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YUSOF ISHAK SECONDARY SCHOOL

MID-YEAR EXAMINATION 2017

THE FIRST PRESIDENT SCHOOL THE FIRST PRESIDENT SCHOOL THE FIRST PRESIDENT SCHOOL THE FIRST PRESIDENT SCHOOL THE FIRST PRESIDENT SCHOOL
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CANDIDATE NAME		
CLASS		

SCIENCE (CHEMISTRY)

3 Express

5078

11 May 2017

Additional Materials: Multiple Choice Answer Sheet

1 hour 30 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces provided on all the work you hand in.
Write in dark blue or black ink on both sides of the paper.
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.

Section A

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 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.

Section B and C

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

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.

A copy of the Periodic Table is printed on Page **20**.

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

For Examiner's Use	
Section A	/ 20
Section B	/ 30
Section C	/ 20
Total	/ 70

[2]

SECTION A: MULTIPLE CHOICE QUESTIONS [20 MARKS]**ANSWER ALL THE QUESTIONS.**

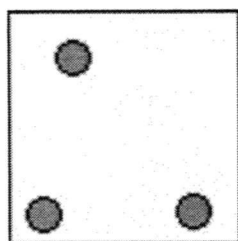
- 1 The following table shows the boiling points of some gases present in a mixture.

gas	boiling point / °C
A	-286
B	-369
C	-346
D	-296
E	-283

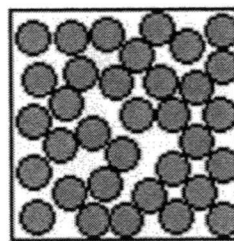
When the mixture of gases is cooled to -300°C , some of these gases liquefy.

Which of the above gases liquefy?

- A** A, B and C
B A, D and E
C B and C
D B, C and D
- 2 The following diagram shows the arrangement of particles in two different physical states.



state A



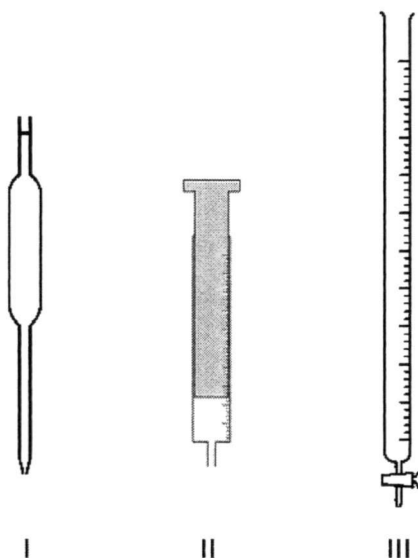
state B

What is the name of the process that represents the change of state from A to B?

- A** condensation
B freezing
C melting
D boiling

[3]

- 3 Which statement about the molecules of hydrogen gas is correct?
- A The molecules possess low kinetic energy.
 - B The molecules vibrate in fixed positions.
 - C The molecules are diatomic.
 - D The molecules slide over one another.
- 4 The diagram shows three pieces of apparatus used for measuring volumes of liquids.

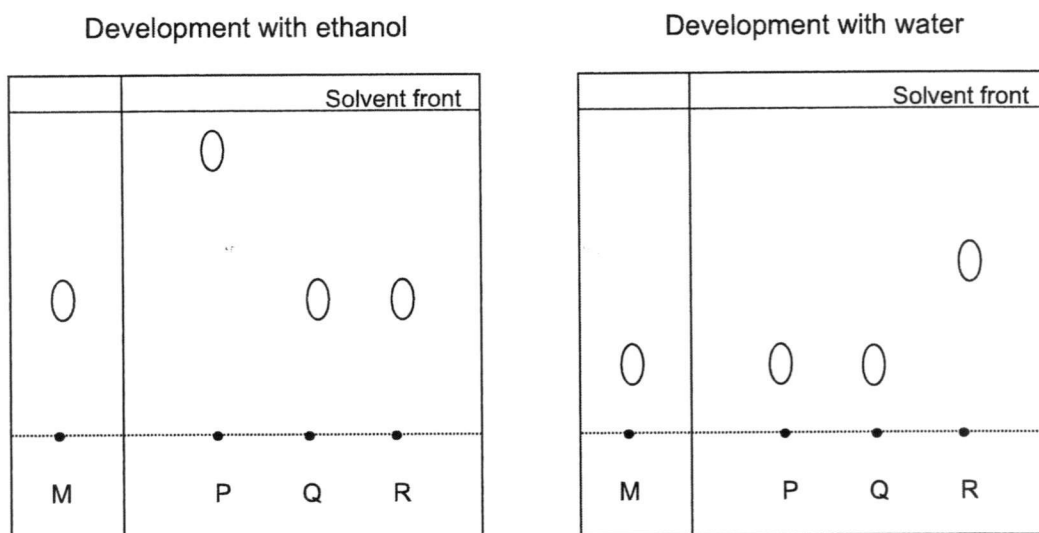


Which apparatus can be used to measure 25.0 cm^3 of distilled water?

