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

ASSUMPTION ENGLISH SCHOOL
PRELIMINARY EXAMINATION 2023

SCIENCE (CHEMISTRY)
5105 / 04
5107 / 04

LEVEL: Sec 4 Normal (Academic) **DATE :** 3 August 2023

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.

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

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.

This question paper consists of 11 printed pages including this page.

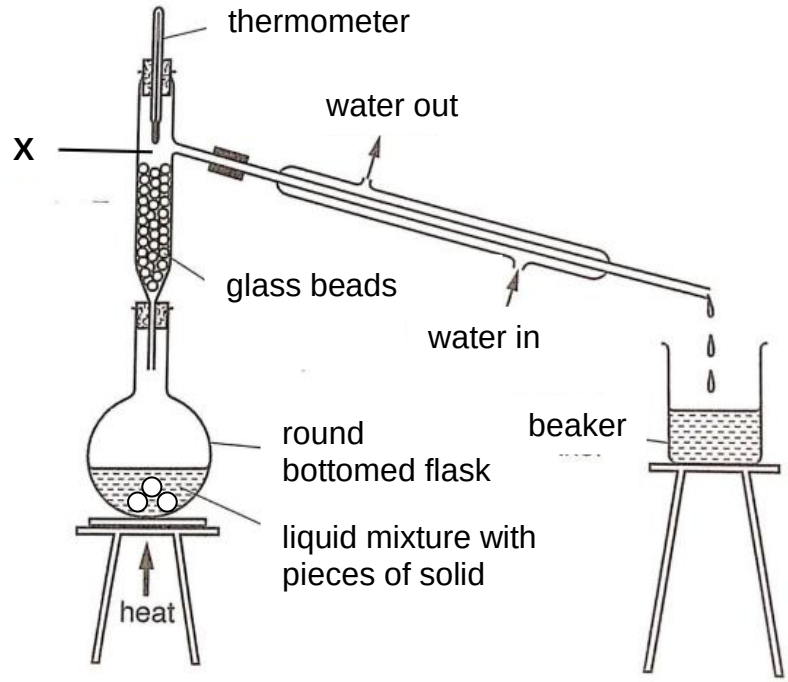
[Turn over

Section A [14 marks]

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

1 A mixture of two miscible substances, methanol and propanol, are to be separated. The boiling points of methanol and propanol are 64 °C and 98 °C respectively.

The mixture is heated in the apparatus shown below.



(a) State the use of pieces of solids added to the liquid mixture during the separation.

…….. [1]

(b) Which of the two substances will be collected in the beaker first?
Explain your answer.

……..

…….. [1]

(c) Describe the arrangement and movement of particles at point **X**.

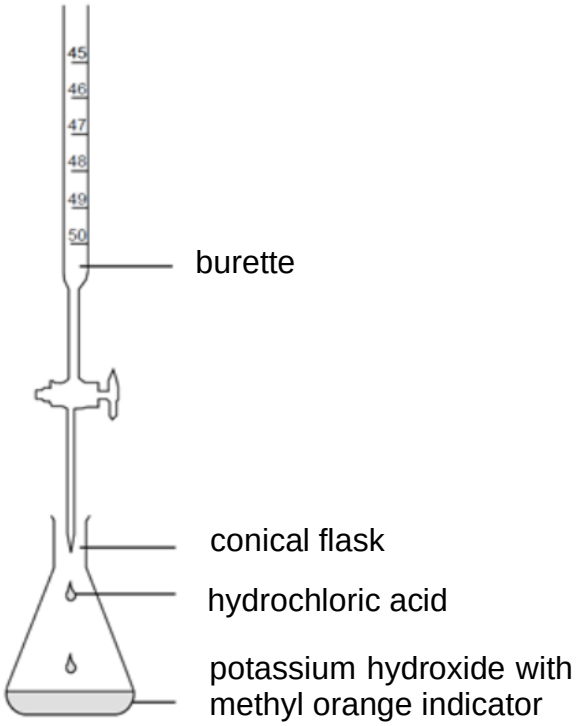
arrangement……

……..

movement……

…….. [2]

2 In a titration experiment, potassium chloride is made by reacting hydrochloric acid with potassium hydroxide solution.



(a) An indicator is a substance which changes colour depending on whether the solution being tested is acidic or alkaline. The diagram below shows the colour of methyl orange at different pH.

