Name: _____( ) Class:_____

CHIJ KATONG CONVENT
MID-YEAR EXAMINATIONS 2018
Secondary Four Express and
Secondary Five Normal (Academic)

SCIENCE (CHEMISTRY, BIOLOGY) 5078/01

Paper 1 Multiple Choice Duration: 1 hour

Classes: 403, 404, 405, 501 and 502

Additional Materials: Optical Answer Sheets

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, registration number and class on all the work you hand in.
Do not use staples, paper clips, highlighters, glue or correction fluid/ tape.

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 Optical Answer Sheet.
Complete the Chemistry and Biology sections on two separate Optical Answer Sheets provided.

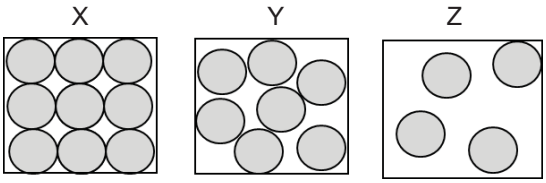
Read the instructions on the Optical Answer Sheet very carefully.

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.

A copy of the Data Sheet is printed on page 16.
A copy of the Periodic Table is printed on page 17.

The use of an approved scientific calculator is expected, where appropriate.

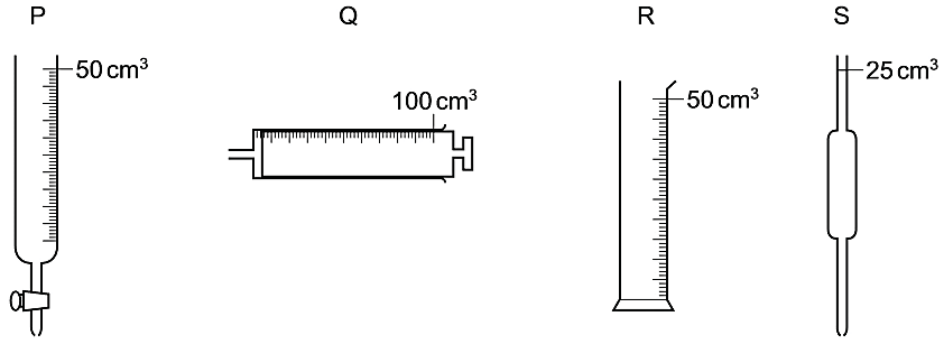
1 Diagrams X, Y and Z represent the three states of matter.



Which change occurs during boiling?

A X to Y
B Y to Z
C Z to X
D Z to Y

2 P, Q, R and S are pieces of apparatus.



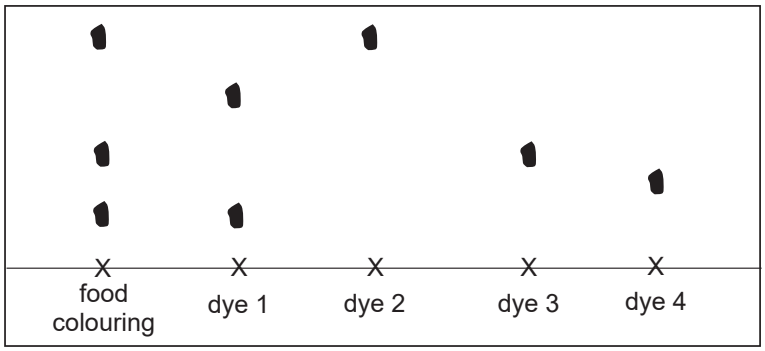
Which row describes the correct apparatus for the measurement made?

	apparatus	measurement made
A	P	15.60 cm^3 of acid to be added to alkali in a titration
B	Q	1 cm^3 of acid to be added to calcium carbonate in an experiment
C	R	75 cm^3 of gas given off in a thermal decomposition reaction
D	S	20.0 cm^3 of alkali to be used in a titration

3 Which method of separation should be used to obtain pure water from copper(II) sulfate solution?

A crystallisation
B evaporation to dryness
C filtration
D simple distillation

4 A food colouring is compared with four different dyes. The chromatogram produced is shown in the diagram.



Which dyes does the food colouring contain?

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

5 The table shows the boiling points of acetone and water.

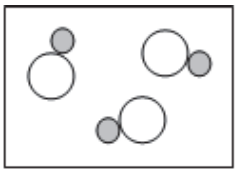
substance	boiling point/ °C
acetone	56
water	100

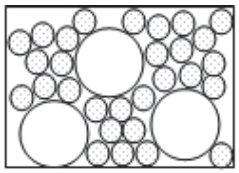
A sample of water was found to contain a small amount of acetone.

What could be the boiling point of the water sample?

A 56 °C
B 78 °C
C 100 °C
D 104 °C

6 Which diagram shows a mixture of two compounds?


A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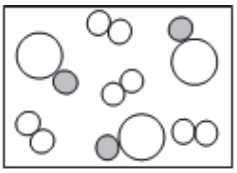
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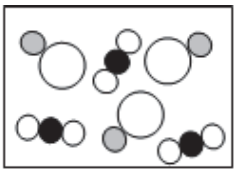

D

7 Which statement about an atom is correct?

A The nucleon number is smaller than the proton number.
B The nucleon number is the sum of the number of protons and electrons.
C The number of proton always equals the number of electrons.
D The number of proton always equals the number of neutrons.

8 How many hydrogen atoms are there in 4 moles of ammonia gas?

A 1.5×10^{23} atoms
B 1.8×10^{24} atoms
C 2.4×10^{24} atoms
D 7.2×10^{24} atoms

9 20 cm^3 of carbon monoxide was burnt in 40 cm^3 of oxygen.

The equation of the reaction is shown.

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

What is the total volume of gas remaining at the end of the reaction?

A 20 cm^3
B 40 cm^3
C 60 cm^3
D 80 cm^3

10 Due to acid rain, the acidity of the soil is increased, making it unsuitable for plant growth.

Which substance is used by farmers to decrease the acidity in the soil?

A calcium carbonate
B calcium hydroxide
C calcium nitrate
D calcium sulfate

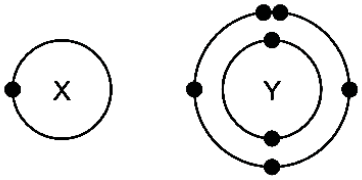
11 An unknown oxide was added separately to hydrochloric acid and aqueous sodium hydroxide. The pH of the resulting solution was measured and shown in the table.

chemical	pH of resulting solution
hydrochloric acid	7.0
sodium hydroxide	7.0

What could the unknown oxide be?

A aluminium oxide
B carbon monoxide
C potassium oxide
D sulfur dioxide

12 The electronic structures of atoms X and Y are shown.



What is the formula of the covalent compound formed between X and Y?

A XY_5
B XY_3
C XY
D X_3Y

13 The table shows the properties of substances J, K, L and M.

substance	density/ g/dm^3	melting point/ °C	electrical conductivity in solid state
J	2.1	115	poor
K	5.7	232	good
L	6.3	1326	poor
M	19.3	1064	good

Which substances are metals?

A J and K only
B J and L only
C K and M only
D L and M only

14 The table shows the electronic configuration of four elements, P, Q, R, S.

element	electronic configuration
P	2.2
Q	2.8
R	2.8.2
S	2.8.7

Which statement is correct?

A P and R are in the same group.
B Q and R have the same number of electron shells.
C Q and S are in the same period.
D R and S have the same number of valence electrons.

15 The table shows the results of some halogen displacement experiments.

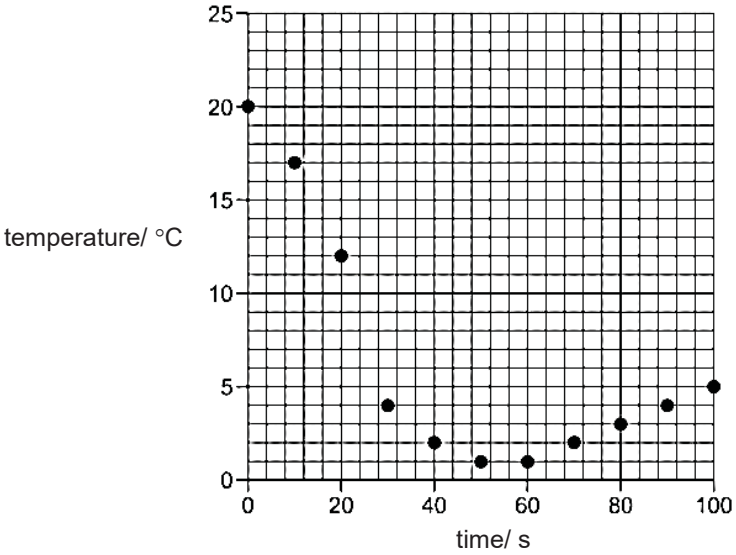
halogen added \ halide solution	X	Y	Z
X		✓	×
Y	×		×
Z	✓	✓	

Key:
✓ visible reaction
× no visible reaction

What row shows the order of halogens in increasing reactivity?

	lowest →		highest
A	X	Y	Z
B	Y	X	Z
C	Y	Z	X
D	Z	X	Y

16 Solid hydrated sodium carbonate was added to aqueous citric acid. The mixture was stirred and the temperature was recorded every 10 seconds. The results are shown on the graph



Which row describes the reaction?

	reaction type	energy change
A	neutralisation	endothermic
B	neutralisation	exothermic
C	precipitation	endothermic
D	precipitation	exothermic

17 Which process is endothermic?

A condensation
B freezing
C photosynthesis
D rusting

18 The effect of temperature on the rate of the reaction between zinc and hydrochloric acid can be investigated by measuring the production of gas.

Which equipment is not required for the investigation?

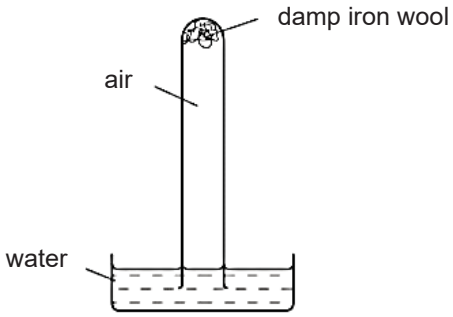
A condenser
B gas syringe
C stopwatch
D thermometer

19 The element vanadium, V, forms several oxides.

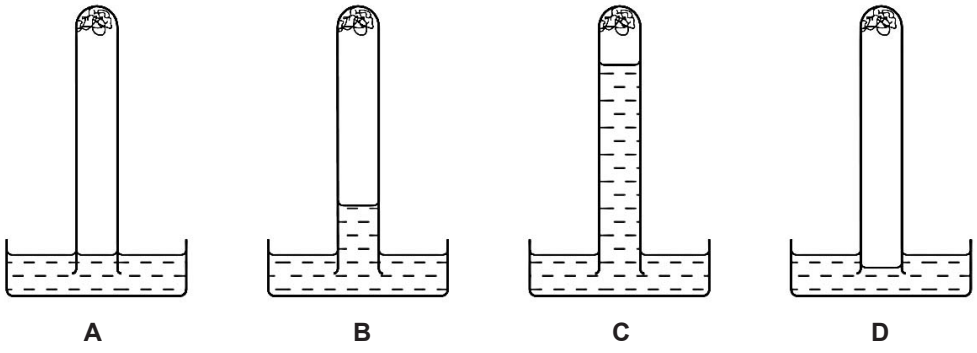
Which reaction shows oxidation taking place?

A $VO_2 \rightarrow V_2O_3$
B $V_2O_5 \rightarrow VO_2$
C $V_2O_3 \rightarrow VO$
D $V_2O_3 \rightarrow V_2O_5$

20 The apparatus shown is set up and left for a week.



Which diagram best shows the level of the water at the end of the week?



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 ctinium –	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 gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: _____( ) Class:_____

CHIJ KATONG CONVENT
MID-YEAR EXAMINATIONS 2018
Secondary Four Express and
Secondary Five Normal (Academic)

SCIENCE (CHEMISTRY) 5078/03

Paper 3 Chemistry Duration: 1 hour 15 minutes

Classes: 403, 404, 405, 501 and 502

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

READ THESE INSTRUCTIONS FIRST

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

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

At the end of the examination, hand in:
(a) Section A;
(b) Section B separately.

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

FOR EXAMINER'S USE	
Paper 1	**/ 20**
Paper 3	
Section A	**/ 45**
Section B	**/ 20**
TOTAL	**/ 85**

This question paper consists of **16** printed pages.

[Turn over

Section A [45 marks]
Answer **all** the questions in the spaces provided.

1 Substances can be classified as elements, compounds or mixtures.
Complete Table 1.1 to describe the following substances.

Table 1.1

substance	classification (element, compound or mixture)	atoms found within the substance
hydrogen sulfide	compound	hydrogen, sulfur
brass		
limestone	compound	

[3]

[Total: 3]

2 Iron is the fourth most common element in the Earth's crust and it is also believed to form a large extent of the Earth's core.

(a) Pure iron can be prepared by the thermal decomposition of iron pentacarbonyl.
Fig. 2.1 shows the structure of iron pentacarbonyl.

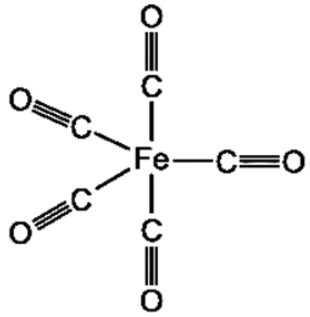


Fig. 2.1

Write the chemical formula for iron pentacarbonyl. ……. [1]

(b) **(i)** Iron metal oxidises partially to form iron(II) oxide.

Predict the electrical conductivity of this compound by including the condition under which conductivity is observed or not at all.

……..

…… [1]

2 **(b)** **(ii)** Complete Table 2.1 to show the number of electrons, neutrons and protons in iron(II) ion and oxide ion.

Table 2.1

	number of protons	number of neutrons	number of electrons
$^{56}_{26}Fe^{2+}$	26		
$^{16}_{8}O^{2-}$		8	

[2]

(c) **(i)** $^{54}_{26}Fe$ and $^{56}_{26}Fe$ are two common isotopes of iron.

Define *isotopes*.

……

…… [1]

(ii) These iron isotopes have different physical properties but exhibit same chemical properties.

Explain this observation.

……

…… [1]

[Total: 6]

3 When a colourless solution of copper(I) chloride is left in a beaker for a period of time, the following reaction takes place.

$$2CuCl(aq) \rightarrow CuCl_2(aq) + Cu(s)$$

(a) Calculate the oxidation state of copper in CuC*l* and CuCl_2.

oxidation state of copper in CuC*l* ……

oxidation state of copper in CuCl_2 …… [2]

(b) Explain, in terms of change in oxidation states, why CuC*l* is both oxidised and reduced in this reaction.

……

…… [2]

3 (c) Describe one observation in this reaction.

……..

……. [1]

[Total: 5]

4 (a) Name the pieces of apparatus most suitable to complete the following laboratory procedures:

(i) separate a precipitate from a solution,

……..…….…..[1]

(ii) measure exactly 25.30 cm^3 of solution into a conical flask,

……..…….…..[1]

(iii) measuring the mass gained in a reaction,

……..…….…..[1]

(iv) bubbling gas into a test-tube containing solution.

……..…….…..[1]

(b) Chromatography can be used to separate the coloured pigments extracted from lavender flowers. The apparatus used is shown Fig. 4.1.

After a few minutes, the solvent vapour fills the whole chromatography jar.

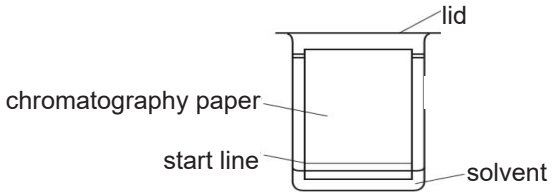


Fig. 4.1

Describe what happens to the movement and arrangement of the solvent particles as they become a vapour.

……..

……..

……..

……. [2]

[Total: 6]

5 A solution of nitric acid is prepared by diluting 0.15 mol to make 100 cm^3 of solution.

(a) Calculate the concentration of this solution in mol/dm^3 and g/dm^3.

concentration = …… mol/dm^3 [1]

concentration = …… g/dm^3 [1]

(b) The chemical equation for the reaction between nitric acid and potassium carbonate is as follows:

$$2HNO_3 + K_2CO_3 \rightarrow 2KNO_3 + CO_2 + H_2O$$

100 cm^3 of 0.5 mol/dm^3 nitric acid is added to an aqueous solution containing 0.02 mol of potassium carbonate.

(i) Calculate the number of moles of nitric acid.

number of moles = …… [1]

(ii) State the limiting reactant in this reaction.

……..……..……..…..[1]

(iii) Calculate the number of moles of potassium nitrate formed.

number of moles = …… [1]

[Total: 5]

6 Fig. 6.1 describes some of the properties and reactions of several substances.

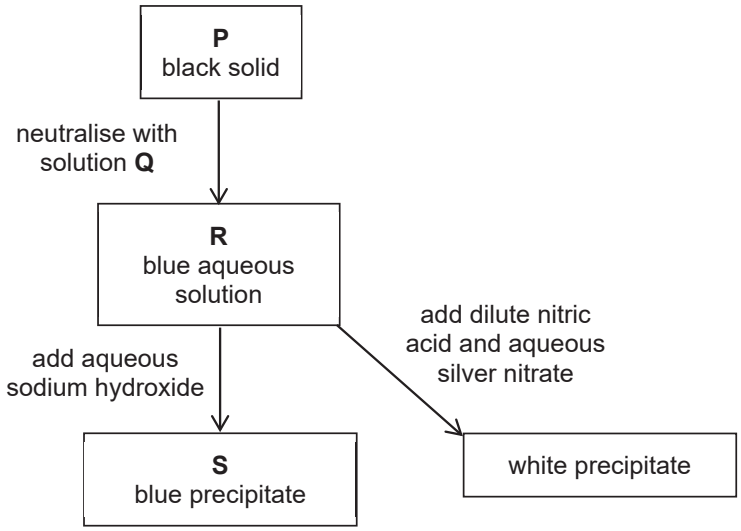


Fig. 6.1

(a) Identify **P**, **Q**, **R** and **S**.

P .....

Q .....

R .....

S ..... [4]

(b) Write the ionic equation for the reaction of **R** with aqueous silver nitrate.

..... [1]

[Total: 5]

7 **(a)** Lithium, sodium and potassium belong to Group I of the Periodic Table.
Table 7.1 shows the observations when these three metals react with water.

Table 7.1

Group I metal	observation
lithium	reacts quickly
sodium	reacts violently
potassium	reacts very violently

(i) Describe and explain the reactivity of Group I metals down the group.

……..

...……

...……

...……

……...…….....[3]

(ii) Rubidium is located below potassium in Group I.

Predict what would happen when rubidium reacts with water.

...……

……...…….....[1]

(iii) Name the gas evolved when Group I metals react with water.

……...…….....[1]

(b) Group 0 elements are also known as noble gases.

(i) State one physical property of noble gases.

...……

……...…….....[1]

(ii) Using your knowledge of electronic structures, explain why elements in Group 0 are unreactive.

...……

...……

……...…….....[1]

[Total: 7]

8 The petrol burnt in car engines react with air to form a mixture of gases.
Table 8.1 shows the composition of the mixture of all the gases coming from car exhaust fumes.

Table 8.1

gas	% of gas in the exhaust fumes
carbon dioxide	15
carbon monoxide	3
hydrocarbons	2
hydrogen	1
oxides of nitrogen	1
oxygen	1
water vapour	18
gas **W**	59

(a) Identify gas **W**. ……. [1]

(b) The amount of carbon dioxide emitted by vehicles contributes to the increasing concentration of the gas in the atmosphere.

Explain why this is a global concern.

.....

.....

.....

……..…….....[2]

(c) Explain why carbon monoxide is found in the exhaust gases.

.....

……..…….....[1]

8 (d) Water is one of the major by-products in the combustion of petrol in vehicles.

Draw a 'dot and cross' diagram of water, showing only the arrangement of electrons on the valence shells.

[2]

(e) The combustion of petrol is exothermic.

(i) Define *exothermic*.

……..……..... [1]

(ii) Give another example of an exothermic reaction.

……..……..... [1]

[Total: 8]

Name: _____( ) Class:_____

Section B [20 marks]
Answer any **two** questions in this section.
Write your answers in the spaces provided.

9 Magnesium sulfate is formed from the reaction between a metal, M and an acid, N.

(a) Name M and N.

M ……

N ..... [2]

(b) Write the balanced chemical equation for the reaction between M and N.

..... [1]

(c) Describe how pure crystals of magnesium sulfate can be prepared using metal M and acid N.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(d) Magnesium sulfate can also be prepared using acid N and another substance.

Name this substance.

..... [1]

9 **(e)** The labels on two bottles, one containing acid N and the other containing aqueous ammonia, were missing.

(i) Briefly describe a method you would use to distinguish between the two solutions.

.....

..... [1]

(ii) State the result you would expect for acid N using the method described in **(e)(i)**.

.....

.....[1]

[Total: 10]

10 Iron is a metal that is commonly used in the construction of ships and bridges.

(a) Iron is extracted from haematite using carbon in a blast furnace. Impurities from the iron are removed using limestone.

Describe how limestone is used to remove impurities from iron and include suitable chemical equations in your answer.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) When iron is exposed to the environment for some time, it starts to rust.

(i) Bridges made of iron are painted to prevent rusting.

Explain how the layer of paint prevents iron from rusting.

.....

..... [1]

10 (b) (ii) Some ships that are made of iron prevent rusting by attaching blocks of zinc to its surface. After some time, it was observed the block of zinc corroded instead of iron.

Explain how attaching blocks of zinc help to prevent the ship from rusting.

.....

..... [1]

(iii) Predict what happens when blocks of silver metal are attached to the iron surface of the ship instead of zinc.

