2022

SECONDARY 4

Normal Academic Exam Paper

NA Science Chemistry

1	Admiralty Sec	SA2
2	Assumption English	SA2
3	Bedok South Sec	SA2
4	Chua Chu Kang Sec	SA2
5	Fuchun Sec	SA2
6	Pasir Ris Sec	SA2
7	Peirce Sec	SA2
8	Woodgrove Sec	SA2

NAME:	NO:	CLASS:

ADMIRALTY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

SUBJECT	:	Science (Chemistry)
CODE/PAPER	:	5105/3, 5107/3
LEVEL/STREAM	:	Secondary 4 Normal (Academic)
DATE	:	2 August 2022
TIME	:	0800h – 0915h
DURATION	:	1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Optical Answer Sheet provided unless this has been done for you.

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 Optical Answer Sheet.

Fill in the Optical Answer Sheet very carefully.

Answers to Paper 3 and Paper 4 must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no more than **30 minutes** on **Paper 3**.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
Any rough working should be done in this question paper.
A copy of the Periodic Table is printed on page 8.
The use of an approved scientific calculator is expected, where appropriate.

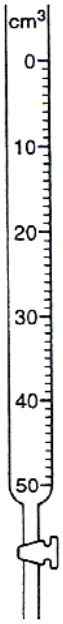
20

DO NOT TURN OVER THIS PAPER UNTIL YOU ARE TOLD TO DO SO.

This question paper consists of **8** printed pages including this cover page.

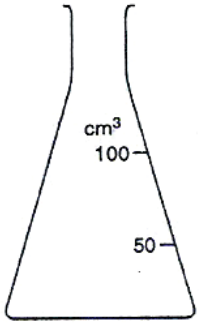
1 Which of the following pieces of apparatus is most suitable for accurately measuring out 16.80 cm^3 of water?

A

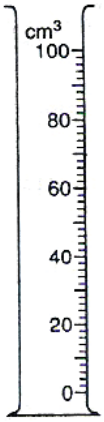


B

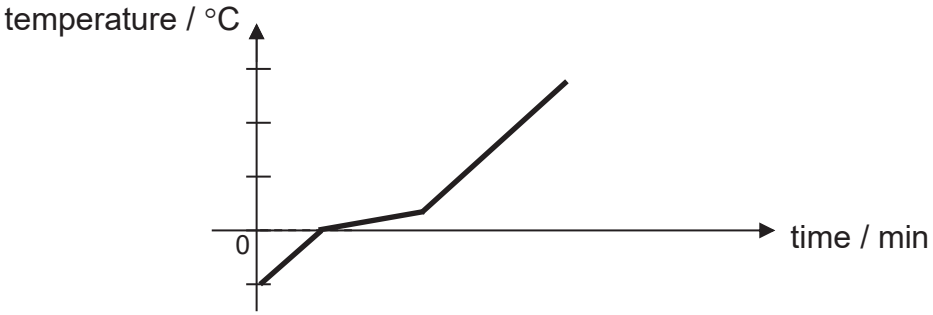
C



D



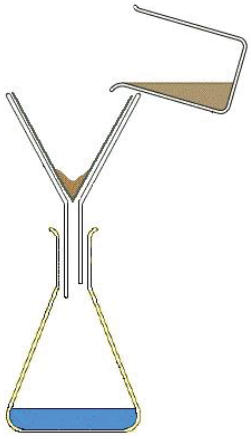
2 The graph below shows the heating curve of solid N.



What does the graph suggest about solid N?

A It is not pure.
B It is a liquid at 0 °C.
C It is an ionic compound.
D It has a high melting point.

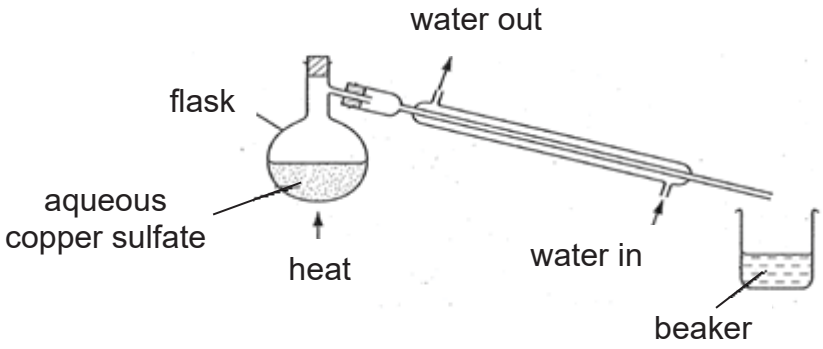
3 The diagram below shows a common experimental set-up used to separate mixtures in the laboratories.



Which of the following mixtures can be separated into its components using the set-up above?

A argon and carbon dioxide
B carbon and iron
C petrol and kerosene
D sand and water

4 The diagram below shows an experiment to obtain water from aqueous copper sulfate.



Aqueous copper sulfate is a blue solution. After 10 minutes of heating, what are the colours of the liquids in the flask and the beaker?

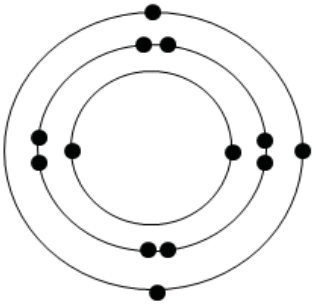
	flask	beaker
A	blue	blue
B	blue	colourless
C	colourless	blue
D	colourless	colourless

5 The table below shows information about four different compounds.

Which of the following correctly shows the elements present in each compound?

	compounds	elements
A	CO_2	copper and oxygen
B	HCl	carbon, hydrogen and lead
C	N_2H_4	hydrogen and nitrogen
D	PbO	phosphorus and oxygen

6 The diagram below shows the electronic structure of an atom of element Q.



In which group and period does element Q belong to?

	group	period
A	II	2
B	II	3
C	III	2
D	III	3

7 Calcium fluoride has the formula CaF_2. Which statement best describes the bond formed between the two elements?

A Each fluorine atom transfers one electron to a calcium atom.
B Each fluorine atom shares one electron with a calcium atom.
C Each calcium atom transfers two electrons, one to each of the fluorine atoms.
D Each calcium atom shares two electrons, one with each of the fluorine atoms.

8 What is the relative formula mass, M_r, of ammonium nitrate, NH_4NO_3?

A 23 **B** 42
C 45 **D** 80

9 The equation below shows the reaction that occurs when ethanol (C_2H_5OH) is burnt in air.

$$C_2H_5OH\ (l) + xO_2\ (g) \rightarrow yCO_2\ (g) + zH_2O\ (l)$$

What are the values of x, y and z needed to balance this equation?

	x	y	z
A	3	2	1
B	3	2	3
C	7	4	2
D	7	4	6

10 In agricultural activities, farmers need to control the acidity of the soil.

Which substance is used to neutralise the soil acidity?

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

11 Salt P reacts with aqueous sodium hydroxide to produce ammonia gas.

Which of the following is a possible identity of salt P?

A ammonium sulfate
B calcium sulfate
C potassium sulfate
D sodium sulfate

12 Which method can be used to prepare the insoluble salt, lead sulfate?

A By reacting excess lead metal with dilute sulfuric acid.
B By reacting excess solid lead oxide with dilute sulfuric acid.
C By reacting excess solid lead hydroxide with dilute sulfuric acid.
D By reacting excess aqueous lead nitrate with aqueous sodium sulfate.

13 Which two chemicals will react to make the salt, copper(II) chloride?

A copper metal and hydrochloric acid
B copper(II) carbonate and hydrochloric acid
C copper metal and sulfuric acid
D copper(II) carbonate and sulfuric acid

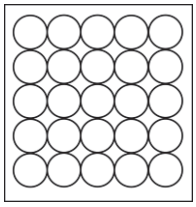
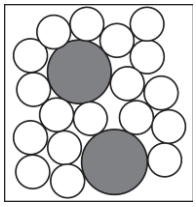
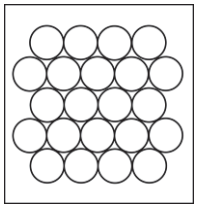
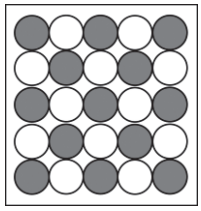
14 Statement 1: Zinc can react with nitric acid.

Statement 2: Nitric acid is made up of three elements – hydrogen, nitrogen and oxygen.

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.

15 Which of the following diagrams best represents the structure of an alloy?

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

16 Which of the following is found on the leftmost side of the Periodic Table?

A halogens
B non-metals
C metals
D noble gases

17 Six different elements T, U, W, X, Y and Z are indicated in the Periodic Table shown below. The letters T, U, W, X, Y and Z do not represent the chemical symbols of the elements.

Which of the following statements is true?

A W is less reactive than X.
B U and Z are diatomic molecules.
C W and X are elements in the same period.
D Y and T are elements with six electrons in the outermost shell.

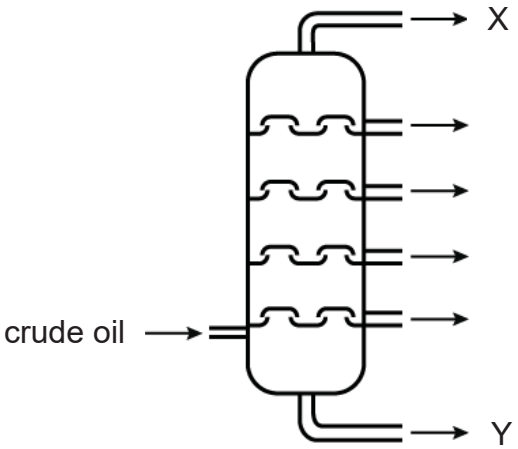
18 Which of the following explains why the components of air can be separated by fractional distillation?

A The components have different boiling points.
B The components have different colours.
C The components have different densities.
D The components have different relative molecular mass.

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

	air pollutant	source
A	carbon monoxide	incomplete combustion of petrol
B	nitrogen oxides	lightning activity
C	sulfur dioxide	volcanoes
D	unburnt hydrocarbons	complete combustion of fossil fuels

20 The diagram below shows the separation of crude oil into fractions.



What are the possible uses of X and Y?

	X	Y
A	making road surfaces	fuel for diesel engines
B	fuel for diesel engines	feedstock for petrochemicals
C	fuel for cooking and heating	making road surfaces
D	lubricating machines	making road surfaces

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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

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

NAME:	NO:	CLASS:

ADMIRALTY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

SUBJECT	:	Science (Chemistry)
CODE/PAPER	:	5105/4, 5107/4
LEVEL/STREAM	:	Secondary 4 Normal (Academic)
DATE	:	2 August 2022
TIME	:	0800h – 0915h
DURATION	:	1 hour 15 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.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in Section A and any **two** questions in Section B.
The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
You are advised to spend no more than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on page 10.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/ 14
Section B	/ 16
Total	/ 30

DO NOT TURN OVER THIS PAPER UNTIL YOU ARE TOLD TO DO SO.

Section A

Answer all questions.

1 Table 1.1 gives information about five particles P, Q, R, S and T. Each particle is either an atom or an ion.

The letters used to represent the particles are not the chemical symbols of any of these particles.

particle	number of protons	number of electrons	number of neutrons
P	4	4	5
Q	8	8	8
R	11	10	12
S	17	17	18
T	17	17	20

Table 1.1

(a) State the nucleon number of particle P.

…….. [1]

(b) Which of the particles, P, Q, R, S and T, are isotopes of the same elements? Explain your answer.

particles ……. and …….

explanation …….

…….. [2]

(c) Which of the particles, P, Q, R, S and T, is an ion?

…….. [1]

2 Table 2.1 shows some of the gases present in dry air, their melting and boiling points, and the approximate percentage composition of these gases in dry air.

gas	melting point / °C	boiling point / °C	percentage composition
argon	- 189	- 186	0.97%
carbon dioxide	---	- 78.5	0.03%
nitrogen	- 210	- 196	
X	- 219	- 182	20%

Table 2.1

(a) Write down the percentage of nitrogen in dry air.

…….. [1]

(b) Identify gas X.

…….. [1]

(c) What is the physical state of argon at - 200 °C?

…….. [1]

(d) Carbon dioxide changes directly from solid to gas at around - 78.5 °C.
Describe what happens to the carbon dioxide molecules when the temperature increases from - 79 °C to - 78 °C. Your answer should describe the process in terms of the kinetic particle theory and of the energy change involved.

……..

……..

……..

……..

……..

……..

…….. [3]

(e) When nitrogen burns in dry air, it forms nitrogen dioxide. The reaction can be represented by the following chemical equation:

$$\_\_\_ N_2 + \_\_\_ O_2 \rightarrow \_\_\_ NO_2$$

(i) Balance the chemical equation above. [1]

(ii) Describe one harmful effect of nitrogen dioxide.

……..

…….. [1]

(iii) Calculate the mass of 1.5 moles of nitrogen dioxide gas.

mass = ……. g [2]

Section B

Answer any **two** questions.

3 A student investigates the reactivity of different metals – potassium, iron, calcium and metal X – with cold water. Metal X is found in Group I of the Periodic Table of Elements.

The student separately adds samples of the metals to cold water. The same mass and surface area of metals are used in each experiment.

The observations made by the student are recorded in Table 3.1.

metal	speed of reaction	number of bubbles
potassium	reacts rapidly	many gas bubbles
iron		
calcium	reacts readily	some gas bubbles
X	reacts very rapidly	many gas bubbles

Table 3.1

(a) Suggest a possible identity of metal X.

…… [1]

(b) Hence, or otherwise, place these metals in order of their reactivity.

most reactive ……

……

……

least reactive …… [1]

(c) Name the gas found in the gas bubbles produced and state a positive test to identify this gas.

gas ……

test ……..

…… [2]

(d) Complete Table 3.1 by suggesting the speed of reaction and number of gas bubbles observed for the reaction between iron and cold water. [1]

(e) Iron can be extracted from iron ore in the blast furnace.

(i) Name a common iron ore that iron is extracted from.

…….. [1]

(ii) In addition to the iron ore in **(e)(i)**, limestone is also added to the blast furnace as one of the raw materials. The purpose of adding limestone is to remove the acidic impurities from the iron produced.

Write two chemical equations to show how limestone is used to remove acidic impurities from the iron produced.

…….....

……..... [2]

4 Magnesium chloride solution can be produced by reacting excess solid magnesium oxide with dilute hydrochloric acid. The mixture is then filtered to move excess solid magnesium oxide to obtain magnesium chloride solution as the filtrate.

(a) Write the balanced chemical equation, with state symbols, for the reaction of magnesium oxide and hydrochloric acid.

……

…… [2]

(b) What type of oxide is magnesium oxide?

…… [1]

(c) Explain why magnesium oxide is added in excess to dilute hydrochloric acid.

…… [1]

(d) Describe how pure and dry magnesium chloride crystals can be produced from the magnesium chloride solution obtained.

……

……

…… [3]

(e) Suggest another substance that can be added to dilute hydrochloric acid to produce magnesium chloride.

…… [1]

5 Ethene belongs to a homologous series called the alkenes.

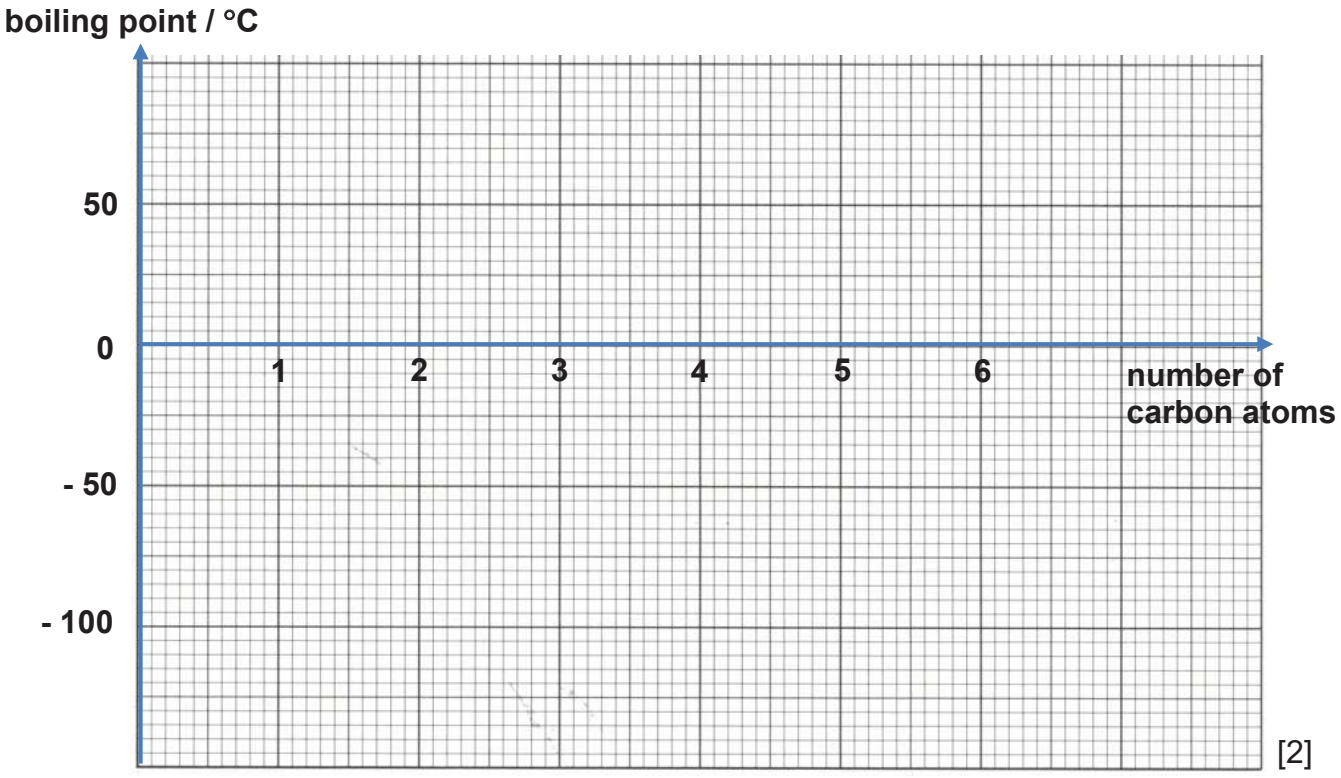
Table 5.1 shows some of the properties of five members of the alkene series.

name	formula	number of carbon atoms in one molecule	boiling point / °C
ethene	C_2H_4	2	- 104
	C_3H_6	3	- 48
butene	C_4H_8	4	- 6
pentene	C_5H_{10}	5	30
hexene	C_6H_{12}	6	63

Table 5.1

(a) Plot a graph of boiling point against the number of carbon atoms for the five alkenes shown, marking each point with a cross (×).

Draw a curved line of best fit.



[2]

(b) What is the name of the alkene with the chemical formula C_3H_6?

..... [1]

(c) Draw a 'dot and cross' diagram to show a C_2H_4 molecule. Show only the electrons in the outermost electron shell.

[2]

(d) C_2H_4 has a boiling point of - 104 °C. Briefly explain why C_2H_4 has such low boiling point.

……

…… [1]

(e) Both C_3H_6 and C_3H_8 are colourless liquid at room temperature. Suggest a test to distinguish between C_3H_6 and C_3H_8.

test ……

results ……

…… [2]

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Admiralty Sec School
Marking Scheme
4NA Science Chemistry
Preliminary Examination 2022

PAPER 3 [20 marks]

1	2	3	4	5	6	7	8	9	10
A	A	D	B	C	D	C	D	B	B

11	12	13	14	15	16	17	18	19	20
A	D	B	B	B	C	A	A	D	C

PAPER 4 SECTION A [14 marks]

Qn.	Description	Mark	Remarks
1(a)	9	[1]	
(b)	**S** and **T** They have the **same number of protons** but **different number of neutrons**.	[1] [1]	
(c)	R	[1]	

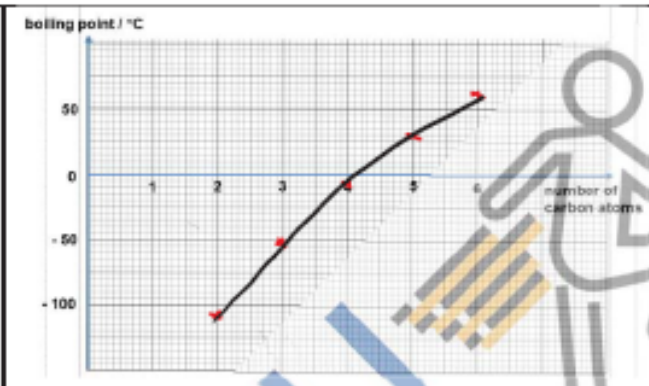
2(a)	79%	[1]	
(b)	Oxygen	[1]	
(c)	Solid	[1]	
(d)	When - 79 °C to - 78 °C, the carbon dioxide molecules **gain energy** and move faster. From **vibrating about fixed position**, the carbon dioxide molecules are now able to **move quickly in all directions**.	[1] [1]	Award one mark: move faster and further apart for points 2 and 3.

	From **very closed packed together in orderly manner**, the carbon dioxide molecules are now **far apart and randomly arranged**.	[1]	
(e)(i)	**1** N_2 + **2** O_2 → **2** NO_2	[1]	
(e)(ii)	Nitrogen dioxide dissolves in rainwater to form **acid rain**, which can corrode metal buildings.	[1]	
(e)(iii)	Mass = Mole × Molar Mass = 1.5 × (14 + 2 × 16) = **69 g**	[1] [1]	

PAPER 4 SECTION B [16 marks]

3(a)	rubidium	[1]	A: caesium
(b)	most reactive **rubidium** **potassium** **calcium** least reactive **iron**	[1]	
(c)	Hydrogen Insert a **lighted splint**. The lighted splint will **extinguish** with a **'pop' sound**.	[1] [1]	A: squeaky sound
(d)	No visible reaction; no gas bubbles	[1]	
(e)(i)	haematite	[1]	
(e)(ii)	$CaCO_3 \rightarrow CaO + CO_2$ $CaO + SiO_2 \rightarrow CaSiO_3$	[1] [1]	

4(a)	$MgO\ (s) + 2HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2O\ (l)$	[2]	1 mark for balance equation 1 mark for state symbols
(b)	Basic oxide	[1]	
(c)	To ensure that the **hydrochloric acid is fully reacted**.	[1]	
(d)	**Heat** to evaporate the magnesium chloride solution until it is **saturated**. Let the hot saturated solution to **cool** for the **crystals to be formed**. **Filter** to obtain the crystals as residue. **Wash the crystals** with cold **distilled water**. **Dry** the crystals between **filter papers**.	[1] [1] [1]	
(e)	Magnesium carbonate / Magnesium hydroxide / Magnesium metal	[1]	

5(a)		[1] [1]	all points plotted correctly curve line of best fit
(b)	propene	[1]	
(c)		[2]	1 mark – correct number of atoms 1 mark – correct arrangement of electrons
(d)	Little energy is needed to overcome the weak intermolecular forces of attraction in C_2H_4.	[1]	
(e)	Add aqueous bromine. Aqueous bromine will turn reddish brown to colourless when added to C_3H_6 but will remain reddish brown when added to C_3H_8.	[1] [1]	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Name: ………………………………………………….. (   ) Class: ……...

ASSUMPTION ENGLISH SCHOOL
PRELIMINARY EXAMINATION 2022

SCIENCE (CHEMISTRY)
5105 / 03
5107 / 03

LEVEL:	Sec 4 Normal (Academic)	**DATE :**	2 Aug 2022
CLASSES:	Sec 4/4, 4/5 and 4/6 SBB	**DURATION:**	1 hour 15 minutes *(Papers 3 & 4)*

Additional Materials provided: 1 sheet of OAS paper

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME, INDEX NUMBER and CLASS at the top of this page and on the OAS paper. **Shade your index number on the OAS paper.**

There are 20 questions in this paper. Answer **ALL** questions. For each question, there are four possible answers A, B, C and D. Choose the correct answer and record your choice in soft or 2B pencil on the OAS paper provided. **DO NOT fold or bend the OAS paper.**

At the end of the examination, hand in your OAS paper and Question Papers separately.

INFORMATION FOR CANDIDATES
You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on the last page of Paper 4.

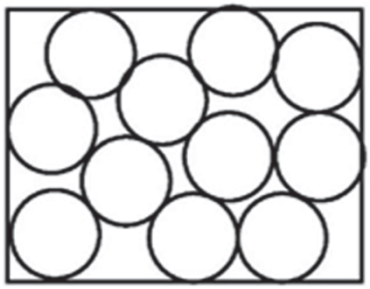
This question paper consists of 10 printed pages including this page.

[Turn over

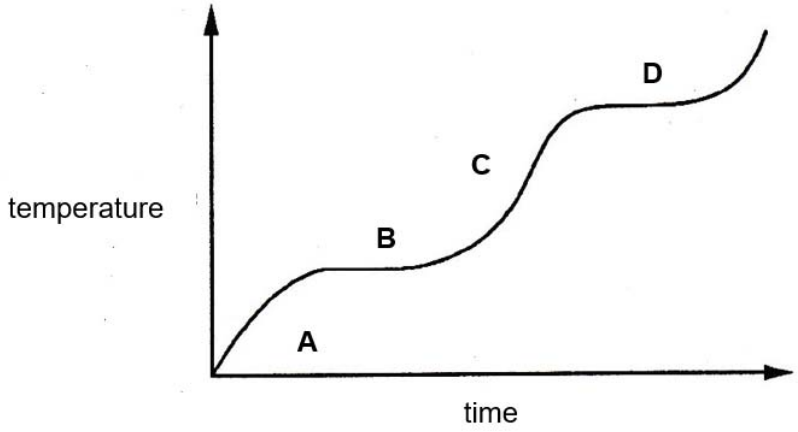
Section A - Multiple Choice Questions (20 marks)

There are **twenty** questions in this section. Answer **ALL** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice on the OAS in soft pencil.

1 The diagram show the arrangement of particles of a substance.



In which region of the graph would all the particles be packed as seen in the above diagram?



2 A student puts 25.0 cm^3 of acid into a conical flask. She then added 4.8 g of solid calcium carbonate and measured the change in temperature of the mixture.

Which set of apparatus does the student need to use to obtain the most accurate results?

A burette, electronic balance, stopwatch

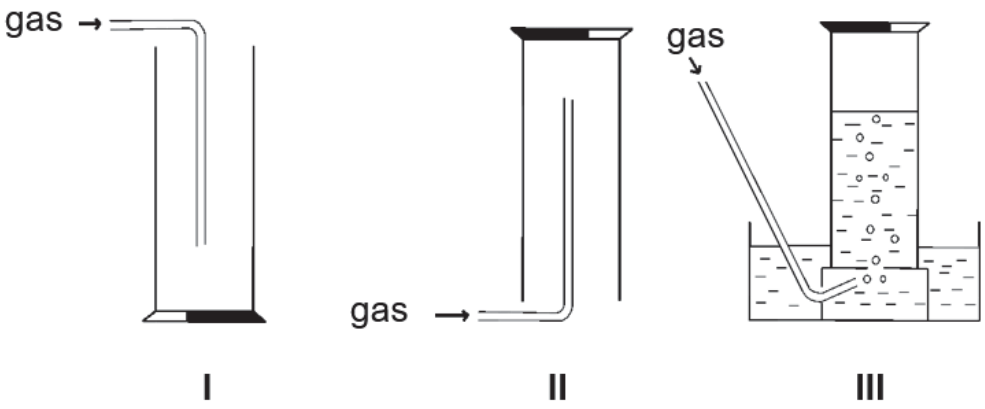
B pipette, electronic balance, thermometer

C pipette, stopwatch, thermometer

D measuring cylinder, electronic balance, thermometer

3 Chlorine is soluble in water and denser than air.

Which method(s) can be used to collect chlorine gas in the Science laboratory?



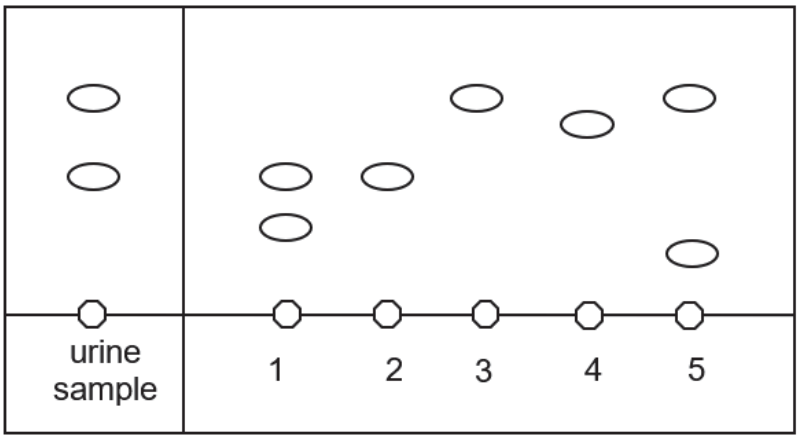
A **I** only

B **II** only

C **I** and **II** only

D **II** and **III** only

4 The diagram below shows a chromatogram of a urine sample that is used to determine whether a person has taken drug substances.



