**(i)** Nitrate [1] All nitrates are soluble. [1] or Sulfate [1] All Ag^+, Cu^{2+}, Zn^{2+} and Fe^{3+} sulfates are soluble. [1]	[2]
		(ii) Add sodium hydroxide, aluminium foil and warm. [0.5] Gas produced turns moist red litmus paper blue. [0.5] or Add barium nitrate / barium chloride. [0.5] A white precipitate is seen. [0.5]	[1]
	(b)	B: silver chloride / AgCl [1] C: copper(II) hydroxide / $Cu(OH)_2$ / iron(II) hydroxide / $Fe(OH)_2$ [1]	[2]
	(c)	The particles are in solid state. They vibrate at their fixed positions. [1] They are closely packed in a orderly manner. [1]	[2]
7	**(a)**	**(i)** Contains only carbon-carbon single bonds	[1]
		(ii) Contains only carbon and hydrogen atoms	[1]
	(b)	$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$	[1]
	(c)	HCl (1) $C_6H_{11}Cl$ (1)	[2]

Section C (20 marks)

8	**(a)**	**(i)** zinc displaces copper / zinc more reactive than copper; [1] $Zn + CuCl_2 \rightarrow ZnCl_2 + Cu$ / $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$; [1] **(ii)** less steep (line) or lower gradient / (because of) decreased rate; [1] ethanoic is a weak(er) acid / only partially ionised / dissociated / lower concentration of hydrogen ions; [1]; graph 3 is below graph 1 and ends at the same volume as graph 1 [1]	[5]
	(b)	3 marks from any 3 differences in observations e.g. • more bubbles with K; • it /K moves faster (on water surface); • Li does not catch fire/K catches fire/K bursts into flame; • it /K fizzes more than Li; • it /K disappears rapidly; • K explodes / lithium does not explode; • K melts / ball with K/ lithium does not melt/ does not go into ball [3] Products: lithium hydroxide [0.5] potassium hydroxide; [0.5] hydrogen/H_2 [1]	[5]

9	(a)	**(i)** Phosphine is a liquid / gas at room condition [1] It is made up of 2 non-metals [1] which will form a covalent compound which is a liquid / gas at room conditions. [1] / Phosphine has low melting and boiling points [1] It is a simple covalent molecule [1] with weak intermolecular forces of attraction. Hence little energy is needed to overcome them. [1] / Phosphine does not conduct electricity in any state [1] It has no mobile ions [1]or mobile electrons to carry the current to conduct electricity. [1] Any 2 points with explanations maximum [5]	[5]
		(ii)  [1] for P, [1] for H	[2]
	(b)	react with hydrogen or hydrogenation [1] in the presence of a nickel catalyst at 60 °C (allow 50-200 °C) [1] because vegetable oils are unsaturated or have carbon-carbon double bonds (vegetable oils are hardened) to make them solid at room temperature or to make them useful as spreads/spreadable [1]	[3]

10	**(a)**	**(i)** 2, 2, 3 [1] (s), (s), (g) [1]	[2]
		(ii)  [1] for 3 pairs of bonds, [1] for 2 unshared electrons per N atom	[2]
		(iii) Mole of NaN_3 = mass / molar mass = 130 / (23+ (14*3)) = 2 [1] Mole ratio NaN_3 : N_2 Fm eqn 2 : 3 Fm data 2 : 3 [0.5] Vol of N_2 = mol x 24 = 3 * 24 = 72 dm^3 [1] It was not efficient as only 60 dm^3 of N_2 was produced. [0.5]	[3]
	(b)	Cracking [1] Big alkane → smaller alkanes + smaller alkene (+ hydrogen) $C_{20}H_{42}$ → $C_{12}H_{26}$ + C_8H_{16} (any appropriate balanced equation) [1] It undergoes cracking to produce small(er) molecules / alkanes hydrocarbons and alkenes or a named alkene [1]	[3]

Prelim Exam 2018
4E/5N Sc(Chem)
Marking Scheme

Section B [45 marks total]

				Marker's Comments
1	**(a)**	C	[1]	
	(b)	B	[1]	
	(c)	B [1] It has only one type of atom. [1]	[2]	
	(d)	A	[1]	
2	**(a)**	**(i)** It has the same number of protons and electrons; 15 each.	[1]	
		(ii) All have the same number of protons (15) / same proton number / same atomic number	[1]	
		(iii) same number of protons (15) / same proton number / same atomic number [1]; Different number of neutrons / different nucleon number / different mass number [1]	[2]	
	(b)	**(i)** 2.8.5 / 2,8,5 [1] **(ii)** non-metal because it accepts electrons / needs 3 electrons to complete valence electron shell / because it is in Group V or 5 electrons in valence shell [1] Note: need both non-metal and reason for one mark	[2]	

3	**(a)**	NO will be oxidised by oxygen in air to form nitrogen dioxide. [1] Nitrogen dioxide will then dissolve in rainwater to form nitric acid which caused acid rain. [1]	[2]	
	(b)	Calcium carbonate is very much less soluble than calcium hydroxide and calcium oxide. [1] Thus, $CaCO_3$ reacts slowly with acid / effective only in reducing acidity of soil / surface in contact / cannot penetrate soil to neutralize acid deeper down. [1]	[2]	
	(c)	The high temperatures of the car engines causes[1] nitrogen in the air to react with oxygen in the air producing oxides of nitrogen. [1]	[2]	
	(d)	➢ irritates the eyes and lungs and cause breathing difficulties [1] ➢ high levels lead to inflammation of the lungs (bronchitis) [1]	[2]	
4	**(a)**	Step 2 Filter to remove excess cobalt(II) carbonate; [1] Step 3 Heat the filtrate till saturation; [1] Step 4 Cool to allow crystals to form; [0.5] Step 5 Rinse crystals with a little distilled water to remove impurities and dry between sheets of filter paper; [0.5]	[3]	

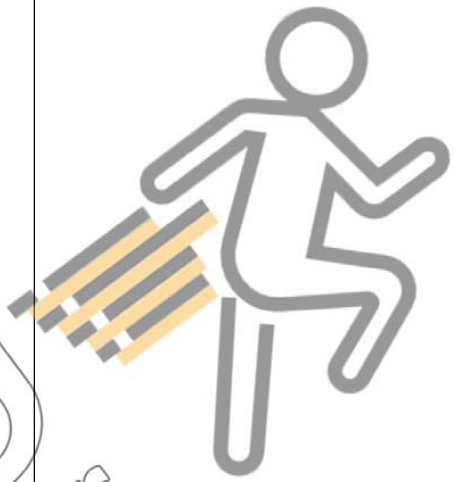
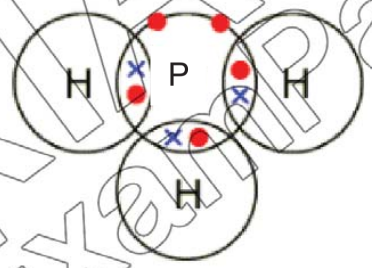
	(b)	**(i)** $CoCO_3$ (s) + 2HCl (aq) → $CoCl_2$ (aq) + CO_2 (g) + H_2O (l) State symbols [1]; balanced chemical equation [1]	[2]	
		(ii) no of moles of HCl = cv = 2 * (40/1000) = 0.08 mol [1] Mole ratio $CoCO_3$: HCl Fm eqn 1 : 2 Fm data 0.04 : 0.08 [1] Mass of $CoCO_3$ = mol * molar mass = 0.04 * (59+12+48) = 0.04 * 119 = 4.76 g [1] 4.76 g of $CoCO_3$ needed but 5.95 g was used. Hence, $CoCO_3$ was in excess. [3]		
5	**(a)**	magnesium → X → iron → lead / Mg > X > Fe > Pb	[1]	
	(b)	no / it will not react **and** zinc is more reactive / iron is less reactive; [1] ignore: zinc is reactive / iron is unreactive	[1]	
	(c)	A greenish ppt/solid [1] and a grey/silver solid are formed. [1]	[2]	
	(d)	Iron is reduced.[1] The oxidation state of iron decreases from +3 in iron(III) oxide to 0 in iron. [1]	[2]	

6	**(a)**	**(i)** Nitrate [1] All nitrates are soluble. [1] or Sulfate [1] All Ag^+, Cu^{2+}, Zn^{2+} and Fe^{3+} sulfates are soluble. [1]	[2]	
		(ii) Add sodium hydroxide, aluminium foil and warm. [0.5] Gas produced turns moist red litmus paper blue. [0.5] or Add barium nitrate / barium chloride. [0.5] A white precipitate is seen. [0.5]	[1]	
	(b)	B: silver chloride / AgCl [1] C: copper(II) hydroxide / $Cu(OH)_2$ / iron(II) hydroxide / $Fe(OH)_2$ [1]	[2]	
	(c)	The particles are in solid state. They vibrate at their fixed positions. [1] They are closely packed in a orderly manner. [1]	[2]	
7	**(a)**	**(i)** Contains only carbon-carbon single bonds	[1]	
		(ii) Contains only carbon and hydrogen atoms	[1]	
	(b)	$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$	[1]	
	(c)	HCl (1) $C_6H_{11}Cl$ (1)	[2]	

Section C (20 marks)

8	**(a)**	**(i)** zinc displaces copper / zinc more reactive than copper; [1] $Zn + CuCl_2 \rightarrow ZnCl_2 + Cu$ / $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$; [1] **(ii)** less steep (line) or lower gradient / (because of) decreased rate; [1] ethanoic is a weak(er) acid / only partially ionised / dissociated / lower concentration of hydrogen ions; [1]; graph 3 is below graph 1 and ends at the same volume as graph 1 [1]	[5]	

	(b)	3 marks from any 3 differences in observations e.g. • more bubbles with K; • it /K moves faster (on water surface); • Li does not catch fire/K catches fire/K bursts into flame; • it /K fizzes more than Li; • it /K disappears rapidly; • K explodes / lithium does not explode; • K melts / ball with K/ lithium does not melt/ does not go into ball [3] Products: lithium hydroxide [0.5] potassium hydroxide; [0.5] hydrogen/H_2 [1]	[5]	

9	(a)	(i) Phosphine is a liquid / gas at room condition [1] It is made up of 2 non-metals [1] which will form a covalent compound which is a liquid / gas at room conditions. [1] / Phosphine has low melting and boiling points [1] It is a simple covalent molecule [1] with weak intermolecular forces of attraction. Hence little energy is needed to overcome them. [1] / Phosphine does not conduct electricity in any state [1] It has no mobile ions [1]or mobile electrons to carry the current to conduct electricity. [1] Any 2 points with explanations maximum [5]	[5]	
		(ii)  [1] for P, [1] for H	[2]	

	(b)	react with hydrogen or hydrogenation [1] in the presence of a nickel catalyst at 60 °C (allow 50-200 °C) [1] because vegetable oils are unsaturated or have carbon-carbon double bonds (vegetable oils are hardened) to make them solid at room temperature or to make them useful as spreads/spreadable [1]	[3]	
10	**(a)**	**(i)** 2, 2, 3 [1] (s), (s), (g) [1]	[2]	
		(ii)  [1] for 3 pairs of bonds, [1] for 2 unshared electrons per N atom	[2]	
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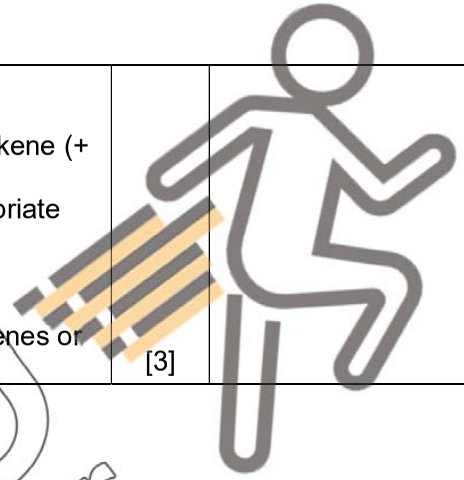
	(b)	Cracking [1] Big alkane → smaller alkanes + smaller alkene (+ hydrogen) $C_{20}H_{42}$ → $C_{12}H_{26}$ + C_8H_{16} (any appropriate balanced equation) [1] It undergoes cracking to produce small(er) molecules / alkanes hydrocarbons and alkenes or a named alkene [1]	[3]	



Bukit Batok Secondary School

PRELIMINARY EXAMINATIONS 2018

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS / CHEMISTRY) **5076 / 01**

Paper 1 Multiple Choice

24 August 2018
0745 – 0845
1 hour

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

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

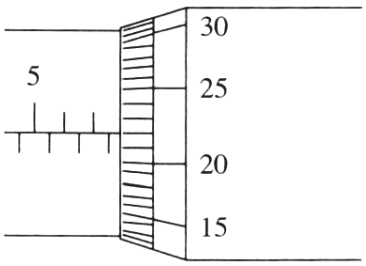
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Electronic calculators may be used.
A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is given at the end of the paper.

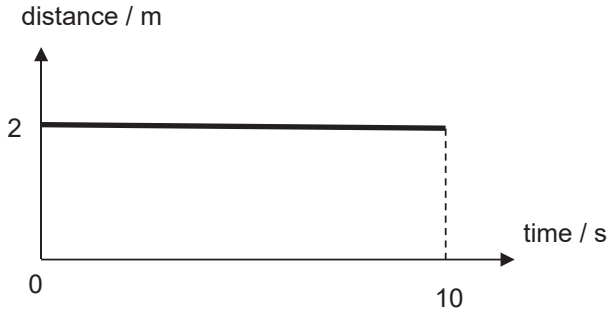
This document consists of **16** printed pages

1 What is the reading shown by the micrometer screw gauge?



A 5.272 mm
B 5.72 mm
C 7.22 mm
D 7.72 mm

2 Which of the following best describes the distance-time graph below?

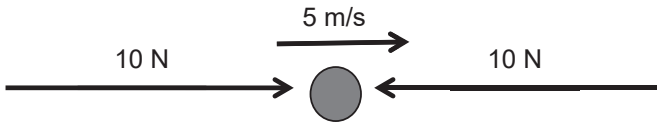


A An object at rest.
B An object moving with a constant speed of 2.0 m/s.
C An object moving with a constant velocity of 2.0 m/s.
D An object moving with a constant acceleration of 2.0 m/s^2.

3 Which of the following consist of only vector quantities?

A mass, distance, time
B friction, velocity, electromotive force
C tension, speed, energy
D weight, displacement, electrostatic force

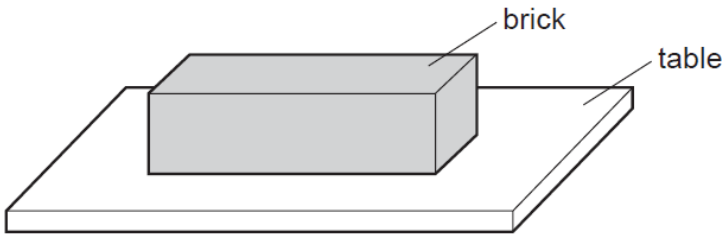
4 A particle moving at constant speed of 5 m/s is being acted on by two 10 N forces as shown.



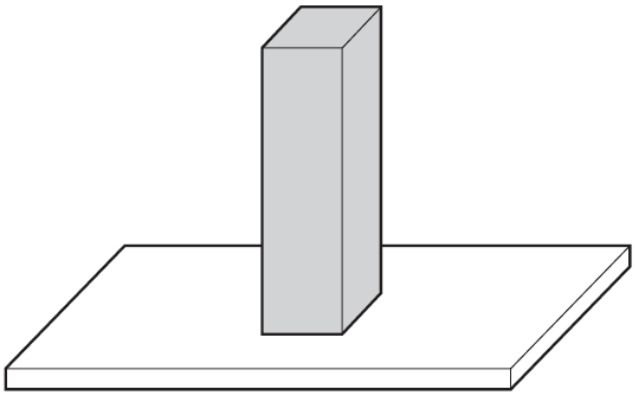
The particle will

A continue to move at 5 m/s in a straight line.
B increase its speed gradually.
C slow down gradually and stop.
D stop immediately.

5 A brick with flat, rectangular sides rests on a table.



The brick is now turned so that it rests on the table on its smallest face.



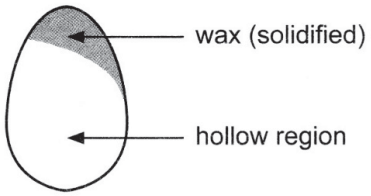
How has this affected the force and the pressure exerted by the brick on the table?

	force	pressure
A	increased	increased
B	increased	unchanged
C	unchanged	increased
D	unchanged	unchanged

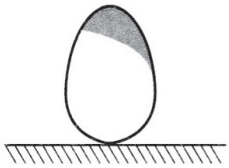
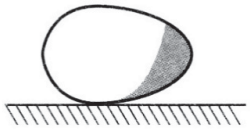
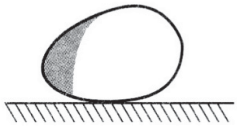
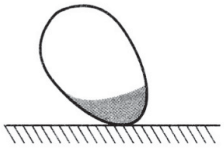
6 When solid A of mass 15 g is immersed in a displacement can filled with water, it displaced the same volume of water as solid B of mass 10 g. Which of the following best describes the densities of solid A and solid B?

A Solid A and solid B have the same density.
B Density of solid A is 0.667 times the density of solid B.
C Density of solid A is 1.5 times the density of solid B.
D Density of solid A is 5 times the density of solid B.

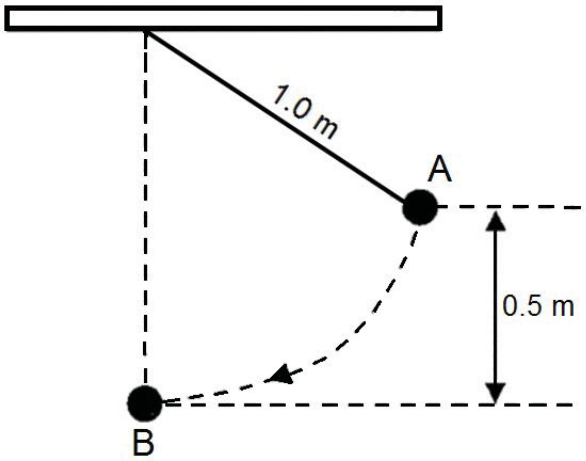
7 An empty egg shell has molten wax solidified inside it as shown in the figure below.



