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BEDOK SOUTH SECONDARY SCHOOL END-OF-YEAR EXAMINATION 2021

3EXP

CANDIDATE NAME

CLASS

REGISTER
NUMBER

SCIENCE (CHEMISTRY)

5076 & 5078

5 October 2021

Additional Material(s): Optical Mark Sheet (OMS)

1 hour 30 minutes

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, except for Section A.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue, or correction fluid.

SECTION A (20 marks)

Write your name, register number, class and subject on the Optical Mark Sheet (OMS) provided.

There are **20** questions. Answer **ALL** questions. For each question, there are four possible answers **A, B, C** and **D**.

Choose the **one** that you consider correct and record your choice in **soft pencil** on the separate Optical Mark Sheet (OMS).

SECTION B (35 marks)

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

SECTION C (20 marks)

There are three questions in this section. Answer only **two** questions in this section.
Write down your answers 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 18.

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

Omission of essential working will result in loss of marks.

You are reminded of the need for **clear presentation** in your answers.

For Examiner's Use	
Section A	20
Section B	35
Section C	20
Total	75

Setter: Mrs Djie SA

Section A: Multiple Choice Questions (20 marks)

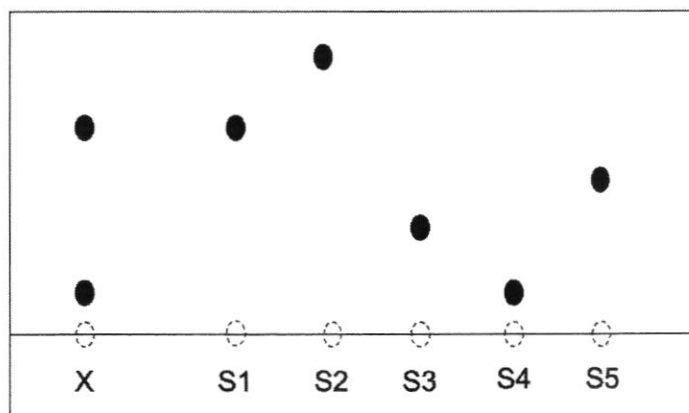
- 1 A student carried out an experiment to study the speed of reaction by collecting the gas produced when a piece of zinc metal was added to dilute sulfuric acid.

Which piece of apparatus is **not** required for this experiment?

- A conical flask B Bunsen burner
C stopwatch D gas syringe

- 2 Chromatography was carried out with an athlete's blood sample to determine the banned substances he had consumed prior to a sports tournament.

The diagram shows the chromatogram obtained. The athlete's blood sample is labelled as X. S1 to S5 are known banned substances.

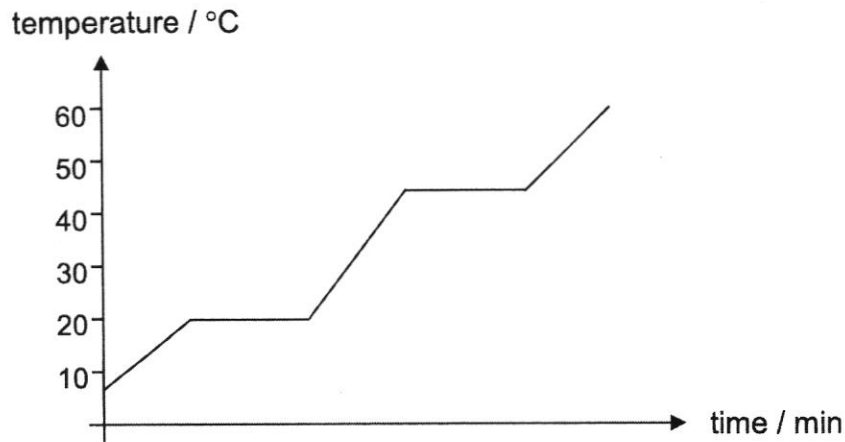


Based on the chromatogram, which banned substance did the athlete consume?