- A I only
 - B III only
 - C I and III
 - D II and III
- 5 Air is a mixture of oxygen, nitrogen and other gases.
- Which statement explains why oxygen can be separated from nitrogen by the fractional distillation of liquid air?
- A Oxygen is denser than nitrogen.
 - B Oxygen is more reactive than nitrogen.
 - C The two elements have fixed melting points.
 - D The two elements have different boiling points.

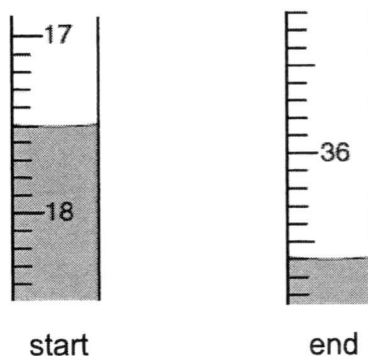
[4]

- 6 A coloured ink M was compared with three different dyes P, Q or R, using water and ethanol as solvents. The chromatograms produced are shown below.



Which does M contain?

- A either Q or R
 B either P or Q
 C P only
 D Q only
- 7 A student added acid from a burette to 20.0 cm³ of alkali in a conical flask. The diagrams below show the acid levels in the burette at the start and end of the addition.

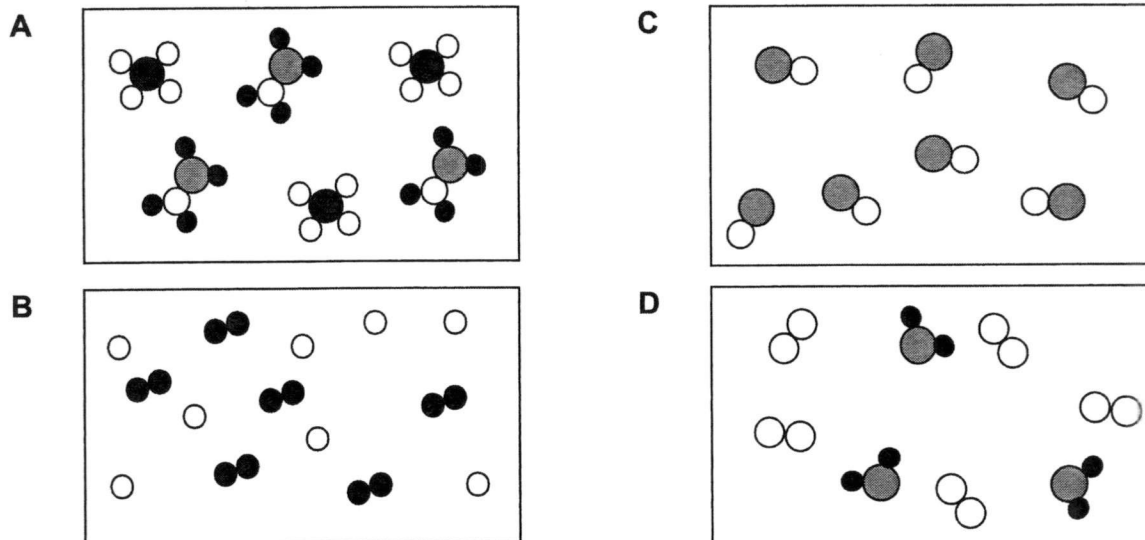


What volume of acid did the student add to the alkali?

- A 16.70 cm³
 B 18.10 cm³
 C 18.90 cm³
 D 19.10 cm³

[5]

8 Which of the following best represents a mixture of elements and compounds?



9 The formulae of the ions of four elements are shown below.



Which statement about these ions is correct?

