

NAME: SCHEMESTREAM:.....

Candidate's signature:ADM. NO:

Date:

233/2

CHEMISTRY PAPER 1

(THEORY)

FORM FOUR

TIME: 2 HOURS

EXAM DATE: 29TH SEPTEMBER, 2023

TIME: 2 HOURS

SIAYA CHEMISTRY ASSOCIATION TERM THREE 2023

Kenya Certificate of Secondary Education (K.C.S.E)

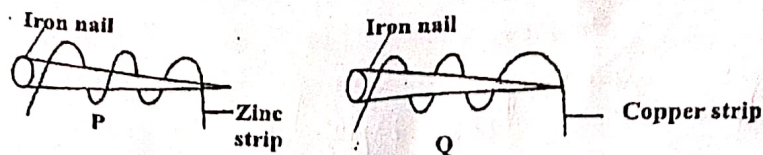
Instructions

- ✓ Write your name and admission number in the spaces provided above.
- ✓ Sign and write the date of examination in the spaces provided above.
- ✓ Answer ALL the questions in the spaces provided.
- ✓ KNEC mathematical tables and silent Non – Programmable calculators may be used.
- ✓ All working MUST be clearly shown where necessary.
- ✓ Candidates should check the question paper and ascertain that all pages are printed as indicated and that no questions are missing.
- ✓ All questions MUST be answered in English.

For Examiner's Use Only

MAXIMUM SCORE	CANDIDATES SCORE
80	

1. Use the diagram below to answer the questions that follow.



a) In which set-up will the iron nail rust? Explain (2 marks)

Q ✓. Copper is less reactive than iron, can not protect/sacrifices for iron

b) State one advantage of rusting (1 mark)

✓ Prevents metals underneath from further damage by offering protective layer

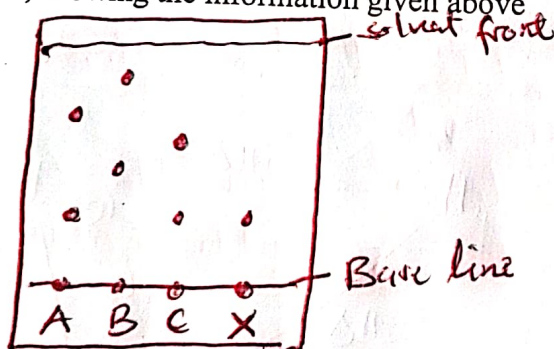
✓ prevent corrosion by offering sacrificial protection Any one ✓

2. During investigation to identify illegal steroids used by three athletes. Urine samples were obtained and labeled as A, B and C. Illegal steroid was labeled as X, each urine sample had 2 components each and urine A and C contain the illegal steroid.

a) Give the name of process used to identify illegal steroids in athletes. (1 mark)

Chromatography

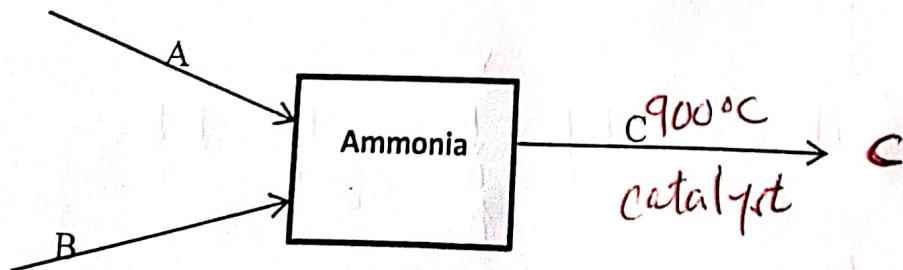
b) Draw a chromatogram, showing the information given above (2 marks)



KEY:

- solvent front and baseline
- 2 sample for each A, B, C
- X sample in line with A and C
- workability

3. The flow chart below shows the process that can be used to obtain substance C from ammonia gas when it is heated to about 900°C in air and in the presence of a catalyst.



a) Ammonia is obtained on large scale by Haber process. Name the raw materials A and B.

