CHEMISTRY
FORM THREE
PAPER 2 (233/2)
END TERM 2
EXAMINATIONS
JULY/AUGUST 2025
MARKING SCHEME

1. (a) Study the following part of periodic table chart and use it to answer the questions that follow. The letters are not the actual symbols of the elements.

						A		
	B		C			D	E	
F	G							
							H	

(i) Which elements form ions with charge of -2?Explain (2mks)

Element A and D
Both require 2 electrons to achieve Octet configuration.

(ii) If the oxides of B and D are separately dissolved in water, what effect will their aqueous solution have on litmus. (2mks)

Oxide of B forms an alkaline solution that turns red litmus blu
Oxide of D forms an acidic solution, that turns blue litmus red.

(iii) How would you expect the ionic reactions of C and E to compare? Explain(2mks)

E has a bigger ionic radius than ionic radius of C: Because E forms ions by gaining electrons, which C ionizes by lose of electron

(iv) Write the formula of the compounds formed between elements G and H (1mk)

$G^{2} \times H^{1} \longrightarrow GH_2$

(v) In terms of structure and bonding, explain why the oxide of D has a lower melting point than the oxides of B. (2mks)

Oxide of D is molecular with weaker vander Waals forces, while the oxide of B is a giant ionic structure with stronger ion bonds.

(vi) Write an equation to show the action of heat on the carbonates with element G (1mk)

$GCO_{3(s)} \longrightarrow GO_{(s)} + CO_{2(g)}$

(b) When 1.5litres of chlorine gas were completely reacted with element B, 5.937g of the product were formed. Determine the relative atomic mass of element B. (Atomic mass of chlorine = 35.5 Molar gas volume = 24litres) (3mks)

$B + Cl_2 \longrightarrow BCl_2$

1.5 Litres of Cl_2 = 5.937g of BCl_2

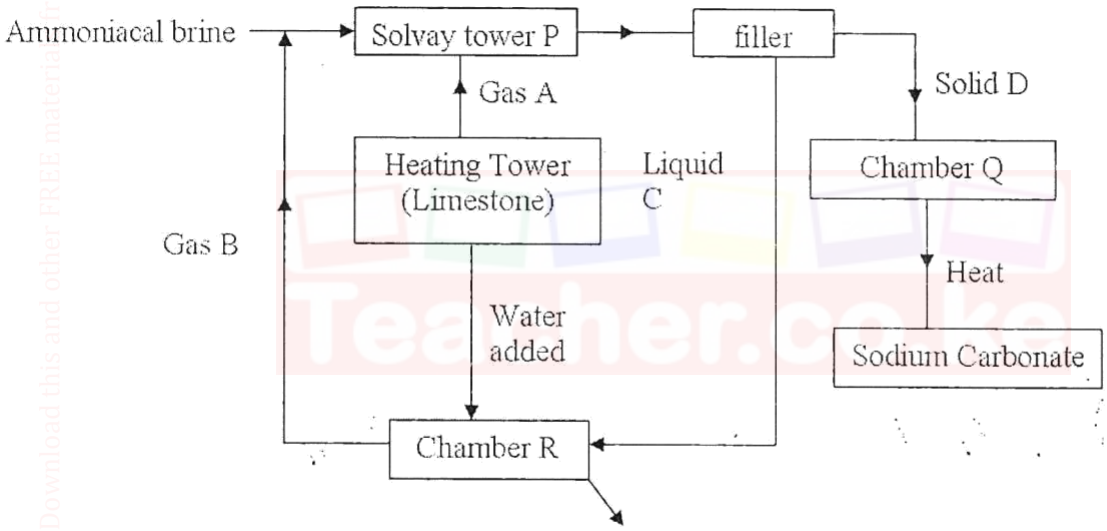
24 litres of Cl_2 = ?

$= \frac{24 \times 5.937}{1.5} = 95g$

R.A.M of B = $BCl_2 - Cl_2$

$= 95 - 24 = 71$

2. The scheme below shows the manufacture of sodium carbonate by the Solvay process. Study it and use it to answer the questions that follow.



(a) Name (i) gases A and B (1mark)

A - Carbon(IV) Oxide.

B - Ammonia gas.

(b) Name liquid C and Solid D (1mark)

C - Ammonium Chloride solution.

D - Sodium hydrogen carbonate.

(c) Write equations for the reactions taking place in tower P and chamber R (2marks)

Chamber P. -> $NH_{3(g)} + NaCl_{(aq)} + CO_{2(g)} + H_2O_{(l)} \longrightarrow NaHCO_{3(s)} + NH_4Cl_{(aq)}$.

