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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.

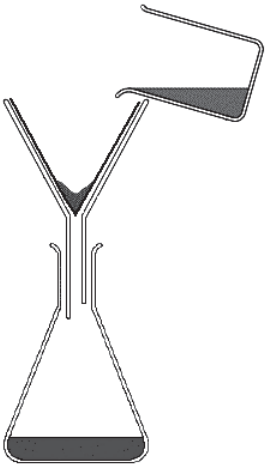
Multiple Choice Questions (40 marks)

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.

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

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

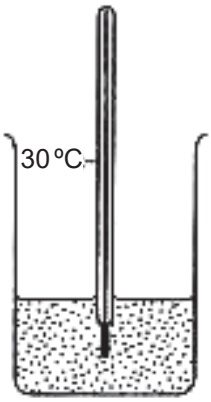
10 Which substance below will **not** react with aqueous potassium hydroxide but will react with dilute hydrochloric acid to form a salt and water?

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?

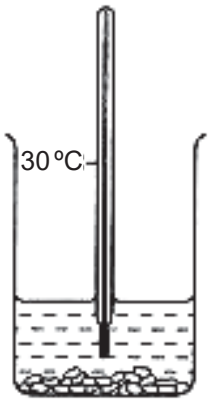
	reagent 1	reagent 2
A	magnesium	ammonium carbonate
B	magnesium chloride	calcium carbonate
C	magnesium oxide	potassium carbonate
D	magnesium sulfate	sodium carbonate

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



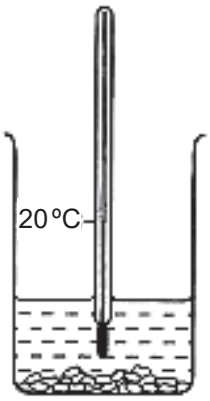
1 g of marble powder in 200 cm^3 of 3 mol/dm^3 of HCl

reaction **A**



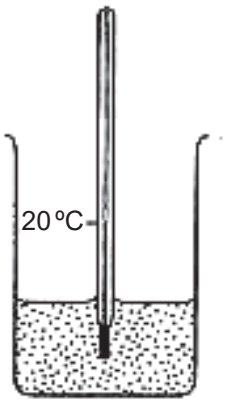
1 g of marble chips in 200 cm^3 of 2 mol/dm^3 of HCl

reaction **B**



1 g of marble chips in 200 cm^3 of 2 mol/dm^3 of HCl

reaction **C**



1 g of marble chips in 200 cm^3 of 1 mol/dm^3 of HCl

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?

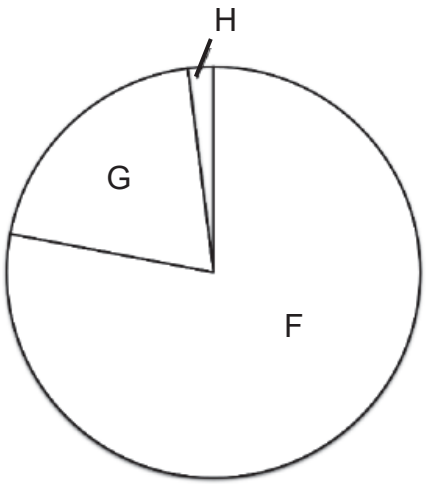
A Caesium has a higher density than potassium.
B Caesium reacts violently with water but potassium reacts explosively with water.
C Potassium atoms are larger than caesium ions.
D Potassium has a lower melting point than caesium.

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.

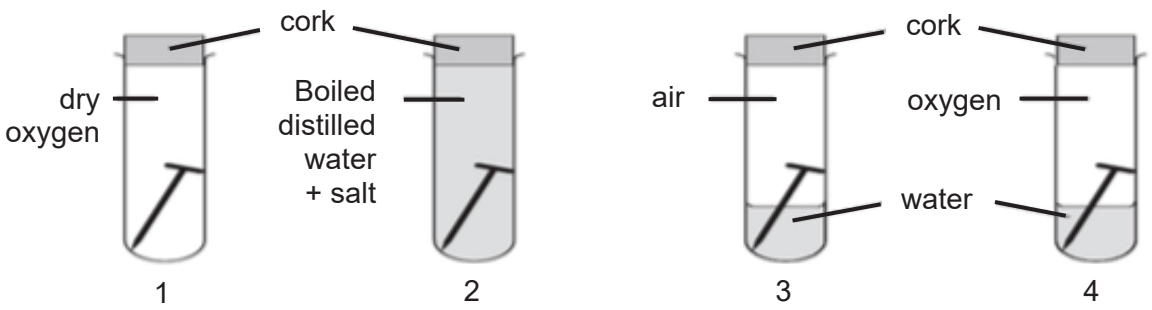
19 A metal X reacts as follows:

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

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).

