SUCCESS PATH PRE-MOCK EXAMINATIONS – 2026

Kenya Certificate of Secondary Education

233/1 – CHEMISTRY (Theory) – Paper 1 **FORM FOUR**

CHEMISTRY PAPER 1
8:00am – 10.00am

Name MARKING SCHEME Index Number.....

Class ..... School N.S Signature.....

Instructions to candidates

(i) Write your name, index number and class in the spaces provided above.
(ii) Sign and write the name of your school in the spaces provided above.
(iii) Answer all the questions in in the spaces provided in the question paper.
(iv) **Non – programmable** silent electronic calculators and KNEC Mathematical tables may be used.
(v) All workings **must** be clearly shown where necessary.
(vi) This paper consists of 13 printed pages.
(vii) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(viii) **Candidates should answer the questions in English.**

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

18	19	20	21	22	23	24	25	26	27	Grand Total	

1. Complete the **Table 1** by writing the observations made when aqueous ammonia and aqueous sodium sulphate are added to solutions containing calcium, aluminum and Iron (II) ions. (3 marks)

Table 1

Ions present	Aqueous ammonia	Aqueous sodium sulphate
Ca^{2+}	No White precipitate	White precipitate
Al^{3+}	White precipitate which is insoluble in excess.	No White precipitate.
Fe^{2+}	Green precipitate	No green precipitate.

2. A group of compounds called chlorofluorocarbons have a wide range of uses but they also have harmful effects on the environment.

(a) Give one use of chlorofluorocarbons. (1 mark)

- Refrigerants in fridges/air conditioners.
- Propellants in aerosol cans. Any 1 correct

(b) State one harmful effect of chlorofluorocarbons on the enviironment. (1 mark)

Depletion of Ozone layer.

3. Element U has atomic number 12 while element V has atomic number 16. How do the melting points of their oxides compare? Explain. (3 marks)

The Oxide of U has a higher melting point than the Oxide of V. UO has a giant ionic structure with strong ionic/electrovalent bond while SO_2 have simple Molecular structure with weak Van der Waals forces.

4. (a) Define the term solubility. (1 mark)

This is the maximum mass of solute that can dissolve in 100g of water at a specific temperature.

(b) 40 g of a saturated solution yields 15g of salt when evaporated to dryness. Calculate the solubility of the salt. (2 marks)

$= 40g - 15g$
$= 25g$

$= \frac{15g}{25g} \times 100$
$= 60g/100g$ of water

5. Hydrogen gas can be prepared by passing steam over heated Magnesium ribbon as shown in the **Figure 1**.

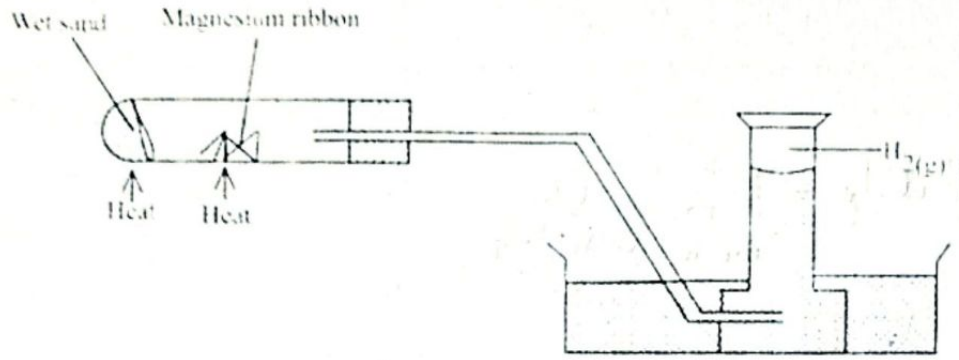


Figure 1

(a) Explain why the delivery tube must be removed from beneath the water before heating is stopped. (1 mark)

To prevent suck-back of water into the hot test tube, which would cause it to crack. ①

(b) Explain why sodium metal is not suitable for this experiment. (1 mark)

Sodium reacts explosively/too violent with steam or water. ①

(c) Give *two* reasons why hydrogen is not commonly used as fuel. (1 mark)

- It is highly flammable/explosive. ½
- It is expensive to produce or store. ½ ①

6. (a) State Graham's law of diffusion. (1 mark)

