



FRIENDS SCHOOL KAMUSINGA



233/1

CHEMISTRY

PAPER 1

(THEORY)

@2026

CHEMISTRY

FORM 4 INTERNAL MOCK 2026

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Instructions To Candidates

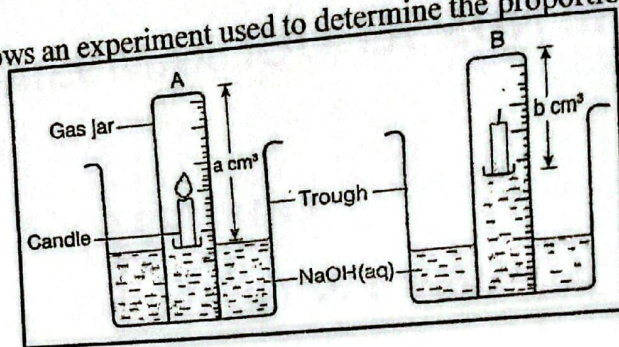
- Sign and write the date of the examination in the spaces provided above.
- Answer All questions in the spaces provided in the question paper.
- Non – programmable silent electronic calculators and KNEC mathematical tables may be used
- Workings must clearly show where necessary.
- Candidate should check the questions paper to ascertain that all the pages are printed as indicated that no questions are missing.
- candidates should answer the questions in English.

For Examiner's Use Only

Questions	Maximum score	Student's score
1 – 29	80	

Answer all questions in this paper in the spaces provided

1. Figure 1 below shows an experiment used to determine the proportion of air used in combustion



- (a) Why was NaOH(aq) used instead of water?

(1 mark)

To absorb the CO_2 gas produced during combustion

- (b) Using the set up in Figure 1, describe how the proportion of air (%) used up during combustion can be calculated.

(2 marks)

Note and record the initial volume $a \text{ cm}^3$ of the air column.

Note and record the final volume $b \text{ cm}^3$ of the air column

Volume of air used is determined by the formula $a \text{ cm}^3 - b \text{ cm}^3$

% of air used is determined by: $\frac{a-b}{a} \times 100\%$

- (c) Identify one source of inaccuracy in results in the experiment above.

(1 mark)

1) Incomplete combustion of the candle } Any one

2) Some oxygen dissolves in NaOH.

3) Air expands during heating of the candle } CO_2

2. The empirical formula of an organic compound is C_2H_2 . When 10.4g of the substance were allowed to evaporate, it occupied 4800 cm^3 at r.t.p. Determine the molecular formula of the compound. (C=12.0, H=1.0, molar gas volume at r.t.p = 24 dm^3).

(2 marks)

$$\text{M.G.V} = 24 \text{ dm}^3 = 24000 \text{ cm}^3$$

$$26n = 52$$

$$\text{Moles} = \frac{4800}{24000} = 0.2 \text{ moles}$$

$$n = 2$$

$$0.2 \text{ moles} \rightarrow 10.4 \text{ g}$$

$$\therefore 1 \text{ mole} \rightarrow \frac{1 \times 10.4}{0.2}$$

$$= 52 \text{ g/mol}$$

$$\text{M.F} = (\text{C}_2\text{H}_2)_2 = \text{C}_4\text{H}_4$$

$$(\text{C}_2\text{H}_2)_n = 52$$

$$(2 \times 12 + 2)n = 52$$

3. (a) When a current of 0.6 A was passed through a molten salt of metal C for 1 ½ hours 3.79g of C were deposited. Determine the charge on metal C. (C=226, 1F=96500C)

$$Q = It = 0.6 \times 5400 = 3240C$$

$$3.79g \rightarrow 3240C$$

$$\therefore 226g \rightarrow \frac{226 \times 3240}{3.79} = 193,203.167C$$

$$96500C \rightarrow 1F$$

$$193,203.167C \rightarrow 2F$$

Charge = +2 i.e. C^{2+}

(2 marks)

(b) Identify the products at the anode when;

(i) Concentrated NaCl solution is electrolyzed.

(1 mark)

Chlorine gas / Cl_2

(ii) Dilute NaCl is electrolyzed.