In which position is the egg shell most stable when placed on a flat, horizontal surface?

A	B	C	D
			

8 A pendulum with length of 1.0 m is displaced to position A and released as shown.



Ignoring air resistance, what is the speed of the pendulum bob as it passes its lowest point B?

A 1.5 m/s
B 2.3 m/s
C 3.2 m/s
D 4.1 m/s

9 A cube of ice is heated to water, then to steam.
Which of the following is true?

A The molecules expand as ice changes to steam.
B The molecules move slower as ice changes to steam.
C The molecules move further apart as the ice changes to steam.
D The molecules move closer to one another as ice changes to steam.

10 A beaker of water is heated at the bottom to form a convection current in the water.
An explanation on how convection occurs contains four statements.

1 Density of expanded water decreases.
2 Warm water that is less dense rises and cold water moves in to replace it.
3 Water at the bottom gains heat and becomes warmer.
4 Water expands.

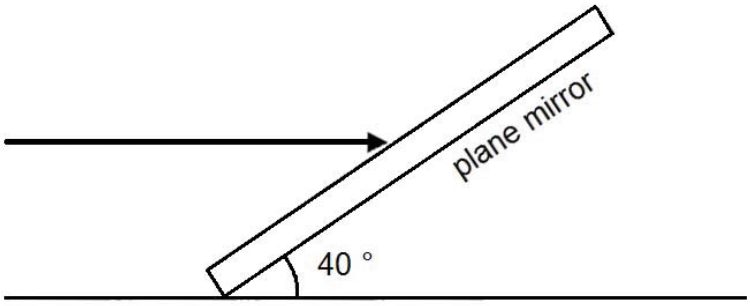
What is the correct order of these four statements?

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

11 The diagram shows an electric flask.
Which of the following statement is true?

A The plastic lid is a good conductor of heat.
B The plastic lid increases heat loss through convection.
C The white colour exterior reduces rate of heat loss by radiation.
D The transparent water level marking increases heat loss by radiation.

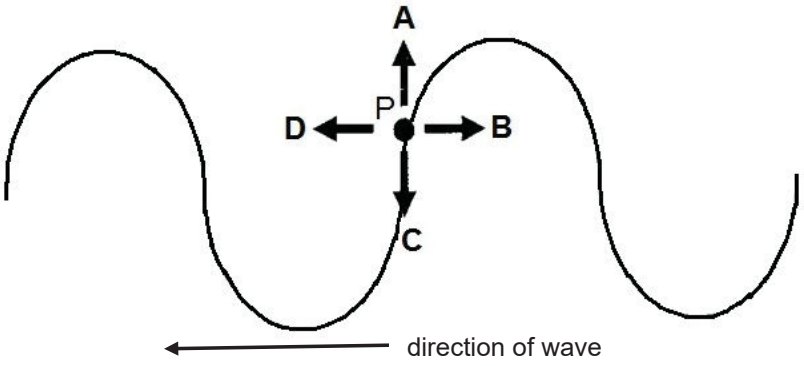
12 A light ray is parallel to the floor and strikes a plane mirror as shown.



What is the angle of incidence?

A 40°
B 50°
C 90°
D 140°

13 A rope is set to oscillate up-and-down to create a transverse wave that moves to the left. At the particular instant below, what is the direction of movement of point P?



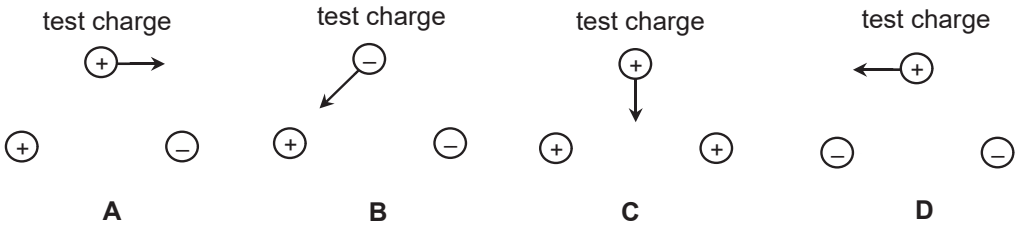
14 What is the speed of X-rays in a vacuum?

A 380 m/s
B 3.0×10^8 m/s
C Slightly less than 3.0×10^8 m/s
D Slightly more than 3.0×10^8 m/s

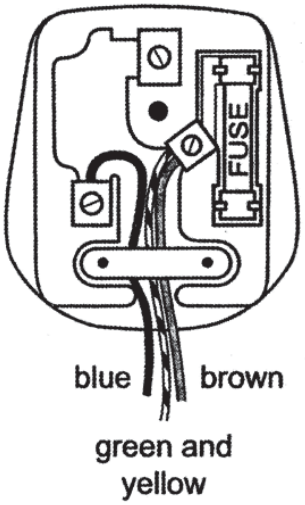
15 Which of the following is **not** an application of gamma rays?

A checking welds
B intruder alarm
C sterilizing equipment
D treatment of cancer

16 Which of the following diagrams correctly shows the direction of the resultant electrostatic force acting on a small test charge?



17 The plug of the vacuum cleaner is wrongly wired as shown.



What is the effect of using the plug wired this way?

A The fuse in the plug blows.
B The metal case becomes live.
C The vacuum cleaner catches fire.
D The vacuum cleaner does not work.

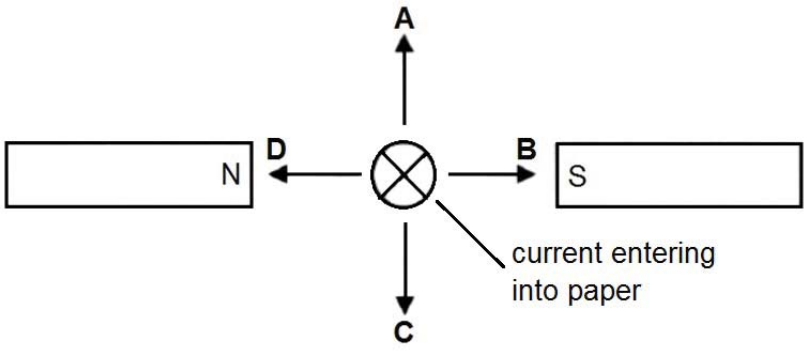
18 Which material is used to make the needle of a plotting compass?

A aluminium
B brass
C iron
D steel

19 One kilowatt-hour of electricity costs $0.20.
How much does it cost to switch on a heater marked “120 V, 3 A” for 90 minutes.

A $0.11
B $2.70
C $64.80
D $108.00

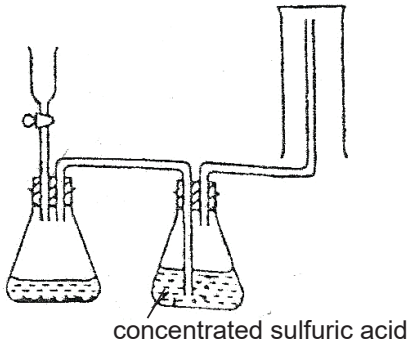
20 The figure below shows a current-carrying conductor between two magnets.
Which of the arrows indicates the direction of the force acting on the conductor?



21 Which of the following is a compound?

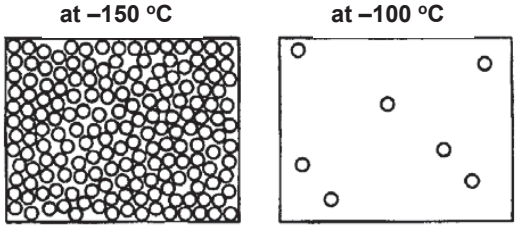
A fluorine
B lithium
C petroleum
D sugar

22 Which of the following gases can be prepared and collected using the apparatus shown?



A ammonia
B carbon dioxide
C hydrogen
D oxygen

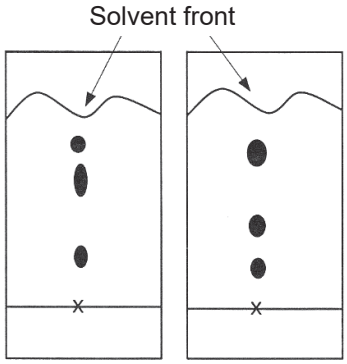
23 The diagrams show the arrangement of molecules in a substance at a pressure of 1 atm and at two different temperatures.



Which substance could the diagrams represent?

Substance	Melting point / °C	Boiling point / °C
A	-183	-89
B	-182	-162
C	-169	-104
D	-114	-85

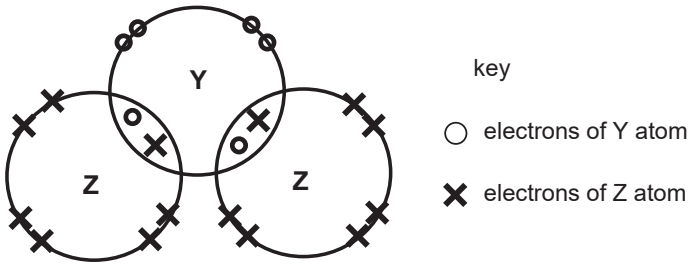
24 Two students carried out chromatography experiments to examine the dyes in a black ink. They used the same ink. The chromatograms obtained by the students are shown below.



Why were the chromatograms different?

A One student used the wrong solvent.
B One student did not use enough solvent.
C The two students used different solvents.
D The solvent moved up the paper at different speeds.

25 The diagram shows the arrangement of electrons in the outer shells of the atoms in the compound YZ_2.



Which pair of elements could be Y and Z?

	Y	Z
A	calcium	fluorine
B	carbon	sulfur
C	oxygen	hydrogen
D	sulfur	chlorine

26 Which ion has the same number of protons as the hydroxide ion?

A O^{2-}
B F^{-}
C Na^{+}
D Mg^{2+}

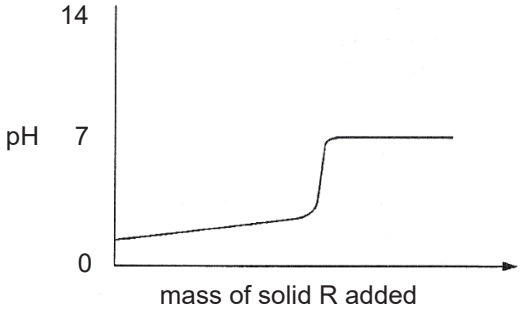
27 Rubidium is in Group I of the Periodic Table.
Which of the following are properties of rubidium chloride?

	formula	melting point	solubility in water
A	RbC*l*	70°C	insoluble
B	RbC*l*	700°C	soluble
C	$RbCl_2$	70°C	soluble
D	$RbCl_2$	700°C	insoluble

28 Which of the following is **unlikely** to react with aqueous sodium hydroxide?

A carbon dioxide
B aluminium oxide
C zinc oxide
D copper (II) oxide

29 Solid R is gradually added to aqueous solution S. The changes in pH are shown in the graph below.



What are R and S?

	R	S
A	insoluble metal oxide	hydrochloric acid
B	insoluble non-metal oxide	sodium hydroxide
C	soluble metal oxide	hydrochloric acid
D	soluble non-metal oxide	sodium hydroxide

30 Test on a sample of polluted water from a factory gives the following results.

Reagent	Result
Hydrochloric acid and aqueous barium chloride	White precipitate
Aqueous ammonia	White precipitate soluble in excess

Which compound is present in the water?

A lead (II) chloride
B lead (II) sulfate
C zinc chloride
D zinc sulfate

31 Magnesium reacts with hydrochloric acid.

$$Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2\ (aq)} + H_{2\ (g)}$$

Which volume of hydrogen at room temperature and pressure is produced if 6g of magnesium reacts with an excess of the acid?

A 1 dm^3
B 6 dm^3
C 12 dm^3
D 24 dm^3

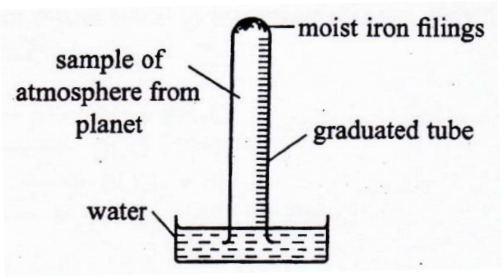
32 Which statement about the production of iron from haematite is correct?

A Coke is used to oxidize the slag.
B Limestone is used to remove basic impurities.
C Molten iron floats on slag at the furnace base.
D The haematite is reduced by carbon monoxide.

33 The atmosphere of a newly discovered planet contains the following gases.

carbon dioxide	20%
nitrogen	40%
oxygen	30%
noble gases	10%

The apparatus below was set up with a 100 cm^3 sample of the atmosphere of the planet in the graduated tube. The volume of the sample was measured at intervals until no further change in volume took place.



What volume of the sample would remain?

A 30 cm^3
B 40 cm^3
C 60 cm^3
D 70 cm^3

34 Which process is endothermic?

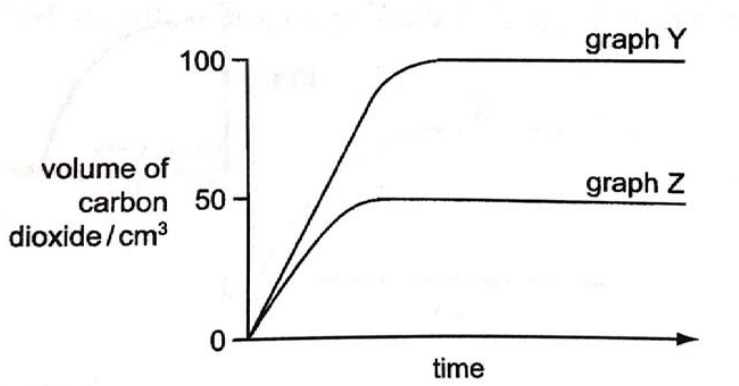
A The formation of a hydrogen-chlorine bond.
B The formation of rust.
C The formation of water from ice.
D The formation of water molecule from oxygen and hydrogen atoms.

35 Which of the following statement described the conversion of a sodium atom, Na, to a sodium ion, Na^+?

A The change is reduction; there is a gain of electron.
B The change is reduction; there is a loss of electron.
C The change is oxidation; there is a gain of electron.
D The change is oxidation; there is a loss of electron.

36 Some crystals of magnesium carbonate were added to an excess of sulfuric acid at room temperature. The volume of carbon dioxide gas produced was measured over a period of time. The results are shown in graph Y.

The experiment was repeated and graph Z was obtained.



Which change was used to obtain the results shown in graph Z?

A Acid of the same volume and half the original concentration was used.
B Half the mass of magnesium carbonate was used.
C Larger crystals of magnesium carbonate was used.
D Using a lower temperature.

37 The table below shows the boiling point ranges of fractions collected from the distillation of a sample of crude oil.

Which fraction contained the smallest molecules?

Fraction	Boiling point range / °C
A	20 – 50
B	50 – 100
C	100 – 150
D	150 - 250

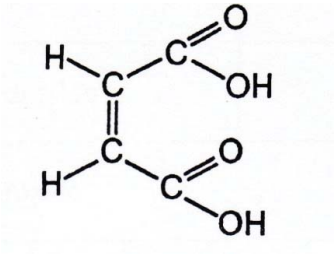
38 'Meta-fuel', $C_8H_{16}O_4$, is a fuel used in camping stoves.
What is the equation for its complete combustion?

A $C_8H_{16}O_4 + 2O_2 \longrightarrow 8C + 8H_2O$
B $C_8H_{16}O_4 + 5O_2 \longrightarrow 8CO + 8H_2O$
C $C_8H_{16}O_4 + 10O_2 \longrightarrow 8CO_2 + 8H_2O$
D $C_8H_{16}O_4 + 8O_2 \longrightarrow 4CO_2 + 4CO + 8H_2O$

39 Which of these reactions does **not** produce carbon dioxide?

A combustion of methane
B fermentation of sugar
C oxidation of ethanol to ethanoic acid
D reaction of ethanoic acid with calcium carbonate

40 A compound, Z, has the molecular structure as shown. How can Z be described?



A an alkane and an acid
B an alkene and an acid
C an alkane and an alcohol
D an alkene and an alcohol

- End of Paper 1 -

DATA SHEET

Colours of some common metal hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

DATA SHEET
The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
						1 H Hydrogen 1											2 He Helium 4
3 Li Lithium 7	4 Be Beryllium 9											5 B Boron 11	6 C Carbon 12	7 N Nitrogen 14	8 O Oxygen 16	9 F Fluorine 19	10 Ne Neon 20
11 Na Sodium 23	12 Mg Magnesium 24											13 Al Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulfur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 64	30 Zn Zinc 65	31 Ga Gallium 70	32 Ge Germanium 73	33 As Arsenic 75	34 Se Selenium 79	35 Br Bromine 80	36 Kr Krypton 84
37 Rb Rubidium 85	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Mo Molybdenum 96	43 Tc Technetium -	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	49 In Indium 115	50 Sn Tin 119	51 Sb Antimony 122	52 Te Tellurium 128	53 I Iodine 127	54 Xe Xenon 131
55 Cs Caesium 133	56 Ba Barium 137	57 – 71 lanthanoids	72 Hf Hafnium 178	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	81 Tl Thallium 204	82 Pb Lead 207	83 Bi Bismuth 209	84 Po Polonium –	85 At Astatine –	86 Rn Radon –
87 Fr Francium –	88 Ra Radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db Dubnium –	106 Sg Seaborgium –	107 Bh Bohrium –	108 Hs Hassium –	109 Mt Meitnerium –	110 Ds Darmstadtium –	111 Rg Roentgenium –	112 Cn Copernicium –	–	114 Fl Flerovium –		116 Lv Livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La Lanthanum 139	58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium 147	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
actinoids	89 Ac Actinium –	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium –	94 Pu Plutonium –	95 Am Americium –	96 Cm Curium –	97 Bk Berkelium –	98 Cf Californium –	99 Es Einsteinium –	100 Fm Fermium –	101 Md Mendelevium –	102 No Nobelium –	103 Lr Lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name:…… Class register no…… Class:……

Bukit Batok Secondary School

PRELIMINARY EXAMINATIONS 2018

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS / CHEMISTRY) 5076/02

Paper 2 Physics

17 August 2018
0745 – 0900
1 hour 15 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
Write in dark blue or black pen
You may use a pencil for any diagrams, graphs or rough working
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions in the spaces provided.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
.....	
.....	
Total	

This document consists of **17** printed pages (including cover page).