..... [1]

(iv) It was observed that ships in the sea tend to corrode more quickly than bridges.

Suggest a reason to explain this phenomenon.

.....

..... [1]

(c) In addition to the production of iron using the blast furnace, iron is also obtained through recycling.

Give two reasons why it is important to recycle metal.

1.....

.....

2.....

..... [2]

[Total: 10]

11 Egg shells are made up mainly of calcium carbonate. A pupil carried out an experiment to react egg shells with excess dilute hydrochloric acid. The gas that was produced was measured at a regular time interval to investigate the speed of the reaction.

(a) Predict the solubility of this gas in water.

..... [1]

(b) Complete the diagram in Fig. 11.1 to show the apparatus which could be used to measure the volume of gas produced.

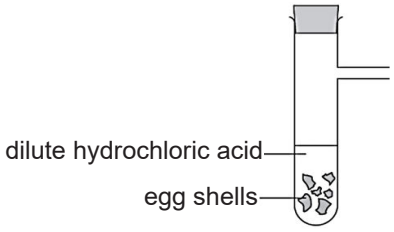


Fig. 11.1 [2]

(c) The results of this experiment are shown in Table 11.1.

Table 11.1

time/ s	0	20	40	60	140	180	200	220
volume of gas/ cm^3	0	14	25	32	48	50	50	50

(i) Plot the results on Fig. 11.2 and draw a smooth curve through the points.

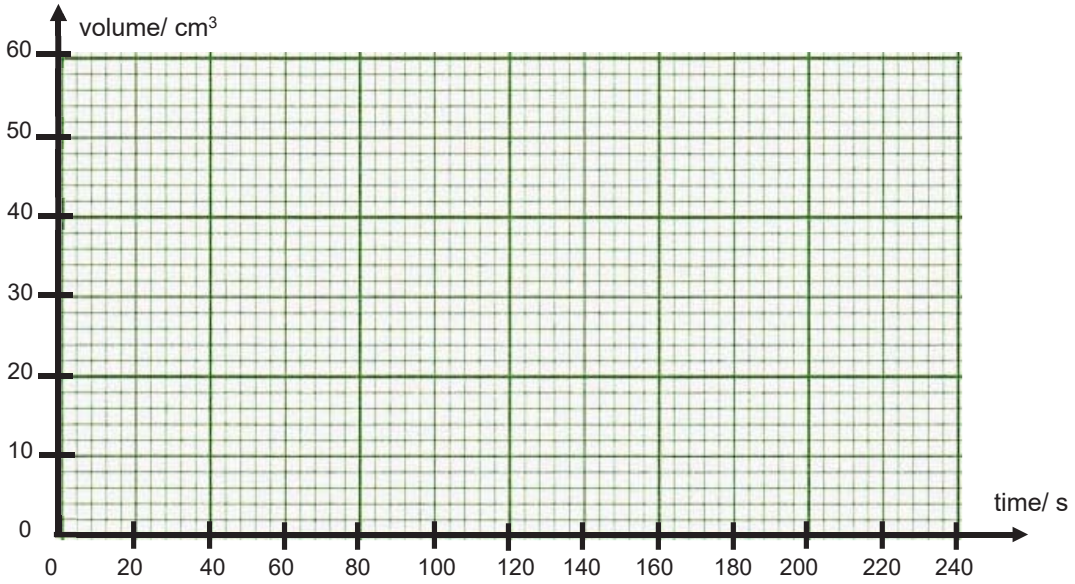


Fig 11.2 [2]

11 (c) (ii) Explain why no further measurements were taken after 220 seconds.

.....

..... [1]

(iii) Using the graph drawn in **(c)(i)**, estimate the volume of gas evolved for the first 100 seconds.

..... [1]

(iv) Calculate the average speed of reaction in cm^3/ s for the first 10 seconds of the reaction.
(Average speed = $\frac{\text{final volume - initial volume}}{\text{duration concerned}}$)

…… cm^3/ s [2]

(v) The experiment is repeated with crushed egg shell.
On the same axes in Fig. 11.2, draw the graph you would expect for the second experiment.
Labelled the graph as 'Q'. [1]

[Total: 10]

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

Key

proton (atomic) number atomic symbol name relative atomic mass

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 –		

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.).

CHIJ Katong Convent

4E/5N Science Chemistry Mid-Year Exam 2018

Answer scheme

Paper 1

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

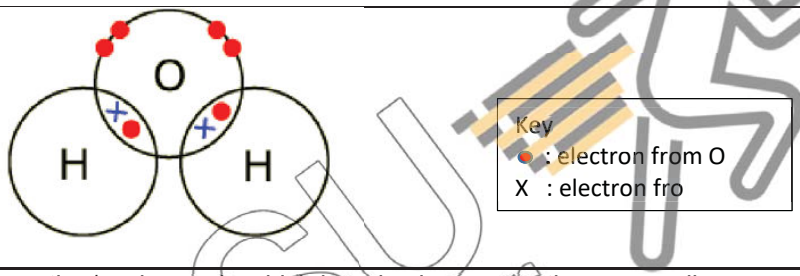
Paper 3

Section A

<table>
<tr><th>Qn</th><th>Answers</th></tr>
<tr><td>1</td><td>
<table>
<tr><td>substance</td><td>classification (element, compound or mixture)</td><td>atoms found within the substance</td></tr>
<tr><td>hydrogen sulfide</td><td>compound</td><td>hydrogen, sulfur</td></tr>
<tr><td>brass</td><td>mixture</td><td>copper, zinc</td></tr>
<tr><td>limestone</td><td>compound</td><td>calcium, carbon, oxygen</td></tr>
</table>
</td></tr>
<tr><td>2a</td><td>$Fe(CO)_5$</td></tr>
<tr><td>2b(i)</td><td>Iron(II) oxide conducts electricity only in molten form.
OR
Iron(II) oxide does not conducts electricity as a solid.</td></tr>
<tr><td>2b(ii)</td><td>
<table>
<tr><td></td><td>number of protons</td><td>number of neutrons</td><td>number of electrons</td></tr>
<tr><td>$^{56}_{26}Fe^{2+}$</td><td>26</td><td>30</td><td>24</td></tr>
<tr><td>$^{16}_{8}O^{2-}$</td><td>8</td><td>8</td><td>10</td></tr>
</table>
</td></tr>
<tr><td>2c(i)</td><td>Isotopes are <u>atoms of the same element</u> with the <u>same number of protons</u> but <u>different number of neutrons.</u></td></tr>
<tr><td>2c(ii)</td><td>As the isotopes have <u>the same number of valence electrons</u>, they possess the same chemical properties.</td></tr>
<tr><td>3a</td><td>oxidation state of copper in $CuCl$ = +1
oxidation state of copper in $CuCl_2$ = +2</td></tr>
<tr><td>3b</td><td>$CuCl$ is oxidised to $CuCl_2$ as the oxidation state of Cu increases from +1 in $CuCl$ to +2 in $CuCl_2$.

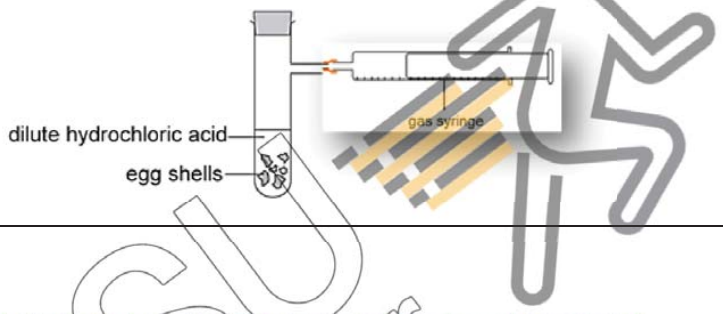
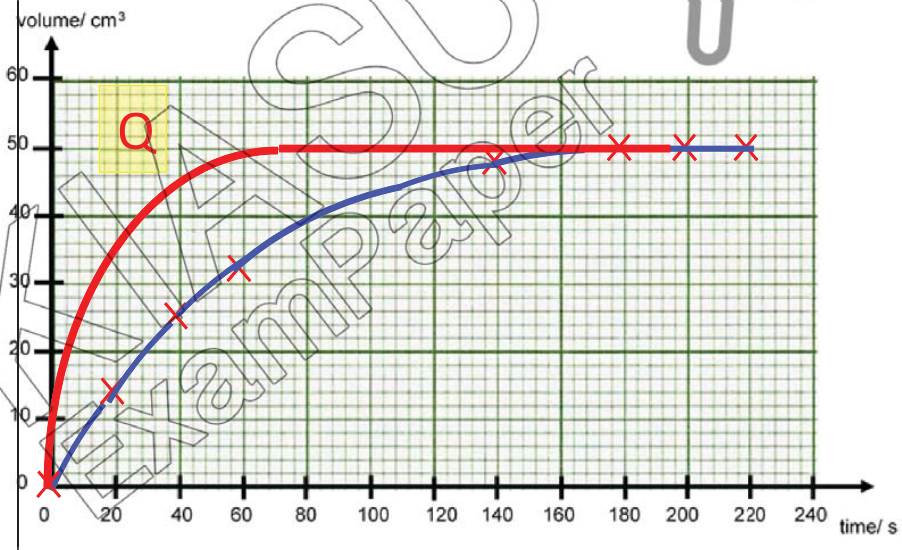
$CuCl$ is reduced to Cu as the oxidation state of Cu decreases from +1 in $CuCl$ to 0 in Cu.</td></tr>
</table>

3c	The colourless solution turns blue OR A pink/ brown/ reddish-brown solid is formed.
4a(i)	filter funnel
4a(ii)	burette
4a(iii)	electronic balance
4a(iv)	delivery tube/ teat pipette
4b	When the solvent particles become a vapour, they are moving at high speeds in all directions and spaced far apart.
5a	Concentration of HNO_3 in mol/dm^3 = 0.15 ÷ $\frac{100}{1000}$ = 1.5 mol/dm^3 Concentration of HNO_3 in g/dm^3 = 1.5 x 63 = 94.5 g/dm^3
5bi	Number of moles of HNO_3 = $\frac{100}{1000}$ x 0.5 = 0.05 mol
5bii	Potassium carbonate / K_2CO_3
5biii	Mole ratio K_2CO_3 : KNO_3 = 1 : 2 Number of moles of KNO_3 = 0.02 x 2 = 0.04 mol
6a	P: copper(II) oxide / CuO Q: hydrochloric acid / HCl R: copper(II) chloride / $CuCl_2$ S: copper(II) hydroxide / $Cu(OH)_2$
6b	Ag^+ (aq) + Cl^- (aq) → AgCl (s)
7ai	The reactivity of Group I metals increases down the group. Down the group, there are more filled electron shells between the nucleus and the valence electron. Hence, there is a greater tendency to lose the valence electron to attain the noble gas electronic configuration.
7aii	It reacts explosively.
7aiii	Hydrogen gas
7bi	Noble gases are/ have • colourless • odourless • gases at room temperature and pressure OR have low melting and boiling points • insoluble in water • poor conductors of electricity • low densities (any one)

7bii	They have fully-filled valence electron shells and already achieved a stable noble gas electronic configuration.
8a	nitrogen/ N_2
8b	Carbon dioxide is a greenhouse gas / causes climate change / causes global warming. This results in ice caps melting (or rise in sea levels) / increased flooding / desertification / increased death of corals.
8c	It is formed due to incomplete combustion.
8d	
8ei	A reaction/ a change in which heat is given out to the surroundings.
8eii	Rusting, respiration, neutralisation or any acceptable answer.

Section B

Qn	Answers
9a	M: magnesium N: sulfuric acid
9b	$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$
9c	Steps for making crystals: 1. Add excess magnesium metal to a test tube containing sulfuric acid and stir. 2. Filter to obtain the filtrate, which is magnesum sulfate solution, and remove the excess magnesium metal residue. 3. Heat the filtrate till it is saturated. 4. Allow the saturated solution to cool so that the salt can crystallise. 5. Filter to collect the crystals. Wash the crystals with a little cold distilled water to remove impurities and dry between sheets of filter paper.
9d	Magnesium oxide / magensium carbonate/ magnesium hydroxide
9ei	Add a few drops of universal indicator solution into each solution. OR Dip a piece of red and blue litmus paper into each solution.
9eii	The solution will turn from green to red. OR The red litmus paper will remain red and the blue litmus paper will turn red.
10a	Limestone is first decomposed by heat to produce carbon dioxide and calcium oxide. $CaCO_3$ (s) → CaO (s) + CO_2 (g)

	Calcium oxide reacts with the impurities from iron, which is sand, to form <u>molten slag</u>. $CaO\ (s) + SiO_2\ (s) \rightarrow CaSiO_3\ (l)$
10bi	Paint serves as a protective layer that prevents iron from coming into contact with <u>water and oxygen</u>.
10bii	Zinc is more reactive than iron, hence zinc will react with water and oxygen first.
10biii	The ship will rust.
10biv	The presence of sodium chloride in seawater results in the increase of the speed of rusting.
10c	✓ Recycling helps to conserve finite/ non-renewable metal ores. ✓ Recycling helps to save energy, hence less fossil fuels are burnt for energy production. ✓ Recycling helps to save cost of extracting metals. ✓ Recycling reduces pollution as recycling metals creates less pollutants than extracting metals from its ores. ✓ Recycling reduces the need of landfills for metal extraction wastes (any two)
11a	The gas (carbon dioxide) is slightly soluble/ insoluble in water.
11b	a labelled gas syringe 
11c(i)	
11c(ii)	All the egg shell (calcium carbonate) had been used up.
11c(iii)	Based on students' graph, Acceptable range of 41 – 43 cm^3

11c(iv)	Based on students' graph average speed = $\frac{volume\ at\ 10\ sec - volume\ at\ 0\ sec}{10\ sec}$
11c(v)	a graph with a higher gradient but same final volume

Name | Reg. No | Class

MAYFLOWER SECONDARY SCHOOL

4EX/5NA

Science (Chemistry) 5076/1
(with Biology/Physics Component) 5078/1
Paper 1

SEMESTRAL ASSESSMENT ONE
May 2018
1 hour

Additional Materials:
Electronic calculator
OTAS Answer Sheet

INSTRUCTIONS TO CANDIDATES:

Do not open this booklet until you are told to do so.
Write your name, index number and class in the spaces at the top of this page and on any separate answer paper used.
Write in soft pencil.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **twenty** 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 OTAS answer sheet.

Read carefully the instructions on the answer sheet.

At the end of the examination, hand in your OTAS sheet and question paper separately.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 9.

This question paper consists of **9** printed pages.

Setter: Mr Timothy Chen Vetter: Mdm Jarina Banu

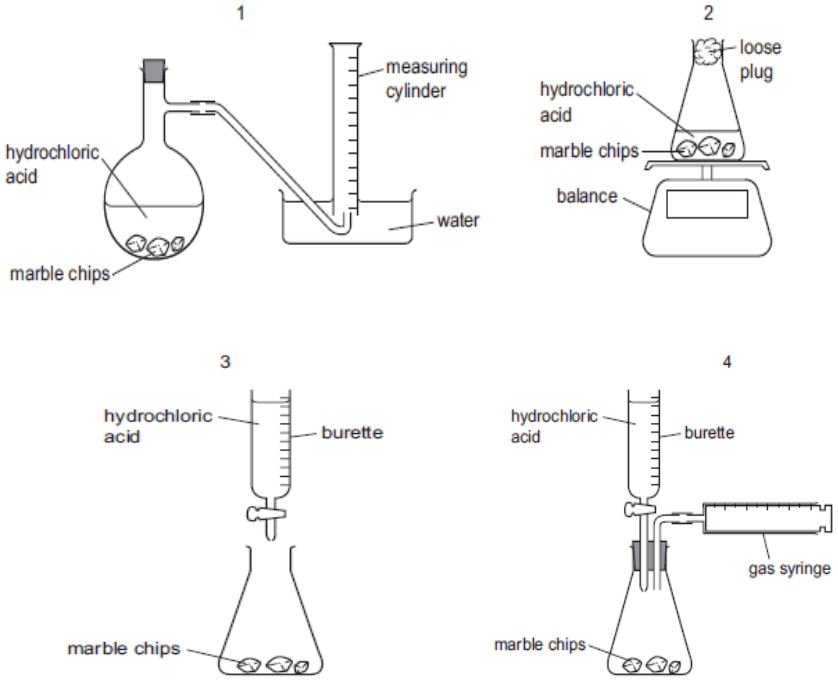
Paper 1 (Multiple Choice Questions)

Answer **all** the questions on the **OTAS**.

21 A student follows the rate of the reaction between marble chips, $CaCO_3$, and dilute hydrochloric acid, by measuring the amount products produced or the amount of reactants reacted.

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

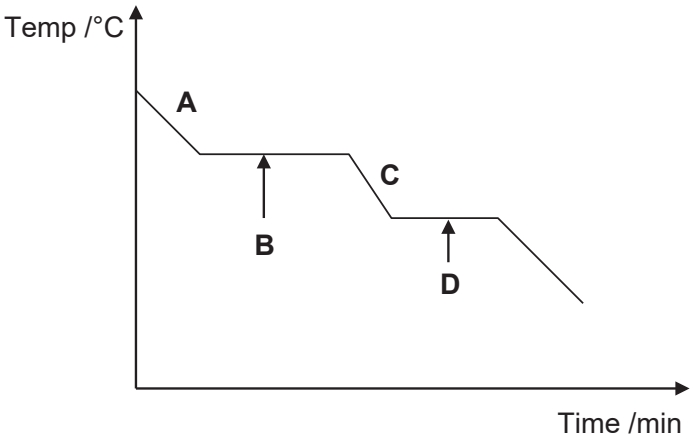
Which diagrams show apparatus that is suitable for this experiment?



A 1 and 2
B 2 and 4
C 1, 2 and 4
D All of the above

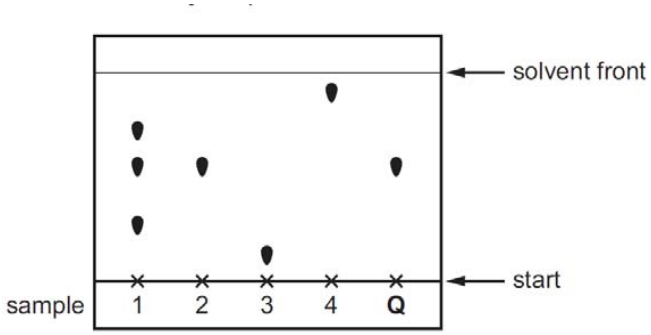
22 A gas is being cooled to room temperature.

Which part of the cooling curve below shows that both the gas and liquid exist together?



23 Four samples are spotted onto chromatography paper. It is known that one of these samples is pure compound **Q**. A separate sample of pure compound **Q** is also spotted onto the paper. The paper is placed in a solvent.

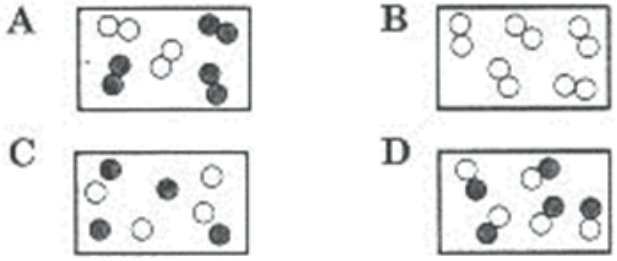
The diagram shows the chromatogram produced.



Which statement is correct?

A Sample 2 has travelled the furthest and sample 3 is pure compound **Q**.
B Sample 3 has travelled the furthest and sample 2 is pure compound **Q**.
C Sample 4 has travelled the furthest and sample 1 is pure compound **Q**.
D Sample 4 has travelled the furthest and sample 2 is pure compound **Q**.

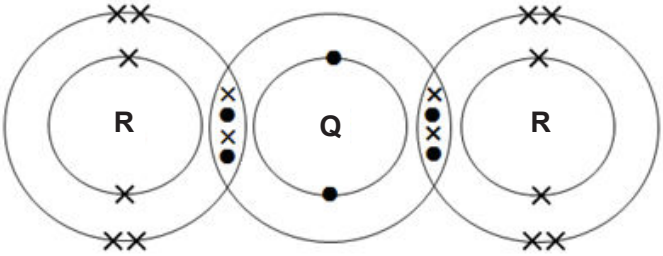
24 Which diagram shows a compound made up of two different elements?



25 Which statement about the particles, F^-, Ne and Na^+ is correct?

A They all contain more electrons than protons.
B They all contain more neutrons than protons.
C They all contain the same number of electrons.
D They all contain the same number of protons.

26 The figure below shows a compound formed by elements **Q** and **R**.



Which of the following is true?

A The compound has a low boiling point.
B The compound has mobile electrons and therefore can conduct electricity.
C The atoms of **R** gain electrons from the atom of **Q** to form an ionic compound.
D The atoms of **Q** and **R** share valence electrons to form a covalent compound with formula $\mathbf{Q_2R}$.

27 Which statement is correct about all ionic compounds?

A They are formed when metals share electrons with non-metals.
B They conduct electricity in the molten state.
C They conduct electricity in the solid state.
D They dissolve in water.

28 Nitrogen monoxide and oxygen react to form nitrogen dioxide.

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

What is the maximum volume of nitrogen dioxide that could be obtained when 1 dm^3 of nitrogen monoxide reacts with 2 dm^3 of oxygen?

A 1.0 dm^3
B 2.0 dm^3
C 3.0 dm^3
D 4.0 dm^3

29 Which sample contains the most atoms?

A 0.5 moles of water
B 0.5 moles of ammonia
C 1.0 moles of carbon dioxide
D 2.0 moles of hydrogen chloride

30 A household cleaning compound is used to remove calcium carbonate from bathroom surfaces.

Bubbles of gas can be seen forming when it is applied to the surface.

