1. The data given below was recorded when metal **M** was completely burnt in air. **M** is not the actual symbol of the metal.   (R.A.M; M=56, O=16)

   Mass of empty crucible and lid   =10.240g
   Mass of crucible, lid and metal M   =10.352g
   Mass of crucible, lid and metal oxide   = 10.400g

   (a) Determine the mass of:

   (i) Metal M   ($\frac{1}{2}$ mark)

   $0.112g$ ✓ $\frac{1}{2}$

   (ii) Oxygen   ($\frac{1}{2}$ mark)

   $0.048g$ ✓ $\frac{1}{2}$

   (b) Determine the empirical formula of the metal oxide.   (2 marks)

   $\frac{0.112}{56} = 2.0 \times 10^{-3}$ $\frac{0.048}{32} = 1.5 \times 10^{-3}$ $\frac{1.5 \times 10^{-3}}{1.5 \times 10^{-3}} = 1.00$ ✓1

   $\frac{2.0 \times 10^{-3}}{1.5 \times 10^{-3}} = 1.333$: 1.00

   $\approx 1 : 1 = MO$ ✓1

2. The grid given below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbol of the element.

M					N	P	T	Z	
R									

(a) Select a letter which represents an element that losses electrons most readily. Give a reason for your answer. (2 marks)

✓ R – largest atomic radius and Ɔ a metal.

(b) Explain why the atomic radius of P is found to be smaller than that of N (2 marks)

– P has a higher nuclear charge than N so the outermost ē are pulled at a greater extent than in N.

(c) Select any two elements that can form an ionic bond. (1mk)

M Z (OR) R Z ✓

3. Distinguish between empirical and molecular formula of a compound. (1 mark)

E·F – Simplest whole number ration in which ✓ atoms combine to form a compound.

M·F – One that defines the number of atoms ✓ of each element present in a compound or molecule.

4. The set up shown below was used to investigate a property of hydrogen gas.

Glass cover   Glass tube

Original level of water

Porous bag

Air
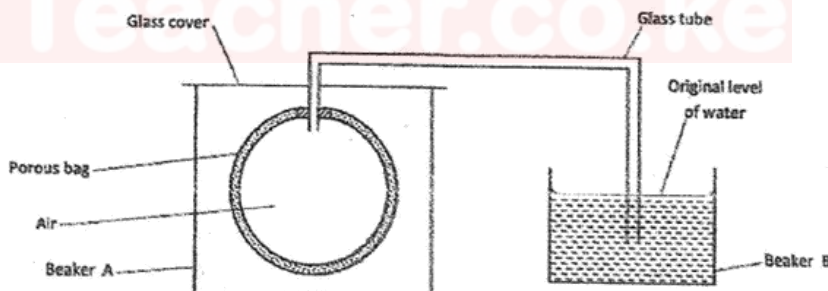
Beaker A   Beaker B

State and explain the observation that would be made in the glass tube if beaker A was filled with hydrogen gas. (3 marks)

Gas Bubbles on Beaker B. – The gas will diffuse through the porous bag pushing air inside the the tube and hence observed as bubbles. ✓

5. (a) State the Charles' law. (1 mark)

For a fixed mass of a gas, the volume is directly proportional to the absolute temperature provided pressure remains constant. ✓

(b). A certain mass of gas occupies 146 dm^3 at 20°C and 98.31 Pa. What will be its

⚡

temperature if its volume is reduced to 133 dm^3 at 101.325 Pa? (2 marks)

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad \checkmark \quad \frac{98.31 \times 146}{293} = \frac{101.325 \times 133}{T_2} = 275K$$

(Correction) ✗ 6. 140cm^3 of nitrogen gas diffuses through a membrane in 70 seconds. How long will it take 200 cm^3 of carbon (IV) oxide gas to diffuse through the same membrane under the same conditions of temperature and pressure? (C=12, N=14, O=16) (3 marks)
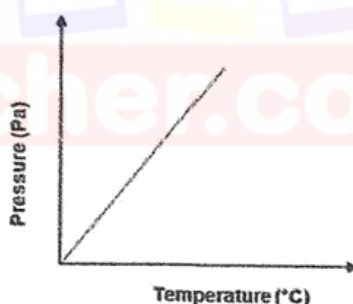
$$140 \rightarrow N_2 \rightarrow 70 \text{ sec}$$
$$200 \rightarrow \text{''} \rightarrow ??$$
$$\frac{200 \times 70}{140} = 100 \text{ sec.}$$

$$\frac{T_A}{T_B} = \sqrt{\frac{mm_A}{mm_B}} \quad \checkmark$$
$$\frac{100}{T_2} = \sqrt{\frac{28}{44}} \quad = 125.36 \text{ sec.} \quad \checkmark$$