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.

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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.

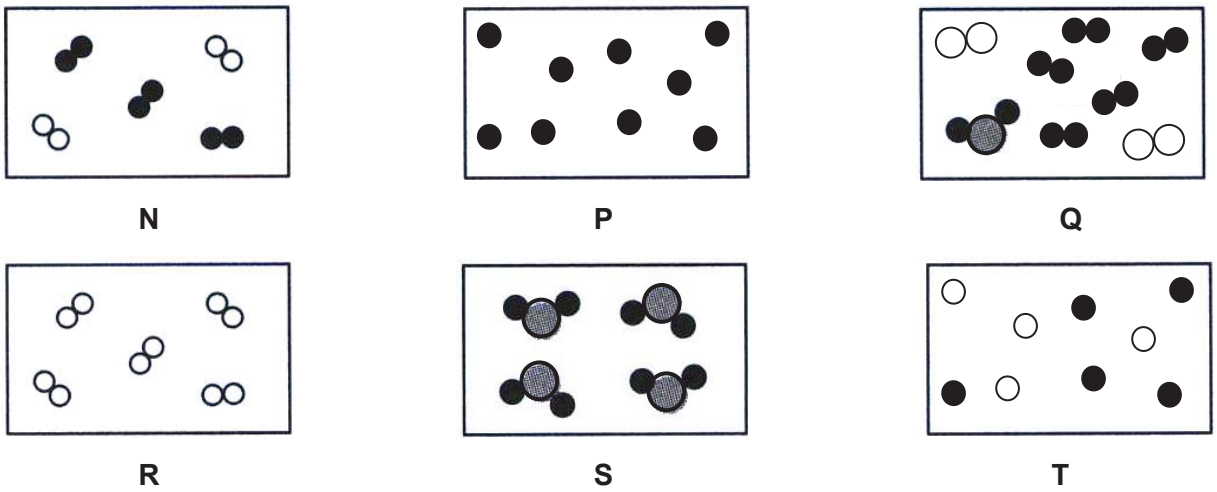


Fig 2.1

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?

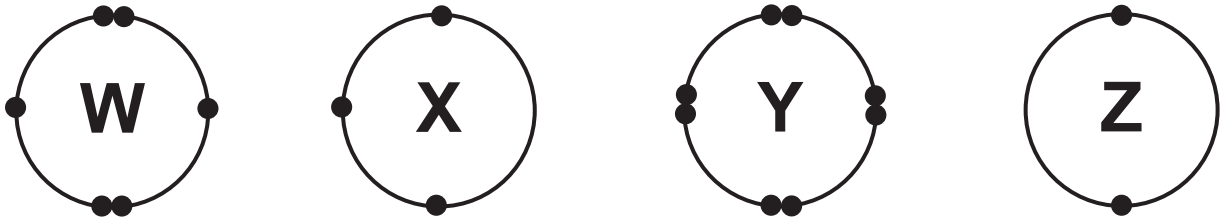
..... [1]

(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.

……

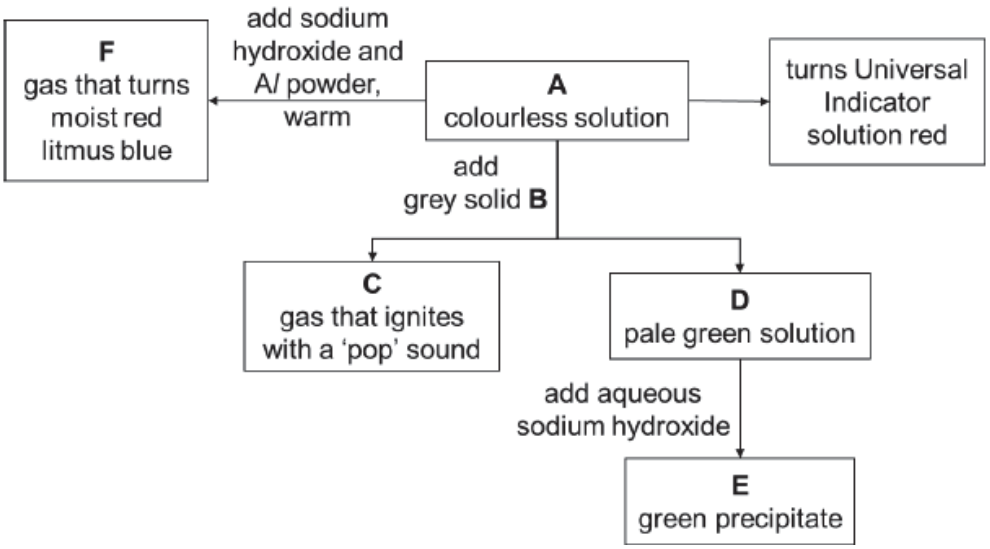
……

……

[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

.....