Chamber R -> $Ca(OH)_{2(aq)} + 2NH_4Cl_{(aq)} \longrightarrow CaCl_{2(aq)} + 2NH_{3(g)} + 2H_2O_{(l)}$.

(d) Name the product formed in chamber at chamber R and give one of its uses (2marks)

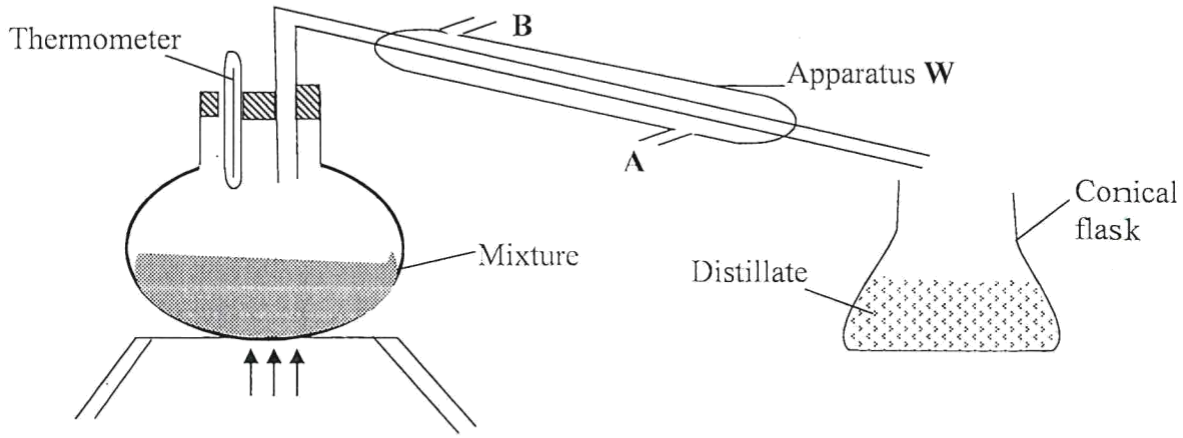
Ammonia - uses.

- Manufacture of fertilizers.
- Manufacture of Nitric acid.
- Refrigerant.
- Softening water.

(e) State three uses of sodium carbonate (2marks)

- Making of glass.
- Softening water.
- Making sodium silicate used in making detergents.
- Paper industry.

3. A student left some crushed fruit mixture with water for some days. He found the mixture had fermented. He concluded that the mixture was contaminated with water and ethanol with boiling point of 100°C and 78°C respectively. The set-up of apparatus below are used to separate the mixture.



(i) Name the piece of apparatus labelled **W** (1mk)

Liebig Condenser.

(ii) What is the purpose of the thermometer in the set-up? (1mk)

To indicate when the liquid is boiling, a thermometer reads constant temperature

iii) At which end of the apparatus **W** should tap water be connected?(1mk)

A.

(iv) Which liquid was collected as the first distillate? Explain (2mk)

Ethanol - Has a lower boiling of 78°c compared to water with a boiling point of 100°c.

(v) What is the name given to the above method of separating mixture?(1mk)

Fractional distillation.

vi)State **two** applications of the above method of separating mixtures (1mk)