7. The graph below shows the relationship between pressure and the temperature of a gas in a fixed volume container.

(a) State the relationship between pressure and temperature that can be deduced from the graph. (1 mark)

$$P \propto T \quad \checkmark$$

Pressure varies directly proportional to temperature; $\checkmark$

(b) Using kinetic theory, explain the relationship shown in the graph. (2 marks)

— In increase in temperature results in increase ∂ k.energy of molecules of the gas that are in constant/random motion and also a subsequent increase in pressure. $\checkmark$
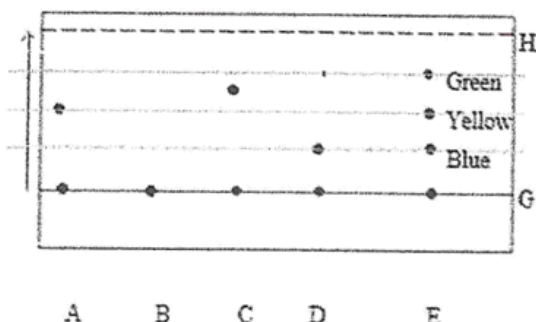
8. Convert the following temperature into absolute scale. (1mk)
   i. 25°C

$$25 + 273 = 298K \quad \checkmark$$

ii. 127°C

$$127 + 273 = 400K \checkmark$$

9. The diagram below shows chromatograms for five different dyes.

(a) Name the technique used to separate the dyes. (1mark)

Chromatography. ✓

(b) What is meant by the term solvent front? Indicate its position in the diagram. (2marks)

furthest point moved by the solvent in a chromatogram. ✓

(c) Which chromatograms were present in dye E? (2marks)

D; A ✓

(d) Which dye is pure? Explain (2marks)

C — It does not have its colour coincide with any of the colours in dye E.

(e) Which dye is

i) Insoluble (1mark)

B ✓

ii) Most soluble (1mark)

C ✓

g) Give **one** condition required to separate the chromatograms present in a dye. (1mark)
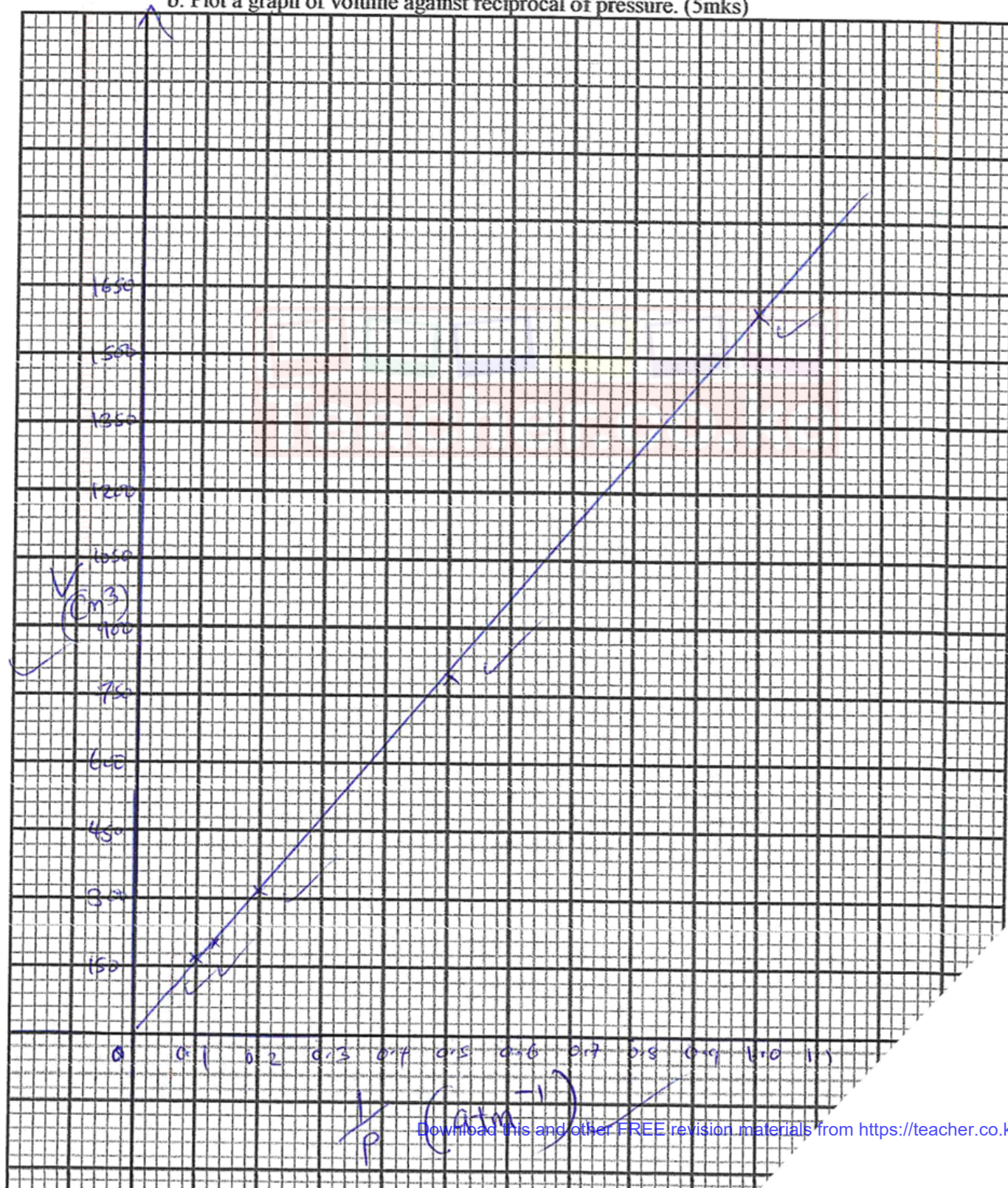
- deSolution of the dyes in the solvent.
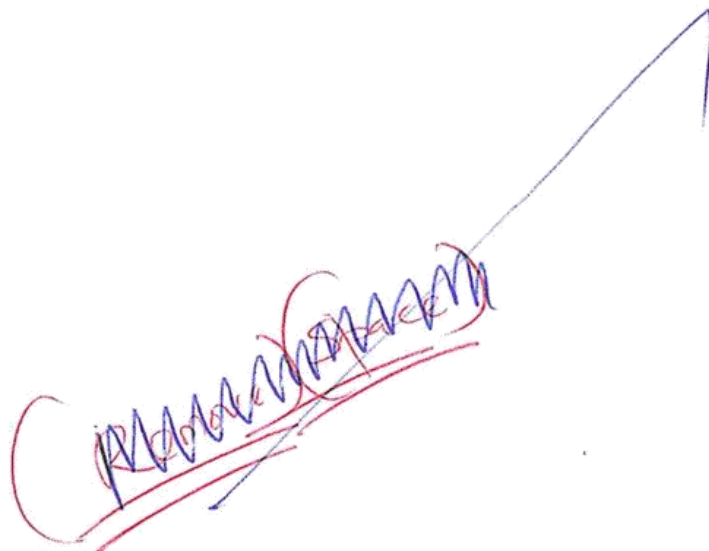- adhesiveness of the dyes on the Chromatogram.