.....

.....

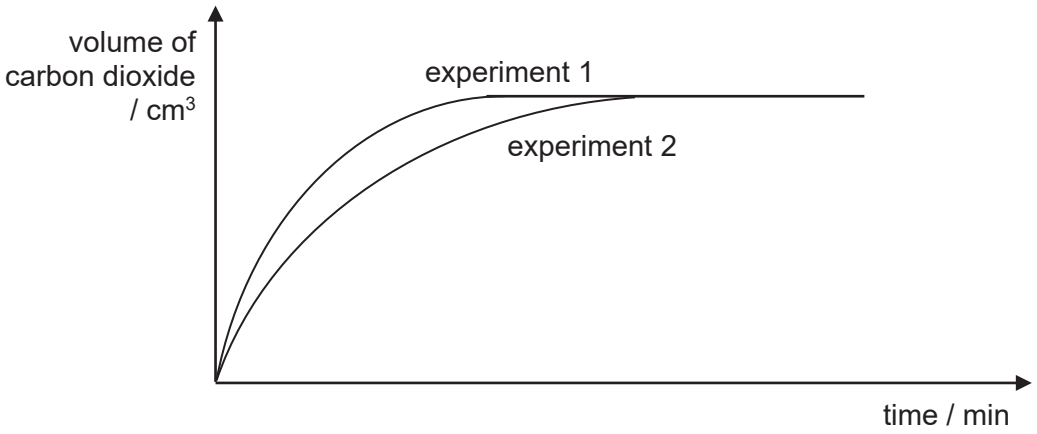
.....

.....

.....

[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.

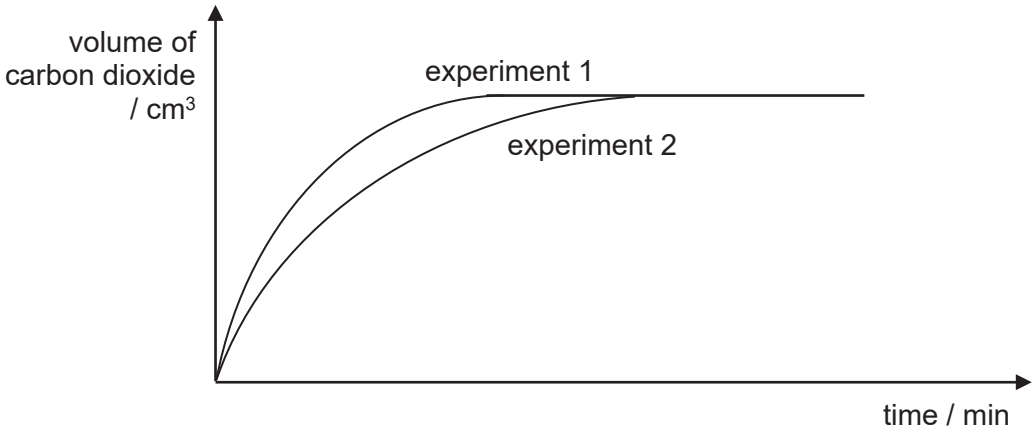
.....

.....

.....

[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**.