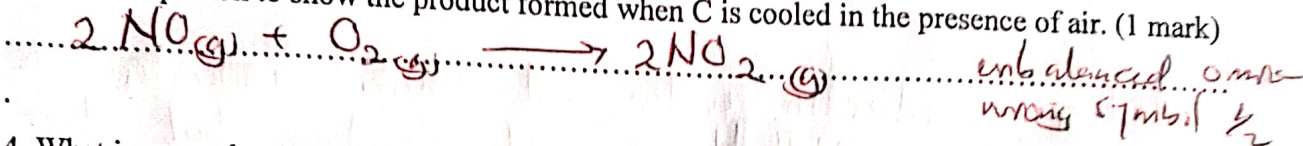
(1 mark) Nitrogen
Hydrogen

b) Name the substance C and the catalyst used.

Nitrogen (II) oxide // NO

(1 mark)

c) Write an equation to show the product formed when C is cooled in the presence of air. (1 mark)



4. What is meant by the term allotropy?

Existence of an element in more than one form in the same physical state.

(1 mark)

b) Which type of Sulphur is formed under the following conditions?

	Conditions	Type of Sulphur
(i)	Mixing sodium thiosulphate with dilute hydrochloric acid	Colloidal Sulphur (1/2 mark)
(ii)	Saturating distilled with Hydrogen sulphide then exposed to air	Powdery sulphur (1/2 mark)
(iii)	Pouring boiling Sulphur into cold water	Plastic sulphur (1/2 mark)
(iv)	Below 96°C	Rhombic sulphur (1/2 mark)

5. An experiment was carried out where hydrogen chloride gas was bubbled through methylbenzene and water in separate beakers. The resulting solutions were tested with blue litmus papers and sodium carbonate

(i) Write the observations made in the following table

(2 marks)

Solution of hydrogen Chloride gas in:	Blue litmus paper	Sodium carbonate
Water	changes red ✓ _{1/2}	Effervescence ✓ _{1/2}
Methylbenzene	No observable change ✓ _{1/2}	No effervescence ✓ _{1/2}

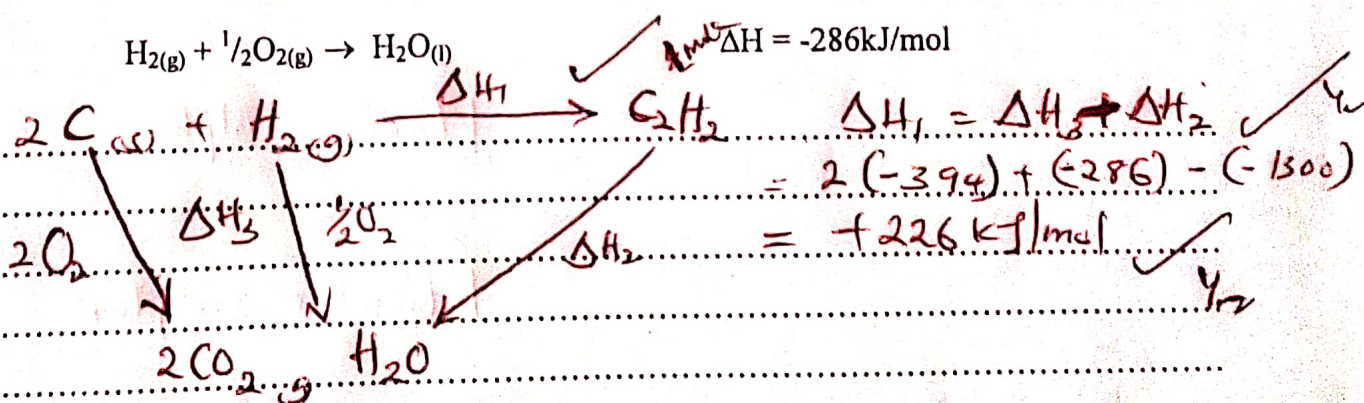
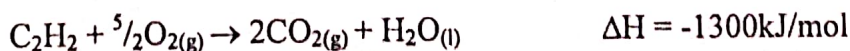
(ii) Explain the observations in (i) above (1 mark)

HCl(g) dissolves in water and ionises/dissociates into H⁺ while in Methylbenzene it dissolves but does not ionise/dissociates