- A S1 and S2 B S1 and S4
C S2 and S4 D S3 and S5
- 3 Which change occurs when a liquid at 50 °C becomes a gas at 120 °C?

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

- 4** The diagram shows the heating curve of a substance.



What is the boiling point of the substance?

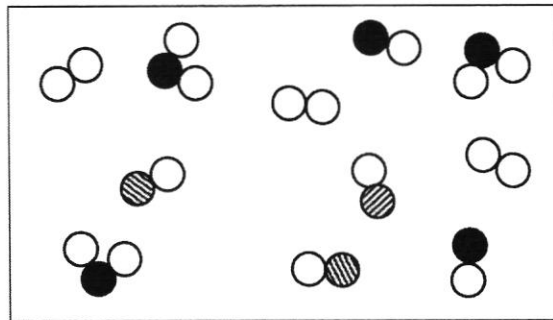
- A** 20 °C
B 34 °C
C 44 °C
D 60 °C

B 34 °C

C 44 °C

D 60 °C

- 5** The diagram shows a mixture of different substances.



Which statement best describes this mixture?

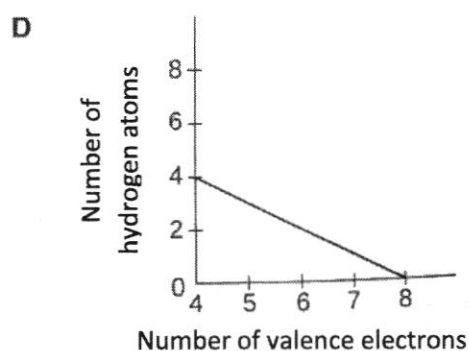
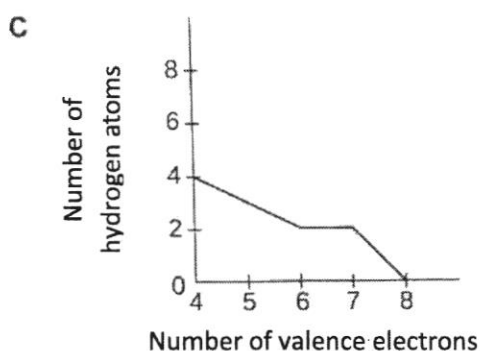
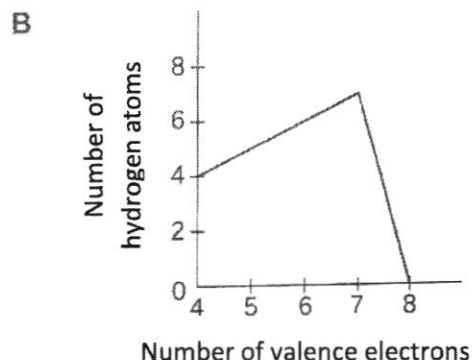
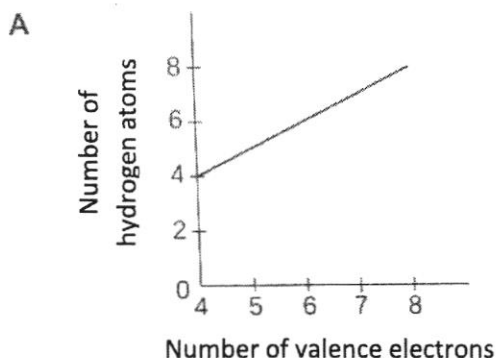
- A** It contains one element and two compounds.
- B** It contains one element and three compounds.
- C** It contains two elements and two compounds.
- D** It contains three elements and one compound.

B It contains one element and three compounds.

C It contains two elements and two compounds.

D It contains three elements and one compound.

- 6 Which graph best represents the relationship between the number of valence electrons of an atom and the number of hydrogen atoms which the atom is most likely to combine with?



- 7 Which statement determines the chemical properties of chlorine?

- A mass number of its atom
- B relative atomic mass of its atom
- C number of electron shells in its atom
- D number of valence electrons in its atom

- 8 Four elements have the following electronic configurations.

W	2, 1
X	2, 2
Y	2, 8, 5
Z	2, 8, 8

Which statement is **not** correct?

