

Candidate Name	Form Class	Index Number
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**ANG MO KIO SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2025
SECONDARY THREE EXPRESS**

SCIENCE
Paper 3 Chemistry

5086/03
1 October 2025
1 hour 15 minutes

Setter: Mrs Joselyn Luei

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

READ THESE INSTRUCTIONS FIRST

Write your Name, Form Class and Index Number at the top of this paper.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams of graphs.

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

Section A

Answer **all** questions.

Write your answers in the spaces provided.

Section B

Answer **one** question.

Write your answers in the spaces provided.

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.

A copy of the Data Sheet is printed on page **18**.

A copy of the Periodic Table is printed on page **19**.

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

This document consists of **19** printed pages and **1** blank page.

[Turn Over

Section A

Answer **all** questions.

- 1 Some substances are given below.

hydrogen	calcium oxide	sulfur dioxide	argon
oxygen	ammonia	hydrogen	aluminium oxide

Using the substances given above, name one substance that

- (a) is a monatomic gas.

..... [1]

- (b) reacts with both acids and bases.

..... [1]

- (c) turns damp blue litmus paper red.

..... [1]

- (d) dissolves in water to form a solution with pH greater than 7.

..... [1]

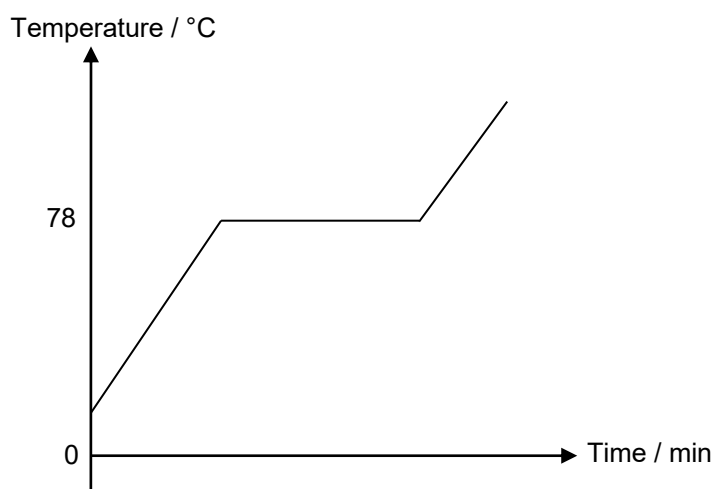
- (e) contains an ion with the charge of +3.

..... [1]

[Total: 5]

2 Using the concept of kinetic particle theory, explain the following:

(a) The heating curve of ethanol is shown below.



The temperature remains constant at 78°C when ethanol boils.

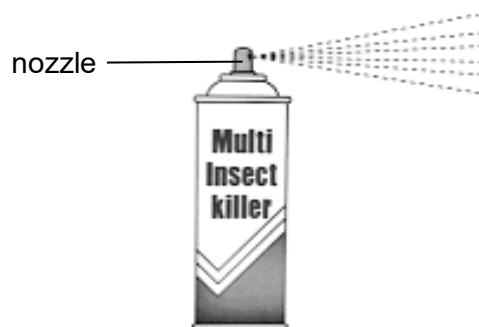
.....

.....

.....

[2]

(b)



The insecticide exists as liquid in the container and turn into gas immediately when it is released into the air by pressing the nozzle. The nozzle feels cold after this.

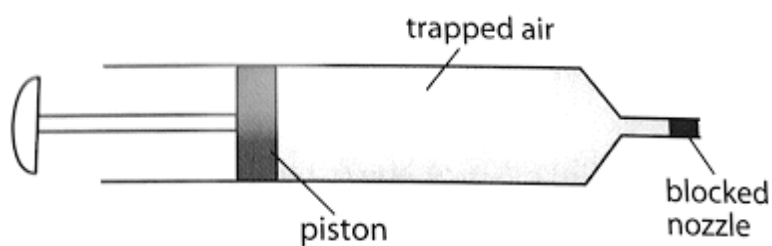
.....

.....

.....

[3]

(c)



The piston of the gas syringe with a blocked nozzle can be pushed in easily. If air was replaced by water, it would be harder to push the plunger.

.....

.....

.....

..... [3]

[Total: 8]

- 3 Table 3.1 shows the information on 5 different atoms. The letters do not represent elements in the Periodic Table.