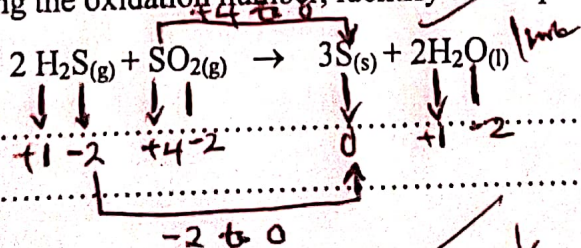
6. a) State the Hess's Law (1 mark)

Energy change in converting reactants to products is the same irrespective of the route in which the change occurs

c) Calculate the molar enthalpy of formation of ethyne (C₂H₂) given the following. (2 marks)



7 (a) Using the oxidation number, identify and explain oxidizing and reducing agent (2 marks)



H₂S → Reducing agent
 Oxidation state of S increases from -2 to 0

SO₂ - Oxidising agent
 Oxidation state of S decreases from +4 to 0

(b) Atomic number of Sulphur is 16. Write the electron configuration of S in SO_3^{2-} (1 mark)

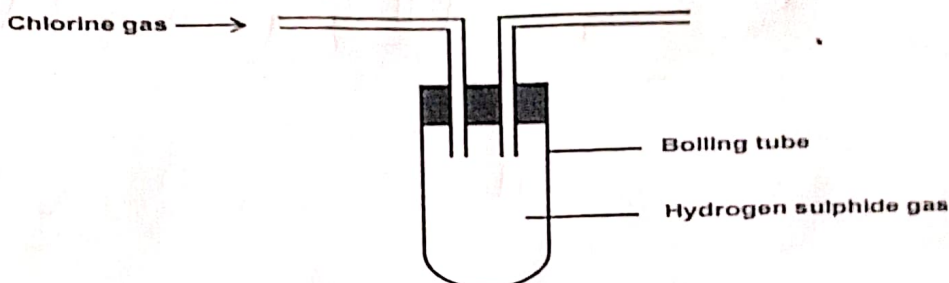
$$S + (-2) \times 3 = -2$$

$$S + (-2) = -2$$

$$S = +4$$

$$S^{4+} - 2.8.2$$

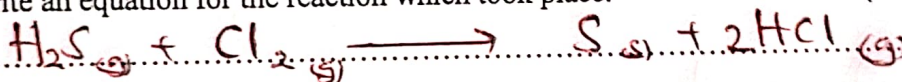
8. In an experiment, Chlorine gas was passed into moist hydrogen Sulphide gas as shown below



a) What observation was made in the boiling tube? (1 mark)

yellow deposit / solid / precipitate

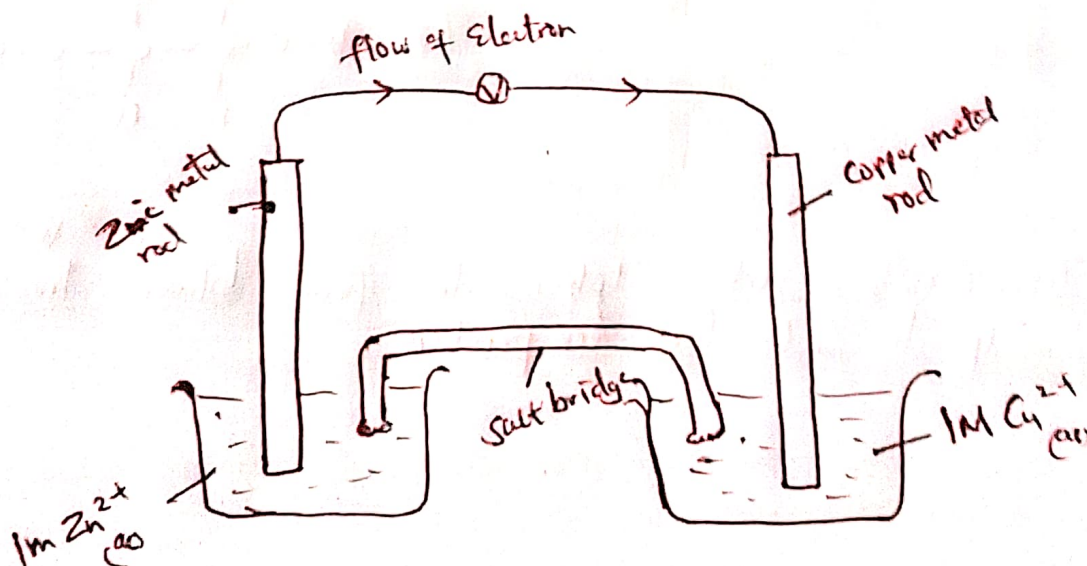
b) Write an equation for the reaction which took place. (1 mark)