State the colour observed when a few drops of methyl orange is added to potassium hydroxide in the conical flask.

…….. [1]

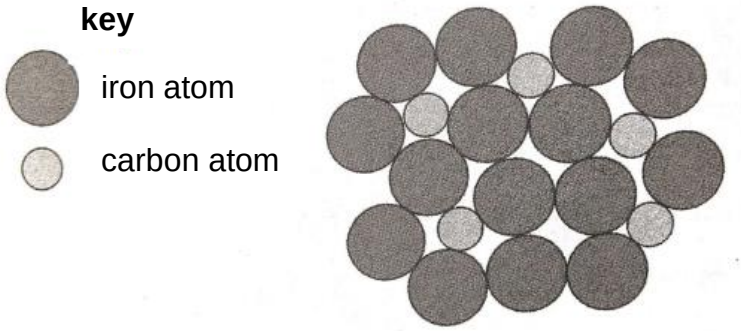
(b) Write the ionic equation for the reaction between hydrochloric acid and potassium hydroxide.

…….. [1]

(c) Suggest another chemical that is safe to react with hydrochloric acid to form potassium chloride when potassium hydroxide is no longer available.

…….. [1]

3 The diagram represents a type of mixture that can be made from iron.
This type of mixture is often used in making bridges.



(a) Give a name to this type of mixture.

…….. [1]

(b) Using your understanding of the diagram above, explain why this type of mixture is used in making bridges.

……..

……..

……..

…….. [2]

(c) This mixture is used to make food containers and it is usually coated with a thin layer of tin to prevent rusting.

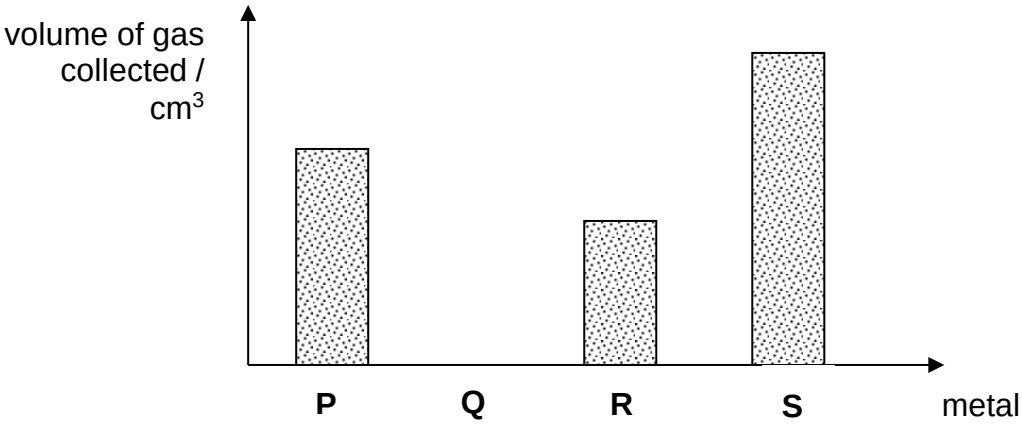
Name the element and the compound which react together with iron to form rust.

element..……..…..

compound……..... [1]

4 Equal amounts of four different powdered metals, **P**, **Q**, **R** and **S**, were added separately to equal volumes of dilute nitric acid.

The graph shows the volume of hydrogen gas collected at the end of five minutes.



(a) Describe a test you can perform to test for hydrogen gas.

test……...

observation…….. [1]

(b) Based on the information, complete the table to match metals **P**, **Q**, **R** or **S** to their possible identities.

metal	**P**, **Q**, **R** or **S**
magnesium	
zinc	
iron	
copper	

[2]

Section B [16 marks]

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

5 The table gives information about sodium, chlorine and hydrogen atoms.

	sodium atom	chlorine atom	hydrogen atom
number of protons	11	17	
number of electrons		17	
arrangement of electrons	2.8.1		1

(a) Complete the table. [2]

(b) State the location of the protons and the electrons in a chlorine atom.

proton……

electron…… [1]

(c) Sodium chloride solid can be made by burning sodium metal in chlorine gas.