What is the pH of this cleaning compound?

A pH 2
B pH 7
C pH 10
D pH 14

31 The table shows the results of adding dilute nitric acid and aqueous sodium hydroxide to four oxides.

Which is the result obtained for aluminium oxide?

	dilute nitric acid	aqueous sodium hydroxide
A	reaction	reaction
B	reaction	no reaction
C	no reaction	reaction
D	no reaction	no reaction

32 A bottle of magnesium carbonate has been contaminated with sodium chloride. How can the pure magnesium carbonate be obtained from this mixture?

A Add acid to the mixture, filter then collect the residue.
B Add acid to the mixture, filter then evaporate the filtrate.
C Add water to the mixture, filter then collect the residue.
D Add water to the mixture, filter then evaporate the filtrate.

33 Which reagent can be used to react with dilute hydrochloric acid to prepare silver chloride?

A solid silver
B solid silver oxide
C solid silver carbonate
D aqueous silver nitrate

34 The results of experiments involving four metals, W, X, Y and Z, and their ions are shown.

$$Y(s) + Z^{+}(aq) \rightarrow Y^{+}(aq) + Z(s)$$
$$W(s) + X^{+}(aq) \rightarrow \text{no reaction}$$
$$Z(s) + X^{+}(aq) \rightarrow Z^{+}(aq) + X(s)$$

What is the order of reactivity of the four metals, most reactive to least reactive?

A W → X → Y → Z
B X → W → Z → Y
C Y → Z → X → W
D Z → Y → W → X

35 Element **Z** is in the same group of the Periodic Table as bromine but has a lower boiling point.

Which statement about **Z** is correct?

A It can displace bromine from an aqueous solution of potassium bromide.
B It has a proton number greater than 35.
C It is a solid at room temperature.
D It loses an electron when it reacts with a metal.

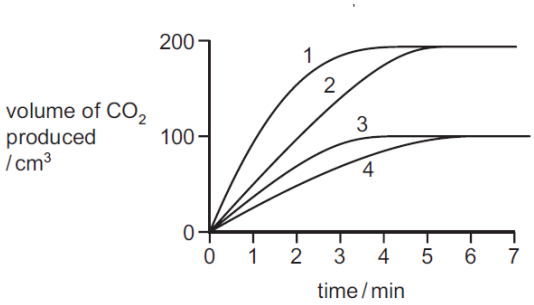
36 Which change always occurs when a metal atom is oxidised?

A It combines with oxygen.
B It gains electrons to form a negative ion.
C It loses electrons to form a positive ion.
D It gains protons to form a positive ion.

37 In four separate experiments, 1, 2, 3 and 4, nitric acid was added to excess marble chips and the volume of carbon dioxide formed was measured.

In all four experiments the same volume of nitric acid was used.
Its concentration, or temperature, or both concentration and temperature, were changed.

The results of the experiments are shown on the graph.



Which statement is correct?

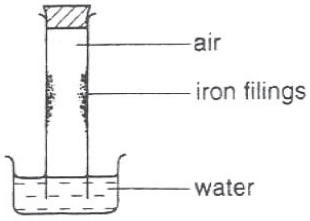
A A lower concentration of acid was used in experiment 3 than in experiment 1.
B Experiment 4 was faster than experiment 3.
C The acid used in experiment 2 was of a lower concentration than in experiment 1.
D The temperature of the acid was the same in experiments 1 and 2.

38 The elements helium, argon and neon are noble gases.

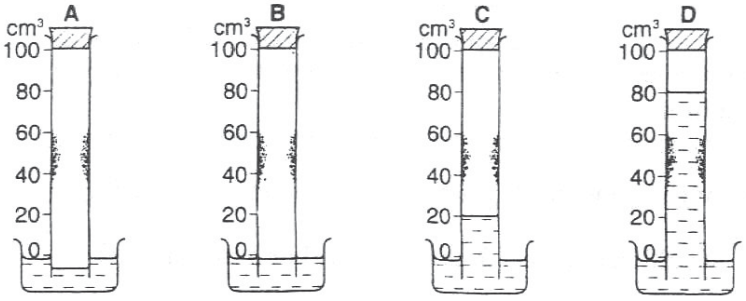
Which statement is correct?

A All these elements have an octet configuration.
B Argon is used to react with impurities in the manufacture of steel.
C Helium is used in balloons as it is more dense than air.
D Neon is used in light bulbs to give an inert atmosphere.

39 The inside of a tube is coated with iron filings. The tube is placed in a trough of Water as shown.



Which diagram represents the likely appearance of the apparatus after one week?



40 When a volcano erupts, which gas is produced in significant amounts?

A carbon monoxide
B methane
C oxides of nitrogen
D sulfur dioxide

-- End of paper 1 --

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
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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
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The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name | Reg. No | Class

MAYFLOWER SECONDARY SCHOOL

4EX/5NA

Science (Chemistry)

5076/3
5078/3

[65 marks]

SEMESTRAL ASSESSMENT ONE
May 2018
1 hour 15 minutes

Additional Materials: Electronic calculator

INSTRUCTIONS TO CANDIDATES:

Do not open this booklet until you are told to do so.
Write your name, index number and class in the spaces at the top of this page and on any separate answer paper used.
Write in dark blue or black pen on both sides of the paper. You may use a soft pencil for any diagrams, graphs or 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 on the spaces provided.
Answers any **two** questions out of the three questions given.

FOR EXAMINER'S USE	
Section	**Marks**
Paper 1 MCQ	**/ 20**
Paper 3 Section A	**/ 45**
Paper 3 Section B	**/ 20**
Paper 5	**/15**
Total	**/ 100**

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.
A copy of the Periodic Table is printed on page 13.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **13** printed pages.

Setter: Mr Timothy Chen | Vetter: Mdm Jarina Banu

Paper 3

Section A (45 marks)

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

1 The apparatus shown in Fig 1.1 can be used to separate a mixture of 3 liquids, **A**, **B** and water.
A has a boiling point of 50 °C while **B** has a boiling point of 78 °C.

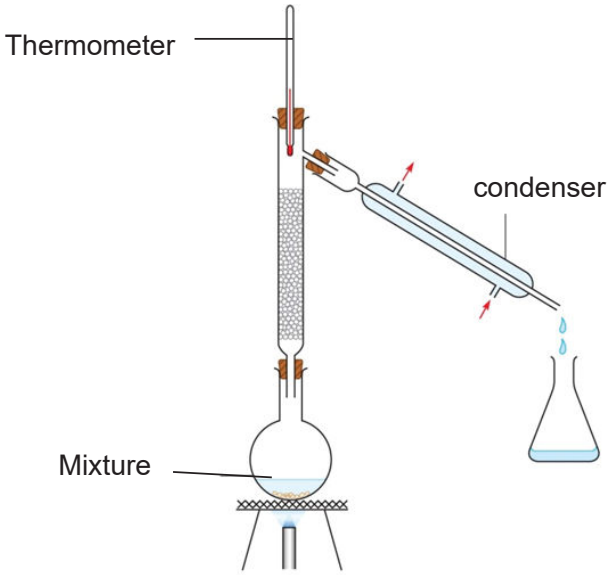

Fig. 1.1

(a) State the name of this method of separation.

……[1]

(b) What is the purpose of the water in the condenser?

……[1]

(c) Predict the temperature of the thermometer when the first distillate appears in the beaker.

Explain why.

……

……

……[2]

2 Table 2.1 shows the number of protons, electrons and neutrons of five particles **Q** to **V**.

Table 2.1

Particle	Number of protons	Number of neutrons	Number of electrons
Q	5	5	4
R	7	7	10
S	8	8	8
T	9	11	9
U	10	10	10
V	16	16	16

Which of the particles, **Q** to **V** in Table 2.1, fit each of the following descriptions?

(a) **(i)** an atom with mass number of 16 …….

(ii) a positive ion …….

(iii) an atom that has 8 valence electrons …….

(iv) two atoms in the same group ……. and …….

[4]

(b) Particle **T** is an isotope of an element found in the Periodic Table.

Name the element and explain why **T** is an isotope of that element.

……...

……...

……...

……..[2]

[Turn over

3 Fig. 3.1 shows the extraction of iron from iron ore.

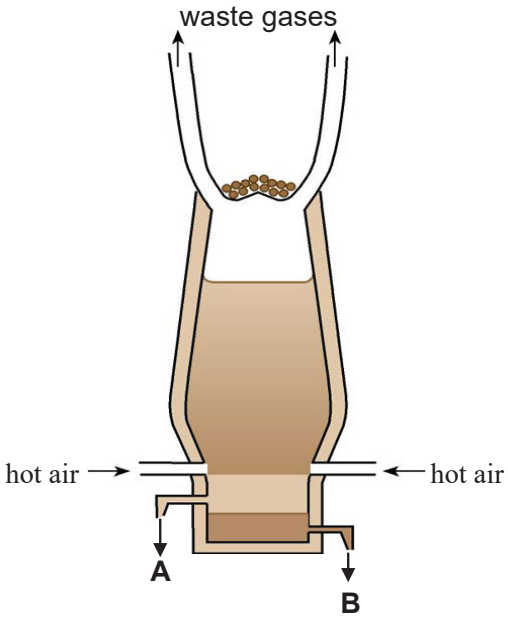

Fig. 3.1

(a) Haematite is the source of iron produced in the Blast Furnace.

(i) Name the reducing agent for the reduction of haematite.

……...[1]

(ii) With the aid of a chemical equation, describe how your answer in **3(a)(i)** reduces haematite to molten iron.

……...

……...

……..

……..[3]

(iii) Besides haematite, name the other 2 raw materials that are added to the Blast Furnace.

……..[2]

(b) Name product **A** and state its usefulness as a substance floating above product **B**.

……...

……..[2]

(c) Iron can be used to make stainless steel.

Stainless steel can be made by adding elements such as chromium and nickel to iron to improve its strength.

(i) What is the name given to mixtures such as stainless steel?

……..[1]

(ii) Explain, in terms of the arrangement of atoms, why stainless steel is harder than pure iron.

……..

…….....

…….....

……..[2]

4 A student titrates 25.0 cm^3 an alkali of metal **X**, **X**OH, with sulfuric acid.

He realizes that 20.0 cm^3 of 0.2 mol/dm^3 of sulfuric acid is required to neutralize the acid fully.

The chemical equation for the reaction is shown below:

$$2\mathbf{X}OH + H_2SO_4 \rightarrow \mathbf{X}_2SO_4 + 2H_2O$$

(a) Name an indicator that can determine the endpoint of the reaction and describe the colour change seen.

……..

……..[2]

(b) **(i)** Calculate the number of moles present in 20.0 cm^3 of the sulfuric acid used.

…….. mol [1]

[Turn over

(ii) Determine the concentration, in mol/dm^3, of **X**OH used.

…… mol/dm^3 [2]

(iii) If the concentration of **X**OH used is 12.8 g/dm^3, calculate the relative mass of **X**OH and, hence, determine the identity of **X**.

Relative mass of **X**OH: …… Identity of **X**: …….. [2]

(c) When **X**OH is added to ammonium chloride, a gas is formed.

Name the gas formed and describe how to test for its identity.

…….....

…….....

…….....[2]

5 Hydrogen can form compounds with both metals and non-metals.

For example, it can form lithium hydride with lithium and also ammonia with nitrogen.

(a) What is the bonding found in lithium hydride?

……..[1]

(b) **(i)** Draw the dot-and-cross diagram to show the arrangement of valence electrons found in lithium hydride and ammonia in the space below.

Lithium hydride:

[2]

Ammonia:

[2]

(ii) Explain, in terms of bonding, why lithium hydride exist as a solid while ammonia exist as a gas at room temperature.

……...

……...

……...

……...

……...[3]

[Turn over

6 Fig. 6.1 describes the reactions of metal **A**.

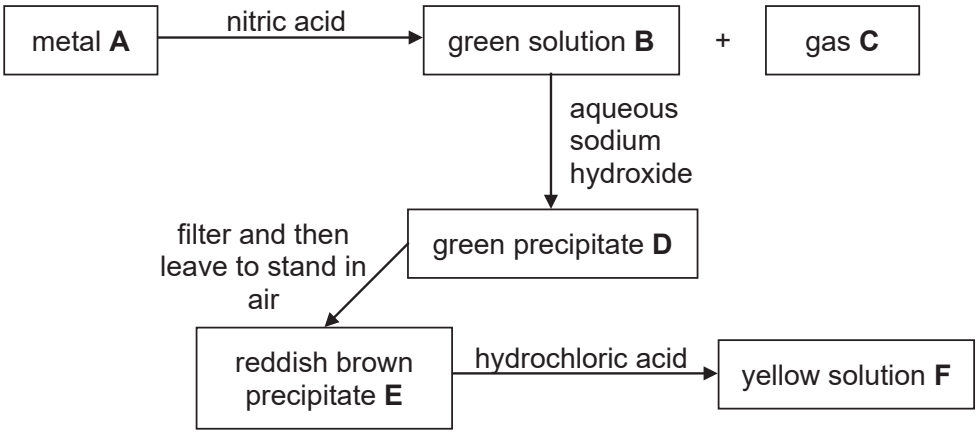

Fig 6.1

(a) Identify the following substances.

A ……

B ……

C ……

D ……

E ……

F ……

[6]

(b) Describe how to test for gas **C** that is formed in the above reactions.

……..

……..[1]

-- End of paper 3 section A --

Paper 3 Section B (20 marks)

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

7 **(a)** **(i)** Name an element from Period 3 and explain how the electronic structure of this element can be used to determine the group the element belongs.

……

……

……

……

……[3]

(ii) Moving from Group I to Group VII across period 3, the character of the elements change.

Describe and explain this change.

……

……

……

……

……[3]

(b) The element with an atomic number of 87 is extremely rare and only about 30 g exist throughout the Earth crust.

Predict one physical and one chemical property of this element.
Write a balanced chemical equation, with state symbols, to represent the chemical property that you have described.

……

……

……

……

……

……

……[4]

[Turn over

8 Coal contains sulfur. When coal is burnt at power stations in an excess of oxygen, sulfur dioxide is formed according to the reaction shown below.

$$S + O_2 \rightarrow SO_2$$

(a) **(i)** Explain why sulfur is considered to be oxidised in this reaction.

……

……[1]

(ii) Find the mass of sulfur burnt if 320 dm^3 of sulfur dioxide is formed at room temperature and pressure.

[3]

(iii) Describe how the release of sulfur dioxide can indirectly cause damage to buildings made of limestone.

……

……

……[2]

(b) Two pollutants can be produced in the internal combustion engines of automobiles.

Name the pollutants and describe how they are produced in the engines of automobiles.

……

……

……

……

……

……[4]

9 **(a)** Explain, in terms of collision theory, how the temperature of reactants affect the speed of reaction.

……

……

……[2]

(b) A student wants to investigate the **rate** of reaction involving particle size.

Given that he has magnesium strips and magnesium powder with some hydrochloric acid, describe how he can conduct a laboratory experiment to do his investigation.

Your description should include the measurement obtained to measure the rate of reaction.

……

……

……

……

……

……

……

……

……[5]

(c) Magnesium can also react with copper(II) sulfate as shown below.

$$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$$

(i) During this reaction, the temperature of the solution increases.
Based on this observation, state what kind of reaction this is.

……[1]

(ii) Explain why this reaction is also considered a displacement reaction.

……

……

……[2]

-- End of section B --
-- End of paper –

[Turn over

12

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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 | Reg. No | Class

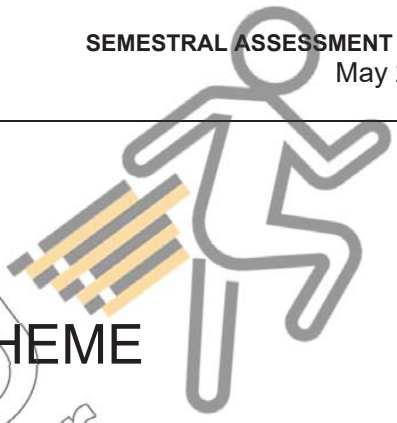
FLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL

4EX5NA

Sci (Chem) **5076 /5078**

[65 marks]

SEMESTRAL ASSESSMENT One
May 2018



ANSWER SCHEME

Setter: Mr Timothy Chen Yanhui Vetter: Mdm Jarina

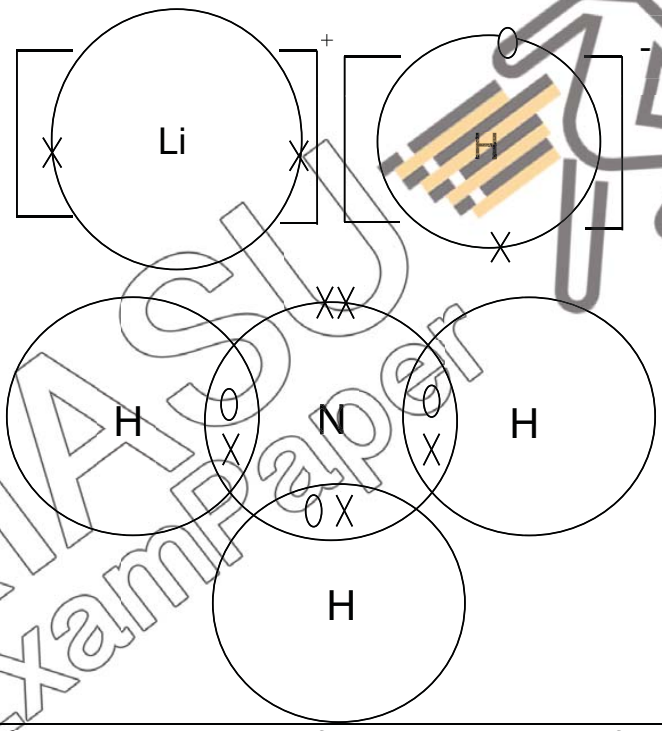
Paper 1 (20m)

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

Paper 2
Section A (45m)

Qn	Part	Answer	Marks
1	**(a)**	Fractional distillation	**1**
	(b)	To condense the vapour entering the condenser as the distillate.	**1**
	(c)	50 °C.	**1**
		It is the boiling point of A which has the lowest boiling point of the 3 substances	**1**
2	**(a)**	**(i)** S	**1**
		(ii) Q	**1**
		(iii) U	**1**
		(iv) V and S	**1**
	(b)	It is fluorine.	**1**
		Both have 9 protons, however,	
		Fluorine has 10 neutrons while T has 11 neutrons.	**1**
3	**(a)**	**(i)** carbon monoxide	**1**
		(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	**1**
		Fe_2O_3 loses oxygen to carbon monoxide,	**1**
		And is thus reduced to form iron /	**1**
		The oxidation state of Fe decreases from +3 in haematite to 0 in iron.	
		(iii) Limestone and	**1**
		coke.	**1**
	(b)	Molten slag.	**1**
		It covers the molten iron, preventing it from oxidising with oxygen.	**1**
	(c)	**(i)** Alloys	**1**
		(ii) Since the sizes of particles in stainless steel are different,	**1**
		this disrupts the regular arrangement of iron, making it harder to slide when a force is applied. (ERC)	**1**
4	**(a)**	Universal indicator.	**1**
		There will be a colour change from purple to green.	**1**

[Turn over

	(b)	**(i)**	Mole of sulfuric acid = 0.02 * 0.2 = 0.004 mol	**1**
		(ii)	Mole of sodium hydroxide = 0.004 * 2 = 0.008 mol	**1**
			Concentration of sodium hydroxide = 0.008 / 0.025 = 0.32 mol/dm^3	**1**
		(iii)	Molar mass = conc (g/dm^3) / conc (mol/dm^3) = 12.8 / 0.32 = 40 g/mol	**1**
			Molar mass of X = 40 – 16 -1 = 23 Therefore, X is sodium.	**1**
	(c)	Ammonia gas. The gas evolved will turn damp red litmus paper blue.		**1** **1**
5	**(a)**	Ionic bonding		**1**
	(b)	**(i)**		**1 mark each for correct transfer/ sharing of electrons for both** **1 mark for no inner shell electrons for both**
		(ii)	Since lithium hydride consist of **strong electrostatic forces** of attraction between positive and negative ions while ammonia consists of **weak intermolecular forces** between ammonia molecules. And because **much more energy** is required to overcome the forces of attraction in lithium hydride compared to ammonia, Therefore, lithium hydride has a much higher melting and boiling point, hence it exist as a solid while ammonia exist as a gas under room temperature.**(ERC)**	**1** **1** **1**

[Turn over

6	(a)	A: iron B: iron(II) nitrate C: hydrogen gas D: iron(II) hydroxide E: iron(III) hydroxide F: iron(III) chloride	1 1 1 1 1 1
	(b)	Test the gas evolved using a burning / lighted splint. It should extinguish with a pop sound	1

Section B (20m)

Qn	Part		Answer	Remarks
7	(a)	(i)	Name 1 element from sodium to argon. Since sodium has an electronic configuration of 2.8.1, showing that it has 1 valence electron. Therefore, it is in Group I.	1 1 1
		(ii)	Across Period 3, the metallic character of the element decreases. Since the tendency of the elements to form positive ions by losing electrons decreases while The tendency increases for elements to gain electrons, forming negative ions as the number of valence electrons increases, Therefore, elements show less metallic character across the period.	1 1 1
	(b)		It is soft / can conduct electricity / low density. It can react with water to form alkali and hydrogen gas. / It can react with halogens to form halides. $2Fr\ (s) + 2H_2O\ (l) \rightarrow 2FrOH\ (aq) + H_2\ (g)$ / $Fr\ (s) + Cl_2\ (g) \rightarrow 2FrCl_2\ (s)$	1 1 **1 mark for balanced chemical equation** **1 mark for state symbols**
8	(a)	(i)	Sulfur gains oxygen to form sulfur dioxide / the oxidation state of sulfur increases from 0 to +2.	1
		(ii)	Mole of sulfur dioxide = 320 / 24 = 13.33 mol Mole ratio of SO_2 : S = 1:1 = 13.33:13.33 Mass of sulfur burnt = 13.33 * 32 = 426.6 = 427g	1 1 1
		(iii)	sulfur dioxide can react with the water to form sulfurous acid. Sulfurous acid oxidises in the air to sulfuric acid which forms acid rain which can damage buildings made of limestone.	1 1

[Turn over

	(b)	Oxides of nitrogen Carbon monoxide Oxides of nitrogen are formed through the reaction of nitrogen and oxygen under high temperature in the engine. Carbon monoxide is formed through the incomplete combustion of petrol / fuel in the engine.		**1** **1** **1** **1**
9	**(a)**	The smaller the particle size, the larger the surface area for reaction to occur. This increases the frequency of collisions between reactant particles, resulting in a faster reaction.		**1** **1**
	(b)	Add **a fixed mass** of magnesium strip to hydrochloric acid of fixed concentration. Collect the **volume** of hydrogen gas collected using a gas syringe and measure the volume of hydrogen gas collected at **regular time intervals** (eg. 30 seconds). Record the values collected and **plot a graph** of volume of hydrogen gas collected against time. Repeat the experiment using magnesium powder instead of magnesium ribbon. Compare the **slopes of the graph** obtained for both ribbon and powder to investigate the rate of reaction.		**1** **1** **1** **1** **1**
	(c)	**(i)**	Exothermic	**1**
		(ii)	Since magnesium is a more reactive metal than copper, Therefore it displaces copper from its sulfate to form magnesium sulfate and copper metal.	**1** **1**

End of Answer Scheme

○

[Turn over

PASIR RIS CREST SECONDARY SCHOOL
Mid-Year Examination
Secondary Four Express and Five Normal Academic

CANDIDATE NAME	
CLASS	/
INDEX NUMBER	

Science (Physics / Chemistry / Biology) **5076, 5078/01**
Paper 1 Multiple Choice **11 May 2018**
1 hour

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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

There are **forty** questions on this paper. Answer all questions.
For each equation 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.