Which two drug substances are present in the urine sample?

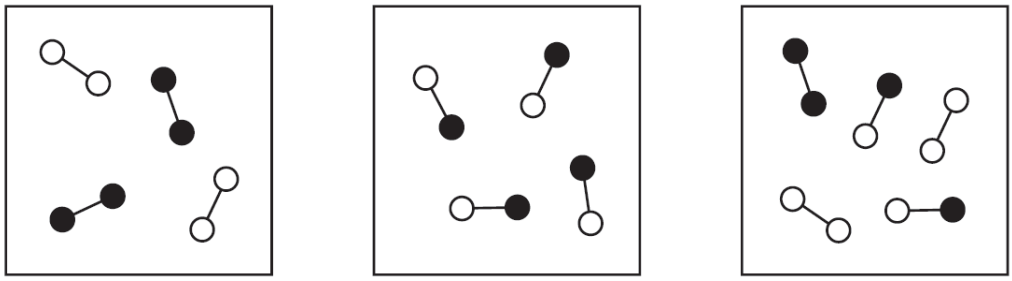
A 1 and 3

B 2 and 3

C 2 and 4

D 2 and 5

5 Which statement about the boxes **X**, **Y** and **Z** is correct?



X **Y** **Z**

A Box **X** contains two compounds and box **Z** contains two elements.

B Box **X** contains two elements and box **Y** contains a mixture.

C Box **X** contains two elements and box **Y** contains one compound.

D Box **Y** contains two compounds and box **Z** contains a mixture.

6 The table shows the number of particles in three atoms **X**, **Y** and **Z**.

	protons	neutrons	electrons
X	7	7	7
Y	7	8	7
Z	7	9	7

Which statement(s) about **X**, **Y** and **Z** is / are correct?

1 They are isotopes of the same element.

2 They have different physical properties.

3 They undergo different chemical reactions.

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

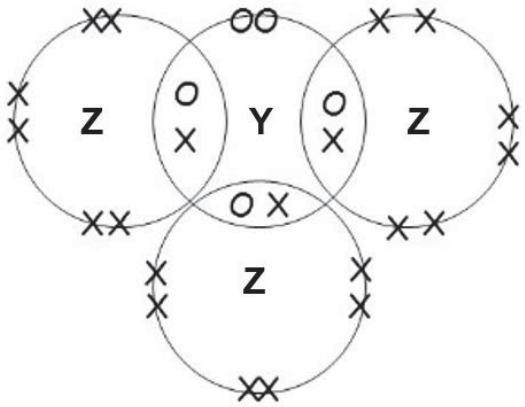
7 The atom is electrically neutral when the number of …....**1**…..... is equal to the number of electrons.

The atom becomes …....**2**…..... charged when it loses electrons.

Which words correctly describes 1 and 2?

	1	**2**
A	protons	positively
B	protons	negatively
C	neutrons	positively
D	neutrons	negatively

8 The diagram below shows the electronic structure of a compound $\mathbf{YZ_3}$.



Which elements could be **Y** and **Z**?

	Y	**Z**
A	aluminium	chlorine
B	beryllium	bromine
C	phosphorus	hydrogen
D	nitrogen	fluorine

9 Copper and nitric acid react together to form copper(II) nitrate, nitrogen monoxide and water as shown below.

$$3Cu + 8HNO_3 \rightarrow \mathbf{x}Cu(NO_3)_2 + 2NO + \mathbf{y}H_2O$$

What values for **x** and **y** balance the equation?

	x	**y**
A	3	4
B	3	8
C	4	3
D	4	8

10 Two statements about acids and bases are given.

1 Quicklime can be added to raise the pH of acidic soil.

2 The ionic equation for neutralisation is H^+ (aq) + OH^- (aq) $\rightarrow$ H_2O (*l*).

Which statement is true?

A Statement 1 is correct but statement 2 is not correct.

B Statement 2 is correct but statement 1 is not correct.

C Both statements are correct and statement 2 explains statement 1.

D Both statements are correct but statement 2 does not explain statement 1.

11 The table below shows the experimental results of four oxides, **P**, **Q**, **R** and **S**.

oxide	react with dilute sulfuric acid	react with potassium hydroxide
P	no	no
Q	no	yes
R	yes	yes
S	yes	no

Which row about the oxides are correct?

	P	**Q**	**R**	**S**
A	acidic	basic	neutral	amphoteric
B	acidic	neutral	amphoteric	neutral
C	neutral	acidic	amphoteric	basic
D	neutral	basic	neutral	amphoteric

12 Which property applies to **all** metals?

A good conductor of electricity

B high density

C high melting point

D soft

13 Why does an iron block **not** rust when it is covered by a layer of paint?

A The paint dissolves the rust that is formed on the iron block.

B The paint acts as a physical barrier to prevent oxygen and water to reach the iron block.

C The paint reacts with rust so there was no rust produced.

D The paint reacts with oxygen and water in place of the iron block.

14 Which physical trends occur as we move down Group I of the Periodic Table?

	melting point	speed of reaction with water
A	decreases	decrease
B	decreases	increase
C	increases	decrease
D	increases	increase

15 The table below shows information about an element at room temperature and pressure.

properties of element	
appearance	grey solid
density	0.75 g/cm^3
melting point	58 °C
reaction with water	reacts vigorously with cold water

In which group is the element likely to be found in the Periodic Table?

A Group 0 **B** Group I

C Group II **D** Group VI

16 Which substance is found in the greatest proportion in natural gas?

A ethane **B** ethene

C hydrogen **D** methane

17 Kerosene, lubricating oil and naphtha are three fractions obtained when crude oil is distilled.

Which is the correct order for their boiling points?

	lowest ⟶		**highest**
A	kerosene	lubricating oil	naphtha
B	kerosene	naphtha	lubricating oil
C	lubricating oil	kerosene	naphtha
D	naphtha	kerosene	lubricating oil

18 **P**, **Q** and **R** are three hydrocarbons.

P	**Q**	**R**
$CH_2=CH_2$	$CH_3\text{-}CH=CH_2$	$CH_3\text{-}CH_2\text{-}CH=CH_2$

What do compounds **P**, **Q** and **R** have in common?

1 They are all alkenes.

2 They are unsaturated hydrocarbons.

3 They have the same boiling point.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

19 A student investigated the reaction of vegetable oils with hydrogen.

100 cm^3 of hydrogen was bubbled through 1 g samples of four different vegetable oils containing a suitable catalyst.

The volume of hydrogen gas remaining after each experiment was recorded.

vegetable oil	volume of hydrogen remaining/cm^3
P	100
Q	85
R	61
S	0

Which vegetable oil(s) is / are unsaturated?

A **S** only

B **Q** and **R** only

C **P**, **Q** and **R** only

D **Q**, **R** and **S** only

20 A hydrocarbon, $C_{16}H_{34}$, is broken down during the process of cracking to produce ethene, another hydrocarbon **X** and hydrogen.

The equation for the reaction is shown.

$$C_{16}H_{34} \rightarrow 4C_2H_4 + \mathbf{X} + H_2$$

Which row describes hydrocarbon **X**?

	formula of **X**	**X** belongs to the homologous series
A	C_8H_{28}	alkane
B	C_8H_{16}	alkene
C	$C_{14}H_{28}$	alkene
D	$C_{14}H_{30}$	alkane

- End of Paper 3 -

Name: ………………………………………………….. (   ) **Class:** ……...

ASSUMPTION ENGLISH SCHOOL
PRELIMINARY EXAMINATION 2022

SCIENCE (CHEMISTRY)
5105 / 04
5107 / 04

LEVEL: Sec 4 Normal (Academic) **DATE** : 2 August 2022

CLASSES: Sec 4/4, 4/5 and 4/6 SBB **DURATION:** 1 hour 15 minutes *(Papers 3 & 4)*

Additional Materials provided: NIL

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME, INDEX NUMBER and CLASS at the top of this page.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions in Section A and any **two** questions in Section B.

In calculations, you should show all the steps in your working, giving your answer at each stage.

You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on the last page of Paper 4.

At the end of the examination, hand in your OAS paper and Question Papers separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Paper 3	20
Section A	14
Section B	16
Total	50

This question paper consists of 13 printed pages including this page.

[Turn over

Section A [14 marks]

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

1 Both lithium and sodium belong to the same group but from different periods in the Periodic Table.

(a) Using their electronic structures, explain the following:

(i) lithium and sodium belong to the same group,

……

…… [1]

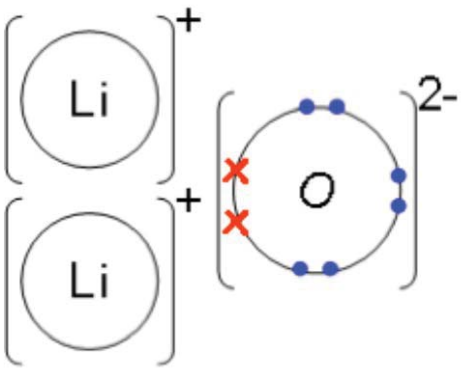
(ii) lithium and sodium belong to different periods.

……

…… [1]

(b) The element oxygen belongs to the same period as lithium but in a different group.

The figure below shows the "dot-and-cross" diagram for the electronic structures of the bonding between lithium and oxygen.



When lithium reacts with oxygen, neutral oxygen atoms change into oxide ions, each with a charge of 2-.

(i) Use the above diagram to explain, how this change takes place.

……

…… [1]

(ii) Use the above diagram to explain, why this change has taken place.

……

…… [1]

(iii) State a physical property of the compound formed.

……

…… [1]

2 Several thousand years ago, cavemen depended on firewood to survive as it can be burnt to provide light and heat.

A caveman became unconscious inside his clay house after breathing in a colourless, poisonous gas. The gas was produced by the burning of firewood inside the house while the door and windows were all closed during a rainy day.

(a) **(i)** Name the colourless gas produced, and give its chemical formula.

Name: …….

Chemical formula: …… [1]

(ii) Explain why the colourless gas was produced.

……

…… [1]

(b) The volcano located several kilometres away from the cavemen erupted. An air pollutant is produced in large quantities by the eruption.

(i) State the pH of the solution formed when the air pollutant dissolves in water.

…… [1]

(ii) Hence, state one harmful effect of the air pollutant on the cavemen.

……

…… [1]

3 The table shows the boiling points of some Group VII elements (halogens).

halogen	atomic number	boiling point / °C
fluorine	9	-188
chlorine	17	-35
bromine	35	58
iodine	53	184
astatine	85	337

(a) Group VII elements form diatomic molecules. With reference to their structure and bonding, explain why halogens have relatively low boiling points.

……..

……..

…….. [2]

(b) A student conducts two experiments to investigate displacement reactions for chlorine and iodine.

In experiment 1, she bubbles greenish-yellow chlorine gas through colourless sodium iodide solution.

In experiment 2, she adds black iodine crystals to colourless sodium chloride solution.

(i) In which experiment would displacement occur? Explain your answer.

……

……

……

…… [2]

(ii) Predict what will be observed in this experiment stated in **(b)(i)**.

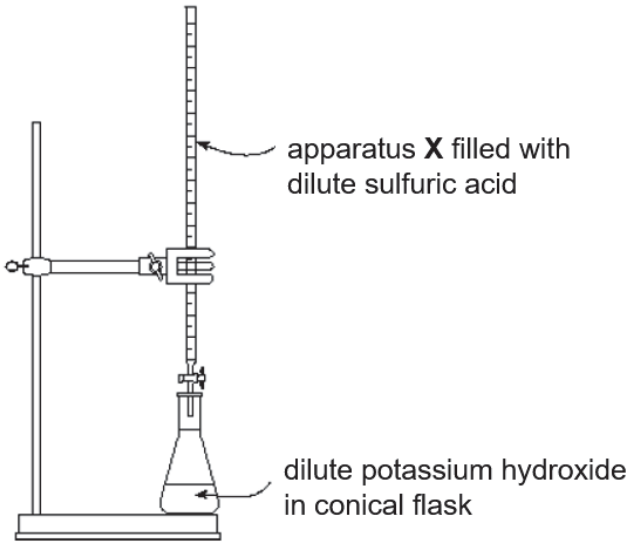
……

…… [1]

Section B [16 marks]

Answer any **two** questions from this section in the spaces provided.

4 The diagram below shows an experimental set-up of a salt preparation method. Dilute sulfuric acid was added drop-wise into dilute potassium hydroxide until all the potassium hydroxide has been neutralized completely.



(a) Name the apparatus **X** that is shown in the above diagram.

…….. [1]

(b) What is the salt preparation method that is shown in the experimental set-up?

…….. [1]

(c) Write a balanced chemical equation between dilute sulfuric acid and dilute potassium hydroxide.

…….. [2]

(d) The experiment was repeated a second time, with a pH meter placed in the dilute potassium hydroxide in the conical flask. The pH meter is able to track changes in the pH of the dilute potassium hydroxide as the reaction progresses.

The table below shows the pH values that the pH meter detected for the volumes of dilute sulfuric acid that was added.

Table 1

volume of dilute sulfuric acid added / cm^3	pH value in conical flask
0.00	13.0
5.00	13.0
10.00	13.0
15.00	12.6
20.00	12.0
25.00	11.2 and then 2.2
30.00	1.6
35.00	1.2
40.00	1.0
45.00	1.0
50.00	1.0

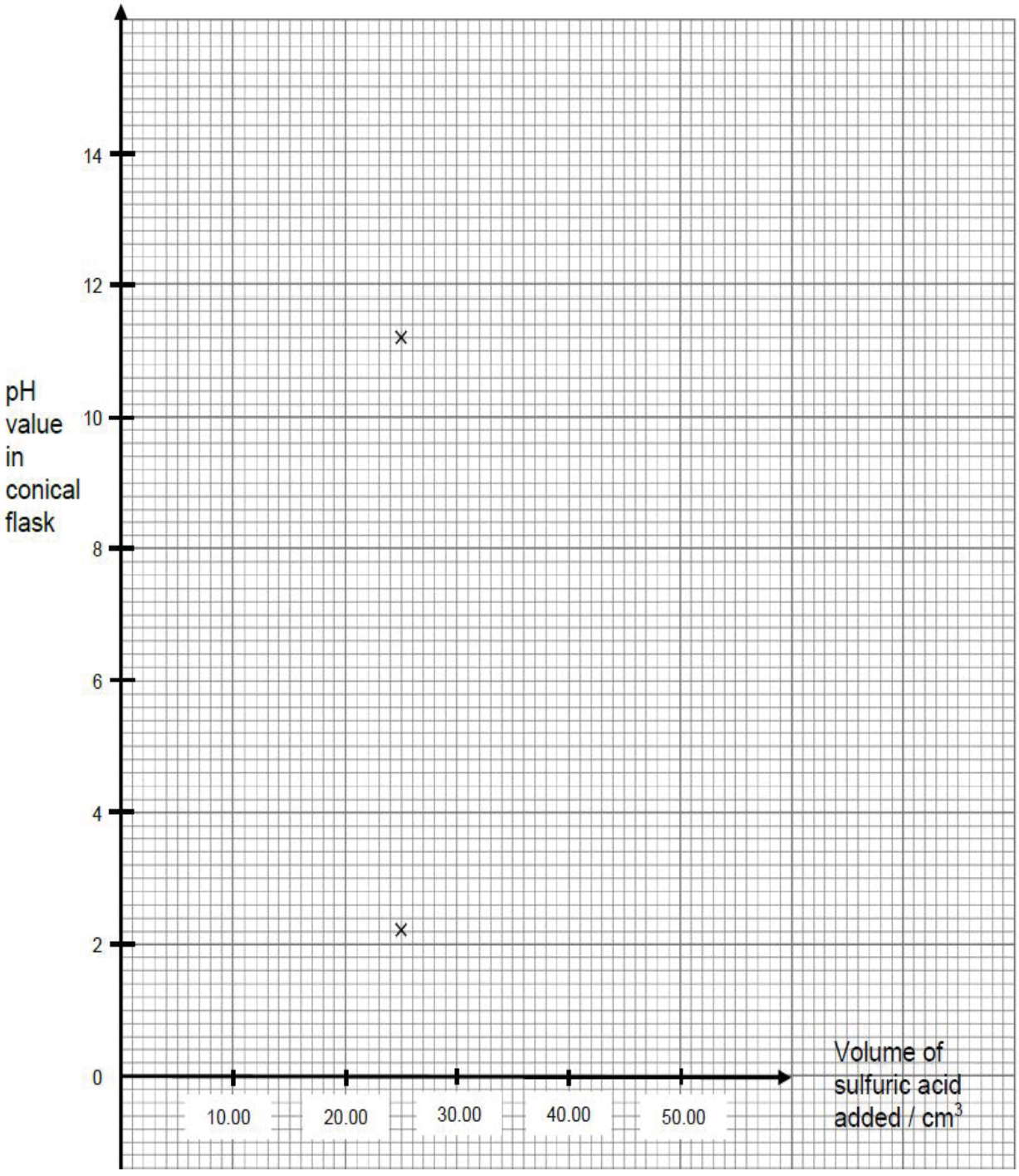
(i) Describe how the pH value in the conical flask changes as more acid is added.

……..

…….. [1]

(ii) A graph of pH value against volume of dilute sulfuric acid added is plotted using the values in the above table. Two of the points have been plotted for you on the next page.

Plot the remaining points and complete the graph by drawing a curved line of best fit on the grid provided.



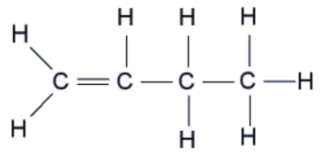
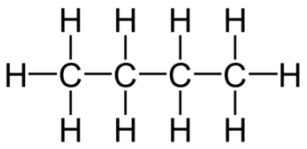
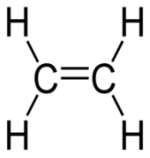
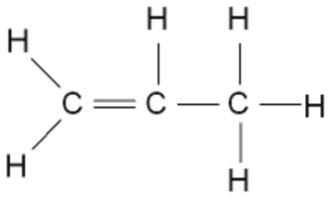
[2]

(e) By referring to the graph above, suggest the volume of dilute sulfuric acid needed to completely neutralise the dilute potassium hydroxide. Show how you have obtained your answer on the graph.

volume of dilute sulfuric acid needed = ……..cm^3 [1]

5 Alkanes and alkenes are two different homologous series of hydrocarbons.

(a) Some organic compounds are given below.

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

(i) State two reasons why compounds **A**, **C** and **D** belong to the same homologous series.

……..

……..

…….. [2]

(ii) Describe a chemical test to differentiate compounds **A** and **B**.

……..

……..

…….. [2]

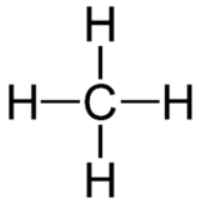
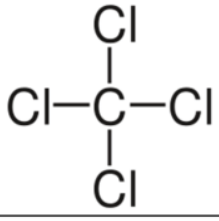
(iii) Compound **C** reacts with hydrogen to form compound **E**. Draw the full structural formula of compound **E**.

[1]

(iv) Compound **D** can be obtained by the cracking of decane. State the conditions required for cracking.

…….. [1]

(b) Compound **F** undergoes a reaction to form tetrachloromethane.

F	**Tetrachloromethane**
	

Name the reagent, condition(s) and reaction required to convert **F** to tetrachloromethane.

reagent: ……

condition(s): ……

reaction: ……... [2]

6 The table shows the results of experiments performed on four different metals, **P**, **Q**, **R** and **S**.

metal	reaction with water	reaction with steam	reaction with dilute hydrochloric acid
P	×	✓	✓
Q	✓	✓	✓
R	×	×	×
S	×	×	✓

key

✓ reaction

× no reaction

(a) Suggest an identity for metal **P**.

…….. [1]

(b) Which metal **P**, **Q**, **R** or **S** would be easiest to extract from its ore?

…….. [1]

(c) Metal **S** belongs to Group III. Write a balanced chemical equation for the reaction between metal **S** and hydrochloric acid.

…….. [1]

(d) A solid block of **S** is left uncovered in the Science laboratory. After a few weeks, it was discovered that the surface of the block has corroded.

State the chemical formulae of the two substances that **S** has reacted to cause it to corrode.

substance	chemical formula
substance 1	
substance 2	

[1]

(e) The carbonate of metal **Q** reacts with dilute nitric acid to produce **Q** nitrate in the following chemical reaction:

$$\mathbf{Q}(s) + 2HNO_3(aq) \rightarrow \mathbf{Q}(NO_3)_2(aq) + CO_2(g) + H_2O(l)$$

110 g of carbon dioxide gas was evolved. Calculate the number of moles of carbon dioxide gas produced.

[2]

(f) Some metals have an unique characteristic property that can be used as a catalyst in the production of margarine from polyunsaturated vegetable oils.

(i) Explain the term "*polyunsaturated*".

……..

…….. [1]

(ii) Name the process where vegetable oils are converted to form solid margarine.

…….. [1]

– End of Paper 4 –

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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

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

[Turn over

ASSUMPTION ENGLISH SCHOOL
PRELIMINARY EXAMINATION 2022
SCIENCE (CHEMISTRY)

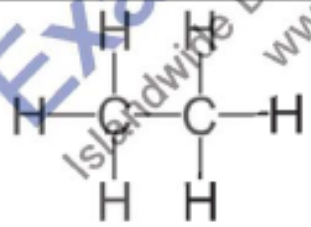
Paper 3

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

Paper 4 – Section A

1	(a)	(i)	Both elements have 1 valence electron.	[1]
		(ii)	Lithium has 2 electron shells and is in Period 2. Sodium has 3 electron shells and is in Period 3.	[1]
	(b)	(i)	Oxygen atom gains 2 electrons from 2 lithium atoms to form an oxide ion.	[1]
		(ii)	To have a completely / fully-filled valence shell / to obtain a stable noble gas electronic configuration.	[1]
		(iii)	Any 1 of the physical property: 1. high melting point / high boiling point 2. can conduct electricity in the molten or aqueous states 3. high density 4. soluble in water, insoluble in organic solvents	[1]
2	(a)	(i)	Name: carbon monoxide Chemical formula: CO	[1]
		(ii)	It is formed due to the incomplete combustion / insufficient amount of oxygen when burning wood.	[1]
	(b)	(i)	3 to 5	[1]
		(ii)	It will cause breathing difficulties.	[1]
3	(a)		Halogens have a simple molecular structure / exists as simple covalent molecules. They are held by weak intermolecular forces of attraction between molecules, requiring low amount of heat energy to overcome them. Therefore, halogens have low boiling points. [2]: 3 points [1]: 2 points	[2]
	(b)	(i)	Experiment 1. Chlorine is more reactive than iodine and will displace iodine from sodium iodide solution.	[1] [1]
		(ii)	The colourless solution will turn dark brown.	[1]

Paper 4 – Section B

4	(a)	Burette		[1]
	(b)	Titration		[1]
	(c)	$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$ [1]: correct chemical formulae [1]: correct balancing		[2]
	(d)	(i)	The pH value decreases as more dilute sulfuric acid is added.	[1]
		(ii)	[1]: correct plotted points [1]: curved line of best fit	[2]
	(e)	$25.00\ cm^3$ Note: Students must illustrate how to obtain the answer by drawing the point from pH 7 on the graph. Students will be awarded full credit if the decimal places are wrong. Allow ECF if graph is drawn wrongly.		[1]
5	(a)	(i)	Any 2 points: 1. They can be represented by a general formula, C_nH_{2n}. 2. Each member differs from its successive member by a $-CH_2-$ unit. 3. They all contains carbon-carbon double bonds. 4. They all contain the same functional group.	[2]
		(ii)	Test: Bubble the gases into bromine solution / aqueous bromine. Observation with compound A: Aqueous bromine turns from reddish brown to colourless. Observation with compound B: Aqueous bromine remains reddish brown.	[1] [1]
		(iii)		[1]
		(iv)	1. High temperature and pressure. 2. Aluminium oxide and silicon dioxide catalyst.	[1]
	(b)	Reagent: chlorine Condition(s): UV light Reaction: Substitution [2]: all 3 are correct [1]: 2 correct		[2]
6	(a)	Aluminium, zinc, iron, lead		[1] [1]
	(b)	R		[1]

	(c)	$2S + 2HCl \rightarrow SCl_2 + H_2$		**[1]**
	(d)	O_2 and H_2O		**[1]**
	(e)	No. of moles of carbon dioxide gas = 110 / (12 + 16 x 2) = 2.5 moles		 **[1]** **[1]**
	(f)	**(i)**	It is a compound with many carbon-carbon double bonds.	**[1]**
		(ii)	Hydrogenation / addition of hydrogen	**[1]**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BEDOK SOUTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022

4NA

CANDIDATE NAME

CLASS

REGISTER NUMBER

SCIENCE (CHEMISTRY)

5105/03

Paper 3 Multiple Choice

23 Aug 2022

Paper 3 and 4: 1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on the Answer Sheet in the spaces provided unless this has been done for you.

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.

Read the instructions on the Answer Sheet very carefully.

Answers to Paper 3 and Paper 4 must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no more than **30 minutes** on **Paper 3**.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 8.
The use of an approved scientific calculator is expected, where appropriate.

Setter: Mr Hubert Song

This document consists of **8** printed pages

Answer **all** the questions in the separate answer sheet provided.

1 The table below shows the melting and boiling points of four pure substances.
Which substance is a liquid at room temperature?

	melting point / °C	boiling point / °C
A	-210	-195.8
B	-7.2	58.8
C	180.5	1330
D	302	337

2 A student wishes to add exactly 22.5 cm^3 of acid to 25.0 cm^3 of an alkali.
Which apparatus should the student use to measure these volumes?

	acid	alkali
A	burette	measuring cylinder
B	burette	pipette
C	measuring cylinder	pipette
D	pipette	burette

3 Which row represents a positively charged ion?

	number of protons	number of neutrons	number of electrons
A	2	2	2
B	9	10	10
C	11	12	11
D	20	20	18

4 Which diagram represents a mixture of nitrogen and oxygen gas?

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

5 The electronic structures of two atoms, X and Y are 2.8.1 and 2.6 respectively.
X reacts with Y to form a compound.

What is the type of bonding present in this compound and the chemical formula of this compound?

	type of bonding	chemical formula
A	covalent	X_2Y
B	covalent	XY_2
C	ionic	XY_2
D	ionic	X_2Y

6 Sulfuric acid reacts with lead(II) hydroxide in the following equation.

$$H_2SO_4 + Pb(OH)_2 \rightarrow \boldsymbol{y}PbSO_4 + \boldsymbol{z}H_2O$$

What are the values of ***y*** and ***z***?

	y	***z***
A	1	1
B	1	2
C	2	2
D	2	4

7 Solid R reacts with both dilute hydrochloric acid and aqueous sodium hydroxide to form salts.

Which could be solid R?

A calcium oxide
B magnesium oxide
C lead(II) oxide
D sulfur oxide

8 The graph shows how the pH changes when different volumes of sodium hydroxide solution are added to 20.0 cm^3 of dilute hydrochloric acid.

Volume of sodium hydroxide (cm^3)

What is the volume of sodium hydroxide solution needed to neutralise 20.0 cm^3 of dilute hydrochloric acid?

A 10.0 cm^3 **B** 25.0 cm^3

C 20.0 cm^3 **D** 30.0 cm^3

9 Which substance is used to decrease the acidity in soil?

A ammonium nitrate **B** magnesium sulfate

C calcium hydroxide **D** potassium chloride

10 Which substance will not react with sulfuric acid to form copper(II) sulfate?

A copper

B copper(II) carbonate

C copper(II) hydroxide

D copper(II) oxide

11 Which statement explains why the chemical properties of sodium and potassium are similar?

A They are in the same group of the Periodic Table.

B They are in the same period of the Periodic Table.

C They are soft and can be cut with a knife.

D They have similar melting points.

12 Several properties of metals can be explained because layers of metal atoms can slide over each other.

Which property cannot be explained by this reason?

A Metals are ductile.

B Metals are malleable.

C Metals can conduct electricity.

D Pure metals are softer than alloys.

13 Which metal reacts readily with hydrochloric acid but does not react with cold water to produce hydrogen gas?

A calcium

B copper

C magnesium

D zinc

14 Which statement explains why recycling ensures that metals will be available in future?

A There are only limited amounts of metals on Earth's surfaces.