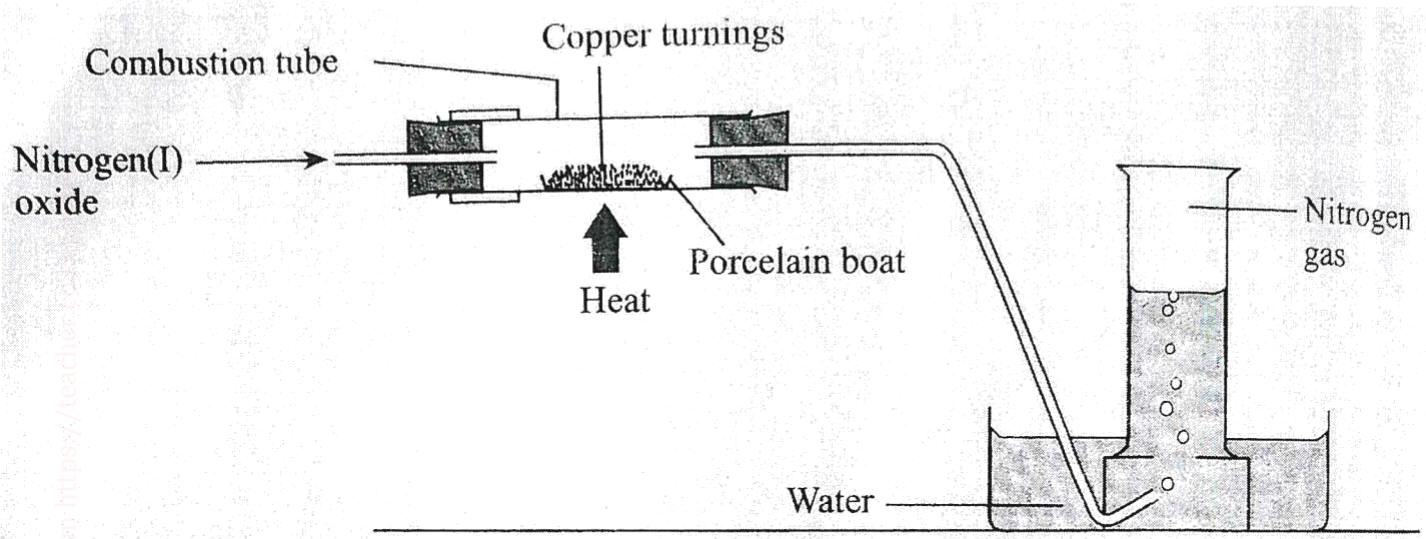
- Separate components of crude oil.
- To isolate O_2 and N_2 from air

- To manufacture spirits

(vi) What properties of the mixture make it possible for the component to be separated by the above methods? (2mk)

They have different but close boiling points.

4. (a) The set up below demonstrates the oxidation of copper to an oxide of copper by nitrogen(I)oxide.Study the diagram and the data below it to answer the questions that follow.



Mass of porcelain boat=14.6g

Mass of boat+copper turnings =24.2g

Mass of boat+oxide of copper=26.6g

	Copper	Oxygen
Mass in grams	9.6	2.4
Number moles	$\frac{9.6}{64}=0.15$	$\frac{2.4}{16}=0.15$
Mole ratio of Copper to Oxygen	$\frac{0.15}{0.15}=1$	$\frac{0.15}{0.15}=1$

(i) Deterine the formula of the oxide of copper. (3mks)

Mass of Copper = 24.2 − 14.6 = 9.6g.

Mass of Oxygen = 26.6 − 24.2 = 2.4g.

(ii) Write an equation for the reaction that occurred in the boat. (1mk)

$Cu_{(s)} + N_2O_{(g)} \longrightarrow CuO_{(s)} + N_{2(g)}$

(iii) Calculate the volume of nitrogen formed at r.t.p. (2mks)

From the equation, 1 mole of Copper reacts with one mole of N_2O to form 1 mole of nitrogen gas. 0.15 moles of Copper react with 0.15 moles of N_2O to form 0.15 moles of N_2.

1 mole of N_2 occupies 24 dm^3 at r.t.p.

0.15 moles = ?

$\frac{0.15 \times 24}{1} = 3.6\ dm^3$

(b) when 5.025g hydrated sodium carbonate were reacted with excess hydrochloric acid,450cm^3 carbon(iv)oxide were produced at r.t.p. calculate the number of moles of water of crystallization in one mole of the salt. (3mks)

$Na_2CO_{3(s)} + 2HCl_{(aq)} \longrightarrow 2NaCl + CO_2 + H_2O_{(l)}$

Mole ratio of sodium carbonate : Carbon(iv) oxide = 1 : 1

Relative formula Mass of Na_2CO_3 = $(2\times23)+12+(3\times16)=106$

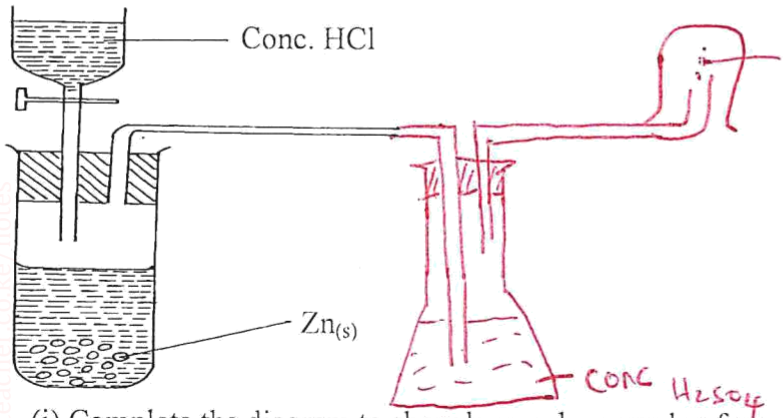
106g Na_2CO_3 = 24000 cm^3 CO_2

? = 450 cm^3

$= \frac{450\times106}{24000} = 1.9875g\ Na_2CO_3$

Mass of water in 5.025g hydrated Na2CO3 = 5.025 − 1.9875 = 3.0375g

5. a)The set-up below was used by a form three student to prepare a dry sample of gas **M**. Study it and use it to answer the questions that follow:-