(1 mark)

Oxygen gas / O_2

4. Sulphur (IV) Oxide has many uses. complete the table below by indicating the role played by sulphur (IV) Oxide in the following. (2mrks)

Area of Use	Role of sulphur(IV) oxide
Grain silos	Kills Pests / Fumigant / prevents growth of A
Fruit and food processing	Preservative

b) Sulphuric acid is used in metallurgical industries to clean steel before it is galvanized. Explain the role of sulphuric acid. (1mrk)

To Remove rust/oxides from the Surface of steel / To pickle the steel.

5. The set up in Figure 2 below shows preparation of ammonia gas by a student.

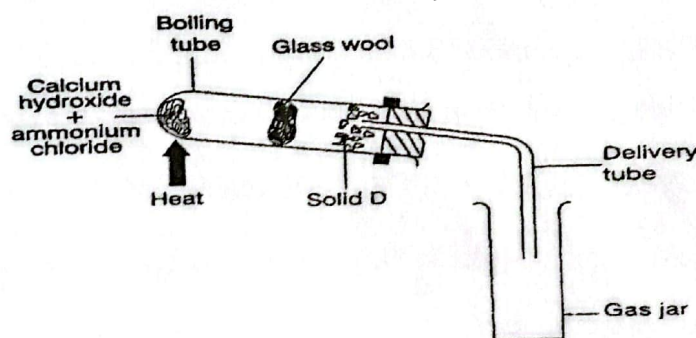


Figure 2

(a) Identify solid D and state its role

Identity Calcium oxide / CaO

(½ mark)

Role To dry NH₃ gas / Absorb Water Vapour

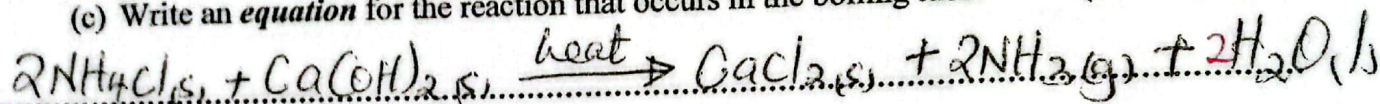
(½ mark)

(b) State **one** mistake in the set up in Figure 2 above.

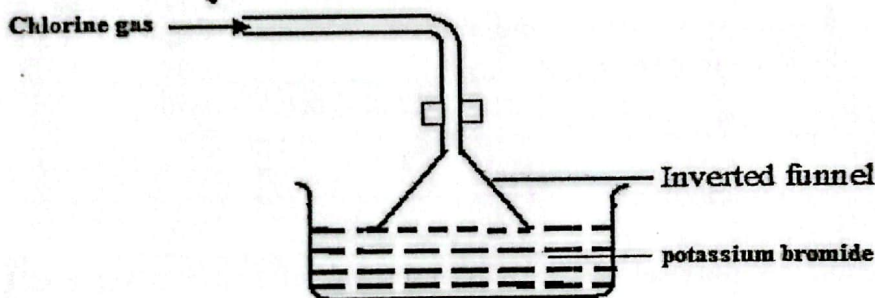
Wrong Method of gas collection since NH₃ is less dense than air.

(c) Write an **equation** for the reaction that occurs in the boiling tube.

(1 mark)



6. The figure below shows how Chlorine gas is bubbled through potassium bromide. Study it and answer the questions that follow.

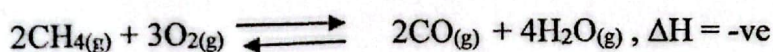


State and Explain the observation made in beaker.

(2mrks)

KBr soln changes from Colourless to ^{Yellow} ~~Brown~~ / Orange.
Cl_{2(g)} has a higher electron affinity hence displaces molecular Bromine from solution.

7. Carbon (II) oxide gas and steam are produced according to the equilibrium below.



Explain how the yield of the products in the above reaction is affected by:

(a) Increase in temperature

(1½ marks)

Yield decreases. The forward reaction is exothermic
hence increase in temperature favours a backward rxn.
Forward reaction is favoured at lower temperature

(b) Lowering pressure.