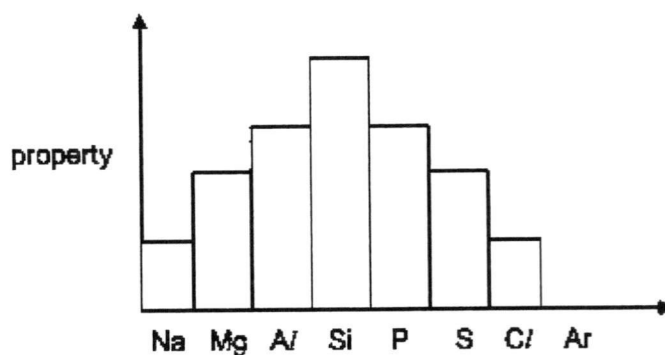
- A** They all have the same number of electrons in their outer shells.
- B** They all have the same number of protons in their nuclei.
- C** They all have the same electronic structure as a noble gas.
- D** They all have more electrons than protons.

10 Which of the following correctly describes the relative atomic mass of an electron and its location in the atom?

	relative atomic mass	location in atom
A	$\frac{1}{1840}$	outside the nucleus
B	$\frac{1}{1840}$	inside the nucleus
C	1	outside the nucleus
D	1	inside the nucleus

[6]

11 The following bar chart shows a property of the elements found in Period 3.



Which property of these elements is represented in this chart ?

- A proton number
- B number of electron shells
- C number of electrons used for bonding
- D number of valence electrons

12 The following table shows the number of neutrons, protons and electrons of six atoms.

atom	number of neutrons	number of protons	number of electrons
U	7	6	6
V	7	7	7
W	10	8	8
X	6	6	6
Y	10	9	9
Z	8	8	8

Identify **two** pairs of isotopes.

	1 st pair	2 nd pair
A	U and X	W and Y
B	W and Y	U and V
C	V and Z	X and Z
D	U and X	W and Z

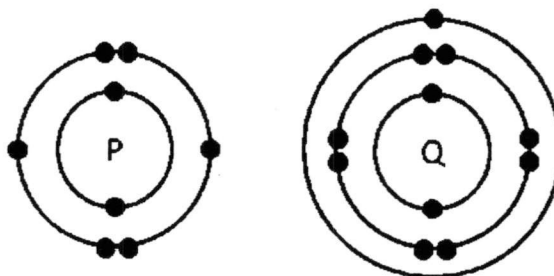
[7]

13 Which **two** statements about a covalent bond are correct?

- 1 It can be formed between two metal atoms.
- 2 It can be formed between two non-metal atoms.
- 3 It is formed by the transfer of electrons between atoms.
- 4 It is formed by sharing electrons between atoms.

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

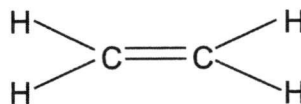
14 The electronic structures of atoms P and Q are shown.



P and Q can react to form a compound. What is the formula of this compound?

- A QP_2
 B Q_2P
 C Q_2P_6
 D Q_6P_2

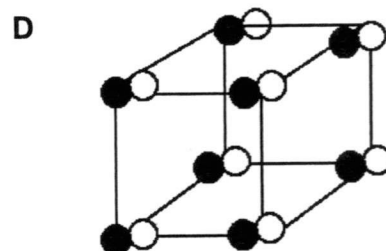
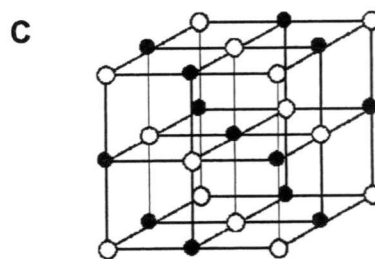
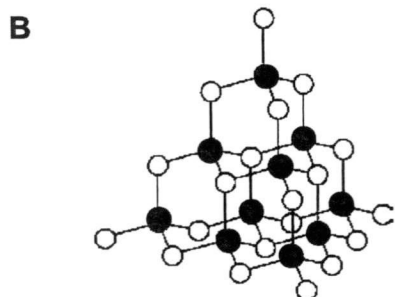
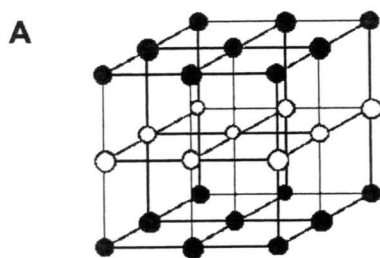
15 What is the total number of shared electrons in the ethene molecule?