SECTION A [45 MARKS]
Answer all the questions in the spaces provided.

1 Fig.1.1 below shows the velocity-time graph of a 900 kg car travelling on a straight horizontal road for the first sixty seconds of its journey.

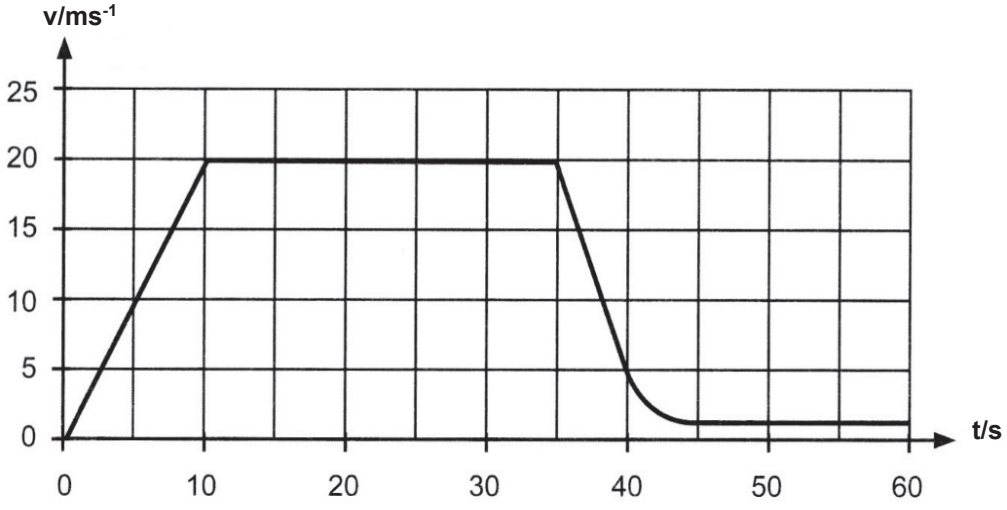


Fig 1.1

(a) Calculate, for the first 10 seconds,

(i) the acceleration of the car,

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

(ii) the resultant force acting on the car.

resultant force = ... N [2]

(b) State how the braking force relates to the forward driving force,

(i) from t = 35 s to t = 45 s and

.....

.....

(ii) between t = 45 s to t = 60 s.

.....

..... [2]

(c) Determine the total distance travelled by the car during the first 30 s of its journey.

total distance = ... m [2]

2 Fig. 2.1 shows a stone supported by two strings that hang from a rod. The tensions in the two strings are 1.3 N and 2.0 N.

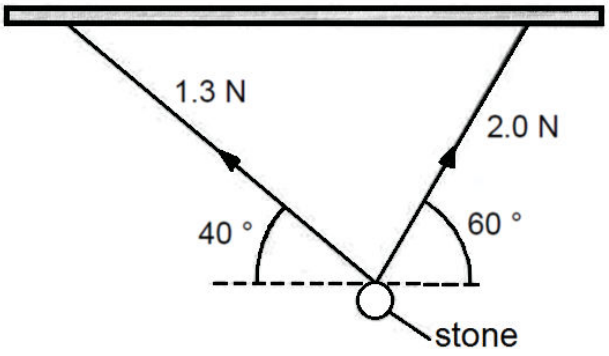


Fig. 2.1 (not drawn to scale)

In the space below, draw a labelled diagram to show the resultant force of the two tensions. Determine the size of the resultant force and the angle between the resultant force and the horizontal.

scale = 1 cm to ..... N

resultant force = ... N

angle = ... [5]

3 Fig 3.1 shows a barrier found in most carparks. The barrier is in equilibrium. The weight of the pole is 450 N and the centre of gravity of the pole is 1.30 m away from the pivot.

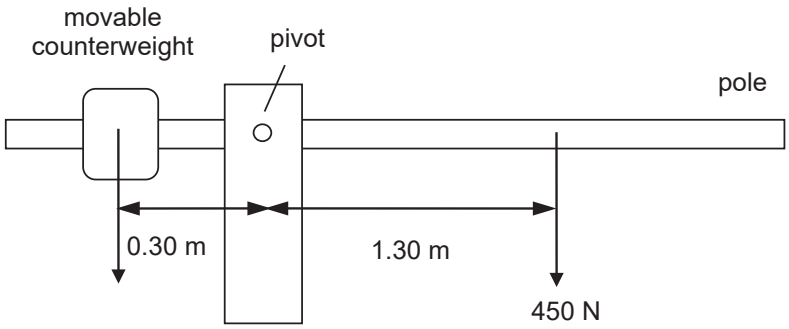


Fig. 3.1

(a) The centre of gravity of the movable counterweight is 0.30 m away from the pivot.

(i) Calculate the weight of the counterweight.

weight of counterweight = ... N [2]

(ii) Hence, calculate the mass of the counterweight.

mass of counterweight = ... kg [1]

(b) Calculate the amount of force acting on the pivot.

force on pivot = ... N [1]

(c) Describe and explain how the gate can be opened.

.....

.....

.....

..... [2]

4 Fig. 4.1 shows a toy car of mass 1.00 kg on a smooth track.
The toy car which is given a slight push starts to move with an initial speed of 2.00 m/s down a smooth track.

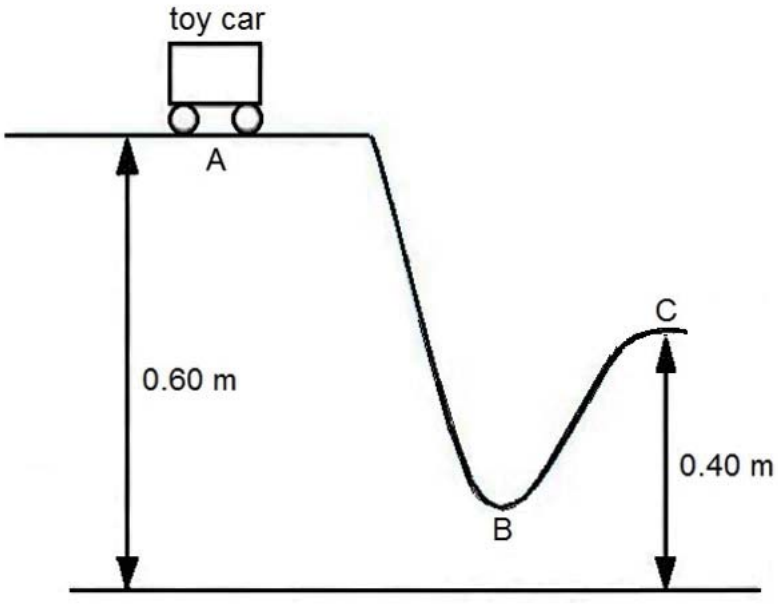


Fig 4.1

(a) State the Principle of Conservation of Energy.

.....

.....

.....

..... [2]

(b) State and explain at which point on the track would the speed of the toy car be at its maximum.

.....

.....

.....

..... [2]

(c) (i) Calculate the gravitational potential energy of the toy car at point **C**.

gravitational potential energy = ... J [1]

(ii) Hence, determine the speed of the toy car at **C**.

speed = ... m/s [2]

5 **(a)** Fig. 5.1 shows how the temperature of an unknown solid substance varies when heated over a Bunsen flame.

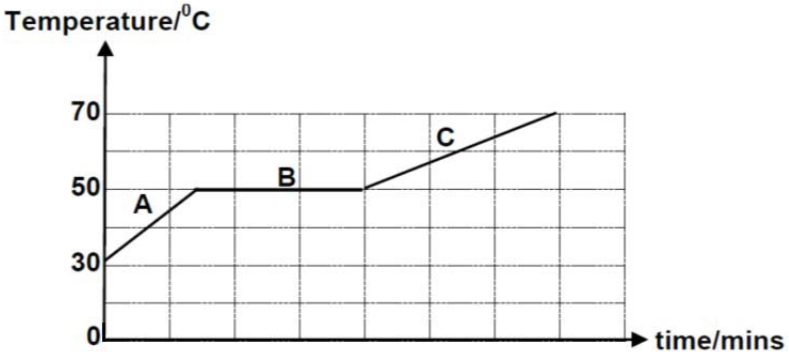


Fig. 5.1

(i) Name the process taking place during stage **B**.

..... [1]

(ii) Describe the movement of the particles at stage **C**.

.....

..... [1]

(iii) Describe the arrangement of the particles at stage **A**.

.....

..... [1]

(b) Explain why a pot of water boils faster with a covered lid.

.....

.....

.....

..... [2]

6 Fig. 6.1 shows a rectangular glass block, **PQRS**, with a refractive index of 1.50. A light ray is incident on the side **PS** of the glass block as shown.

(a) What is meant by the phrase *refractive index of 1.50*?

.....

..... [1]

(b) A ray of light is incident on the side **PS** at 75° and is refracted into the glass block at 40°.

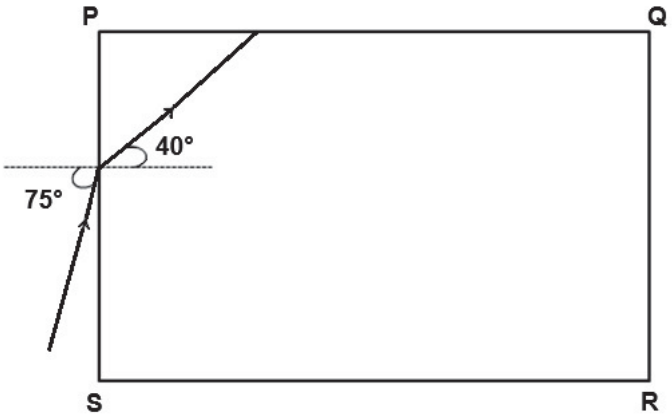


Fig. 5.1

(i) Show that the refractive index of the glass block is 1.50. [1]

(ii) Calculate the critical angle of the glass block.

critical angle = ... ° [2]

(iii) Complete the path of the light ray until it emerges into the air again.
Label all the angles clearly. [2]

7 **(a)** A beam of light is travelling parallel to the axis of a thin lens, as shown in Fig. 7.1. Point **F** is the focal point of the lens.

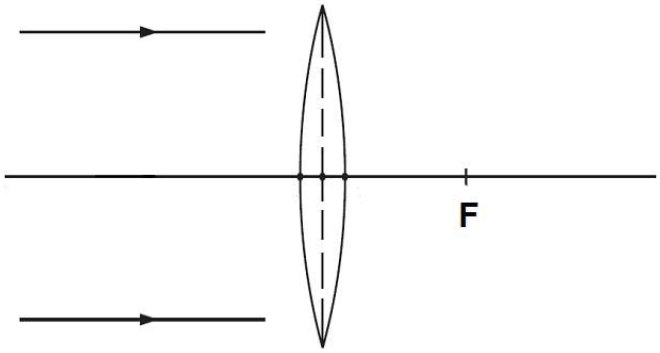


Fig. 7.1

On Fig. 7.1, complete the paths of the two rays after passing through the lens. [2]

(b) In this part of the question, you are required to draw an accurate ray diagram using the grid on Fig. 7.2 for the lens in part **(a)**.

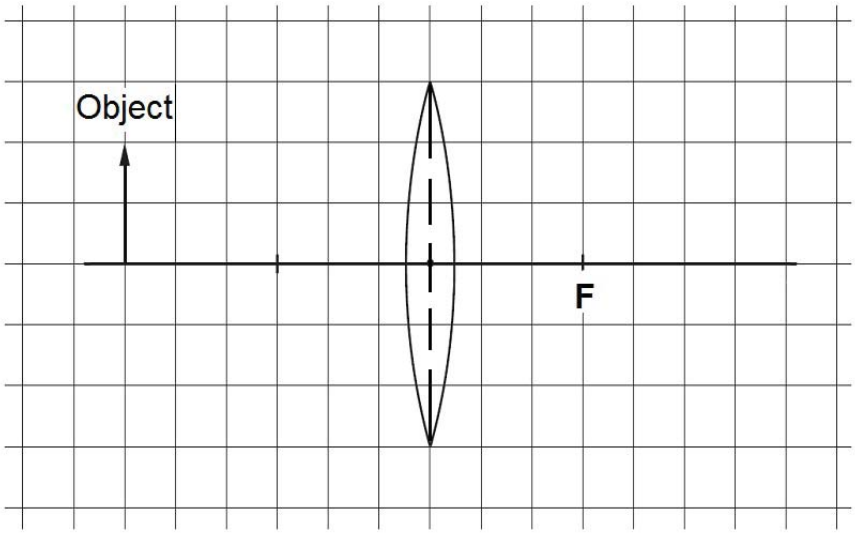


Fig. 7.2

(i) On the diagram, draw two rays from the top of the object through the lens to locate the position of the image. Label the image "**I**" beside it. [2]

(ii) From your diagram, state **one** similarity about the image and the object.

.....

..... [1]

8 Fig. 8.1 shows an arrangement that is used to remove dust particles from the smoke in a factory chimney.

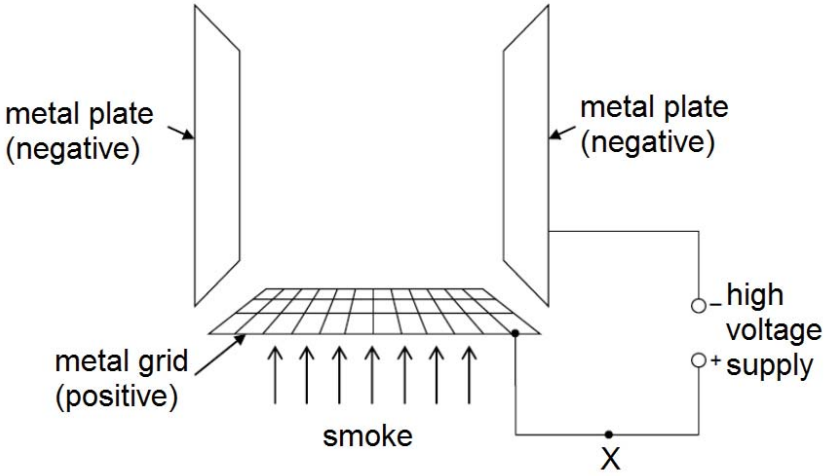


Fig. 8.1

When smoke passes through the metal grid, this results in the dust particles having a net positive charge.

(a) Explain what happened to the dust particles as they pass through the metal grid.

.....

.....

.....

..... [2]

(b) If 6.0 C of charges flow past point **X** in 1.0 minute, calculate the current flowing through **X**.

current = ... A [1]

SECTION B [20 MARKS]

Answer **ANY TWO** questions from this section.

9 Fig. 9.1 shows a metal cylinder which contains 0.000 46 m^3 of oil. The total mass of the cylinder and the oil is 1.2 kg. The mass of the cylinder is 0.800 kg and the space above the oil is air. The gravitational field strength is 10 N/kg.

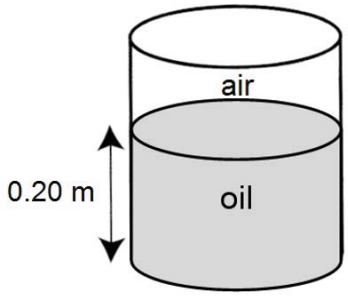


Fig. 9.1

(a) State **two** differences between the mass and the weight of a substance.

Difference 1: .....

.....

Difference 2: .....

.....

[2]

(b) Calculate the weight of the oil.

weight = ... [1]

(c) Calculate the density of the oil in SI unit.

density = ... [2]

(d) Calculate the pressure exerted by the oil on the base of the cylinder in SI unit.

pressure = ... [2]

(e) State and explain how the values of each of the following quantities would change when the cylinder and the oil is brought to the Moon, where the gravitational field strength is reduced.

(i) density of oil.

.....

..... [1]

(ii) pressure exerted by the oil on the base of the cylinder.

.....

.....

..... [2]

10 (a) A boy holds the loose end of a long rope which is fixed to a pole.
He moves it up and down at a rate of 20 complete oscillations in every 50 seconds.
Fig. 10.1 shows a section of the wave moving along the rope.