(1½ marks)

The yield increases. The products have more gaseous molecules. The forward reaction is accompanied by increase in volume.

8. The structures below are a representation of cleansing agents M and N.



M



N

(i) Identify the agents.

(1 mark)

M. Soapless detergent.

N. Soapy detergent / Soap.

ii) Explain why agent M causes water pollution.

(1 mark)

M is non-biodegradable. Causes foaming in rivers and lakes preventing dissolution of oxygen in water.

iii) Tetraoxophosphate is usually added to remove Ca^{2+} and Mg^{2+} during cleaning and provides nutrients for aquatic plants. The plants grow quickly depleting the dissolved oxygen. Name the process described.

(1 mark)

Eutrophication

9. Ethane reacts with bromine according to the equation below.



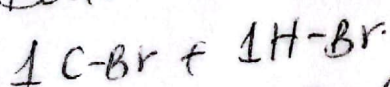
Using the bond energies in the table below calculate the energy change for the reaction that occurs.

Bond	C - H	C - Br	Br - Br	H - Br	C - C
Bond energy	413	280	193	365	3 46

(3 marks)

Bonds broken
 $1 \text{ C-H} + 1 \text{ Br-Br}$
 $= 413 + 193 = 606 \text{ kJ}$

Bonds Formed:



$$280 + 365 = 645 \text{ kJ}$$

$$\Delta H = 606 - 645$$

$$= -39 \text{ kJ}$$

10. a) Name the major raw material from which Aluminium is extracted. (1 mark)

Bauxite

(b) Explain why cryolite is added to aluminium oxide before electrolysis. (1 mark)

To lower the M.P. of Al_2O_3 from $2015^\circ C$ to $800^\circ C$

c) Explain why Aluminium is extracted using electrolysis. (1 mark)

Is Highly reactive hence cannot be extracted by reduction.

11. An unknown, colourless solution G has the following properties;

- (i) Turns blue litmus paper red
- (ii) Reacts with a clean magnesium ribbon to produce a gas which extinguishes a burning splint with a 'pop' sound
- (iii) Reacts with sodium carbonate powder to form a colourless gas which forms a white precipitate with calcium hydroxide solution
- (iv) When warmed with an oxide of copper, a blue solution is formed
- (v) On addition of Barium nitrate, a white precipitate is produced

(a) What do properties (i) and (ii) indicate about solution G? (1 mark)

It is acidic ✓

(b) Write the formulae for the;

(i) Blue solution.

(½ mark)

$CuSO_4$

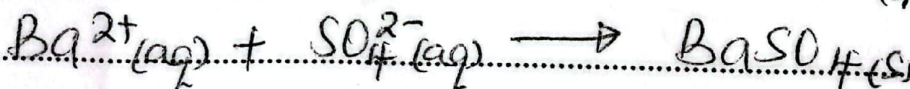
(ii) Oxide of copper.

(½ mark)

CuO

(c) Write an ionic equation for property (v).

(1 mark)



12. (a) Define the term half-life.

(1 mark)

..... is the time taken for half the initial
..... mass/no. of atoms of a radioactive nuclide to decay.

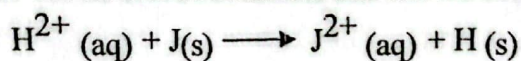
(b) A certain nuclide has a half-life of 2.5 hours. What percentage of a given mass of the nuclide will be left after 7.5 hrs?

(2 marks)

$$\text{No. of } t_{1/2} = \frac{7.5}{2.5} = 3 \quad \checkmark$$

$$100\% \xrightarrow{1t_{1/2}} 50\% \xrightarrow{1t_{1/2}} 25\% \xrightarrow{1t_{1/2}} 12.5\% \quad \checkmark$$

13. Study the overall equation for an electrochemical cell shown below;



Which species undergoes oxidation? Explain

(1 mark)

J(s). Its oxidation number increases from
zero to +2 in $\text{J}^{2+}(\text{aq})$.
Loses 2 electrons

14. (a) Name the subatomic particle that has no charge and state where it is located in the atom.

(1 mark)

Neutron. Its in the nucleus.