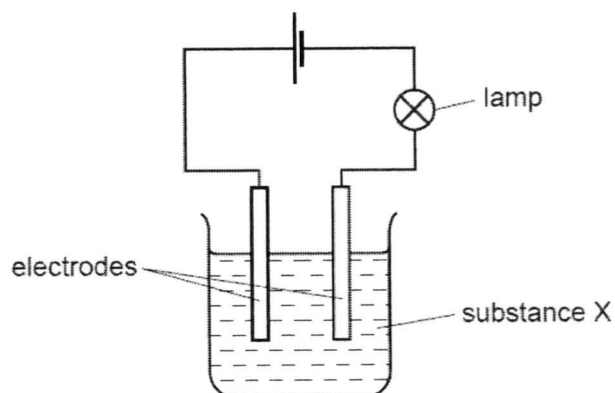
- A 6
 B 8
 C 10
 D 12

[8]

- 16 Which of the following structures correctly represents the arrangement of particles in sodium chloride?



- 17 In the circuit below, the lamp lights up.



What could substance X be?

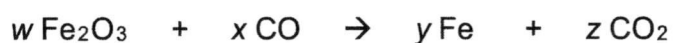
- A** a solution of ethanol in water
- B** a solution of potassium fluoride in water
- C** liquid ethanol
- D** solid potassium fluoride

[9]

- 18 Potassium hydroxide and sulfuric acid react to produce potassium sulfate and water. Which of the following shows the ionic equation for the reaction?

- A $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
 B $2\text{K}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{K}_2\text{SO}_4(\text{aq})$
 C $2\text{K}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{K}_2\text{SO}_4(\text{s})$
 D $\text{K}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{KHSO}_4(\text{s})$

- 19 Iron (III) oxide reacts with carbon monoxide according to the following equation:



What values of w , x , y and z would balance this equation?

	w	x	y	z
A	1	2	2	3
B	1	3	2	3
C	1	3	1	2
D	2	1	1	2

- 20 A hydrocarbon molecule C_xH_y has a relative molecular mass (M_r) of 42.

What are the values of x and y ?

[Relative atomic masses: A_r : H, 1; C, 12]

	x	y
A	1	2
B	3	6
C	6	3
D	6	6

End of Section A

[10]

SECTION B: STRUCTURED QUESTIONS [30 MARKS]ANSWER **ALL** THE QUESTIONS.

WRITE YOUR ANSWERS IN THE SPACES PROVIDED.

- 1 Fig. 1 contains information about five substances **K**, **L**, **M**, **N** and **O**.

K is a solid which melts on heating to form a yellow liquid that cannot be made into a simpler substance.		L is a blue liquid that can be separated into three dyes by chromatography.
	M is a black solid formed by burning copper in oxygen gas. Heat is liberated in this process.	
N is a white solid that can be separated into two different substances by adding water and filtering.		O is a colourless substance with a fixed melting point and a fixed boiling point.

Fig. 1

Classify each of the substances as either an element, a compound, a mixture or either an element or a compound.

Complete Table 1 by placing ticking (✓) the correct box for each substance.

substance	element	compound	mixture	either element or compound
K				
L				
M				
N				
O				

Table 1**[5]**

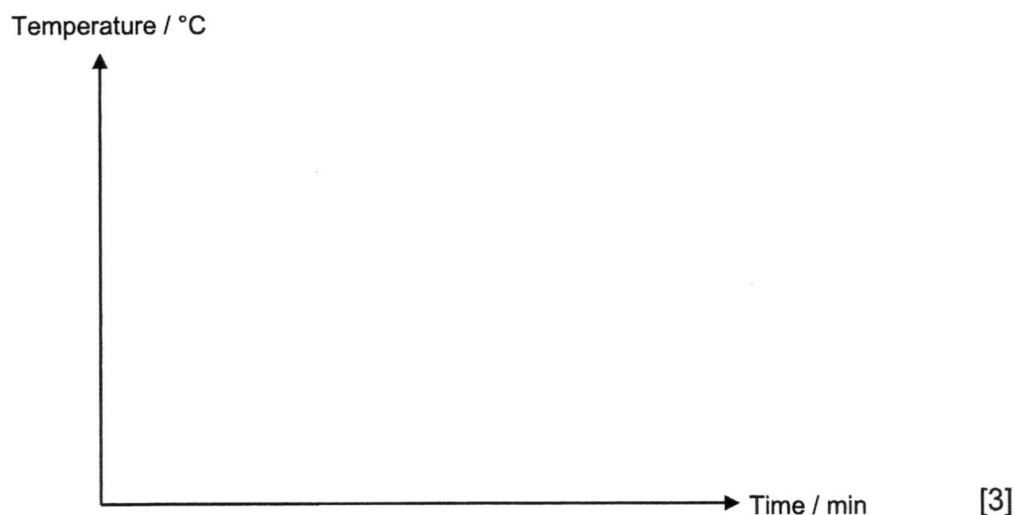
[11]