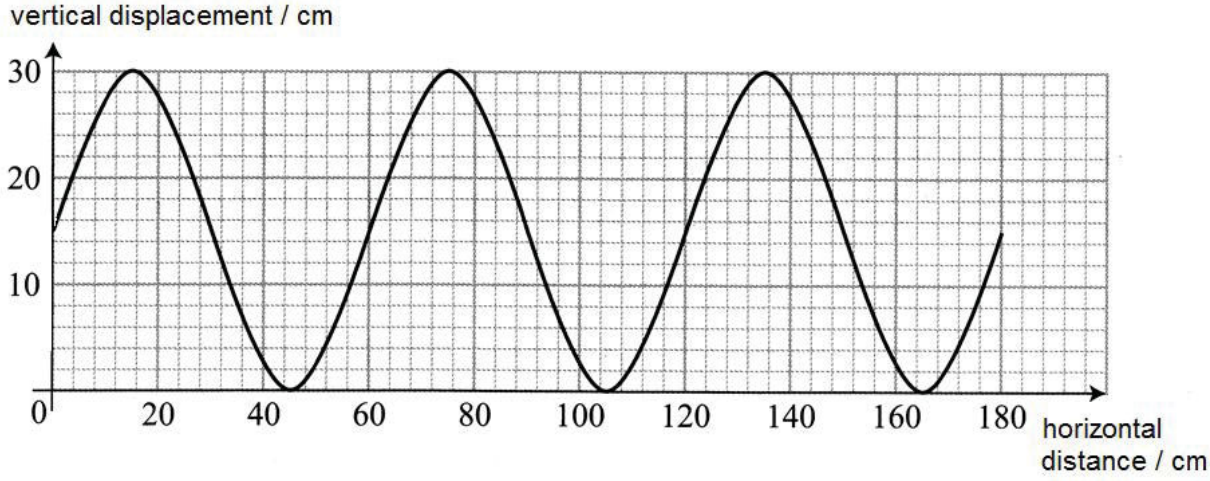


Fig. 10.1

(i) State the value of the amplitude of the wave.

amplitude = ... [1]

(ii) Calculate the frequency of the wave.

frequency = ... [2]

(iii) Calculate the speed of the wave.

speed = ... [2]

(b) Fig. 10.2 shows the cone of a loudspeaker that is producing sound waves in air.
At any given moment, a series of compressions and rarefactions exist along the line **PQ**.

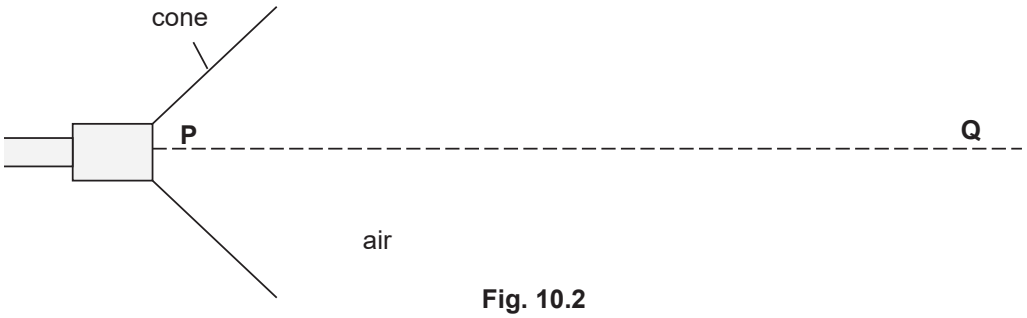


Fig. 10.2

The sound wave experience a rarefaction at **P**.

(i) On Fig 10.2, draw the wave lines to represent **two** wavelengths of compressions and rarefactions between **P** and **Q**.
Use the letter **C** to mark **two** compressions and the letter **R** to mark **two** rarefactions along **PQ**. [2]

(ii) With reference to the sound wave travelling along **PQ** in Fig. 10.2, explain what is meant by a *longitudinal* wave.

.....

..... [1]

(iii) To the right of **Q**, there is a large vertical wall 50 m in front of the loudspeaker.
The speed of sound in air is 340 m/s.
Calculate the time taken for the echo to return to **P**.

time taken = ... [2]

11 (a) Fig. 11.1 below shows an electrical circuit with a lamp and two resistors

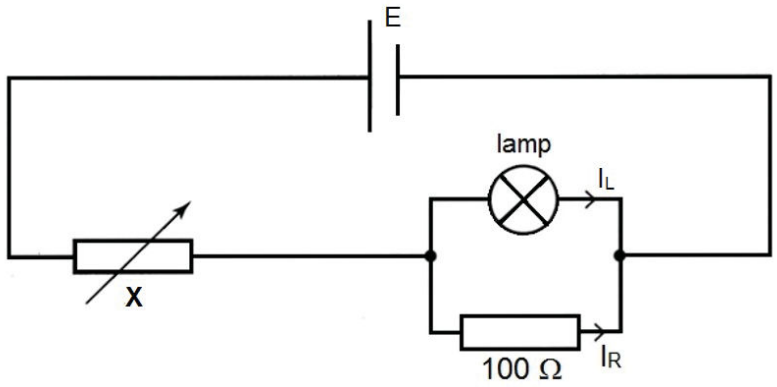


Fig. 11.1

(i) Name the component **X**.

..... [1]

Fig. 11.2 shows the graph of current against potential difference for the lamp **alone**. The potential difference across the lamp is 4.0 V.

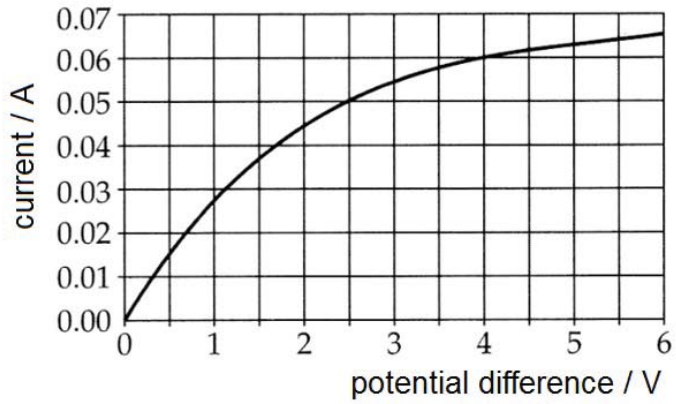


Fig. 11.2

Determine

(ii) the current in the lamp, I_L.

I_L = ... [1]

(iii) the current in the 100 Ω resistor, I_R.

I_R = ... [2]

(iv) the current in component **X**.

current through **X** = ... [1]

(b) Fig. 11.3 shows a type of electromagnetic lock in a door.

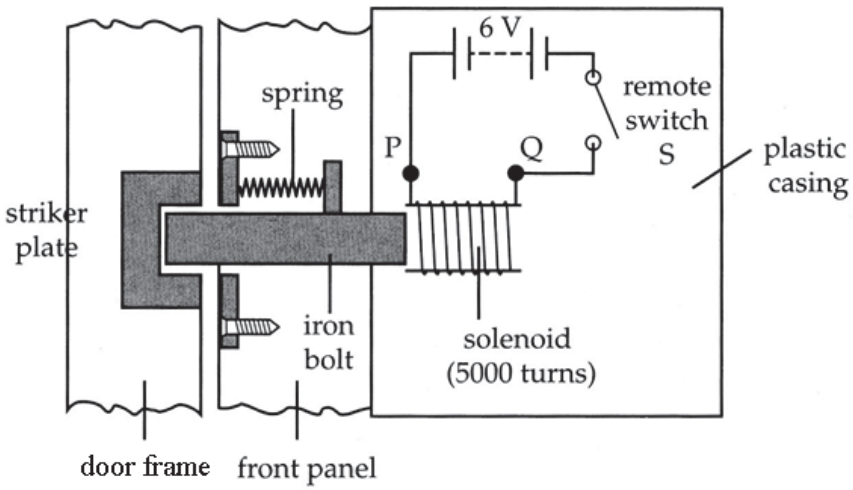


Fig. 11.3

When switch S is closed, the iron bolt moves to the right and out of the striker plate, allowing the door to be opened.

(i) Explain why the iron bolt moves to the right and into the solenoid when the switch is closed.

.....

.....

.....

.....

.....

..... [3]

(ii) After using the electric lock for a year, the 6 V battery goes "flat" and its e.m.f. drops to 4 V.
Why the electromagnetic lock does **not** work now?

.....

.....

.....

..... [2]

****** END OF PAPER 2 ******

2018 Preliminary Examination Marking Scheme
[Sec. 4 Express / 5 Normal (Academic) 5076 Science Physics Paper 2]

SECTION A [45 MARKS]

1 (a) (i) acceleration, $a = \frac{v-u}{t} = \frac{20-0}{10}$ [1 for working]

$= \underline{\textbf{2.0 m/s}^2}$ [1 for ans]

(ii) resultant force, $F_R = ma = (900)(2.0)$ [1 for working]

$= \underline{\textbf{1 800 N}}$ [1 for ans]

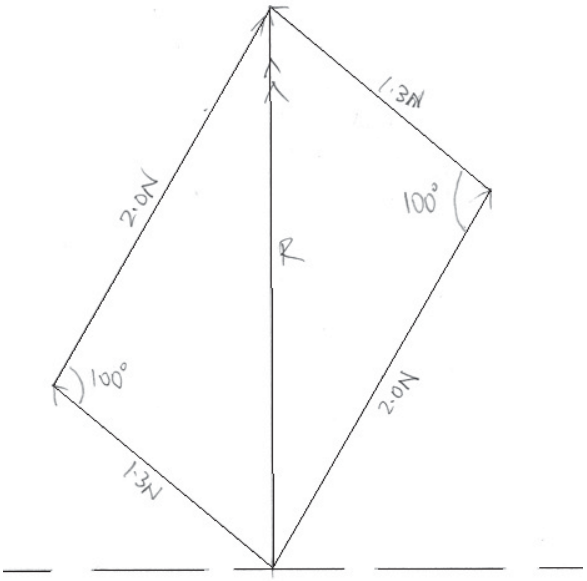
(b) (i) From t = 35 s to t = 45 s, the **braking force is greater than the forward driving force**. [1]

(ii) Between t = 45 s to t = 60 s, **the braking force is equal to the forward driving force**. [1]

(c) Total distance = ½ (10)(20) + (20)(20)
= 100 + 400 [1 for working]
= **500 m** [1 for ans]

2 [**Maximum = 2** for correct length of arrows]
[To deduct 1 mark for lack of arrows or wrong arrow]
[To deduct 1 mark for lack of angles or wrong angle between arrows]

Suitable scale = **1 cm to 0.2 N** [1]
resultant force = **2.56 ± 0.02 N** [1 for value within range]
angle of resultant with horizontal = **90° ± 1°** [1 for angle within range]



3 **(a)** Using Principle of Moments,

(i) W x 0.30 m = 450 N x 1.30 m [1 for working]

$$W = \frac{450 \times 1{,}30}{0.30}$$

= **1950 N** [1 for ans]

(ii) Using $W = mg$

$$m = \frac{W}{g}$$

$$= \frac{1950}{10}$$

= **195 kg** [1 for working & ans]

(b) Force on pivot = 1950 N + 450 N

= **2400 N** [1 for working & ans]

(c) The gate can be opened by **shifting the counterweight further away from the pivot**. **(OR shift to the left)**. [1]

so the **counterclockwise moment** produced by the force of the counterweight is **larger than** the **clockwise moment** produced by the weight of the pole. [1]

4 **(a)** Energy cannot be created or destroyed.
It can only be converted from one form to another; [1]
the total energy of an isolated system is constant. [1]

(b) At **point B**. [1]
At this point the **change in height of the toy car is the greatest** and the largest amount of GPE would have been converted to KE and thus the car would be at the greatest speed. [1]

(c) **(i)** GPE at point **C** = mgh
= (1.00)(10)(0.40) = **4.0 J** [1 for working & ans]

(ii) Total energy at point **A** = KE at point **A** + GPE at point **A**
= ½ mv^2 + mgh
= ½ (1.00) $(2.00)^2$ + (1.00)(10)(0.60)
= 2.0 + 6.0 = **8.0 J** [1 for working & ans]

Total energy at point **A** = GPE at point **C** + KE at point **C**
8.0 = mgh + ½ mv^2
8.0 = (1.00)(10)(0.40) + ½ mv^2
8.0 – 4.0 = ½ (1.00) v^2
$v = \left(\sqrt{8.0}\right)$
= **2.83 m/s** [1 for ans & unit]
[allow ecf from **(c)(i)**]

5 (a) (i) melting [1]

(ii) During stage **C,** the molecules are **sliding past one another**. [1]

(iii) The molecules at stage **A** are **closely packed together**. [1]

(b) With a covered lid, it reduces heat loss to the surroundings by:

- **prevents convection current from forming**.
- reducing **evaporation from the water surface**,
- **reducing conduction through the layer of trapped air** between the water and the lid.

[any TWO answers, 1 mark each, max = 2]

6 (a) "*refractive index of 1.50*" shows that
the **ratio** of the **sine of the incident angle** to the **sine of the refracted angle is 1.50** OR
Ratio of the **speed of light in vacuum** to the **speed on light in the medium is 1.50**. [1]

(b) (i) Refractive index, $n = \frac{\sin i}{\sin r} = \frac{\sin 75°}{\sin 40°}$

= 1.50 (shown) [1 for working]

(ii) $n = \frac{1}{\sin c}$

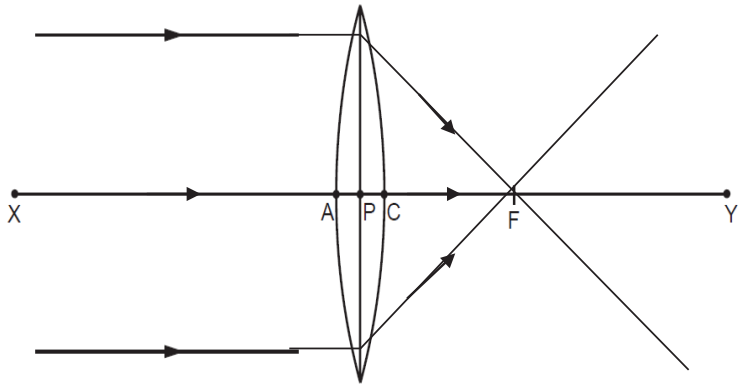
$1.50 = \frac{1}{\sin c}$ [1 for working]

$c = \sin^{-1}\left(\frac{1}{1.50}\right)$

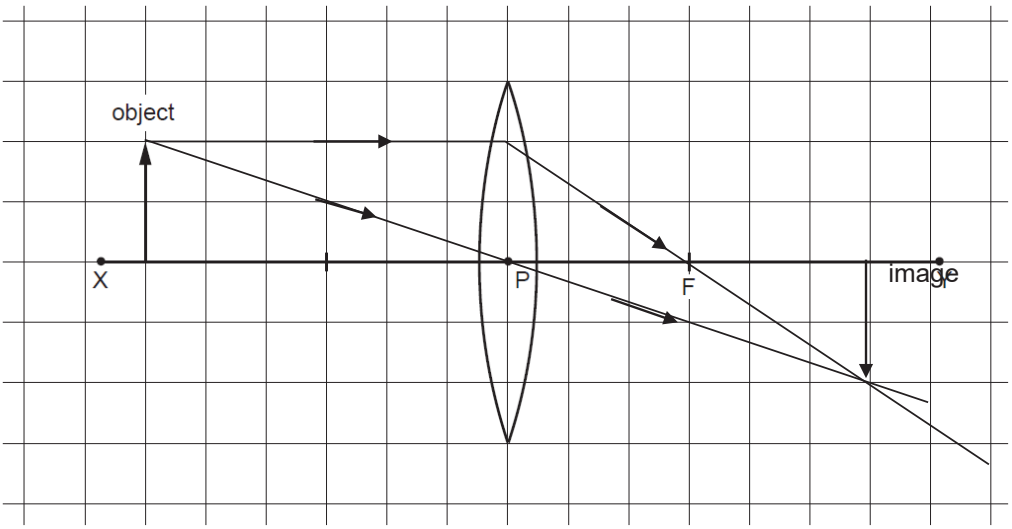
= **41.8 °** [1 for ans]

(b) (iii) [1 for Total Internally Reflected ray, angle 50°, at side **PQ**]
[1 for emergent ray at side **QR**, angle = 75°]

7 (a) [1 mark for each ray converging onto F on the right after passing through the lens]
[**max = 2 marks**]



(b) (i) [1 mark for each ray, **max = 2 marks**]



(ii) The **object distance is the same as the image distance**. OR
The **size of the image is the same as the size of the object**. [1]

8 (a) When the dust particles come into contact with the grid, they **lose electrons to the grid** [1]. Thus the particles will have less negative charges than positive charges and end up with a net positive charge and this cause it to be **attracted to the metal plate**. [1]

(b) Using I = Q / t
= 6.0 / (1 x 60) = **0.10 A** [1 for working & ans]

SECTION B [2 X 10 = 20 MARKS]

9 (a) [**Any TWO** answers. 1 mark each. **Maximum = 2**]

Mass	Weight
A measure of the amount of matter in an object.	The force of gravitational attraction on an object.
SI unit: kilogram (kg)	SI unit: newton (N)
Measured with a beam balance.	Measured with a spring balance.
Mass remains unchanged when it is moved to another place with different gravitational attraction.	Weight changes when it is moved to another place with different gravitational attraction.