- A **W** and **X** are metals but **Y** and **Z** are non-metals.
- B **Z** is a stable and unreactive element.
- C All four elements are in the same period in the Periodic Table.
- D All four elements are in different groups in the Periodic Table.

14 Which statement about the elements in the Periodic Table is correct?

- A Elements are arranged in order of their nucleon number.
- B Elements are arranged in order of their proton number.
- C The reactivity of Group I elements decreases down the group.
- D Elements in the same group form either positive ions or negative ions.

15 The table below shows the results on adding dilute sulfuric acid and sodium hydroxide to four oxides, **A**, **B**, **C** and **D**.

Which oxide is amphoteric?

	dilute sulfuric acid	sodium hydroxide
A	no reaction	reaction
B	no reaction	no reaction
C	reaction	reaction
D	reaction	no reaction

16 Flowers of a hydrangea bush are blue when grown in acidic soil and pink when the soil is alkaline.

Which substance is added to the soil of a hydrangea with blue flowers so that it produces pink flowers?

- A sodium chloride
- B cobalt chloride
- C hydrochloric acid
- D calcium hydroxide

17 An aqueous solution of compound **R** reacts with aqueous ammonia to form a reddish-brown precipitate. When aluminium powder was added and the mixture heated, a gas that turns damp red litmus paper blue is given off.

What is compound **R**?

- A iron(II) nitrate
- B iron(III) nitrate
- C ammonium nitrate
- D ammonium chloride

18 Ethane burns completely in oxygen according to the equation below.



Which numbers will correctly balance this equation?

	p	q	r	s
A	1	2	2	1
B	1	3	2	2
C	2	2	2	1
D	2	3	2	2

19 How many different chlorides in total could be prepared by the reaction of dilute hydrochloric acid with the following substances?

- copper
- magnesium
- silver
- zinc carbonate

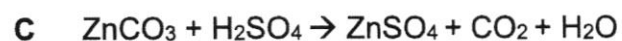
A 1

B 2

C 3

D 4

20 Which method of preparation of a pure salt solution requires the use of a pipette and burette?



End of Section A

Section B: Structured Questions(35 marks)Answer **all** the questions in the spaces provided.

- 1 The melting and boiling points of three substances **X**, **Y** and **Z** are listed in the table below.

substance	melting point / °C	boiling point / °C
hydrogen chloride	-114	-85
bromine	-7	59
sodium hydroxide	318	1388

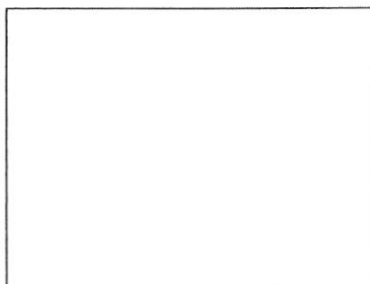
- (a) Which substance shows a change in state when temperature increases from 100 °C to 350 °C?

..... [1]

- (b) Which substance has particles which can be compressed easily at 0 °C?

..... [1]

- (c) In the space below, draw the arrangement of bromine particles at 10 °C.



[1]

- (d) Describe the change in the attractive forces and the energy of particles when hydrogen chloride changes from solid to liquid state.

.....

 [1]

- (e) Use kinetic particle theory to describe the arrangement and movement of bromine as temperature increases from -20 °C to 0 °C.

.....

 [3]

[Total: 7]

- 2 Fig. 2.1 shows the nuclei of four different atoms, **A**, **B**, **C** and **D**.