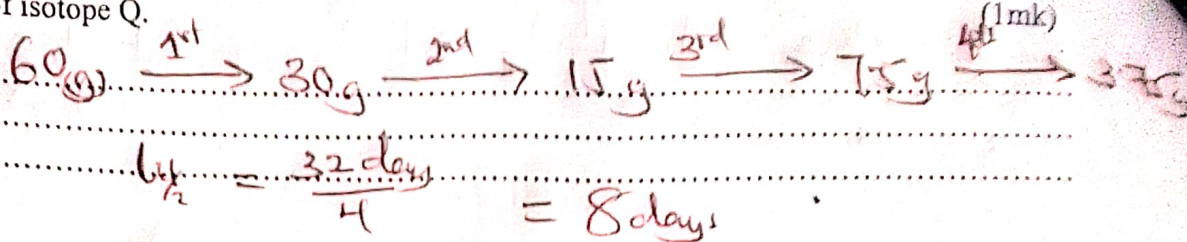
c) What precaution should be taken in carrying out this experiment? Give a reason. (1 mark)

Should be carried in fume chamber or fume hood or both H_2S and Cl_2 are poisonous

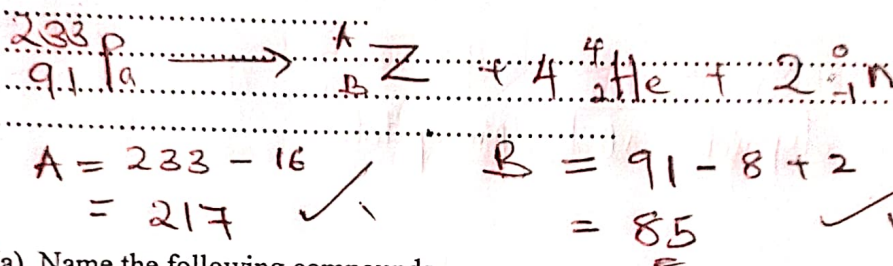
9. Given that the E^\ominus of $\text{Cu}(s)/\text{Cu}^{2+}(\text{aq})$ is $+0.34\text{V}$ and that of $\text{Zn}(s)/\text{Zn}^{2+}(\text{aq})$ is -0.76V , draw a labelled diagram of zinc and copper electrochemical cell. (3 marks)



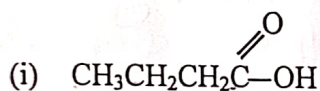
10. a) 60g of a radioactive isotope Q was reduced to 3.75 g after 32 days. Determine the half-life of isotope Q. (1mk)



b) An isotope of protactinium ${}^{233}_{91}\text{Pa}$ emitted a total of four Alpha particles and two beta particles to form an atom Z. Work out the mass number and atomic number of atom Z. (2mks)



11. (a) Name the following compounds.

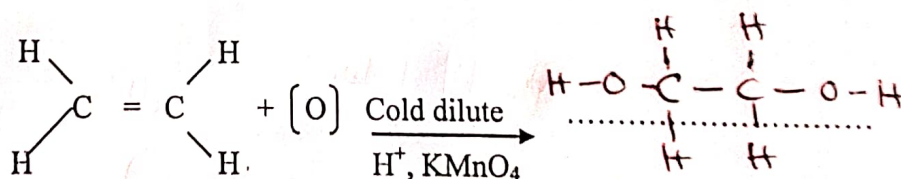


Butanoic acid ✓ 1mk



Propylethanoate ✓ 1mk

b) Complete the following equation. (1mk)



12. Egg proteins contains iron, sulphur among other chemicals. Explain why the egg yolk often turns black when boiled for a long time. (2mks)

Iron combine with Sulphur to form black Iron (II) Sulphide at high temperature. ✓ 2mks