- 2 Table 2 below shows the melting points and boiling points of two different substances, **R** and **S**.

substance	melting point / °C	boiling point / °C	physical state	
			at 25°C	at 100°C
R	35	120		
S	23	95		

Table 2

- (a) Complete Table 2 to indicate the physical states of the substances at 25°C and at 100°C. [2]
- (b) A pure sample of substance **R** was heated from 25 °C to 150 °C. Sketch, on the axes below, the heating curve that would be obtained. Label all critical values clearly. On the graph, also label the regions where melting and boiling will occur.



- (c) Would the same heating curve be obtained if an impure sample of substance **R** was heated instead? Explain your answer.

.....

.....

..... [2]

[12]

- 3 A mixture of two white solids, sodium chloride and sugar, were mixed together by accident. A student was tasked to recover sugar crystals from this mixture. He decided to use an organic solvent, ethanol, to separate the two solids.

- (a) By considering the type of bonding present in sodium chloride and sugar, explain why ethanol is a suitable solvent to use for this separation.

.....

 [2]

- (b) The steps that the student takes are illustrated in Fig. 3 below.

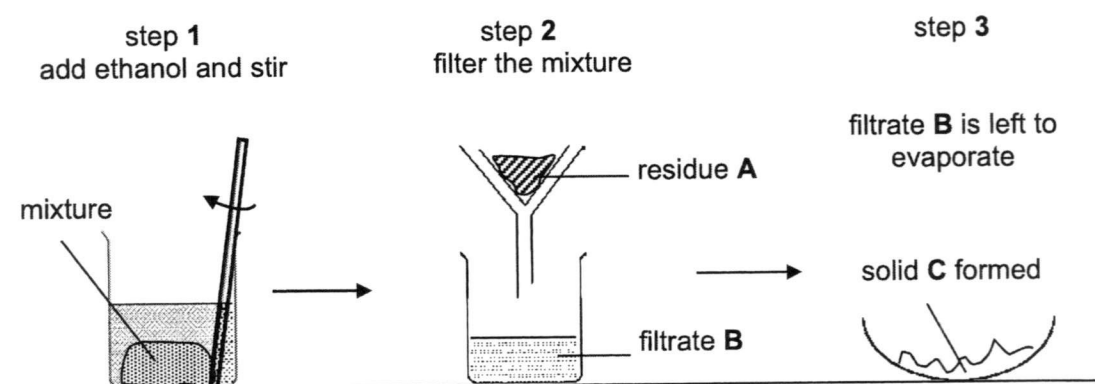


Fig. 3

- (c) What substance is present in the following?

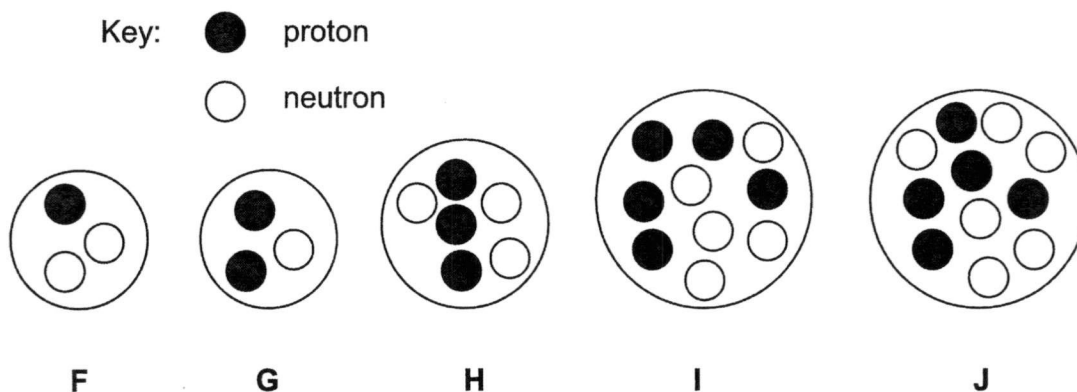
- (i) residue A
 (ii) filtrate B
 (iii) solid C [3]

- (d) Suggest why the student decided to leave filtrate B to evaporate in the open, instead of heating it.

