



Name	Class	Register No.
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**SECONDARY 4 EXPRESS
PRELIMINARY EXAMINATION 2025**

SCIENCE (PHYSICS, CHEMISTRY)	5086/03
SCIENCE (CHEMISTRY, BIOLOGY)	5088/03

Paper 3 Chemistry
Wednesday 0800 – 0915

27 Aug 2025
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 on all the work you hand in.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use staples, paper clips, glue or correction fluid.

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

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer **one** question.

Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.

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

This document consists of 16 printed pages, including the cover page.

[Turn over

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

- 1 Fig. 1.1 shows the electronic structures of five atoms, A, B, C, D and E.

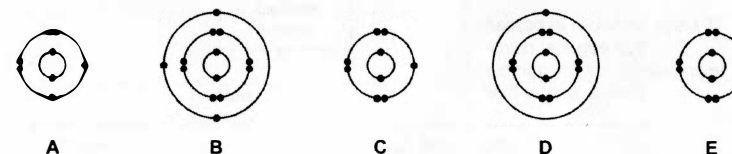


Fig. 1.1

- (a) Select the atom based on Fig. 1.1 to answer the following questions.

Each letter may be used once, more than once or not at all.

- (i) The atom that is in Group 17 of the Periodic Table.

..... [1]

- (ii) The atom that has 13 protons.

..... [1]

- (iii) The atom that is a noble gas.

..... [1]

- (iv) The atom that forms a stable ion with a 2- charge.

..... [1]

- (b) Complete Table 1.2 to show the number of electrons, neutrons and protons in the sulfur atom and oxide ion.

Table 1.2

	number of electrons	number of neutrons	number of protons
$^{34}_{16}\text{S}$	16		
$^{18}_8\text{O}^{2-}$		10	

[4]

[Total: 8]

- 2 Table 2.1. gives the boiling points of four alcohols.

Table 2.1

alcohol	boiling point / °C
butanol	117
ethanol	79
pentanol	138
propanol	97

Fig. 2.2 shows the set-up that can be used to obtain propanol from a mixture containing the four alcohols.

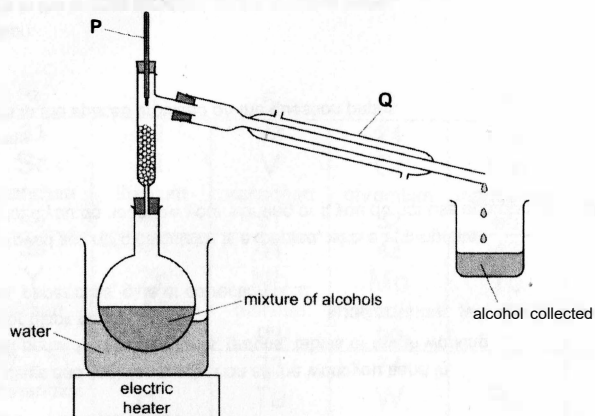


Fig. 2.2

- (a) Name this method of separation.
..... [1]
- (b) State the purpose of the apparatus labelled P and Q.
P
Q [2]
- (c) Explain why it is safer to heat the mixture of alcohols in the set-up shown in Fig. 2.2 rather than with a Bunsen burner.
..... [1]
- (d) Explain why the set-up in Fig. 2.2 **cannot** be used to obtain butanol and pentanol from the mixture.
..... [1]

[Total: 5]

- 3 A solution of hydrochloric acid has a concentration of 1.5 mol/dm³.
The graph in Fig. 3.1 shows how the temperature of the mixture varies with the volume of aqueous sodium hydroxide added to a 25.0 cm³ sample of the hydrochloric acid.

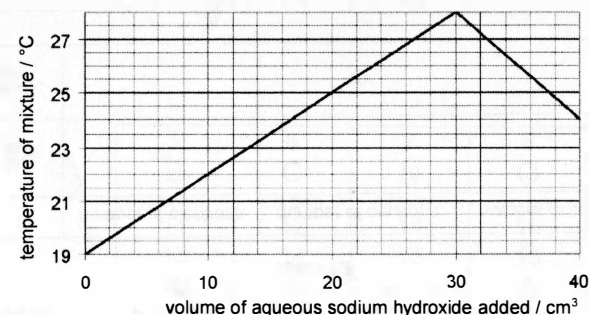


Fig. 3.1

- (a) The chemical equation for the reaction between hydrochloric acid and aqueous sodium hydroxide is given below.
- $$\text{NaOH(aq)} + \text{HCl(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$$
- (i) Name the type of reaction between hydrochloric acid and aqueous sodium hydroxide.
..... [1]
- (ii) Deduce the ionic equation, including state symbols, for the reaction between hydrochloric acid and aqueous sodium hydroxide.
..... [2]
- (b) (i) Using Fig. 3.1, state whether the reaction is endothermic or exothermic and determine the volume of aqueous sodium hydroxide added that gave the highest temperature reading.
..... [2]
- (ii) Explain why the temperature of the mixture falls when the volume of aqueous sodium hydroxide added is more than the volume identified in (b)(i).
..... [1]

- (c) (i) Calculate the number of moles of hydrochloric acid in 25.0 cm^3 of the given sample.