(i) Complete the diagram to show how a dry sample of gas **M** can be collected (3mks)

(ii) State the identity of gas **M** (1mk)

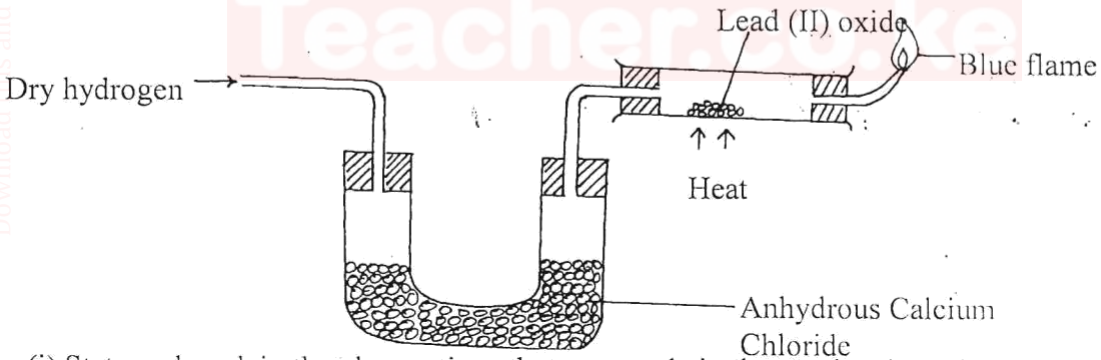
Hydrogen

iii) state two industrial uses of gas M.(2mks)

(i) Mixed with Oxygen to produce acetylene flame used in cutting Metals.
(ii) Used in hot air ballons.
(iii) used in rocket as fuels.
(iv) - used in manufuture of HCl and Ammonia. (v) Hydrogenation.

b)What property of concentrated sulphuric acid is being employed in the above preparation? (1mk) The set-up below was used to investigate the properties of hydrogen

Conc H_2SO_4 is less volatile hence displaces a more volatile ions from it's salts.



(i) State and explain the observations that was made in the combustion tube as the reaction progressed to completion (2mks)

The colour change from orange to shiny grey. This is due to reduction of Lead (II) oxide to Lead Metal by hydrogen and it's self being oxidised to water

(ii) Write equations for the reactions ;

I) In the combustion tube (1mk)

$H_{2(g)} + PbO_{(s)} \longrightarrow Pb_{(s)} + H_2O_{(l)}$.

II) At the jet of the delivery tube (1mk)

$H_{2(g)} + O_{2(g)} \longrightarrow H_2O_{(l)}$.

Naturally occurring boron exists as two isotopes, boron-10 B with a relative abundance of 20% and boron-11 B with a relative abundance of 80%.

(a) How many electrons does each atom of boron contain? (1mk)

5 Electrons.

(b) How many neutrons does each atom of the most abundant isotope contain? (1mk)

A – 5
B – 6.

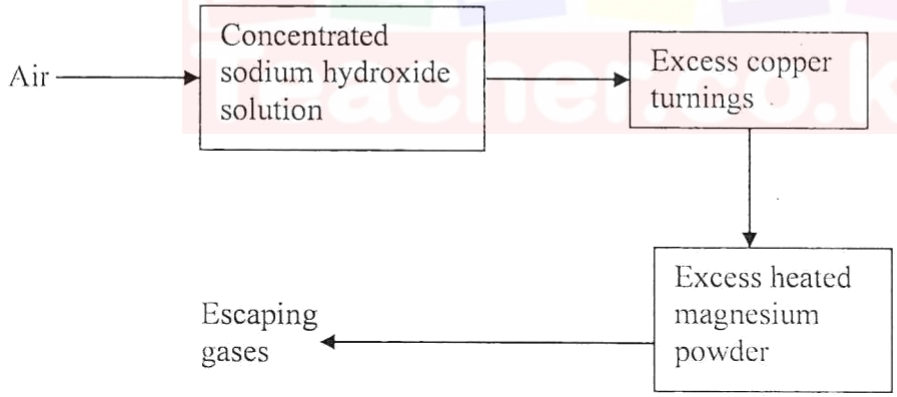
(c) Calculate the relative atomic mass of boron. (3mks)

