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- 21 Which information correctly describes the movement of particles in the three physical states?

	solid	liquid	gas
A	stationary	move freely throughout the liquid	move about rapidly in any direction
B	stationary	move about rapidly in any direction	vibrating about fixed position
C	vibrating about fixed position	move freely throughout the liquid	move about rapidly in any direction
D	vibrating about fixed position	stationary	move freely throughout the liquid

- 22 A student intends to measure the speed of reaction between a fixed mass of marble chips and fixed volume of dilute hydrochloric acid.



Which piece of apparatus is **not** required?

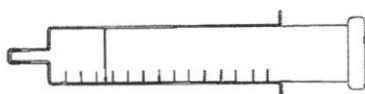
A



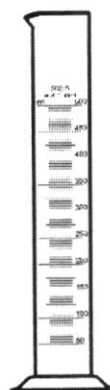
B



C



D



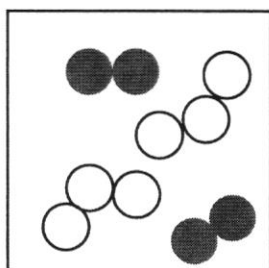
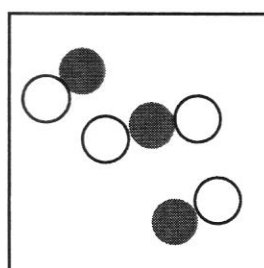
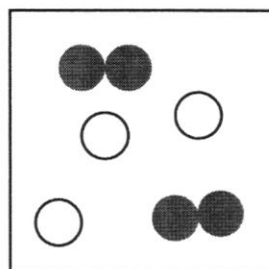
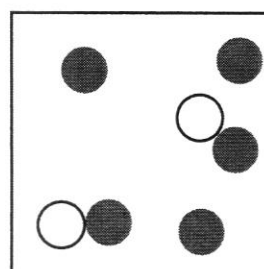
10

23 Ethanol and water are miscible liquids.

Which method could be used to separate a mixture of ethanol and water and how is the purity of separated ethanol checked?

	method of separation	purity check
A	filtration	add aqueous bromine
B	filtration	find the boiling point
C	fractional distillation	add aqueous bromine
D	fractional distillation	find the boiling point

24 Which diagram represents a mixture of two compounds?

A**B****C****D**

25 The nucleus of an atom has neutrons and protons.

Which statement about an atom is correct?

- A** The nucleus has a negative charge.
- B** The nucleus and electrons repel each other.
- C** Neutrons and protons have different relative mass.
- D** The nucleus contains most of the mass of the atom.

26 Which statement about covalent compounds is **incorrect**?

- A** They are formed by the sharing of electrons between the atoms.
- B** They conduct electricity as they have free-moving electrons.
- C** They do not dissolve in water but are soluble in organic solvent.
- D** They have low melting and boiling points due to the weak intermolecular forces between the molecules.

27 Element Q has an electronic structure 2,4.

Element R has an electronic structure 2,8,6.

What would be the formula of the compound formed between Q and R?

- A** QR₂ **B** Q₂R **C** QR₃ **D** Q₂R₃

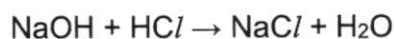
28 An equation is shown.



Which numbers will correctly balance this equation?

	w	x	y	z
A	1	3	2	2
B	1	2	3	3
C	2	3	4	3
D	2	1	2	3

29 25 cm³ of aqueous 0.5 mol/dm³ hydrochloric acid exactly neutralises 20 cm³ of aqueous sodium hydroxide.



What is the concentration of the sodium hydroxide solution?

- A** 0.3 mol/dm³
- B** 0.5 mol/dm³
- C** 0.625 mol/dm³
- D** 1.25 mol/dm³

12

- 30** Which pair of reagents can be used to produce an aqueous solution containing copper(II) sulfate salt?
- A** copper and dilute sulfuric acid
B copper(II) carbonate and dilute hydrochloric acid
C copper(II) hydroxide and sodium sulfate
D copper(II) oxide and dilute sulfuric acid
- 31** The table below shows the observations when oxides of three elements, Q, R and S are added to water.

	observations in water
Q oxide	Dissolved to form a solution with pH 2
R oxide	Dissolved to form a solution with pH 7
S oxide	Dissolved to form a solution of pH 10

What are elements Q, R and S?