The rate of diffusion of a gas is inversely proportional to the square root of its density/molar mass at constant temperature and pressure. ①

(b) Explain why a balloon filled with helium gas deflates faster than a balloon of the same size filled with argon gas. (2 marks)

Helium has a lower molar mass compared to argon; so it diffuses out through the balloon pores faster. ②

6c//

7. Copper (II) sulphate reacts with Barium chloride according to the equation below:

$$CuSO_{4(aq)} + BaCl_{2(aq)} \longrightarrow CuCl_{2(aq)} + BaSO_{4(s)} \quad -17.7\ kJ/mol$$

Calculate the temperature change when 900 cm^3 of 1 M copper (II) sulphate were added to 600 cm^3 of 1 M barium chloride. (Heat capacity of solution is 4.2 $J\,g^{-1}\,K^{-1}$ and density 1 $g\,cm^{-3}$) (3 marks)

Moles of $BaCl_2 = \frac{600 \times 1}{1000}$ ($CuSO_4$ is in excess)

$= 0.6$ moles ✓

$Q = 0.6 \times 17.7$

$= 10.62\ kJ$

$= 10,620\ J$. ✓

$\Delta T = \frac{Q}{mc}$

$= \frac{10620}{1500 \times 4.2}$ ✓

$= 1.69^{\circ}C$. ✓

8. Using iron filings, describe an experiment that can be conducted to show that oxygen is present in air. (3 marks)

Place moist iron filings in a graduated beaker/a measure. ✓

Invert the beaker over a trough of water. Connect two syringes with air and iron ~~fillings~~ filings between them.

Leave the set-up for several days until the iron rust completely and the water level stops rising. ✓

The water rises by 20–21% indicating that oxygen has been used

9. (a) Hydrogen chloride gas can be prepared by reacting sodium chloride with an acid.

(i) Write an equation for the reaction between sodium chloride and the acid. (1 mark)

$NaCl_{(s)} + H_2SO_{4(l)} \longrightarrow NaHSO_{4(s)} + HCl_{(g)}$ ✓

(ii) Give *two* chemical properties of hydrogen chloride gas. (1 mark)

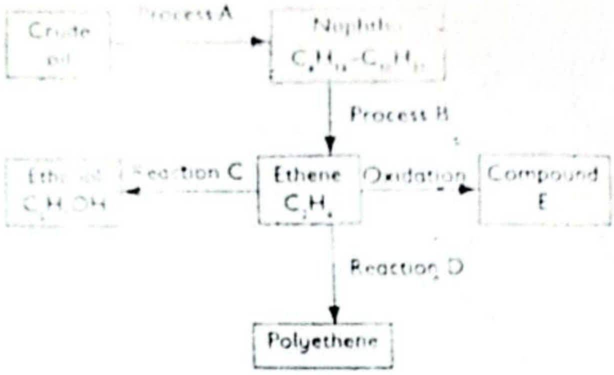
- It reacts with NH_3 gas to form dense white fumes of NH_4Cl. ✓
- It dissolve in water to form a strongly acidic solution (H^+Cl^-) that turns blue litmus paper red. ✓

(b) Calcium oxide can be used to dry ammonia gas. Explain why Calcium oxide is not used to dry hydrogen chloride gas. (1 mark)

CaO is basic; it reacts with HCl gas which is acidic to form $CaCl_2$ and H_2O.

of

10. The figure below shows a flow chart. Study it and answer the questions that follow.



(a) Name process:

(i) A. (½ mark)

Fractional distillation. ✓½

(ii) B. (½ mark)

Cracking // Thermal cracking ✓½

(b) State one conduiation necessary for th reaction C to take place. (1 mark)

- Phosphoric (V) acid as catalyst // Catalyst.
- High temperature (300°C)
- High pressure (60–70 atm).