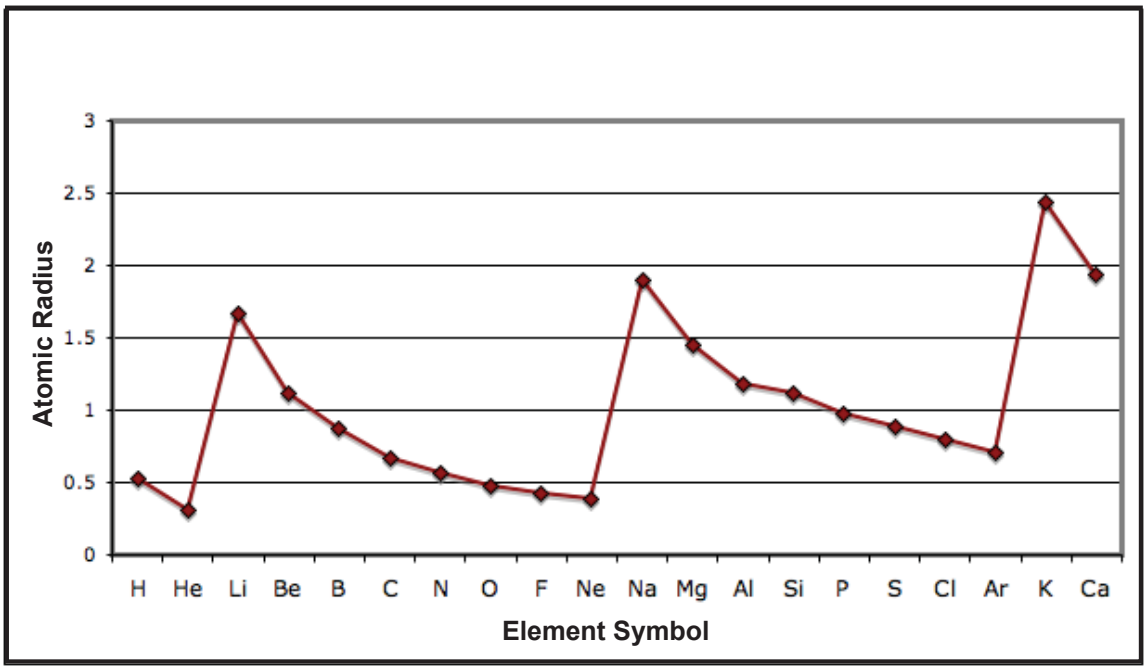


[1]

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

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).

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

Qn no.	Answer Scheme							Marks Allocated
1	**A**	6	**B**	11	**D**	16	**B**	[1] each
2	**D**	7	**D**	12	**D**	17	**A**	20 m max
3	**C**	8	**C**	13	**B**	18	**D**	
4	**C**	9	**C**	14	**A**	19	**C**	
5	**A**	10	**C**	15	**A**	20	**D**	

1

purpose	name of substance
reducing the acidity in soil	**calcium oxide / calcium hydroxide / lime / slaked lime / calcium carbonate**
testing for presence of carbon dioxide gas	**limewater / calcium hydroxide**
testing for presence of chloride ions in water	**acidified silver nitrate / acidified lead(II) nitrate / acidified silver sulfate**

1m each
Reject: chemical formula of substances

[3]

Total: 3

2(a) S [1]

2(b) N [1]

2(c) Q [1]

2(d) P [1]

Total: 4

3(a) 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] [2]

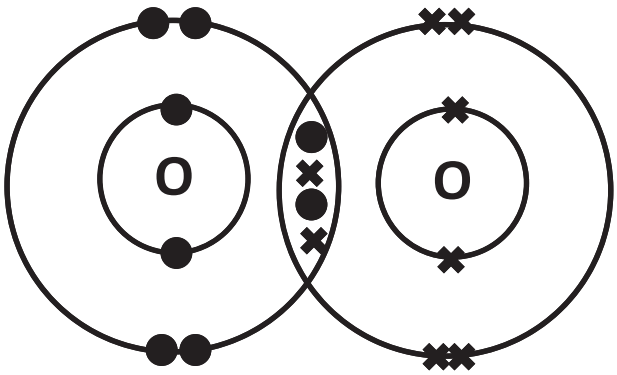
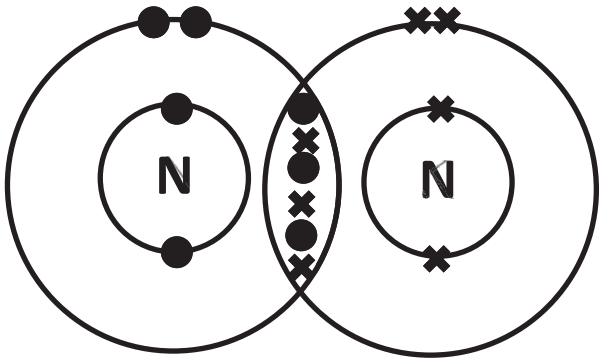
3(b)(i) X_2W_3 (**reject:** W_3X_2) [1]

3(b)(ii) 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]. [2]

Reject: “break strong electrostatic forces of attraction”, “break ionic bonds”, “giant ionic structure”, “oppositely charged particles / molecules / atoms”.

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) 4(a)(ii) 4(b) 4(c) 4(d)	An alloy is a **mixture containing** at least **one metal with other elements / substances**. It is **more corrosion-resistant / does not rust easily**. 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. **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. 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].	[1] [1] [3] [2] [2] Total: 9
5(a) 5(b) 5(c) 5(d)	Low melting point / low boiling point / light-green in colour / does not conduct electricity / exist as diatomic molecules [Any **two**] 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. Cl_2 (g) + Zn (s) → $ZnCl_2$ (s) 1m – correct balanced equation; 1m – correct state symbols **Chlorine is more reactive than bromine** [1]. Hence, it can **displace bromine** [1] to form potassium chloride and bromine.	[2] [2] [2] [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)		[2]
	Note: **1m deducted if students only shows valence electrons**	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