	Q	R	S
A	sulfur	calcium	nitrogen
B	sulfur	nitrogen	calcium
C	calcium	nitrogen	sulfur
D	nitrogen	sulfur	calcium

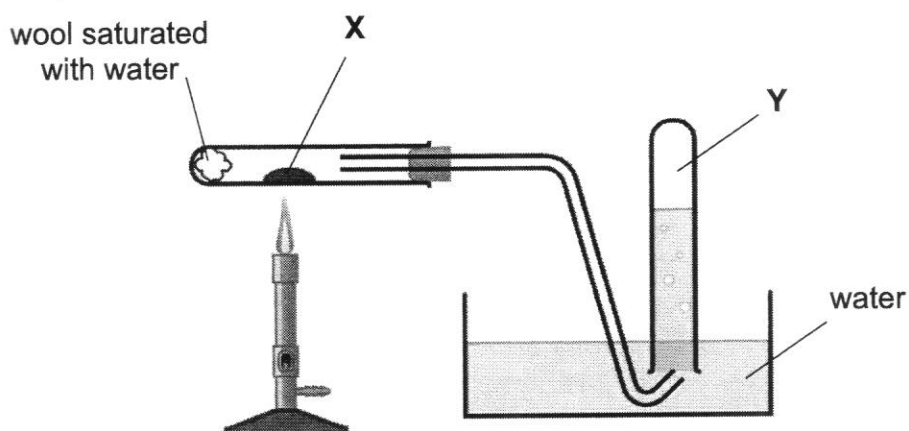
- 32** Which three salts can be prepared by titration?
- A** sodium sulfate, potassium chloride, ammonium nitrate
B barium sulfate, potassium chloride, lead(II) sulfate
C zinc sulfate, silver chloride, sodium nitrate
D barium sulfate, lead(II) chloride, ammonium nitrate

13

33 Which reaction is **not** an example of a redox reaction?

- A** $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$
B $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$
C $2\text{Al} + 3\text{CuO} \rightarrow \text{Al}_2\text{O}_3 + 3\text{Cu}$
D $\text{KOH} + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O}$

34 Steam is passed over a heated solid X. Gas Y is collected.



What are substances **X** and **Y**?

	X	Y
A	silver	hydrogen
B	lead	oxygen
C	copper	oxygen
D	zinc	hydrogen

14

35 Experiments are carried out for metals P, Q and R. The table shows the results.

experiment	P	Q	R
Can the metal be extracted by reducing its oxide with carbon?	no	yes	yes
Does the metal displace zinc from zinc chloride?	yes	no	yes

What is the order of reactivity of the metals?

	most reactive	—————>	least reactive
A	P	R	Q
B	Q	P	R
C	Q	R	P
D	R	Q	P

36 Which reaction takes place in the blast furnace?

- A** $3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$
B $\text{SiO}_2 + \text{CaO} \rightarrow \text{CaSiO}_3$
C $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
D $\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$

37 Which statements about alkali metals is correct?

- A** Their reactivities decrease down Group I.
B They form oxides on reacting with water.
C Their melting points decrease down Group I.
D They form covalent bonds with the halogens.

38 An energy change takes place as ammonium nitrate is dissolved in water at 30°C. The temperature changes by 4.5°C.

What is the final temperature?

- A** 25.5°C
B 30.0°C
C 34.5°C
D 37.0°C

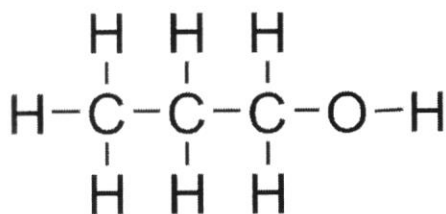
15

- 39** Methane, the first member of the alkane homologous series, has a boiling point of -161°C .

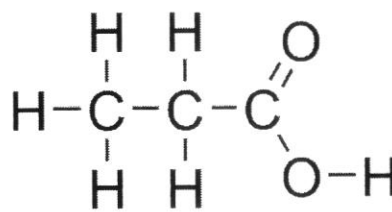
Which molecular formula and boiling point could be correct for another alkane member in the series?

	molecular formula	boiling point/ $^{\circ}\text{C}$
A	C_2H_4	-88
B	C_2H_6	-89
C	C_3H_6	-69
D	C_3H_8	-200

- 40** Compound X can be oxidised to compound Y.



compound X



compound Y

What are compounds X and Y?