(b) Using W = mg
= (1.2 – 0.800)(10)
= **4.0 N** [1 for working, ans & unit]

(c) Using density $= \frac{m}{V} = \frac{0.400}{0.00046}$ [1 for working]
= **870 kg/m^3** [1 for ans & unit]

(d) Using $P = \frac{F}{A} = \frac{4.0}{\left(\frac{0.00046}{0.20}\right)}$ [1 for working]
= **1740 Pa** [1 for ans & unit]

(e) (i) Density **does not change**. Since **Density = Mass / Volume**, both the **mass and volume of the liquid does not change**. [1]

(ii) Pressure will be **reduced**. [1]
According to **P = F/A, weight W (= F) of the liquid is smaller on Moon with base area remains constant**. [1]

10 (a) (i) amplitude = **15.0 cm** [1]

(ii) frequency, f = no of oscillations / time
= 20 / 50 [1 for working]
= **0.40 Hz** [1 for ans & unit]

(iii) Using $v = f\lambda$
v = 0.40 x 60 [1 for working]
= **24 cm /s or 0.24 m/s** [1 for ans & unit]
[allow ecf from **(a)(ii)** for value of frequency]

(b) (i) lines = 1 mark
Labelling of **C** and **R** = 1 mark

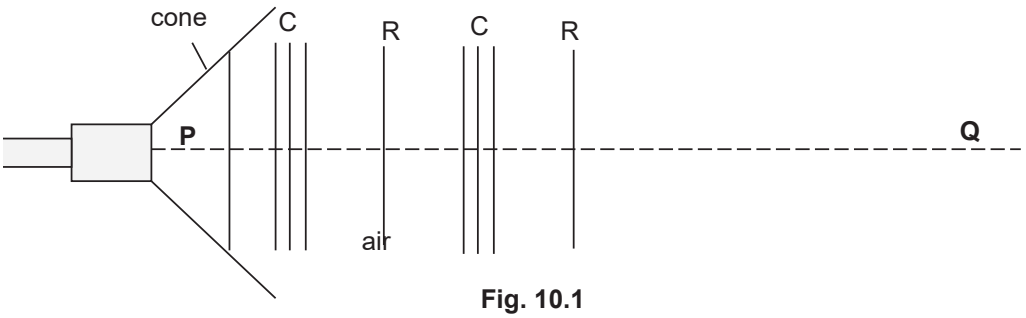


Fig. 10.1

(ii) The sound wave **travels in the direction** (along PQ)
parallel to the direction of the vibration of the air molecules. (along PQ). [1]

(iv) Time = $\frac{2 \times \text{distance}}{\text{speed}} = \left(\frac{2 \times 50}{340}\right)$ [1 for working]

= **0.29 s (accept 0.294 s)** [1 for ans & unit]

11 (a) (i) Rheostat or variable resistor [1]

(ii) (From the graph) current I_L = **0.060 A** [1 for ans & unit]

(iii) Using V = IR

current $I_R = \frac{V}{R} = \frac{4.0}{100}$ [1 for working]

= **0.040 A** [1 for ans & unit]

(iv) current I_X = 0.06 + 0.04

= **0.10 A** [1 for ans & unit]

(b) (i) When the switch is closed, the **solenoid becomes an electromagnet**. [1]
The iron bolt is then **attracted to the solenoid due to magnetic induction**. [1]
This **strong attractive force will overcome the force of the spring** and cause the lock to be unlocked. [1]

(ii) At 4 V, there is **little current flowing through the solenoid**. [1]
Therefore **the magnetic field strength of the solenoid is too weak to attract the iron bolt**. [1]

Name: …… Index No. …… Class: ……

BUKIT BATOK SECONDARY SCHOOL

GCE O LEVEL PRELIMINARY EXAMINATION

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

SCIENCE **5076/03**

Paper 3 Chemistry

15 August 2018

1030 – 1145 h

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
Write in dark blue or black pen
You may use a pencil for any diagrams, graphs or rough working
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions in the spaces provided.
Write your answers in the spaces provided on the Question Paper.

Section B

Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

Electronic calculators may be used.
A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is given at the end of the paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **19** printed pages

Section A [45 marks]
Answer **all** the questions.
Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows the composition of unpolluted, dry air.

(a) Write in the missing name of the gas which occupies 78% of air. [1]

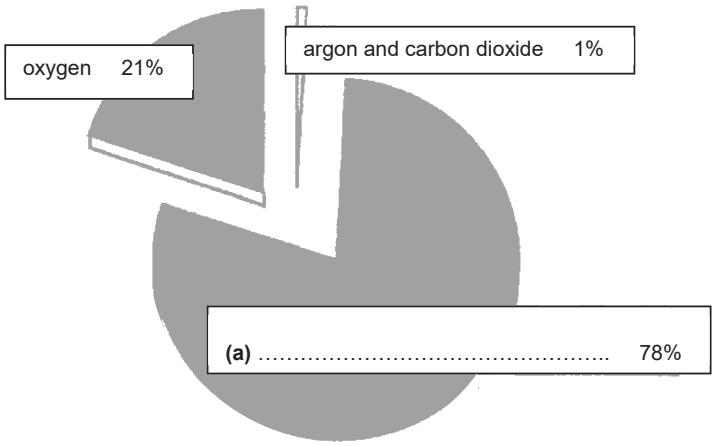


Fig. 1.1

(b) Name two gases that pollute the atmosphere and name the chemical source of each.

Gas 1 .....

Source .....

.....

Gas 2 .....

Source .....

..... [4]

2 A student collected some water from a polluted river.
The water contains some soluble solids and insoluble clay.

(a) State a method that can separate the clay from the rest of the water.

…… [1]

(b) The student then boiled the river water to obtain the soluble solids.
Fig. 2.1 shows how she heated the water.

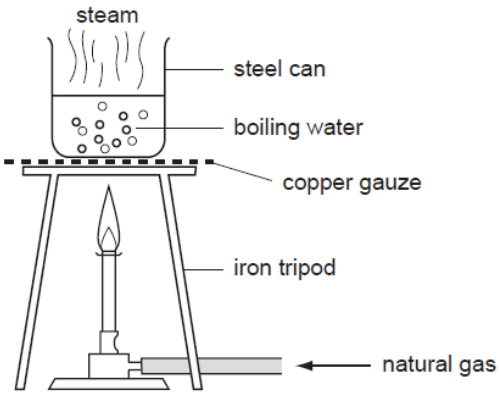


Fig. 2.1

The student wrote in her practical sheet that "*the boiled river water is pure because the universal indicator remains green when it is added to the boiled river water.*"

Do you agree with her statement? Explain.

……..

…….. [1]

(c) On cooling, steam will condense. Describe what happens to the spacing and movement of the particles of steam during condensation.

changes to spacing

……..

changes to movement

…….. [2]

3 Cold packs are used to reduce swelling, inflammation and pain by removing the heat. A list of chemicals from a science laboratory is shown below:

ammonium nitrate, dilute hydrochloric acid, water, anhydrous sodium carbonate, sodium hydroxide

(a) From the list of chemicals provided above, select a **pair** of chemicals that can be used for making a cold pack in a science laboratory.

…….. [1]

(b) Explain your answer in **(a)** and state the type of energy change.

……....

…….. [2]

4 A solution of nitric acid, HNO_3, has a concentration of 126 g/dm^3.

(a) **(i)** Calculate the relative molecular mass of nitric acid.
[Relative atomic masses, A_r : H, 1; N, 14; O, 16]

relative molecular mass = …….. [1]

(ii) Calculate the concentration of the solution in mol/dm^3.

concentration = …….. [1]

(b) Magnesium carbonate reacts with this solution of nitric acid as follows:

$$MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O + CO_2$$

(i) What mass of magnesium carbonate react with 500 cm^3 of nitric acid?

Mass of magnesium carbonate = …….. [2]

(ii) Find the volume of carbon dioxide gas produced in this reaction.

Volume of carbon dioxide = …….. [1]

(c) Another nitric acid solution is made by diluting 1.0 mol to make 2.0 dm^3 of solution. What is the concentration of this solution in mol/dm^3?

concentration …….. [1]

5 Fig. 5.1 shows the properties of some elements in Group VII.

Properties	X	Y	Iodine
melting point / °C	- 7.2	- 101.0	114.0
boiling point / °C	58.8	- 35.0	184.0
reaction with aqueous potassium iodide	colourless solution turns brown	colourless solution turns brown	
reaction with cold aqueous sodium hydroxide	reacts quickly and less vigorously to form a colourless solution	reacts rapidly and vigorously to form a colourless solution	reacts slowly to form a colourless solution

Fig. 5.1

(a) State the physical state and colour of **Y** at room temperature and pressure.

…… [1]

(b) Using evidence from Figure 5.1, explain and deduce the identity of **X**.

……

……

……

……

……

…… [3]

(c) Iodine reacts with cold aqueous sodium hydroxide according to the equation:

$$2NaOH + I_2 \rightarrow NaI + NaOI + H_2O$$

(i) Explain why both element **X** and **Y** undergoes similar reaction with cold aqueous sodium hydroxide.

……

…… [1]

(ii) Hence, construct a chemical equation for the reaction between element **X** and cold aqueous sodium hydroxide.

…… [1]

6 Equal masses of lumps of lead (II) carbonate were reacted with three different acids of the same concentration in three separate experiments I, II and III. The acids were in excess and all other conditions were kept the same.

Experiment	Reagents	
I	Lead (II) carbonate	Nitric acid
II	Lead (II) carbonate	Sulfuric acid
III	Lead (II) carbonate	Ethanoic acid

The mass of the lead (II) carbonate was measured and calculated at regular time intervals and the results for experiments I and II are shown in Figure 6.1.

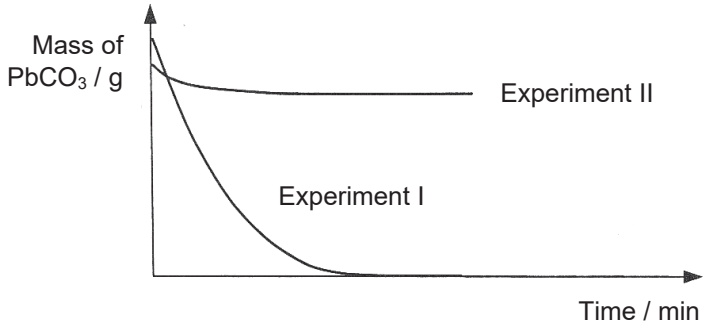


Fig. 6.1

(a) Using Fig. 6.1, determine if lead (II) carbonate react completely with sulfuric acid. Explain your answer.

…… [1]

(b) **(i)** In experiments I and III, would ethanoic acid react faster than nitric acid? Explain your answer in terms of hydrogen ions in the acids.

……..

……..

……..

…… [2]

(ii) Lead (II) ethanoate is a white, crystalline substance with a sweetish taste and is soluble in water.

Sketch on the same axes above, the result for experiment III. [1]

(c) Briefly outline how a pure and dry sample of lead (II) nitrate can be made from lead (II) carbonate.

.....

.....

.....

.....

.....

.....

..... [4]

7 Propane and propene are both organic compounds.

(a) Compare how they react, if at all, with
(i) oxygen,
(ii) hydrogen.

.....

.....

.....

.....

.....

.....

.....

.....

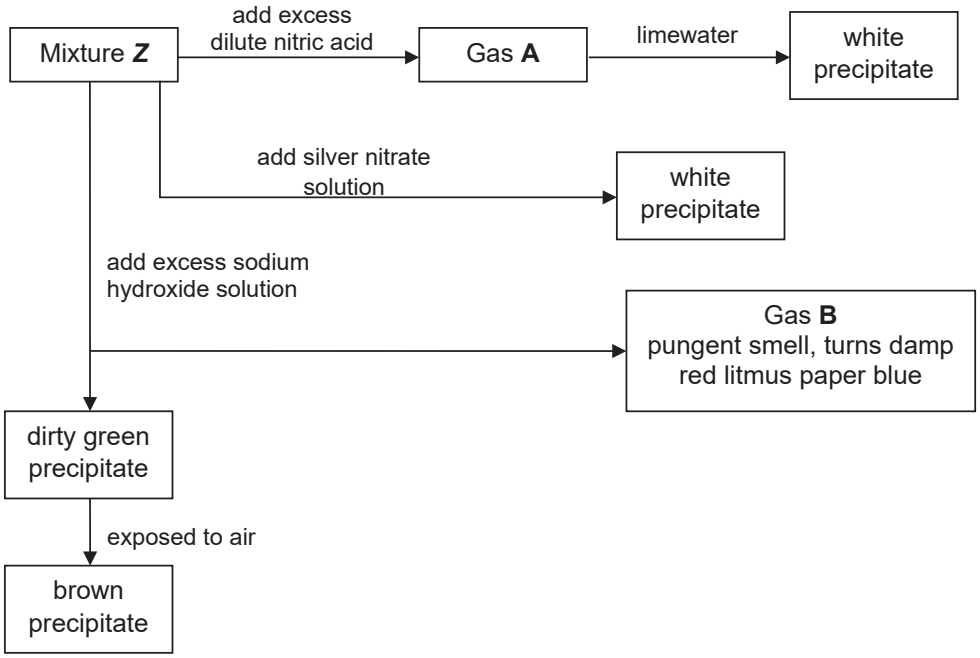
.....

..... [5]

(b) Write a chemical equation for any one of these reactions.

..... [1]

8 A mixture ***Z*** was made by dissolving two salts, ***X*** and ***Y***, in water. A series of reactions was carried out on mixture ***Z*** as shown below.



(a) Identify the **four** ions that are present in mixture ***Z***. Justify your answers. [4]

Ions	Formula	Reasons
1		
2		
3		
4		

(b) Predict what would be observed if excess ammonia solution was added to a sample of mixture ***Z***.

…….

……... [1]

(c) No reaction was observed when ammonia solution was added to aqueous solution of salt ***Y***.

Give the names of salts ***X*** and ***Y***.

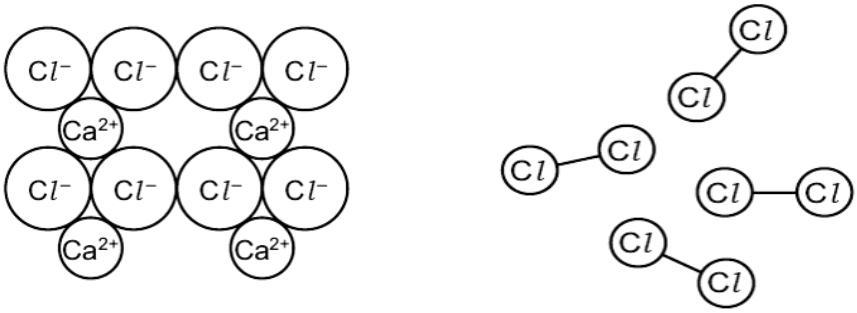
X : ……...

Y : …… [2]

- End of Section A -

Section B [20 marks]
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

9 Fig. 9.1 shows the structures of calcium chloride and chlorine gas.



calcium chloride **chlorine gas**

Fig. 9.1

(a) Chlorine exists as two isotopes, ^{35}Cl and ^{37}Cl.
Describe the similarities and differences between these two isotopes.

……

……

…….. [3]

(b) Calcium reacts with chlorine atoms to form calcium chloride.
Fig. 9.2 shows the physical properties of calcium chloride and chlorine.

	conductivity	boiling point/ ^{O}C
calcium chloride	conducts in molten state but not in solid state	1935
chlorine gas	does not conduct electricity	-34

Fig. 9.2

(i) Predict and explain the electrical conductivity of strontium chloride.

……

……

…….. [2]

(ii) Explain how a calcium atom combines with chlorine atoms to form calcium chloride. Your answer should include:

- electronic structures of atoms
- force of attraction in the compound

……

……

……

…….... [3]

(iii) Give a reason why chlorine gas has such a low boiling point.

……

……

…….... [2]

[Total : 10 marks]

10 (a) Duralumin is an alloy made up mainly of aluminium and copper atoms.

Fig. 10.1 shows how the strength of duralumin changes with the different percentage of copper added.

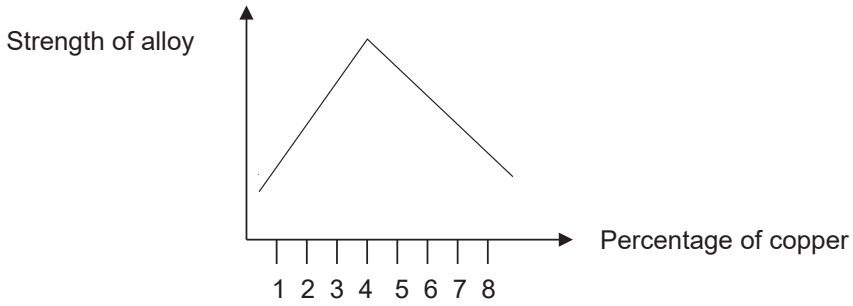


Fig. 10.1

(i) Using the information from Figure 10.1, estimate the percentage of copper that will produce the strongest duralumin mixture.

..... [1]

(ii) Explain, with the aid of a well-labelled diagram of duralumin, why it is stronger than pure aluminium.

.....

.....

..... [2]

(b) Fig. 10.2 shows the results of an experiment in which four metals are placed in solutions of other metal nitrates.

Solution		Metals added			
Metal nitrate	**Colour**	**Calcium**	**Chromium**	**Cobalt**	**Copper**
Calcium nitrate	Colourless	No reaction	No reaction	No reaction	No reaction
Chromium (III) nitrate	Green	Colourless solution and grey solid	No reaction	No reaction	No reaction
Cobalt (II) nitrate	Pink	Colourless solution and grey solid	Green solution and grey solid	No reaction	No reaction
Copper(II) nitrate	blue	Colourless solution and reddish-brown solid		Pink solution and reddish-brown solid	No reaction

Fig. 10.2

(i) Arrange the four metals in order of their reactivity starting with the most reactive.

…… [1]

(ii) Predict two observations when chromium is added to copper(II) nitrate solution.

……

……

…… [2]

(c) One possible chemical reaction between metal **Y** and the solution of salt **X** is as follows:

$$\mathbf{Y} + \mathbf{X}(NO_3)_2 \rightarrow \mathbf{X} + \mathbf{Y}(NO_3)_2$$

(i) Complete the table below with the missing information.

formula	oxidation state of Y
Y	
$\mathbf{Y}(NO_3)_2$	

[2]

(ii) Using the data above, explain whether **Y** is an oxidizing or a reducing agent.

……

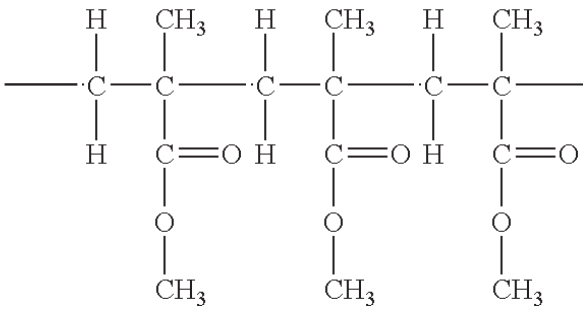
……

……

…… [2]

[Total : 10 marks]

11 Poly(methyl methacrylate) is formed by addition polymerisation.
Its structure is shown below.



(a) (i) Draw the structure of the monomer of poly(methyl methacrylate).

[1]

(ii) Explain why and how the monomer drawn in **(a)(i)** can undergo addition polymerisation to form poly(methyl methacrylate).