$R.A.M = \left(\frac{\text{Mass of A} \times \text{R.A}}{100}\right) + \left(\frac{\text{Mass of B} \times \text{R.A}}{100}\right) = \frac{19 \times 20}{100} + \left(\frac{11 \times 80}{100}\right)$

$2 + 8.8 = 10.8$

(d) Make a diagrammatic representation of an atom of the least abundant isotope of boron showing the distribution of electrons and composition of the nucleus. (2mks)

II. Air was passed through several reagents as shown below:



(a) Write an equation for the reaction which takes place in the chamber containing Magnesium powder (1mk)

$3Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_{2(s)}$.

(b) Name **one** gas which escapes from the chamber containing magnesium powder. Give a reason for your answer (1mk)

Argon – It is inert.

(c) State two industrial uses of hydrogen gas (1mk)

Happ – Haber process to Manufacture Ammonia.
– Welding
– Hydrogenation –

6.In the preparation of magnesium carbonate, magnesium was burnt in air and the product collected. Dilute sulphuric acid was then added and the mixture filtered and cooled. Sodium carbonate was added to the filtrate and the contents filtered. The residue was then washed and dried to give a white powder.

(a) Give the name of the product (1mk)

Magnesium Oxide.

(b) Write the chemical equation for the formation of the product (1mk)

$2Mg_{(s)} + O_{2(g)} \longrightarrow 2MgO_{(s)}$.

(c) (i) Name the filtrate collected after sodium carbonate was added.(1mk)

Sodium Sulphate.

(ii) Write down the chemical formula of the white powder (1mk)

$MgCO_3$

(d) Write a chemical equation for the reaction between product in **(a)** and the acid (1mk)

$MgO_{(s)} + H_2SO_{4(aq)} \longrightarrow MgSO_{4(aq)} + H_2O_{(l)}$.

(e) Write an ionic equation to show the formation of the white powder(1mk).

$Mg^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow MgCO_{3(s)}$.

(f) Write an equation to show what happens when the white powder is strongly heated. (1mk)

$MgCO_{3(s)} \longrightarrow MgO_{(s)} + CO_{2(g)}$.

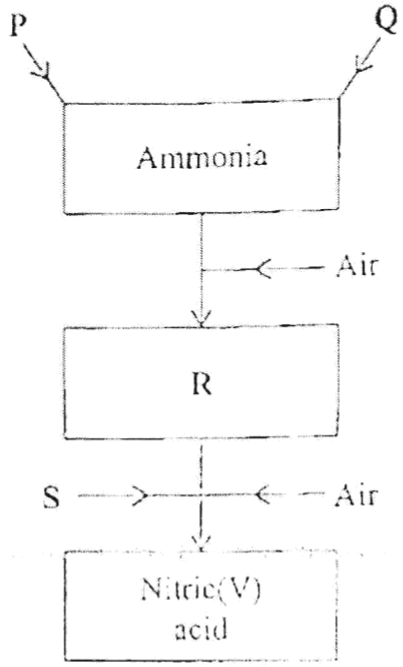
(g) Identify the ions present in the filtrate after addition of sodium carbonate. (1mk)

Na^+ ion and SO_4^{2-} ions.

(h) What is the name given to the reaction that takes place when sodium carbonate was added to the filtrate? (1mk)

Precipitation / double decomposition.

7. The figure below is a flow chart that shows the process that occurs in the manufacture of nitric(v)acid.



(a) Name substance P,Q,R and S. (3mks)

P – Nitrogen
Q – Hydrogen
R – Nitrogen(II) oxide
S – water

(b) To obtain substance R, ammonia is heated to 900^0c in presence of air and the catalyst. The product is cooled in air.

I) Name the catalyst for the reaction. (1mk)

Platinum catalyst.

II) Write the equations for the reactions described in (b) (2mk).

$4NH_{3(g)} + 5O_2 \longrightarrow 4NO_{(g)} + 6H_2O_{(l)}$

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

III) Other than nitric(v)acid, name another product that is formed (1mk

Nitric(III) acid.

(c) When ammonia is reacted with nitric (v)acid, it produces a nitrogenous fertiliser.

I) Explain why fertilisers play major role in food production. (2mks)

Nitrogenous fertiliser provide nitrogen which is needed for plant growth hence increasing food production.

II) State two problems associated with the use of nitrogenous fertilisers (2mks)

- It causes eutrophication.
- Because of high solubility in water nitrogenous fertilisers are prone to leaching hence polluting water.