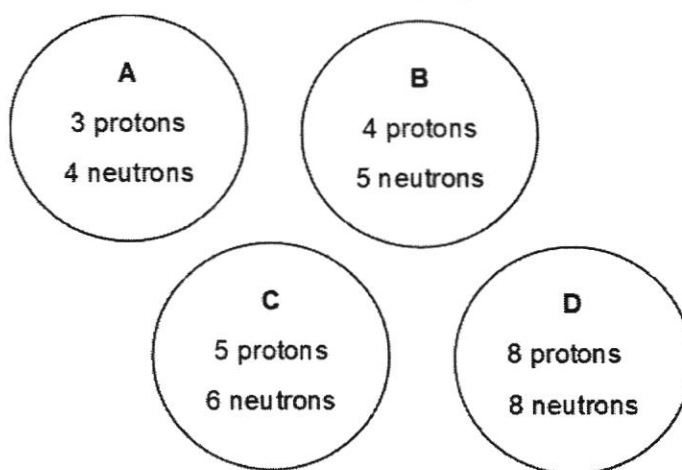


Fig. 2.1

- (a) State the letter(s) which represent(s) the nucleus of an atom

(i) with an atomic number 5,

..... [1]

(ii) with 1 valence electron,

..... [1]

- (b) Atom **A** and **D** can combine to form a compound.

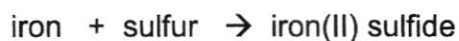
Write down the chemical formula of the compound formed.

..... [1]

[Total: 3]

- 3 A mixture is obtained when iron powder is mixed with sulfur powder.

A compound, iron(II) sulfide, is formed when a mixture of iron powder and sulfur powder is strongly heated.



Using the two examples mentioned above, explain clearly two differences between a mixture and a compound.

.....

.....

.....

..... [2]

[Total: 2]

- 4 A student set up the apparatus shown in Fig. 4.1 to separate a mixture of ethanol (boiling point 78°C) and water (boiling point 100°C)

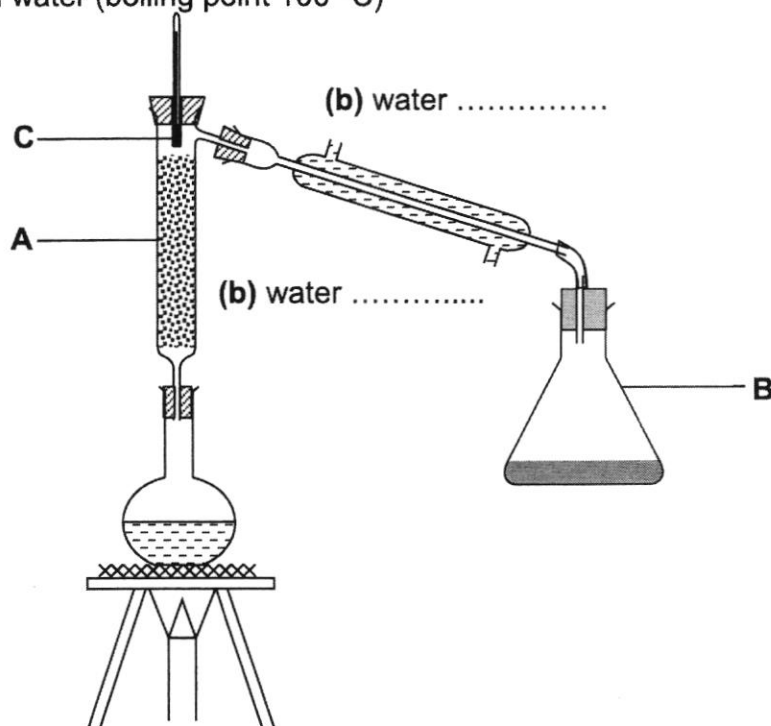


Fig. 4.1

- (a) What is the function of the condenser?
..... [1]
- (b) On the diagram above, indicate the direction of water in and out of the condenser. [1]
- (c) State one error the student made in the experimental set-up. Explain why.
.....
..... [2]
- (d) State the temperature at C when first liquid starts to distil over.
..... [1]
- (e) Explain why a fractionating column is needed in the above experimental set-up.
..... [1]

[Total: 6]

[illegible]

Use the letters from the table to match the following statements.

- (a) Element(s) that form(s) acidic oxides.

[1]

- (b)** Atoms of this element loses two electrons when they form ions.

- (c) These two elements combine together to form an ionic compound with a formula XY_2 .