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.
A copy of the Data Sheet is printed on page 8.
A copy of the Periodic Table is printed on page 9.
The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use
40
Parent's Signature

This document consists of **9** printed pages, including the cover page.

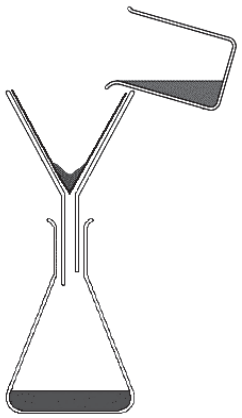
Multiple Choice Questions (40 marks)

Answer all questions.

1 A student mixes 25 cm^3 samples of acid solution with different volumes of alkali solution.
At every 30 seconds, the student measures the change in temperature.
Which piece of apparatus is **not** needed?

A gas syringe
B measuring cylinder
C thermometer
D stop watch

2 A separation technique is shown below.



Which pair of mixtures can best be separated by the above technique?

A aqueous sodium chloride and aqueous copper(II) sulfate
B dilute hydrochloric acid and aqueous potassium hydroxide
C magnesium carbonate and dilute nitric acid
D zinc oxide and aqueous calcium nitrate

3 The table shows the melting and boiling points of four substances.

Which of the following substances contains particles that are sliding past each other at room temperature (25 ºC)?

	melting point / ºC	boiling point / ºC
A	– 110	– 55
B	– 20	15
C	0	100
D	744	1214

4 Aqueous sodium hydroxide is added to aqueous salt Z and a white precipitate formed. The white precipitate dissolved when excess sodium hydroxide is added.

When this reaction was completed, aluminium foil is added to the solution. The gas given off turned damp red litmus blue.

What is aqueous salt Z?

A calcium nitrate
B lead(II) sulfate
C zinc nitrate
D zinc sulfate

5 The symbols for two ions are shown below.

$$^{19}_{9}F^{-} \qquad\qquad ^{21}_{11}Na^{+}$$

Which of the following statements is correct?

A Both the ions contain the same number of electrons.
B Both the ions contain the same number of protons.
C The fluoride ion contains more electrons than the sodium ion.
D The sodium ion contains more neutrons than the fluoride ion.

6 Statement 1: Non-metals share electrons to attain electronic configuration of a noble gas.

Statement 2: Non-metals share electrons to form covalent compounds.

Which of the following is true?

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

7 Which change occurs when magnesium bonds with chlorine?

A Chlorine loses seven electrons to form a noble gas configuration.
B Chlorine shares electrons with magnesium to form a molecule of magnesium chloride.
C Magnesium gains two electrons for form Mg^{2+} ions.
D Magnesium loses two electrons to form Mg^{2+} ions.

8 50 cm^3 of nitrogen gas reacts with 50 cm^3 of oxygen gas to produce nitrogen dioxide. The chemical equation for the reaction is given below:

$$N_2\,(g) + 2\,O_2\,(g) \rightarrow 2\,NO_2\,(g)$$

What are the volumes of the gases remaining at room temperature and pressure?

	volume of gases / cm^3		
	nitrogen	oxygen	nitrogen dioxide
A	0	0	100
B	0	25	50
C	25	0	50
D	25	25	50

9 20 g of magnesium oxide, MgO, reacts completely with 500 cm^3 of dilute nitric acid.

The chemical equation of the reaction is as follows:

$$MgO\,(s) + 2\,HNO_3\,(aq) \rightarrow Mg(NO_3)_2\,(aq) + H_2O\,(l)$$

What is the concentration of the acid used?
[relative atomic masses, A_r: O, 16; Mg, 24]

A 0.002 mol/dm^3
B 0.008 mol/dm^3
C 2 mol/dm^3
D 8 mol/dm^3

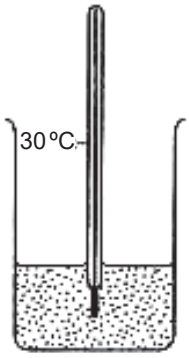
10 Which substance below will **not** react with aqueous potassium hydroxide but will react with dilute hydrochloric acid to form a salt and water?

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

11 Which pair of reagents can be best used to prepare insoluble magnesium carbonate?

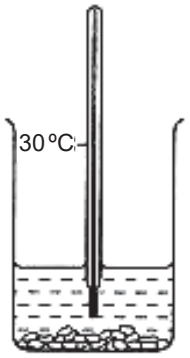
	reagent 1	reagent 2
A	magnesium	ammonium carbonate
B	magnesium chloride	calcium carbonate
C	magnesium oxide	potassium carbonate
D	magnesium sulfate	sodium carbonate

12 Which of the following reactions will have the slowest rate of reaction?



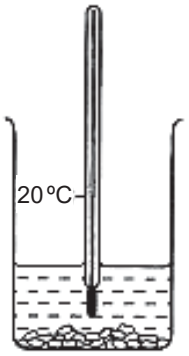
1 g of marble powder in 200 cm^3 of 3 mol/dm^3 of HC*l*

reaction **A**



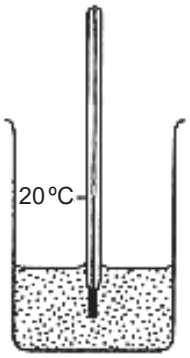
1 g of marble chips in 200 cm^3 of 2 mol/dm^3 of HC*l*

reaction **B**



1 g of marble chips in 200 cm^3 of 2 mol/dm^3 of HC*l*

reaction **C**



1 g of marble chips in 200 cm^3 of 1 mol/dm^3 of HC*l*

reaction **D**

13 What determines the Group of an element in the Periodic Table?

A The number of completely filled electron shells.
B The number of electrons in the valence shell.
C The number of electron shells containing electrons.
D The number of protons in the nucleus.

14 Caesium and potassium are both in Group I of the Periodic Table.

Which of the following statements about the elements is correct?

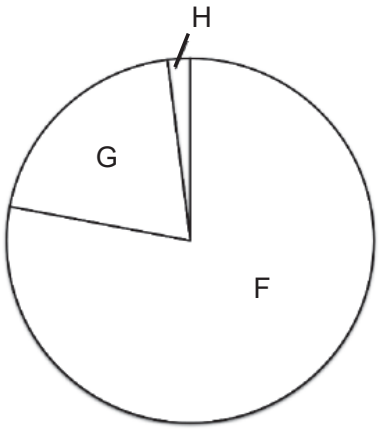
A Caesium has a higher density than potassium.
B Caesium reacts violently with water but potassium reacts explosively with water.
C Potassium atoms are larger than caesium ions.
D Potassium has a lower melting point than caesium.

15 Chlorine is in Group VII of the Periodic Table.

Which of the following statements is a property of chlorine?

A It can displace bromine from aqueous sodium bromide.
B It forms a basic oxide.
C It has a darker colour than iodine.
D It is a monoatomic element.

16 The pie-chart shows the composition of pure air.



Which of the following rows correctly identifies gases F, G and H?

	F	G	H
A	nitrogen	carbon dioxide	oxygen
B	nitrogen	oxygen	argon
C	oxygen	nitrogen	carbon dioxide
D	water vapour	oxygen	hydrogen

17 Which of the following statement(s) is/are true for **all** metals?

1 They conduct electricity.
2 They form basic oxides.
3 They have high melting points.
4 They have high densities.

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

18 Excess dilute nitric acid is added to brass.
Which of the following observations is correct?

A A blue solution is observed.
B A colourless solution is observed.
C A grey deposit is observed and a blue solution is formed.
D A reddish-brown deposit is observed and a colourless solution is formed.

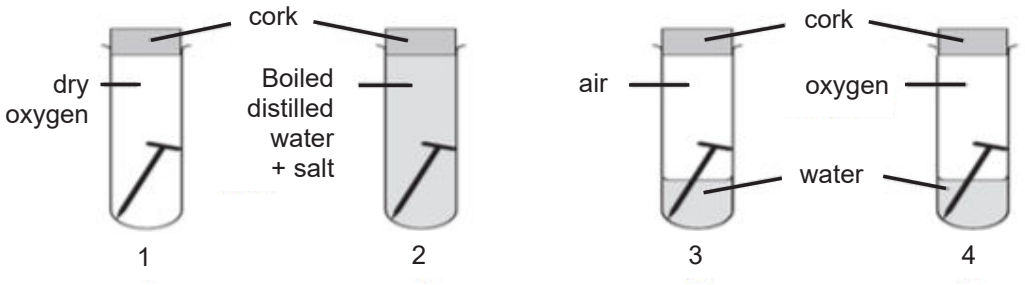
19 A metal X reacts as follows:

X + dilute acid → salt + hydrogen gas
X + cold water → no reaction
X + aqueous silver nitrate → silver metal + nitrate of X

By comparing X with calcium and silver, which of the following shows the correct order of reactivity of the metals, starting with the least reactive?

A calcium, silver, X
B calcium, X, silver
C silver, X, calcium
D X, calcium, silver

20 An experiment was set up as shown below to investigate the rate of rusting under different conditions.



Which of the following predicts the order of the test-tubes in which rust would first appear?

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

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		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.).

PASIR RIS CREST SECONDARY SCHOOL
Mid-Year Examination
Secondary Four Express and Five Normal Academic

CANDIDATE NAME					
CLASS		/		INDEX NUMBER	

Science (Chemistry) **5076, 5078 / 03**
Paper 3 **7 May 2018**
1 hour and 15 minutes

No additional materials

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces above.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, 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.
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 15.
A copy of the Periodic Table is printed on page 16.

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

For Examiner's Use
65
Parent's Signature

This document consists of **16** printed pages, including the cover page.

Section A [45 marks]

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

1 Name the substances needed for the following purposes.

purpose	name of substance
reducing the acidity in soil	
testing for presence of carbon dioxide gas	
testing for presence of chloride ions in water	

[3]

[Total: 3 marks]

2 The diagrams **N**, **P**, **Q**, **R**, **S** and **T** in Fig 2.1 represent the particles in different substances.

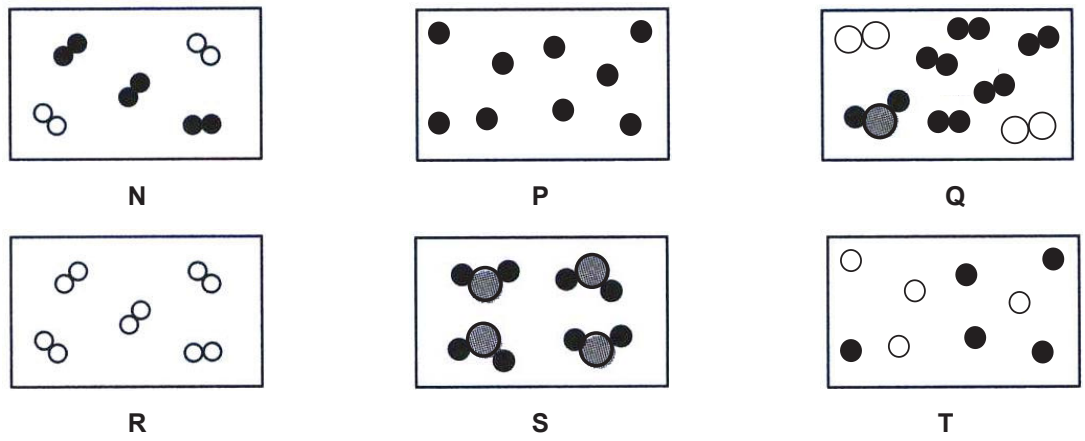


Fig 2.1

Use the diagrams **N**, **P**, **Q**, **R**, **S** and **T** to answer the questions below.

(a) Which of the following above best represents liquid water?

..... [1]

(b) Which of the following above best represents a mixture containing fluorine and chlorine gases?

..... [1]

(c) Which of the following above best represents air?

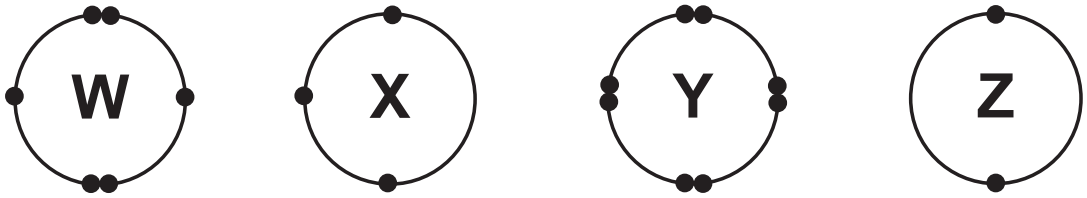
..... [1]

(d) Which of the following above best represents neon gas?

..... [1]

[Total: 4 marks]

3 The atomic structures of atoms **W**, **X**, **Y** and **Z** are shown below. The elements are found in Period 3 of the Periodic Table. The letters do not represent the elements and only the valence electrons of the elements are shown.



(a) State and explain which group does atom **Z** belongs to in the Periodic Table.

.....

.....

[2]

(b) **(i)** Write the chemical formula of the compound formed between atoms **W** and **X**.

.....

[1]

(ii) The compound formed between **W** and **X** has a melting point of 1100 ºC. In terms of structure and bonding of the compound formed, explain why it has a high melting point.

.....

.....

.....

[2]

(c) Explain why atom **Y** is the least chemically reactive as compared to the other atoms.

.....

.....

.....

[1]

[Total: 6 marks]

4 The Blast furnace reaction is an industrial process used to obtain iron from its ore. The iron obtained is usually used to produce stainless steel, an *alloy*, which is harder and stronger than pure iron. Stainless steel is an important material in construction building.

(a) **(i)** Define the term, *alloy*.

……..

[1]

(ii) Apart from its hardness and strength, state another advantage of using stainless steel as an industrial material.

……..

[1]

(b) Carbon, also known as coke, is added to the Blast furnace reaction for the extraction of iron. The chemical equation for this reaction is given below.

$$2\ Fe_2O_3\ (s)\ +\ 3\ C\ (s)\ \rightarrow\ 4\ Fe\ (l)\ +\ 3\ CO_2\ (g)$$

Given 30% of iron(III) oxide, Fe_2O_3, is present in 1000 kg of haematite used, calculate the mass of carbon required for the extraction of iron.
[relative atomic masses, A_r: C, 12; O, 16; Fe, 56]

mass of carbon required = ……

[3]

(c) Silicon dioxide, SiO_2, is an impurity produced in Blast furnace.
Explain how silicon dioxide is removed from the Blast furnace.

……

……

……

[2]

(d) During the production of iron, sulfur dioxide gas is produced. Explain why sulfur dioxide gas produced pose an environmental threat to water bodies.

……

……

……

[2]

[Total: 9 marks]

5 Chlorine gas, a member of the halogens, is an element in Group VII of the Periodic Table.

(a) State **two** physical properties of chlorine, other than existing as a gas at room temperature and pressure.

……

……

[2]

(b) Explain, using its electronic structure, why chlorine is found in Period 3 of the Periodic Table.

……

……

[2]

(c) Chlorine gas reacts vigorously with hot zinc metal to produce solid zinc chloride.
Construct a balanced chemical equation, including state symbols, for the reaction.

……

[2]

(d) When chlorine gas is bubbled into aqueous potassium bromide, potassium chloride and bromine solution is obtained. Explain why this reaction occurs.

……

……

……

[2]

[Total: 8 marks]

6 **(a)** Metals **A**, **B** and **C** are placed in salt solutions as shown in the table.

metal	result of placing metal in solution of		
	salt of **A**	salt of **B**	salt of **C**
A		no reaction	**C** displaced
B	**A** displaced		**C** displaced
C	no reaction	no reaction	

Arrange the reactivity of the metals, starting with the least reactive metal.

…….....……

[1]

(b) Explain why carbon can be used to obtain zinc from zinc oxide but not to obtain sodium from sodium oxide.

…….....……

…….....……

…….....……

[2]

(c) Sodium metal is kept in oil to prevent it from corrosion.
Explain how the oil prevents the sodium metal from corrosion, stating clearly the conditions that cause the corrosion of sodium.

.....……..

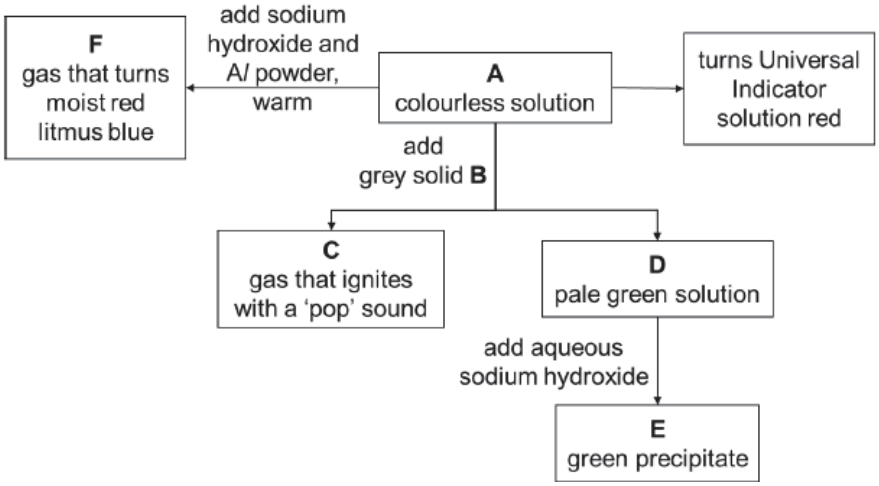
…….....……

…….....……

[3]

[Total: 6 marks]

7 The figure below describes the reactions between colourless solution **A** and grey solid **B**.



(a) Identify **A**, **B**, **C**, **D**, **E** and **F**.

A .....

B .....

C .....

D .....

E .....

F .....

[6]

(b) Construct a balanced ionic equation for the formation of precipitate **E**. State symbols are **not** required.

.....

[2]

(c) Explain why grey solid **B** cannot be a metal carbonate.

.....

.....

[1]

[Total: 9 marks]

Section B [20 marks]

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

Write your answers in the spaces provided.

8 Nitrogen, oxygen and argon gases can be extracted from compressed liquefied air (mixture of miscible liquids) at –200 ºC.

(a) **(i)** State the separation method used to obtain the gases separately at –200 ºC.

.....

[1]

(ii) Describe the changes in movement of the air particles as it is compressed and cooled from room temperature to –200 ºC.

.....

.....

[1]

(b) Oxygen is a reactive non-metal.

Describe, in terms of the number of electrons gained, lost or shared, what happens when

(i) an oxygen atom combines with magnesium atom(s).

.....

.....

[2]

(ii) an oxygen atom combines with fluorine atom(s).

.....

.....

[2]

(c) **(i)** Draw a ‘dot-and-cross’ diagram for nitrogen gas.

[2]

(ii) Draw a ‘dot-and-cross’ diagram for oxygen gas.

[2]

[Total: 10 marks]

9 **(a)** State **two** physical properties of copper metal.