Write a balanced chemical equation, including state symbols, for this reaction.

…….. [2]

(d) Explain why sodium chloride must be dissolved in water first before it can conduct electricity.

……..

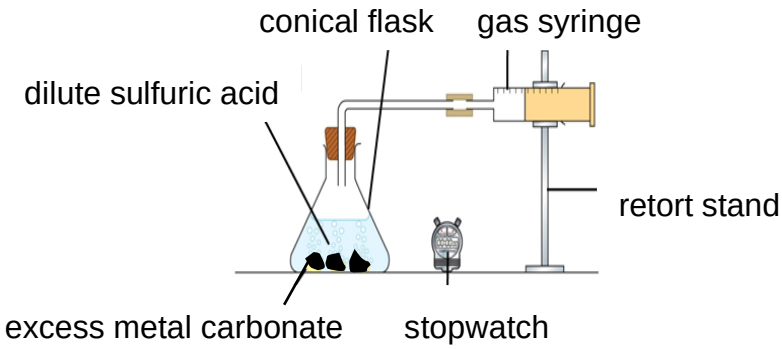
…….. [1]

(e) Hydrogen chloride gas, HC*l*, is made by reacting hydrogen with chlorine.

Draw a 'dot and cross' diagram of a HC*l* molecule. Your diagram should show only the outer shell electrons.

[2]

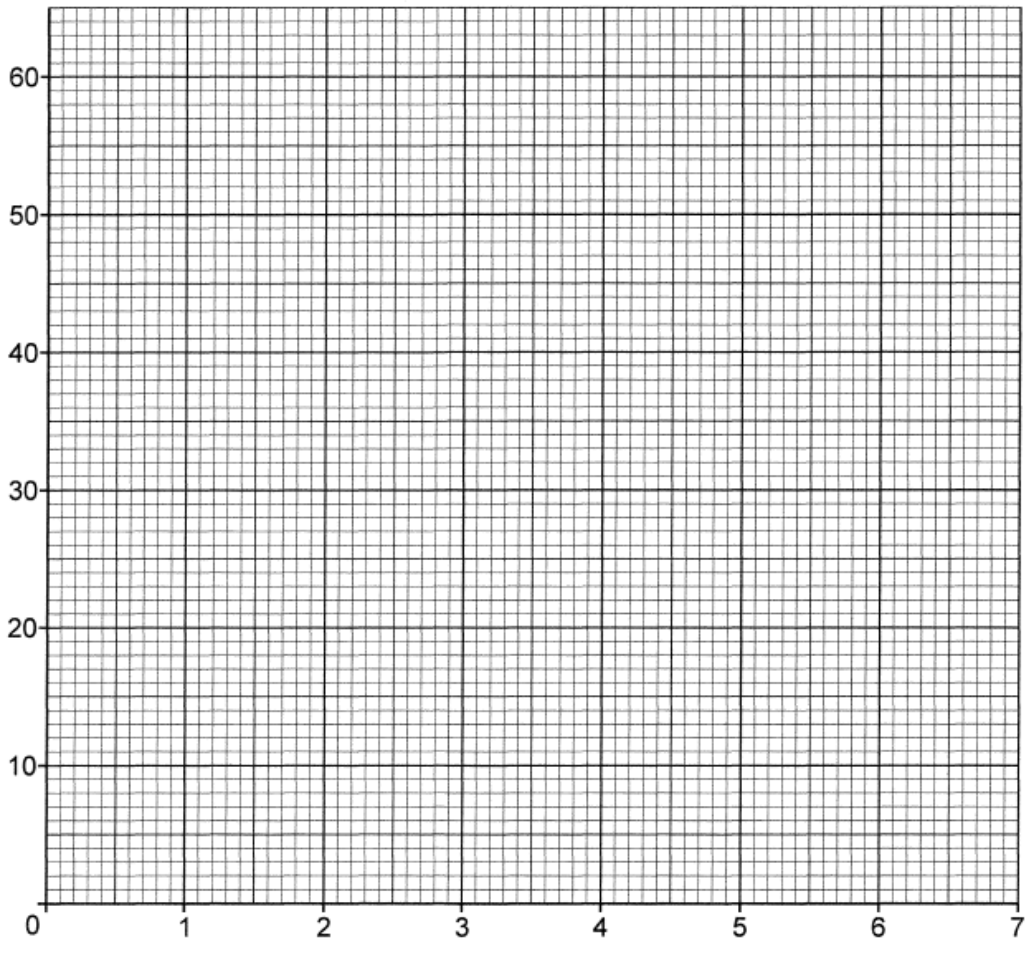
6 Excess metal carbonate, **X**CO_3, was added to 100 cm^3 of dilute sulfuric acid as shown in the diagram.