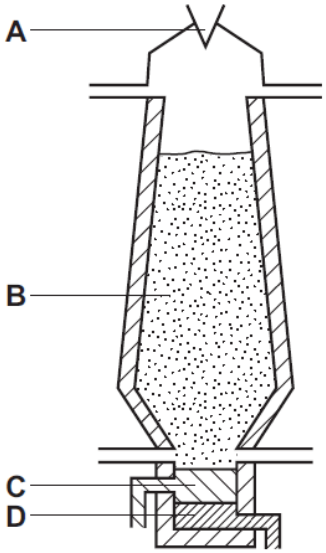
B Disposal of metals in landfills are unsightly.

C Recycling costs less than obtaining metals from their ores.

D Recycling avoids the environmental damage caused by opening new mines.

15 The diagram shows a blast furnace.

In which part is iron ore changed into iron?



16 Air is a mixture of gases.

Which gas is present in the least amount in air?

A carbon dioxide **B** nitrogen

C hydrogen **D** oxygen

17 Which pollutant gas is produced by both lightning activity and internal combustion engines?

A carbon monoxide **B** ozone

C nitrogen monoxide **D** sulfur dioxide

18 Which petroleum fraction is used as a fuel for aircraft engine?

A kerosene **B** petrol

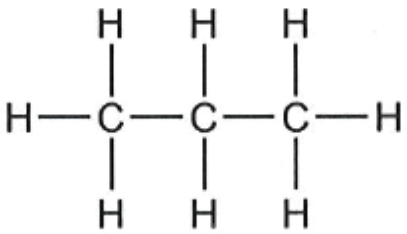
C diesel **D** bitumen

19 Octene is an alkene containing eight carbon atoms per molecule.
What is its molecular formula?

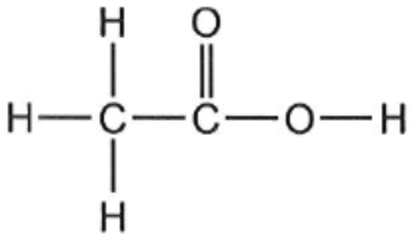
A C_8H_{14} **B** C_8H_{18}
C C_8H_{16} **D** C_8H_{20}

20 Which diagram shows an unsaturated hydrocarbon?

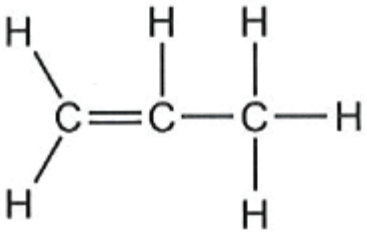
A



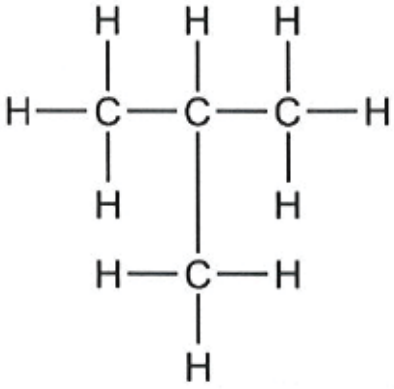
B



C



D



--- End of Paper 3 ---

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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

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

BEDOK SOUTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022

4NA

CANDIDATE NAME

CLASS

REGISTER NUMBER

SCIENCE (CHEMISTRY)

5105/04

Paper 4 Chemistry

23 August 2022

Paper 3 and 4: 1 hour 15 minutes

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

READ THESE INSTRUCTIONS FIRST

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

Answer **all** questions in Section A and any **two** questions in Section B.
The use of an approved scientific calculator is expected, when appropriate.
In calculations, you should show all the steps in your working, giving your answer in each stage.
You are advised to spend no longer than 30 minutes in Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the periodic table is printed on page 9.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks in given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

Setter: Mr. Hubert Song

Section A (14 marks)

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

1 Dilute sulfuric acid is added to the following test-tubes.

P	Q	R	S
			
magnesium ribbon	sodium hydroxide solution	barium nitrate solution	copper metal

(a) Upon addition of dilute sulfuric acid, in which of the above test-tube(s) does the following take place?

(i) bubbles produced ……..…… [1]

(ii) precipitation …… [1]

(b) Write the ionic equation of a neutralisation reaction. Include the state symbols.

.....…… [1]

(c) Write a balanced chemical equation of the reaction in test-tube **P** when dilute sulfuric acid was added.

.....…… [2]

2 In the extraction of iron in the blast furnace, waste gases are released.

(a) Identify one gas released that is harmful.

.....…… [1]

(b) State its harmful effect.

.....……

.....…… [1]

3 The details of 5 atoms, **V, W, X**, **Y** and **Z** are shown in the table below.

atom	relative mass	number of neutrons	number of electrons	number of protons
V	7			3
W	9		4	
X		3		3
Y		12	12	
Z	27			13

(a) Fill in the blanks with the appropriate information. [3]

(b) State two different atoms that belong to period 3 of the Periodic Table.

..... [1]

(c) **(i)** Define the term isotopes.

.....

..... [1]

(ii) Which of the above atoms are isotopes?

..... [1]

(iii) Explain why isotopes have the same chemical properties.

..... [1]

Section B (16 marks)

Answer any **two** questions from this section in the spaces provided.

4 Bromine is an element found in Group VII. The table below shows some properties of compounds containing the element bromine.

name of compound	chemical formula	melting point /°C	electrical conductivity
bromomethane	CH_3Br	- 93.7	non-conductive
magnesium bromide	$MgBr_2$	711.0	conducts electricity in molten and aqueous state

(a) Identify the type of chemical bond present in the above compounds.

bromomethane ……

magnesium bromide …… [1]

(b) Explain why bromomethane cannot conduct electricity.

……

…… [1]

(c) Explain why magnesium bromide has a high melting point.

……

……

…… [2]

(d) Draw a 'dot and cross' diagram of magnesium bromide. Show only the outer electrons.

[2]

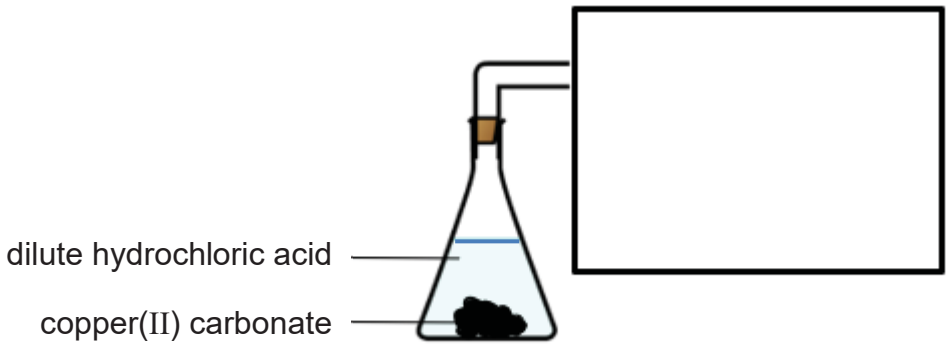
(e) Aqueous chlorine was added to a beaker containing aqueous magnesium bromide. It was observed that the reaction mixture turned reddish brown. Explain the given observation.

……

……

…… [2]

5 The diagram below shows the setup to prepare copper(II) chloride. Excess copper(II) carbonate was added to a conical flask containing dilute hydrochloric acid.



(a) In the box above, draw a suitable apparatus or additional setup to collect the gas evolved from the reaction. [1]

(b) Identify the gas evolved and describe a positive test for the gas identified.

gas evolved …… [1]

test ……

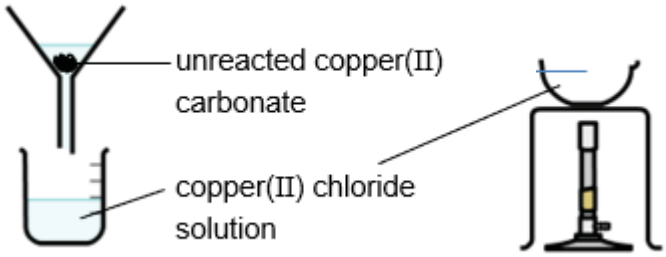
…… [1]

(c) 15.2 g of copper(II) carbonate was added to the flask in the beginning of the experiment.

Calculate the amount of copper(II) carbonate present in moles.

amount of copper(II) carbonate = …… mols [2]

(d) After the reaction is completed, the mixture in the conical flask is filtered to obtain copper(II) chloride solution. The solution is then heated as shown in the diagram below.



(i) Describe the steps to be carried out after heating in order to obtain dry copper(II) chloride crystals.

……..

……..

…….. [2]

(ii) Besides copper(II) carbonate, name another possible substance that can be reacted with dilute hydrochloric acid to form copper(II) chloride.

…….. [1]

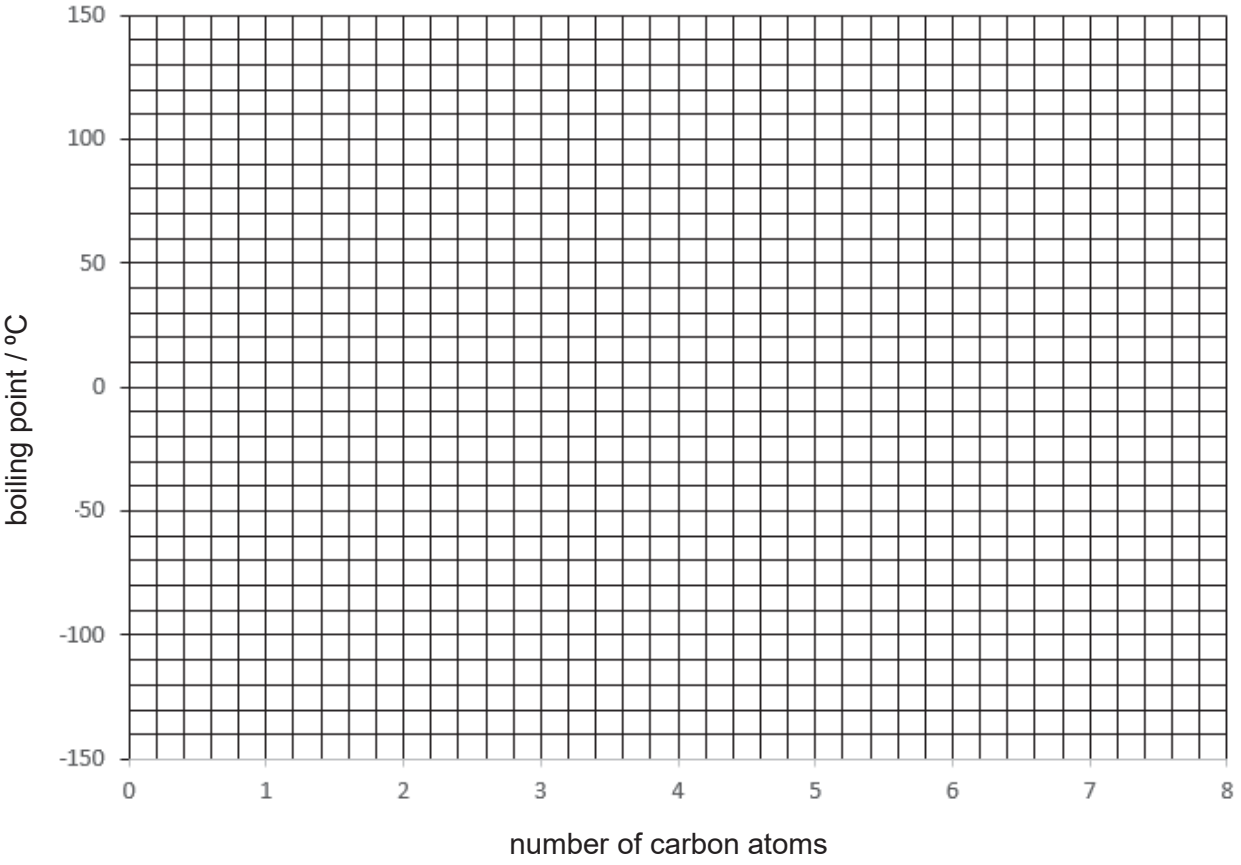
6 Alkenes is a homologous series consisting of unsaturated hydrocarbons.

The table below shows the boiling points of different alkenes.

alkene	**number of carbon atoms**	**boiling point /°C**
ethene	2	- 102
propene	3	- 48
butene	4	- 6
pentene	5	30
hexene	6	
heptene	7	93

(a) Plot a graph of the boiling points, marking each point with a cross (×).

Draw a curved line of best fit.



[2]

(b) Using your graph, determine the boiling point of hexene.

boiling point of hexene ……..…….. [1]

(c) Explain the term unsaturated.

…….

……. [1]

(d) Describe a test to distinguish a saturated hydrocarbon from an unsaturated hydrocarbon.

…….

…….

……. [2]

(e) An equation of a cracking reaction is given below.

$$C_{10}H_{22} \rightarrow \mathbf{X} + C_2H_4 + C_5H_{12}$$

(i) Draw the full structural formula for **X** in the box below.

[1]

(ii) State the conditions required for catalytic cracking.

……..…….. [1]

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
						1 H hydrogen 1											2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
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19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
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Key

proton (atomic) number
atomic symbol
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relative atomic mass

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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.).


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BEDOK SOUTH SECONDARY SCHOOL

2022 UPPER SECONDARY SCIENCE(CHEMISTRY)
SECONDARY Four Normal Acad SA2
ANSWER KEY

Setter: Hubert Song

Paper 3 (20 marks)

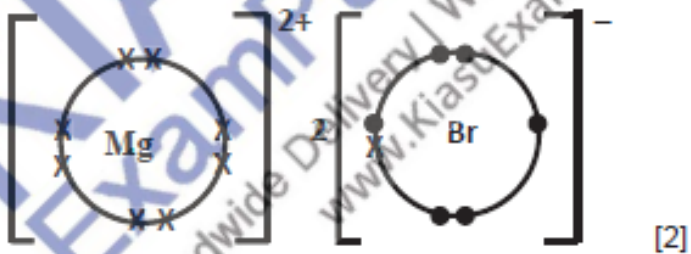
1.	B	5.	D	9.	C	13.	D	17.	C
2.	B	6.	B	10.	A	14.	A	18.	A
3.	D	7.	C	11.	A	15.	B	19.	C
4.	B	8.	B	12.	C	16.	A	20.	C

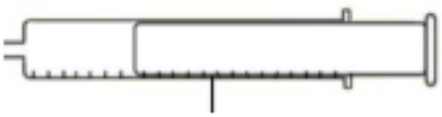
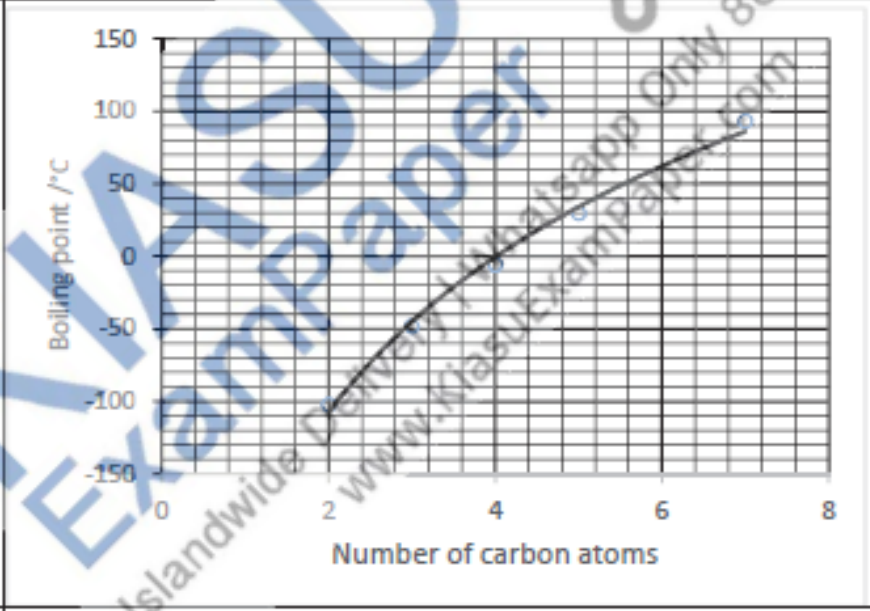
Paper 4
Section A (14 marks)

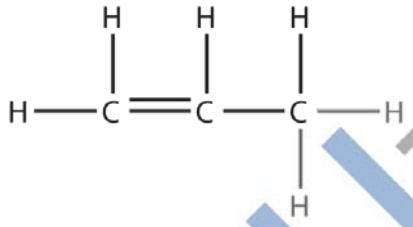
1	(ai)	P [1]	
	(aii)	R [1]	
	(b)	$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ [1]	
	(c)	$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$ [1] formula [1] balanced equation	
2	(ai)	carbon monoxide [1]	
	(aii)	CO prevents body/red blood cell from transporting oxygen [½] hence can cause giddiness or death. [½]	
3	(a)	<table><tr><th>atom</th><th>relative mass</th><th>number of neutrons</th><th>number of electrons</th><th>number of protons</th></tr><tr><td>V</td><td>7</td><td>4</td><td>3</td><td>3</td></tr><tr><td>W</td><td>9</td><td>5</td><td>4</td><td>4</td></tr><tr><td>X</td><td>6</td><td>3</td><td>3</td><td>3</td></tr><tr><td>Y</td><td>24</td><td>12</td><td>12</td><td>12</td></tr><tr><td>Z</td><td>27</td><td>14</td><td>13</td><td>13</td></tr></table> 0-2 – [0]	

		3-5 – [1] 6-8 – [2] 9-10 [3]	
3	(b)	Y and Z [1] Accept magnesium and aluminium	
	(ci)	Atoms of the same element with same number of protons but different number of neutrons. [1]	
	(cii)	V and X [1] (both must be correct)	
	(ciii)	Both of the atoms have same number of electrons (in the valence/outermost shell.) [1] Reject: they are from the same group/period.	

Section B (16 marks)

4	(a)	Bromomethane3: covalent [½] Magnesium bromide: ionic [½]	
	(b)	It does not have mobile ions or electrons. [1] accept: No mobile charged carriers.	
	(c)	Magnesium bromide has a giant ionic lattice structure [1] where the oppositely charged ions are held together by strong electrostatic forces of attraction [½]which requires a large amount of energy to overcome. [½]	
	(d)	 [2] x – Electrons of magnesium • – Electrons of bromide	
	(e)	Chlorine is more reactive [1] and displaced bromide [1] which forms reddish brown aqueous bromine	

5	(a)	 correct syringe with suitable size [1]	
	(b)	Gas evolved: carbon dioxide [1] Test: bubble the gas through limewater. White precipitate forms if carbon dioxide is present. [1] **No error-carry-forward if student mentioned hydrogen and correct gas test for hydrogen with lighted splint.**	
	(c)	M_r of $CuCO_3$ = 64 + 12 + 3(16) = 124 [1] No of mol = 15.2 / 124 = 0.123 mol (3sf) [1]	
	(di)	Let the saturated solution cool to form crystals [½] Filter to obtain solid crystals [½] Wash with cold distilled water [½] Dry between pieces of filter paper [½]	
	(dii)	Copper(II) oxide [1]	
6	(a)	 	
		[1] for correct plots [1] for curved best fit line	
	(b)	62°C [1]	
	(c)	Contains carbon-carbon double covalent bond (C=C) [1]	
	(d)	add aqueous bromine to the hydrocarbon solution. [1] Aqueous bromine will remain reddish brown in saturated hydrocarbon [½] but it decolourises rapidly when added to unsaturated hydrocarbon. [½]	

	(ei)	 [1]	
	(eii)	presence of catalysts [½] and high temperature [½]	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1 In an experiment, a student needs to measure 36.50 cm^3 of a solution.

Which apparatus would measure this volume most accurately?

A beaker

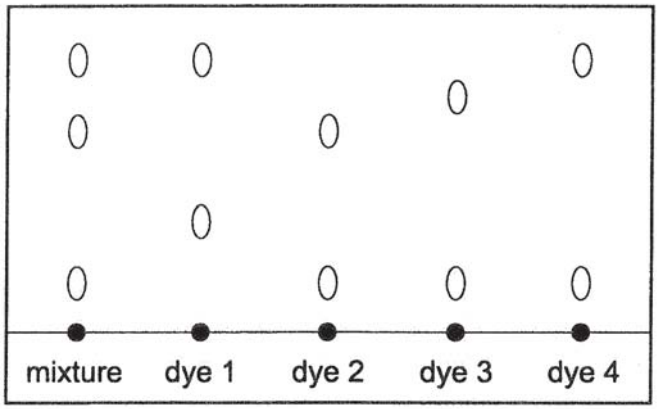
B burette

C measuring cylinder

D pipette

2 A mixture of coloured dyes is compared with other dyes using chromatography.

The chromatogram is shown below.



Which dye(s) is/are present in the mixture?

A 1 and 3

B 2 and 3

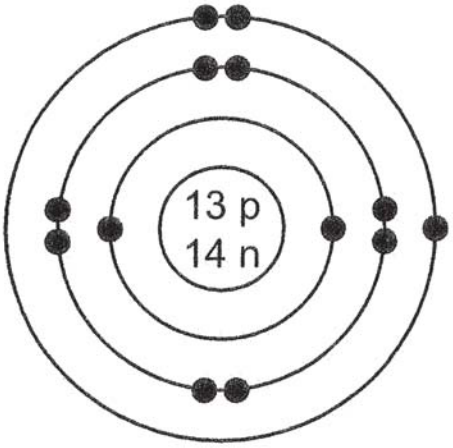
C 2 and 4

D 2 only

3 Which substance is a solid at 20 °C?

	melting point / °C	boiling point / °C
A	−117	78
B	−93	69
C	0	100
D	36	130

4 The diagram shows the structure of an atom of an element.



key
● = electron
n = neutron
p = proton

What is the nucleon number of this element?

A 13

B 14

C 27

D 40

5 Which change occurs when an atom forms a positive ion?

A It gains electrons.

B It gains protons.

C It loses electrons.

D It loses protons.

6 Which row describes the properties of a covalent molecule?

	boiling point	electrical conductivity
A	high	good
B	high	poor
C	low	good
D	low	poor

7 Relative atomic mass, A_r is defined by comparing the mass of one atom with the mass of another atom, Z.

What is Z?

A ^{12}C

B ^{1}H

C ^{24}Mg

D ^{16}O

8 The equation shows the reaction that occurs when ethanol burns in air.

$$C_2H_5OH + xO_2 \rightarrow yCO_2 + zH_2O$$

What are the values of *x*, *y* and *z* needed to balance the equation?

	x	*y*	*z*
A	2	2	2
B	2	2	3
C	2	3	3
D	3	2	3

9 Four different solutions, J, K, L and M are tested with Universal Indicator.

solution	J	K	L	M
colour with universal indicator	green	red	purple	orange

Which solution(s) is/ are acidic?

A J and M

B K and M

C K only

D L only

10 Milk is slightly acidic. When exposed to air, milk turns 'sour' as bacteria produce more acids.

What is the change in pH of the milk as it turns sour?

A 2.0 to 7.0

B 6.5 to 8.5

C 6.5 to 4.5

D 9.0 to 4.5

11 When aluminium and carbon burn in oxygen, oxides are formed.

Which row identifies the type of oxide that is formed by each one of them?

	aluminium oxide	carbon dioxide
A	amphoteric	acidic
B	amphoteric	basic
C	basic	acidic
D	basic	basic

12 Which equation, when completed, will show the production of a salt and hydrogen?

A $CuCO_3(s) + 2HCl(aq) \rightarrow$

B $2NaOH(aq) + H_2SO_4(aq) \rightarrow$

C $CuO(s) + H_2SO_4(aq) \rightarrow$

D $Mg(s) + 2HCl(aq) \rightarrow$

13 Sodium, silicon and argon are all in the same period of the Periodic Table.

Which statement about these elements is correct?

A They all have the same number of electron shells.

B They all have the same number of electrons in their atoms.

C They all have the same number of protons in their atoms.

D They all have the same number of electrons in their outer shell.

14 Chlorine and iodine are in Group VII in the Periodic Table.

How do the colours and melting points of chlorine and iodine compare?

	lighter colour	higher melting point
A	iodine	iodine
B	iodine	chlorine
C	chlorine	iodine
D	chlorine	chlorine

15 The diagram shows the position of elements L, M, Q, R and T in the Periodic Table.

These letters are not the chemical symbols of the elements.

Which statement about these elements is correct?

A L and M are halogens.

B L, M and Q are all metals.

C T exists as diatomic molecules.

D T is more reactive than R.

16 What is the property of **all** metals?

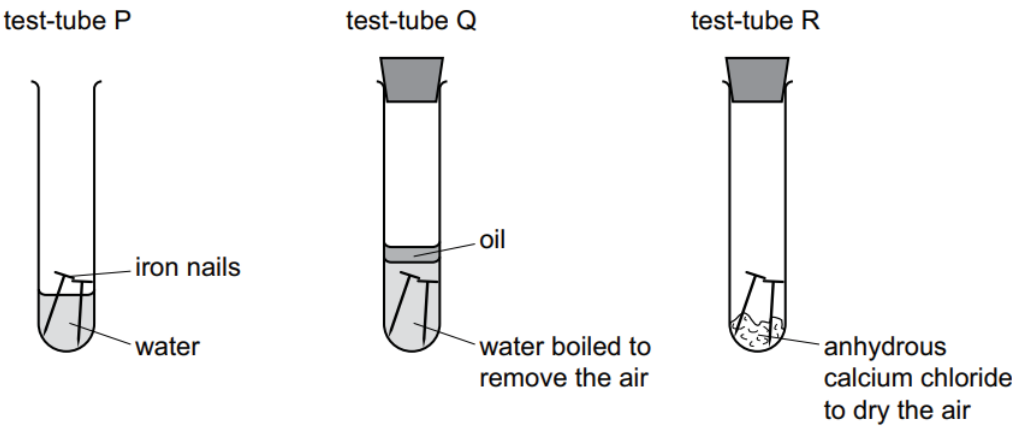
A conduct electricity

B hard

C low melting points

D reacts with water

17 The diagrams show experiments involving the rusting of iron.



In which test tubes will rusting **not** take place?

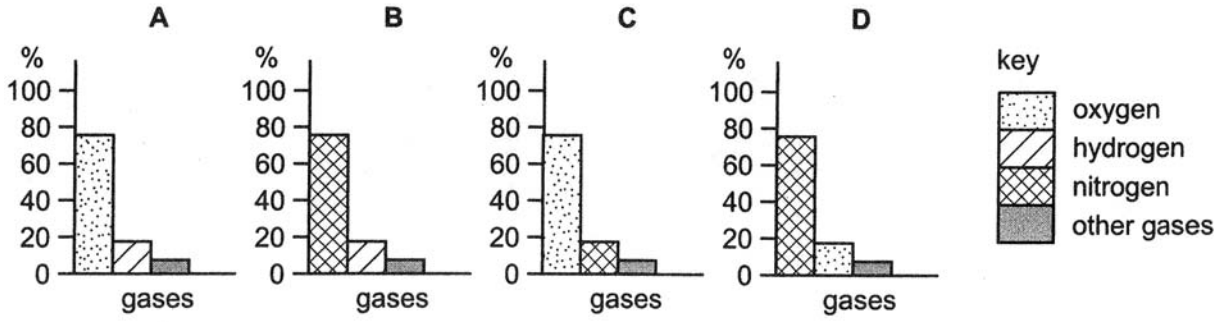
A P, Q and R

B P and Q only

C P and R only

D Q and R only

18 Which bar chart best represents the approximate composition by volume of air?



19 The table shows some unknown fractions obtained from the fractional distillation of petroleum, together with their uses.

fractions	uses
1	making chemicals
2	aircraft fuel
3	making polishes and waxes

Which row identifies fractions 1, 2 and 3?

	1	2	3
A	lubricating oil	diesel oil	paraffin
B	diesel oil	lubricating oil	naphtha
C	naphtha	paraffin	lubricating oil
D	paraffin	naphtha	diesel oil

20 Which row shows the general formula for alkenes and the effect of alkenes on aqueous bromine?

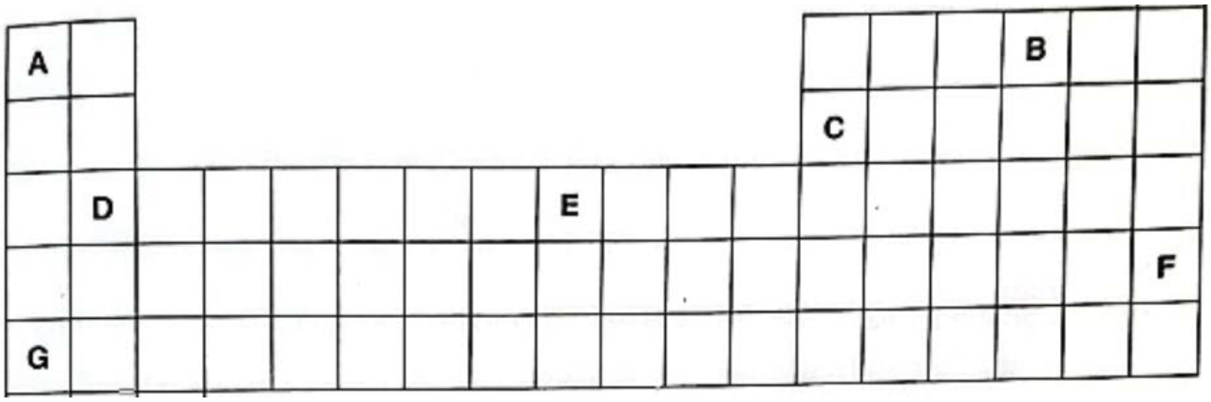
	general formula	effect on aqueous bromine
A	C_nH_{2n}	decolourised
B	C_nH_{2n}	no visible change
C	C_nH_{2n+2}	decolourised
D	C_nH_{2n+2}	no visible change

END OF PAPER 3

Section A

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

1 The diagram shows part of the Periodic Table of the Elements.



Use the letters A to G in the diagram to answer the following questions.