Property 1: ……

Property 2: ……

[2]

(b) Describe a way to prepare a pure sample of copper(II) sulfate crystals, from copper metal. Use the following information to help you

- copper does not react with dilute acids
- copper burns in oxygen to form a black solid, which is copper(II) oxide
- copper(II) oxide is insoluble in water
- copper(II) sulfate is soluble in water

……

……

……

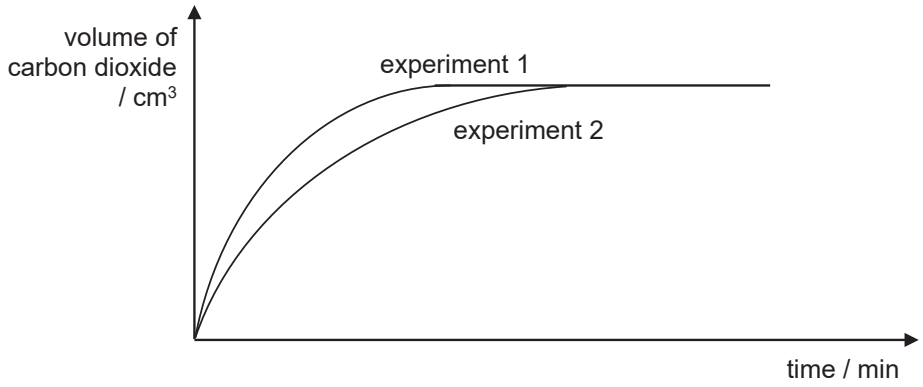
……

……

……

[4]

(c) 10 g of copper(II) carbonate lumps were reacted with excess 1.0 mol/dm^3 hydrochloric acid and the carbon dioxide gas produced was collected. The experiment was repeated again but using excess 2.0 mol/dm^3 hydrochloric acid. The graph of the data collected is plotted and shown below.



experiment 1: 10 g of copper(II) carbonate lumps with excess 2.0 mol/dm^3 hydrochloric acid

experiment 2: 10 g of copper(II) carbonate lumps with excess 1.0 mol/dm^3 hydrochloric acid

(i) State why the production of carbon dioxide gas stopped after a period of time.

……

[1]

(ii) Use your knowledge of reacting particles to explain why a higher concentration of acid results in a faster rate of reaction.

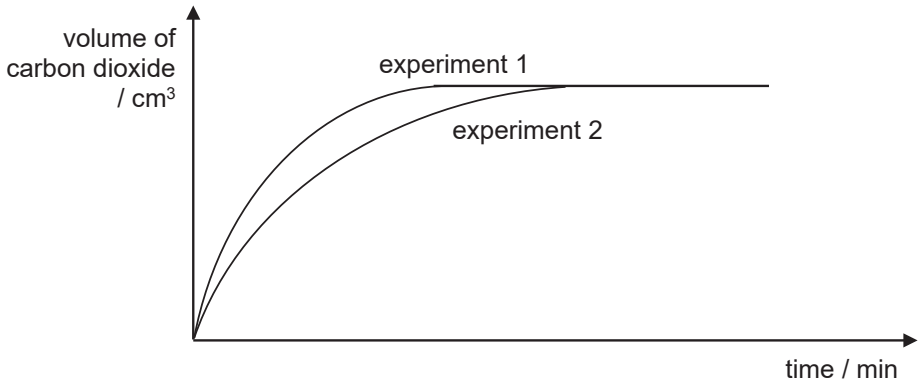
.....

.....

.....

[2]

(iii) The experiment is repeated using 5 g of **powdered** copper(II) carbonate and excess 2.0 mol/dm^3 hydrochloric acid. Add to **Fig. 9.1** the graph you would expect. The original graphs are already included. Label the new graph as **3**.

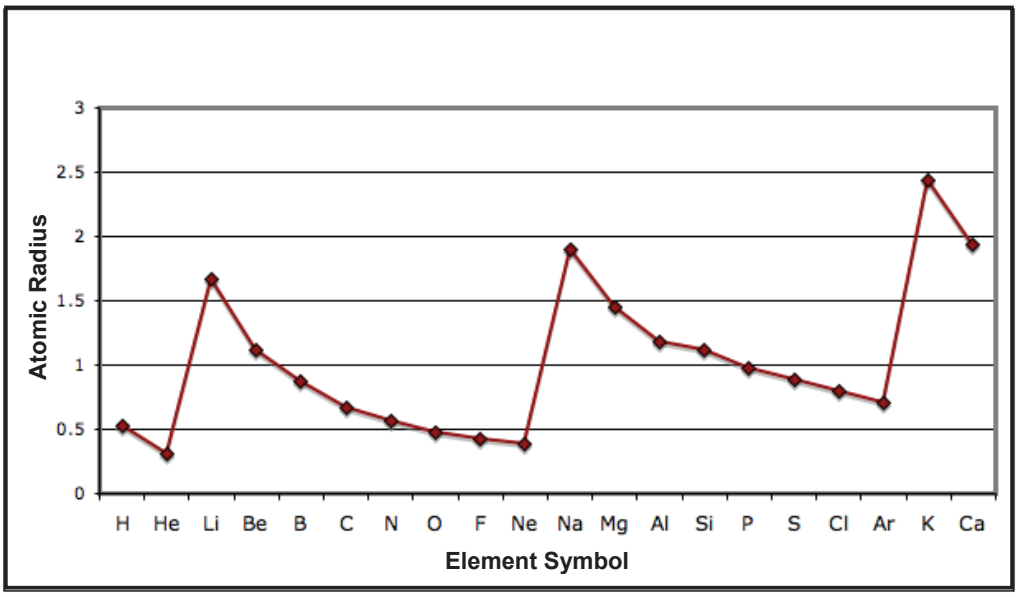


[1]

Fig. 9.1

[Total: 10 marks]

10 **(a)** The diagram below shows the atomic radius of the first 20 elements in the Periodic Table.



(i) Use the diagram above to describe the change in atomic radius **across** the Period and **down** the Group.

……..

……..
[2]

(ii) Describe the change in the character of the elements across Period 3 and how it affects the respective oxides formed.

……..

……..
[2]

(b) Lithium, potassium and sodium are Group I elements.
State **one** physical property trend and **one** chemical property trend of these elements.

physical property trend ……...

chemical property trend ……...
[2]

(c) Describe a laboratory investigation that can be used to justify the relative positions of iron, magnesium and silver in the reactivity series. You may include a diagram if it helps you to answer the question.

Diagram

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

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

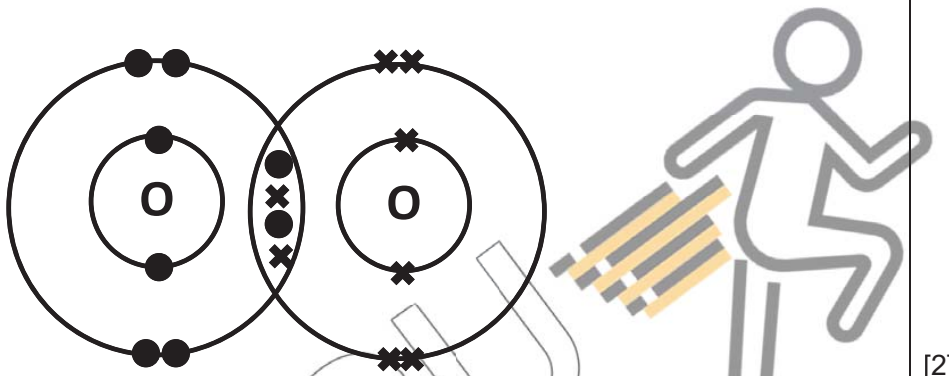
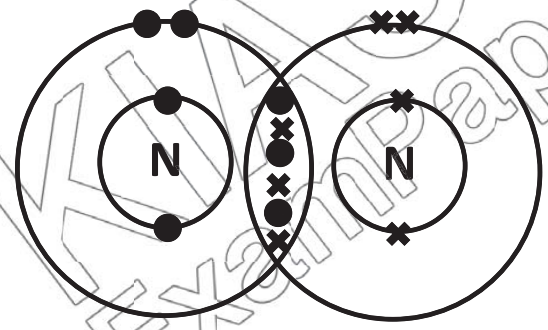
Secondary 4 Express and 5 Normal Academic Science(Chemistry)
Mid-Year Examination
Mark Scheme

<table>
<tr><td>Qn no.</td><td colspan="8">Answer Scheme</td><td>Marks Allocated</td></tr>
<tr><td>1</td><td>A</td><td>6</td><td>B</td><td>11</td><td>D</td><td>16</td><td>B</td><td>[1] each</td></tr>
<tr><td>2</td><td>D</td><td>7</td><td>D</td><td>12</td><td>D</td><td>17</td><td>A</td><td>20 m max</td></tr>
<tr><td>3</td><td>C</td><td>8</td><td>C</td><td>13</td><td>B</td><td>18</td><td>D</td><td></td></tr>
<tr><td>4</td><td>C</td><td>9</td><td>C</td><td>14</td><td>A</td><td>19</td><td>C</td><td></td></tr>
<tr><td>5</td><td>A</td><td>10</td><td>C</td><td>15</td><td>A</td><td>20</td><td>D</td><td></td></tr>
<tr><td>1</td><td colspan="8"><table><tr><td>purpose</td><td>name of substance</td></tr><tr><td>reducing the acidity in soil</td><td>calcium oxide / calcium hydroxide / lime / slaked lime / calcium carbonate</td></tr><tr><td>testing for presence of carbon dioxide gas</td><td>limewater / calcium hydroxide</td></tr><tr><td>testing for presence of chloride ions in water</td><td>acidified silver nitrate / acidified lead(II) nitrate / acidified silver sulfate</td></tr></table>1m each
Reject: chemical formula of substances</td><td>[3]
Total: 3</td></tr>
<tr><td>2(a)</td><td colspan="8">S</td><td>[1]</td></tr>
<tr><td>2(b)</td><td colspan="8">N</td><td>[1]</td></tr>
<tr><td>2(c)</td><td colspan="8">Q</td><td>[1]</td></tr>
<tr><td>2(d)</td><td colspan="8">P</td><td>[1]
Total: 4</td></tr>
<tr><td>3(a)</td><td colspan="8">Z belongs to <u>group II</u> because [1]
it contains <u>two valence electrons</u>. OR
It has <u>two electrons</u> in the <u>outermost electron shell</u>. [1]</td><td>[2]</td></tr>
<tr><td>3(b)(i)</td><td colspan="8">X_2W_3 (reject: W_3X_2)</td><td>[1]</td></tr>
<tr><td>3(b)(ii)</td><td colspan="8">The compound formed has a <u>giant lattice structure</u> [1]. Thus, large amount of energy is needed to <u>overcome</u> <u>strong electrostatic forces of attraction between the oppositely charged ions</u> [1].

Reject: “break strong electrostatic forces of attraction”, “break ionic bonds”, “giant ionic structure”, “oppositely charged particles / molecules / atoms”.</td><td>[2]</td></tr>
</table>

3(c)	It has **eight valence electrons** / **a completely filled valence shell** / **does not need to take in, give out or share electrons with other elements**.	[1] Total: 6
4(a)(i)	An alloy is a **mixture containing** at least **one metal with other elements / substances**.	[1]
4(a)(ii)	It is **more corrosion-resistant / does not rust easily**.	[1]
4(b)	Mass, Fe_2O_3, present = 30% x 1000 = **300 kg** [1] Mole, Fe_2O_3 = (300 x 1000) ÷ (2 x 56 + 3 x 16) = **1875 mol** [1] Mole ratio: 2 Fe_2O_3 : 3 C 1875 : 2812.5 Mass, C = 2812.5 x 12 = **33 750 g / 33.75 kg** [1] Note: 1. Allow ECF for wrong answer. 2. –1 if no/wrong units written for final answer.	[3]
4(c)	**Limestone** [1] is used to remove silicon dioxide. It **decomposes at high temperature** in Blast furnace to produce basic **calcium oxide** [1], which reacts with silicon dioxide.	[2]
4(d)	Sulfur dioxide gas **dissolves in rainwater**, producing **acid rain** [1]. This causes the water bodies to be more acidic, **killing marine/aquatic lives / fishes** [1].	[2] Total: 9
5(a)	Low melting point / low boiling point / light-green in colour / does not conduct electricity / exist as diatomic molecules [Any **two**]	[2]
5(b)	Chlorine has an electronic structure of **2.8.7** [1], hence it contains **3 electrons shells** [1] filled with electrons. Therefore, it is in period 3.	[2]
5(c)	Cl_2 (g) + Zn (s) → $ZnCl_2$ (s) 1m – correct balanced equation; 1m – correct state symbols	[2]
5(d)	**Chlorine is more reactive than bromine** [1]. Hence, it can **displace bromine** [1] to form potassium chloride and bromine.	[2] Total: 8

6(a)	**C**, **A**, **B** (only answer)	[1]
6(b)	Carbon **is more reactive than zinc** [1], but **less reactive than sodium** [1]. Hence it displaces zinc from zinc oxide but not sodium from sodium oxide.	[2]
6(c)	By keeping sodium in oil, the oil **creates a physical barrier** [1] that prevents the surface of sodium metal to come in contact with **oxygen gas** [1] and **water / water vapour** [1], which causes corrosion.	[3]
		Total: 6
7(a)	A – nitric acid or HNO_3 B – iron metal or Fe C – hydrogen gas or H_2 D – iron(II) nitrate or $Fe(NO_3)_2$ E – iron(II) hydroxide or $Fe(OH)_2$ F – ammonia or NH_3 1m each; **accept chemical formula**	[6]
7(b)	$Fe^{2+} + 2\ OH^- \rightarrow Fe(OH)_2$ 1m – correct equation; 1m – balanced equation	[2]
7(c)	A metal carbonate will **produce carbon dioxide gas**, instead of hydrogen gas. OR A metal carbonate **does not produce hydrogen gas** when reacted with acid.	[1]
		Total: 9

8(a)(i)	Fractional distillation	[1]
8(a)(ii)	It changes from **moving rapidly in random directions / moving at great speed in different directions** to **sliding over each other randomly / in different directions** within the liquid.	[1]
8(b)(i)	Each oxygen atom **gains two electrons from magnesium** [1], forming oxide ion. **Each magnesium atom loses/transfers two electrons** [1] to oxygen, forming magnesium ion.	[2]
8(b)(ii)	Each oxygen atom **shares two valence electrons** [1] with **two fluorine atoms** [1].	[2]
8(c)(i)		[2]
8(c)(ii)	 Note: **1m deducted if students only shows valence electrons**	[2]
		Total: 10

9(a)	High density / High melting and boiling points / conducts electricity / conducts heat / malleable / ductile / shiny surface / Solid at room temperature / Pink/brown solid [Any **two**]	[2]
9(b)	**Heat/Burn copper metal in air / in oxygen to produce copper(II) oxide.** [1] To an **excess amount of CuO**, **add** a fixed volume of **sulfuric acid** and stir the mixture. [1] **Filter** to remove the excess CuO from the mixture. [1] **Warm/Heat** the filtrate to saturation and then **allow it to cool** for crystallization to occur. [1]	[4]
9(c)(i)	**Copper(II) carbonate is used up**.	[1]
9(c)(ii)	At a higher concentration, there are **more reactant particles per unit volume** [1]. Hence, the **frequency of effective collisions between particles increases** [1], leading to a faster rate of reaction.	[2]
9(c)(iii)	Graph showing **half the volume of carbon dioxide gas** and **faster rate of reaction** compared to Graph 1. Graph **must be labelled**.	[1] Total: 10
10(a)(i)	Atomic radius **increases down the group** [1]and **decreases across the period** [1].	[2]
10(a)(ii)	The elements changes from **metals to non-metals across the period** / **becomes less metallic across the period** / **metallic to non-metallic character across the period** [1] and the oxides changes from **basic to acidic across the period** [1].	[2]
10(b)	Physical property trend: **melting or boiling point decreases** / **density increases** [1] Chemical property trend: **chemical reactivity increases** [1]	[2]

10(c)	Reaction condition [1]: state the use of either **water / steam / dilute acids** Data collection [1]: **counting the number of bubbles produced / measure volume of gas produced at regular intervals / measure lost in mass over regular intervals** Comparison of data [1]: The beaker / test-tube / boiling-tube **with more bubbles produced will be magnesium, followed by iron**. **Silver will not have any bubbles produced as it is unreactive towards acid**. OR **Measure the gas collected at regular intervals and plot a graph of volume of gas produced over time / Measure the lost in mass at regular intervals and plot a graph of mass reading on scale balance against time**. The graph with **steepest gradient will be magnesium,** followed by **iron**, followed by **silver which shows a horizontal line due to its chemical unreactivity**. Justification of relative positions [1]: Hence, **magnesium is the most reactive, followed by iron, and silver is the least reactive**. (or vice versa)	[4] Total: 10

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS
MID-YEAR EXAMINATION 2018

SCIENCE (CHEMISTRY) 5076
May 2018
1 hour

READ THESE INSTRUCTIONS FIRST

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

Section A
There are **ten** questions in this section. 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 the boxes provided on **page 4**.

Section B & C
Answer **all** questions in the spaces provided.

The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 8.

Section	Marks
A	/10
B	/20
C	/10
Total	/40

This document consists of 9 printed pages (inclusive of this page).

Setter: Mr Mohd Riffaii **[Turn over**

Section A: Multiple Choice Questions [20 marks]

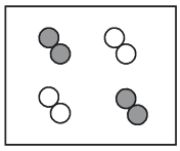
21 A mixture contains an organic liquid **J**, and a dilute solution of potassium chloride.
Liquid **J** boils at 21 °C and is immiscible in water.

Which two methods of separation should be used in sequence to obtain samples of liquid **J** first before solid potassium chloride?

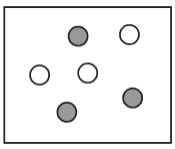
	method 1	method 2
A	use a separating funnel	evaporation
B	evaporation	sublimation
C	distillation	filtration
D	filtration	evaporation

22 Which diagram represents a mixture of diatomic elements?

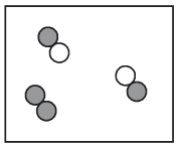
A



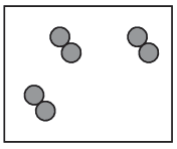
B



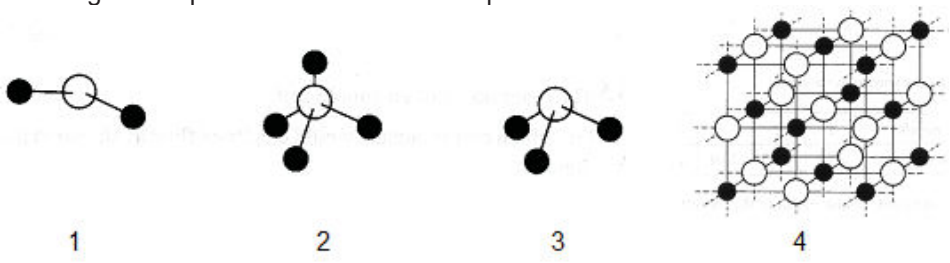
C



D



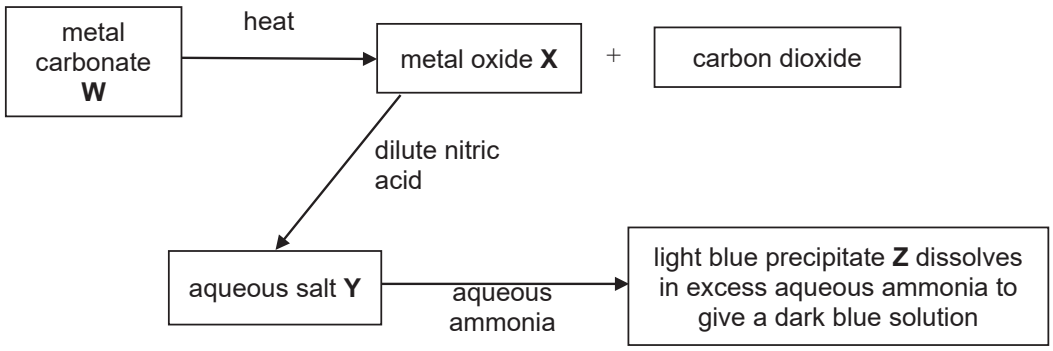
23 The diagrams represent four different compounds.



In which row are the compounds correctly named?

	1	2	3	4
A	ammonia	sodium chloride	methane	water
B	methane	ammonia	sodium chloride	water
C	water	ammonia	methane	sodium chloride
D	water	methane	ammonia	sodium chloride

24 Study the following reaction scheme.



What is the identity of metal carbonate **W**?

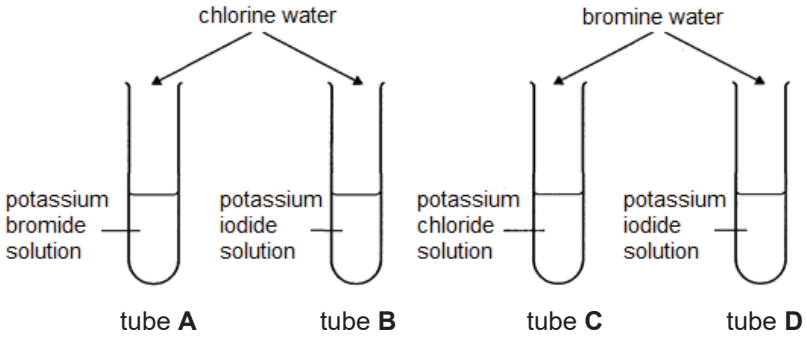
A copper(II) carbonate

B iron(II) carbonate

C iron(III) carbonate

D zinc carbonate

25 The diagrams show a series of experiments carried out using chlorine water and bromine water.



Which test tube, **A**, **B**, **C** or **D** shows no change in colour?

26 Which of the following processes is an endothermic reaction?

A combustion

B freezing

C photosynthesis

D respiration

27 Sulfur undergoes changes when it reacts with air and water.
The substances that sulfur form are represented in the following stages.

Stage 1	Stage 2	Stage 3	Stage 4
S	SO_2	SO_3	H_2SO_4

Which of the following shows the correct change in oxidation states of sulfur in each stage of the process?

	S	SO_2	SO_3	H_2SO_4
A	0	+2	+6	+8
B	0	+4	+6	+6
C	+2	0	+6	+6
D	+6	+6	+2	0

28 Which statements about the pollutant carbon monoxide are correct?

1 It is a colourless and odourless gas.
2 It is formed by the complete combustion of natural gas.
3 It reacts with the haemoglobin in the blood and reduce the transport of oxygen.