Table 3.1

atom	number of protons	number of neutrons
P	16	22
Q	14	14
R	16	20
S	12	14
T	18	22

- (a) Which atom is stable and unreactive? Explain your answer.

.....

..... [2]

- (b) Which atoms are isotopes of the same element? Explain why.

.....
 [2]

- (c) The ion of atom **S** combines with bromine to form a compound.

- (i) Write down the chemical formula of the ion formed by atom **S**.

..... [1]

- (ii) Deduce the chemical formula of the ionic compound formed when atom **S** combines with bromine.

..... [1]

[Total: 6]

- 4 Fig 4.1 below shows students' drawings of particles in gases.

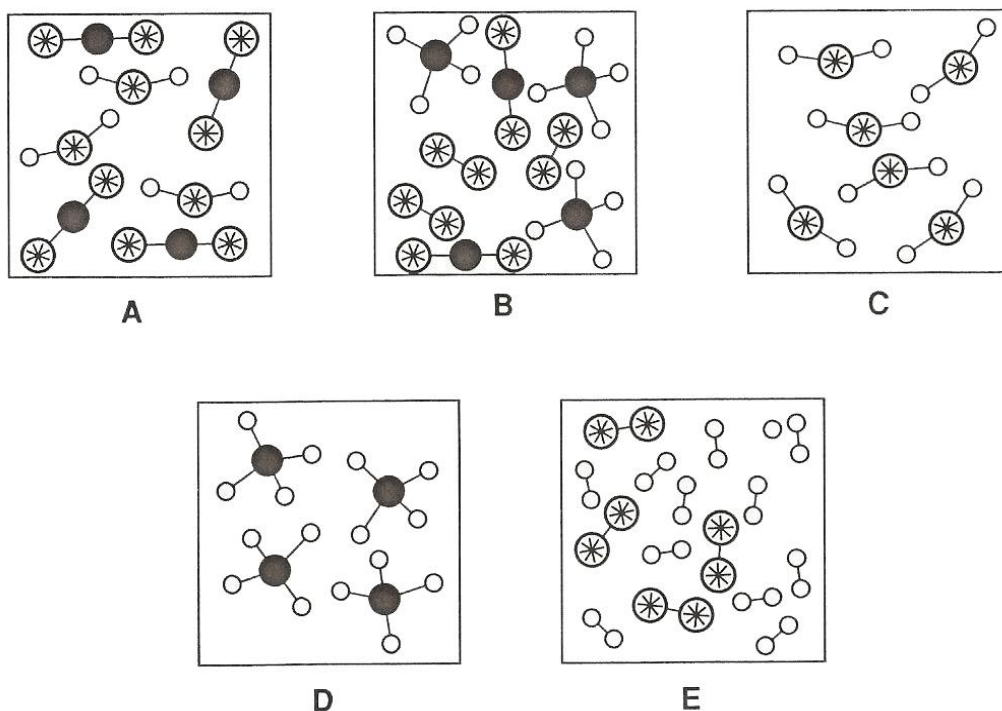


Fig 4.1

Which of the students' drawings, **A**, **B**, **C**, **D** or **E**, best represents

- (a) molecules of steam;

..... [1]

(b) a mixture of elements;

..... [1]

(c) a mixture of compounds and an element;

..... [1]

(d) a mixture of compounds.

..... [1]

[Total: 4]

5 Metals such as iron and zinc can be extracted from its compounds, iron(III) oxide and zinc oxide respectively.

The extraction of iron from its compound involved many stages.

Stage 1: Carbon reacts with oxygen to form carbon dioxide.

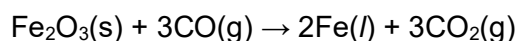
Stage 2: Carbon dioxide reacts with solid carbon to form carbon monoxide.

(a) Write a balanced chemical equation for the reaction in stage 1 and 2.

Stage 1

Stage 2 [2]

(b) In stage 3, iron(III) oxide reacts with carbon monoxide to form iron and carbon dioxide as shown below.



(i) Define the term relative molecular mass.

.....

 [2]

- (ii) Calculate the relative formula mass of iron(III) oxide, Fe_2O_3 .

[1]

- (iii) A sample of 320 g of iron(III) oxide is reacted with excess carbon monoxide gas.
Calculate the number of moles of iron(III) oxide present in the sample.