(b) An ion of element K has the formula ${}^{10}_{5}\text{K}^{3+}$

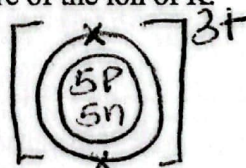
i) Write the electronic configuration of the ion.

(1 mark)

2

ii) Draw the structure of the ion of K.

(1 mark)



(iii) Write the formula of the oxide of K.

(1 mark)

K_2O_3

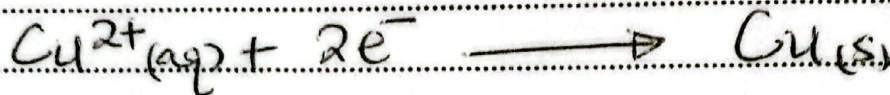
15. Electroplating refers to the process of coating a reactive metal with a layer of less reactive.

a) Give ONE reason for electroplating.

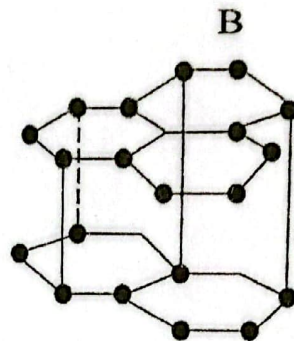
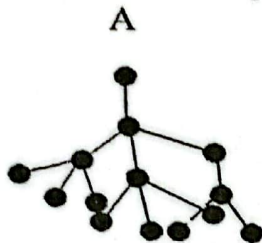
(1 mark)

- To prevent rusting/corrosion
- To improve the appearance of the metal / Aesthetic value.

b) During Electroplating of iron spoon with copper the type of electrolyte that should be used is copper (ii) sulphate solution. Write the equation for the reaction at the cathode. (1mrk)



16. The following diagrams show the structure of two allotropes of carbon. Study them and answer the questions that follow.



(a) Name the allotropes.

A. Diamond ✓

B. Graphite ✓

(1 mark)

(b) Which allotrope conducts electricity? Explain.

(2 marks)

B. ✓ Has delocalised electrons in its structure.
Graphite ✓

17. Fluorine, Chlorine and Bromine has the boiling point of -188, -35 and 59 Explain the trend in the boiling points.

B.P's increase down the group, (2mrks)
This is due to the Increase in size of the molecules from Fluorine to Bromine which increases the strength of the van der waals forces down the group.

18. Describe how solutions containing Zn^{2+} and Al^{3+} ions can be distinguished in the laboratory. (3 marks)

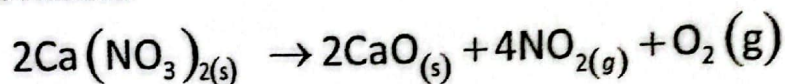
To two separate test tubes containing the solutions, add $\text{NH}_3(\text{aq})$ dropwise until in excess. For Zn^{2+} , a white ppt that dissolves in excess is observed. A white ppt that does not dissolve in excess $\text{NH}_3(\text{aq})$ solution is observed for $\text{Al}^{3+}(\text{aq})$.

X Use Na_2CO_3

Al^{3+} - Efferecence

Zn^{2+} - No efferecence.

19. Ten grams of calcium nitrate were completely decomposed on heating according to the reaction.

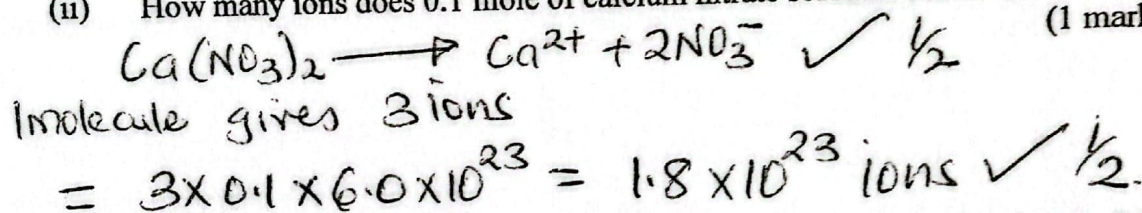


- (i) Determine the mass of the residue CaO that was left. (Ca=40, N=14, O=16) (2 marks)

$$\begin{aligned} \text{RMM of Ca(NO}_3)_2 &= 164 \\ \text{Moles of Ca(NO}_3)_2 &= \frac{10}{164} = 0.06098 \\ \text{Mole ratio Ca(NO}_3)_2 : \text{CaO} &= 1:1 \end{aligned}$$

$$\begin{aligned} \text{RMM of CaO} &= 56 \\ \text{Mass of CaO} &= 56 \times 0.06098 \\ &= 3.42 \text{ g} \end{aligned}$$