(a) Which two elements are in the same Group? ………………and …………… [1]

(b) Which is the least reactive element? …………………………………… [1]

[Total : 2]

2 Some gases pollute the atmosphere.

(a) State one major source for each of the gaseous pollutants in the table.

gas	source
carbon monoxide	
sulfur dioxide	

[2]

(b) Name one other gas that is an atmospheric pollutant.

…………………………………….. [1]

[Total : 3]

3 The table below shows the mass of ions present in a 100 cm^3 sample of alkaline water.

ion	formula of ion	mass of ion in 100 cm^3 sample of water / mg
calcium	Ca^{2+}	125
chloride	Cl^{-}	120
magnesium	Mg^{2+}	12
phosphate	PO_4^{3-}	95
potassium	K^{+}	140
hydroxide	OH^{-}	160
sodium	Na^{+}	58
sulfate	SO_4^{2-}	30

(a) Write the chemical formula of the compound when sodium ion combines with hydroxide ion.

…………………………………………………………………………………………………… [1]

(b) Draw a 'dot and cross' diagram to show the bonding in calcium chloride.

Show only the outer shell electrons.

[2]

(c) Which ion present in alkaline water causes the water to be alkaline?

…………………………………………………………………………………………………… [1]

(d) Describe the observation when a piece of damp red litmus paper is placed into the alkaline water.

…………………………………………………………………………………………………… [1]

[Total: 5]

4 **(a)** Calculate the relative formula mass, M_r of magnesium sulfate, $MgSO_4$.

[relative atomic masses, A_r: Mg, 24; S, 32; O, 16]

Show your working.

relative formula mass = …………………………… [1]

(b) Magnesium sulfate can be made by reacting magnesium metal with dilute sulfuric acid. This is the chemical equation for the reaction.

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

(i) What does (aq) tell you about magnesium sulfate?

…………………………………………………………………………………………… [1]

(ii) State an apparatus that could be used to collect and measure the volume of hydrogen gas.

…………………………………………………………………………………………… [1]

(iii) Calculate the number of moles in 6 g of magnesium.

[relative atomic masses, A_r: Mg, 24]

Show your working.

number of moles of magnesium = ……………… mol [1]

[Total:4]

Section B

Answer any **two** questions from this section in the spaces provided.

5 **(a)** **(i)** Besides the iron ore, name **two** other starting materials that are added to the blast furnace in the extraction of iron.

…………………….……. and …………………….………. [2]

(ii) In the blast furnace, carbon monoxide reacts with iron ore to produce molten iron.

Complete and balance the following equation

Fe_2O_3 + CO → ……………………………. + ………………………….. [1]

(b) The table shows the results of tests performed on metals **R**, **S**, **T** and **U**.

Key ✓ reaction x no reaction	metal	reaction with water	reaction with steam	reaction with dilute hydrochloric acid
	R	x	✓	✓
	S	x	x	✓
	T	✓	✓	✓
	U	x	x	x

(i) Which metal (**R**, **S**, **T** or **U**) could be copper? ……………………………………… [1]

(ii) Which metal (**R**, **S**, **T** or **U)** could be zinc? ………..…………………………… [1]

(c) State **two** advantages of recycling metals.

1. ……...…………………………………………………………………………………………

…………………………………………………………………………………………………..

2. ……..………………………………………………………………………………………..

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

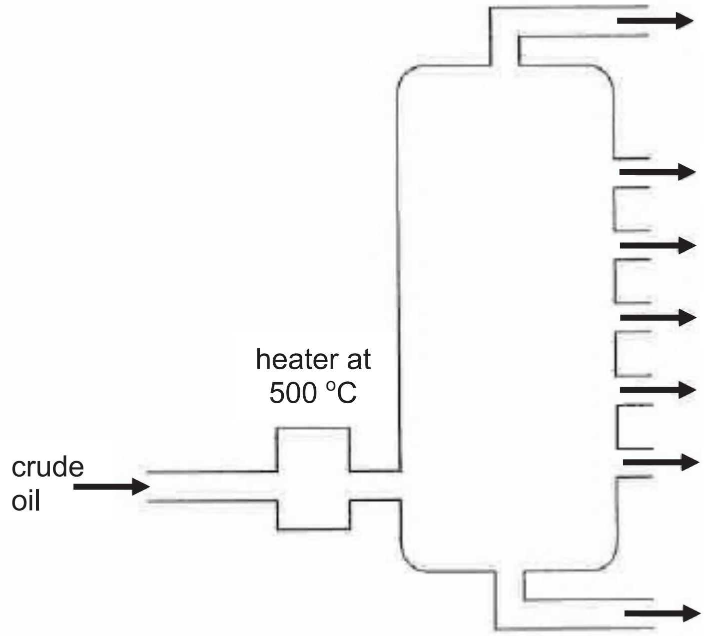
(d) When an aluminium drink can is dropped onto the ground from a height, the aluminium can becomes dented.

Which physical property of aluminium metal does this show?

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

[Total : 8]

6 The diagram shows the apparatus used to separate the fractions from crude oil.



fractions	**range of boiling points / °C**
gases	less than 35
petrol / gasoline	35 - 70
naptha	70 - 170
paraffin / kerosene	170 - 250
diesel	250 - 350
lubricating oil	350 - 500
bitumen	over 500

(a) What is the name given to this process?

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

(b) What physical property of all the fractions makes this separation process possible?

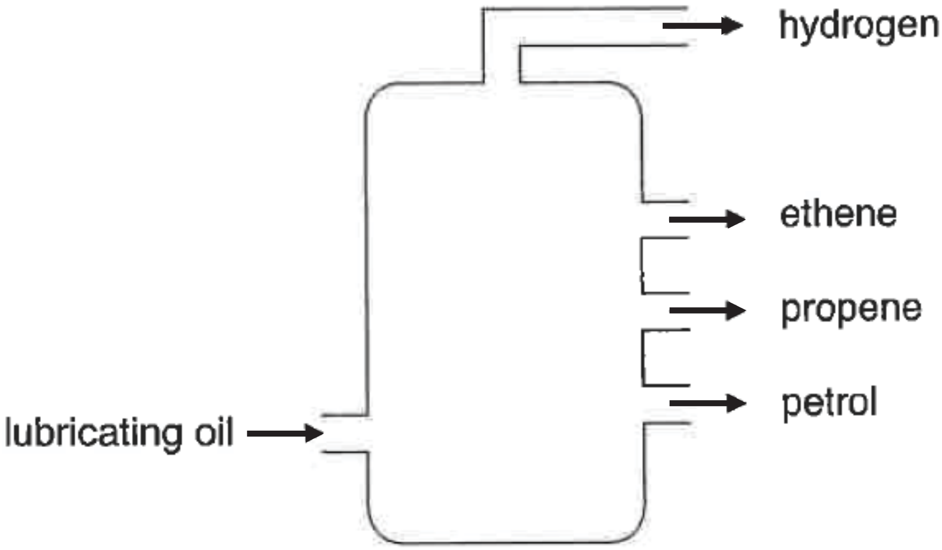
………………………………………………………………………………………………... [1]

(c) Decane is a chemical obtained from crude oil. It has a boiling point of 174 °C.

In which fraction would you find decane?

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

(d) The lubricating oil fraction is passed through a 'cracker' to produce the chemical substances shown below.



(i) What is meant by *cracking*?

.... [1]

(ii) Under what condition(s) do/does cracking occur?

.... [2]

(iii) Explain why cracking is important in the oil industry.

....

.... [1]

(iv) Ethene is an unsaturated hydrocarbon with the formula C_2H_4.

Draw the structural formula for one molecule of ethene.

[1]

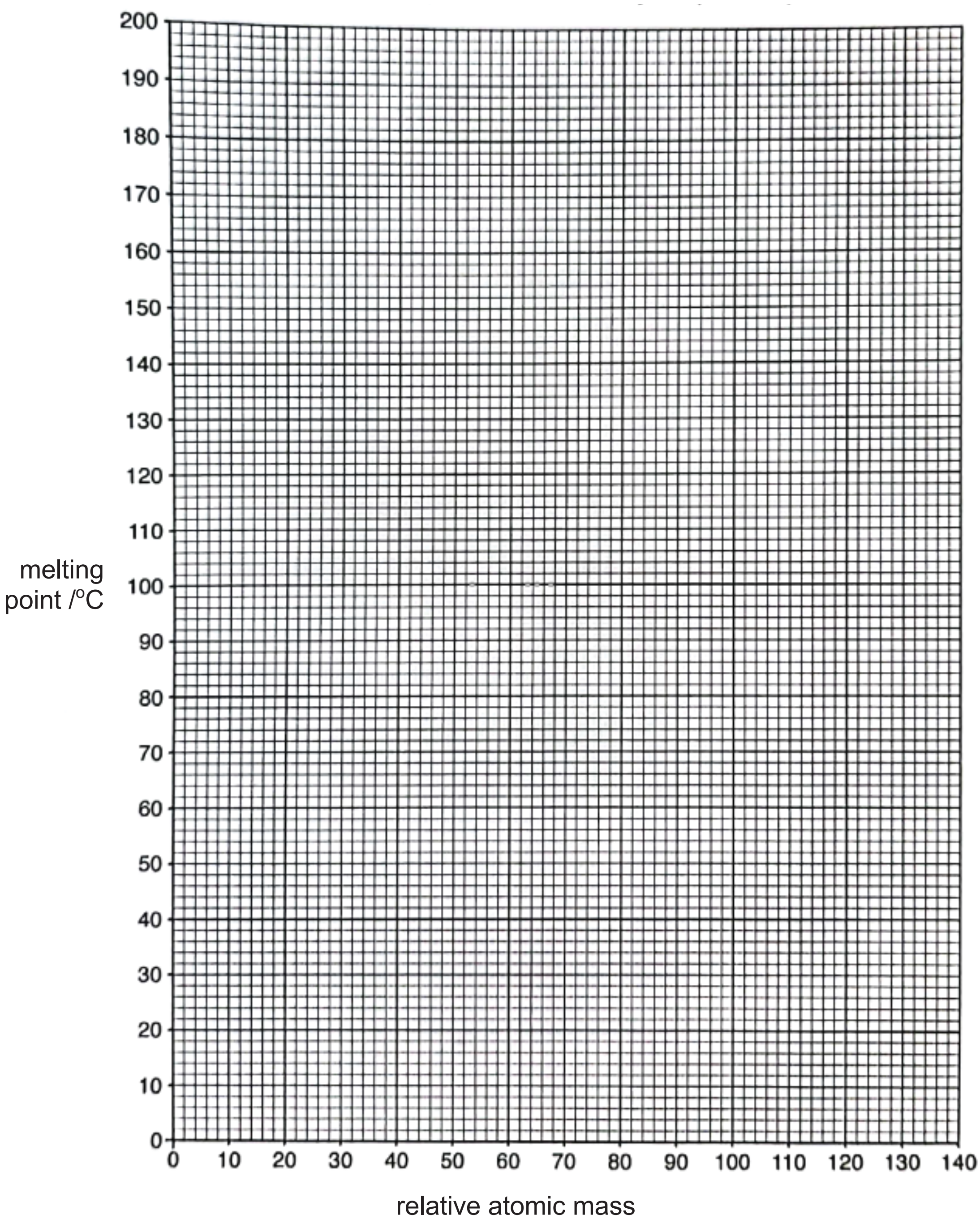
[Total: 8]

7 **(a)** The table shows the relative atomic masses, A_r and the melting points of some Group I metals.

metal	relative atomic masses, A_r	melting point/ °C
lithium	7	181
sodium	23	98
potassium	39	
rubidium	85	39
caesium	133	28

(i) Plot a graph of melting point against relative atomic mass, marking each point with a cross (x). [1]

(ii) Draw a curved line of best fit, using all your plotted points. [1]



(iii) Use your graph to predict the melting point of potassium.

melting point of potassium = …… ^{o}C [1]

(iv) Explain why all these elements are placed in Group I of the Periodic Table.

……

…… [1]

(b) **(i)** Describe one observation made when sodium is added to water.

……

…… [1]

(ii) Write a balanced chemical equation for the reaction of sodium with water.

…… [2]

(iii) Arrange the Group I metals lithium, sodium and potassium in order of increasing chemical reactivity.

least reactive ……

……

most reactive …….. [1]

[Total : 8]

END OF PAPER 4

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).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Secondary 4N
Science (Chemistry)
Prelim Examination 2022

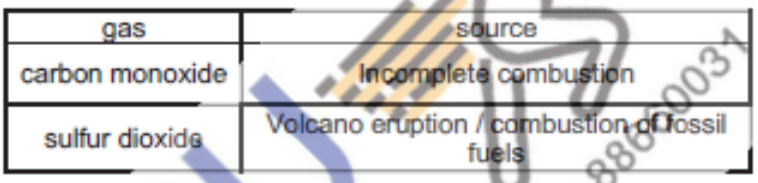
Mark Scheme

Paper 3 (20 marks)

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

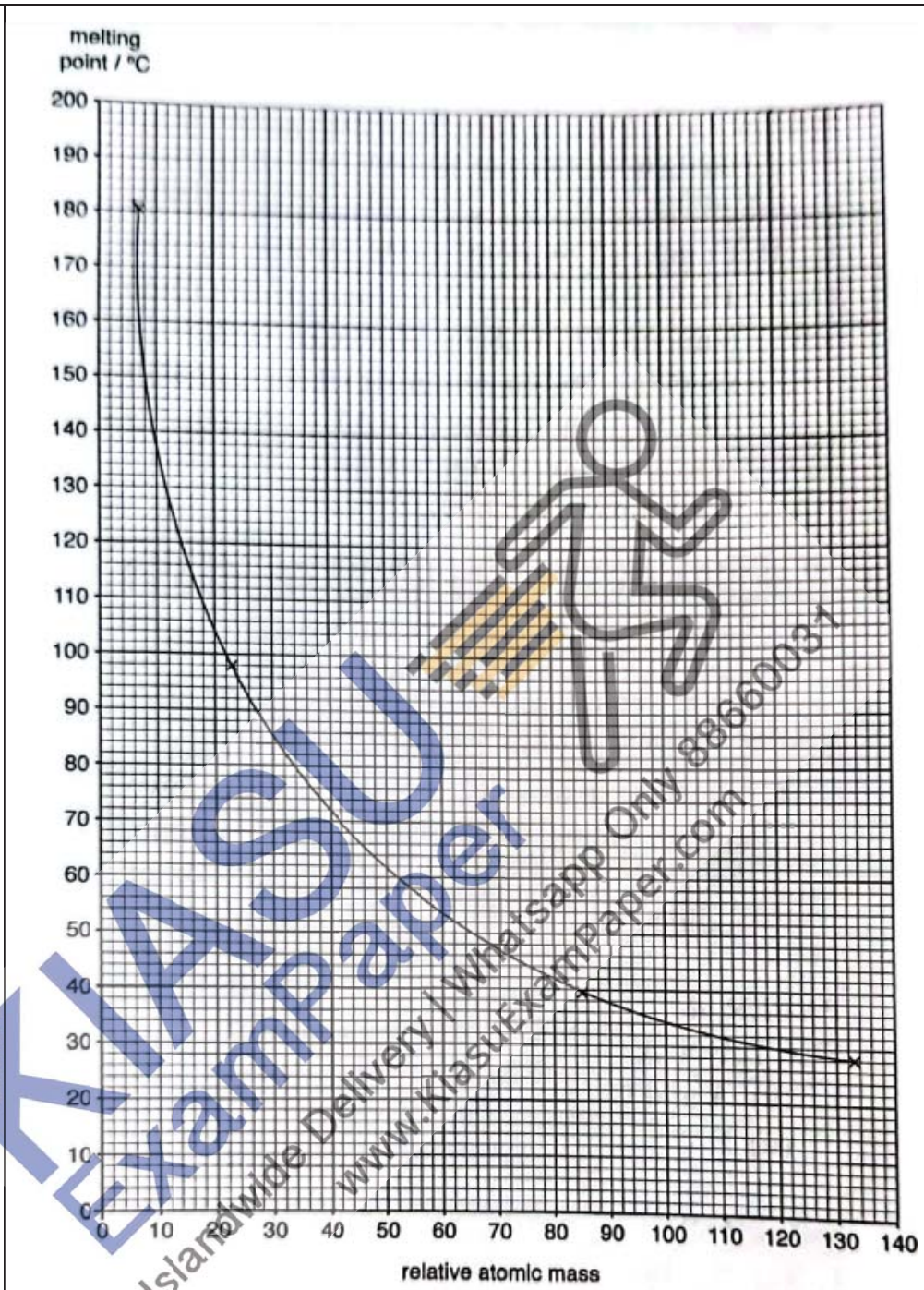
A – 5, B - 3, C – 6, D - 6

Paper 4
Section A (14 marks)

Qn	Answer	Marks
1 (a)	A and G	1
(b)	F	1
		Total: 2
2 (a)		2
(b)	methane / ozone / unburned hydrocarbons / oxides of nitrogen / nitrogen oxide or nitrogen dioxide	1
		Total: 3
3 (a)	NaOH	1
(b)		1 mark for calcium ion 1 mark for 2 chloride ion
(c)	hydroxide/ OH^-	1
(d)	Red litmus paper turns blue.	1
		Total: 5
4 (a)	24+32+4x16 = 120	1
(b)(i)	Dissolved in water OR solution	1
(ii)	gas syringe	1
(ii)	no. of moles = 6 / 24 = 0.25 mol	1
		Total: 4

Section B (16 marks)

Qn	Answer	Marks
5a(i)	coke, limestone,	2
(ii)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	1
b(i)	U	1
(ii)	R	1
c	-To conserve limited amount of metal ores - To use less energy/ fossil fuel/ cost for the extraction of metal from its ores - To reduce land/ air pollution due to the mining of metal ores Any 2 = 2 m	1 1
d	malleable (reject: soft)	1
		Total: 8
6a	fractional distillation	1
b	boiling point	1
c	Paraffin/kerosene	1
d(i)	Cracking is a chemical process of breaking down large molecule into smaller molecules for useful molecules	1
(ii)	High temperature, high pressure catalyst [3 – 2m, 2,1 – 1m]	1
(iii)	It produces smaller more useful molecules / chemical feedstock to produce a wide range of organic compounds / produce petrol or naptha from larger fractions	1 1
(iv)		1
		Total: 8

7a		
(i)	4 points plotted	1
(ii)	Best fit line	1
(iii)	allow for ECF from graph 74°C	1
(iv)	They have one valence electron.	1
b(i)	Burst into flame/ float around the water surface/ bubbles gas/ gas formed (any 1)	1

(ii)	$2Na + 2H_2O \rightarrow 2NaOH + H_2$ 1 m for chemical formula, 1m for balance	2
(iii)	least reactive <u>lithium</u>, <u>sodium</u>, most reactive <u>potassium</u>	All 3 correct - 1
		Total: 8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FUCHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR NORMAL (ACADEMIC)

CANDIDATE NAME							CLASS		
CENTRE NUMBER	S						INDEX NUMBER		

SCIENCE 5105/03

Paper 3 Chemistry **Thursday, 28 July 2022**

Papers 3 and 4: 1 hour and 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number, index number and class on the Answer Sheet in the spaces provided.

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.

Read the instructions on the Answer Sheet very carefully.

Answers to Paper 3 and Paper 4 must be handed in separately.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

You are advised to spend no more than **30 minutes** on **Paper 3**.

You may proceed to answer Paper 4 as soon as you have completed Paper 3.

Any rough working should be done in this booklet.

A copy of the Periodic Table is provided on Page 10 of Paper 4.

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

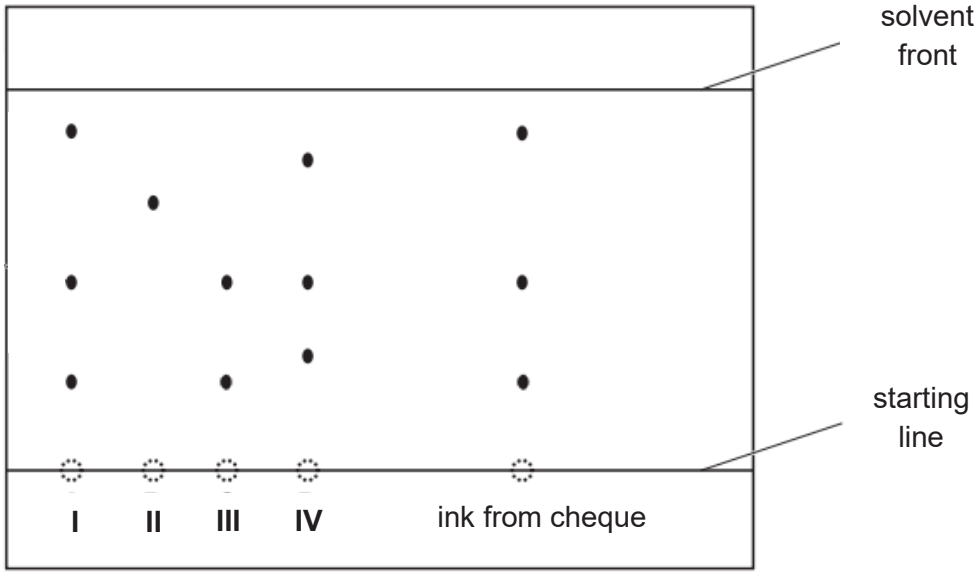
Setter: Ms Tan Ying Rui

This document consists of 8 printed pages.

1 A forensic scientist is investigating the ink that has been used to forge the signature on a cheque.

She separates the colours in some inks using paper chromatography.

The chromatogram is shown below.



What is true about the chromatogram?

A Ink **II** must be a pure substance.

B Ink **III** was used to forge the cheque.

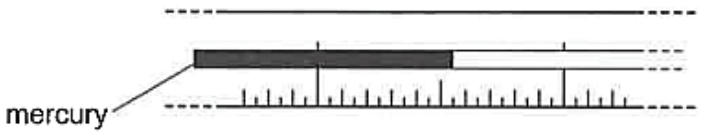
C The dyes must have different boiling points.

D The line on the paper must be drawn in ink.

2 The boiling point of an unknown liquid is higher than that of water.

The student places a thermometer in the boiling unknown liquid.

The diagram represents part of the stem of this thermometer without numbers.



What is the boiling point of the unknown liquid?

A 64.5°C **B** 85.5°C **C** 104.5°C **D** 115.5°C

3 The table shows the melting points of four different substances.

Which substance is a pure solid at a temperature of 20°C?

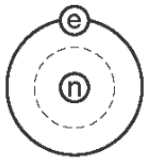
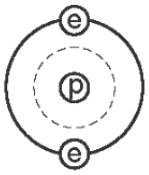
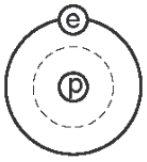
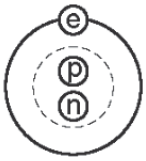
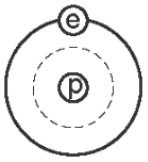
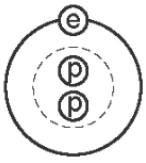
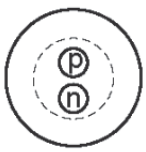
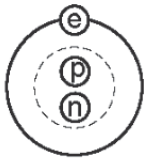
	melting point/°C
A	32
B	25 to 28
C	−20 to −30
D	−35

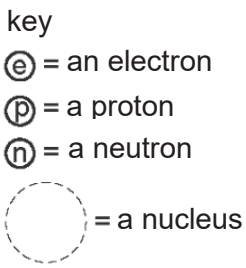
4 A fluorine atom is represented as $^{19}_{9}F$.

How many electrons does one fluoride ion, F^-, contain?

A 9 **B** 10 **C** 11 **D** 19

5 Which pair of diagrams represents a pair of isotopes?

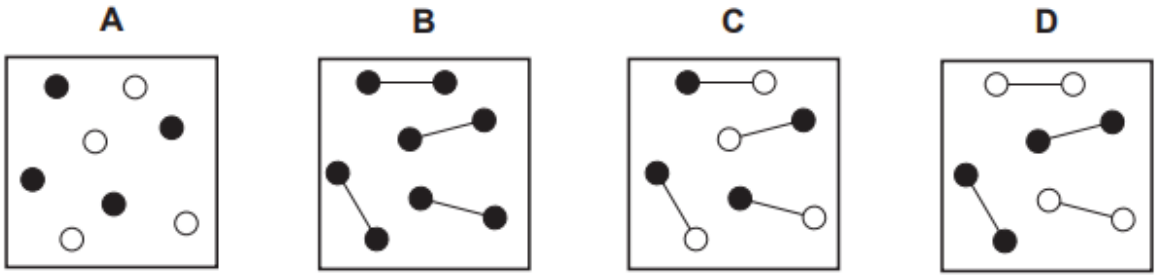
	diagram 1	diagram 2
A		
B		
C		
D		



6 Which row shows the general properties of a covalent molecule?

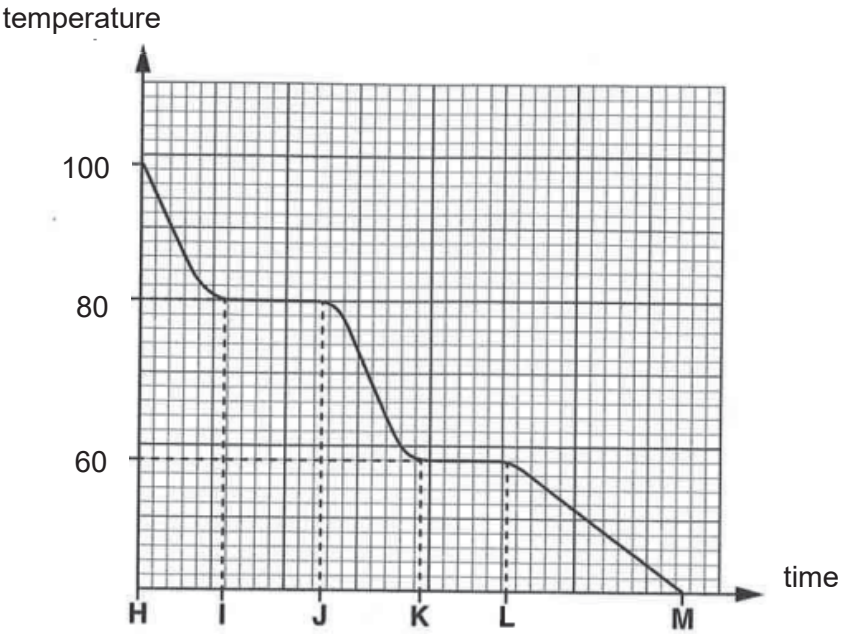
	melting point	solubility in water	conducts electricity	
			solid	liquid
A	high	yes	no	yes
B	high	no	yes	yes
C	low	yes	no	no
D	low	no	no	no

7 Which of the following diagrams shows a mixture of hydrogen gas and fluorine gas?



8 A substance exists as a gas at 80 °C. It was allowed to cool over a period of time.

The cooling curve for the gas is shown below.



What happens to the particles from **I** to **J**?

A The particles lose energy and move closer together.

B The particles lose energy and move further apart.

C The particles gain energy and move closer together.

D The particles gain energy and move further apart.

9 A 0.004 mol sample of an element has a mass of 0.092 g.

What is the name of the element?

A beryllium **B** calcium **C** sodium **D** vanadium

10 Nitrogen reacts with hydrogen to form ammonia.

$$xN_2 + yH_2 \rightarrow zNH_3$$

What values of x, y and z balance the equation?

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

11 Lithium, carbon and zinc are elements that can react with oxygen to form oxides.

Which row identifies the type of oxide that is formed by each of them?

	lithium oxide	carbon dioxide	zinc oxide
A	alkaline	acidic	amphoteric
B	amphoteric	acidic	alkaline
C	acidic	amphoteric	alkaline
D	alkaline	amphoteric	acidic

12 Salts can be prepared by reacting dilute nitric acid with a

1 metal
2 metal oxide
3 metal carbonate

Which methods can be used to prepare copper(II) nitrate?