[1]

- (iv) Calculate the volume of 6 moles of carbon dioxide gas produced in the reaction.

[1]

[Total: 7]

- 6 (a) Choose the best method of separation to obtain the underlined substance in each of the following:

crystallisation	fractional distillation	filtration
magnetic attraction	simple distillation	evaporation to dryness

- (i) ethanol from water:

..... [1]

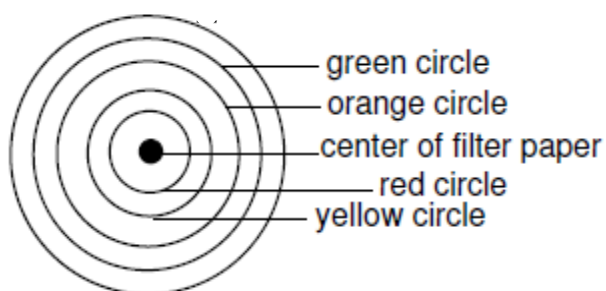
- (ii) sand from sodium chloride:

..... [1]

- (iii) pure water from salt solution:

..... [1]

- (b) The different colours of dyes in black ink were separated. Two drops of the black ink were placed at the centre of a filter paper and allowed to dry. Drops of distilled water were slowly added to the centre of the filter paper. After some time, four coloured circles were seen, as shown in the diagram below.



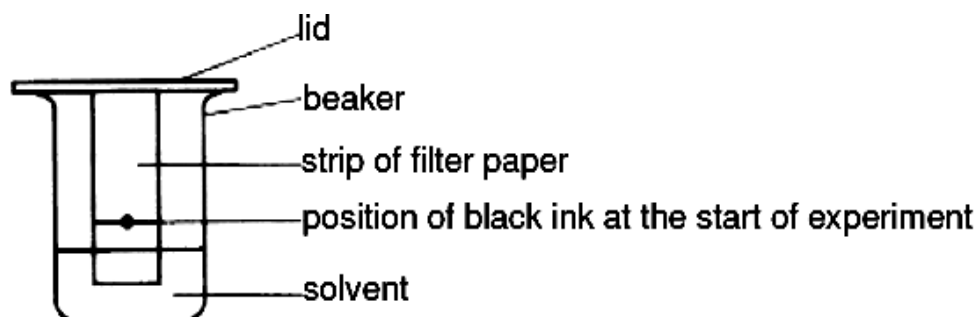
- (i) What is the name of the separation technique used?

..... [1]

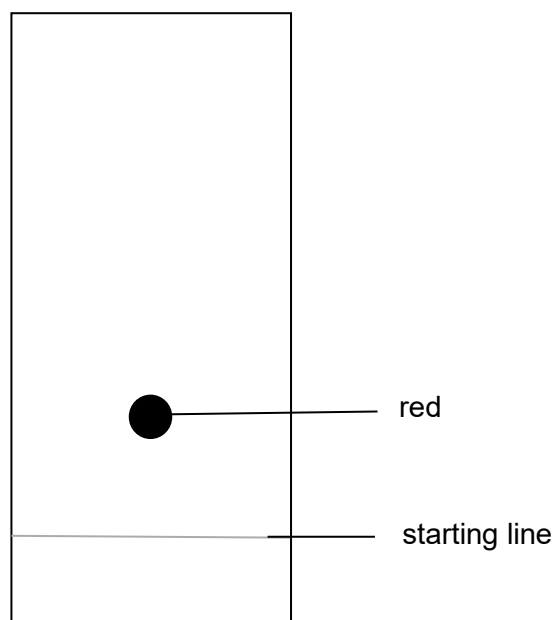
- (ii) How many different dyes were there in the black ink?

..... [1]

- (iii) An alternative set of apparatus for this experiment is shown below. In this case, a strip of filter paper was used and the filter paper was dipped into a water.



Complete the diagram below with labels to show the results you would expect if the water is allowed to reach the lid.



[2]

[Total: 7]

- 7 The label below has been taken from a can of Tango Sparkling Apple Drink.