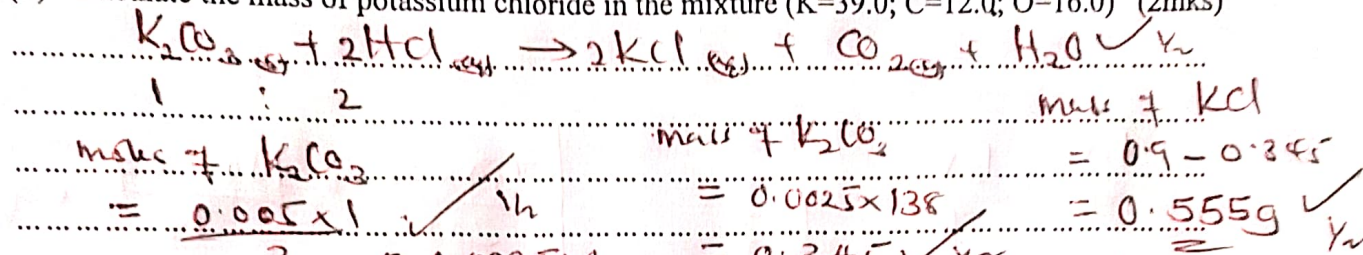
13. 0.9g of potassium chloride and potassium carbonate mixture completely reacted with 25cm^3 of 0.2M hydrochloric acid

(i) Determine the number of moles of the acid used

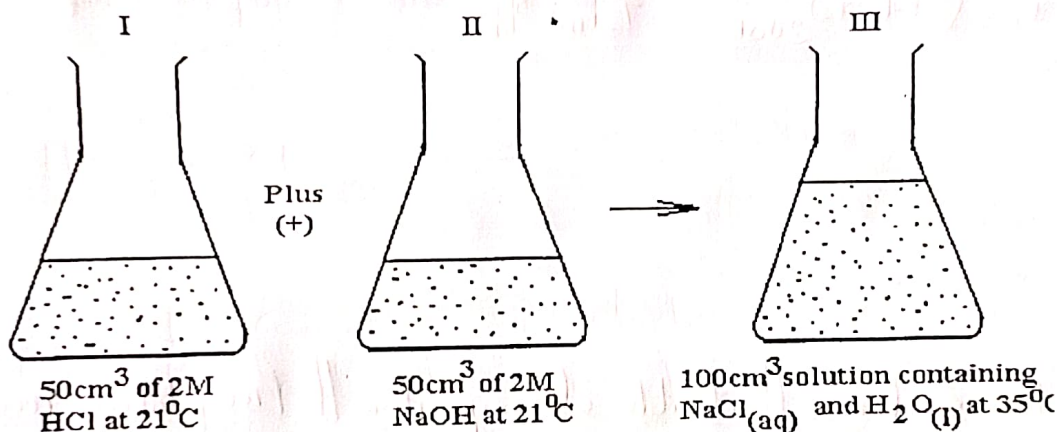
(1mks)

$$\frac{25 \times 0.2}{1000} = 0.005 \text{ moles}$$

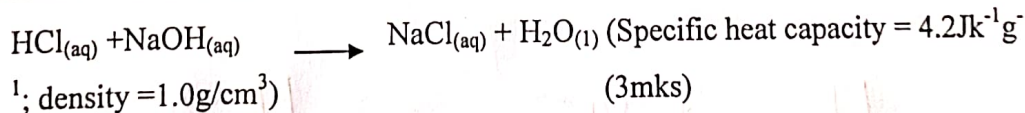
(ii) Calculate the mass of potassium chloride in the mixture (K=39.0; C=12.0; O=16.0) (2mks)



14. The diagrams below represent a neutralization process carried by a student.



Calculate the heat of neutralization in joules per mole for the reaction:



$$Q = mc\Delta T$$

$$= 100 \text{ g} \times 4.2 \times 14 = 5880 \text{ J}$$

$$\text{Molar heat} = \frac{5880 \text{ J}}{0.1 \text{ mol}} = 58800 \text{ J/mol}$$

$$\frac{50 \times 2}{1000} = 0.1 \text{ mol}$$

15. a) State Charles' law:

(1 mk)