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

13 Sodium, silicon and phosphorous are all in Period 3 of the Periodic Table.

Which statement about these elements is correct?

A They all have the same number of outermost electrons in their atoms.
B They all have the same chemical reactivity.
C They all have the same number of filled electron shells.
D They all have the same number of nucleons in their atoms.

14 Which row about chlorine is correct?

	state at room temperature	colour	displacement reactions
A	gas	pale yellow	does not displace any halogens
B	gas	yellow-green	displaces bromine from bromides
C	liquid	yellow-green	displaces fluorine from fluorides
D	liquid	reddish-brown	displaces iodine from iodides

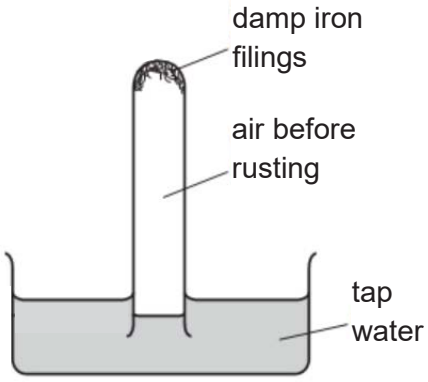
15 Sulfur dioxide is a common atmospheric pollutant.

Which process produces sulfur dioxide?

A a reaction in air when lightning strikes
B high temperatures in car engines
C the combustion of fossil fuels
D the reaction of a limestone building with acid rain

16 Iron filings are placed in a damp test-tube containing 80 cm^3 of air.

The test tube was placed in water and left for a week.



What is the volume of the air left in the test tube after a week?

A 56 cm^3 **B** 64 cm^3 **C** 72 cm^3 **D** 78 cm^3

17 The equations show some of the reactions that occur in a blast furnace.

$$C + O_2 \rightarrow CO_2$$
$$CO_2 + C \rightarrow 2CO$$
$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

What is the function of the coke, C?

A to oxidise haematite to obtain molten iron
B to produce carbon monoxide to reduce the iron ore
C to react with impurities to form molten slag
D to undergo decomposition to form carbon dioxide

18 Which statements give reasons for recycling metals?

1 It is cheaper than extracting metals from their metal ores.
2 It prevents unsightly waste metal left in the environment.
3 It increases the cost of transport of waste to recycling sites.
4 It prevents the rapid depletion of non-renewable and finite resources.

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

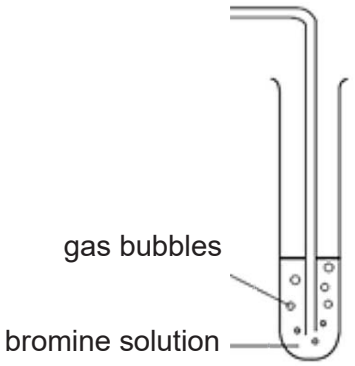
19 The table shows the composition of natural gas.

What is R?

gas	% in natural gas
R	93.1
ethane	3.4
nitrogen	2.3

A argon
B hydrogen
C methane
D oxygen

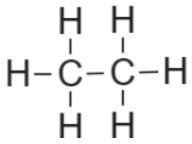
20 The diagram shows an apparatus used to test a gas.



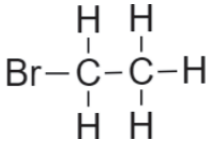
The bromine solution becomes colourless.

What is the structure of the gas?

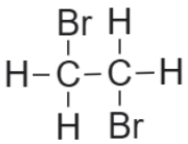
A



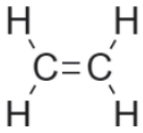
B



C



D



FUCHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR NORMAL (ACADEMIC)

CANDIDATE NAME							CLASS		
CENTRE NUMBER	S						INDEX NUMBER		

SCIENCE 5105/04

Paper 4 Chemistry **Thursday, 28 July 2022**

Papers 3 and 4: 1 hour and 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 on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in Section A and any **two** questions in Section B.
The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is provided on Page 10 of Paper 4.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/14
Section B	/16
TOTAL	/30

Setter: Ms Tan Ying Rui

This document consists of **10** printed pages.

Section A

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

1 **(a)** Two solutions are mixed and a yellow precipitate is formed.

State a method by which the precipitate can be separated from the mixture.

…….. [1]

(b) State the process by which magnesium can be extracted from its metal ore.

…….. [1]

(c) State the reaction by which vegetable oil can be converted to margarine.

…….. [1]

2 The arrangement of electrons in the atoms of six different elements is shown in the table. The letters do not represent the chemical symbols of the elements.

element	**P**	**Q**	**R**	**S**	**T**	**U**
arrangement of electrons	1	2, 4	2, 6	2, 8, 2	2, 8, 6	2, 8, 7

Use the letters, **P**, **Q, R**, **S**, **T**, and **U** to answer the following questions.

(a) Which element has a proton number of 12?

…… [1]

(b) Which two elements are in the same group of the periodic table?

…….. and …….. [1]

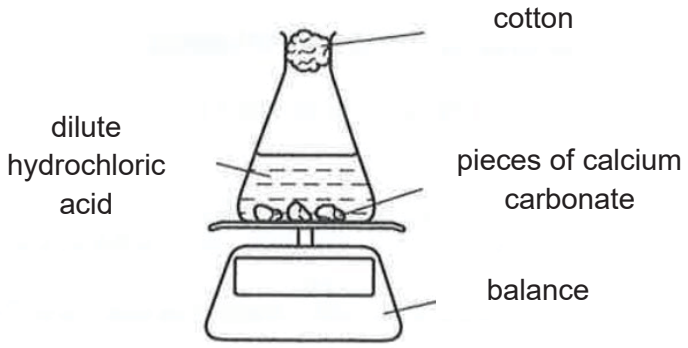
(c) Which element relights a glowing splint?

…… [1]

(d) Particles **P** and **R** can combine to form a covalent molecule with the formula $\mathbf{P_2R}$.
Draw a 'dot and cross' diagram of a $\mathbf{P_2R}$ molecule. Show outer shell electrons only.

[2]

3 (a) A student uses the apparatus below to study the reaction between dilute hydrochloric acid and an excess of calcium carbonate.



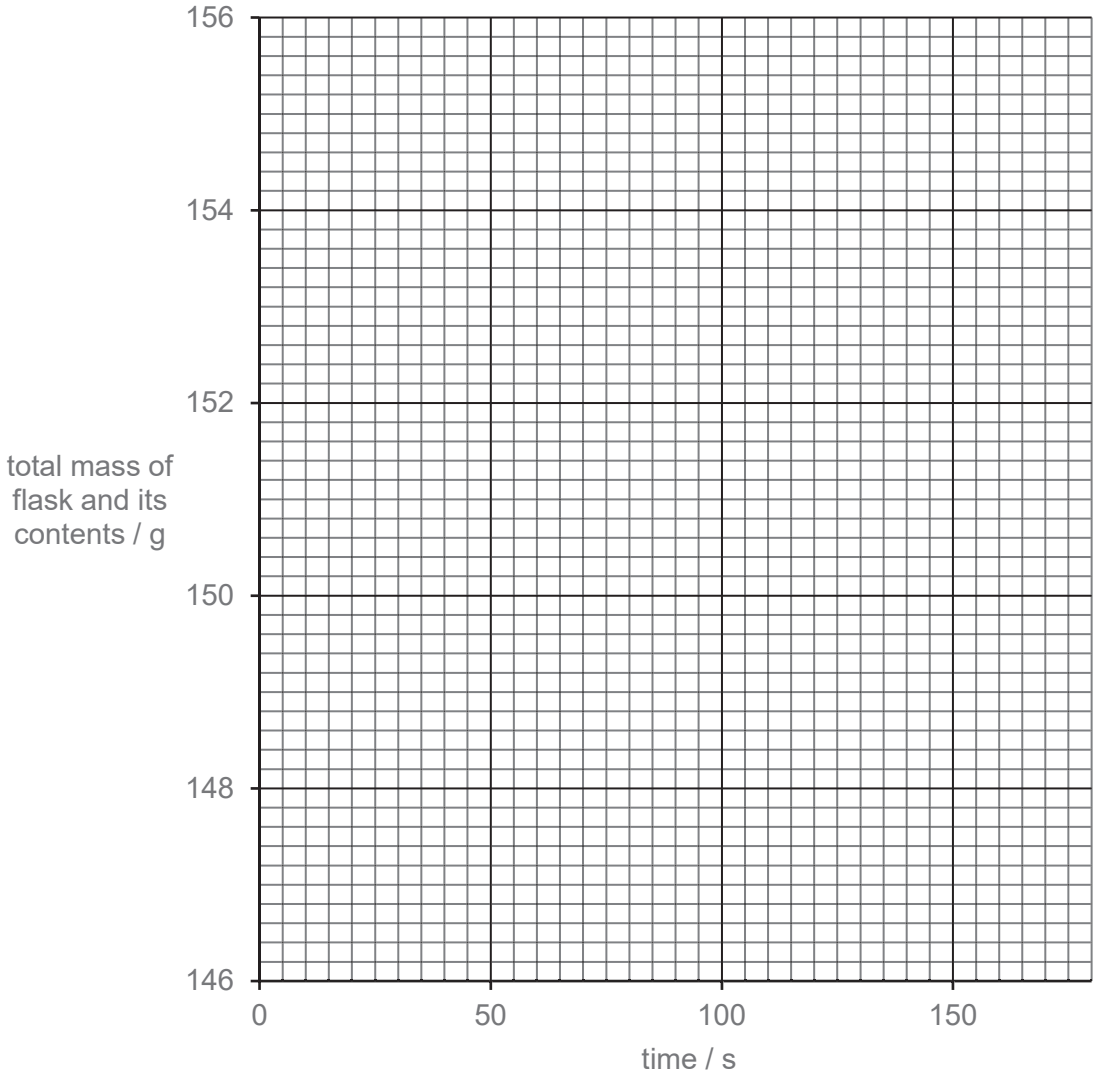
The mass of the conical flask is measured at 30-second intervals.

The results obtained by the student are shown in the results table.

time (s)	0	30	60	90	120	150	180
total mass of flask (g)	155	153.4	152.4	151.6	151.2	151	151

(i) Plot a graph of mass against time, marking each point with a cross (x). [1]

(ii) Draw a best fit line taking into account all the plotted points. [1]



(b) Use your graph to estimate the time at which the reaction is completed.

time = …… [1]

(c) Suggest why the total mass of the flask and its contents decreases with time.

……..

…… [1]

(d) The student wanted to obtain crystals of calcium chloride from the contents of the flask.

Calcium chloride is soluble in water.

Describe how the student could obtain crystals of calcium chloride from the contents of the flask, after the reaction is complete.

……..

……..

……..

…… [2]

Section B

Answer any **two** questions from this section in the spaces provided.

4 (a) The table below shows the list of ions and its percentage composition in a packet of fertiliser.

name	formula	percentage composition (%)
	NH_4^+	5.3
magnesium	Mg^{2+}	1.6
nitrate	NO_3^-	11.7
potassium	K^+	7.7
phosphate	PO_4^{3-}	5
sulfate		2.65

(i) Fill in the blanks in the table above. [1]

(ii) State the number of metal ions present in the fertiliser.

…… [1]

(iii) State the ion which is highest in percentage composition.

…… [1]

(b) Elemental nitrogen is an important nutrient that is required for plants to grow well.
The fertilizer contains ammonium nitrate, which is a good source of elemental nitrogen.

Calculate the number of moles in 60 g of ammonium nitrate, NH_4NO_3.
[relative atomic masses, A_r: N, 14; H, 1; O, 16]

number of moles of NH_4NO_3 = …… [2]

(c) A farmer wanted to grow some pumpkins on a patch of soil of pH 6. Pumpkins grow well in slightly alkaline soil.

Explain how adding calcium hydroxide could make the soil more suitable for growing pumpkins.

……..

…… [1]

(d) The farmer added calcium hydroxide and ammonium nitrate to the soil separately.

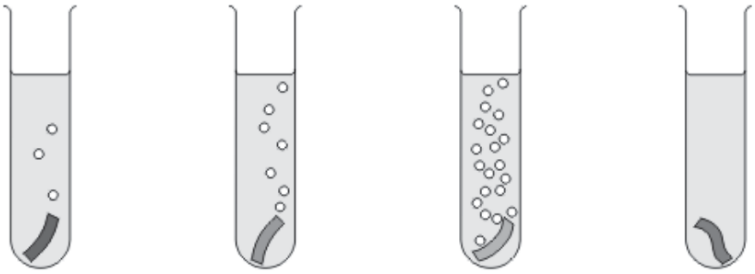
Explain, in terms of the chemistry involved, why it is **not** advisable to mix calcium hydroxide and ammonium nitrate before adding it to the soil.

……..

……..

…… [2]

5 (a) The diagram below shows some observations when four metals are added into a test tube containing cold water.



W **X** **Y** **Z**

(i) Arrange the metals in decreasing order of their reactivity.

most reactive ……

……

……

least reactive …… [1]

(ii) Name the gas that is produced when metal reacts with cold water and suggest a positive test to determine the identity of the gas produced.

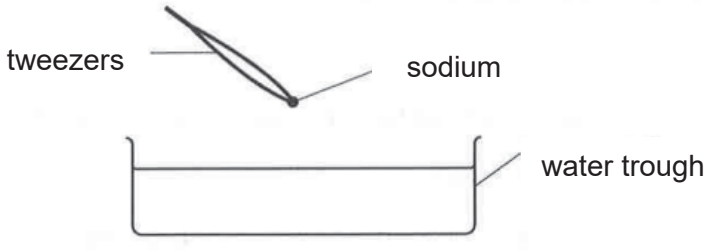
name ……

test ……

…… [2]

(b) A scientist wanted to investigate the reaction of sodium with cold water.

He uses a pair of tweezers to remove a small piece of sodium from a bottle filled with oil and added it to a water trough as shown below.



(i) Explain why sodium is usually stored in oil.

……

…… [1]

(ii) Describe the colour change that you would observe when a few drops of Universal Indicator were added to the water trough after the sodium metal was allowed to react with the water.

……

…… [1]

(c) Metal oxides are one of the products that are formed when metal reacts with steam.

Sodium atoms can form Na^+ ions and oxygen atoms can form O^{2-} ions.

(i) State the chemical formula of sodium oxide.

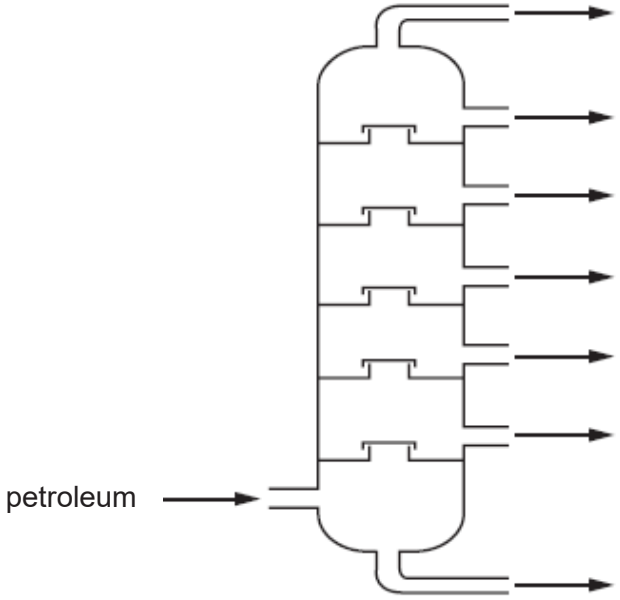
chemical formula of sodium oxide …… [1]

(ii) Explain why sodium oxide can conduct electricity in molten and aqueous state, but not in solid state.

……

…… [2]

6 (a) Crude oil is a mixture of different hydrocarbon molecules. The mixture can be separated by the process of fractional distillation.



(i) What physical property of the different carbon molecules in crude oil allows them to be separated by fractional distillation?

……. [1]

(ii) The hydrocarbons in the top fraction exist as gases at room temperature.

Describe the arrangement and movement of particles in a gas.

arrangement ……

movement ……

……. [1]

(b) Larger hydrocarbons that are obtained from fractional distillation, can be broken down into smaller molecules through a process called cracking.

State two conditions required for cracking to occur.

1. ……...

2. ……. [1]

(c) The hydrocarbon *octane* has the molecular formula, C_8H_{18}.

(i) Complete the equation below for the cracking of octane in which propene, C_3H_6, is produced together with **one** other product.

$C_8H_{18} \rightarrow$ …… + …… [1]

(ii) Draw the full structural formula for propene, C_3H_6, showing all the atoms and bonds present.

[1]

(d) **(i)** Write a balanced chemical equation for the complete combustion of ethane, C_2H_6.

…… [2]

(ii) Identify the atmospheric pollutants that will be produced if ethane is burned in a limited supply of air.

…… [1]

End of Paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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

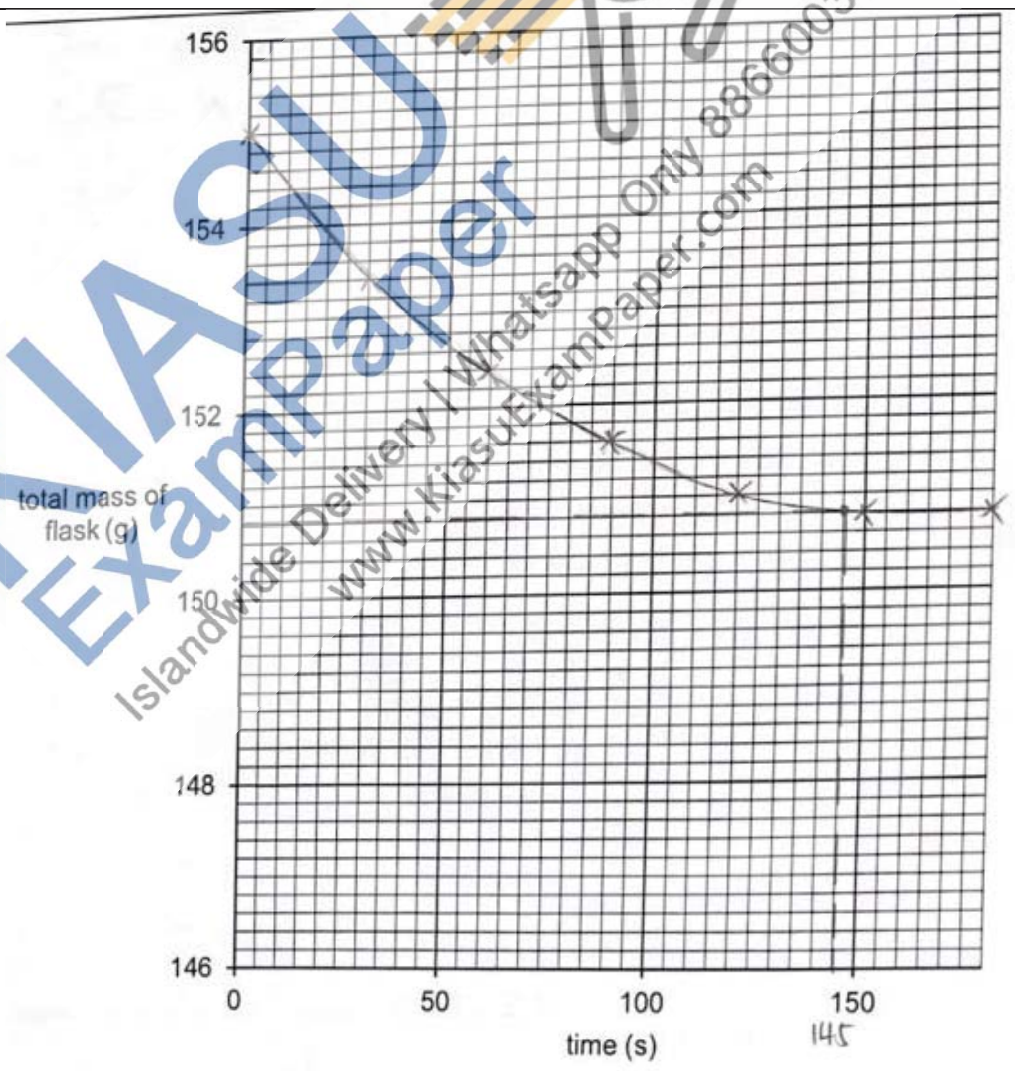
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

1	2	3	4	5	6	7	8	9	10
A	**D**	**A**	**B**	**B**	**D**	**D**	**A**	**C**	**B**

11	12	13	14	15	16	17	18	19	20
A	**C**	**C**	**B**	**C**	**B**	**B**	**B**	**C**	**D**

1	**(a)**	Filtration	[1]
	(b)	Extraction via electrolysis	[1]
	(c)	Addition/hydrogenation	[1]

2	**(a)**	**S**	[1]
	(b)	**R** and **T**	[1]
	(c)	**R**	[1]
	(d)		[2]

3	**(a)**		
	(b)	145 s	[1]

	(c)	As the reaction proceeds, carbon dioxide is produced and it escapes the flask, causing the total mass of the flask and its contents to decrease over time.	[1]
	(d)	Filter out excess calcium carbonate and collect the filtrate in an evaporating dish. Heat the filtrate until a saturated solution forms. Allow the saturated solution to cool until crystals are formed. Filter the saturated solution and dry the crystals between sheets of filter paper. 2 points – 1M All 4 points – 2M	[2]

4 (a) (i)

name	formula	percentage composition (%)
ammonium	NH_4^+	5.3
magnesium	Mg^{2+}	1.6
nitrate	NO_3^-	11.7
potassium	K^+	7.7
phosphate	PO_4^{3-}	5
sulfate	SO_4^{2-}	2.65

[1]

(ii) 2 [1]

(iii) nitrate [1]

(b) Mr of NH_4NO_3 = 14 + 4 × 1 + 14 + 16 × 3
= 80 [1m]
Number of moles = 60/80
= 0.75 mol [1m]

(c) Calcium hydroxide is alkaline. When it is added to the soil, it increases the pH of the acidic soil, making the soil slightly alkaline and suitable for growing pumpkins. [1]

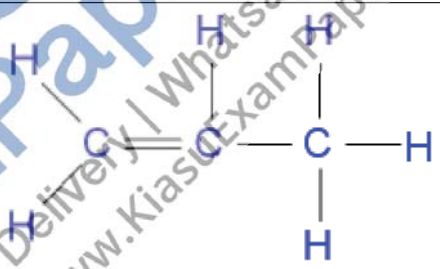
(d) When calcium hydroxide and ammonium nitrate are added, they react together to calcium nitrate, water and ammonia. [1] The elemental nitrogen escapes in the form of ammonia gas and does not get absorbed by the soil. [1] [2]

5 (a) (i) Arrange the metals in decreasing order of their reactivity.

most reactive	Y
	X
	W
least reactive	Z

(ii) name **hydrogen**

			test **insert lighted splint into test tube containing the gas, the gas extinguishes the lighted splint with a 'pop' sound.**	[2]
	(b)	**(i)**	Sodium is stored in oil as it is very reactive and can react explosively with it comes into contact with moisture in the air.	[1]
		(ii)	The universal indicator would turn from dark green to blue/purple.	[1]
	(c)	**(i)**	Na_2O	[1]
		(ii)	In molten and aqueous state, the sodium and oxide **ions can move freely** to conduct electricity.[1] In solid state, **the ions are held in fixed position** and cannot move to conduct electricity. [1]	[2]

6	**(a)**	**(i)**	Different boiling points	[1]
		(ii)	arrangement **the particles are very far apart in a disorderly manner.**	[1]
			movement **the particles move rapidly and randomly**	
	(b)	**1.**	**Aluminium oxide/Al_2O_3/Catalyst**	
		2.	**600°C/High Temperature**	[1]
	(c)	**(i)**	$C_8H_{18} \rightarrow C_3H_6 + C_5H_{12}$	[1]
		(ii)		[1]
	(d)	**(i)**	$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$	[2]
		(ii)	Carbon monoxide, carbon particles/soot	[1]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Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 NORMAL ACADEMIC
PRELIMINARY EXAMINATION 2022

SCIENCE (CHEMISTRY) 5105/03

Paper 3 Multiple Choice
MONDAY **15 AUG 2022**
0830 – 0945 **Papers 3 and 4 : 1 h 15 minutes**
Additional Materials : Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Answer Sheet in the spaces provided and at the top of this page.

There are **twenty** questions in this section. Answer all questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

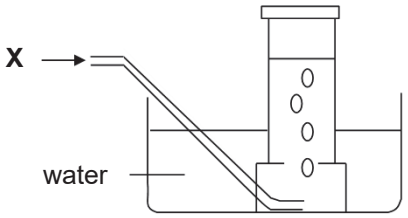
Answers to Paper 3 and Paper 4 must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on **page 10**.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **10** printed pages, including this cover page.

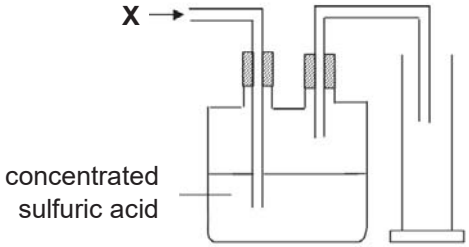
Setter: Ms Jaslin Jiang **[Turn over**

1 A basic gas **X** is denser than air and is very soluble in water.
Which method is used to collect a sample of the gas?

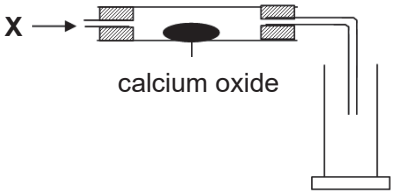
A



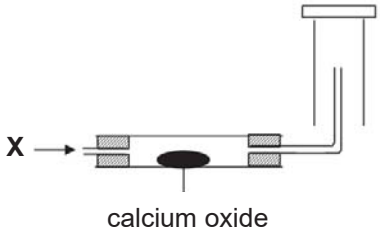
B



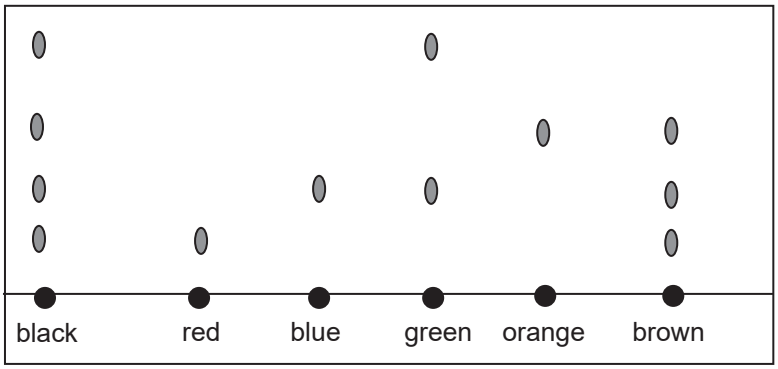
C



D



2 A chromatogram of several inks is shown.

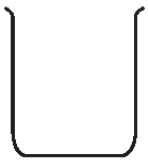


Which of the following three inks, when mixed, does **not** produce black ink?

A blue, green, brown
B blue, green, red
C green, brown, orange
D green, brown, red

3 Which apparatus is most appropriate to measure exactly 24.5 cm^3 of a liquid?

A



B

C

D

4 Students are asked to state

- the number of atoms in one formula unit of hydrogen sulfate; and
- the relative formula mass, M_r of this formula unit.

Which option shows the correct answers?

	number of atoms	M_r
A	3	49
B	4	50
C	7	82
D	7	98

5 The following table shows information about elements **X** and **Y**.

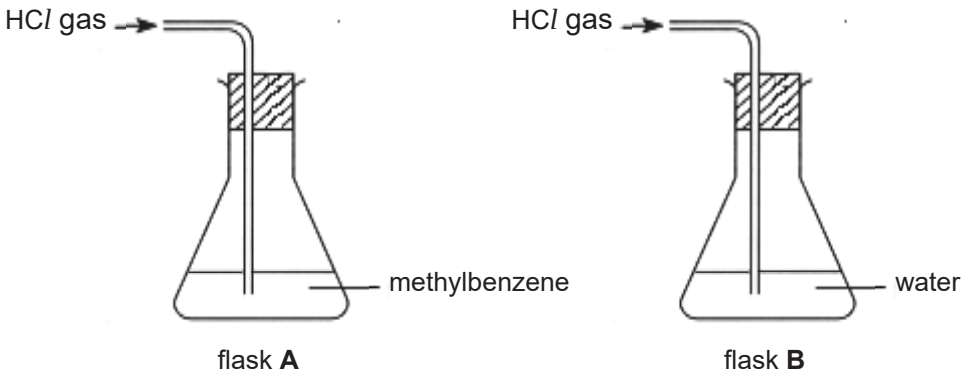
element	proton number	mass number
X	11	23
Y	8	17

What is the chemical formula and type of bonding present in the compound formed between **X** and **Y**?

	chemical formula	type of bond
A	$\mathbf{XY_2}$	covalent
B	$\mathbf{XY_2}$	ionic
C	$\mathbf{X_2Y}$	covalent
D	$\mathbf{X_2Y}$	ionic

6 Hydrogen chloride gas is soluble in both methylbenzene, an organic solvent, and in water.

In an experiment, hydrogen chloride gas is bubbled into the different solvents.