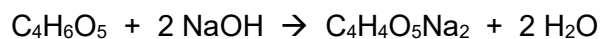
INGREDIENTS:

CARBONATED WATER,
APPLE JUICE, SUGAR,
GLUCOSE, MALIC ACID,
SODIUM BENZOATE,

- (a) The apple flavour is improved by the presence of malic acid, $C_4H_6O_5$. Malic acid is a weak acid. Which ion is responsible for its acidic property?

..... [1]

- (b) It was found that the Tango Sparkling Apple Drink was neutralised by 0.06 g of sodium hydroxide. The equation for the reaction is shown below:



- (i) Calculate the number of moles of sodium hydroxide used.

[1]

- (ii) Calculate the mass of the malic acid in the Tango Sparkling Apple Drink.

[3]

- (iii) Calculate the mass of sodium malate, $\text{C}_4\text{H}_4\text{O}_5\text{Na}_2$, produced.

[3]

[Total: 8]

- 8 Fig. 8.1 shows the structures of solid sodium chloride and gaseous hydrogen chloride.

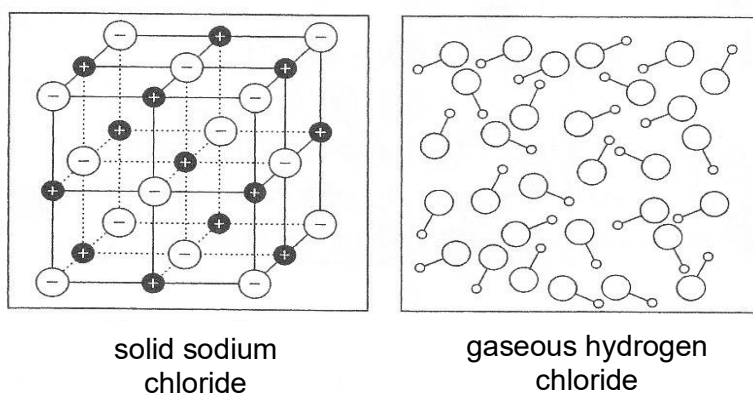


Fig. 8.1

- (a) (i) Name the type of bonding present in hydrogen chloride and sodium chloride.

hydrogen chloride

sodium chloride [1]

- (ii) Draw a 'dot and cross' diagram to show the arrangement of electrons in hydrogen chloride. Show only the valence electrons.
[proton number of H: 1; proton number of Cl:17]

[2]

- (iii) Draw a 'dot and cross' diagram to show the arrangement of electrons in sodium chloride. Show only the valence electrons.
[proton number of Na: 11; proton number of Cl:17]

[2]

(b) In terms of the bonding,

- (i) explain why sodium chloride has a higher melting point than hydrogen chloride.

.....

.....

.....

.....

.....

[3]

- (ii) explain why sodium chloride will conduct electricity in molten state and not in solid state.

.....

.....

..... [2]

[Total: 10]

Section B

Answer **one** question from this section.

- 9 Fig. 9.1 shows a process used to separate a mixture.
The mixture contains methanol (boiling point 65 °C) and ethanol (boiling point 78 °C).