- (d)** Element(s) that exist(s) as monoatomic atom(s) in nature.

[Total: 4]

- 6 (a)** Ethanoic acid is a weak acid.

- (i) Define the term *weak acid*.

[1]

- (ii) State the formula of the ion that causes the solution to be acidic.

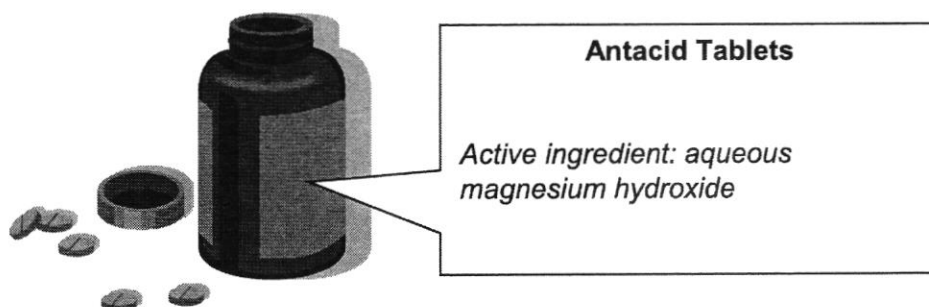
[1]

- (b)** Write an ionic equation for the reaction between dilute nitric acid and sodium hydroxide.

- (c) Gastric pain is a condition whereby there is an overproduction of hydrochloric acid found in gastric juices in the stomach. This often leads to churning of the stomach, resulting in pain.

Antacid tablets are usually prescribed for the relief of such discomfort.

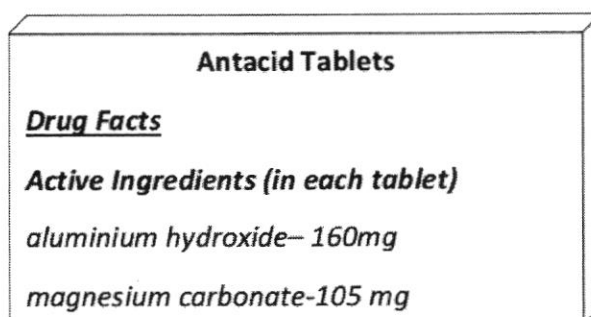
The label of one such brand of antacid is shown below:



- (i) Write the balanced equation for the reaction between the antacid and hydrochloric acid.

[1]

- (ii) Another brand of antacid tablets can also be used to neutralise the acidity in the stomach.



Explain how this brand of tablets results in excessive gas production in one's stomach and why it does not reduce the acidity in the stomach as effectively.

[2]

[Total: 6]

- 7 When two substances are mixed together in solution, they form a precipitate of silver chloride.

(a) Name these **two** substances.

(i) _____

(ii) _____

[1]

(b) Write a balanced equation with state symbols for the above chemical reaction.

_____ [2]

(c) Describe the three steps you would use to obtain a pure dry sample of silver chloride using the substances you suggested in (a).

.....
.....
.....
.....

[3]

(d) State and explain if copper(II) sulfate can be prepared by the above method.

.....
.....

[1]

[Total: 7]

End of Section B

Section C: Free Response Questions (20 marks)Answer any **two** questions in this section.

Write your answers in the spaces provided

- 8 In 1861, Bunsen and Kirchhoff found that Rubidium has two naturally occurring isotopes; rubidium-85 (^{85}Rb) and rubidium-87 (^{87}Rb).

(a) Define the term *isotope*.

.....
..... [1]

- (b) Both isotopes of rubidium react with chlorine to form rubidium chloride. This compound is commonly used as a biomarker as it dissolves very well in water and is readily absorbed by the human body.

(i) Rubidium is in Group I and its atomic symbol is Rb.

Suggest the chemical formula of rubidium chloride.

..... [1]

(ii) Explain why both isotopes form a compound of rubidium chloride with the same chemical formula.

.....
..... [1]

(c) (i) Draw the electronic configuration of a chlorine atom. [1]

(ii) Write the electronic configuration of a chlorine atom = [1]

(d) Compare and predict the electrical conductivity of rubidium chloride in solid state and when dissolved in water. Explain your answer in terms of structure and bonding.