When a few drops of Universal Indicator solution is added into flask **A**, the indicator remained green but turned red when added to flask **B**.

What could be the reason?

A HC*l* does not produce hydrogen ions in methylbenzene.
B HC*l* does not produce hydroxide ions in methylbenzene.
C HC*l* neutralises the Universal Indicator solution.
D HC*l* neutralises methylbenzene.

7 Which oxide reacts with both acids and alkalis?

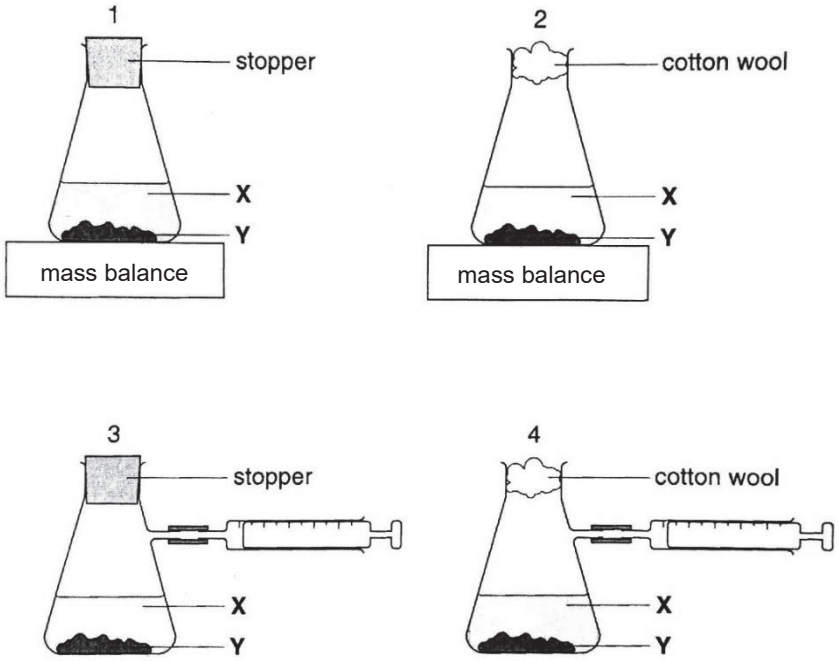
A	calcium oxide	**B**	lead(II) oxide
C	nitrogen monoxide	**D**	sulfur trioxide

8 Most salts can be prepared by reacting a carbonate with an acid.

Which salt **cannot** be prepared by the above method?

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

9 Liquid **X** reacts with solid **Y** to form a gas.



Which two diagrams show suitable methods for investigating the rate of reaction?

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

10 Which indicator gives the least accurate pH value of a soil sample?

A	datalogger with pH sensor	**B**	litmus paper
C	red cabbage solution	**D**	Universal Indicator

11 A student thinks that element **Q** is a metal because it has a high melting point and a high boiling point. What other properties could element **Q** have to show that it is a metal?

1 **Q** conducts electricity when solid.
2 **Q** forms an acidic oxide, **Q**O_2.
3 **Q** is malleable.

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

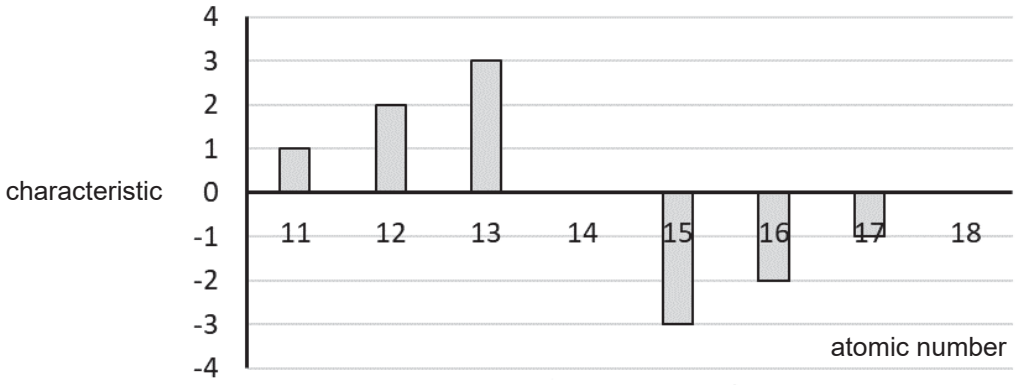
12 The following shows part of the Periodic Table. The letters do not represent the actual symbols of the elements.

Period	Group								
	I	II		III	IV	V	VI	VII	0
1									
2	**U**	**S**						**T**	
3	**Y**							**Z**	

Which statement is **false**?

A The compound formed between **S** and **T** has the formula of **S**T_2.
B The oxides of **U**, **Y** and **S** are basic.
C **U**, **S** and **Y** are metals, while **T** and **Z** are non-metals.
D **Y** has a higher boiling and melting point than **U**.

13 The graph shows the trend of a characteristic across elements in period 3.



What is the characteristic?

A charge of ions
B ease of gaining electrons
C number of electron shells
D number of valence electrons

14 Three elements, **X**, **Y** and **Z**, have consecutive, increasing proton numbers. If element **X** is in Group IV, what will be the symbol for the ion of element **Z** in its compounds?

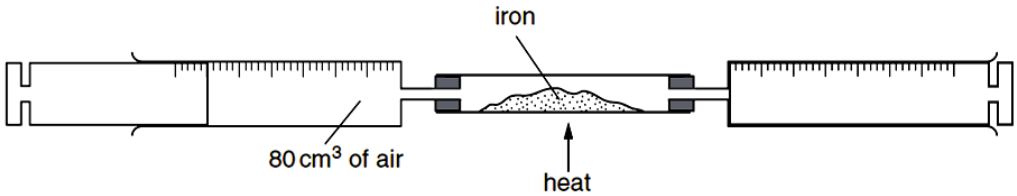
A Z^+
B Z^{2+}
C Z^-
D Z^{2-}

15 A steel factory and a chemical factory are built near to a city. The limestone buildings in the city begin to crumble.

Which gas is most likely to cause this damage?

A carbon dioxide
B carbon monoxide
C nitrogen dioxide
D oxygen

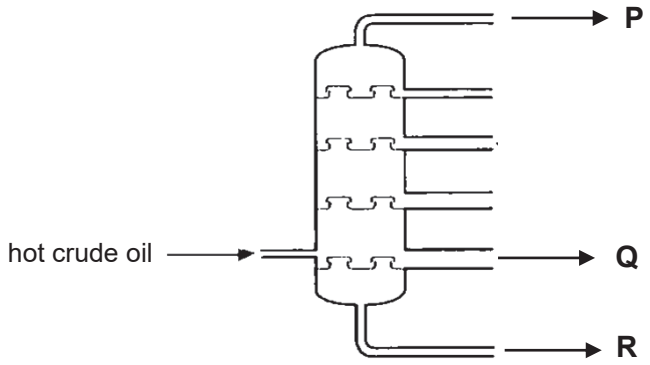
16 A 80 cm^3 sample of air is trapped in a gas syringe. The air is slowly passed over heated iron in a tube until there is no further decrease in volume.



When cooled to the original temperature, what is the volume of gas remaining?

A 17 cm^3
B 21 cm^3
C 63 cm^3
D 80 cm^3

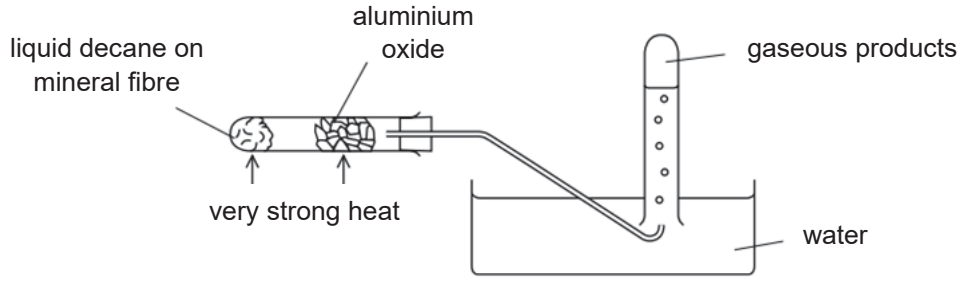
17 The diagram represents a fractionating column used to separate crude oil.



Which of the following correctly represents the uses of these fractions?

	P	Q	R
A	fuel for cooking	lubricating machines	for making roads
B	fuel for big vehicles	lubricating machines	fuel for cooking
C	lubricating machines	fuel for cooking	fuel for aircrafts
D	for making roads	fuel for cooking	lubricating machines

18 The apparatus shown was set up and a sample of decane, $C_{10}H_{22}$, was heated strongly in the presence of aluminium oxide. The products obtained were a mixture of gaseous compounds and a diatomic gas.



Which row correctly indicates the process that occurred and the equation for the reaction that took place?

	process	equation
A	cracking	$C_{10}H_{22} \rightarrow 3C_2H_4 + C_4H_{10}$
B	cracking	$C_{10}H_{22} \rightarrow 3C_2H_4 + C_4H_8 + H_2$
C	reduction	$C_{10}H_{22} \rightarrow 2C_2H_4 + 2C_3H_6 + H_2$
D	substitution	$C_{10}H_{22} \rightarrow 3C_2H_4 + C_4H_8 + H_2$

19 Natural gas contains mainly methane.

Which products are formed when methane is burned completely?

A carbon and water
B carbon dioxide and hydrogen
C carbon dioxide and water
D carbon monoxide and water

20 Which of the hydrocarbons in the table may be members of the same homologous series?

hydrocarbon	1	2	3	4
state at room temperature	gas	gas	liquid	liquid
reaction with oxygen	burns	burns	burns	burns
reaction with bromine	decolourise bromine	no reaction	decolourise bromine	no reaction

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

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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

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

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 NORMAL ACADEMIC
PRELIMINARY EXAMINATION 2022

SCIENCE (CHEMISTRY) 5105/04

Paper 4
MONDAY **15 AUG 2022**
0830 – 0945 **Papers 3 and 4 : 1 h 15 minutes**

Candidates answer on Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

Answer all questions in Section A and any **two** questions in Section B.
The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on **page 10**.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each equation or part question.

This document consists of **10** printed pages, including this cover page.

Setter: Ms Jaslin Jiang **[Turn over**

Section A [14 marks]

Write your answers in the spaces provided.

1 The diagrams in Fig. 1.1 represent the particles in six different substances, **A** to **F**, at room temperature and pressure.

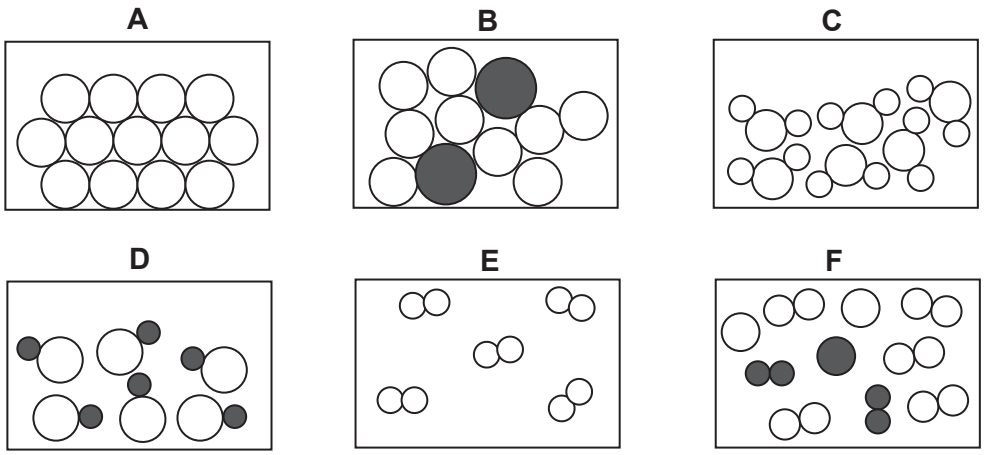


Fig. 1.1

Classify the six substances, **A** to **F**, as compound, element or mixture in Table 1.2.

Table 1.2

compound	element	mixture

[3]

2 Reacting an acid with a base is a common method of preparing salts. This is known as an acid-base reaction.

Table 2.1 gives details of three salts that can be prepared by acid-base reactions.

Table 2.1

salt	formula	relative formula mass, M_r
copper(II) sulfate	$CuSO_4$	160
potassium chloride	KC*l*	
zinc nitrate	$Zn(NO_3)_2$	

(a) Use data from the Periodic Table to complete Table 2.1 by calculating the missing M_r values. [2]

(b) Calculate the mass of 0.3 moles of zinc nitrate.

mass of zinc nitrate = …… g [1]

(c) Name the acid and the base required to produce potassium chloride.

acid ……..……

base ……..……..…..…… [1]

(d) When preparing salts by this method, just enough acid is added to react exactly with all of the base.

What is the pH of the solution formed at the end of the reaction to produce potassium chloride?

pH = …… [1]

3 Fig. 3.1 shows the structural formulae of four hydrocarbon compounds **J**, **K**, **L** and **M**.

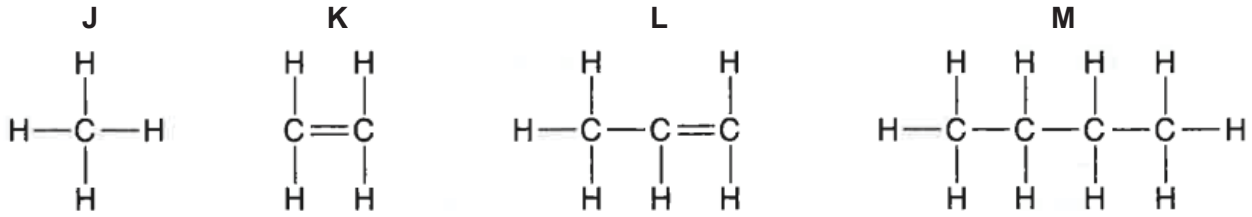


Fig. 3.1

State which of the compounds **J**, **K**, **L** and **M**

(a) are saturated, ……. [1]

(b) decolourise aqueous bromine, ……. [1]

(c) take part in addition reactions. ……. [1]

4 Table 4.1 shows the composition of air in two towns, **A** and **B**.

Table 4.1

town	oxygen %	nitrogen %	carbon dioxide %	sulfur dioxide %
A	20.0	78.7	0.2	0.0
B	18.8	78.7	0.9	0.5

(a) Name one component of air **not** listed in Table 4.1.

…….. [1]

(b) **(i)** Suggest a reason why there is more sulfur dioxide in town **B**.

…….. [1]

(ii) State one harmful effect that sulfur dioxide has on the environment.

……..

…….. [1]

Section B [16 marks]

Answer any **two** questions in the spaces provided.

5 **(a)** A gaseous substance is allowed to cool. The temperature of the substance is taken at regular intervals. A graph of the reading obtained is shown in Fig. 5.1.

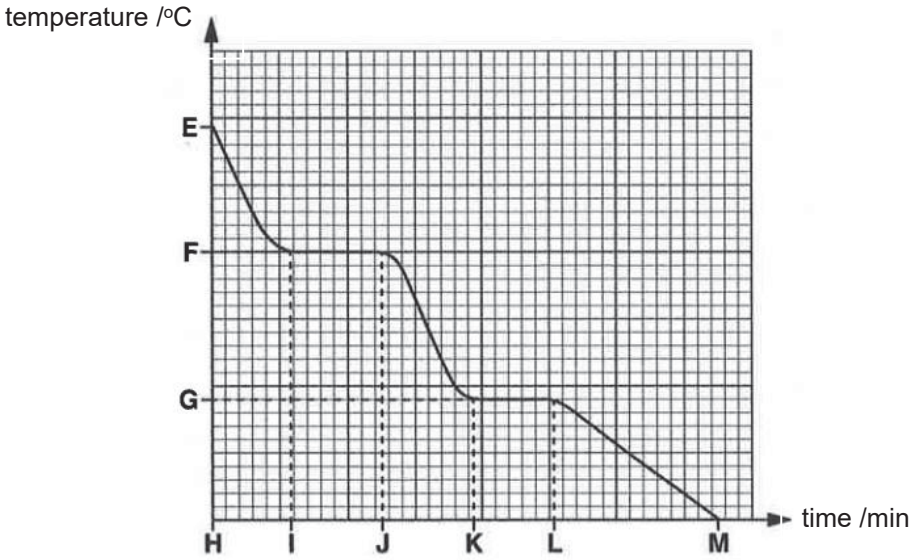


Fig. 5.1

(i) Between which **two** letters on the time axis is there **only** solid present?

…… and …… [1]

(ii) Name the process occurring at temperature **F**.

process is …….. [1]

(iii) What is happening to the substance between time **K** and time **L**? Explain your answer in terms of the kinetic particle theory.

……..

……..

……..

…… [2]

(b) **(i)** Aluminium chloride can be prepared by heating aluminium in chlorine gas. The aluminium chloride formed is an ionic compound at room temperature and pressure. Describe how the ions present in aluminium chloride are formed from atoms of aluminium and atoms of chlorine.

……

……

……

…… [2]

(ii) The reaction between potassium carbonate and aluminium chloride can be represented by the following equation.

$3K_2CO_3(aq) + \ldots\ldots Al Cl_3(aq) + \ldots\ldots H_2O(l) \rightarrow \ldots\ldots Al(OH)_3(s) + \ldots\ldots KCl(aq) + \ldots\ldots CO_2(g)$

Complete the balancing of the equation for this reaction. [1]

(iii) State the meaning of each of the state symbols shown in the equation in **(b)(ii)**.

(aq) = …… (g) = ……

(l) = ..…… (s) = …… [1]

6 **(a)** Chlorine is a member of the group in the Periodic Table known as the halogens.

(i) Name two other members of the halogen group.

…….. and …….. [1]

(ii) Arrange these three halogens in order of increasing chemical reactivity.

least reactive ……..

……..

most reactive ……..

[1]

(iii) Chlorine reacts with hydrogen to form hydrogen chloride.
Draw a 'dot and cross' diagram to show a molecule of hydrogen chloride. Show the outer electrons only.

[2]

(b) Fig. 6.1 shows the structure of two atoms, **X** and **Y**.

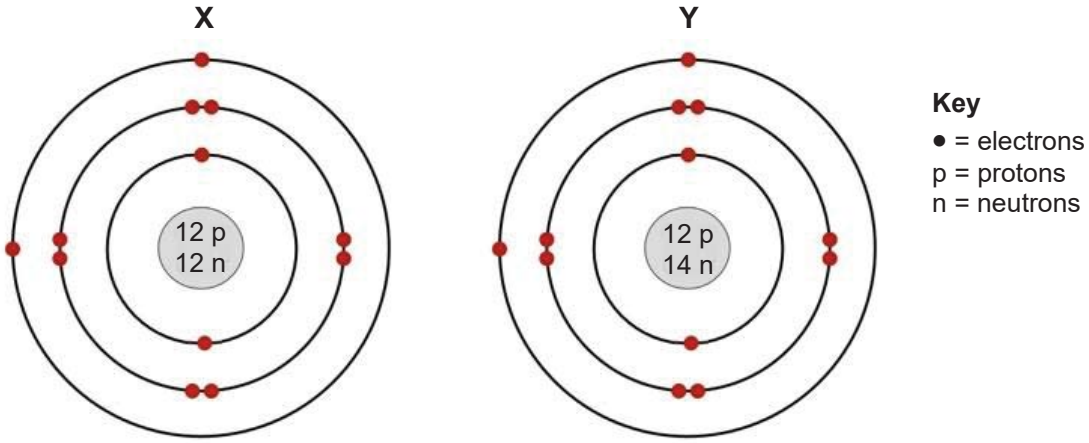


Fig. 6.1

The symbol for a helium atom is $^{4}_{2}He$.

(i) Using data from the Periodic Table and Fig. 6.1, write the symbol for atom **Y**.

…….. [2]

(ii) **X** forms ionic compounds.
Using data from the Periodic Table and Fig. 6.1, write the symbol for an ion of **X**.

…… [1]

(iii) What term is used to describe the relationship between atoms **X** and **Y**?

…… [1]

7 **(a)** **(i)** Name the three starting materials added to the blast furnace in the extraction of iron.

…….. , …….. and …….. [2]

(ii) Suggest two gases likely to be present in the waste gases emitted from the blast furnace.

…….. and …….. [1]

(b) Some baked bean cans made of iron are coated with a thin layer of tin to prevent rusting. If the coating is scratched then the iron underneath starts to rust.
Name the element and the compound which together react with the iron to form rust.

element ……..

compound …….. [2]

(c) Table 7.1 shows some observations made when four metals are treated separately with cold water and with steam.

Table 7.1

metal	observation with cold water	observation with steam
calcium	reacts quickly with many bubbles seen	explosive reaction
copper	no observed change	no observed change
iron	no observed change	reacts very slowly
magnesium	slow reaction with some bubbles seen	burns with a bright glow

(i) Arrange these metals in order of their reactivity.

most reactive ⟶ least reactive

[1]

(ii) Zinc is placed between iron and magnesium in the reactivity series of metals.

Using Table 7.1, suggest what observations would be made when zinc is treated separately with cold water and with steam.

cold water …….

steam …… [2]

The Periodic Table of Elements

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 –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).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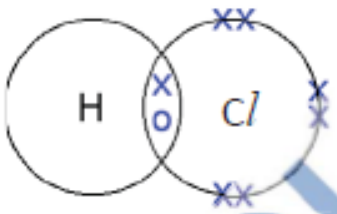
Answers to Sc(Chemistry) Prelim 2022

Paper 3

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

Paper 4

<table>
<tr><th>Qns</th><th>Suggested Answers</th><th>Marks allocated</th></tr>
<tr><td colspan="3">Section A</td></tr>
<tr><td>1</td><td>
<table>
<tr><td>compound</td><td>element</td><td>mixture</td></tr>
<tr><td>C and D</td><td>A and E</td><td>B and F</td></tr>
</table>
6 x ½ mark each</td><td>3</td></tr>
<tr><td>2</td><td>(a)
<table>
<tr><td>salt</td><td>formula</td><td>relative formula mass, M_r</td></tr>
<tr><td>copper(II) sulfate</td><td>$CuSO_4$</td><td>160</td></tr>
<tr><td>potassium chloride</td><td>KCl</td><td>74.6 [1]</td></tr>
<tr><td>zinc nitrate</td><td>$Zn(NO_3)_2$</td><td>189 [1]</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>(b) mass of zinc nitrate = 0.3 × 189
= 56.7 g [1]</td><td>1</td></tr>
<tr><td></td><td>(c) acid : hydrochloric acid
base : potassium hydroxide/oxide [no marks if formula given]
*must be completely correct</td><td>1</td></tr>
<tr><td></td><td>(d) pH = 7</td><td>1</td></tr>
<tr><td>3</td><td>(a) J and M [1]
(b) K and L [1]
(c) K and L [1] *must be completely correct</td><td>3</td></tr>
<tr><td>4</td><td>(a) water vapour / noble gases [1]
(b) (i) Presence of <u>coal-burning</u> power station/factories
or Near <u>active volcanoes</u> [1]
(ii) Dissolve in rain water to <u>form acid rain</u> which destroys the plants' chloroplast / harms aquatic lives due to the increases acidity in soil/river / decreases pH of soil/river [1]</td><td>3</td></tr>
</table>

Section B		
5	(a) (i) L and M [1] (ii) condensation [1] (iii) The particles lose energy [½] and increase in the forces of attractions [½]. They start to rearrange themselves to become closely packed [½] and vibrate in/about its fixed position [½].	4
	(b) (i) Each aluminium atom loses 3 valence electrons to become Al^{3+} [1] while each chlorine atom gains 1 electron to become Cl^- [1]. (ii) $3K_2CO_3(aq) + 2AlCl_3(aq) + 3H_2O(l) \rightarrow 2Al(OH)_3(s) + 6KCl(aq) + 3CO_2(g)$ *must be completely correct (iii) aq = aqueous g = gas l = liquid s = solid *must be completely correct	4
6	(a) (i) fluorine / bromine / iodine / astatine *any two answers – 1 mark (ii) fluorine > chlorine > bromine > iodine > astatine [1] (most) (least) (iii)  correct ratio of H : Cl [1] correct number of shared electrons [1]	4
	(b) (i) $^{26}_{12}Y$ nucleon number = 26 [1] proton number = 12 [1] accept both Y and Mg (ii) X^{2+} or Mg^{2+} [1] (iii) isotope [1]	4
7	(a) (i) coke, limestone and haematite [2] *must be completely correct (ii) carbon monoxide/carbon dioxide/nitrogen/noble gases [1] *any two answers	3
	(b) element – oxygen [1] compound – water [1]	2
	(c) (i) most reactive → least reactive calcium | magnesium | iron | copper *must be completely correct (ii) cold water – no observed change [1] steam – burns slowly with a slight/little glow [1]	3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Class | Register No.

Candidate Name_____

PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR NORMAL (ACADEMIC)

SCIENCE (CHEMISTRY) **5105/03, 5107/03**
Paper 3 (Multiple Choice) **26 July 2022**
Papers 3 and 4: 1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet, Periodic Table

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Answer Sheet in the spaces provided unless it has been done for you.

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.

Read the instructions on the Answer Sheet very carefully.

Answers to Paper 3 and Paper 4 must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no longer than **30 minutes** on **Paper 3**.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

1 Which substance is a gas at 28°C?

	melting point/°C	boiling point/°C
A	−54	45
B	−21	23
C	32	78
D	43	123

2 Some students are asked to describe the differences between gases and liquids.

Three of their suggestions are:

1. gas molecules are further apart than liquid molecules
2. gas molecules are bigger than liquid molecules
3. gas molecules move freely but liquid molecules vibrate around fixed positions

Which suggestion(s) is/are correct?

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

3 Which method is used to obtain a sample of pure salt crystals from a solution of the salt?

A crystallisation
B distillation
C evaporation
D filtration

4 A student makes some crystals.

How should the student test the purity of the crystals?

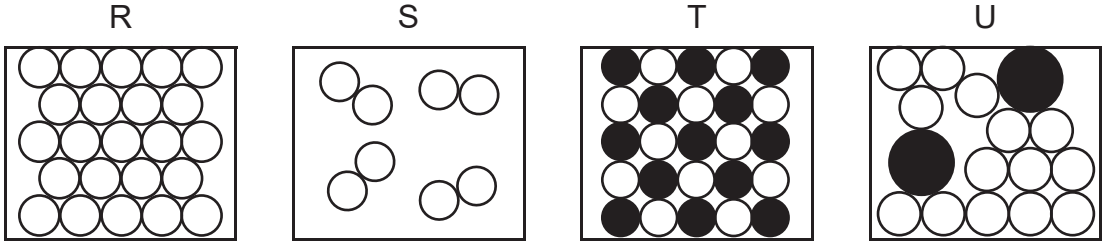
A colour of crystals
B melting point of crystals
C size of crystals
D solubility of crystals

5 Compounds contain two or more elements chemically combined.

Which list contains only compounds?

A CH_4 Cl_2 NaCl
B CH_4 H_2 H_2O
C Cl_2 CO H_2O
D HCl H_2O H_2SO_4

6 The diagrams show the arrangement of particles in four substances.



Which row correctly describes these four substances?

	R	S	T	U
A	compound	compound	element	element
B	element	compound	mixture	mixture
C	element	element	compound	mixture
D	mixture	mixture	compound	compound

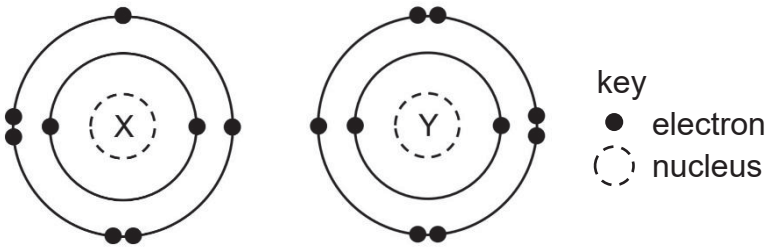
7 The table below shows the number of protons, electrons and neutrons of four different particles.

particle	number of protons	number of electrons	number of neutrons
W	19	18	18
X	15	15	18
Y	20	18	20
Z	15	15	16

Which pair of particles are isotopes?

A **W** and **X**
B **W** and **Y**
C **X** and **Y**
D **X** and **Z**

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



X and Y react to form a covalent compound. What is its formula?