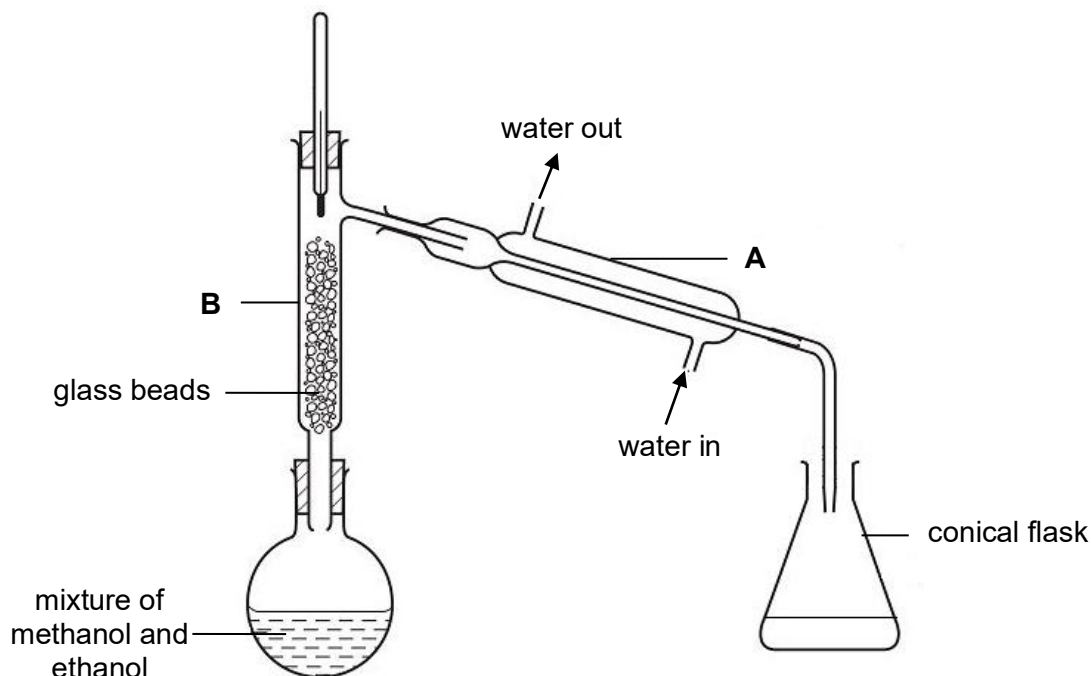


Fig. 9.1

- (a) Name the apparatus labelled **A** and **B**.

apparatus **A**

apparatus **B** [2]

- (b) Glass beads are often found in apparatus **B**. Explain the important role that the glass beads in apparatus **B** play in this separation technique.

.....

.....

..... [2]

- (c) (i) What will happen to the amount of distillate collected in the conical flask if the direction of the water flow into apparatus **A** was reversed?

..... [1]

- (ii) Explain your answer in part (c)(i).

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

- (d) Boiling chips are often added to the mixture to be distilled. Explain the purpose of the boiling chips.

..... [1]

- (e) One commonly used material for boiling chip is calcium carbonate. When calcium carbonate, CaCO_3 is reacted with hydrochloric acid, HCl , it produces calcium chloride, a gas and water.

- (i) Write a balanced chemical equation for the reaction between calcium carbonate and hydrochloric acid.

..... [2]

- (ii) Suggest a method to collect and measure the volume of the gas that is produced from this reaction.

..... [1]

[Total: 10]

- 10** Acids dissolve in water to form solutions that conduct electricity. Different acids have different electrical conductivities.

The electrical conductivity of a solution is a measure of the ability of the solution to conduct electricity. The higher the concentration of H^+ ions present in the solution, the better the solution conducts electricity and hence the solution will have a higher electrical conductivity.

Table 10.1 shows the electrical conductivity of 100 cm^3 of different acidic solutions. Each solution has a concentration of 1.0 mol/dm^3 .

Table 10.1

Acid	Chemical Formula	Concentration of H^+ ions present in solution / mol/dm^3	Electrical Conductivity / mS
nitric acid	HNO_3	1.0	?
hydrochloric acid	HCl	1.0	4.5
sulfuric acid	H_2SO_4	2.0	6.4

- (a)** Predict the electrical conductivity of nitric acid and explain your answer.

Electrical conductivity: mS

Reason:

..... [2]

- (b)** By comparing the chemical formulae, suggest why sulfuric acid has a higher concentration of hydrogen ions present in the solution.

.....

..... [2]

(c) When some calcium hydroxide solution is added to the sulfuric acid solution, insoluble calcium sulfate and water are produced and the electrical conductivity of the acid decreases.

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

..... [2]

(ii) Suggest why the electrical conductivity of the acid decreases.

..... [1]

(d) Acid reacts with carbonate to produce salt, a gas and one other product.

(i) Name the gas produced and describe a test for this gas.

Name of gas:

Test for the gas:

..... [2]

(ii) Give the name of the other product.

..... [1]

[Total: 10]

END OF PAPER

Colours of Some Common Metal Hydroxides

aluminium hydroxide	white
calcium hydroxide	white
copper (II) hydroxide	light blue
iron (II) hydroxide	green
iron (III) hydroxide	red-brown
zinc hydroxide	white

The Periodic Table of Elements

Group																								
1	2											13	14	15	16	17	18							
Key proton (atomic) number atomic symbol name relative atomic mass							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
		3	4	5	6	7	8	9	10	11	12													
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 —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —							

lanthanoids

actinoids

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 162	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
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 dm³ at room temperature and pressure (r.t.p.).
 The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$.

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