	X	Y
A	butanol	propanoic acid
B	ethanol	propanol
C	propanol	propanoic acid
D	ethanol	ethanoic acid



CHRIST CHURCH SECONDARY SCHOOL
2022 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS/ 5 NORMAL (ACADEMIC)

CANDIDATE NAME/ INDEX			()	CLASS		
CENTRE NUMBER	S			EXAM INDEX NUMBER		

SCIENCE (PHYSICS, CHEMISTRY)

Paper 3

5076/03

8 July 2022

1 hour 15 minutes

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

READ THESE INSTRUCTIONS FIRST

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

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

Section A

Answer **all** questions.

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 13.

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

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

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **14** printed pages.

[Turn over

2

Section A

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

- 1 Table 1.1 shows some information about four different substances.

Table 1.1

substance	chemical formula	solubility in water
lead(II) nitrate	$\text{Pb}(\text{NO}_3)_2$	
lead(II) sulfate	PbSO_4	insoluble
sodium carbonate		soluble
barium carbonate	BaCO_3	insoluble

- (a) Complete the table by filling in the blank boxes. [2]

- (b) A white precipitate of lead(II) carbonate is formed when two substances in the table are mixed together.

- (i) Name these two substances.

..... [1]

- (ii) Describe how you would obtain a pure sample of lead(II) carbonate from the result of this mixing.

.....

 [3]

3

2 Magnesium, copper and iron are metals.

(a) State two physical properties of metals.

.....

.....

..... [2]

(b) (i) Table 2.1 shows the reactions of the three metals with dilute hydrochloric acid and cold water. Put a tick (✓) if a reaction will take place and a cross (X) if a reaction will not take place.

Table 2.1

metal	reaction with cold water	reaction with dilute hydrochloric acid
magnesium		
copper		
iron		

[3]

(ii) Place the three metals in order of chemical reactivity, with the most reactive first.

most reactive

.....

least reactive

[2]

(c) Iron rusts under certain conditions.

(i) State the conditions required for iron to rust.

.....

..... [2]

(ii) State one way to prevent iron from rusting.

.....

..... [1]

4

- 3 Fig. 3.1 describes some of the reactions of a metal salt **R**.