A 1 and 2 only

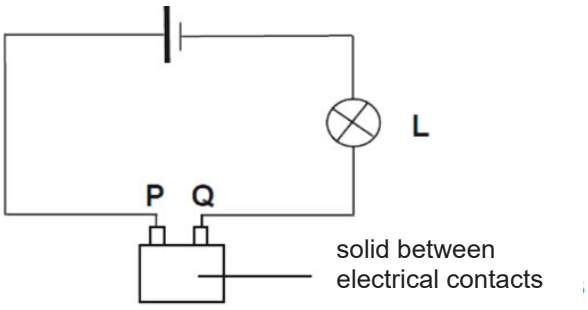
B 2 and 3 only

C 1 and 3 only

D 1, 2 and 3

29 The diagram shows a complete circuit.

Which solid, when placed between **P** and **Q**, would cause the light bulb **L** to light up?



A copper

B hydrogen fluoride

C sodium chloride

D sulphur

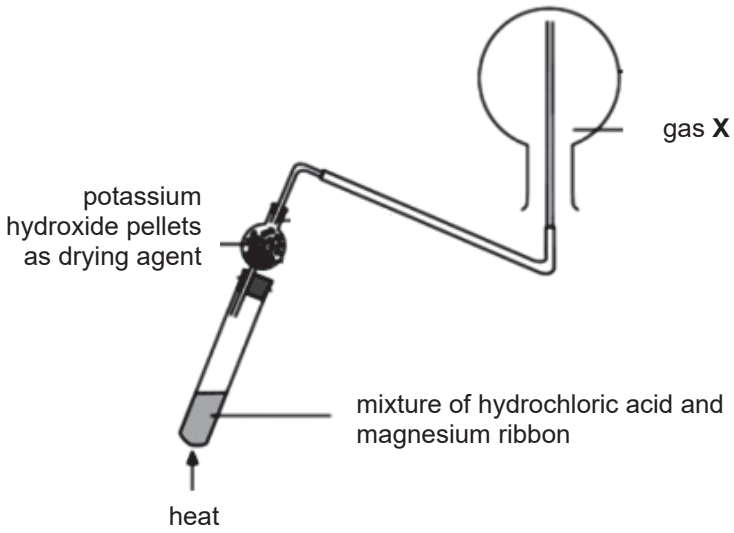
30 In the preparation of salts, which of the following would require the use of a burette and pipette?

A calcium sulfate **B** sodium sulfate

C silver sulfate **D** zinc sulfate

31 The diagram shows an upward delivery method for gas **X**.

What is the nature of the gas?



A The gas is soluble in water and denser than air.

B The gas is soluble in water and less dense than air.

C The gas is insoluble in water and denser than air.

D The gas is insoluble in water and less dense than air.

32 Which ionic equation represents the neutralisation of dilute sulfuric acid with aqueous sodium hydroxide?

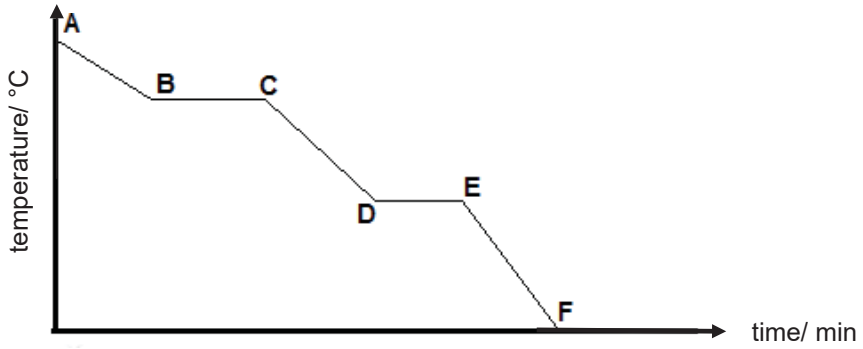
A $H^+ + OH^- \rightarrow H_2O$

B $NaOH + H^+ \rightarrow Na^+ + H_2O$

C $H_2SO_4 + 2OH^- \rightarrow SO_4^{2-} + 2H_2O$

D $SO_4^{2-} + 2Na^+ \rightarrow Na_2SO_4$

33 The diagram shows a cooling curve of steam.



Which of the following options correctly describes the changes that occur between points **C** to **D**?

	separation of particles	energy of particles	attractive forces between particles
A	decreases	increases	decreases
B	decreases	decreases	increases
C	increases	increases	decreases
D	increases	decreases	increases

34 An element has an atomic number of 4.

Which statement about this element is correct?

A It forms ions by losing electrons.

B It has four occupied electron shells in each of its atoms.

C It is an unreactive gas at room temperature and pressure.

D It is found in Group IV of the Periodic Table.

35 An element X forms an ion of X^{2+}.

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

A Group I

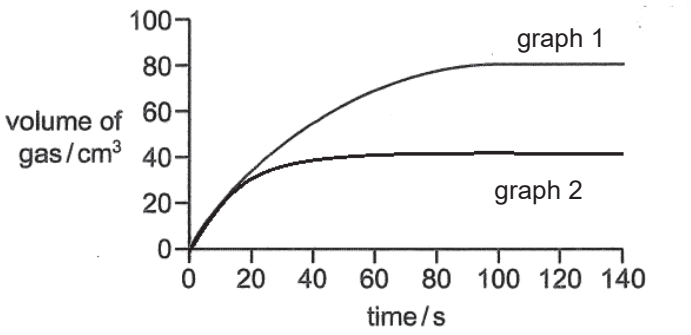
B Group II

C Group V

D Group VI

36 Some zinc carbonate was reacted with excess dilute nitric acid.

The graph shows the volume of carbon dioxide gas evolved at 20 second intervals until the reaction has finished. Graph 1 shows the results obtained from this reaction.



Which of the following could have been changed to produce graph 2?

A The concentration of acid was doubled.

B The concentration of acid was halved.

C The mass of zinc carbonate was halved.

D The particle size of the zinc carbonate was doubled.

37 The reaction between hydrochloric acid and calcium carbonate is shown.

$$2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$$

What volume of 1.0 mol/dm^3 hydrochloric acid is needed to react completely with 1.0 g of calcium carbonate (M_r = 100)?

A 10 cm^3 **B** 20 cm^3

C 100 cm^3 **D** 200 cm^3

38 Which of the following substances is **not** present in the reaction during the extraction of iron?

A calcium oxide **B** calcium carbonate

C calcium hydroxide **D** calcium metasilicate

39 Which oxide will neither react with acids nor alkalis?

A carbon dioxide **B** carbon monoxide

C magnesium oxide **D** zinc oxide

40 The results of three metal displacement experiments are tabulated as shown.

experiment	metal	metal nitrate solution		
		JNO_3	**K**NO_3	**L**NO_3
1	**J**	-	no reaction	**L** displaced
2	**K**	**J** displaced	-	**L** displaced
3	**L**	no reaction	no reaction	-

What is the order of reactivity of these metals?

	most reactive ⟶ least reactive		
A	**J**	**K**	**L**
B	**K**	**L**	**J**
C	**K**	**J**	**L**
D	**L**	**J**	**K**

End of Paper

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.).

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC
MID YEAR EXAMINATION 2018

SCIENCE (PHYSICS, CHEMISTRY) **5076/03**

Paper 3 Chemistry **07 May 2018**

Monday 0800 – 0915 **1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
You may use a soft 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 use 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 15.
A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
Section A	
Total	

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

This document consists of **16** printed pages, including the cover page.

Setter: Mr Mohd Riffaii **[Turn over**

Section A

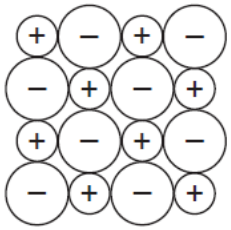
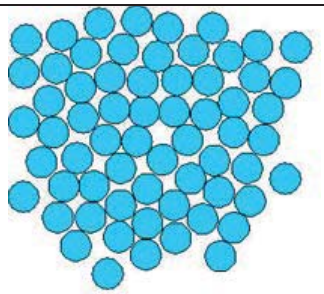
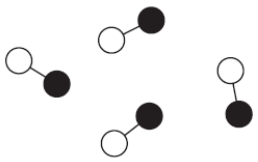
Answer **all** the questions in the spaces provided.

For Examiner's Use

1 **(a)** Use **three** words from the box below to describe each substance in Table 1.1. The words can be used once, more than once, or not at all.

solid	liquid	gas	atom	molecule
element	compound	mixture	ions	

Table 1.1

substance	diagram	description words
A		1 …… 2 …… 3 …….……..
B		1 …… 2 …… 3 …….……..
C		1 …… 2 …… 3 …….……..

[3]

(b) **(i)** Explain why substance **A** will conduct electricity when dissolved in water.

……..... [1]

(ii) Suggest another way of making substance **A** conduct electricity.

……..... [1]

For Examiner's Use

2 Spots of different coloured dyes were placed along a pencil line on a sheet of chromatography paper. The paper was then placed in a solvent.

Fig. 2.1 shows the chromatogram obtained.

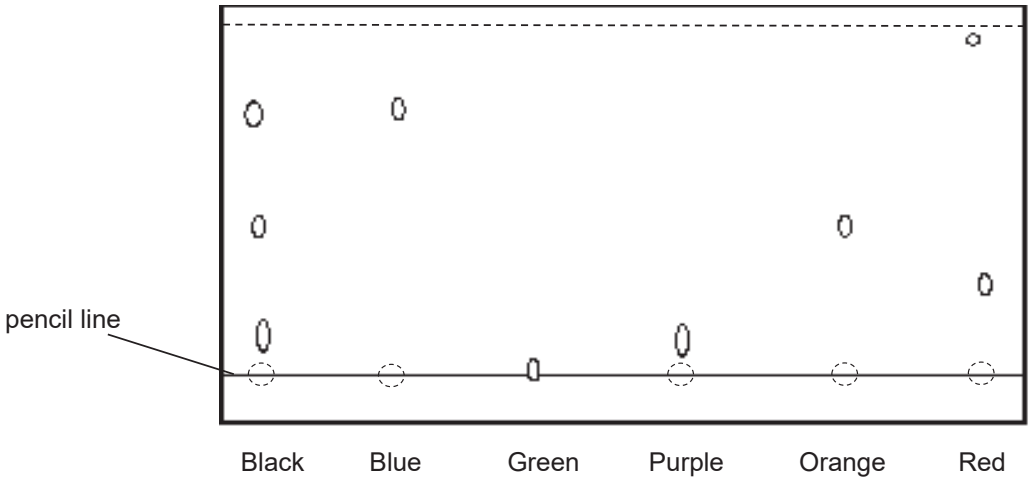


Fig. 2.1

(a) Which physical property allows chromatography to separate components of the dyes?

……..…… [1]

(b) Based on Fig. 2.1, what can be deduced about the components of the black dye?

……..…… [1]

(c) Suggest why the start line was drawn in pencil line and **not** in ink for this experiment?

……..……

……..…… [1]

For Examiner's Use

3 Hydrogen bromide has a melting point of –87 °C and a boiling point of –67 °C.

(a) Draw a 'dot and cross' diagram to show the arrangement of electrons in a molecule of hydrogen bromide. Show only the outer shell electrons.

[2]

(b) Hydrogen bromide dissolves in water to form an acidic solution which is colourless.

(i) Give the formula of the ion which causes the acidity.

…… [1]

(ii) Describe what is seen when chlorine gas is bubbled through the solution.

……

…… [1]

(iii) Construct an ionic equation, including state symbols, for the reaction you have described in **(ii)**.

…… [2]

For Examiner's Use

4 Zinc blende is an ore that contains mainly zinc sulfide (ZnS). The extraction of zinc from its ore happens in the blast furnace.

The ore of zinc blende is roasted in air (oxygen) to form zinc oxide which is then reduced with carbon monoxide in the blast furnace, similar to the extraction of iron from haematite.

The extraction of zinc can be represented by the equation as shown.

$$ZnO + CO \rightarrow Zn + CO_2$$

(a) State which substance is reduced and give a reason for your answer.

substance reduced ……

reason ……. [2]

(b) Zinc produced by the blast furnace is often alloyed to increase its hardness and strength. Brass is an alloy of zinc and copper.

(i) Draw the structure of brass in the box provided in Fig. 4.1.

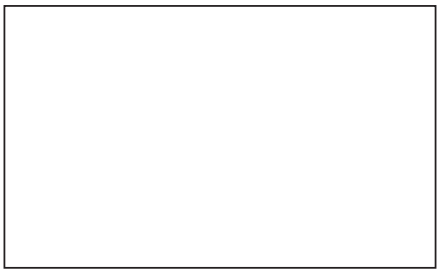


Fig. 4.1 [1]

(ii) With reference to your drawing in Fig. 4.1, explain why brass is harder and stronger compared to pure zinc.

……

……

…… [2]

5 The reaction between copper(II) oxide and hydrogen can be represented by the equation as shown.

For Examiner's Use

$$CuO(s) + H_2(g) \rightarrow H_2O(g) + Cu(s)$$

In this reaction, 0.40 g of solid copper(II) oxide was used.

(a) **(i)** Calculate the number of moles of copper(II) oxide used in the reaction.

[1]

(ii) Hence, determine the number of moles of hydrogen gas is required for all the copper(II) oxide to be used up in the reaction.

[1]

(b) It is also known that 165 cm^3 of hydrogen gas was used in the reaction.

(i) Using your answer from **(a)**, determine the limiting reagent.
Explain your answer clearly by showing all relevant calculations.

[3]

(ii) Hence or otherwise, calculate the mass of water vapour produced at the end of the reaction.

[2]

For Examiner's Use

6 Part of the Periodic Table is shown in Fig. 6.1.
The letters are **not** the actual chemical symbol of the elements.

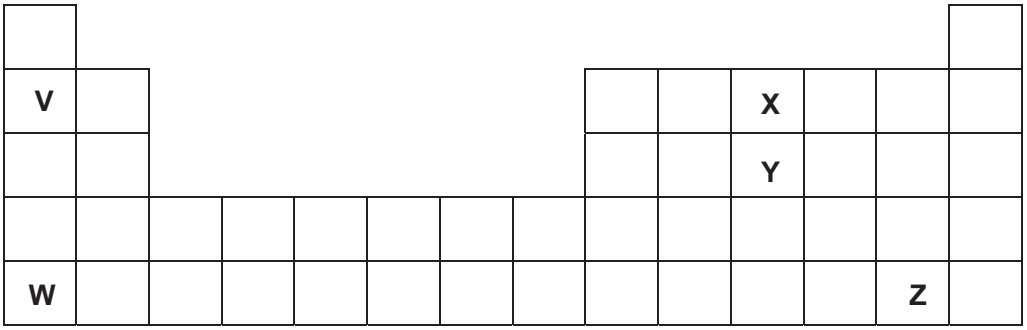


Fig. 6.1

For each of the following statements, decide whether the statement is true or false and state a reason for your decision.

(a) **W** is more metallic than **Z**.

.....

..... [1]

(b) **V** is less reactive than **W**.

.....

..... [1]

(c) **V** has a lower melting point than **W**.

.....

..... [1]

(d) **X** has more electron shells than **Y**.

.....

..... [1]

For Examiner's Use

7 Study the flowchart in Fig. 7.1 and answer the following questions.

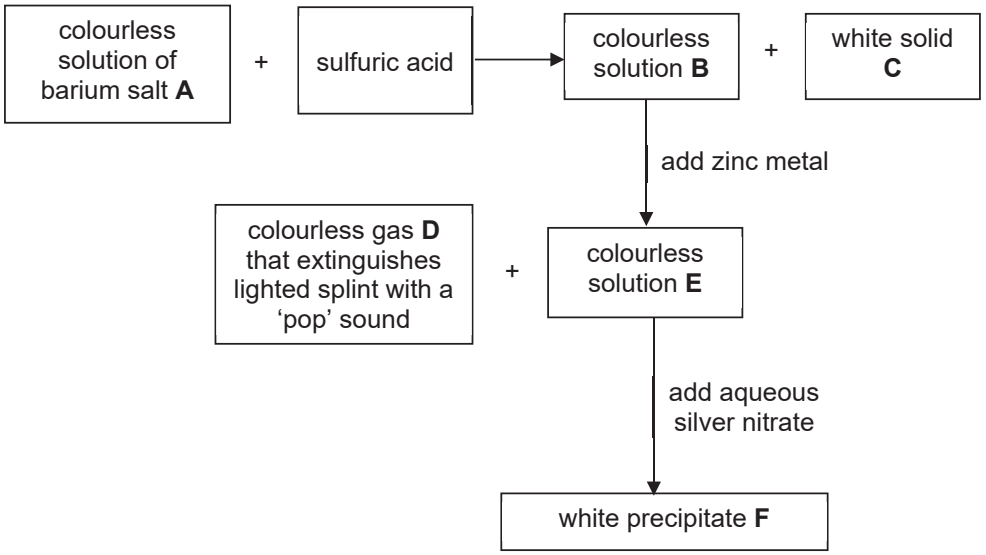


Fig. 7.1

(a) Identify substances **A** to **F**.

A ……...

B ……...

C ……...

D ……...

E ……...

F ……... [6]

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

……..…….…… [2]

For Examiner's Use

8 **(a)** A chemical company makes salts for use in industries. Table 8.1 shows some names and formulae of salts with the names of the acids and other compounds used to make them.

Complete the table by writing the missing information.

Table 8.1

name of salt	formula of salt	name of acid used to make salt	name of the other compound used to make salt
sodium sulfate	Na_2SO_4		
potassium phosphate	K_3PO_4	phosphoric acid	
silver chloride	$AgCl$		
calcium phosphate		phosphoric acid	calcium hydroxide

[3]

(b) Fig. 8.2 shows a rusted car. However, not all the parts have rusted. The areas that have not rusted are either painted or have plastic coatings.

Fig. 8.2

Explain how the paint and plastic coating can slow down rusting.

.....

..... [2]

(c) Harmful gases released into the atmosphere can form acid rain which speeds up rusting.

Name **one** such gas which causes acid rain and state its source.

..... [2]

For Examiner's Use

Section B

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

Write your answers in the spaces provided.

9 Read the information about chlorine.

> Chlorine ranks among the top ten chemicals produced today. Chlorine is produced by passing an electric current through a concentrated solution of sodium chloride or through molten sodium chloride. This process is one of the most important commercial processes in industry. Chlorine, in one form or another, is added to most swimming pools, spas, and public water supplies because it kills bacteria that cause disease. Many people also use chlorine to bleach their clothes. Large paper and pulp mills use chlorine to bleach their products.
>
> Two naturally occurring isotopes of chlorine exist, chlorine-35 and chlorine-37.
> Chlorine exists commonly both in the Earth's crust and in seawater as sodium chloride.
> Smaller amounts of potassium chloride and magnesium chloride also occur in seawater.
>
> Chlorine is very reactive. The reaction between chlorine and other elements can often be vigorous. For example, chlorine reacts explosively with hydrogen to form hydrogen chloride.

(a) The information contains examples of a mixture.
Identify **two** mixtures in the information.

……. [1]

(b) The chemical symbols of the two chlorine isotopes are shown below.

$^{37}_{17}Cl$ $^{35}_{17}Cl$

Compare and contrast the structures of the nuclei in chlorine isotopes.

……

……

……. [2]

For Examiner's Use

(c) Magnesium burns in chlorine gas to produce magnesium chloride.

(i) Complete Table 9.1 which gives information about the two ions in magnesium chloride.

Table 9.1

name of ion	number of protons	number of neutrons	number of electrons	electronic structure
magnesium ion	12			2,8
chloride ion	17	18		

[2]

(ii) Draw a 'dot' and cross diagram to show the arrangement of electrons in magnesium chloride. Show only outer shell electrons.

[2]

(d) Chlorine can react with hydrogen to form hydrogen chloride. Hydrogen chloride is a gas at room temperature.

(i) In terms of electrons, describe the bonding in hydrogen chloride.

……..……..

……..…….. [1]

(ii) At room temperature, magnesium chloride is a solid while hydrogen chloride is a gas.
Use your knowledge of the bonding in magnesium chloride and hydrogen chloride to explain the difference in physical state.

……....

……..…..

……..…..

……..

……..…….. [2]

For Examiner's Use

10 **(a)** Hydrochloric acid is used for rust removal while sodium hydroxide is used in detergents.

(i) State the colour of Universal Indicator in dilute hydrochloric acid and in aqueous sodium hydroxide.

……

…… [2]

(ii) Explain briefly, in terms of ions in solution, the reason for the difference in acidity and alkalinity of hydrochloric acid and sodium hydroxide solutions.

……

…… [2]

(iii) The reaction between hydrochloric acid and magnesium metal produces a soluble salt, magnesium chloride.
Describe the steps to obtain a pure sample of magnesium chloride from the reaction.

……

……

……

……

……

…… [4]

(b) In an experiment, 20.0 cm^3 of 1.50 mol/dm^3 sodium hydroxide exactly neutralised 25.0 cm^3 of hydrochloric acid. Using the chemical equation provided for the reaction, calculate the concentration of the hydrochloric acid used.

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

[2]

For Examiner's Us

11 **(a)** Fig. 11.1 shows the speed of reaction between calcium carbonate and hydrochloric acid in two different experiments.

Experiment 1 was performed using 10 g of powdered calcium carbonate.
Experiment 2 was performed using 10 g calcium carbonate in lumps.