[1]

- (ii) Based on the given equation in (a), what is the number of moles of sodium hydroxide which reacted with the hydrochloric acid in c(i)?

[1]

- (iii) Use the information in (c)(i) and c(ii) to calculate the concentration of aqueous sodium hydroxide used to completely react with the hydrochloric acid added.

[1]

[Total: 9]

- 4 Fig. 4.1 shows the reactions of some substances.

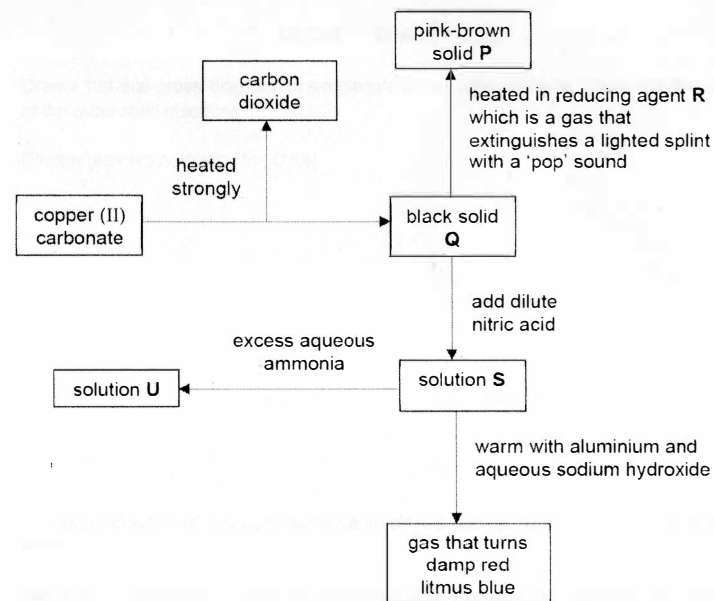


Fig. 4.1

- (a) Identify the substances P, Q, R, and S.

(i) P

(ii) Q

(iii) R

(iv) S

[4]

- (b) Write a balanced chemical equation, including state symbols, for any one of the reactions in Fig. 4.1.

[3]

- (c) State the colour of solution U.

[1]

[Total: 8]

- 5 A student investigates the reaction of small pieces of excess zinc carbonate with dilute sulfuric acid at 20 °C.

(a) Fig. 5.1 show the volume of carbon dioxide gas released as the reaction proceeds.

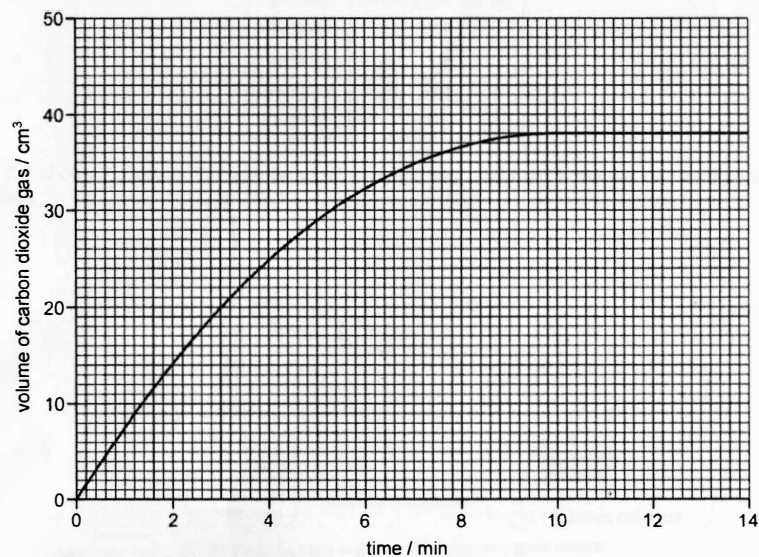


Fig. 5.1

- (i) Suggest why the volume of carbon dioxide gas remains the same after 10 minutes.
- [1]
- (ii) Deduce the time taken from the start of the experiment to collect 20 cm³ of carbon dioxide gas.
- [1]
- (iii) The student repeats the experiment at 30 °C. All other conditions are kept the same.

Draw a line **on the grid** in Fig. 5.1 to show how the volume of carbon dioxide gas changes with time when the reaction is carried out at 30 °C. [2]

- (b) The student repeats the experiment using zinc carbonate powder instead of small pieces of zinc carbonate.

Explain, in terms of collisions of particles, how the rate of reaction differs when zinc carbonate powder is used instead of pieces of zinc carbonate.

..... [2]

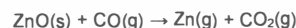
- (c) (i) State the formula of the ion that is present in an aqueous solution of all acids.
- [1]
- (ii) A few drops of Universal indicator was added to the reactants at the beginning of the experiment.