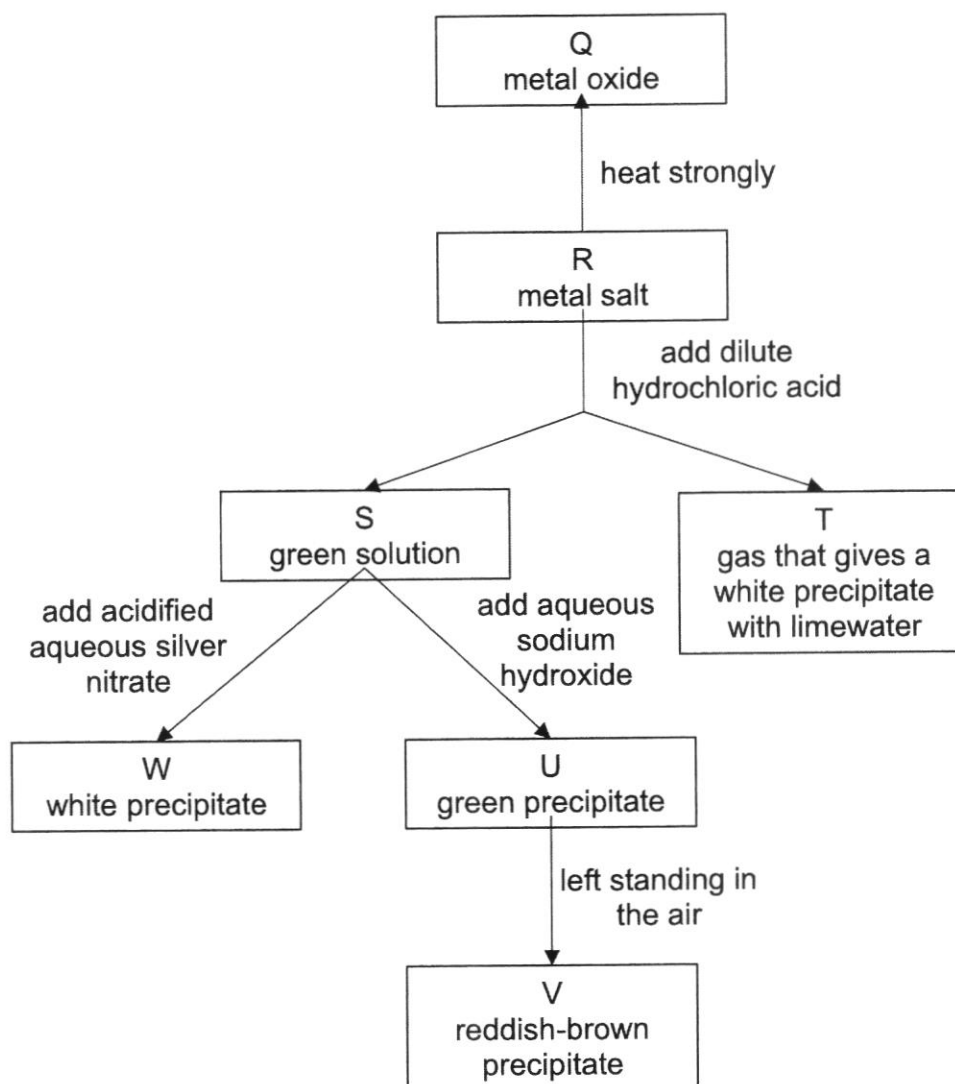


Fig. 3.1

Name **Q, R, S, T, U, V, and W**.

Q

R

S

T

U

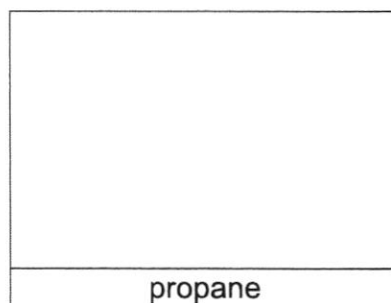
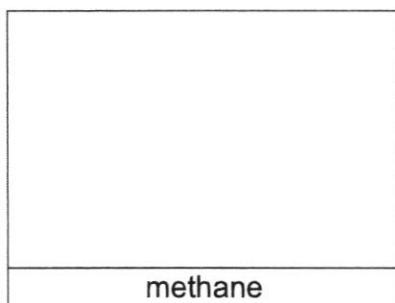
V

W

[7]

- 4 Methane and propane are organic compounds in the same homologous series.

(a) Draw the full structural formula of methane and propane.



[2]

(b) (i) Name the homologous series that consists of methane and propane.

..... [1]

(ii) State the general formula for the homologous series named in part (b)(i).

..... [1]

(c) State two general properties of a homologous series.

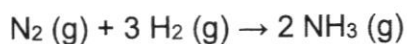
.....
.....
..... [2]

(d) Describe a chemical reaction of methane. State the products and conditions clearly.

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

6

- 5 Nitrogen, N_2 , and hydrogen, H_2 , combined on a large scale to form ammonia, NH_3 as shown in the equation below.



- (a) (i) Define relative molecular mass.

.....

 [1]

- (ii) Calculate the relative molecular mass of ammonia.

[Relative atomic masses: Ar: H, 1; N, 14]

[1]

- (b) (i) Calculate the volume of ammonia produced when 240 dm^3 of nitrogen reacts in excess hydrogen. All volumes are measured at room temperature and pressure.

[3]

- (ii) Calculate the mass of this volume of ammonia.

[Relative atomic masses: Ar: H, 1; N, 14]

[1]

- 6 Indigestion is caused by having too much hydrochloric acid in the stomach. Antacid tablets containing calcium hydroxide are commonly used to treat indigestion.

(a) (i) Calcium hydroxide is an alkali. State the symbol for the ion that causes this alkalinity.

..... [1]

(ii) State two properties of calcium hydroxide.

.....

.....

..... [2]

(b) (i) Write the balanced chemical equation to show the reaction between hydrochloric acid and calcium hydroxide. State symbols are **not** required.

..... [2]

(ii) What name is given to this type of reaction?

..... [1]

(iii) Write an ionic equation to represent this reaction.

..... [1]

Section B

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

7 Fluorine and chlorine are halogens found in Group VII of the Periodic Table.

- (a) Using the electronic structures of these two elements, explain why both elements appear in the same group of the Periodic Table.

.....

 [2]

- (b) For these two elements, suggest **two** similarities in their physical properties and **two** trends in their physical properties.

Similarities:

 Trends:.....

 [4]

- (c) Chlorine reacts with calcium to form a compound named calcium chloride.