- (ii) How many ions does 0.1 mole of calcium nitrate solution contain ($L = 6.0 \times 10^{23}$) (1 mark)



20. The table below gives the solubilities of Sodium Bromide and Sodium Sulphate at 20°C and at 60°C;

Substance	Solubility in g/100g of water	
	20°C	60°C
Sodium Bromide	55	75
Sodium Sulphate	10	12

When aqueous mixture containing 60g of NaBr and 7g of Na₂SO₄ in 100g water at 80°C was cooled to 20°C, some crystals were formed;

- (i) Identify the crystals. (1 mark)

~~Sodium Sulphate~~
Sodium bromide

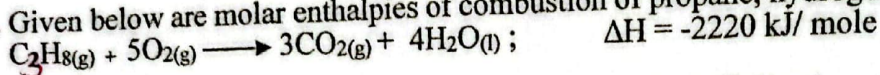
- (ii) Determine the mass of the crystals formed. (1 mark)

$$60 - 55 = 5 \text{ g}$$

- (iii) Name the method used to obtain the crystals. (1 mark)

Fractional crystallisation

21. Given below are molar enthalpies of combustion of propane, hydrogen and carbon.



Use the above information to calculate the molar enthalpy of formation of propane. (3 marks)

$$\Delta H_f + \Delta H_c = \Delta H_1 + \Delta H_2$$

$$\Delta H_f + (-2220) = (4 \times -286) + (3 \times -393)$$

$$\Delta H_f = 2220 + (-1144) + (-1179)$$

$$\Delta H_f = -103 \text{ kJ mol}^{-1}$$

22. Magnesium is hard to cut with a knife however it is Ductile and Malleable while calcium is brittle hence cannot be cut with a knife. Define.

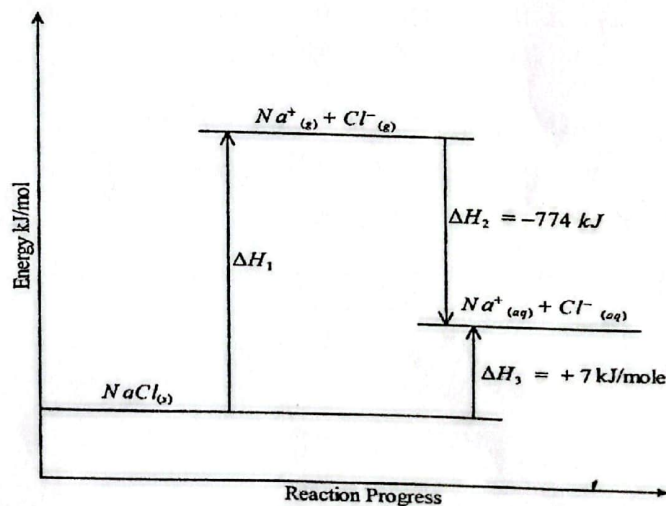
(i) Ductile.

Ability of a Metal to be drawn into wires without breaking. (1mrk)

(ii) Some metals produce sound when struck, Name the property described. (1mrk)

Sonorousity

23. The diagram below shows energy changes in a reaction. Use it to answer the questions that follow.



(a) What is the name given to ΔH_3

(1 mark)

Enthalpy of Solution

Heat

(b) Calculate the value for ΔH_1

(1 mark)

$$\Delta H_1 = +7 + 774 = +781 \text{ kJ/mol}$$

(c) State one factor that determines the amount of hydration energy.

(1 mark)

Charge of the ion: - Higher charge $\Rightarrow$ higher hydration energy.
Ionic radius: - Smaller ion requires higher hydration energy.