The volume of gas **Y** produced at room conditions was measured every minute. The results are shown in the table:

time / min	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0
volume of gas **Y** / cm^3	0.0	20.0	33.0		52.0	58.0	60.0	60.0

(a) **(i)** Plot a graph of volume of gas **Y** against time, marking each point with a cross (x). Draw a curve of best fit, taking into account all your plotted points. [2]



(ii) From your graph determine the total volume of gas **Y** collected after 3 minutes.

volume of gas **Y** collected = ……cm^3 [1]

(iii) Describe a test to identify the gas produced.

test……

observation…….. [1]

(b) 0.75 mol of the metal carbonate has a mass of 87 g.

(i) Calculate the relative molecular mass of the metal carbonate, **X**CO_3.

relative molecular mass of **X**CO_3 = ……..…... [1]

(ii) Using your answer in **(a)(i)**, identify metal **X**, with the help of the Periodic Table. Show your working.
(relative atomic mass, A_r: C, 12; O, 16).

[1]

metal **X** is ……

(c) After the reaction is complete, a mixture of metal sulfate solution and excess metal carbonate is obtained in the conical flask.

Describe how you would obtain pure crystals of the metal sulfate from the mixture.

……..

……..

……..

……..

…….. [2]

7 **(a)** A hydrocarbon C_8H_{20} is heated strongly at high temperature and in the presence of a catalyst.

The equation for one of the reactions occurring is shown.

$$C_8H_{20} \rightarrow C_3H_6 + \mathbf{X} + CH_4$$

(i) Name the process represented by this reaction.

…….. [1]

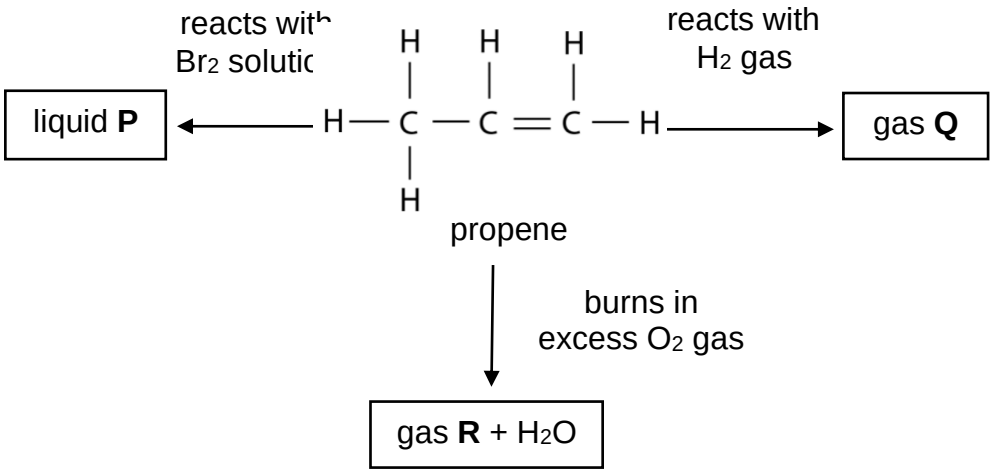
(ii) State the chemical formula for compound **X**.

…….. [1]

(iii) Suggest a separation technique to obtain propane, C_3H_6 from the mixture of 3 products.

…….. [1]

(b) The flowchart shows a series of chemical reactions that propene can undergo.



(i) Describe the change you would observe when propene reacts with Br_2 solution to form liquid **P**.

…….. [1]

(ii) Name the type of reaction when propene reacts with H_2 gas.

…….. [1]

(iii) Draw the structure for gas **Q**.

[1]

(iv) Write a balanced chemical equation when propene burns in excess oxygen gas.

…….. [2]

– 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.).

Turn over