- (i) Draw a diagram to show the electronic structure of calcium chloride.

[2]

- (ii) Using the structure, explain why calcium chloride has a very high melting point.

.....

 [2]

8 Fig 8.1 shows some reactions of ethene.

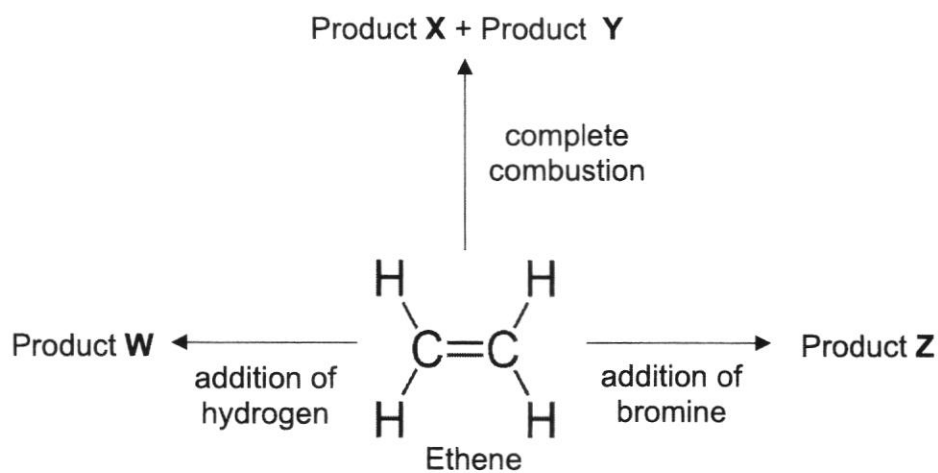
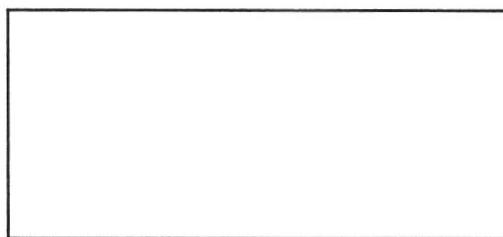
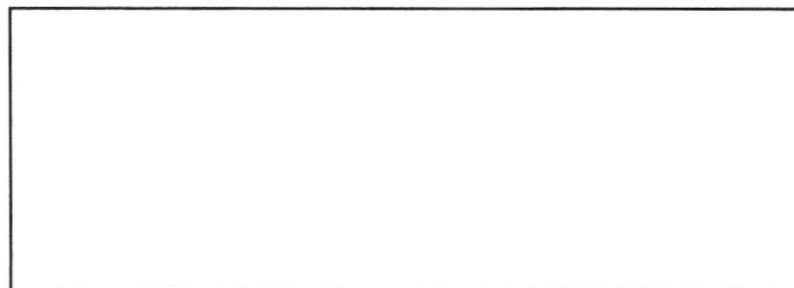


Fig 8.1

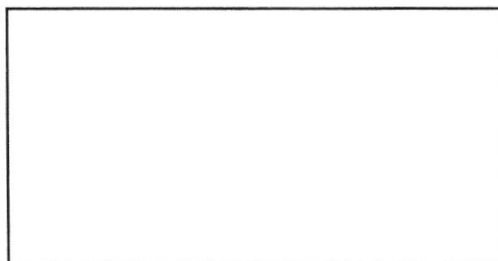
(a) Draw the full structural formulae for products **W**, **X**, **Y** and **Z**.



Product W



Products X and Y



Product Z

[4]

- (b) Describe a chemical test and the observation that allow you to distinguish between ethene and product **W**.

test

.....

results

.....

..... [3]

- (c) Ethene undergoes addition polymerisation to form poly(ethene). Poly(ethene) is a type of plastic that is used to make items such as plastic bags, toys and clingfilm.

- (i) Briefly explain how poly(ethene) can be formed by addition polymerisation. State the conditions clearly.

.....

.....

..... [2]

- (ii) Write an equation for the addition polymerisation of ethene. State symbols are **not** required.

[1]

11

- 9 (a) 5.0 g of calcium carbonate lumps reacted with 50 cm³ of 0.5 mol/dm³ nitric acid to produce carbon dioxide gas.

State and explain two ways to increase the speed of this reaction.

.....

.....

.....

.....

.....

.....

..... [4]

- (b) The speed of reaction can be determined by measuring the volume of carbon dioxide gas produced.