.....
.....
.....
..... [3]

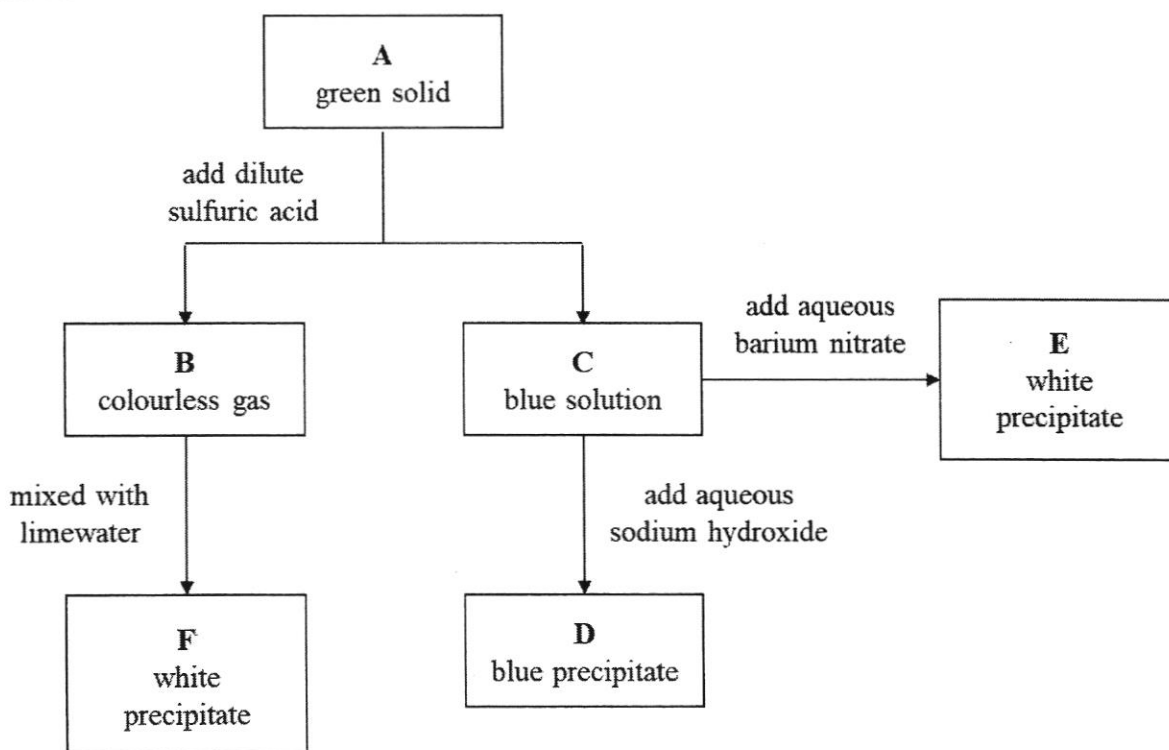
- (e) Rubidium tarnishes quickly on exposure to air to form rubidium oxide. State the type of oxide that rubidium oxide is. Predict its reaction with an acid or alkali, if any.

.....

 [2]

[Total: 10]

- 9 The diagram below shows some of the properties and reactions of the substances **A**, **B**, **C**, **D** and **E**.



- (a) Name the following substances.

(i) green solid **A**,

(ii) colourless gas **B**,

(iii) blue solution **C**,

(iv) blue precipitate **D**,

(v) white precipitate **E**. [5]

- (b) Write a balanced chemical equation, for the reaction of green solid **A** with dilute sulfuric acid.

..... [1]

- (c) Suggest a test to identify colourless gas B.

[1]

- (d) Copper(II) oxide and zinc oxide are insoluble in water. Describe and explain how you can obtain copper(II) oxide from a mixture of copper(II) oxide and zinc oxide.

[3]

[Total: 10]

- 10 The radii of atoms and ions can be measured.