A XY
B X_2Y
C XY_2
D X_2Y_2

9 Which row shows the general properties of an ionic compound?

	melting point	soluble in water	conducts electricity	
			solid	liquid
A	high	no	no	yes
B	high	yes	no	yes
C	low	no	no	no
D	low	yes	yes	yes

10 Ethane, C_2H_6, burns as shown.

$$2C_2H_6 + \ldots O_2 \rightarrow 4CO_2 + 6H_2O$$

Which number of oxygen molecules balances the equation above?

A 6
B 7
C 10
D 14

11 Carbon, $^{12}_{6}C$, and sulfur, $^{32}_{16}S$, form the compound carbon disulfide, CS_2.

What is the relative molecular mass, M_r of carbon disulfide?

A 6 + 16
B 6 + (2 × 16)
C 12 + 32
D 12 + (2 × 32)

12 Which of the following contains both an acidic oxide and a basic oxide?

A carbon dioxide and carbon monoxide
B carbon monoxide and magnesium oxide
C sulfur dioxide and magnesium oxide
D zinc oxide and water

13 Ammonium chloride is heated with substance X. Ammonia gas is given off.

What type of substance is X?

A acid
B base
C metal
D salt

14 Which salt is best prepared by precipitation?

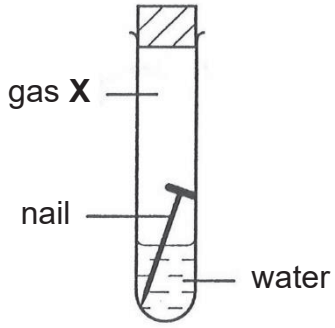
A barium nitrate
B calcium carbonate
C potassium chloride
D sodium carbonate

15 Which property do **all** metals have?

A They conduct electricity.
B They have a grey or silver colour.
C They have high density.
D They have high melting points.

16 An iron nail is placed in a closed test-tube, containing gas **X**.

The nail rusts.



What is gas **X**?

A argon
B carbon dioxide
C nitrogen
D oxygen

17 Which trends occur when moving down Group I of the Periodic Table?

	melting point	speed of reaction with water
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

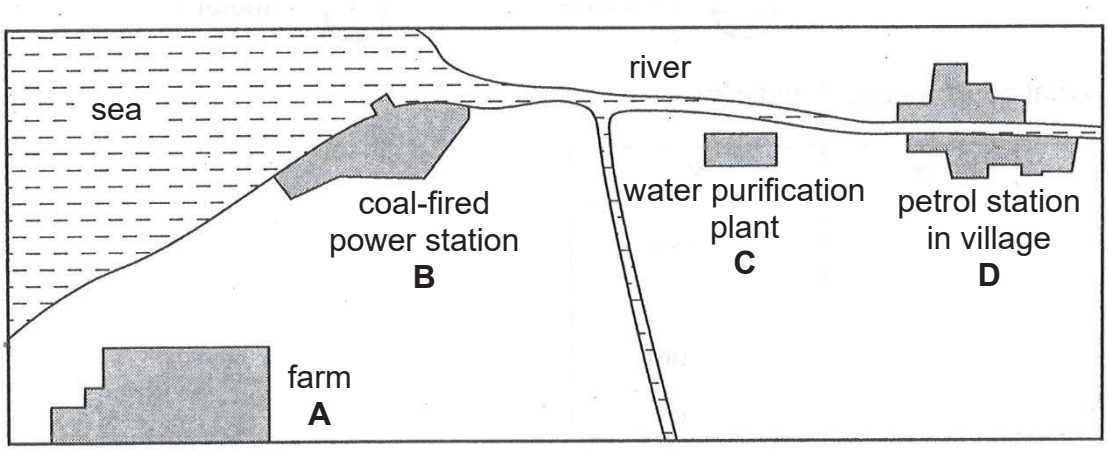
18 Some properties of Group VII elements are shown.

Group VII	melting point/°C	boiling point/°C
fluorine	−220	−118
chlorine	−101	**Y**
bromine	**X**	59
iodine	114	184

What could be the values of **X** and **Y**?

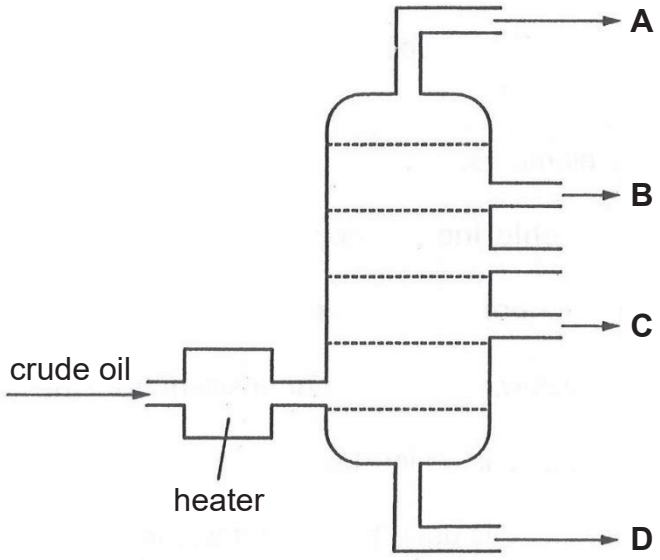
	X	**Y**
A	−150	−35
B	−150	103
C	−7	−35
D	−7	103

19 Which place on the map is most likely to be producing large quantities of sulfur dioxide?



20 The diagram shows a fractionating column.

From which level of the column is the substance used for making roads obtained?



B L A N K P A G E

Class	Register No.

Candidate Name_____

PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR NORMAL (ACADEMIC)

SCIENCE **5105/04, 5107/04**
Paper 4 Chemistry **26 Jul 2022**
Papers 3 and 4: 1 hour 15 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in Section A and any two questions in Section B.
The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Total	

Section A

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

1 **(a)** Complete the table to show the relative charge and the relative mass for each of the particles shown.

particle	relative charge	relative mass
electron		
neutron		
proton		

[3]

(b) Complete the table for sodium and fluorine atoms.

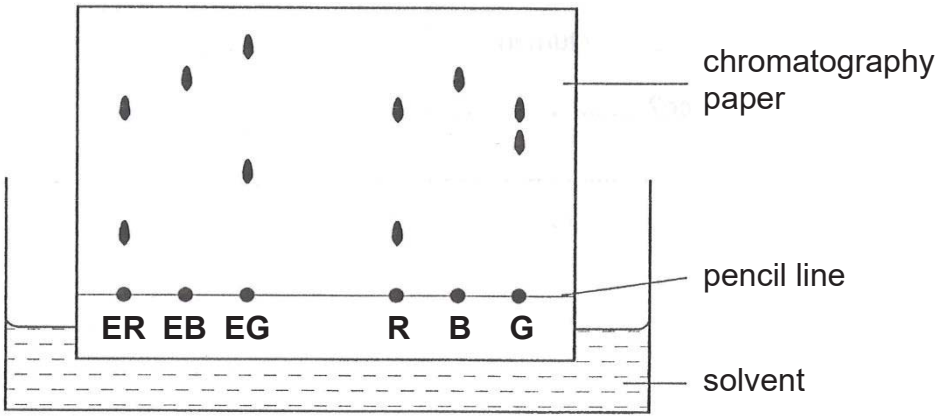
atom	relative atomic mass	number of protons	number of neutrons	number of electrons
sodium	23	11		
fluorine			10	9

[2]

(c) Draw “dot and cross” diagrams of the ions formed by the reaction between sodium and fluorine atoms. Show only the electrons in the outer shells.

[2]

2 A chemist in a food factory used chromatography to find out if three food colours, red (**R**), blue (**B**) and green (**G**) are safe to eat. He compared the chromatograms with those of safe edible colours, red (**ER**), blue (**EB**) and green (**EG**).



(a) (i) How many dyes are present in edible green? ……... [1]

(ii) Which of the food colours **R**, **B** and **G** would be safe to use in food?

……..

Explain your answer. ……..

……..

……. [2]

(b) Explain why the line is drawn in pencil and not in ink.

……..

……..

……. [1]

3 All the elements in Group VII of the Periodic Table react with hydrogen.

Fluorine reacts in the dark, explosively, at very low temperatures.

Chlorine reacts in the presence of sunlight, explosively, at room temperature.

Bromine reacts in the presence of sunlight if heated to about 200 °C.

(a) Suggest **two** conditions needed for iodine to react with hydrogen

1. ……..

2. …… [2]

(b) Each element in Group VII consists of molecules which are **diatomic**.

State the definition of **diatomic**.

……..

……..

……..[1]

Section B

Answer any **two** questions from this section in the spaces provided.

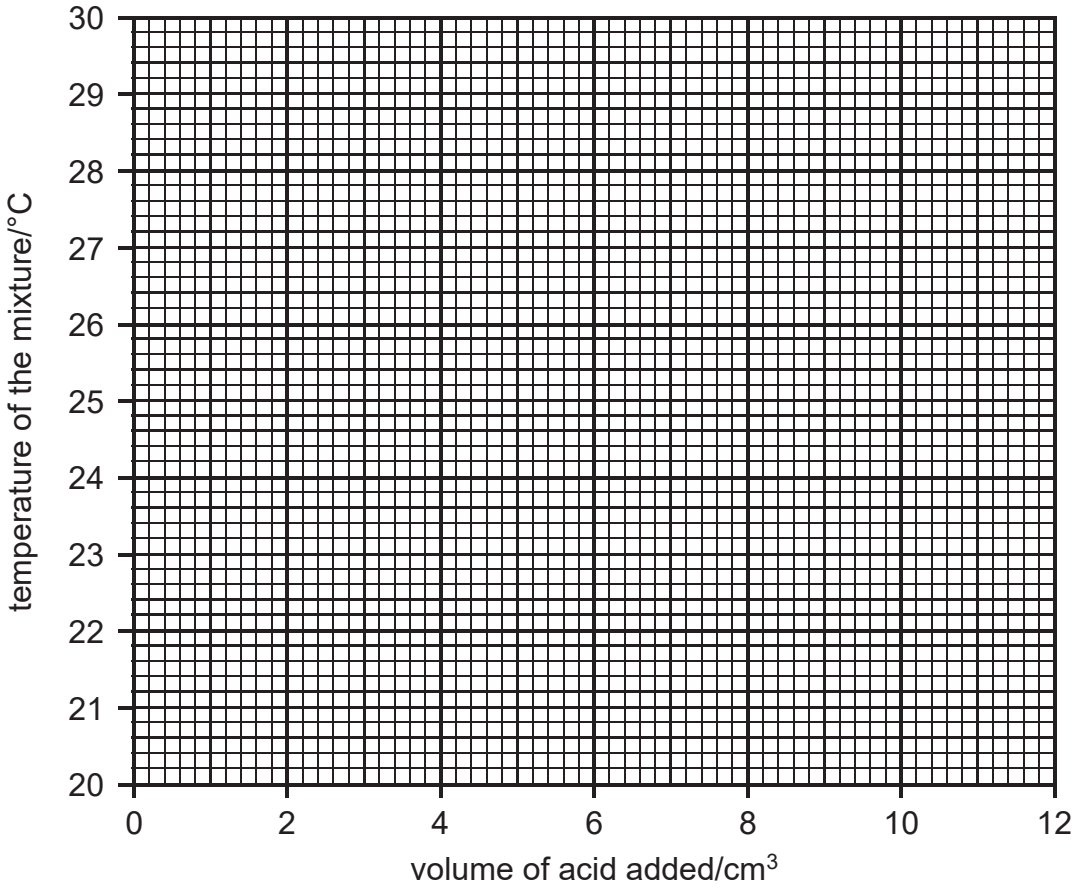
4 An experiment is carried out to investigate the reaction between sodium hydroxide and an acid. In this reaction sodium chloride is produced.

A solution of the acid is placed into a burette. A pipette is used to transfer a 10.0 cm^3 portion of sodium hydroxide to a conical flask. Five drops of Universal indicator are added to the flask.

The mixture is stirred, its temperature taken and its colour noted.

To this mixture, 2.0 cm^3 of the acid is added with stirring. Again the temperature is taken and the colour of the mixture is noted. This is repeated several times. The following results are obtained.

volume of acid added/ cm^3	0.00	2.00	4.00	6.00	8.00	10.00	12.00
temperature of the mixture/°C	20.0	22.4	24.8	27.2	28.0	26.4	24.8



(a) Plot a graph of the temperature of the mixture against volume of acid added. Draw **two** intersecting lines, taking into account all the relevant points, to show the rise and fall in temperature. [3]

(b) Use the graph to determine the volume of acid needed to completely neutralise the sodium hydroxide solution.

…….. cm^3 [1]

(c) What is the colour of the mixture after the addition of 12.0 cm^3 of acid?

……... [1]

(d) **(i)** Name the acid used in this experiment.

……. [1]

(ii) Write a chemical equation for the reaction of this acid with sodium hydroxide.

……. [1]

(e) Why is a burette used to add the acid in this experiment rather than a measuring cylinder?

……..

……..

……..[1]

5 **(a)** A student carried out experiments to find the order of reactivity of four metals. He placed a sample of each metal in the four solutions shown in the table. He recorded the results in the table.

solution \ metal	copper	lead	silver	zinc
copper(II) nitrate	×	✓	×	✓
lead(II) nitrate	×	×	×	✓
silver nitrate	✓	✓	×	✓
zinc nitrate	×	×	×	×

key

✓ reaction took place

× no reaction

(i) Put the four metals in order of reactivity. Place the most reactive first.

most reactive ……

……

……

least reactive …… [2]

(ii) Suggest why it would be best to clean the metals with sandpaper before the start of the experiment.

……..

……..

…… [1]

(b) Calcium reacts with oxygen to form calcium oxide as shown in the equation.

$$2Ca(s) + O_2(g) \rightarrow 2CaO(s)$$

(i) What do the letters (s) and (g) stand for?

…… [2]

(ii) Calculate the number of moles of calcium if 4 g of calcium are burnt in oxygen.

number of moles of calcium = …… mol [1]

(iii) If the reaction produces 0.2 moles of calcium oxide. Calculate the mass of the calcium oxide produced.

mass of calcium oxide = …… g [1]

(c) Why is it important that metals are recycled?

……..

……..[1]

6 **(a)** The first two members of the alkane homologous series are methane, CH_4, and ethane, C_2H_6.

The first two members of the alkene homologous series are ethene, C_2H_4, and propene, C_3H_6.

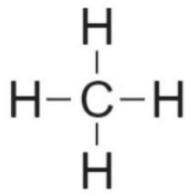
(i) Give the name and formula for the third member of the **alkane** series.

name ……..… formula ……..…… [1]

(ii) Give the general formula for the **alkane** homologous series.

……. [1]

(iii) The structural formula for methane is given as an example.
Draw the structural formula for ethane and ethene.

methane	ethane	ethene
		

[2]

(iv) Describe one test that could be used to distinguish between a sample of ethane and ethene. Name the reagent used and the result obtained.

reagent ……...

result with ethane …….

result with ethene ……[2]

(b) Cracking is used to break up large hydrocarbon molecules into smaller ones.

Decane, $C_{10}H_{22}$, is a large hydrocarbon molecule that can be cracked in the refinery.

$$C_{10}H_{22} \rightarrow \mathbf{X} + C_2H_4$$
decane ethene

(i) Give the chemical formula of **X**.

…… [1]

(ii) State the conditions required for cracking of hydrocarbons.

……..

……..

…… [1]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PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR NORMAL (ACADEMIC)
MARKING SCHEME

SCIENCE (CHEMISTRY) **5105/03, 5107/03**
Paper 3 (Multiple Choice) **26 Jul 2022**

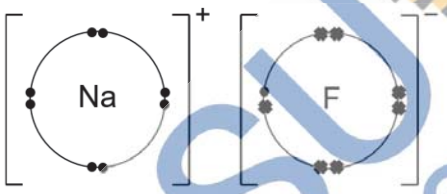
1	2	3	4	5	6	7	8	9	10
B	A	A	B	D	C	D	C	B	B
11	12	13	14	15	16	17	18	19	20
D	C	B	B	A	D	B	C	B	D

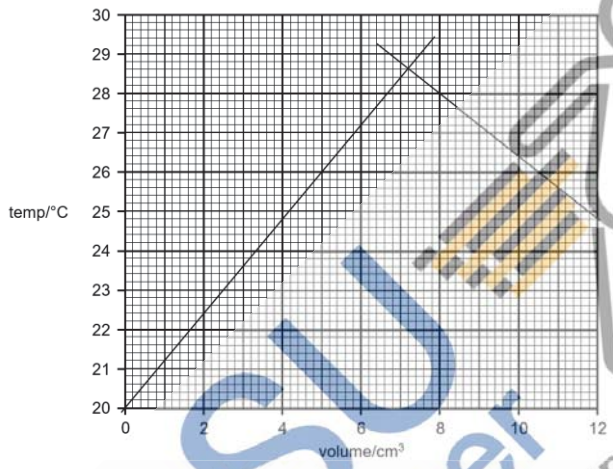
Paper 4 (Theory) **5105/04, 5107/04**

S/No	Answers		Remarks
	Section A		
1(a)	[3]		[1] per row

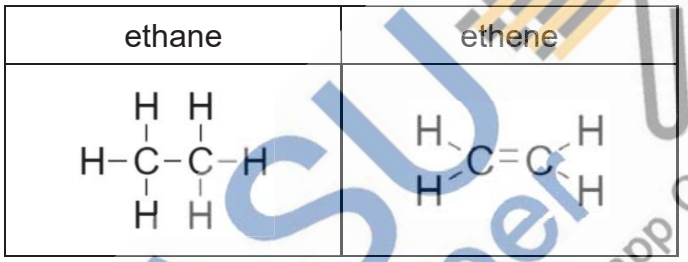
particle	relative charge	relative mass
electron	−1	$\frac{1}{1840}$
neutron	0	1
proton	+1	1

Setter: Mr Tan Kok Heong

<table>
<tr><th>S/No</th><th>Answers</th><th></th><th>Remarks</th></tr>
<tr><td>1(b)</td><td>
<table>
<tr><td>atom</td><td>relative atomic mass</td><td>number of protons</td><td>number of neutrons</td><td>number of electrons</td></tr>
<tr><td>sodium</td><td>23</td><td>11</td><td>12</td><td>11</td></tr>
<tr><td>fluorine</td><td>19</td><td>9</td><td>10</td><td>9</td></tr>
</table>
</td><td>[2]</td><td>[1] per row</td></tr>
<tr><td>1(c)</td><td> 
</td><td>[2]</td><td>[1] per ion</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>2(a)(i)</td><td>2</td><td>[1]</td><td></td></tr>
<tr><td>2(a)(ii)</td><td>R and B [1]
R and B contains similar dyes as ER and EB respectively which are edible [1]</td><td>[2]</td><td></td></tr>
<tr><td>2(b)</td><td>Ink contains dyes that <u>will dissolve in the solvent and be separated</u> [1], affecting the chromatogram</td><td>[1]</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>3(a)</td><td>1. <u>Presence of sunlight</u>
2. <u>High temperature above 200 °C</u></td><td>[2]</td><td></td></tr>
<tr><td>3(b)</td><td><u>Molecule consists of 2 atoms chemically combined, the atoms can be the same or different</u></td><td>[1]</td><td></td></tr>
</table>

S/No	Answers		Remarks
	Section B		
4(a)		[3]	[1] plot points [1] per intersecting line
4(b)	7.2 cm^3	[1]	
4(c)	red	[1]	
4(d)(i)	Hydrochloric acid	[1]	
4(d)(ii)	$NaOH + HCl \rightarrow NaCl + H_2O$	[1]	
4(e)	Burette is **more accurate at measuring** the volume of acid added as compared to a measuring cylinder	[1]	

S/No	Answers		Remarks
5(a)(i)	most reactive zinc lead copper least reactive silver	[2]	[2] 3-4 correct [1] 2 correct [0] 0-1 correct
5(a)(ii)	Sandpaper is used to remove the layer of oxide so that the metal can react with the solution	[1]	
5(b)(i)	(s) is solid state and (g) is gaseous state	[2]	[1] per physical state
5(b)(ii)	Number of moles of Ca = 4/40 = **0.1 mol** [1]	[1]	
5(b)(iii)	M_r of CaO = 40 + 16 = 56 Mass of Ca = 0.2 × 56 = **11.2 g** [1]	[1]	
5(c)	Conserve natural resources/ Reduce environmental problems related to extracting metals from their ores/ Saves cost of extracting metals from ores	[1]	Any 1 of 3 possible answers

S/No	Answers		Remarks
6(a)(i)	name propane formula C_3H_8	[1]	Both answer must be correct
6(a)(ii)	C_nH_{2n+2}	[1]	
6(a)(iii)		[2]	[1] per organic compound
6(a)(iv)	reagent aqueous bromine (accept bromine water) result with ethane no reaction/no visible change result with ethene reddish-brown aqueous bromine is decolourised	[2]	[1] reagent [1] both results
6(b)(i)	C_8H_{18}	[1]	
6(b)(ii)	High temperature (about 600 °C) and catalysts of aluminium oxide and silicon dioxide	[1]	

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Name	Index Number	Class

WOODGROVE SECONDARY SCHOOL

A COMMUNITY OF FUTURE-READY LEARNERS AND THOUGHTFUL LEADERS

N LEVEL PRELIMINARY EXAMINATION 2022

LEVEL & STREAM : **SECONDARY FOUR NORMAL (ACADEMIC)**

SUBJECT (CODE) : **SCIENCE (CHEMISTRY) (5105)**

PAPER NO : **3**

DATE (DAY) : **17 AUGUST 2022 (WEDNESDAY)**

DURATION : **1 HOUR 15 MINUTES (FOR BOTH PAPERS 3 AND 4)**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
You may use a soft pencil for any diagrams, graphs or rough working.
Write your name and index number on the Answer Sheet in the spaces provided.
Do not use staples, paper clips, glue or correction fluid.

There are **twenty** questions on this section. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Answers to Paper 3 and Paper 4 must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no more than **30 minutes** on **Paper 3**.
Any rough working should be done in this paper.
A copy of the Periodic Table is printed on page 9.
The use of an approved scientific calculator is expected, where appropriate.

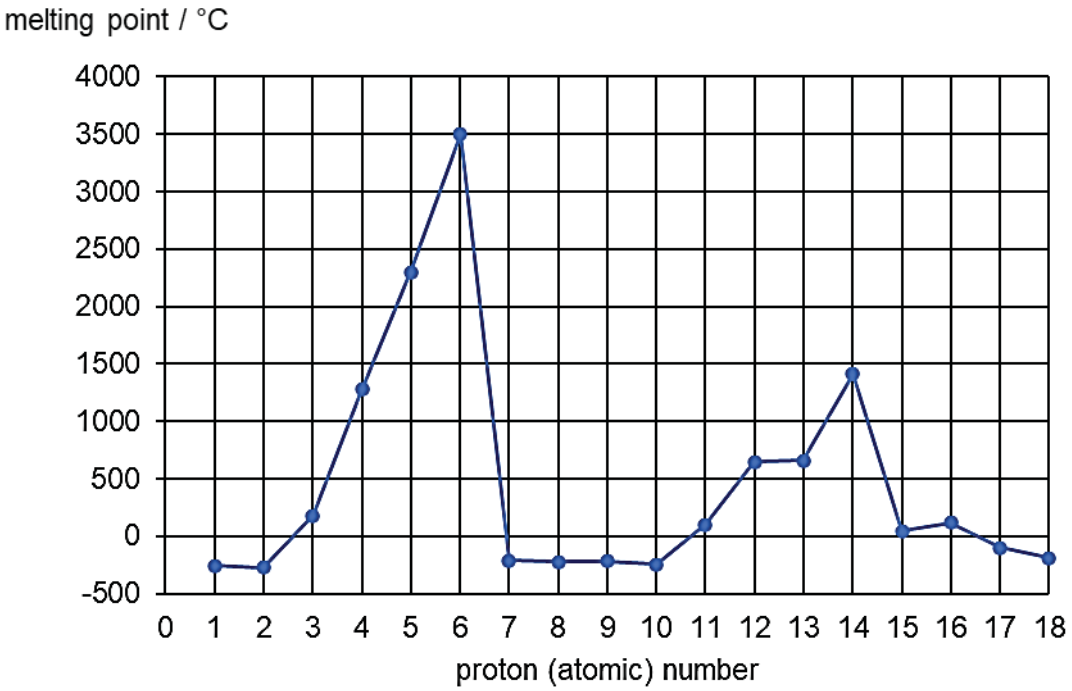
Student's Signature		**Parent's Signature**		**For Examiner's Use**	
Date		**Date**		**Total**	20

This document consists of **10** printed pages including this cover page.

1 Which of the following changes will result in particles moving at a slower speed?

A H_2O (l) → H_2O (g)
B Fe (s) → Fe (l)
C Br_2 (g) → Br_2 (l)
D CO_2 (s) → CO_2 (g)

2 The graph below shows the melting points of the first 18 elements of the Periodic Table.



At 500 °C, how many elements are in the liquid state?

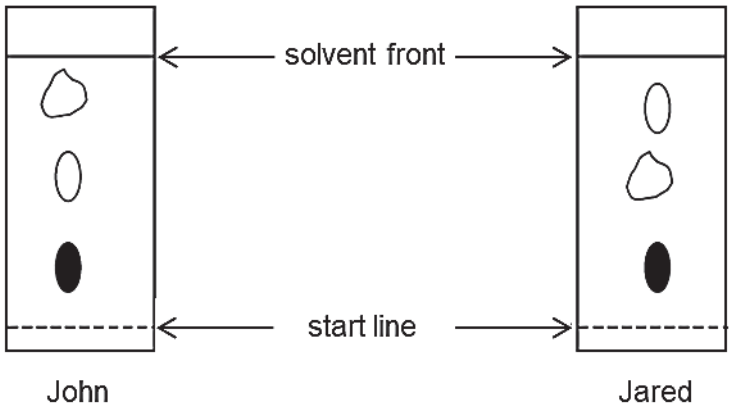
A 6
B 10
C 12
D 16

3 Jane wishes to measure the rate of change of temperature when 5.00 g of magnesium is added to 25.3 cm^3 of dilute hydrochloric acid.

Which row correctly indicates the apparatus she needs for the experiment?

	stopwatch	electronic balance	burette	thermometer	measuring cylinder	conical flask
A	✓	✗	✗	✓	✓	✓
B	✓	✓	✓	✓	✗	✓
C	✗	✓	✓	✓	✗	✓
D	✗	✓	✓	✗	✗	✗

4 John and Jared each carried out a chromatography experiment to investigate the dyes present in the ink from the same pen. The chromatograms are shown below.



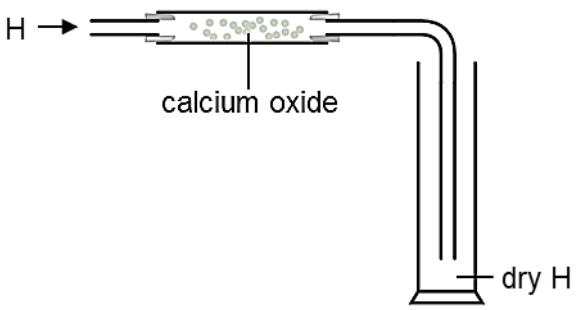
Which is a possible explanation for the difference in their chromatograms?

A different amounts of the solvent used
B different amounts of the pen ink used
C different solvents used
D different starting time

5 Which row shows the correct number of electrons and neutrons for the particle?

	particle	number of electrons	number of neutrons
A	H^+	1	0
B	He	2	4
C	Mg^{2+}	10	12
D	P^{3-}	12	16

6 The diagram shows a setup used to dry and collect gas H.



Which row correctly shows the properties of gas H?

	nature	density (compared to air)
A	acidic	higher
B	acidic	lower
C	alkaline	higher
D	alkaline	lower

7 The table shows the colours and the solubilities of four solids in water.

solid	colour	solubility in water
P	blue	insoluble
Q	blue	soluble
R	green	insoluble
S	green	soluble

Excess water is added to a mixture of two solids before filtration was carried out. A green filtrate and blue residue were obtained.

Which two solids are present in the mixture?

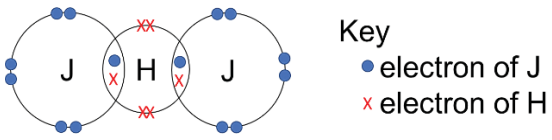
A P and R
B P and S
C Q and R
D Q and S

8 The chemical formula of potassium chromate is $K_2Cr_2O_4$.

What is the chemical formula of sodium chromate?

A $NaCrO_2$
B $NaCr_2O_4$
C Na_2CrO_2
D $Na_2Cr_2O_4$

9 The diagram shows the arrangement of valence electrons in a compound formed by two elements, J and H.



Which row shows the groups of J and H in the Periodic Table?