.....
 [1]

[13]

- 4 Fig. 4 below represents the nuclei of five different atoms, **F**, **G**, **H**, **I** and **J**. These letters are *not* the chemical symbols of the elements.

**Fig. 4**

Using the letters **F** to **J**, answer the following questions. Each letter may be used once, more than once or not at all.

- (a) Which element has a nucleon number of 6?

..... [1]

- (b) Which element is a noble gas?

..... [1]

- (c) Which element is an isotope of hydrogen?

..... [1]

- (d) Which element is most likely to form an ion of +1 charge?

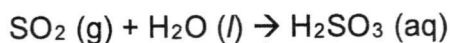
..... [1]

- (e) Which **two** elements have the same electronic configuration?

..... [1]

[14]

- 5 Sulfur dioxide is a toxic gas that dissolves readily in water to form sulfurous acid, H_2SO_3 . This is represented by the chemical equation:



- (a) Calculate the relative molecular masses (M_r) of sulfur dioxide and sulfurous acid. Show all your working clearly.

[Relative atomic masses: A_r : H, 1; O, 16; S, 32]

(i) SO_2

(ii) H_2SO_3

[2]

- (b) At room temperature and pressure, 1.8 dm^3 of sulfur dioxide gas was dissolved in 100 cm^3 of water.

- (i) Calculate the number of moles of sulfur dioxide gas involved in this reaction.

[1]

- (ii) The number of moles of sulfurous acid formed was the same as the number of moles of sulfur dioxide reacted in (b)(i).

Calculate the concentration, in mol/dm^3 , of the sulfurous acid formed.

[2]

[15]

- (c) In general, gases which have a relative molecular mass that is less than 30 are less dense than air.

Using this information and your answer in (a)(i), draw a diagram to show how a dry sample of sulfur dioxide gas can be collected.

Name this method of gas collection.

[2]

End of Section B

[16]

SECTION C: FREE RESPONSE QUESTIONS [20 MARKS]ANSWER **ALL** THE QUESTIONS.

WRITE YOUR ANSWERS ON THE SPACES PROVIDED.

- 6 Chlorine has two naturally-occurring isotopes, $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$.

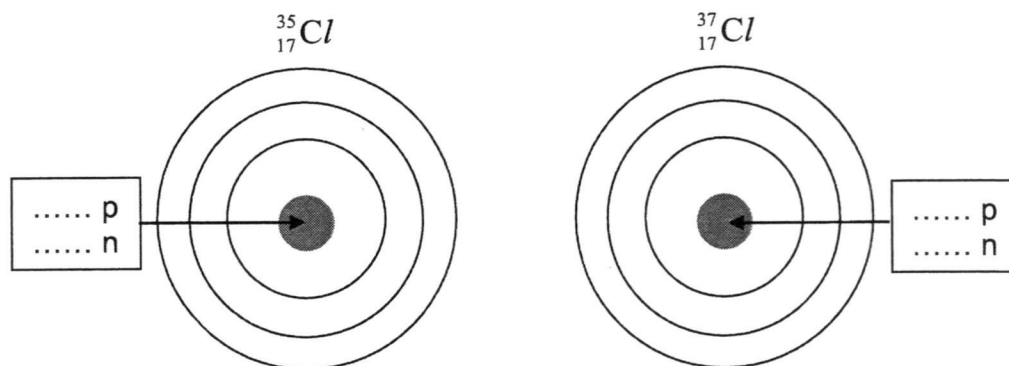
(a) Define *isotopes*.

.....
 [1]

(b) Complete Fig. 6.1 and Fig. 6.2 below to show the electronic structure of

$^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$. Indicate on both diagrams:

- (i) the number of protons (p) and neutrons (n) in each isotope;
- (ii) the electronic configuration of each isotope;
- (iii) the arrangement of electrons in each isotope.



Electronic configuration = Electronic configuration =

Fig. 6.1**Fig. 6.2**

[4]

(c) With reference to Fig. 6.1 and 6.2, describe the similarities and differences in the atomic structure and electronic structure of $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$.

.....

 [2]

[17]

- (d) Define *relative atomic mass*.

.....
.....

[1]

- (e) The natural abundance of $^{35}_{17}\text{Cl}$ is 75.8% while the natural abundance of $^{37}_{17}\text{Cl}$ is 24.2%. Calculate the relative atomic mass of chlorine, giving your answer correct to 3 significant figures.

[1]

- (f) Silicon has three naturally-occurring isotopes, silicon-28, silicon-29 and silicon-30.