The table shows some about atomic radii and ionic radii of some Group I and Group VII elements.

element	number of electron shells	atomic radius/ pm	number of shells of electrons in +1 ion	ionic radius/ pm
lithium	2	152	1	68
sodium		185		98
potassium		227		133

element	number of electron shells	atomic radius/ pm	number of shells of electrons in -1 ion	ionic radius/ pm
fluorine		71		133
chlorine	3	99	3	181
bromine		115		196

(1 000 000 000 000 pm = 1m)

- (a) Complete both tables to show the number of shells of electrons in the atoms and ions of Group I and Group VII elements.

[2]

- (b) State the common name is given to the elements in

(i) Group I _____

(ii) Group VII _____

[1]

- (c) Use your knowledge of electronic structures to answer these questions.

(i) Explain why are lithium, sodium and potassium are grouped together.

[1]

- (ii) Explain why when moving across the Periodic Table from lithium to fluorine, the character of these elements changes from being metallic to non-metallic.

.....
.....
..... [2]

- (d) Group I and Group VII show different trends in their properties.

- (i) Describe the trend in melting point down each group.

.....
..... [1]

- (ii) Describe the trend in reactivity down each group.

.....
..... [1]

- (iii) Describe the change in the radius when a sodium atom forms a sodium ion.

.....
..... [1]

- (iv) Suggest why the radius of a sodium atom changes in this way when it forms a sodium ion.

.....
..... [1]

[Total: 10]

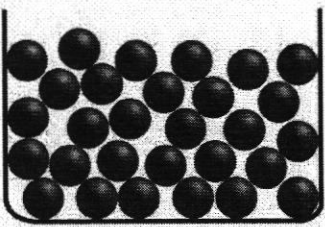
End of Section C

SCIENCE(CHEMISTRY) 5076/5078
 SEC 3 EXPRESS
 EOY EXAMINATION 2021 MARK SCHEME

Section A (20 marks)

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

Section B (35 marks)

1	(a)	Sodium hydroxide	1
	(b)	Hydrogen chloride	1
	(c)	 Liquid state	1
	(d)	Attractive forces between particles decreases (1/2) while the energy of particles increases (1/2)	1
	(e)	When temperature increases from -10 °C, the closely packed solid bromine particles (1/2) begins to gain energy (1/2) and vibrate faster in fixed position (1/2). At -7 °C, solid bromine gains enough energy to overcome attraction force (1/2) to move apart and can slide past one another (1/2) resulting in arrangement of particles being disorderly and less closely packed(1/2).	3
2	(a)i	C	1
	ii	A	1
	(b)	A ₂ D	1
3		Difference 1- A mixture is made up of two elements not chemically combined/ formed by physically mixing two substances. A compound is a substance made up of two elements chemically combined together.	1
		Difference 2- Heating is needed in forming a compound but no chemical change takes place is forming a mixture Or Energy change like heating is needed during formation of compound, no energy change in d formation of mixture.	1
4	(a)	To absorb heat from the vapour so the vapour can condense to liquid state/ to cool the vapour and condense it to liquid Reject: For condensation to take place	1
	(b)	water out from the top / water in from the bottom	1

	Correct direction of water in and out.	
(c)	Apparatus B cannot be stoppered. [1] Pressure build up prevent the distillate from flowing down [1]	2
(d)	78°C	1
(e)	Mixture consists of 2 liquids of different boiling points, so fractionating column is needed to separate liquids with different boiling points.	1
5 (a)	C and D	1
(b)	B	1
(c)	B and C	1
(d)	E	1
6 (a)	(i) A substance partially ionises to produce hydrogen ions in water	1
	(ii) H^+	1
(b)	$H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$	1
(c)	(i) $Mg(OH)_2 + 2 HCl \rightarrow MgCl_2 + 2H_2O$	1
	(ii) <u>Carbon dioxide gas</u> will be produced as the <u>magnesium carbonate present will react with the acid in the stomach.</u> [1] This may not be effective as <u>carbon dioxide is an acidic gas</u> which add on to the acidity in the stomach. [1] <i>Ignore if relates to carbon dioxide form causing bloating as this is not related to effectiveness of the use of antacid in this context.</i>	2
7 (a)	(i) silver nitrate (ii) hydrochloric acid or sodium chloride	1
(b)	$AgNO_3 (aq) + HCl (aq) \rightarrow AgCl (s) + HNO_3 (l)$	1
(c)	Mix equal volume of two solutions in (a) [1] Filter the mixture to obtain silver chloride as residue [1] Wash the residue with some deionised water and dry between filter papers [1]	3
(d)	No, Copper(II) sulfate is a soluble salt, cannot be prepared by precipitation method.	1