Describe, with the aid of a labelled diagram, an experiment to measure the speed of this reaction.

Diagram

.....

.....

.....

.....

..... [4]

- (c) Fig 9.1 shows the graph of the volume of carbon dioxide produced against time when 5.0 g of calcium carbonate lumps reacted with 50 cm³ of 0.5 mol/dm³ nitric acid.

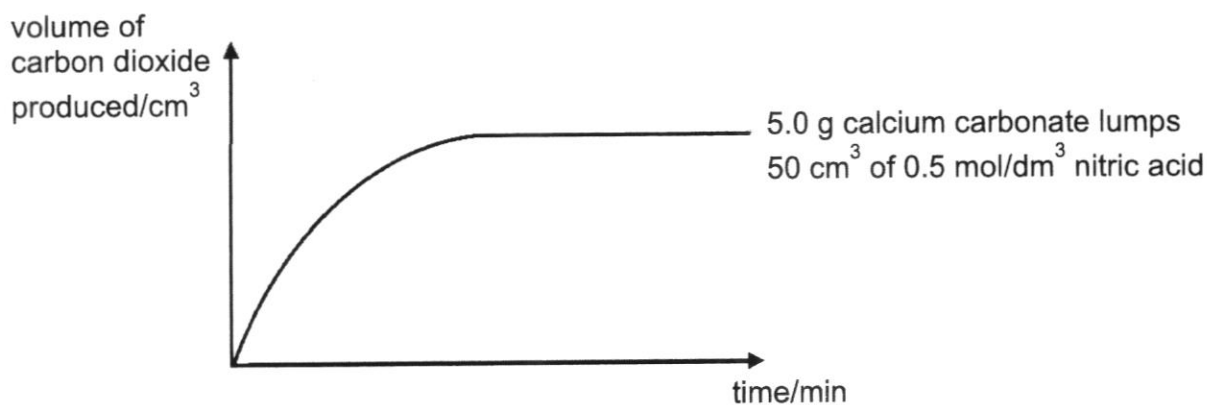


Fig 9.1

On Fig 9.1,

- (i) sketch the graph you would expect when the experiment is repeated using 50 cm³ of 0.1 mol/dm³ nitric acid. Label this graph as (i). [1]
- (ii) sketch the graph you would expect when the experiment is repeated using 5.0 g of powdered calcium carbonate. Label this graph as (ii). [1]

4E5N Sci(Chem) Prelims 2022
Marking Scheme

Paper 1

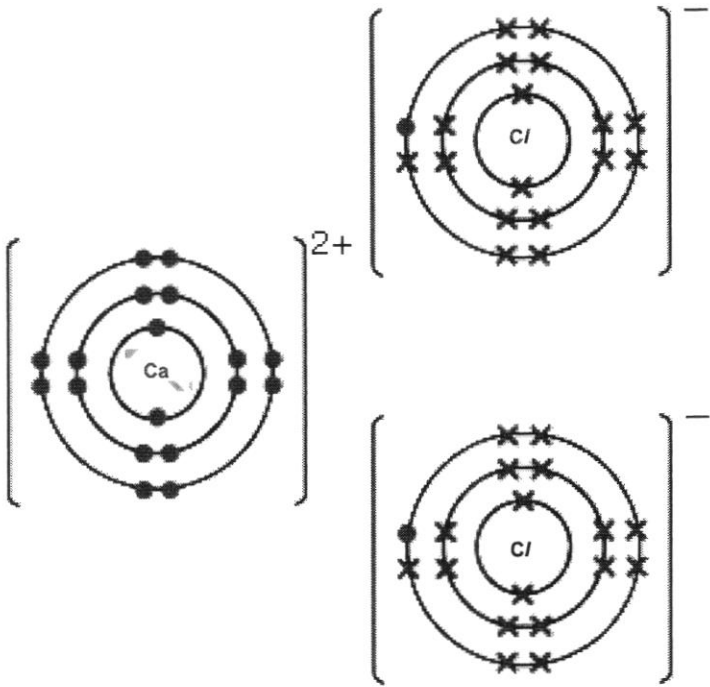
21	22	23	24	25	26	27	28	29	30
C	B	D	B	D	B	A	A	C	D