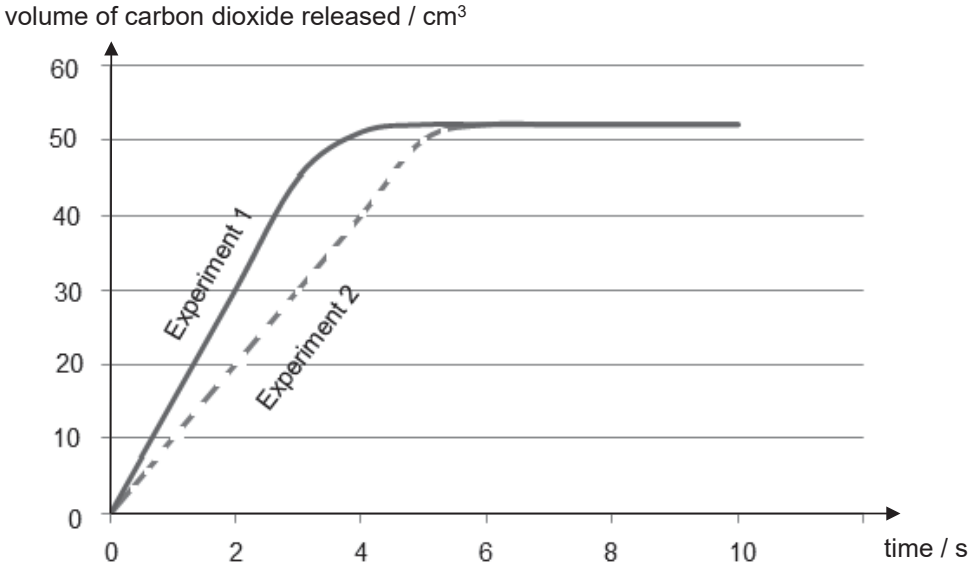


Fig. 11.1

(i) Based on the graphs, compare the speed of reaction for the two experiments.

.....

..... [1]

(ii) Use your knowledge of reacting particles to explain why the particle size of calcium carbonate affects the speed of reaction.

.....

.....

.....

..... [2]

(iii) Write a balanced chemical equation, including state symbols, for the reaction between calcium carbonate and hydrochloric acid.

..... [2]

(b) Sketch on Fig. 11.1 the speed of reaction for **5 g of powdered calcium carbonate**. Label this 'Experiment 3'. [1]

(c) The temperature of the mixtures increased during the reaction in both experiments 1 and 2.

(i) Suggest whether the reactions are exothermic or endothermic.

…… [1]

(ii) Explain in terms of bond breaking and bond forming for your answer in **c (i)**.

……

……

……

……

……

…… [2]

(iii) Suggest a method that can be used to accurately determine that all the acid has been used up during the reaction.

…… [1]

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.).

Answers for Paper 1							
21	A	26	C	31	D	36	C
22	A	27	B	32	A	37	B
23	D	28	C	33	B	38	C
24	A	29	A	34	A	39	B
25	C	30	B	35	B	40	C

Pasir Ris Secondary School

SECONDARY 4 EXPRESS
MID-YEAR EXAMINATION 2018

SCIENCE (CHEMISTRY) 5076

Paper 1: Friday 0800 – 0900 04 May 2018

Paper 3: Monday 0800 - 0915 07 May 2018

20 + 65 marks

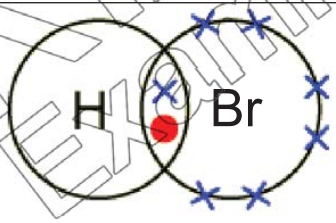
MARKING SCHEME

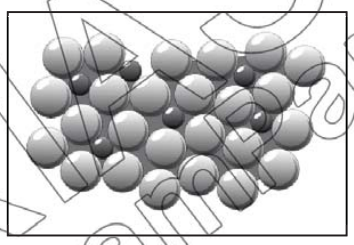
This document consists of **14** printed pages (inclusive of this page).

Setter: Mr Mohd Riffaii

[Turn over

Section A: Structured Questions [45 marks]

<table>
<tr><td>1</td><td>(a)</td><td colspan="3"><table><tr><th>description words</th><th></th></tr><tr><td>1 solid
2 ions
3 compound</td><td>Students incorrectly state mixture due to the different charges.</td></tr><tr><td>1 liquid
2 element
3 atom</td><td>Students incorrectly state solid due to the connecting atoms or molecule</td></tr><tr><td>1 gas
2 compound
3 molecule</td><td>Students incorrectly state mixture due to the different coloured shapes failing to appreciate the line or as atoms.</td></tr><tr><td colspan="2">Any order</td></tr></table>1 mark for every 3 correct answers</td><td>[3]</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Presence of mobile ions to act as charge carriers to enable conduction of electricity</td><td>Missing key terms of mobile ions act as charge carriers. Students state free electrons which is reserved for metals.</td><td>[1]</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Heating A till it melts / A is in molten state.</td><td>Students state electrolysis and electroplating it as a method.</td><td>[1]</td></tr>
<tr><td></td><td></td><td></td><td>[Total: 5 marks]</td><td></td><td></td></tr>
<tr><td>2</td><td>(a)</td><td colspan="2">Different solubilities of components in solvent</td><td>Many students wrote solubility as a one-word response. Failing to state solubility of the dyes.</td><td>[1]</td></tr>
<tr><td></td><td>(b)</td><td colspan="2">Contains blue, purple and orange</td><td>Most who got wrong failed to indicate blue as well as they felt it wasn’t perfectly in line.</td><td>[1]</td></tr>
<tr><td></td><td>(c)</td><td colspan="2">Graphite/Carbon in the pencil is insoluble in the solvent and would not affect the results.</td><td>Students failed to answer question of why pencil was used by only stating why ink is not used. Some used ‘lead’ as a term to explain about the carbon from pencil.</td><td>[1]</td></tr>
<tr><td></td><td></td><td colspan="2">[Total: 3 Marks]</td><td></td><td></td></tr>
<tr><td>3</td><td>(a)</td><td colspan="2"> 
</td><td>Most could not recall how to draw the bromine electrons properly. Left blank.
Legend stated only as hydrogen/bromine</td><td>[2]</td></tr>
</table>

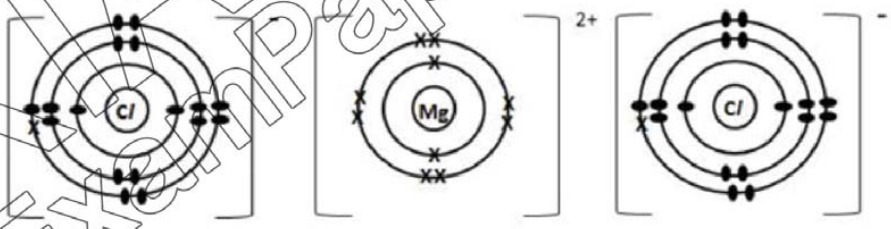
	(b)				
		(i)	H^+	Students wrote equations of HBr or H^- .	[1]
		(ii)	Colourless solutions starts to turn reddish - brown	Students described the displacement reaction itself rather than colour observations. Some stated yellow instead of reddish brown.	[1]
		(iii)	Cl_2 (g) + $2Br^-$ (aq) → $2Cl^-$ (aq) + Br_2 (aq) [1] – correct chemical formula/ions [1] – correct state symbols (2nd mark is only awarded if the 1st mark is given)	Very poorly done. 98% could not do this question and could not balance equation. Need to revisit this topic.	[2]
				[Total: 6 marks]	
4	(a)	Substance reduced: ZnO has been reduced [1] Reason: ZnO has lost an oxygen atom to form Zn / oxidation number of Zn has decreased from +2 in ZnO to 0 in Zn. [1]		**substance reduced**: most incorrectly state as just Zn. **Reason:** students are able to explain the loss of oxygen to identify the substance reduced. However, their phrasing is wrong using *oxygen has been reduced from zinc oxide.*	[2]
	(b)	(i)		most students who made mistakes drew orderly arranged atoms or did not differentiate the size of the atoms enough. the size of the atoms enough. Labelling might help.	[1]
		(ii)	The <u>different sized atoms disrupts the orderly arrangement</u> [1] of pure metal. This makes it <u>harder for the layers to slide over one another</u> [1] thereby making it harder.	Most fail to get the full marks by either omitting *different size disrupts orderly arrangement.*	[2]
				[Total: 5 marks]	
5	(a)	(i)	Mr of CuO = 64 + 16 = 80 No. of moles of CuO $= \frac{0.40}{80}$ $= 0.0050$ moles		[1]

		(ii)	Mole ratio, $CuO:H_2$ is 1:1, hence 0.0050 moles of H_2 is required	Students fail to state why the value is same as a(i).	[1]
	(b)	(i)	No. of moles of hydrogen gas used $= \frac{165}{24000}$ $= 0.006875$moles [1] Mole ratio, $CuO:H_2$ is 1:1 0.005mole of CuO requires only 0.005 moles of H_2. However, 0.006875moles of H_2 is used. Hence H_2 is in excess. [1] CuO is the limiting reagent. [1]	Quite a large number of students had not done this part as they forgot to change cm3 to dm3. They also had forgotten the formula. Lastly, they incorrectly associate CuO and H2 mole directly by looking which is more rather than by looking at amount of H2 available vs needed.	[3]
		(ii)	Mr of water vapour = 2 + 16 = 18 Mole ratio of $CuO:H_2O$ is 1:1. Hence 0.005mols of water vapour is formed. [1] Mass of water vapour = 0.005 x 18 = 0.09g [1]	Quite a fair number of students erroneously used the amount of hydrogen used in a(i). to calculate the number of moles. 1m was given for method mark.	[2]
				[Total: 7 marks]	
6	(a)		True; In the same Period, metallic character of elements decreases from left to right of PT so W is more metallic than Z.	Most students were able to do this question. However the explanation needs improvement as they only say the Z is a halogen rather than showing less character of a metal.	[1]
	(b)		True; On moving down Group I elements, the reactivity increases so V is less reactive than W.	Most students could do this well.	[1]
	(c)		False; On moving down Group I elements, the melting point of the element decreases so V should have a higher melting point than W.	Quite a fair number of students had forgotten trends of Grp 1	[1]
	(d)		False, On moving down any group, the number of electron shells in the atoms of the element increases so X should have less electron shells than Y.	Almost all students were able to answer this question well.	[1]

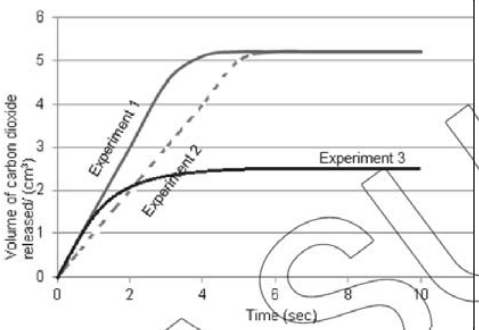
		(No mark for reason if 'true/false' is incorrect.)		
			[Total: 4 marks]	
7	(a)	A: barium chloride B: hydrochloric acid C: barium sulfate D: hydrogen gas E: zinc chloride F: silver chloride	**A** students could not identify the acid. **B** students could not identify the acid as HCl. Most placed Barium sulfate in this option. **C** most left this blank **D** all students could identify this **E** some students were able to identify this but was not able to work backwards. **F** as above	[6]
	(b)	$2AgNO_3$ (aq) + $ZnCl_2$ (aq) → 2AgCl (s) + $Zn(NO_3)_2$ (aq) $BaCl_2$ (aq)+ H_2SO_4 (aq) → $BaSO_4$ (s) + 2HCl (aq) 2HCl (aq) + Zn (s) → $ZnCl_2$ (aq) + H_2 (g)	Most students who could not do the above could not write a balanced equation. Some also wrote nonsensical response as the reaction cannot go through.	[2]
			[Total: 8 marks]	
8	(a)	<table><tr><td>name of salt</td><td>formula of salt</td><td>name of acid used to make salt</td><td>name of the other compound used to make salt</td></tr><tr><td>sodium sulfate</td><td>Na_2SO_4</td><td>**sulfuric acid**</td><td>**sodium oxide/hydroxide/carbonate**</td></tr><tr><td>potassium phosphate</td><td>K_3PO_4</td><td>phosphoric acid</td><td>**potassium oxide/ hydroxide/carbonate**</td></tr><tr><td>silver chloride</td><td>AgCl</td><td>**hydrochloric acid**</td><td>**silver nitrate**</td></tr><tr><td>calcium phosphate</td><td>**$Ca_3(PO_4)_2$** Few recalled the charge for phosphoric acid</td><td>phosphoric acid</td><td>calcium hydroxide</td></tr></table>	[3]
	(b)	The paint and plastic coating acts as a barrier [1] to	Most students could identify why the paint can be used to prevent rusting but quite a large number did not state how it acts as a protective layer/ barrier from the reactants.	[2]

		Prevent / minimize oxygen and water from coming into contact with iron directly [1]		
	(c)	Nitrogen dioxide – motor vehicles Sulfur dioxide – factories / coal/ volcanic eruptions	Most correctly stated the gases SO2 but CO was another incorrect response.	[2]
			[Total: 7 marks]	
	Section B – Free Response Questions [20 marks]			*For Examiner's Use*
9	(a)	Solution of sodium chloride and seawater	Many stated swimming pool, tap but the water was only inferred not mentioned.	[1]
	(b)	Both have same number of protons, 17. They have different number of neutrons, Cl-35 has 18 neutrons while Cl-17 has 20 neutrons.	Many students correctly stated the the same number in proton but did not elaborate on the difference in the number of neutron through calculation to show how they knew the neutron was different.	[1] [1]
	(c)	(i) Table 8.1		[2]

name of ion	number of protons	number of neutrons	number of electrons	electronic structure
magnesium ion		**12**	**10** Ions mean that there is a difference between proton and electron. Mg loses 2 electrons	
chloride ion			**18** Chlorine gains one electron	**2,8,8**

		(ii)  charges [1], electrons [1] Most failed to draw the proper charges and wrongly indicated the outermost shell for magnesium with 2 electrons.		[2]

	(d)	(i)	Hydrogen and chlorine share a pair of electrons between them.	Most wrongly stated by just stating it has covalent bonds without describing further.	[1]
		(ii)	Magnesium chloride is a solid at room temperature as a large amount of energy is required to overcome the strong electrostatic forces of attraction between oppositely charged ions. Hydrogen chloride is a gas at room temperature as only a small amount of energy is required to overcome the weak intermolecular forces of attraction between molecules.	Most students failed to state everything to get full marks. Many confused between structure and bonding. Structure describes how the particles are packed and its movement and arrangement.	[1] [1]
				[Total : 10 marks]	
10	(a)	(i)	Universal indicator in hydrochloric acid is red while it is purple in sodium hydroxide. Reject orange/yellow for hydrochloric acid and blue for sodium hydroxide	Orange and blue are synonymous for weak acid and alkalis	[2]
		(ii)	There are more H^+ ions than OH^- ions in acid. [1] There are more OH^- than H^+ ions in alkaline solutions. [1]	Acids have both types of ions only that there are more of one type than the other. The converse is true.	[2]
		(iii)	Add magnesium/carbonate/oxide in excess to acid [1] Filter the mixture to obtain magnesium as residue and keep the filtrate [1] Heat the filtrate to saturate the solution and allow it to cool to allow crystals to form [1] Dry the crystals between sheets of filter paper [1]	By drawing out the reaction, students can visualise better and not omit the steps.	[4]
	(b)		No. of moles of NaOH = 0.02x1.5 = 0.03 [1] Concentration of HCl = 0.03 / 0.0250 [1] = 1.20 mol/dm^3		[2]
				[Total: 10 marks]	
11	(a)	(i)	Experiment 1 has a faster rate of reaction than experiment 2. / Experiment 1 took a faster time to complete than experiment 2.	Steeper gradient indicates a faster rate of reaction.	[1]
		(ii)	Powdered calcium carbonate has a larger surface area to volume	Most omitted to state which particle was the smaller one and assumed the reader to	[2]

			ratio / larger total surface area <u>exposed to collisions</u>. [1] Results in <u>higher frequency of effective collisions [1]</u>, thus greater speed of reaction.	know. Many used higher **probability** instead of frequency.	
		(iii)	$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$	Most could not recall reactions between acid and carbonates and the product obtained.	[2]
	(b)			Sizeable number of students failed to label the correct term. Students failed to appreciate the half volume compared to first graph. Students did not follow the reaction speed of the first graph.	[1]
	(c)	(i)	Exothermic reactions.	Heat increase is exothermic reaction	[1]
		(ii)	<u>Greater energy is given off when bonds</u> of products <u>are formed</u> [1] then <u>energy taken in from surrounding</u> in <u>breaking bonds [1]</u> of reactants. Hence there is a net increase in temperature.	Students failed to appreciate how bonds of existing compunds need to be broken in order to form new bonds. Breaking of bonds require energy which is **taken in** (endo) from surroundings. Forming of bonds require the energy to be **given out** to surroundings (exo). Since final is exo it means that more energy is given off than taken in.	[2]
		(iii)	Using a pH meter.	***accurately*** = use instrument to measure	[1]
				[Total: 10 marks]	

End of Paper

West Spring Secondary School
MID-YEAR EXAMINATION 2018

Science (Chemistry) **5076/5078**

SECONDARY 4/5 EXPRESS / NORMAL (ACADEMIC)

Name _____ ( ) **Date** 10 May 2018

Class _____ **Duration:** 1 hr 45 min

Additional Materials: Periodic Table

READ THESE INSTRUCTIONS FIRST

Write your index number, class and name on all the work you hand in.
You may use a HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
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 (20 Marks)
Answer **all** questions.
Write your answers in the spaces provided on page 6.

Section B (45 Marks)
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
Show **all** relevant workings.

Section C (20 Marks)
Answer **both** questions.
Write your answers in the spaces provided.
Show **all** relevant workings.

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

FOR EXAMINER'S USE	
Section A	/20
Section B	/45
Section C	/20
Total	/85

This document consists of **16** printed pages including this cover page.

Setter Mr. Joel Lee **[Turn over**

Section A

Answer all questions in the spaces provided on page 6.

1 The approximate pH values of four aqueous substances are shown.
Which substance could be used to neutralise excess acid in the stomach?

	substance	pH
A	baking soda	9
B	salt	7
C	orange juice	4
D	vinegar	3

2 Which two substances react without giving off a gas?

A citric acid and calcium carbonate
B hydrochloric acid and magnesium.
C nitric acid and aqueous ammonia.
D sodium hydroxide and ammonium sulfate.

3 Which ionic equation represents the reaction between aqueous potassium hydroxide and dilute sulfuric acid?

A $H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$
B $H_2SO_4 (aq) + 2K^+ (aq) \rightarrow K_2SO_4 (aq) + H_2 (g)$
C $2K^+ (aq) + SO_4^{2-} (aq) \rightarrow K_2SO_4 (aq)$
D $KOH (aq) + H^+ (aq) \rightarrow K^+ (aq) + H_2O (l)$

4 A student proposed a few methods to safely prepare a sample of sodium chloride in the laboratory:

1 sodium hydroxide and hydrochloric acid
2 sodium metal and hydrochloric acid
3 sodium nitrate and hydrochloric acid

Which of the above method(s) may be used?

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

5 Which of the following contains the greatest number of atoms?

A 0.5 mol of helium
B 30 dm^3 of krypton
C 40 g of calcium
D 100 g of gold

6 What is the mass of sodium hydroxide present in 500 cm^3 of 1.0 mol/dm^3 sodium hydroxide solution?

A 0.5 g
B 20 g
C 40 g
D 2 kg

7 In a reaction, 10 cm^3 of butene (C_4H_8) was burnt in 80 cm^3 of oxygen. The equation for the reaction is shown:

$$C_4H_8\,(g) + 6O_2\,(g) \rightarrow 4CO_2\,(g) + 4H_2O\,(l)$$

At the end of the reaction, what is the total volume of gas remaining?
(all volumes are measured at r.t.p.)

A 40 cm^3
B 60 cm^3
C 80 cm^3
D 100 cm^3

8 Which air pollutant below is **not** correctly matched to its source?

	pollutant	source
A	carbon monoxide	incomplete combustion of petrol in car engines
B	nitrogen oxides	lightning activity
C	sulfur dioxide	decomposition of organic matter
D	unburned hydrocarbons	incomplete combustion of petrol in car engines

9 The data below gives the concentration of various air pollutants, in parts per billion, in four different cities.

In which city are limestone buildings under the greatest threat from pollution?

	carbon monoxide	oxides of nitrogen	sulfur dioxide
A	5	45	11
B	17	11	23
C	25	8	32
D	108	5	23

10 Which statement about the elements of the Periodic Table is correct?

A Group 0 elements are unreactive metals.
B Group II elements tend to form positive ions.
C Group VII elements exist as single atoms.
D The elements become more metallic from the left of the Periodic Table to the right.

11 Fluorine, F, is an element in Group VII of the Periodic Table.
Which of the following statements about fluorine is **false**?

A Fluorine exists as diatomic molecules.
B Fluorine forms ions with a -1 charge.
C Fluorine has a higher melting point than chlorine.
D Fluorine is a non-metal.

12 The reaction between iron(III) ions and iodide ions is represented by the following ionic equation:

$$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$$

Which statement about the reaction is correct?

A Fe^{2+} ions are oxidised by loss of electrons.
B Fe^{3+} ions are reduced by gain of electrons.
C Fe^{3+} ions are reduced by loss of electrons.
D I^{-} ions are oxidised by gain of electrons.

13 Aqueous solution **X** is known to contain a powerful oxidising agent.
To two separate samples of solution **X**, a solution of potassium iodide was added to one, while a solution of acidified potassium manganate(VII) was added to the other.