(c) Compound C has following pacentage composition by mass: 38.7% carbon, 9.7% hydrogen and 51.6% oxygen. Given that 0.05 moles of comound E has a mass of 3.1g, calculate molecular formula of the E (2 mark)

	C	H	O
Mass by %	38.7	9.7	51.6
Ram	12	1	16
Mole	$\frac{38.7}{12}$	$\frac{9.7}{1}$	$\frac{51.6}{16}$
	3.225	9.7	3.225
Mole ratio	$\frac{3.225}{3.225}$ = 1	$\frac{9.7}{3.225}$ = 3	$\frac{3.225}{3.225}$ = 1

EF CH_3O ✓½

Molar mass $= \frac{3.1}{0.05}$ $= 62\,g/mol$ ✓½

$(CH_3O)_n = 62$

$\frac{31n}{31} = \frac{62}{31}$

$n = 2$

MF $= C_2H_6O_2$ ✓1

11. The table below shows some properties of three substances. Complete the table by filling in the types of forces and structures in each substance. (3 marks)

Substance	M.P.°C	B.P.°C	Electrical conductivity		Type of forces	Structure
			Solid	Molten	~~Van der waals~~	~~Simple molecular~~
X	– 101	–35	Poor	Poor	Van der waals ~~Metallic bond~~	Simple molecular ~~Giant metallic~~
Y	650	– 1110	Good	Good	Metallic bond ~~Ionic bond~~ ~~Electrovalent~~	~~Simple~~ Giant metallic
Z	714	–1142	Poor	Good	Ionic bond / electrovalent	Giant ionic

12. The elemets sulphur, phosphorous and chlorine are regarded as having simple molecular structures.

(a) Write the molecular formula of;

(i) Sulphur (½ mark)

S_8 ✓1

(ii) Phosphorous (½ mark)

P_4 ✓1

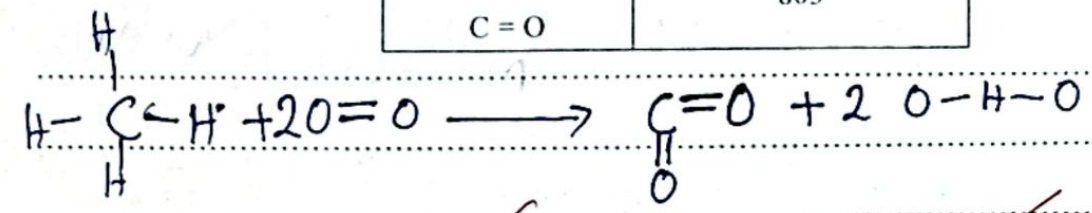
(b) Arrange these three elements in order of their increasing melting point. Explain this trend. (2 marks)

$S_8 > P_4 > Cl_2$; Melting point increases as molecular size/mass increases because van der waals forces become stronger. ✓1

13. Use the bond energies below to calculate the heat of reaction for burning of methane. (3 marks)

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

Bond	Bond energy(kJ/mol)
C - H	435
O - H	464
O = O	497
C = O	803



ΔH = Energy used in bond Breaking − Energy used in bond formation ✓1

$= [4(435) + 2(497)] - 2(803) + 4(464)$

$= 2734\,kJ - 3462\,kJ$

$\Delta H = -728\,kJ/mol$ ✓1

14. When excess lead (II) nitrate solution was added to a solution containing sodium chloride, the precipitate formed was found to weigh 5.5g. Determine the amount of sodium chloride in the solution. (Pb = 207, Cl = 35.5, Na = 23). (3 marks)

$Pb(NO_3)_{2(aq)} + 2NaCl_{(aq)} \rightarrow PbCl_{2(s)} + 2NaNO_{3(aq)}$

Molar mass of $PbCl_2$: $= 207 + (35.5 \times 2)$
$= 278\ g/mol.$

Mole of $PbCl_2 = \frac{5.5}{278}$
$= 0.01978$ mole.