Section C (20 marks)

8	(a)	Atoms of the same element with different no of neutrons, but same no of protons/ electrons	1
	(b)	(i) RbCl	1
		(ii) Both isotopes have same number of valence electrons ie 1	1
	(c)	Electronic configuration of chlorine atom = 2.8.7	1
		Drawing of chlorine atom showing correct no of electrons in 3 shells	1
	(d)	Solid rubidium chloride cannot conduct electricity as the ions are held in fixed positions (by strong electrostatic attraction forces) in the crystal lattice structure .	1
		When it dissolves in water, rubidium chloride solution can conduct electricity as the ions are mobile OR all there are ions as mobile charge carriers .	1
	(e)	Basic oxide. [1] It has no reaction with alkalis but reacts with acid to form salt and water.	1
9	(a)	A- copper(II) carbonate	1
		B - carbon dioxide	1
		C- copper(II) sulfate	1
		D - copper(II) hydroxide	1
		E- barium sulfate	1
	(b)	$\text{CuCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$	1
	(c)	Bubble the gas into lime water, white precipitate is formed	1
	(d)	1) Add excess NaOH to the mixture and stir. [Zinc oxide is amphoteric oxide and will react with NaOH, copper(II) oxide is basic oxide and does not react with NaOH] 2) Filter the reaction mixture. Residue obtained is copper(II) oxide 3) Wash the residue with deionised water. Dry the residue with filter paper.	1 1 1

10 (a)	<table><tr><th>element</th><th>no of electron shells</th><th>no of electron shells in +1 ion</th></tr><tr><td>Lithium</td><td>2</td><td>1</td></tr><tr><td>Sodium</td><td>3</td><td>2</td></tr><tr><td>Potassium</td><td>4</td><td>3</td></tr></table>	element	no of electron shells	no of electron shells in +1 ion	Lithium	2	1	Sodium	3	2	Potassium	4	3	2
	element	no of electron shells	no of electron shells in +1 ion											
	Lithium	2	1											
	Sodium	3	2											
	Potassium	4	3											
	<table><tr><th>element</th><th>no of electron shells</th><th>no of electron shells in -1 ion</th></tr><tr><td>Fluorine</td><td>2</td><td>2</td></tr><tr><td>Chlorine</td><td>3</td><td>3</td></tr><tr><td>Bromine</td><td>4</td><td>4</td></tr></table>	element	no of electron shells	no of electron shells in -1 ion	Fluorine	2	2	Chlorine	3	3	Bromine	4	4	
	element	no of electron shells	no of electron shells in -1 ion											
	Fluorine	2	2											
	Chlorine	3	3											
	Bromine	4	4											
No of electron shells in atom – 1m														
No of electron shells in ions-1m														
(b)	(i) Group I – alkali metals (ii) Group VII- halogen	1												
(c)	(i) They only have 1 valence electron. (ii) Number of valence electron increase across the period. Elements with valece electrons 3 or less tend to lose electrons to form positive ion -metals Elements with more than 4 valence electrons tend to gain electrons to form negative ions – non-metals	1 1 1												
(d)	(i) Melting point decreases down Group I, increases down Group VII (ii) Reactivity increases down Group I, decreases down Group VII	1 1												
(e)	(i) When a sodium atom forms an ion, the radius decreases. (ii) When a sodium atom forms an ion, it loses one electron shell due to loss of valence electron.	1 1												