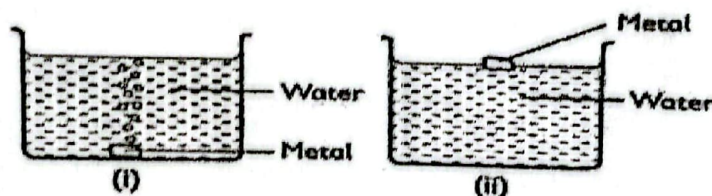
24. (i) Give the name of the third member of the alkyne homologous series (1mrk)

But-1-yne.

ii) Describe a chemical test that can be used to distinguish between propane and Prop-1-yne. (2marks)

To two separate test tubes containing (acidified) KMnO_4 , bubble the gases. The purple H^+/KMnO_4 remains purple when propane is bubbled through. But H^+/KMnO_4 changes to colourless when prop-1-yne is bubbled through.

25. Some metals were reacted with cold water. Hydrogen gas is given off. The diagram below shows reactions of the metals.



(a) Predict the metals in set-up (i) and (ii)

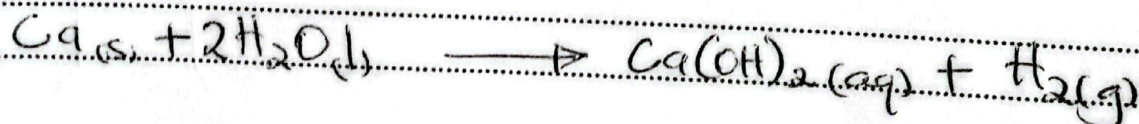
(1mrk)

(i) Calcium

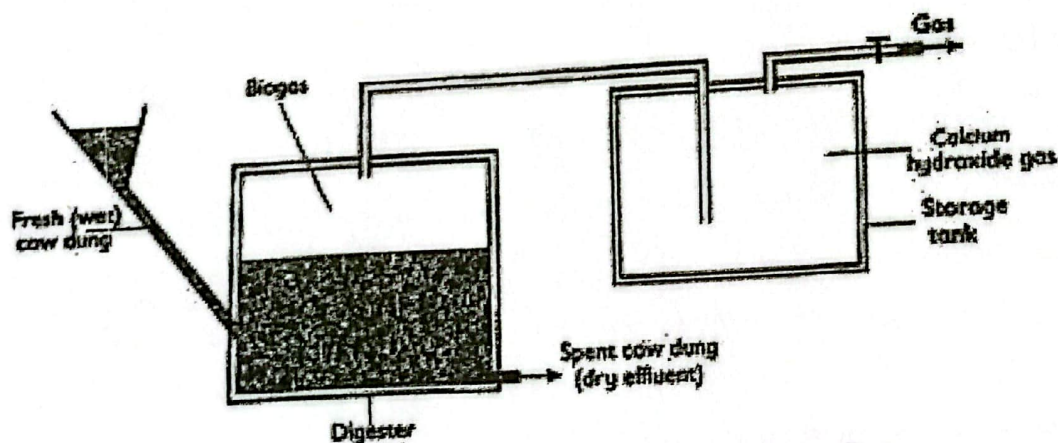
(ii) Sodium

(b) Write equation for the reaction taking place in set-up (i)

(1mrk)



26. When manure rots in tanks called digester, biogas which is a mixture of 60% methane and 40% carbon (IV) Oxide is formed. Biogas is used as a fuel.



- (a) Explain how calcium hydroxide in the gas storage improve the fuel. (1mark)

Absorbs the CO_2 gas that does not support combustion.