31	32	33	34	35	36	37	38	39	40
B	A	D	D	A	B	C	A	B	C

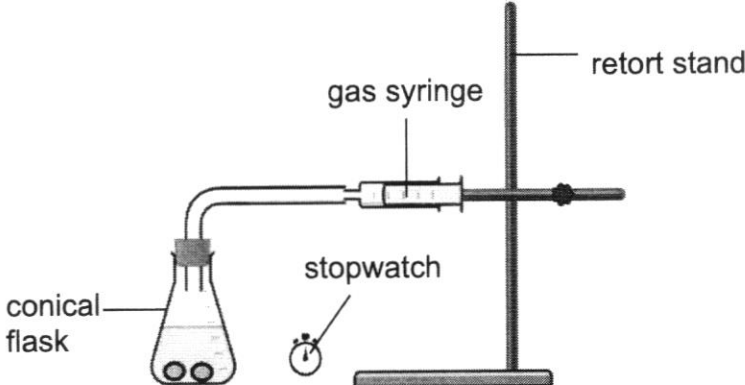
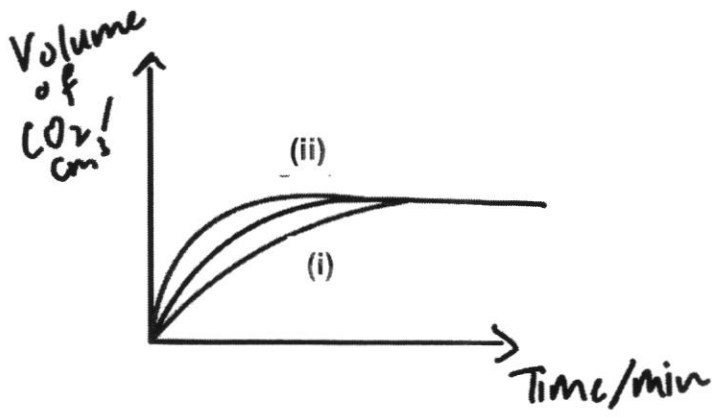
Paper 3
Section A

Qn	Answer			Marks/ Remarks
1a	substance	chemical formula	solubility in water	1 m per blank
	lead(II) nitrate	$\text{Pb}(\text{NO}_3)_2$	<u>soluble</u>	2 m
	lead(II) sulfate	H_2SO_4	soluble	
	sodium carbonate	<u>Na_2CO_3</u>	soluble	
	barium carbonate	BaCO_3	insoluble	
1bi	Lead(II) nitrate and sodium carbonate			1 m
1bii	<u>Filter</u> the mixture through a filter funnel with <u>filter paper</u> [1] <u>Wash</u> the residue with <u>distilled water</u> [1] <u>Dry</u> the residue between <u>two filter paper</u> [1] <i>R: Wash and dry</i>			3 m
2a	Good conductor of heat Good conductor of electricity High densities High melting and boiling points Malleable and ductile <i>Any 2 points above or reasonable answers</i>			2 m
2bi	metal	reaction with cold water	reaction with dilute hydrochloric acid	6 pt – 3 m 4-5 pt – 2 m 2-3 pt – 1 m 0-1 pt – 0 m
	magnesium	✓	✓	
	copper	X	X	
	iron	X	✓	
2bii	Magnesium (most reactive) > Iron > Copper (least reactive)			3 pt – 2 m 2 pt – 1 m 0 – 1 pt – 0 m
2ci	<u>Oxygen</u> in air [1] <u>Water</u> [1]			2 m
2cii	Coat the iron with a layer of paint/grease; Cover the iron with a plastic; Electroplating; <i>Any one point above</i>			1 m
3	Q – iron(II) oxide R – iron(II) carbonate S – iron(II) chloride T – carbon dioxide U – iron(II) hydroxide V – iron(III) hydroxide W – silver chloride			7 m