State the colour change observed in the solution as the reaction proceeded.

..... [1]

[Total: 8]

- 6 (a) Zinc oxide reacts with carbon monoxide to form zinc and carbon dioxide.



- (i) Explain, in terms of oxidation states, why the reaction between zinc oxide and carbon monoxide is a redox reaction.

.....

 [2]

- (ii) Explain, in terms of bonding and structure, why zinc oxide exists as a solid while carbon monoxide exists as a gas at room temperature and pressure.

.....

 [3]

- (b) Table 6.1 compares the reactivity of zinc with that of three other metals.

Table 6.1

metal	reactivity with cold water	reactivity with steam
barium	reacts rapidly	
cobalt	no reaction	reacts slowly when heated
magnesium	reacts very slowly	reacts rapidly
zinc	no reaction	reacts easily when heated

- (i) Use the information in Table 6.1 to arrange the four metals in order of their reactivity, from the least reactive to the most reactive.

..... [1]

- (ii) Zinc is found in Group 12 while lithium is found in Group 1 of the Periodic Table.

Describe one way in which the physical property of zinc differs from that of lithium.

..... [1]

[Total: 7]

- 7 Hydrogen peroxide, H_2O_2 , is a covalent compound. It decomposes to form water and oxygen.



- (a) Draw a 'dot-and-cross' diagram for a molecule of hydrogen peroxide. Show only the arrangement of the outer shell electrons.

[Proton (atomic) number: H, 1; O, 16]

..... [2]

- (b) The decomposition of hydrogen peroxide involves a change from the liquid state to the gaseous state.

Describe the difference in both the movement and arrangement of particles in a liquid and in a gas.

.....

 [2]

- (c) When aqueous hydrogen peroxide was added to acidified aqueous potassium manganate(VII), the purple solution turned colourless. When aqueous hydrogen peroxide was added to acidified aqueous potassium iodide, the colourless solution turned brown.

What deductions can you make about hydrogen peroxide from these two observations? Explain your answer.

.....

 [2]

- (d) An experiment was conducted to determine the mass of hydrogen peroxide used to form the aqueous solution by measuring the volume of gas produced.

- (i) Draw a labelled diagram to show how you could carry out the experiment to collect the measured volume of gas.

[2]

- (ii) Calculate the number of moles of oxygen gas produced if 48 cm³ of the gas was collected at room temperature and pressure.

[One mole of any gas at room temperature and pressure has a volume of 24 dm³.]

[1]

- (iii) Hence, calculate the mass of oxygen produced in the experiment.

[1]

[Total: 10]

Section B

Answer one question from this section.

- 8 (a) Fig. 8.1 shows the structure of malic acid.

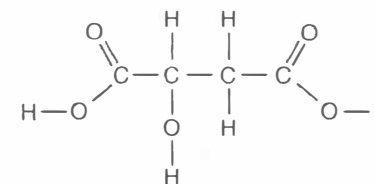


Fig. 8.1

Malic acid is a carboxylic acid because it contains a –COOH group. Malic acid also contains an –OH group.

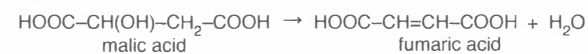
- (i) Name the homologous series of compounds which contain the –OH group.

[1]

- (ii) Describe and explain what will be observed in the solution when acidified potassium manganate(VII) is added to malic acid and warmed.

[2]

- (b) When heated, malic acid forms fumaric acid.



Describe a chemical test to distinguish aqueous malic acid and aqueous fumaric acid.

[2]

- (c) Fig. 8.2 shows the structure of compound X.

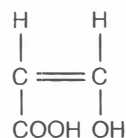


Fig. 8.2

Compound X can undergo a chemical reaction to form a polymer.

- (i) Use Fig. 8.2 to explain how it can form addition polymers.

.....
 [2]

- (ii) Name the necessary conditions for compound X to form a polymer.

.....
 [1]

- (iii) Draw a section of the polymer to show two repeat units.

[2]

[Total: 10]

- 9 (a) A volcano erupted, causing villagers to fall ill and damage to vegetation.

- (i) Name an air pollutant released by the volcano and state one health effect on the villagers.

.....
 [2]

- (ii) Explain how the gases released during the volcanic eruption damage vegetation around the volcano.

.....
 [1]

- (b) Fossil fuels can be separated into useful fractions by fractional distillation.

- (i) Describe how the fractions are separated.

.....

 [3]

- (ii) Propane is a hydrocarbon obtained from the fossil fuels and is used as a fuel to produce heat when burnt.

Write a chemical equation for the complete combustion of propane.

..... [2]

- (iii) The use of fossil fuels is not sustainable in the long run.

Explain why the use of biofuels such as bioethanol is said to be more environmentally friendly.

.....

 [2]

[Total: 10]

- End of Paper 3 -