……

……

……

…… [2]

(b) Ethanol can be obtained from glucose through the process of fermentation. One of the conditions of this process is having an anaerobic environment. Otherwise, substance **X** will be produced instead.

(i) Write the chemical equation for fermentation of glucose.

…… [1]

(ii) Draw the structural formula of substance **X**.

[1]

(iii) Describe a laboratory experiment to differentiate ethanol and substance **X**.

.....

.....

.....

.....

..... [3]

(iv) A student carries out fermentation in a laboratory. To speed up the process, he heats up the mixture to 100 ºC. Explain why he will **not** obtain ethanol.

.....

..... [1]

(v) State one use of ethanol.

..... [1]

[Total : 10 marks]

- End of Paper –

DATA SHEET

Colours of some common metal hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

DATA SHEET

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H Hydrogen 1										2 He Helium 4
3 Li Lithium 7	4 Be Beryllium 9											5 B Boron 11	6 C Carbon 12	7 N Nitrogen 14	8 O Oxygen 16	9 F Fluorine 19	10 Ne Neon 20
11 Na Sodium 23	12 Mg Magnesium 24											13 Al Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulfur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 64	30 Zn Zinc 65	31 Ga Gallium 70	32 Ge Germanium 73	33 As Arsenic 75	34 Se Selenium 79	35 Br Bromine 80	36 Kr Krypton 84
37 Rb Rubidium 85	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Mo Molybdenum 96	43 Tc Technetium -	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	49 In Indium 115	50 Sn Tin 119	51 Sb Antimony 122	52 Te Tellurium 128	53 I Iodine 127	54 Xe Xenon 131
55 Cs Caesium 133	56 Ba Barium 137	57 – 71 lanthanoids	72 Hf Hafnium 178	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	81 Tl Thallium 204	82 Pb Lead 207	83 Bi Bismuth 209	84 Po Polonium –	85 At Astatine –	86 Rn Radon –
87 Fr Francium –	88 Ra Radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db Dubnium –	106 Sg Seaborgium –	107 Bh Bohrium –	108 Hs Hassium –	109 Mt Meitnerium –	110 Ds Darmstadtium –	111 Rg Roentgenium –	112 Cn Copernicium –	–	114 Fl Flerovium –		116 Lv Livermorium –		

Key

proton (atomic) number

atomic symbol

lanthanoids	57 La Lanthanum 139	58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium 147	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
actinoids	89 Ac Actinium –	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium –	94 Pu Plutonium –	95 Am Americium –	96 Cm Curium –	97 Bk Berkelium –	98 Cf Californium –	99 Es Einsteinium –	100 Fm Fermium –	101 Md Mendelevium –	102 No Nobelium –	103 Lr Lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Bukit Batok Secondary School
Sec 4 Express, 5 Normal (Academic)
Science (Chemistry)

PRELIMINARY EXAMINATIONS 2018
ANSWERS

Paper 1 : Multiple Choice Questions (20 marks)

21	**D**	Sugar = $C_6H_{12}O_6$ where carbon, hydrogen and oxygen atoms are chemically bonded together
22	**C**	Conc sulfuric acid H_2SO_4 dries acidic gases (so they don't react). Upward delivery is used to collect gases which are less dense than air. NH_3 will react with conc H_2SO_4 though it can be collected via upward delivery. CO_2, H_2 and O_2 will not react with conc H_2SO_4 thus can be dried & collected. Only H_2 is less dense than air to be collected via upward delivery method.
23	**C**	Melting point of substance is to be <-150°C and boiling point <-100°C.
24	**C**	Different substances have different solubility in different solvents.
25	**D**	Y – from Group VI because it has 6 valence electrons Z – from Group VII because it gas 7 valence electrons
26	**B**	Hydroxide ion = OH^- There are 8 protons in oxygen and 1 proton in hydrogen atoms = 9 protons F- ion has 9 protons (each fluorine atom has 9 protons, it takes in 1 electron to form a fluoride ion, proton number is not affected thus remains the same).
27	**B**	Rubidium chloride is made up of Rb^+ and Cl^- ions thus RbCl. Group I metals have low melting point and are soluble in water.
28	**D**	Acidic oxide (CO_2) and amphoteric oxides (Al_2O_3 and ZnO) can react with NaOH which is a base.
29	**A**	R is a solid which can react with solution S in a neutralisation reaction. Thus R = insoluble metal oxide (ie a solid) and S = acid (solution)
30	**D**	$BaCl_2$ gives white precipitate = SO_4^{2-} present White precipitate soluble in excess aq NH_3 = Zn^{2+} ion present
31	**B**	No of moles of Mg = mass ÷ molar mass = 6g ÷ 24 = 0.250 mol 1mol Mg produces 1mol H_2 Volume of H_2 = no of moles x molar volume = 0.250 mol x 24 dm^3 = <u>*6 dm^3*</u>
32	**D**	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ Answer is **NOT** (B) because **<u>LIME</u>** is used to remove acidic impurities, not **limestone**. **<u>LIME</u>** is produced of heat limestone. $CaCO_3 \rightarrow CaO + CO_2$ $CaO + SiO_2 \rightarrow CaSiO_3$
33	**D**	30% of O_2 will be used up, 70% of air left.
34	**C**	(A) formation of bond = exothermic (B) rusting = exothermic (C) melting (ice absorb heat) = endothermic (D) H_2 combust in O_2 to form H_2O = exothermic
35	**D**	Na atom (2.8.1) loses 1 electron to form Na^+ ion (2.8). Loss of electrons = oxidation
36	**B**	½ volume of CO_2 produced , thus ½ mass of limiting reactant ($MgCO_3$) used.

37	**A**	Smallest molecules = lowest boiling point range
38	**C**	Complete combustion produce carbon dioxide and water.
39	**C**	Oxidation of ethanol to ethanoic acid produces water.
40	**B**	It has C=C and carboxyl group (COOH).

Paper 3 Section A : Short Answer Questions (45 marks)

1a. Nitrogen 1m

1b. Gas : Sulfur dioxide (sulfur trioxide)
Source : Burning of coal in power stations / factories

Gas : Carbon monoxide
Source : Incomplete combustion of carbon-containing fuels in vehicles

Gas : Oxides of nitrogen
Source : Produce when oxygen and nitrogen react at high temperature gas 1m
when fuel is burned/combusted in vehicle engines source 1m

2a. filtration 1m

2b. No. no mark
The purity of the liquid is determined by the fixed boiling point.
OR
The universal indicator remains green can only prove that the liquid has a neutral pH (pH 7).
OR
The universal indicator can only prove whether the solution is acidic or alkaline, but cannot show whether the water is pure. either 1m

2c. **Changes to spacing**
The spacing decreases, from moving far apart to closely packed. 1m

Changes to movement
The movement slows down, from moving randomly at high speeds to sliding past one another in random motion. 1m

3a. Ammonium nitrate and water 1m

3b. Endothermic. 1m
When ammonium salts react with water, the reaction take in / absorb energy from surrounding, causing surrounding temperature to drop / decrease. 1m

4ai. M_r of HNO_3 = 1 + 14 + 3(16) = 63 1m

4aii. Concentration of HNO_3 = concentration in g/mol ÷ molar mass
= 126 g/mol ÷ 63
= ***2.00 mol/dm^3*** 1m

4bi. No of moles of HNO_3 = concentration x volume
= 2.00 mol/dm^3 x (500/1000) dm^3
= 1.00 mol 1m

2 mol of HNO_3 reacts with 1 mol of $MgCO_3$
1.00 mol of HNO_3 reacts with 0.500 mol of $MgCO_3$

Mass of $MgCO_3$ = no of moles x molar mass 1m
= 0.500 mol x [24 + 12 + 3(16)] *ecf if 1st 1m wrong*
= ***42 g*** *overall -1 if any answer not in 3sf*

4bii. 2 mol of HNO_3 produces 1 mol of CO_2
1.00 mol of HNO_3 produces 0.500 mol of CO_2

Volume of CO_2 = no of moles x molar volume
= 0.500 mol x 24 dm^3
= ***12 dm^3*** 1m

4c. Concentration = no of moles ÷ volume
= 1.0 mol ÷ 2 dm^3
= ***0.500 mol/dm^3*** 1m

5a. Pale yellow / yellowish-green gas 1m

5b. X could be bromine since it is a liquid. 1m

It is more reactive than iodine since it is able to displace iodine. 1m

But it is less reactive than Y since it reacts less vigorously with sodium hydroxide. 1m

5ci. All of them have seven valence electrons. 1m

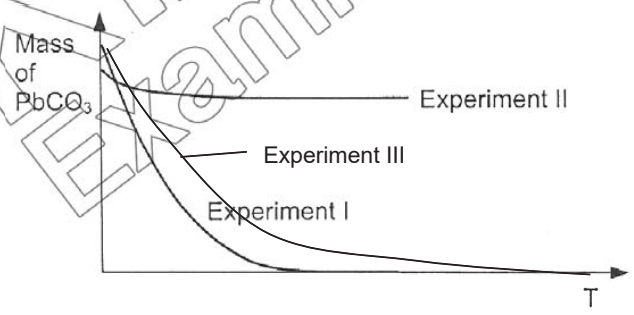
5cii. $2NaOH + X_2 \rightarrow NaX + NaOX + H_2O$ (or use Br for X) 1m

6a. No. Lead (II) sulfate produced is an insoluble salt / there is mass of lead (II) sulfate left. 1m

6bi. No. Ethanoic acid is weak acid but nitric acid is a strong acid. 1m

It has / produces lesser H+ ions per unit volume compared to nitric acid. 1m
(Frequency of collisions is lesser thus reaction is slower)

6bii.



1m

6c. (1) Add excess lead (II) carbonate to nitric acid. 1m
(2) Filter to remove excess lead (II) carbonate.
Obtain the filtrate, lead (II) nitrate. (not necessary) 1m
(3) Heat lead (II) nitrate solution till saturation.
Leave to cool for crystals to form. 1m
(4) Filter out the crystals.
Pat dry between filter papers 1m

7a. Both propane and propene reacts with excess oxygen to produce carbon dioxide and water. 1m

Both undergoes incomplete combustion to produce carbon monoxide and water. 1m

Propane does not react with hydrogen. 1m

Propene reacts with hydrogen at (200 °C with nickel catalyst) to produce propane. 1m
have ( ) 1m

7b. $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$
$2C_3H_8 + 10O_2 \rightarrow 6CO_2 + 8H_2O$
$2C_3H_6 + 6O_2 \rightarrow 6CO + 6H_2O$
$2C_3H_8 + 7O_2 \rightarrow 6CO + 8H_2O$
$C_3H_6 + H_2 \rightarrow C_3H_8$ either eqn 1m

8a.

Ions	Formula	Reasons
1	Fe^{2+}	*green precipitate formed after adding sodium hydroxide which turned brown over time*
2	NH_4^+	*ammonia gas produced when sodium hydroxide is added*
3	CO_3^{2-}	*carbon dioxide produced after adding nitric acid*
4	Cl^-	*white precipitate formed after adding silver nitrate*

each formula + reason 1m
total 4m

8b. Dirty green precipitate formed which is insoluble in excess aqueous ammonia. 1m
Turns brown on standing / when exposed to air bonus 1m

8c. X = iron (II) chloride 1m
Y = ammonium carbonate 1m

Explanation:
Possible answers are
(a) iron (II) chloride and ammonium carbonate
(b) iron (II) carbonate and ammonium chloride
However, iron (II) carbonate is an insoluble salt (both X and Y dissolve).
Also, no reaction when aq NH_3 added to Y so Y is an ammonium salt.

Paper 3 Section B : 3 Questions choose 2 (20 marks)

9a. Both have 17 protons. 1m

They have different number of neutron / atomic mass. 1m

^{35}Cl has 18 neutrons/ mass number of 35.
^{37}Cl has 20 neutrons/mass number of 37. 1m

9bi. Strontium chloride conducts in molten state but not in solid state. no marks
The ions (Sr^{2+} and Cl^-) are mobile in molten state. 1m
But they cannot move (and are fixed in positions) when in solid state. 1m

9bii. Calcium atom has an electronic configuration of 2.8.8.2.
Chlorine has an electronic configuration of 2.8.7. 1m

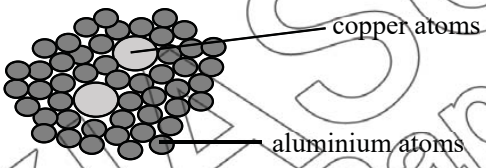
Each calcium atom transfers two valence electrons to 2 chlorine atoms. 1m

Ca^{2+} and Cl^- ions are formed which are attracted by electrostatic forces of attraction. 1m

9biii. Weak intermolecular force between chlorine molecules required 1m
little amount of energy to overcome. 1m

10ai. 4% 1m

10aii.



1m

Copper atoms is bigger than aluminium atoms thus they disrupt the orderly arrangement of aluminium atoms and prevent them from sliding. 1m

10bi. Calcium > chromium > cobalt > copper 1m

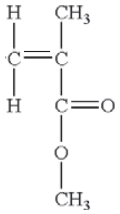
10bii. Blue solution turns green. 1m
Brown solids formed. 1m

10ci. Y: 0 1m
$Y(NO_3)_2$: +2 1m

10cii. It is a reducing agent. no marks

Y is oxidised as the oxidation state of Y increases from 0 in Y to +2 in $Y(NO_3)_2$. 1m

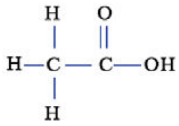
Y reduces $X(NO_3)_2$ by decreasing the oxidation state of X from +2 to 0 in X. 1m

11ai.  1m

11aii. At **high temperature and pressure (**and in the presence of a catalyst), the **carbon-carbon double bonds** of the monomer **break** / the monomer has C=C bonds which break. 1m

Each monomer forms single bonds and joins with two other monomers. form the polymer, poly(methyl methacrylate). 1m

11bi. $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2CO_2$ 1m

11bii.  1m

11biii. Add potassium manganate(VII) to both substances. 1m
If it turns from purple to colourless, it is substance is ethanol. 1m
If it remains purple, it is substance X. 1m

Also accept –
Use of blue litmus paper
X turns blue litmus paper red
Blue litmus paper remains blue if its ethanol.

Add suitable metal / metal carbonate
If susbstance X, effervescence seen.
H_2 produced with caused lighted splint to extinguish with pop sound (if use metal)
CO_2 produced which formed white precipitate in limewater (if use metal carbonate)

11biv. When the mixture is heated, the yeast denatures and stops the reaction. 1m

11bv. Solvent in paints and varnishes
Manufacture of perfumes, detergent, deodorants etc.
Found in alcoholic drinks like beer, wines and spirits
Used in preparation of ethanoic acid
(Any one) 1m

Bukit Batok Secondary School
Sec 4 Express, 5 Normal (Academic)
Science (Chemistry)

PRELIMINARY EXAMINATIONS 2018
ANSWERS

Paper 3 Section A : Short Answer Questions (45 marks)

1a. Nitrogen 1m

1b. Gas : Sulfur dioxide (sulfur trioxide)
Source : Burning of coal in power stations / factories

Gas : Carbon monoxide
Source : Incomplete combustion of carbon-containing fuels in vehicles

Gas : Oxides of nitrogen
Source : Produce when oxygen and nitrogen react at high temperature gas 1m
when fuel is burned/combusted in vehicle engines source 1m

2a. filtration 1m

2b. No. no mark
The purity of the liquid is determined by the fixed boiling point.
OR
The universal indicator remains green can only prove that the liquid has a neutral pH (pH 7).
OR
The universal indicator can only prove whether the solution is acidic or alkaline, but cannot show whether the water is pure. either 1m

2c. **Changes to spacing**
The spacing decreases, from moving far apart to closely packed. 1m

Changes to movement
The movement slows down, from moving randomly at high speeds to sliding past one another in random motion. 1m

3a. Ammonium nitrate and water 1m

3b. Endothermic. 1m
When ammonium salts react with water, the reaction take in / absorb energy from surrounding, causing surrounding temperature to drop / decrease. 1m

4ai. M_r of HNO_3 = 1 + 14 + 3(16) = 63 1m

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= ***12 dm^3*** — 1m

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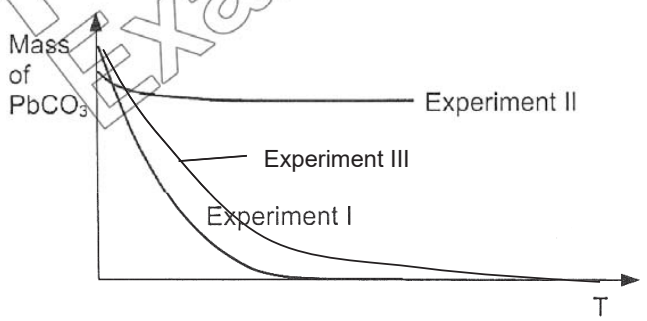
6bii.



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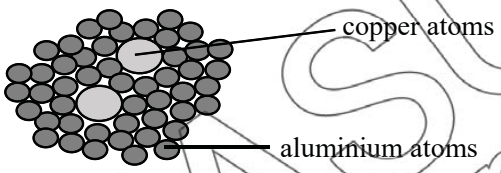

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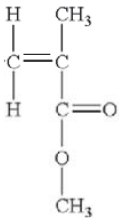
11ai.  1m

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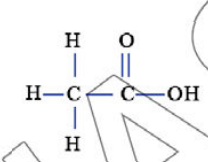
11bii.  1m

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Geylang Methodist School (Secondary)
Preliminary Examination 2018

5076/01

SCIENCE (PHYSICS/CHEMISTRY)

Paper 1 Multiple Choice

Sec 4 Express
Sec 5 Normal (A)

Additional materials: Optical Answer Sheet

1 hour

Setter :
Mr Iskander

24 August 2018

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, index number and class on the Optical Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Read the instructions on the Optical Answer Sheet very carefully.

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

Any rough working should be done in this booklet.

Gravitational field strength is assumed to be 10 N/kg unless otherwise specified.