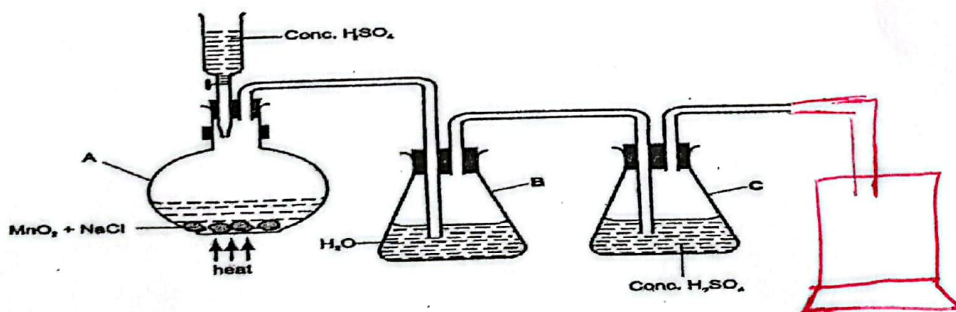
- (b) State one disadvantage of using biogas as a fuel. (1mark)

- Produces CO_2 that causes global warming.
- Production is slow and requires a large digester.

- (c) Give one use of the Dry effluent. (1mark)

Used as fertilizer to improve soil fertility.

27. Chlorine can be prepared by Oxidation of chloride ions by oxidizing agents as shown in the diagram below.



Explain the function of the following.

- (i) Concentrated sulphuric(VI) Acid in the reaction vessel A. (1mark)

Displaces HCl gas from NaCl .

(ii) Water in container B.

Dissolve any HCl acid fumes because of their high solubility compared to Cl_2 gas. (1mark)

(iii) Complete the set-up to show how dry chlorine gas is collected. (1mark)

28. i) State Boyles law. (1mark)

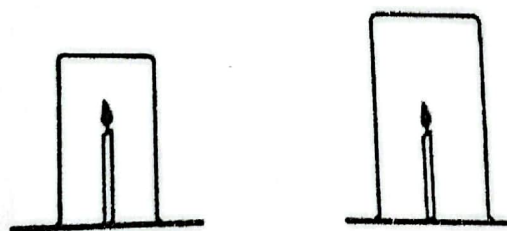
The volume of a fixed Mass of a gas is inversely proportional to pressure at constant temperature.

ii) A gas occupies 4dm^3 at a pressure of 152mmHg . Calculate the gas pressure when the volumes are reduced to 1.5dm^3 . (2marks)

$$P_1 V_1 = P_2 V_2$$

$$P_2 = \frac{P_1 V_1}{V_2} = \frac{152 \times 4}{1.5} = \underline{405.33 \text{ mmHg}}$$

(a) A burning candle was covered with beakers of different sizes. The time taken for the candle to go off in the different beakers was recorded.



(b) Explain why the same kind of candles be used in all the experiments. (1mark)

The candles should burn at the same rate / To keep other variables constant (1mark)

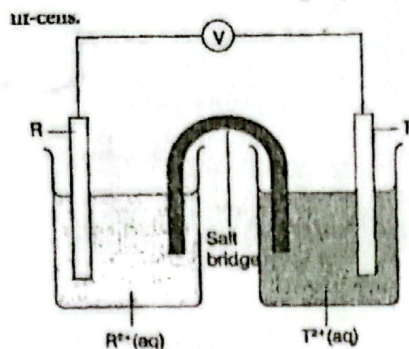
(c) Explain why the candle takes longer to go off in the larger beaker. (1mark)

Larger beaker contains more volume of air hence more oxygen

(d) The experiment was repeated with a shorter candle. The time recorded for the candle to go off was longer than in the first experiment. Explain the observation. (1mark)

Shorter candle has a smaller flame hence uses oxygen at a slower rate.

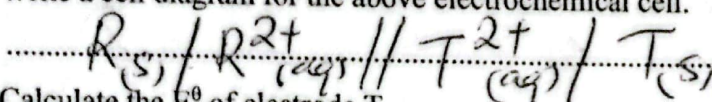
29. The diagram below shows a cell made up of the half-cells of elements R and T.



Given that the electrode potential for the above cell is +3.22V and the standard electrode potential of the half-cell R is -2.38V.

(a) Write a cell diagram for the above electrochemical cell.

(1 mark)



(b) Calculate the $E^{\ominus}$ of electrode T.

(1 mark)

$$E^{\ominus} = E_R - E_T$$

$$+3.22 = E_R - (-2.38) \quad | \quad E_R = +3.22 - 2.38$$

$$E_R = +0.84V$$

(c) Which is a stronger oxidizing agent.

(1 mark)

T^{2+} has a more positive reduction potential