Mole ratio: $(NaCl : PbCl_2) = 2:1$

Mole of NaCl
$= 0.01978 \times 2.$
$= 0.03956.$

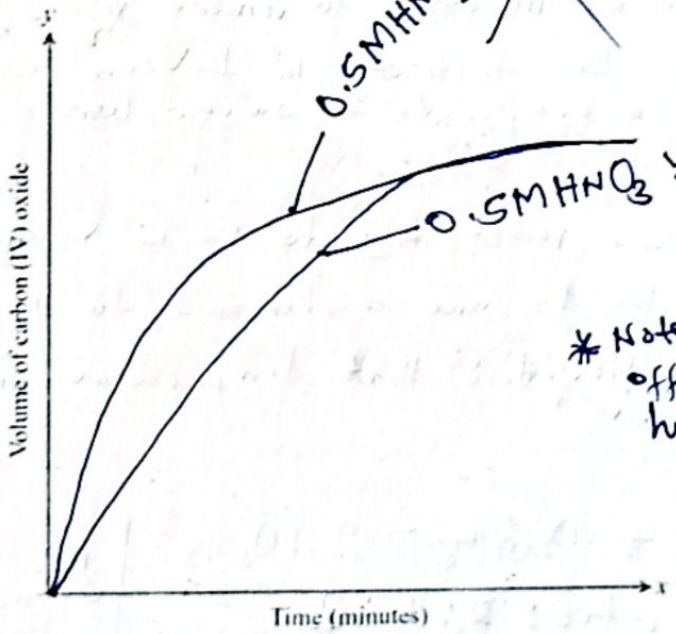
Mass $NaCl = 0.03956 \times (23+35.5)$
$= 2.31g.$

15. In an experiment 40cm³ of 0.5M Nitric acid was reacted with excess sodium carbonate and the volume of carbon (IV) oxide produced recorded with time. The experiment was repeated using the same volume and concentration of ethanoic acid and the volume of carbon (IV) oxide produced recorded with time.

(a) Why was sodium carbonate used in excess? (1 mark)

To ensure that all acid (HNO_3) reacts completely.

(b) On the graph below, sketch and label the curves of the volumes of carbon (IV) oxide produced against time. (2 marks)



* Note: Both must level off at the same horizontal plane.

16. Starting with copper metal, describe how a solid sample of copper (II) carbonate can be prepared. (3 marks)

React copper metal with Concentrated Nitric (V) acid to form copper (II) Nitrate solution. Add Sodium Carbonate solution (Any soluble carbonate) to copper (II) nitrate solution to precipitate $CuCO_3$. Filter the mixture to obtain the copper (II) carbonate as residue. Wash the residue with distilled water and dry between filter papers.

17. (a) A sample of water in a beaker was found to boil at 101.5°C at 1 atmospheric pressure. Assuming that the thermometer was not faulty, explain this observation. (1 mark)

The water is impure; the presence of impurities raises the boiling point of water above 100°C.

(b) Describe an experimental procedure that can be used to extract oil from nut seeds. (2 marks)

- Crush/grind the nut seeds using a mortar and pestle to increase the surface area.
- Add a suitable solvent e.g propane or ethanol) and stir to dissolve the oil.
- Filter the mixture to remove solid remains.
- Leave the filtrate in the sun or use a water bath to evaporate the solvent, leaving the oil behind.

18. (a) State Gay-Lussac's Law. (1 mark)

When gases react, they do so in volumes which bear a simple ratio to one another and to the volumes of the products, provided that temperature and pressure remain constant.

(b) 180cm³ of Nitrogen (II) oxide gas was reacted with 400cm³ of Oxygen gas. Calculate the total volume of the gases at the end of the reaction. (2 marks)

$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$

Volume ratio: 2 : 1 : 2

NO used 180cm³

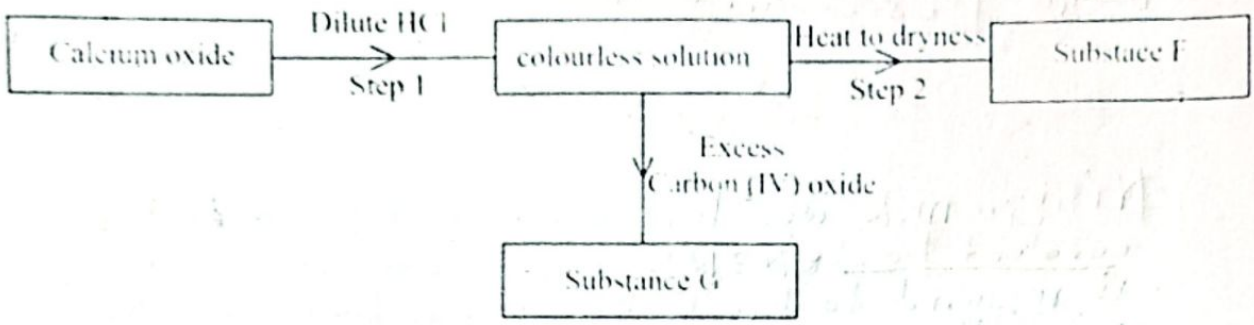
O_2 required: $\frac{180}{2} = 90\ cm^3$

Oxygen remains $= 400 - 90$
$= 310\ cm^3$

NO_2 produced $= 180\ cm^3$

Total: $310 + 180$
$= 490\ cm^3$

19. Study the flow chart below and answer the questions that follow:



(a) Give the name of the process that takes place in step 1. (1 mark)

Neutralization.