Volume of a fixed mass of a gas is directly proportional to its absolute temperature under at a constant pressure

b) A gas R at 27°C and 750mmHg was found to occupy 36cm³. calculate the temperature at which the same mass of R will occupy twice the volume at a pressure of 1000mmHg. (2 mks)

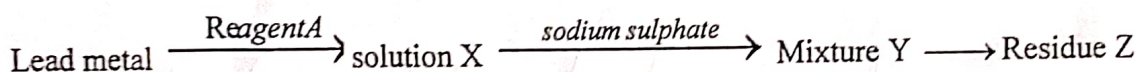
$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$T_2 = ?$

$P_1 = 750 \text{ mmHg}$	$P_2 = 1000 \text{ mmHg}$
$V_1 = 36 \text{ cm}^3$	$V_2 = 36 \times 2 = 72 \text{ cm}^3$
$T_1 = (27 + 273) = 300 \text{ K}$	$T_2 = ?$

$$\frac{750 \times 36}{300} = \frac{1000 \times 72}{T_2}$$
$$T_2 = 800 \text{ K}$$

16. The reaction below refers to the preparation of lead (II) sulphate starting with lead metal.



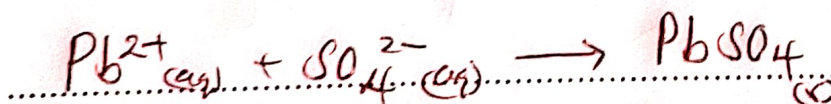
(a) Name the type of reaction between solution X and sodium sulphate solution

(1mark)

Ion Exchange // double decomposition // Precipitation reaction

(b) Write an ionic equation for the reaction in (a) above

(1mark)

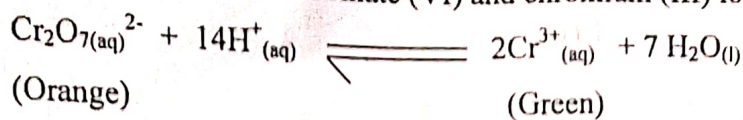


(c) Explain why it is not possible to prepare residue Z using Lead metal and dilute Sulphuric acid

(1mark)

Insoluble PbSO_4 formed forms a coat on the metal preventing further reaction.

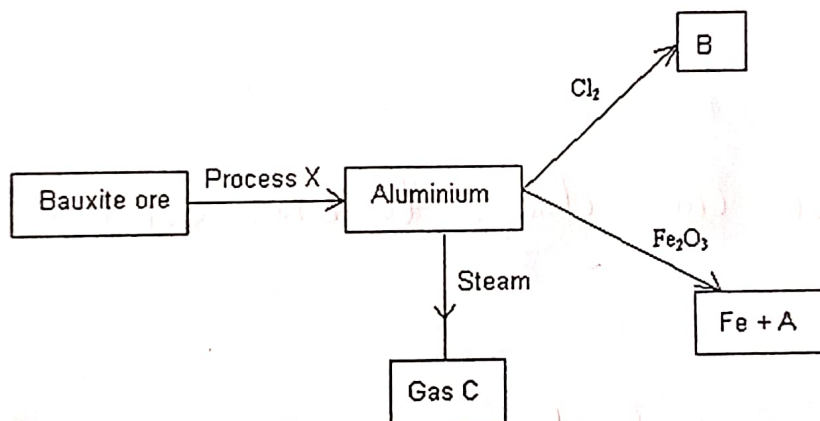
17. A dynamic equilibrium between chromate (VI) and chromium (III) ions is shown below



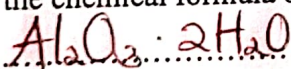
State and explain the observation made when dilute sodium hydroxide solution is added to the equilibrium mixture. (3mks)

Intensity of Orange colour increases. Addition of NaOH provides OH ions which react with H⁺ decreasing H⁺ concentration on the left hand side. more Cr³⁺ combine with water to form Cr₂O₇²⁻.