10. Use the table below to answer the questions that follow.

Pressure in (atmospheres)	10	8	5	2	1
Volume (cm³)	160	200	320	800	1600
Reciprocal of pressure $\left(\frac{1}{P}\right)$	0·1	0125	0·2	0·5	1

a. Complete the table. (2mks)

b. Plot a graph of volume against reciprocal of pressure. (5mks)

d. What is the relationship between the volume and reciprocal of pressure? (1mk)

An increase in volume = direct increase in $\left(\frac{1}{p}\right)$ ⟹ directly proportional

11. (a). The table below shows some properties of chlorine, bromine and iodine.

Element	Formula	Colour and state at (R.T.P)	Solubility in water
Chlorine	Cl_2	(i) Pale green (gas)	Soluble
Bromine	Br_2	Brown liquid	(ii) Fairly soluble
Iodine	I_2	(iii) Purple (solid)	Slightly soluble

Complete the table by giving the missing information in (i), (ii) and (iii) above. (3mks)

i) Pale green (gas)
ii) Fairly soluble
iii) Purple – solid.

(b). Chlorine gas is prepared by reacting concentrated hydrochloric acid with either Manganese (IV) oxide or Potassium permanganate.

(i). Write the equation for the reaction between concentrated hydrochloric acid and Manganese (IV) oxide. (1mk)

$$MnO_{2(s)} + 4HCl_{(l)} \longrightarrow MnCl_{2(aq)} + Cl_{2(g)} + 2H_2O$$

(ii). What is the role of manganese (iv) oxide in this reaction? (1mk)

Oxidizing agent

(iii). When potassium permanganate is used instead of manganese (iv) oxide, heating is not required. Explain. (1mk)

$KMnO_4$ is a stronger oxidizing agent than MnO_2.

(iv). Give one advantage of using potassium permanganate over manganese (IV) oxide. (1mks)

– Reaction does not require any heating.

(v). Iron metal reacts with chlorine to form substance E. Identify substance E.   (1mk)

$FeCl_3$ ✓ (iron (III) chloride.)

(vi). Write a chemical equation to represent the reaction in (V) above.   .(1mk)

$2Fe_{(s)} + 3Cl_{2(g)} \rightarrow 2FeCl_3$ ✓