(b) Give the name of substance G. (1 mark)

Calcium hydrogen carbonate.

(c) Give one use of substance F. (1 mark)

- Used as a drying agent (deliquescent) ✓
- For de-icing roads. ✓

Any 1

20. When a sample of concentrated sulphuric (VI) acid was left in an open beaker in a room for two days, the volume was found to have increased slightly.

(a) What property of concentrated sulphuric (VI) acid is shown by the above reaction? Explain. (2 marks)

Hygroscopy // Being hygroscopic; Acid absorb water vapour from the atmosphere, which increases the total volume.

(b) State one use of concentrated sulphuric (VI) acid that depends on the property named above. (1 mark)

Used as a drying agent.

21. Name the apparatus that can be used to:

(a) Measure fixed volume of solutions. (1 mark)

✓ pipette – Syringe ✓
✓ volumetric flask – Burette. Any

(b) Lower a burning piece of magnesium ribbon into a gas jar. (1 mark)

Deflagrating spoon. ✓

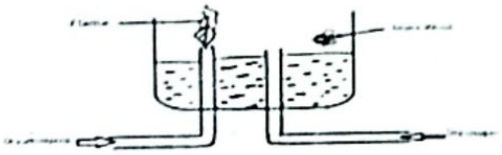
(c) Store and keep substances free from moisture. (1 mark)

Desiccator. ✓1

22. (a) Explain why a high temperature is required for nitrogen to react with oxygen. (1 mark)

Nitrogen molecules have a very strong ~~triple~~ triple covalent bond (N≡N). A high amount of energy is required to break these bonds before the atoms can react with oxygen.

(b) Dry ammonia and dry oxygen were reacted as shown in the diagram below:



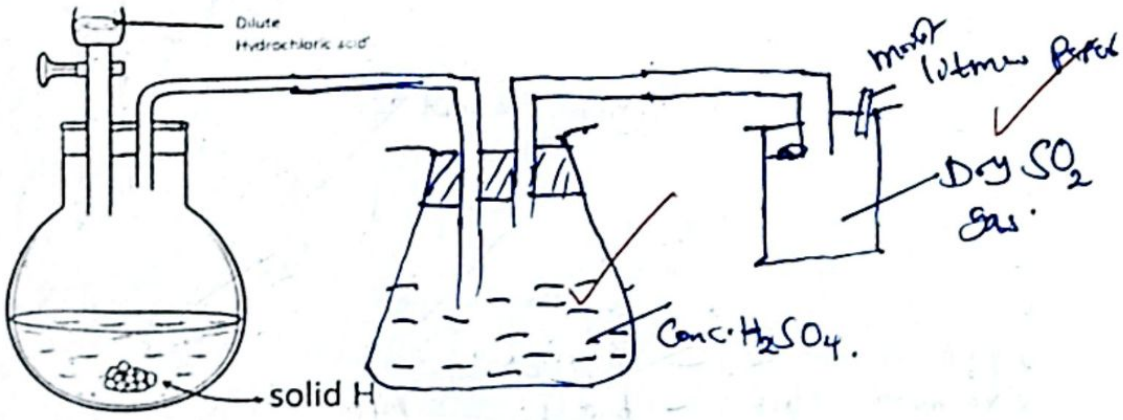
(i) What is the purpose of the glass wool? (1 mark)

- To provide a large surface area for the reaction to occur. ✓
- To hold the catalyst in place. ✓

(ii) What products would be formed if red hot platinum was introduced into a mixture of ammonia & oxygen? (1 mark)

- Nitrogen (II) oxide // (NO) ✓½
- H_2O // Water ✓½

23. The diagram below shows an incomplete set up used to prepare sulphur(IV) oxide in the laboratory.



(a) Identify solid H. (1 mark)

Sodium sulphite (Na_2SO_3)
Calcium sulphite ($CaSO_3$) Any 1

(b) Complete the set-up above to show how dry sulphur (IV) oxide maybe collected. (2 marks)

24. Temporary water hardness can be removed by boiling

(a) What is hard water (1 mark)

Water that contains dissolved salts of Ca^{2+} or Mg^{2+} and does not latter easily with soap.