Qn	Answer	Marks/ Remarks
4a	$\begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \text{H} \end{array}$ methane $\begin{array}{ccccc} & \text{H} & & \text{H} & & \text{H} \\ & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ & & & & & \\ & \text{H} & & \text{H} & & \text{H} \end{array}$ propane	1 m for each correct structure (All bonds must be drawn) 2 m
4bi	alkane	1 m
4bii	$\text{C}_n\text{H}_{2n+2}$	1 m
4c	same functional group; similar chemical properties; gradual change in their physical properties as we go down the series from one member to the next; <i>Any 2 points above</i>	2 m
4d	Combustion [1] Methane burn readily in <u>excess oxygen/air</u> [1] to produce <u>carbon dioxide and water</u> [1] Incomplete combustion [1] Methane burn in <u>limited oxygen/air</u> [1] to produce <u>carbon monoxide, carbon and water</u> [1] <u>Substitution reactions</u> [1] Methane <u>react with halogens/chlorine/bromine in presence of UV light</u> [1] to form <u>chloromethane</u> and <u>hydrogen chloride</u> [1] <i>Any one reaction above</i>	3 m
5ai	Relative molecular mass is the <u>average mass of one molecule of that element/compound compared to 1/12 of the mass of one carbon-12 atom</u>	1 m
5aii	Relative molecular mass = $14 + 3 = 17$ No mark awarded if unit is written	1 m
5bi	mole of nitrogen = $240 / 24 = 10 \text{ mol}$ [1] $\text{N}_2 : \text{NH}_3 = 1 : 2$ Mole of ammonia = $10 \times 2 = 20 \text{ mol}$ [1] Volume of ammonia = $20 \times 24 = 480 \text{ dm}^3$ [1]	3 m
5bii	Mass of ammonia = $20 \text{ mol} \times 17 = 340 \text{ g}$ [1]	1 m
6ai	OH^- ion	1 m
6aii	taste bitter and feels soapy conduct electricity in aqueous state turns red litmus paper blue pH value more than 7 reacts with acid to form salt and water	2 m

Qn	Answer	Marks/ Remarks
	reacts with ammonia salt to form salt, ammonia gas and water Any 2 points above	
6bi	$\text{Ca(OH)}_2 + 2 \text{HCl} \rightarrow \text{CaCl}_2 + 2 \text{H}_2\text{O}$	1 m – chemical formula 1 m – balanced equation
6bii	Neutralisation reaction	1 m
6biii	$\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$ No mark awarded without state symbols	1 m
7a	Fluorine: (2,7) and Chlorine: (2,8,7) [1] The elements are in the same group as they have <u>7 valence electrons</u> [1] <i>No mark awarded if student state valence electrons</i>	2 m
7b	Similarities: Low melting and boiling points [1] Coloured elements [1] Trends: Melting and boiling points increase down the group [1] Colour intensity increases/gets darker down the group [1]	4 m
7ci	 [1] – correct cation [1] – correct anion	2 m

Qn	Answer	Marks/ Remarks
	Deduct overall 1 m if student did not draw all electrons	
7cii	Calcium chloride has a <u>giant lattice structure</u> [1] Large amount of energy is required to overcome the <u>strong electrostatic forces between the oppositely-charged ions</u> [1]	2 m
8a	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \\ \text{W} \end{array}$ $\begin{array}{c} \text{H} \quad \text{Br} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{Br} \quad \text{H} \\ \text{Z} \\ \text{accept any isomers} \end{array}$ Products X and Y	4 m
8b	test: add butane and butene to the <u>bromine solution</u> [1] Observation: 1) product W <u>will not decolourise bromine solution</u> / butane will not cause the bromine solution to turn from reddish brown to colourless [1] 2) <u>ethene will decolourise bromine solution</u> / butene will cause the bromine solution to turn from reddish brown to colourless [1]	3 m
8ci	Under <u>high temperature and pressure and presence of a catalyst</u> [1], Poly(ethene) can be formed by addition polymerisation of ethene monomers [1]	2 m
8cii	$ \begin{array}{ccc} \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ n \text{ C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \\ \text{ethene} \end{array} & \longrightarrow & \begin{array}{c} \left(\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n \\ \text{poly(ethene)} \end{array} \end{array} $	1 m
9a	Increase the concentration of nitric acid [1] At a higher concentration, there are <u>more reactant particles</u> to collide and the <u>frequency of effective collisions increase</u> [1] Use powdered calcium carbonate [1] Powdered calcium carbonate has a <u>higher exposed surface area</u> for collision and the <u>frequency of effective collisions increase</u> [1] Increase the temperature of nitric acid [1]	4 m

Qn	Answer	Marks/ Remarks
	At higher temperature, more reactant particles <u>possess energy equal to or greater than the activation energy</u> and <u>frequency of effective collisions increase</u> [1] Any 2 points above	
9b	 [1] – all apparatus correctly drawn [1] – all apparatus clearly labelled Set up the apparatus as shown above. Record the volume of gas produced in the gas syringe at regular intervals [1] Plot a graph of volume of gas against time [1]	4 m
9ci/9cii		2 m