A copy of the Periodic Table is printed on page .

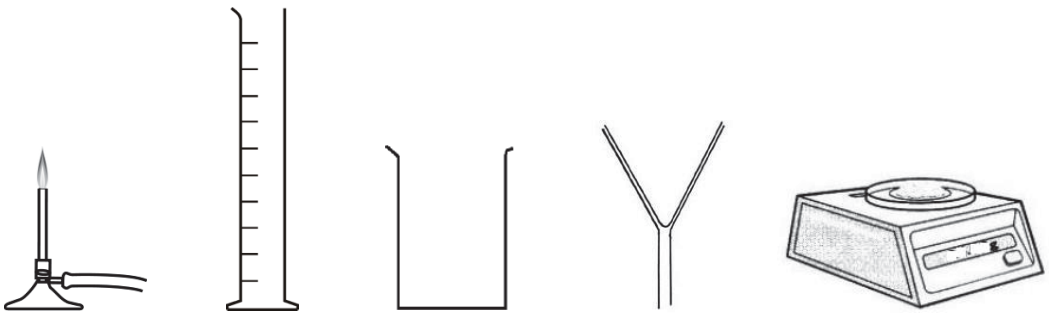
This document consists of printed pages.

[Turn over

1 Silver chloride is insoluble in water.

Silver chloride is made by adding 20.0 cm^3 of aqueous silver nitrate to 20.0 cm^3 of dilute hydrochloric acid.

Which pieces of apparatus are needed to obtain solid silver chloride from aqueous silver nitrate and dilute hydrochloric acid?

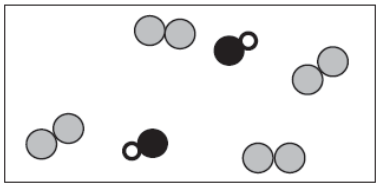


1 2 3 4 5

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

2 The diagram below shows the arrangement of gases in a balloon.

Which pair of gases could be in the balloon?



A argon and hydrogen chloride
B argon and nitrogen
C hydrogen and nitrogen
D hydrogen chloride and nitrogen

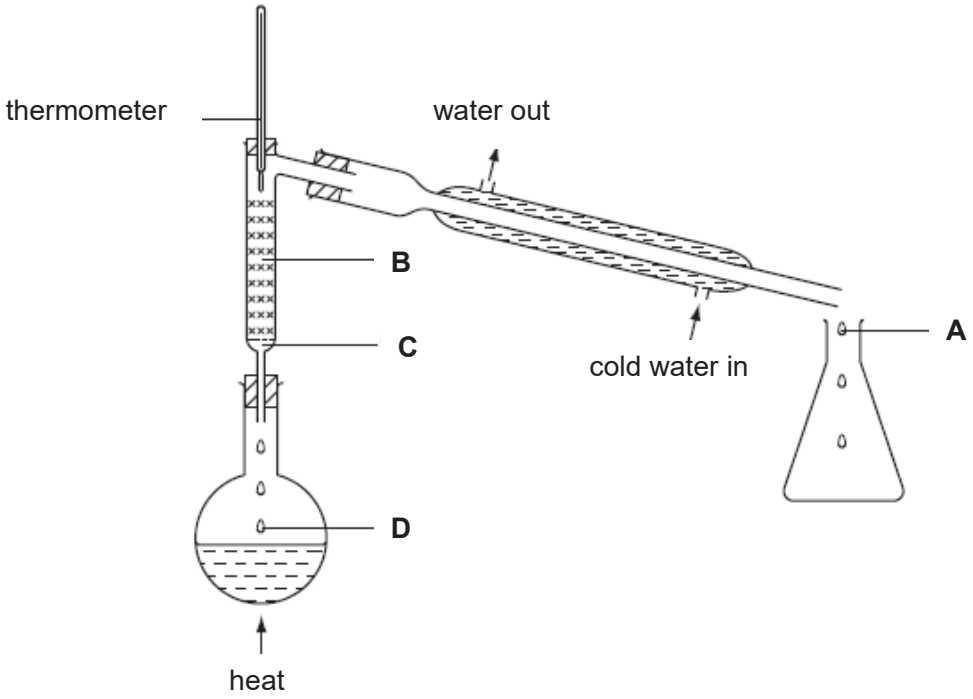
3 Salt can be separated from sand by using the processes shown.

What is the correct order for the processes?

	first →			last
A	filter	dissolve	evaporate	crystallise
B	dissolve	evaporate	crystallise	filter
C	dissolve	evaporate	filter	crystallise
D	dissolve	filter	evaporate	crystallise

4 A mixture containing equal volumes of two liquids that mix completely but do not react together is placed in the apparatus shown and heated until the thermometer first shows a steady reading.

At which position will there be the highest proportion of the liquid with the lower boiling point?



5 Which of the following changes will result in the particles moving at a higher speed?

A I_2 (g) → I_2 (s)
B CO_2 (s) → CO_2 (g)
C H_2O (*l*) → H_2O (s)
D N_2 (g) → N_2 (*l*)

6 An imaginary element Gemsium(Gm) contains 111 protons and 141 neutrons.

Which one of the following represents an atom of Gemsium?

A $^{141}_{30}Gm$

B $^{141}_{111}Gm$

C $^{111}_{141}Gm$

D $^{252}_{111}Gm$

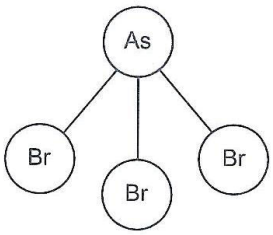
7 The nucleon number and proton number of an atom of P and atom of Q are shown.

	P	Q
nucleon number	85	80
proton number	37	35

Which statement about P and Q is correct?

A An atom of P has fewer electrons than an atom of Q.
B An atom of P has more neutrons than an atom of Q.
C P is above Q in the same group of the Periodic Table.
D P is in the same period in the Periodic Table as Q.

8 A molecule of arsenic bromide, $AsBr_3$, has the structure shown.



Which properties could be correct for arsenic bromide?

	melting point/^oC	electrical conductivity at room temperature
A	31	does not conduct
B	39	conducts
C	650	conducts
D	755	does not conduct

9 A student thinks that element Q is a metal because it has a high melting point and a high boiling point.

What other properties could element Q have if it is a metal?

1 Q conducts electricity when solid.
2 Q forms an acidic oxide, QO_2.
3 Q is malleable.

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

10 In the Periodic Table, caesium, lithium and sodium are in the same group.

Which statement about caesium is likely to be correct?

A It forms a nitrate, $Cs(NO_3)_2$.
B It forms an insoluble hydroxide.
C It has a density greater than potassium.
D It reacts slowly with water at room temperature.

11 Astatine is at the bottom of Group VII in the Periodic Table.

Which of the following is a property of astatine?

A It forms a basic oxide.
B It is a good conductor of electricity.
C It forms a covalent compound of formula NaAt.
D It is displaced by chlorine from aqueous potassium astatide.

12 When two aqueous solutions are mixed in a test-tube, a reaction occurs and the test-tube feels hot.

Which statement is correct?

A An exothermic reaction takes place as the reacting chemicals gain energy.
B An exothermic reaction takes place as the reacting chemicals lose energy.
C An endothermic reaction takes place as the reacting chemicals gain energy.
D An endothermic reaction takes place as the reacting chemicals lose energy.

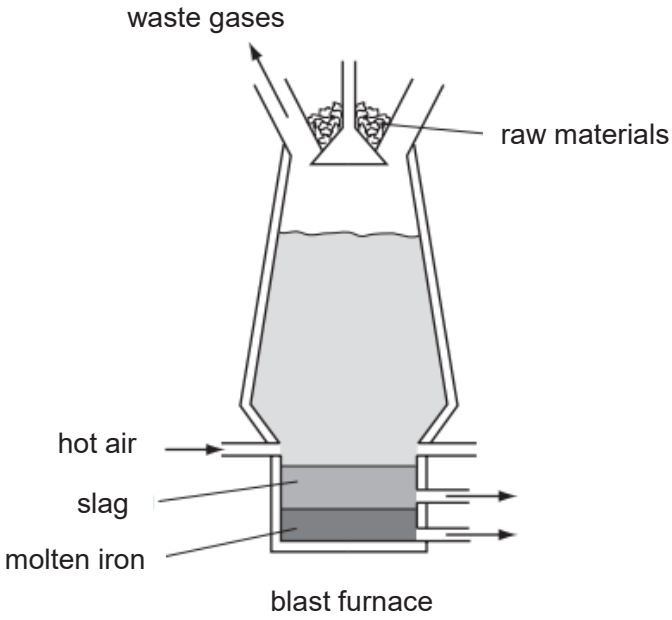
13 2.0 g of magnesium are completely burnt in pure oxygen.

$$2Mg + O_2 \rightarrow 2MgO$$

Which volume of oxygen is used in this reaction at room temperature and pressure?

A 0.5 dm^3 **B** 1.0 dm^3
C 1.5 dm^3 **D** 2.0 dm^3

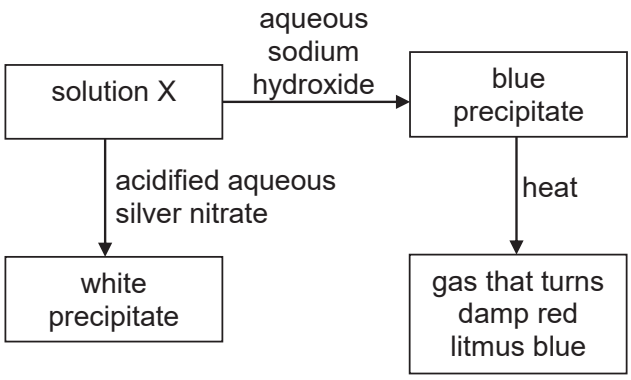
14 Iron is produced in a blast furnace as shown in the diagram below.



Which statement about this process is correct?

A Carbon is oxidised to carbon dioxide.
B Carbon monoxide is produced by the thermal decomposition of calcium carbonate.
C Haematite is reduced by calcium carbonate.
D Impurities are removed by the hot air blast.

15 The diagram below shows some of the reactions of solution X.

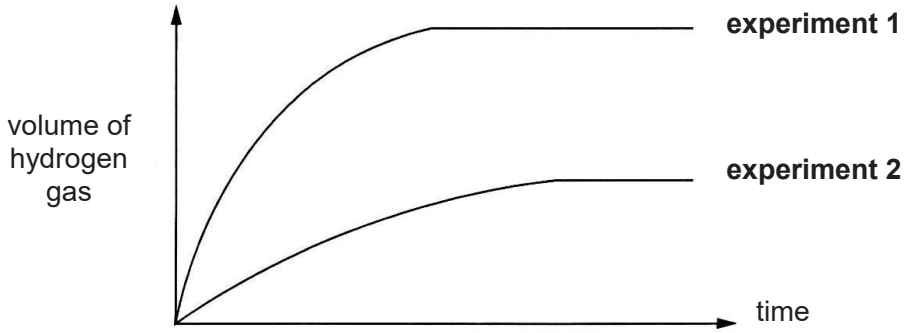


Which of the following the substance(s) is/are present in solution X?

A copper(II) nitrate only
B ammonium chloride only
C zinc nitrate and copper(II) nitrate
D ammonium chloride and copper(II) chloride

16 Zinc powder was added to excess dilute sulfuric acid at room temperature. The volume of hydrogen gas produced was measured over a period of time.

The graph labelled **experiment 1** shown below was obtained.



Which change was made to obtain the results shown in **experiment 2**?

A Half the mass of zinc granules was used.
B Half the concentration of dilute sulfuric acid was used.
C Larger zinc strip of the same mass was used.
D Dilute sulfuric acid at lower temperature was used.

17 Crude oil is fractionally distilled into useful fractions.

Which option matches the fraction to its use?

	fraction	use
A	bitumen	feedstock for the petrochemical industry
B	diesel oil	fuel for aircraft engines
C	petrol	fuel for engines in buses, lorries and trains
D	petroleum gas	fuel for cooking and heating

18 Many countries have taken measures to ensure that the amount of sulfur in unleaded petrol and diesel fuels are kept low.

Which of the following could be the reason for such measures?

A To cut down the amount of fuel used in vehicles.
B To reduce the acidity of the rain.
C To reduce incomplete combustion.
D To prevent the pH of soil from increasing.

19 Which reaction describes the following equation?

$$C_{15}H_{32} \rightarrow C_{10}H_{22} + C_3H_6 + C_2H_4$$

A addition
B cracking
C oxidation
D substitution

20 The table shows the observations made when an organic compound X reacts with aqueous bromine and acidified potassium manganate (VII).

reagent	observation
aqueous bromine	no change
acidified potassium manganate(VII)	purple solution turns colourless

What is compound X?

A ethane
B ethanoic acid
C methanol
D propene

End of paper

DATA SHEET
The Periodic Table Of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 162	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium –	91 Pa protactinium –	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Geylang Methodist School (Secondary)

End of Year Examination 2018

Candidate Name			
Class		Index Number	

SCIENCE **5076/03, 5078/03**

Paper 3 Chemistry **Sec 4 Express**
Sec 5 Normal (A)

Additional Materials : Writing Paper **1 hour 15 minutes**

Setter: Miss Ng Sio Ying **17 August 2018**

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Periodic Table is printed on page 14.

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

For Examiner's Use	
Section A	/45
Section B	
.....	/10
.....	/10
Total	/65

This document consists of **13** printed pages and **1** blank page.

[Turn over

Section A

Answer all the questions in this section.
Write your answers in the spaces provided on the question paper.

1 The diagram shows part of the Periodic Table. Only some of the elements are shown.

							H										
													C	N		F	
													Si	P	S	Cl	
			Ti				Fe			Cu	Zn			As		Br	

(a) Answer each of the following questions using only those elements shown in the diagram. Each element may be used once, more than once or not at all.

Give one element which

(i) oxidises in the presence of water and air to form rust,

……...

(ii) forms an ion of $\mathbf{Y}^-$ which has only three completely filled shells of electrons,

……...

(iii) forms an oxide which is amphoteric,

……...

(iv) is a colourless diatomic gas,

……...

(v) is found as an impurity in fossil fuels and burns in air to produce an air pollutant that causes acid rain.

……...
[5]

(b) Element **X** is a noble gas with two electron shells. Label this element as **X** in the Periodic Table above. [1]

2 Fig. 2.1 shows some reactions of copper(II) nitrate, $Cu(NO_3)_2$.

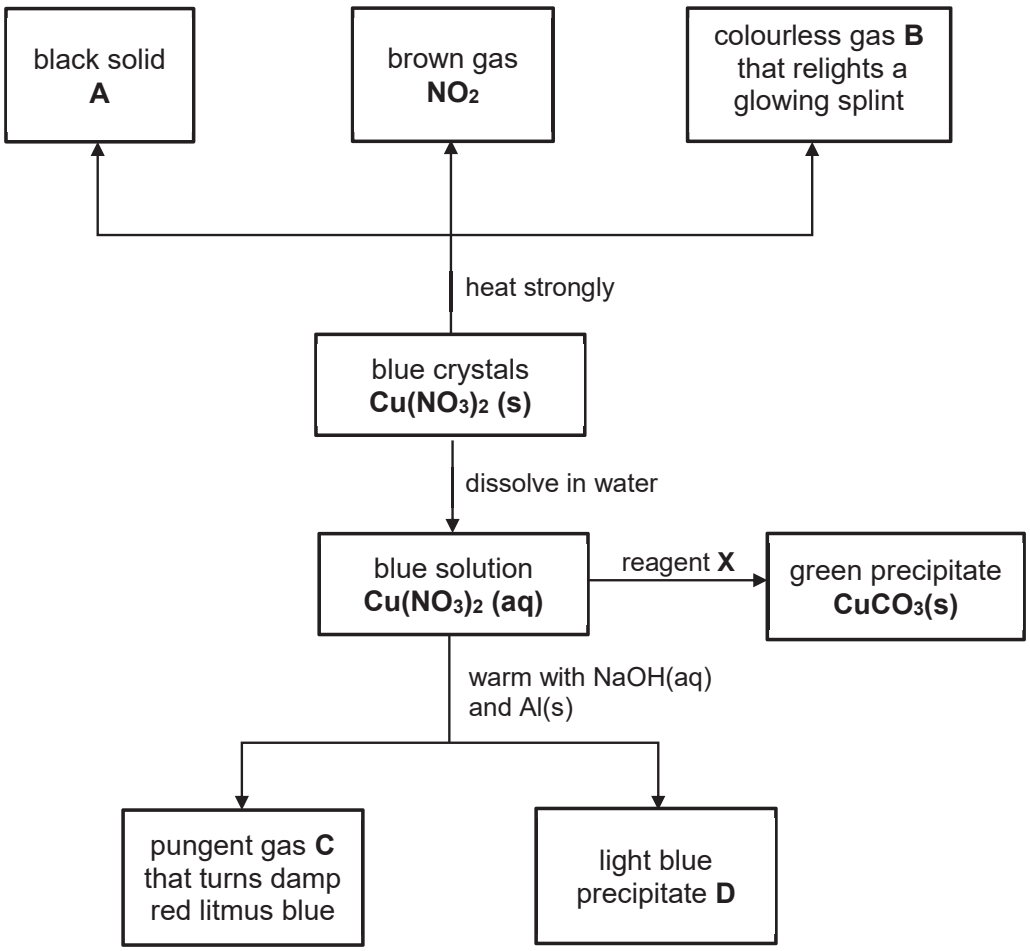


Fig. 2.1

(a) Identify the substances **A** – **D**.

A .....

B .....

C .....

D .....

[4]

(b) Copper(II) nitrate solution reacts with reagent **X** to form copper(II) carbonate.

(i) Suggest the name of reagent **X**.

……..
[1]

(ii) Construct the balanced chemical equation, with state symbols, for the reaction between copper(II) nitrate solution with reagent **X** to form copper(II) carbonate.