(b) Write a chemical equation to show how temporary hardness is removed by boiling. (1 mark)

$Ca(HCO_3)_{2(aq)} \xrightarrow{Heat} CaCO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$ or
$Mg(HCO_3)_{2(aq)} \xrightarrow{Heat} MgCO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$

(c) State one advantage of hard water. (1 mark)

Provides Ca^{2+} ions which are essential for strengthening of bones and teeth in humans.

25. (a) What is a fuel. (1 mark)

— Is a substance that produces useful energy when it undergoes a chemical or a nuclear reaction.
— Any substance that react with oxygen to release a significant

(b) Calculate the heat value of ethanol if its molar enthalpy of combustion is 1360kJmol^{-1}.
(C=12.0, O=16.0, H=1.0) (2 marks)

Molar mass $C_2H_5OH = (12\times2) + (6\times1) + 16$
$= 46g/mol$

Heat value $= \frac{\text{Molar enthalpy}}{\text{Molar mass}}$

$= \frac{1360kJ}{46g}$
$= 29.57kJ/mol$

26. Use the following chemical equation to answer the equatios that follow:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

Identify;

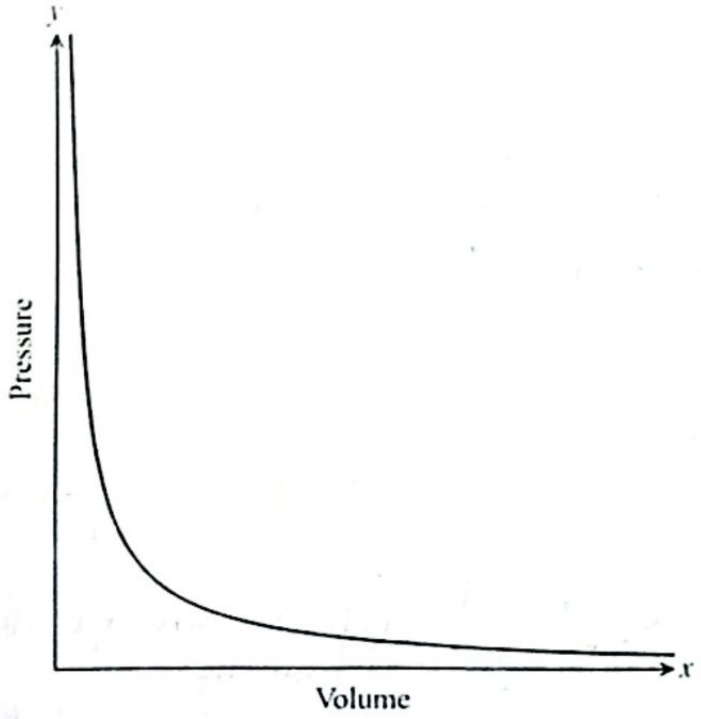
(a) The acid in the forward reaction. Explain. (1 mark)

H_2O; It donates a proton (H^+) to ammonia molecule to form NH_4^+.

(b) A base in the forward reaction. Explain. (1 mark)

NH_3; It accepts a proton to form NH_4^+ ✓

27. The graph below shows the behavior of a fixed mass of a gas at constant temperature.



(a) What is the relationship between the volume and pressure of the gas. (1 mark)

As pressure increases, volume decreases.

The volume of a fixed mass of a gas is inversely proportional to it pressure at constant temperature. ✓

(b) 3 litres of oxygen gas at one atmosphere pressure were compressed to two atmospheres at constant temperature. Calculate the new volume occupied by the oxygen gas. (2 marks)

$P_1V_1 = P_2V_2$ ✓

$1 \times 3 = 2 \times V_2$

$V_2 = \frac{3}{2}$

$= 1.5$ litres ✓