18. The extraction and some properties of aluminium are summarized in the flow chart below.



(i) Give the chemical formula of Bauxite. (½ mk)



(ii) Name the substances A, B and C in the diagram above. (1 ½ mks)

A: Aluminium Oxide || Al₂O₃

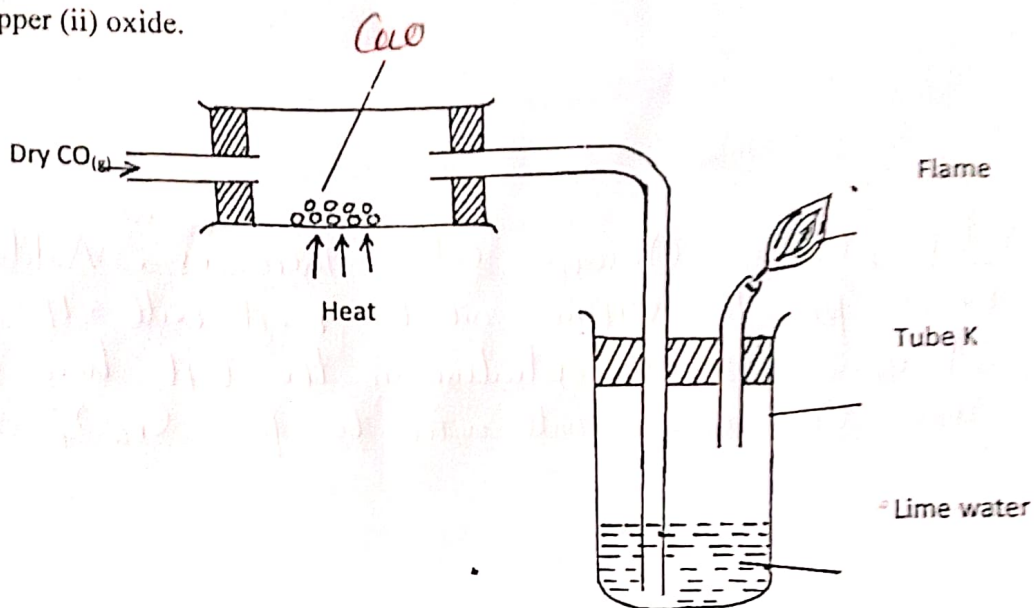
B: Aluminium Chloride || AlCl₃

C: Hydrogen gas || H₂

(iii) Explain the use of Cryolite in the extraction of Aluminium. (1mk)

To lower the melting point of Aluminium oxide

19. The apparatus shown below was used to investigate the effect of carbon (II) oxide on copper (II) oxide.



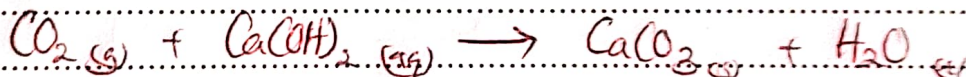
- a) State the observation that was made in the combustion tube at the end of the experiment.

(1mk)

Black CuO changes to brown solid ✓

- b) Write an equation for the reaction that took place in tube K.

(1mk)