……..
[2]

(iii) Describe the steps used in a laboratory to prepare a pure sample of powdered copper(II) carbonate from copper(II) nitrate solution and reagent **X**.

……...

……...

……...

……...

……...

……...

……...
[3]

(c) Describe how hydrochloric acid and limewater can be used to show that carbonate ions are present in copper(II) carbonate.

……...

……..

……..

……..
[2]

3 Titanium, Ti, is a metal used in the aerospace industry. It exists naturally as titanium-iron oxide, $FeTiO_3$, in a mineral called ilmenite. To extract titanium, the compound is first converted to titanium tetrachloride, $TiCl_4$, which is being heated to 2000°C with magnesium in an atmosphere of a noble gas, argon.

The extraction of titanium from its chloride is represented by the following equation.

$$TiCl_4 + 2Mg \rightarrow 2MgCl_2 + Ti$$

(a) What is the mass of magnesium chloride formed when 12 kg of titanium is extracted?
[Relative atomic masses: A_r: Ti, 48; Mg, 24; Cl, 35.5]

mass of magnesium chloride = …… kg [2]

(b) Calculate the smallest mass of titanium-iron oxide, $FeTiO_3$, needed to produce 12 kg of titanium.
[Relative atomic masses: A_r: Ti, 48; Fe, 56; O, 16]

mass of titanium-iron oxide = …… kg [2]

4 Fig. 4.1 shows the materials used to make ballpoint pen.

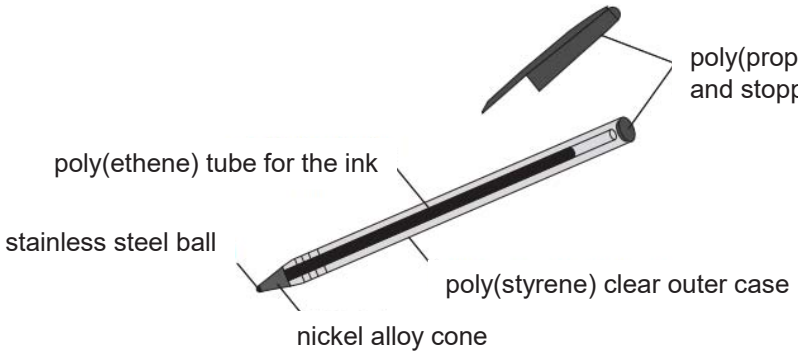


Fig. 4.1

(a) With reference to the arrangement of atoms, explain why alloys such as steel are used as materials in the pen, instead of pure metals.

……..

……..

……..

……..
[2]

(b) Give one advantage and one disadvantage of recycling the materials from this ballpoint pen.

……..

……..

……..

……..
[2]

5 **(a)** Use your knowledge of electronic structures to explain the following statements.

(i) Elements in Group II have similar chemical properties.

……...

(ii) Elements in Group 0 lack chemical reactivity.

……...
[2]

(b) Element **Z** with an atomic number of 85 is a highly unstable radioactive element.

(i) Suggest two ways in which chlorine differs in properties from element **Z**.

……...

……...

……...

……...
[2]

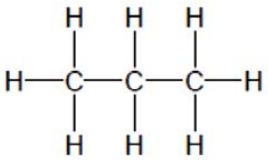
(ii) Excess chlorine is bubbled through a solution of Na**Z**.

Write a chemical equation for the reaction. State symbols are not required.

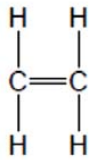
……...
[1]

6 The structures of five organic compounds are shown below.

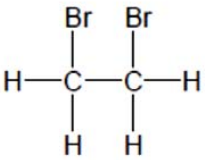
A



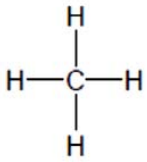
B



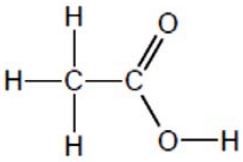
C



D



E



(a) Answer each of the following questions using the letters that represent each compound.

(i) Which two compounds are in the same homologous series?

……

(ii) Which compound is formed when ethanol reacts with atmospheric oxygen?

……

(iii) Which compound reacts with steam to form ethanol?

……

[3]

(b) A solution of ethanol can be made by fermentation of glucose.

(i) Draw the structural formula of ethanol.

[1]

(ii) State two conditions required for the fermentation of glucose.

……

……

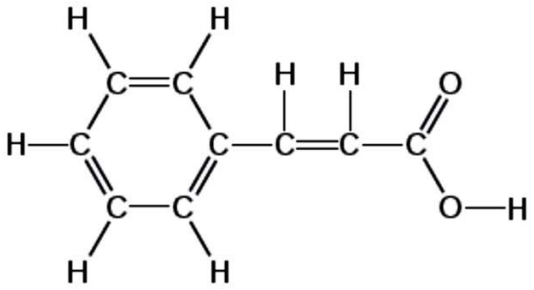
[2]

(iii) Calculate the relative molecular mass of ethanol and the percentage by mass of carbon in each molecule of ethanol.
[Relative atomic masses: A_r: H, 1; C, 12; O, 16]

[2]

7 Cinnamic acid is found in plants called balsams.

The structure of cinnamic acid is shown below.



(a) Cinnamic acid is an unsaturated compound.

(i) What is meant by the term *unsaturated*?

……..
[1]

(ii) Describe a chemical test to show that cinnamic acid is unsaturated.

chemical test

……...

……...

result with cinnamic acid

……...

……..
[2]

(b) Balsam flowers contain a mixture of pigments.

A student uses chromatography to separate the pigments in balsam flowers. He puts the pigment mixture on a sheet of chromatography paper as well as five spots of pure pigments **A**, **B**, **C**, **D** and **E**.

The results are shown as a chromatogram in Fig. 7.1.

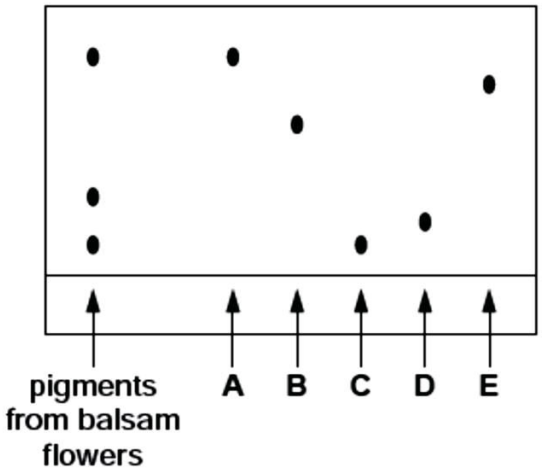


Fig. 7.1

(i) Which of the pigments are present in balsam flowers?

……..
[1]

(ii) Draw the apparatus that could be used to produce this chromatogram.

[2]

Section B

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

Write your answers in the writing papers provided.

8 Fluorine is the lightest halogen and exists as a highly reactive pale yellow diatomic gas at room temperature and pressure. Fluorine is found in nature in the form of calcium fluoride crystals, called fluorite.

(a) The following equation describes the reaction between fluorine gas and water.

$$2F_2\ (g) + 2H_2O\ (l) \rightarrow O_2\ (g) + 4HF\ (aq)$$

Given that 48 cm^3 of fluorine gas reacts with excess water, calculate the **volume** and **mass** of oxygen gas produced at room temperature and pressure. [2]

(b) Draw and label the electronic structures of fluorine gas and calcium fluoride.
[Proton numbers: F, 9; Ca, 20] [4]

(c) Use these structures to explain why, at room temperature and pressure, calcium fluoride is a solid and fluorine is a gas. [4]

9 **(a)** The reaction of metal **X** with water places it between calcium and iron in this order of reactivity. Explain why **X** would displace copper if added to a solution of copper(II) sulfate. [2]

(b) Aluminium does not react with cold water. Does this give a true indication of the reactivity of this element? Explain your answer. [2]

(c) Iron is produced in the blast furnace by heating a mixture of iron(III) oxide, coke and limestone with air.

Describe the reactions involved in this extraction.
Include an equation of a redox reaction. [6]

10 Dilute hydrochloric acid reacts with calcium carbonate to produce carbon dioxide.

(a) **(i)** With the aid of a diagram, design and describe an experiment in a laboratory to show how the rate of reaction between these two substances depends on the particle size of calcium carbonate. [4]

(ii) Describe the measures you would take to ensure that your experiment is fair. [2]

(iii) State and explain how the rate of reaction between two substances is affected by the particle size of one substance. Use your knowledge of reacting particles in your explanation. [2]

(b) Increasing the concentration of acid can change the speed of a reaction. State and explain how it affects the speed of the reaction. Use your knowledge of reacting particles in your explanation. [2]

End of Paper

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Geylang Methodist School (Secondary)
Preliminary Examination 2018
Secondary 4E5N Science (Chemistry) Answer Scheme

Paper 1

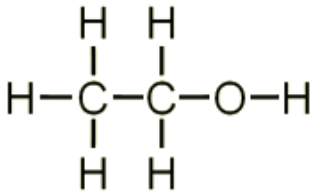
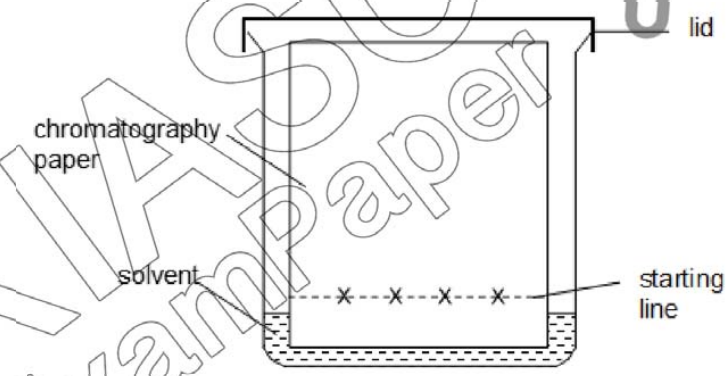
1	2	3	4	5	6	7	8	9	10
C	D	D	A	B	D	B	A	C	C

11	12	13	14	15	16	17	18	19	20
D	B	B	A	D	A	D	B	B	C

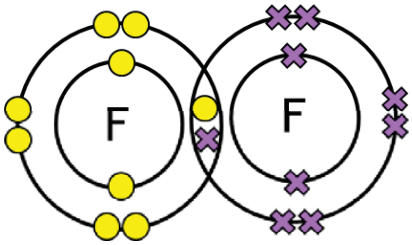
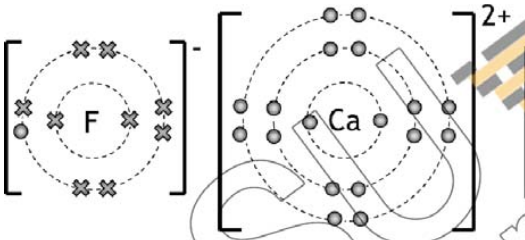
Paper 3 Section A

Question			Marking Point	Marks
1	(a)	(i)	Fe	1
		(ii)	Cl	1
		(iii)	Zn	1
		(iv)	H or N	1
		(v)	S	1
	(b)		*Position of **X**: Group 0, 2nd element* (Ne)	1
			Total:	**6**
2	(a)		**A** – copper(II) oxide **B** – oxygen gas **C** – ammonia gas **D** – copper(II) hydroxide	4 (1M each)
	(b)	(i)	Any soluble carbonate e.g. sodium carbonate / potassium carbonate	1
		(ii)	$Cu(NO_3)_2$ (aq) + Na_2CO_3 (aq) → $CuCO_3$ (s) + 2 $NaNO_3$ (aq) Balanced chemical equation – 1 State symbols – 1	2
		(iii)	Mix the solutions together and stir.	1
			Filter the mixture to obtain copper(II) carbonate as the residue.	1
			Wash the residue with distilled water.	1
	(c)		Add hydrochloric acid to copper(II) carbonate.	1
			Effervescence observed, gas produced forms white precipitate when passed into limewater.	1
			Total:	**12**

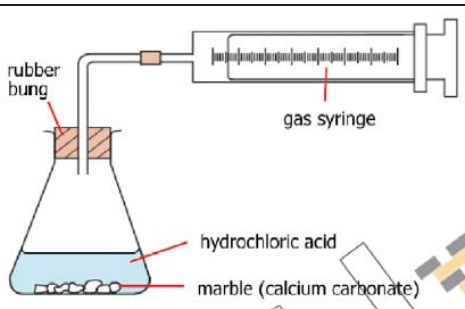
Question			Marking Point	Marks
3	**(a)**		No. of moles of titanium = 12 000 / 48 = 250 moles No. of moles of $MgCl_2$ = 250 x 2 = 500 moles	1
			Mass of $MgCl_2$ = 500 x (24 + 35.5 x 2) = 47500 g = 47.5 kg	1
	(b)		% mass of Ti in $FeTiO_3$ = 48 / (56+48+16x3) x 100% = 31.57894 %	1
			Mass of $FeTiO_3$ to produce 12kg of Ti = 12/31.57894 x 100 = 38 kg	1
			Total:	**4**
4	**(a)**		Alloys are harder than pure metals.	1
			The different sized atoms disrupt the orderly arrangement of atoms, Hence making it difficult for the metal atoms to slide over one another.	1
	(b)		Advantage: • Conserves finite resources of crude oil/metal ores. • Reduces use of landfill. • Less problems caused from disposal. • Materials used are non-biodegradable. • Less expensive than producing from raw materials.	Any 1
			Disadvantage: • Difficulty / high cost to separate the materials. • Not all materials can be recycled.	Any 1
			Total:	**4**
5	**(a)**	(i)	They all have 2 valence electrons.	1
		(ii)	They all have complete/full valence shell.	1
	(b)	(i)	• Chlorine has lower boiling/melting point than astatine/**Z**. OR Chlorine is a gas at room temperature but astatine/**Z** is a solid at room temperature. • Chlorine is greenish yellow in colour but astatine/**Z** is black in colour. • Chlorine is more reactive than astatine/**Z**.	Any 2
	(b)	(ii)	$Cl_2 + 2\ NaZ \rightarrow Z_2 + 2\ NaCl$	2
			Total:	**6**
6	**(a)**	(i)	A and D	1
		(ii)	E	1
		(iii)	B	1

Question			Marking Point	Marks
	(b)	(i)		1
		(ii)	37°C, absence of oxygen, presence of yeast	Any 2
		(iii)	Mr of ethanol = 2x12 + 6 + 16 = <u>46</u> (no units)	1
			%mass of carbon = 24/46 x 100% = <u>52.2%</u> (3sf)	1
			Total:	**8**
7	**(a)**	(i)	Compound consists of at least one C=C bond	1
		(ii)	Add compound to aqueous bromine/ bromine solution/ bromine water.	1
			Reddish brown aqueous bromine decolourises.	1
	(b)	(i)	A and C (both must be correct)	1
		(ii)	 Proportional drawing – 1 Appropriate labels – 1	2
			Total:	**6**

Section B

Question			Marking Point	Marks
8	(a)		Volume of oxygen = 48/2 = 24 cm^3	1
			No. of moles of oxygen = 0.024 / 24 = 0.001 Mass of oxygen = 0.001 x 32 = 0.032 g.	1
	(b)		 Fluorine gas Correct sharing – 1 Correct number of valence electrons – 1  Calcium fluoride Correct calcium ion – 1 Correct fluoride ion – 1	4
	(c)		Fluorine is a covalent molecule. It has weak intermolecular forces of attraction	1
			which requires small amount of energy to overcome/ has low boiling point hence it is a gas at r.t.p.	1
			Calcium fluoride is an ionic compound. It has strong electrostatic forces of attraction between the ions	1
			which requires large amount of energy to overcome/ Has high melting point hence is a solid at room temperature.	1
			Total:	**10**

Question			Marking Point	Marks
9	(a)		X is more reactive than iron, which is more reactive than copper.	1
			Hence X is more reactive than copper.	1
	(b)		No. Aluminium reacts with oxygen to form a layer of aluminium oxide	1
			which is unreactive and hence prevents the aluminium metal from reacting with water.	1
	(c)		Coke burns in air to form carbon dioxide	1
			Carbon dioxide reacts with more coke to form carbon monoxide.	1
			Carbon monoxide reacts with iron(III) oxide to form iron and carbon dioxide.	1
			Limestone decomposes to form calcium oxide and carbon dioxide.	1
			Calcium oxide reacts with sand (silicon dioxide) to form calcium silicate/molten slag.	1
			Equation of Redox reaction • $C + O_2 \rightarrow CO_2$ • $CO_2 + C \rightarrow 2\ CO$ • $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$	Any 1
			Total:	**10**

Question			Marking Point	Marks
10	(a)	(i)	 Weigh **2.0 g** of calcium carbonate **lumps** and place in a conical flask. Add **50cm^3** of **1mol/dm^3 dilute hydrochloric acid** into the flask. Record the **time taken for effervescence to stop / time taken to collect 10 cm^3 of gas** Repeat experiment with **powdered** calcium carbonate and compare the time taken for both experiments. Marking points (1M each): • Appropriate **diagram** with suitable labels • Use of **appropriate mass** of calcium carbonate and **volume** of acid • Use of different particle size of calcium carbonate (**lumps vs powdered** or **large lumps vs small lumps**) in two experiments. • Observation or change that is measured to compare the rate of reaction (**time taken for effervescence to stop / time taken to collect fixed volume of gas**)	4
		(ii)	• **Concentration** of dilute hydrochloric acid used is the same. • **Mass** of calcium carbonate used is the same. • **Temperature** of both experiments is the same. *Reject*: Equal volume of dilute hydrochloric acid Shake the acid to ensure reaction is complete Repeat experiment and obtain average of results.	Any 2
		(iii)	The smaller the particle size, the larger the total surface area for particles to collide,	1
			resulting in increased number of effective collisions and hence higher speed of reaction. (opposite is true)	1
	(b)		The higher the concentration of acid, the higher the speed of reaction	1
			The more concentrated the acid, the more acid particles per unit volume, resulting in increased number of effective collisions	1
			Total:	**10**