Given that the relative atomic mass of silicon is 28.0855, which isotope occurs in the greatest abundance?

..... [1]

[18]

- 7 When elements react with oxygen, a compound called an *oxide* is typically formed. For example, carbon reacts with oxygen to form carbon dioxide. Sodium reacts with oxygen to form sodium oxide.

- (a) Write a balanced chemical equation, including the state symbols, for the formation of sodium oxide from sodium metal and oxygen gas.

..... [2]

- (b) Draw a 'dot and cross' diagram to show the arrangement of electrons in a molecule of carbon dioxide in the space below. Show only the valence electrons of each atom. [Proton numbers: C, 6; O, 8]

[2]

- (c) Draw a 'dot and cross' diagram to show the arrangement of electrons in sodium oxide in the space below. Show all the electrons in each atom. [Proton numbers: O, 8; Na, 11]

[2]

[19]

- (d) With reference to the structure and bonding, explain why sodium oxide is a solid and carbon dioxide is a gas at room temperature and pressure.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

End of Paper

The Periodic Table of Elements

Group																			III	IV	V	VI	VII	0
I	II																					2		
																						He helium 4		

[20]

lanthanoids

actinoids

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

YUSOF ISHAK SECONDARY SCHOOL

MID-YEAR-EXAMINATION 2017

SCIENCE (CHEMISTRY)
Express

Secondary
THREE

Setter: Miss Chan Siming

Marking Scheme

SECTION A: MULTIPLE CHOICE QUESTIONS [20 MARKS]

Qn	1	2	3	4	5	6	7	8	9	10
Ans	<u>B</u>	<u>A</u>	<u>C</u>	<u>C</u>	<u>D</u>	<u>D</u>	<u>D</u>	<u>D</u>	<u>C</u>	<u>A</u>

Qn	11	12	13	14	15	16	17	18	19	20
Ans	<u>C</u>	<u>D</u>	<u>D</u>	<u>B</u>	<u>D</u>	<u>C</u>	<u>B</u>	<u>A</u>	<u>B</u>	<u>B</u>

SECTION B: STRUCTURED QUESTIONS [30 MARKS]

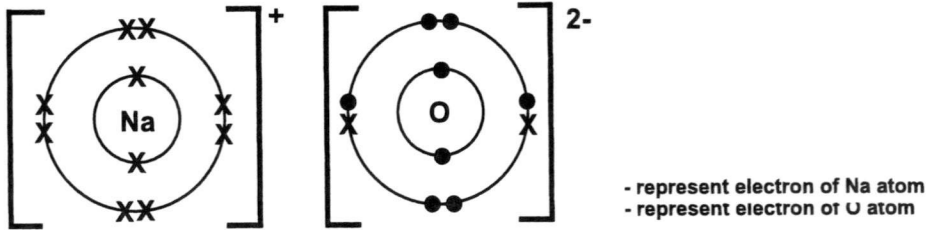
Qn	Answer					Marks	
1	substance	element	compound	mixture	either element or compound	1 mark for each correct substance	
	K	✓					
	L			✓			
	M		✓				
	N			✓			
	O				✓		
2	(a)	substance	melting point / °C	boiling point / °C	physical state		1 mark for each substance
					at 25°C	at 100°C	
		R	35	120	Solid	Liquid	
		S	23	95	Liquid	Gas	

	(b)	Temperature / °C 150 120 35 25 boiling melting Time / min 1m – correct shape of graph 1m – correct melting and boiling points labelled (35°C and 120°C) 1m – correct labelling of melting and boiling										
	(c)	The heating curve obtained would be <u>different</u>. Impurities would cause the substance to <u>melt/boil over a range of temperatures</u>, instead of at a fixed temperature.	1 1									
3	(a)	Sodium chloride is an <u>ionic compound</u> hence it will be <u>insoluble</u> in ethanol. Sugar is a <u>covalent compound</u> hence it will be <u>soluble</u> in ethanol. <i>Answers such as: Ethanol will only dissolve one of the solids – award 1m</i>	1 1									
	(b)	<table border="1"> <tr> <td>(i)</td> <td>Sodium chloride</td> <td>1</td> </tr> <tr> <td>(ii)</td> <td>Sugar solution</td> <td>1</td> </tr> <tr> <td>(iii)</td> <td>Sugar crystals</td> <td>1</td> </tr> </table>	(i)	Sodium chloride	1	(ii)	Sugar solution	1	(iii)	Sugar crystals	1	
(i)	Sodium chloride	1										
(ii)	Sugar solution	1										
(iii)	Sugar crystals	1										
	(c)	Sugar will <u>decompose</u> upon heating.	1									
4	(a)	H	1									
	(b)	G	1									
	(c)	F	1									
	(d)	H	1									
	(e)	I and J	1									
5	(a)	<table border="1"> <tr> <td>(i)</td> <td>M_r of $\text{SO}_2 = 32 + 2 \times 16 = 64$</td> <td>1</td> </tr> <tr> <td>(ii)</td> <td>M_r of $\text{H}_2\text{SO}_3 = 2 \times 1 + 32 + 3 \times 16 = 82$</td> <td>1</td> </tr> </table>	(i)	M_r of $\text{SO}_2 = 32 + 2 \times 16 = 64$	1	(ii)	M_r of $\text{H}_2\text{SO}_3 = 2 \times 1 + 32 + 3 \times 16 = 82$	1				
(i)	M_r of $\text{SO}_2 = 32 + 2 \times 16 = 64$	1										
(ii)	M_r of $\text{H}_2\text{SO}_3 = 2 \times 1 + 32 + 3 \times 16 = 82$	1										