Which of the following correctly describes the colour of solution **X** in the respective samples?

	after addition of aqueous potassium iodide	after addition of aqueous acidified potassium manganate(VII)
A	brown	colourless
B	brown	purple
C	colourless	colourless
D	colourless	purple

14 The ionic equations below represent the reactions between four metals zinc, iron, **X** and **Y** and the aqueous ions of one of the other listed metals.

$$Zn + \mathbf{X}^{2+} \rightarrow Zn^{2+} + \mathbf{X}$$
$$Zn + Fe^{2+} \rightarrow Zn^{2+} + Fe$$
$$\mathbf{X} + Fe^{2+} \rightarrow \text{no reaction}$$
$$\mathbf{Y} + Zn^{2+} \rightarrow \mathbf{Y}^{2+} + Zn$$

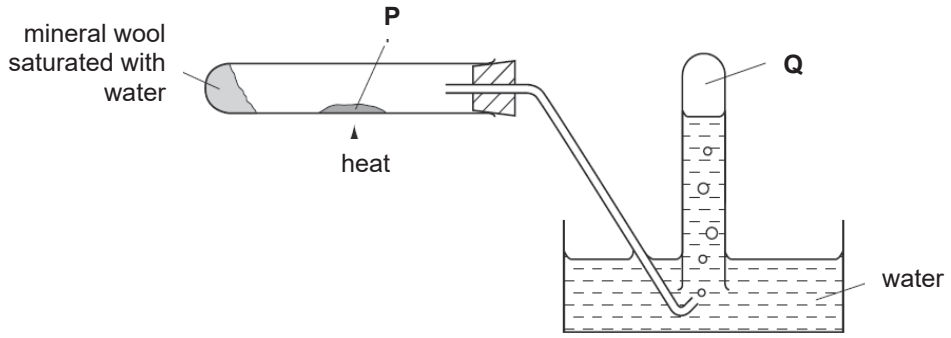
What is the correct order of reactivity of the metals?

	most reactive	→		least reactive
A	**X**	Fe	Zn	**Y**
B	**Y**	Fe	X	Zn
C	**Y**	Zn	Fe	**X**
D	Zn	**Y**	**X**	Fe

15 Which of the following explains why recycling ensures that metals will be available in the future?

A Dumping of metals in landfill sites is unsightly.
B Recycling avoids the environmental damage of opening new mines.
C Recycling costs less than obtaining metals from their ores.
D There are only limited amounts of metals in the Earth's surface.

16 In the experiment shown below, steam is passed over heated solid **P**, which reacts to give gas **Q**:



Which of the following could be **P** and **Q**?

	P	Q
A	copper	hydrogen
B	potassium	oxygen
C	silver	oxygen
D	zinc	hydrogen

17 Aqueous sodium hydroxide and aqueous ammonia were added separately to two different aqueous solutions each containing the same metallic ion. In both cases, a white precipitate was formed which dissolved when excess sodium hydroxide or ammonia was added.

What is the ion?

A Al^{3+}
B Ca^{2+}
C K^{+}
D Zn^{2+}

18 An aqueous solution of compound **Z** reacts with aqueous sodium hydroxide to form a green precipitate. A piece of aluminium foil is added to the mixture and heated; a gas that turns damp red litmus paper to blue is given off.

What is **Z**?

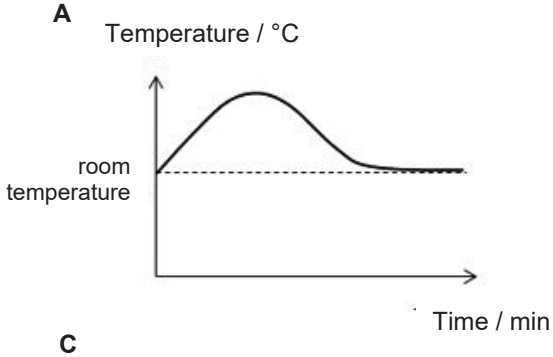
A ammonium nitrate
B copper(II) nitrate
C iron(II) chloride
D iron(II) nitrate

19 Which of the following processes is exothermic?

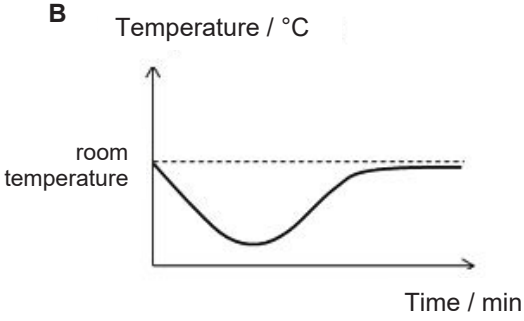
A Burning of petrol in car engines
B Evaporation of a water puddle
C Melting tar for the paving of roads
D Sublimation of dry ice

20 The dissolving of ammonium nitrate in water is an endothermic process.
Which graph correctly shows how the temperature of the mixture changes over time when ammonium nitrate is dissolved in water and the solution is allowed to stand?

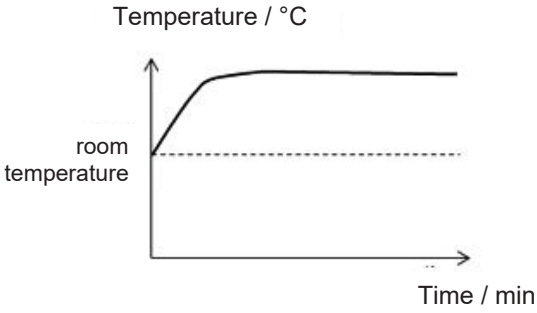
A



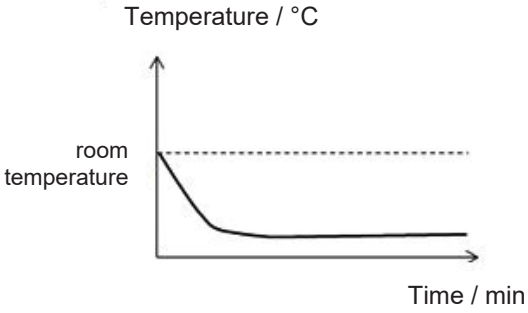
B



C



D



Answers

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

Section B

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

1 The physical and chemical properties of five unknown oxides are summarised in Table 1.1.

Table 1.1

unknown oxide	state at r.t.p	solubility in water	pH of aqueous solution	reacts with dilute hydrochloric acid?	reacts with dilute sodium hydroxide?
A	solid	soluble	14	yes	no
B	solid	insoluble	-	yes	yes
C	gas	soluble	7	no	no
D	solid	insoluble	-	yes	no
E	gas	soluble	2	no	yes

(a) Which oxide(s) is/are:

(i) non-metallic?

…….. [2]

(ii) able to form an alkali?

…….. [1]

(iii) amphoteric?

…….. [1]

(b) Give an example for your answer in **(a)(iii)**.

…….. [1]

(c) Suggest the identity of oxide **A**.

…….. [1]

2 Phosphorus is an element that does not react with water, but will react readily in air, forming an oxide.

Fig. 2.1 below shows a piece of phosphorus fastened to a copper wire and left for a few days in the set up. The water slowly rises up the tube.

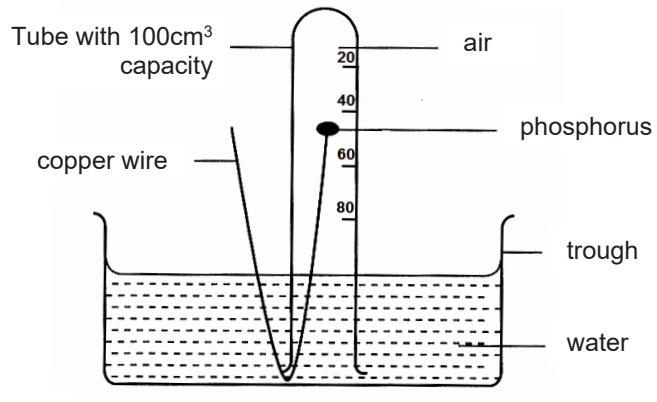


Fig. 2.1

(a) State the gas in air that phosphorus has reacted with.

…… [1]

(b) At which mark will the water level approximately be after a few days?

…… [1]

(c) State two gases that are left in the tube after a few days.

…… [2]

3 When a mixture of aluminium powder and zinc oxide is heated, the mixture burns vigorously with a bright flame, and may even explode. The reaction is illustrated by the equation below.

$$2Al + ZnO \rightarrow Al_2O_3 + 3Zn$$

(a) Is the reaction endothermic or exothermic? Explain your answer.

……

…… [2]

(b) State whether zinc oxide is oxidised or reduced. Explain your answer in terms of electron transfer.

……

……

…… [2]

4 A common reaction iron undergoes is rusting. Fig. 3.1 below shows an experiment where some iron nails have been exposed to different conditions in four test tubes **A**, **B**, **C** and **D**.

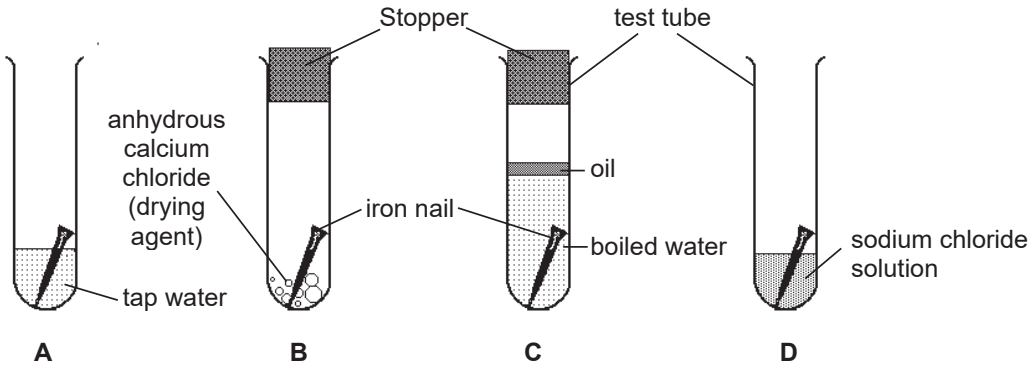


Fig. 3.1

(a) In which test tube(s) will the iron nail not rust? Explain your answer.

.....

.....

.....

..... [3]

(b) In which test tube will the iron nail rust the fastest?

..... [1]

5 The electronic configurations of lithium, sodium and potassium are shown in Table 5.1.

Table 5.1

element	symbol	proton number	electronic configuration
lithium	Li	3	2,1
sodium	Na	11	2,8,1
potassium	K	19	2,8,8,1

(a) Explain why these three elements are in the same group of the Periodic Table.

……

…….. [1]

(b) For one of the metals in Table 5.1, name the products of its reaction with water.

…….. [2]

(c) Name one other element that is in the same group as the elements in Table 5.1.

…….. [1]

(d) Describe how the reactivity of the element in **(c)** would differ from the elements in Table 5.1.

…….. [1]

6 An unknown metal **M** forms the nitrate **M**NO_3. The compound is stable, but decomposes upon strong heating.

When a 17.0 g sample of **M**NO_3 was heated, it decomposed completely according to the equation:

$$2\mathbf{M}NO_3\,(s) \rightarrow 2\mathbf{M}NO_2\,(s) + O_2\,(g)$$

At the end of the reaction, 2400 cm^3 oxygen was collected.

(a) Is the above decomposition reaction exothermic or endothermic one? Explain your answer.

……

…….. [2]

(b) Calculate the number of moles of **M**NO_3 that decomposed.

[2]

(c) Calculate the molar mass of **M**NO_3, and hence determine the identity of **M**.

Identity of **M** : …… [3]

(d) Describe a test you would perform to confirm the identity of the oxygen produced.

……

…….. [2]

7 Group VII and Group 0 are found at the right side of the Periodic Table.

(a) What are the names given to elements in Group VII and Group 0?

…….. [1]

(b) Explain why the elements in Group 0 are unreactive.

……

…….. [1]

(c) A student is given four substances below.

aqueous bromine	aqueous chlorine
aqueous potassium bromide	aqueous potassium chloride

Describe how she could use **two** of the substances to perform an experiment to show that chlorine is more reactive than bromine. Include the observations you would expect her to make, and construct a balanced chemical equation of the reaction.

……

……

……

……

…….. [3]

8 Fig. 8.1 describes some of the reactions of two unknown substances **A** and **B**.

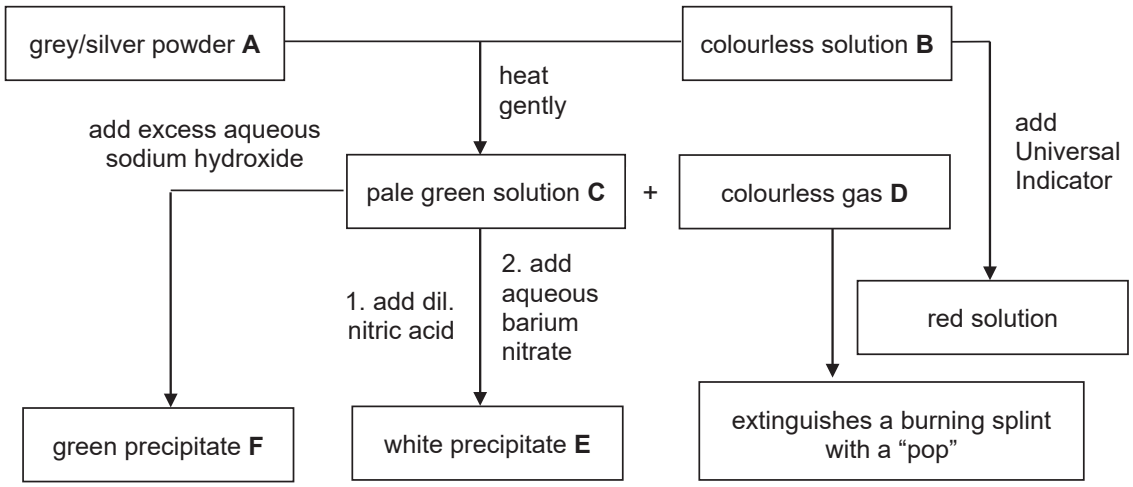


Fig. 8.1

(a) Identify unknown substances **A** – **F**.

A: .....

B: .....

C: .....

D: .....

E: .....

F: .....

[6]

(b) Write a balanced chemical equation for any one of the reactions in Fig. 8.1.

..... [2]

Section C

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

9 Iron is extracted from iron ore in the blast furnace, as shown in Fig. 9.1 below.

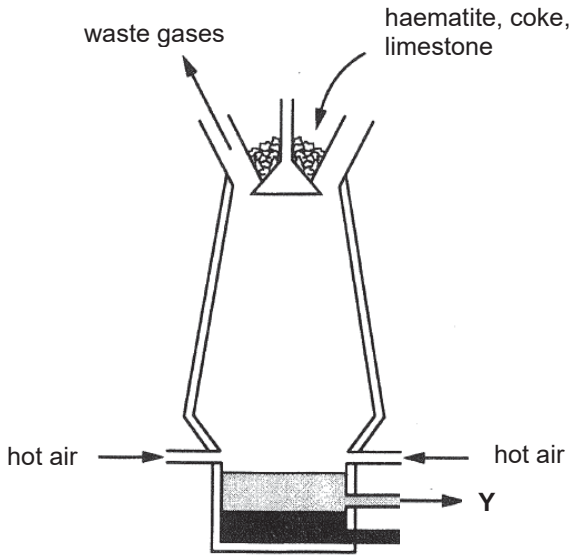


Fig. 9.1

(a) In the furnace, the coke is converted to carbon monoxide. A redox reaction then takes place between iron(III) oxide in haematite and carbon monoxide to produce iron and carbon dioxide.

(i) Write a balanced chemical equation for the reaction between iron(III) oxide and carbon monoxide.

…… [1]

(ii) Explain why the reaction in **(i)** is a redox reaction.

……

……

…… [2]

(iii) Identify the reducing agent in reaction **(a)(i)**.

…… [1]

(b) Pure iron from the blast furnace is frequently mixed with other elements to form alloys. Give one example of this alloy, and explain why it is preferred to pure iron.

.....

..... [2]

(c) Identify substance **Y**, and explain how it is formed. Include the relevant chemical equation(s) in your answer.

.....

.....

.....

.....

..... [4]

10 Magnesium nitrate is commonly used as a dehydrating agent; it is also present in some fertilisers.

A student prepared a sample of magnesium nitrate by adding magnesium oxide to 200 cm^3 of nitric acid of an unknown concentration. The equation is shown below:

$$2HNO_3\ (aq) + MgO\ (s) \rightarrow Mg(NO_3)_2\ (aq) + H_2O\ (l)$$

In this particular reaction, 7.4 g of magnesium nitrate was collected at the end of the reaction.

(a) Given that the nitric acid reacted completely, calculate the moles of nitric acid that reacted and hence its concentration in mol/dm^3.

[3]

(b) Outline an experimental procedure to describe how pure crystals of zinc nitrate may be prepared using a similar method as above. State clearly the reagents that you use.

……

……

……

……

……

……

……

……

…….. [6]

(c) Explain why sodium nitrate cannot be prepared with the method in **(b)**.

……

…….. [1]

End of Paper

West Spring Secondary School
Science Department – Mid-Year Exam [2018]
Marking Scheme

Name of Setter(s): Joel Lee
Title of Assessment: Secondary 4 Express / 5 Normal (Academic)
Subject: Science (Chemistry) 5076/5078
Duration: 1hr 45mins

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

Section B [45 marks]			
Q/No	**Answer**	**Comments/ Suggestions to Markers**	**Marks**
1(a)(i)	Oxides **C** and **E**	CAO	2
1(a)(ii)	Oxide **A**	CAO	1
1(a)(iii)	Oxide **B**	CAO	1
1(b)	lead(II)/aluminium/zinc oxide	CAO	1
1(c)	Any Group I oxide (sodium oxide, potassium oxide etc.)		1
2(a)	Oxygen	CAO	1
2(b)	It will be at approximately the 80cm^3 mark.	CAO	1
2(c)	Any 2: Nitrogen / Argon / Carbon dioxide / Water vapour	CAO	2
3(a)	The reaction is exothermic. It gives burns vigorously/may explode, signifying that a lot of heat is given out to the surroundings.	CAO OWTTE	1 1
3(b)	Zinc oxide is reduced. Zn gains 2 electrons from Zn^{2+} in ZnO to Zn. (Students need to specify no. of electrons to get the mark.)	CAO	1 1
4(a)	The nail will not rust in tubes **B** and **C**. There is no moisture/water in tube B, and There is no oxygen in tube C.	CAO OWTTE OWTTE	1 1 1

4(b)	Tube **D**.	CAO	1
5(a)	They have the same number of valence electrons.	CAO	1
5(b)	Lithium/sodium/potassium hydroxide and hydrogen gas.	CAO	2
5(c)	Rubidium/caesium/francium	CAO	1
5(d)	It is more reactive.	CAO	1
6(a)	The reaction is endothermic, because heat needs to be supplied/heat is taken in for the reaction to start	OWTTE	2
6(b)	Moles of oxygen = 2400 / 24000 = 0.10 mol. Moles of **M**NO_3 = 0.10 x 2 = 0.20 mol.	CAO	1 1
6(c)	Molar mass of one mol. of **M**NO_3 = 17.0 / 0.2 = 85 g/mol A_r of **M** = 85 – [14 + (3x16)] = 23 Therefore **M** is sodium.	CAO (ecf allowed)	1 1 1
6(d)	Insert a glowing splint into a test tube containing the gas. If it relights, the gas is oxygen.	CAO	1 1
7(a)	Halogens (Group VII) and noble gases (Group 0)	CAO	1
7(b)	They have a fully filled valence shell, which confers stability.	CAO	1
7(c)	Mix aqueous chlorine and aqueous potassium bromide. The mixture of solutions will turn from colourless to brown as bromine is displaced. 2 KBr + Cl_2 → 2 KCl + Br_2	CAO	1 1 1
8(a)	**A**: iron **B**: sulfuric acid **C**: iron(II) sulfate **D**: hydrogen **E**: barium sulfate **F**: iron(II) hydroxide	1m each	6
8(b)	Fe + H_2SO_4 → $FeSO_4$ + H_2 $FeSO_4$ + 2NaOH → Na_2SO_4 + $Fe(OH)_2$ $FeSO_4$ + $Ba(NO_3)_2$ → $Fe(NO_3)_2$ + $BaSO_4$ (Any one)	CAO 1m for correct formula, 1m for balanced equation.	2

Section C [20 marks]			
9(a)(i)	$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3CO_2$		1
9(a)(ii)	It is a redox reaction as Fe_2O_3 is reduced to Fe, and CO is oxidised to CO_2. Fe_2O_3 loses oxygen while CO gains oxygen.	1m for stating oxidised and reduced species 1m for explanation	2
9(a)(iii)	CO is the reducing agent.	CAO	1
9(b)	(Stainless) steel is one iron-based alloy. It is preferred as it is stronger / more corrosion resistant than pure iron.	CAO	1 1
9(c)	**Y** is slag. The limestone added to the furnace decomposes to form calcium oxide and carbon dioxide. The calcium oxide reacts with acidic impurities / silicon dioxide in the haematite to form slag. (1m can be given for the role of limestone in removing acidic impurities, without mention of its decomposition) $CaO + SiO_2 \rightarrow CaSiO_3$	CAO OWTTE CAO	1 1 1 1
10(a)	Moles of $Mg(NO_3)_2$ = 7.4 / 148 = 0.050 mol. Moles of HNO_3 = 0.050 x 2 = 0.10 mol. Conc. of HNO_3 = 0.10 / (200/1000) = 0.50 mol/dm^3	CAO	1 1 1
10(b)	The reagents used are nitric acid and zinc metal/carbonate/oxide. 1. Add excess zinc metal/carbonate/oxide to nitric acid. 2. After the reaction is complete, filter to obtain zinc nitrate solution as the filtrate. 3. Heat the solution to obtain a saturated solution. 4. Cool the saturated solution to crystallise zinc nitrate. 5. Filter to obtain crystals of zinc nitrate, wash with cold distilled water and dry.	OWTTE	1 1 1 1 1 1
10(c)	Sodium carbonate, the starting material, is soluble in water.	OWTTE	1