	J	H
A	I	VII
B	VI	I
C	VI	VII
D	VII	VI

10 Which ionic equation represents the neutralisation of aqueous sodium hydroxide with dilute nitric acid?

A $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
B $Na^+(aq) + NO_3^-(aq) \rightarrow NaNO_3(aq)$
C $Na^+(aq) + HNO_3(aq) \rightarrow NaNO_3(aq) + H^+(aq)$
D $NaOH(aq) + H^+(aq) \rightarrow Na^+(aq) + H_2O(l)$

11 What is the mass of 0.5 moles of ammonia gas?

A 0.50 g
B 1.70 g
C 8.50 g
D 17.0 g

12 Which pair of reactants will **not** react?

A copper and aqueous silver nitrate
B copper and dilute nitric acid
C copper(II) chloride and aqueous silver nitrate
D copper(II) nitrate and aqueous sodium hydroxide

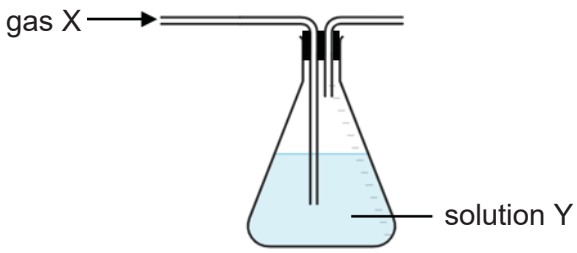
13 Which equation, when complete, will form a salt and hydrogen?

A $Ag(s) + HCl(aq) \rightarrow$
B $CuO(s) + H_2SO_4(aq) \rightarrow$
C $CuCO_3(s) + 2HCl(aq) \rightarrow$
D $Zn(s) + H_2SO_4(aq) \rightarrow$

14 What is the approximate volume of oxygen present in 370 cm^3 of air?

A 4 cm^3
B 21 cm^3
C 78 cm^3
D 289 cm^3

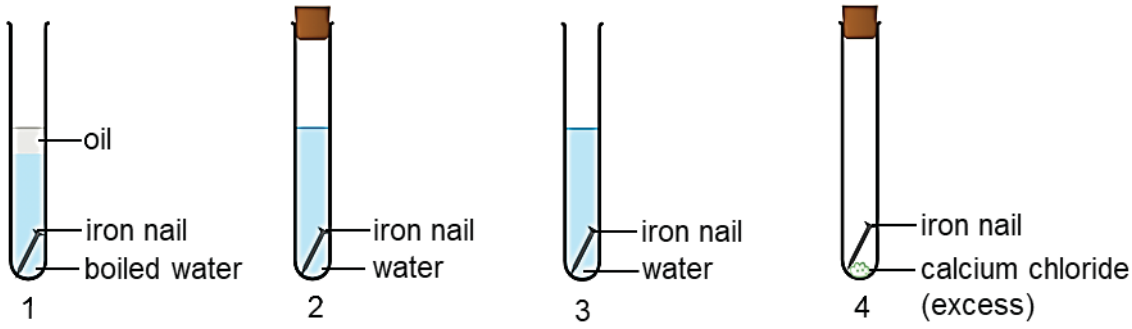
15 Gas X is bubbled into solution Y. No visible change is seen in solution Y.



What can be X and Y?

	X	Y
A	ammonia	Universal Indicator
B	carbon monoxide	Universal Indicator
C	carbon dioxide	limewater
D	chlorine	aqueous potassium iodide

16 Four experiments, 1, 2, 3 and 4, are set up to investigate the rusting of iron nails over a long period of time.



In which test tube(s) will the iron nail **not** rust?

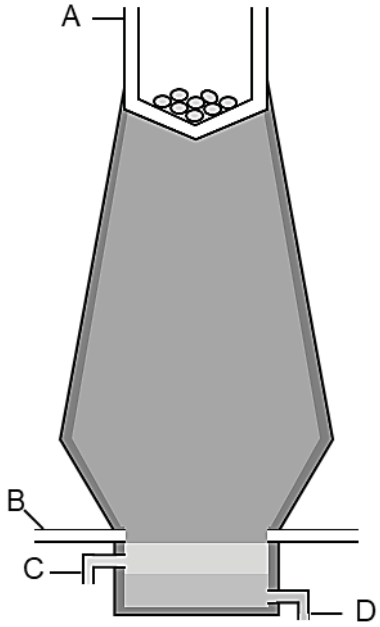
A 2 only
B 1 and 4
C 2 and 3
D 1, 2 and 4

17 Which property explains why alloys are stronger than pure metals?

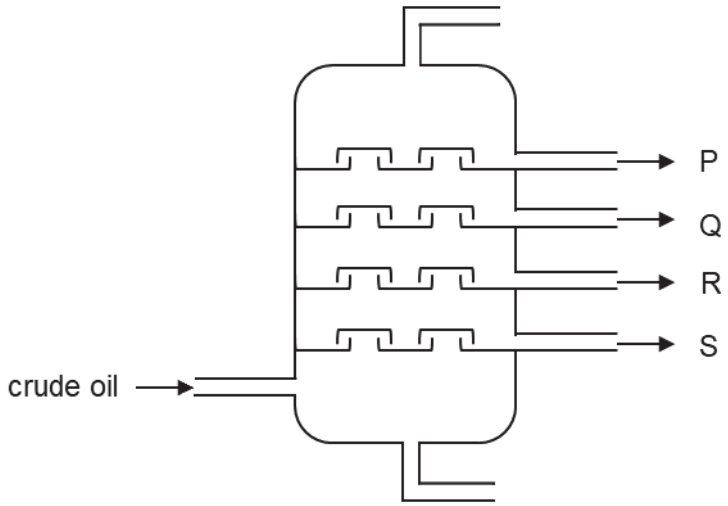
A atomic size
B density
C electrical conductivity
D number of valence electron

18 Iron is extracted from haematite using the blast furnance shown.

In which part is molten iron obtained?



19 The diagram shows the process of obtaining fractions P, Q, R and S from crude oil.



Which statement is true?

A All fractions obtained contain one type of hydrocarbon only.
B Fraction Q is more viscous than fraction R.
C Fraction R is more flammable than fraction S.
D Fraction S has a lower boiling point than fraction P.

20 Which activity can lead to the formation of acid rain?

A adding calcium hydroxide to soil
B combustion of fossil fuel
C extraction of natural gas
D incomplete combustion of hydrocarbons

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 De darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key: proton (atomic) number; atomic symbol; name; relative atomic mass

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

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

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Name	Index Number	Class

WOODGROVE SECONDARY SCHOOL

A COMMUNITY OF FUTURE-READY LEARNERS AND THOUGHTFUL LEADERS

N LEVEL PRELIMINARY EXAMINATION 2022

LEVEL & STREAM : **SECONDARY FOUR NORMAL (ACADEMIC)**

SUBJECT (CODE) : **SCIENCE (CHEMISTRY) (5105)**

PAPER NO : **4**

DATE (DAY) : **17 AUGUST 2022 (WEDNESDAY)**

DURATION : **1 HOUR 15 MINUTES (FOR BOTH PAPERS 3 AND 4)**

READ THESE INSTRUCTIONS FIRST

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

Answer **all** questions in Section A and any **two** questions in Section B.
The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on page 11.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

				For Examiner's Use	
				Section A	/14
Student's Signature		**Parent's Signature**		**Section B**	/16
Date		**Date**		**Total**	/30

This document consists of **12** printed pages including this cover page.

Section A

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

1 The proton (atomic) and relative atomic mass of some atoms are given in the table.

The letters do **not** represent the chemical symbols of the elements.

atom	proton (atomic) number	relative atomic mass
J	11	23
K	17	35
L	17	37
M	18	40
N	20	40

Use the letters **J**, **K**, **L**, **M**, and **N** to answer the following questions.

(a) Which atom is a noble gas?

_____ [1]

(b) Which pair of atoms are isotopes?

_____ and _____ [1]

(c) Which atom(s) is/are metals?

_____ [1]

(d) Which pair of atoms have the same number of neutrons?

_____ and _____ [1]

2 Aqueous bromine is bubbled through ethene. A reaction occurs.

(a) Describe the observation seen.

_____

_____ [1]

(b) Draw the full structural formula of the product formed.

[1]

(c) Ethene can burn in limited oxygen to produce carbon monoxide. Explain the effect of carbon monoxide on our health.

_____

_____ [1]

3 Magnesium reacts with excess chlorine to form magnesium chloride, $MgCl_2$.

(a) Construct a balanced chemical equation for the reaction.

[1]

(b) Draw a 'dot and cross' diagram to show the bonding in magnesium chloride. Show only the valence electrons.

[2]

(c) Explain, using bonding and structure, why magnesium chloride has a high melting point.

[2]

(d) Other than chlorine, dilute hydrochloric acid can be added to magnesium to form magnesium chloride. Describe how a pure, dry sample of magnesium chloride can be formed from magnesium and dilute hydrochloric acid.

[2]

End of Section A

Section B

Answer any **two** questions from this section in the spaces provided.

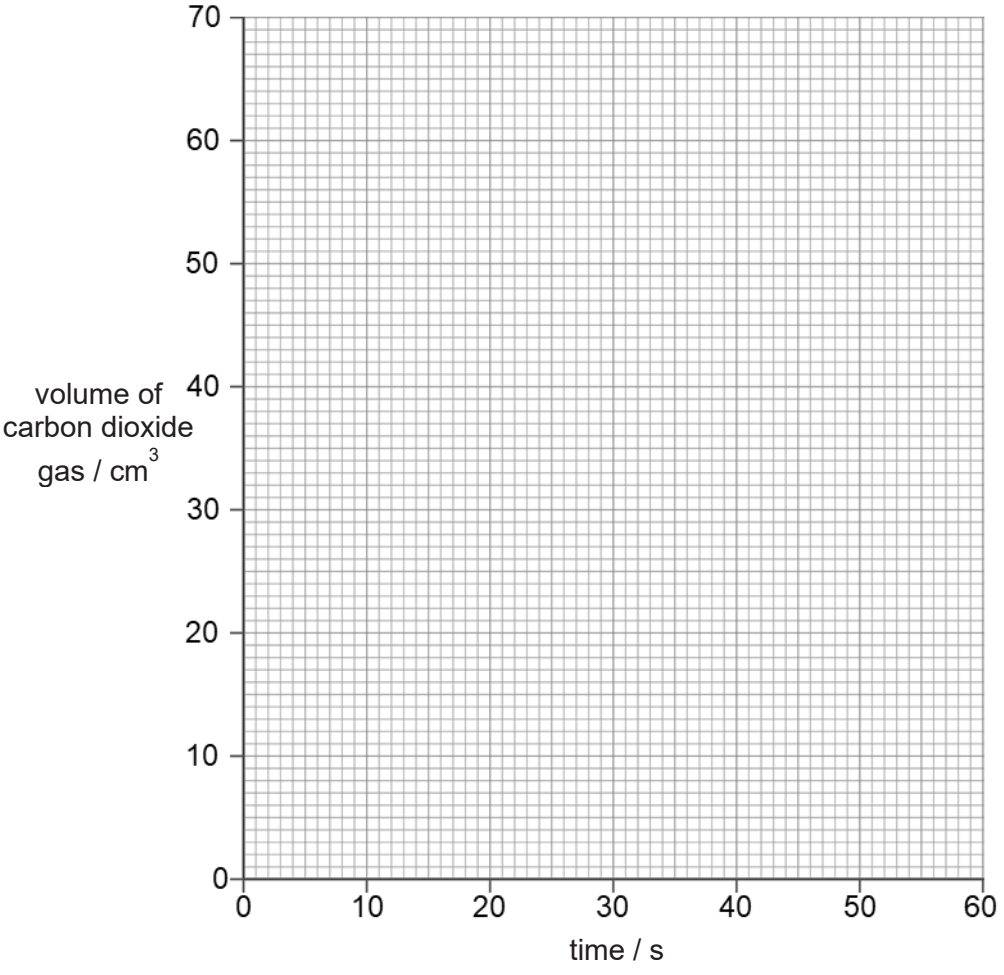
4 When calcium carbonate is added to excess dilute nitric acid, calcium nitrate, water and carbon dioxide are produced. Carbon dioxide gas is collected in a gas syringe and the total volume is recorded in 10-second intervals.

The results are shown in the table.

time / s	volume of carbon dioxide gas / cm^3
0	0
10	28
20	46
30	56
40	58
50	58

(a) Plot a graph of the volume of carbon dioxide gas against time. Mark each point with a cross (x). [1]

(b) Draw a curved line of best fit taking into account **all** your plotted points. [1]



(c) From your graph, determine the volume of carbon dioxide gas collected at 24 seconds.

volume of carbon dioxide gas _____ cm^3 [1]

(d) Explain why the volume of carbon dioxide remains at 58 cm^3 after 40 seconds.

_____

_____ [1]

(e) Write a balanced chemical equation for the reaction between calcium carbonate and dilute nitric acid.

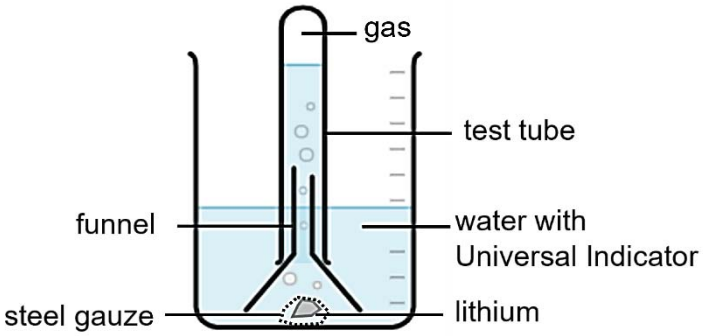
_____ [2]

(f) Describe the test to identify carbon dioxide gas produced from the reaction.

_____

_____ [2]

5 The diagram shows the set up used to collect gas produced from the reaction between lithium and cold water. A piece of lithium metal is held in place with steel gauze and 3 drops of Universal Indicator solution is added to the water.



(a) Explain why lithium must be held in place by the steel gauze.

_____

_____ [1]

(b) Describe the test to identify the gas produced from the reaction.

_____

_____

_____ [2]

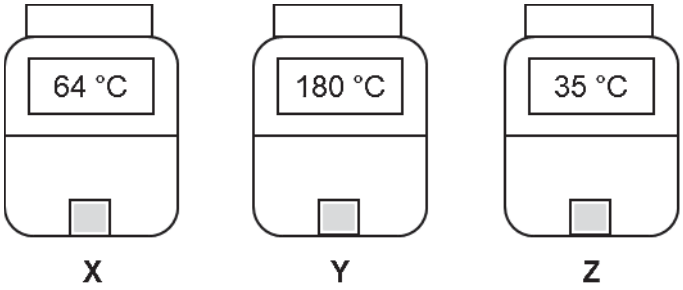
(c) A colour change is observed in the water containing Universal Indicator. State the colour change and explain the observation.

colour change _____

explanation _____

_____ [2]

Three different metals, lithium, potassium and sodium, are stored in separate containers filled with oil. The identities of the metal in each container are unknown except for its melting point. The melting points are labelled on each container.



(d) Identify the metal in each container.

X _____

Y _____

Z _____ [1]

(e) All three metals are in the same group in the Periodic Table. Based on their electronic structure, explain why they belong to the same group.

_____

_____ [1]

(f) Give a reason why metals should be recycled.

_____

_____ [1]

6 The table shows the relative molecular masses of five hydrocarbons **P**, **Q**, **R**, **S** and **T**, and the number of carbon atoms in each of their molecules.

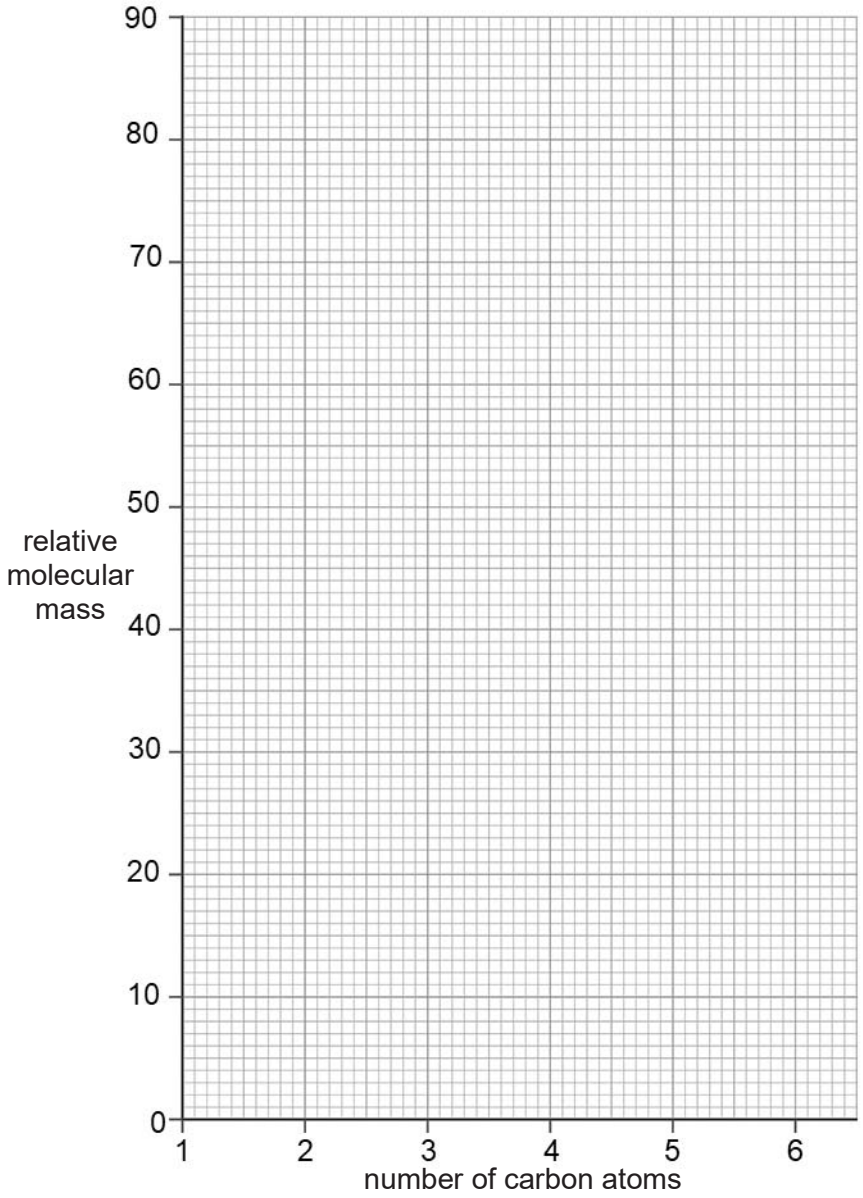
hydrocarbon	number of carbon atoms	relative molecular mass
P	2	30
Q	3	40
R	4	58
S	5	72
T	6	86

(a) Plot a graph of the relative molecular mass against number of carbon atoms. Mark each point with a cross (x). [1]

(b) One of the hydrocarbons is **not** from the same homologous series.

Draw a straight line of best fit **without** including the point for this hydrocarbon.

[1]



(c) From the graph, determine the relative molecular mass of the hydrocarbon that is part of the same homologous series but **not** plotted in the graph.

relative molecular mass _____ [1]

(d) One hydrocarbon in the same homologous series has a chemical formula of C_9H_{20}. Calculate the relative molecular mass of C_9H_{20}.

relative molecular mass _____ [1]

(e) Margarine can be manufactured from polyunsaturated vegetable oils.

(i) State the meaning of *polyunsaturated*.

_____

_____ [1]

(ii) State the reactant and conditions required for the manufacture of margarine from polyunsaturated vegetable oils.

reactant _____

conditions _____ [2]

(iii) Describe one difference in physical property between margarine and vegetable oil.

_____

_____ [1]

End of Section B

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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

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

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WOODGROVE SECONDARY SCHOOL
N Level Preliminary Examination 2022

Sec 4NA Science Chemistry
Marking Scheme

Paper 3

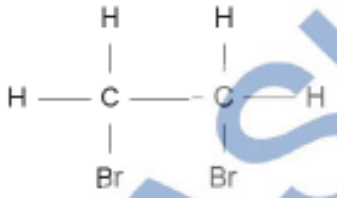
Q	Ans
1	C
2	C
3	B
4	C
5	C

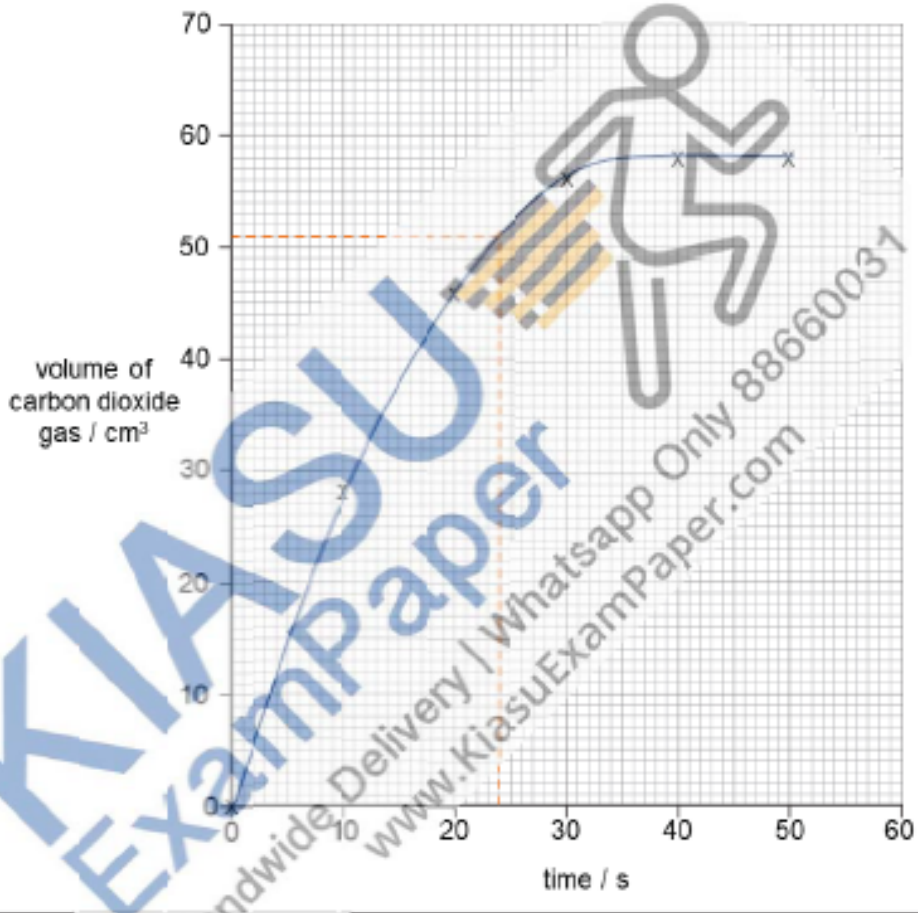
Q	Ans
6	C
7	B
8	D
9	D
10	A

Q	Ans
11	C
12	B
13	D
14	C
15	B

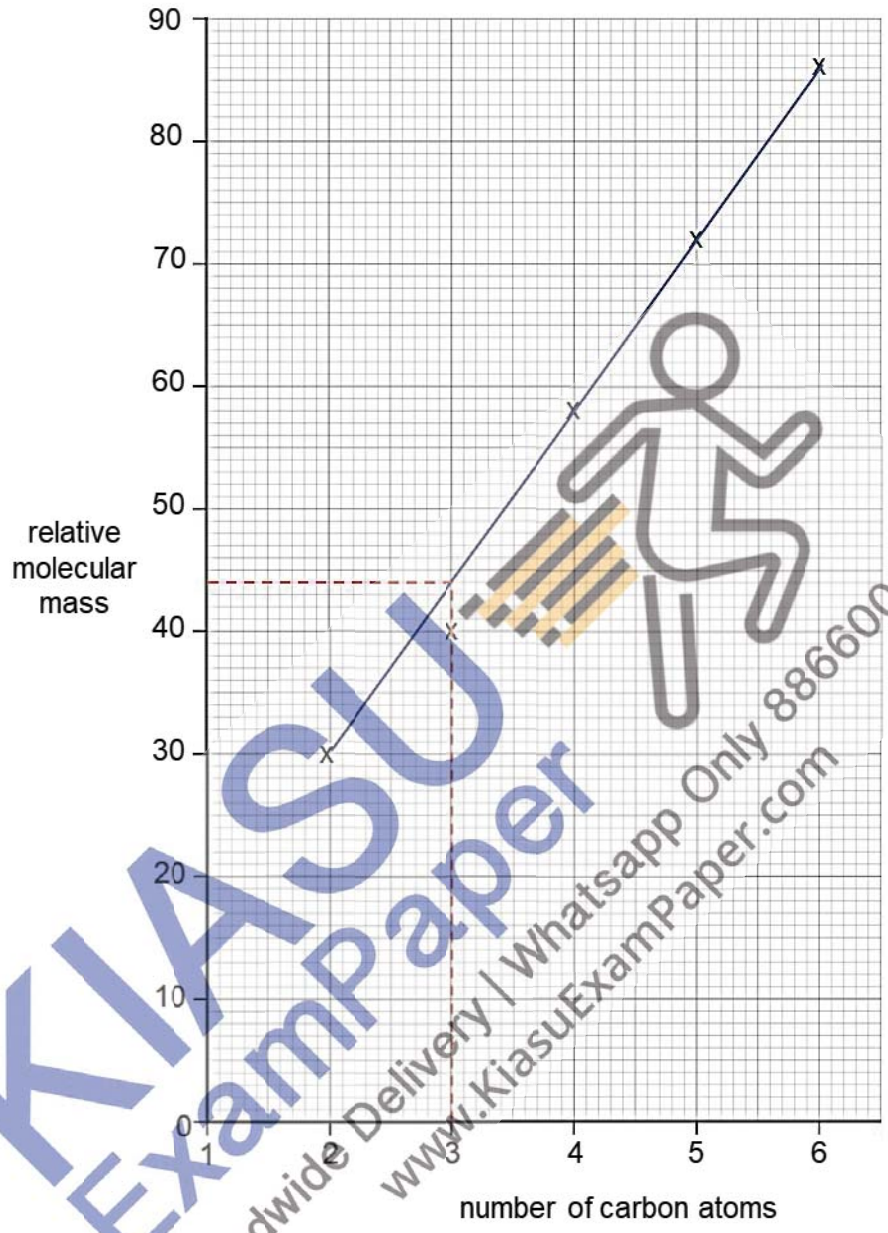
Q	Ans
16	B
17	A
18	D
19	C
20	B

Paper 4

No.	Guidance	Remarks
1a	M	1
1b	K and L	1
1c	J and N Both to be identified for 1 m	1
1d	L and N	1
2a	Brown bromine decolourises/ turns colourless	1
2b	 One Br on each carbon atom Two carbon atoms Reject ethene	1
2c	Binds with red blood cells, causing breathing difficulties	1
3a	$Mg + Cl_2 \rightarrow MgCl_2$	1
3b	 1 for Mg 1 for Cl and key	2
3c	Magnesium chloride is an ionic compound with giant ionic crystal lattice structure.	1

	A lot of energy is needed to overcome the strong electrostatic forces of attraction between magnesium and chloride ions.	1
3d	Add excess magnesium warm dilute hydrochloric acid. Filter the mixture. Heat the filtrate to form a saturated solution. Allow it to cool and crystals will be formed. Filter, wash and dry the crystals between pieces of filter paper. First two steps – 1 m Last three steps – 1 m	1 1
4a, b		1 1
4c	based on candidate's graph 51 cm^3 (based on example shown)	1
4d	All the calcium carbonate is used up/ No more calcium carbonate left. Reject the reaction is complete.	1
4e	$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$ 1 m for correct chemical formula 1 m for correct balancing	1 1
4f	Bubble the gas into limewater.	1

	If white precipitate is formed, the gas is carbon dioxide.	1
5a	Lithium has a lower density than water./ Lithium floats on water.	1
5b	Insert a lighted splint into the gas. If gas extinguished lighted splint with a 'pop' sound, the gas is hydrogen. Identification of the gas required	1 1
5c	Colour: Green to purple Explanation: Lithium reacts with water to form aqueous lithium hydroxide. Aqueous lithium hydroxide is alkaline. Allow blue for colour change. Should specify one colour.	1 1
5d	X: sodium Y: lithium Z: potassium	1
5e	All three metals have 1 valence electron.	1
5f	Any of the following: Metals are finite resources and would eventually run out. Recycling of metals causes less pollution compared to extraction of metals.	1

6a, b		1 1
6c	44	1
6d	128	1
6ei	More than one C=C bond	1
6eii	Reactant: hydrogen Conditions: nickel catalyst, 200 °C	1 1
6eiii	Margarine is a solid at room temperature while vegetable oil is a liquid./ Margarine has a higher melting point than vegetable oil.	1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