	(b)	(i)	No. of moles of $\text{SO}_2 = \frac{1.8 \text{ dm}^3}{24 \text{ dm}^3} = 0.075 \text{ mol}$	1
		(ii)	No. of moles of $\text{H}_2\text{SO}_3 = 0.075 \text{ mol}$ $100 \text{ cm}^3 = 0.1 \text{ dm}^3$ Concentration of $\text{H}_2\text{SO}_3 = \frac{0.075 \text{ mol}}{0.1 \text{ dm}^3} = 0.75 \text{ mol/dm}^3$	1 1
	(c)	M_r of $\text{SO}_2 = 64$ Hence SO_2 is more dense than air and the method of gas collection used should be <u>downward delivery</u> . Diagram:		1 1

SECTION C: FREE RESPONSE QUESTIONS [20 MARKS]

6	(a)	Isotopes are atoms of the same element with the <u>same number of protons and electrons</u> but <u>different number of neutrons</u> .	1
	(b)	Electronic configuration = 2.8.7 Fig. 6.1 Electronic configuration = 2.8.7 Fig. 6.2 1m each – correct no. of protons and neutrons for each isotope 1m – correct arrangement of electrons for both isotopes 1m – correct electronic configuration for both isotopes	4

	(c)	Similarities: Both $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$ have <u>17 protons</u> found in the nucleus, and <u>17 electrons</u> found in electron shells around the nucleus. Difference: $^{35}_{17}\text{Cl}$ has <u>18 neutrons</u> found in the nucleus, whereas $^{37}_{17}\text{Cl}$ has <u>20 neutrons</u> found in the nucleus. <i>If students wrote something to the extent of "same number of protons and electrons but different number of neutrons", without being specific about the number of sub-atomic particles found in each isotope, award 1m only</i>	1
	(d)	The relative atomic mass of an atom is the average mass of one atom of that element compared to $\frac{1}{12}$ the mass of one carbon-12 atom.	1
	(e)	A_r of chlorine = $\frac{75.8}{100} \times 35 + \frac{24.2}{100} \times 37 = 35.5$ (to 3 s.f.)	1
	(f)	<u>Silicon-28</u> occurs in the greatest abundance.	1
7	(a)	$4\text{Na (s)} + \text{O}_2 \text{ (g)} \rightarrow 2\text{Na}_2\text{O (s)}$ 1m – correct chemical formulae of all substances 1m – correctly balanced with correct state symbols	2
	(b)	 1m – correct type of bonding (covalent) + correct ratio (2 C to 1 O) 1m – correct number of electrons	2
	(c)	 1m – correct charge of ions + correct ratio (2 Na to 1 O) 1m – correct number of electrons	2

7	(d)	Sodium oxide is an <u>ionic compound</u> where the ions are held together in a <u>giant lattice structure</u> [1]. A <u>large amount of energy</u> is required to overcome <u>strong electrostatic forces of attraction between oppositely charged ions</u> [1]; hence, sodium oxide has a high melting and boiling point and exists as a solid at room temperature and pressure. Carbon dioxide is a <u>covalent compound</u> with a <u>simple molecular structure</u> [1]. <u>Little amount of energy</u> is required to overcome the <u>weak intermolecular forces <i>between</i> the molecules</u> [1]; hence, carbon dioxide has a low melting and boiling point and exists as a gas at room temperature and pressure.	4
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