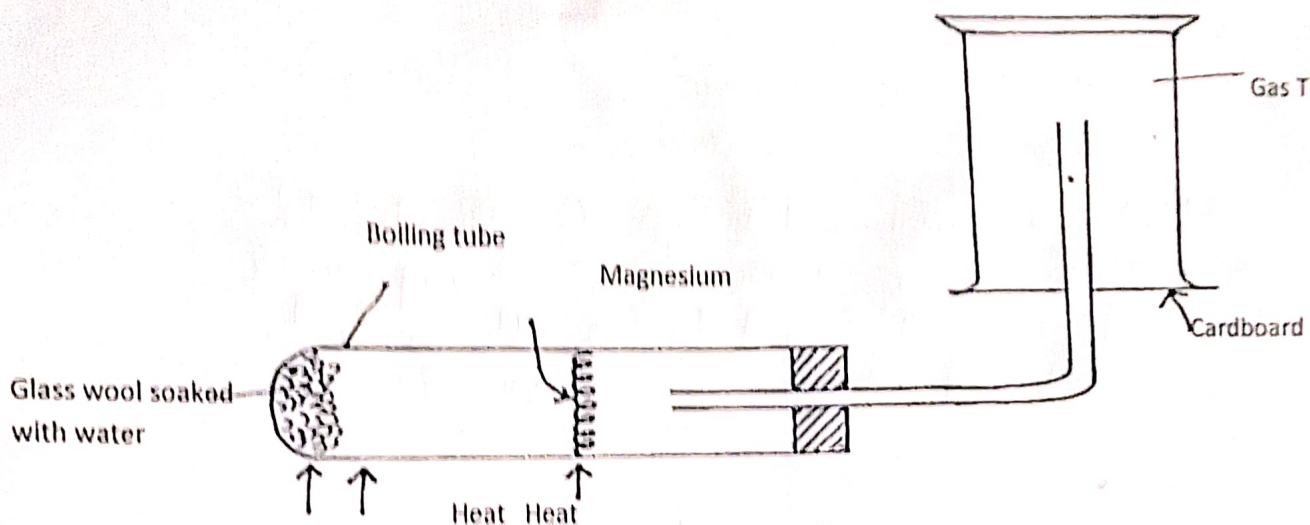


- c) Why is it necessary to burn the gas coming out of tube K.

(1mk)

CO gas is poisonous. ✓

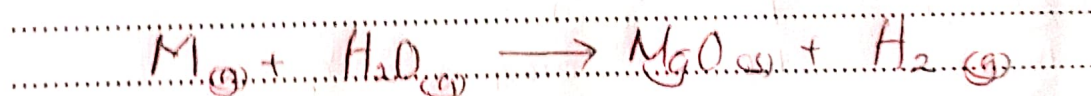
20. The set up below was used to react magnesium with steam.



a) Why is glass wool heated before heating magnesium? (1mk)

To drive out air into the tube by generating steam

b) Write down the equation for reaction that occurred in the boiling tube. (1mk)



c) Why is gas T collected as shown? (1mk)

It is less dense than air

21. Elements P and Q have atomic numbers 13 and 8 respectively. Write down the electron arrangement of the ions.

(i) P^+ (1mk)

2.8.2 ✓ 1mk

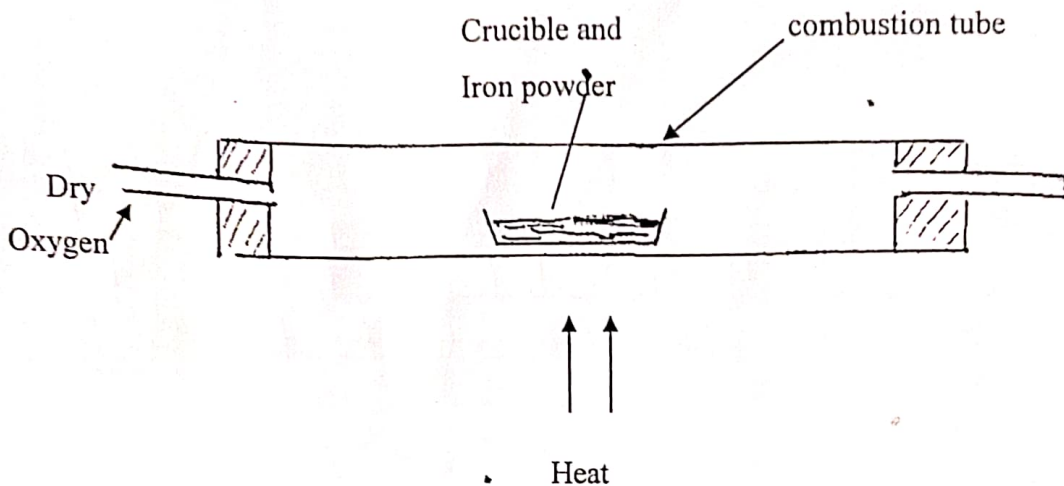
(ii) Q^- (1mk)

2.7 ✓ 1mk

(b) Write down the formula of the compound formed between element P and Q (1mk)

P_2Q_3 ✓ 1mk

22. Iron powder was heated in the presence of oxygen using the apparatus shown below. During the experiment the following data was obtained.



Mass of empty crucible = 10.98gms.

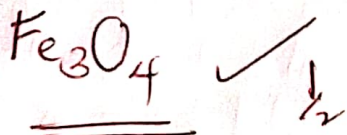
Mass of crucible + Iron before reaction = 12.66 gms

Mass of crucible + Iron after reaction = 13.30 gms

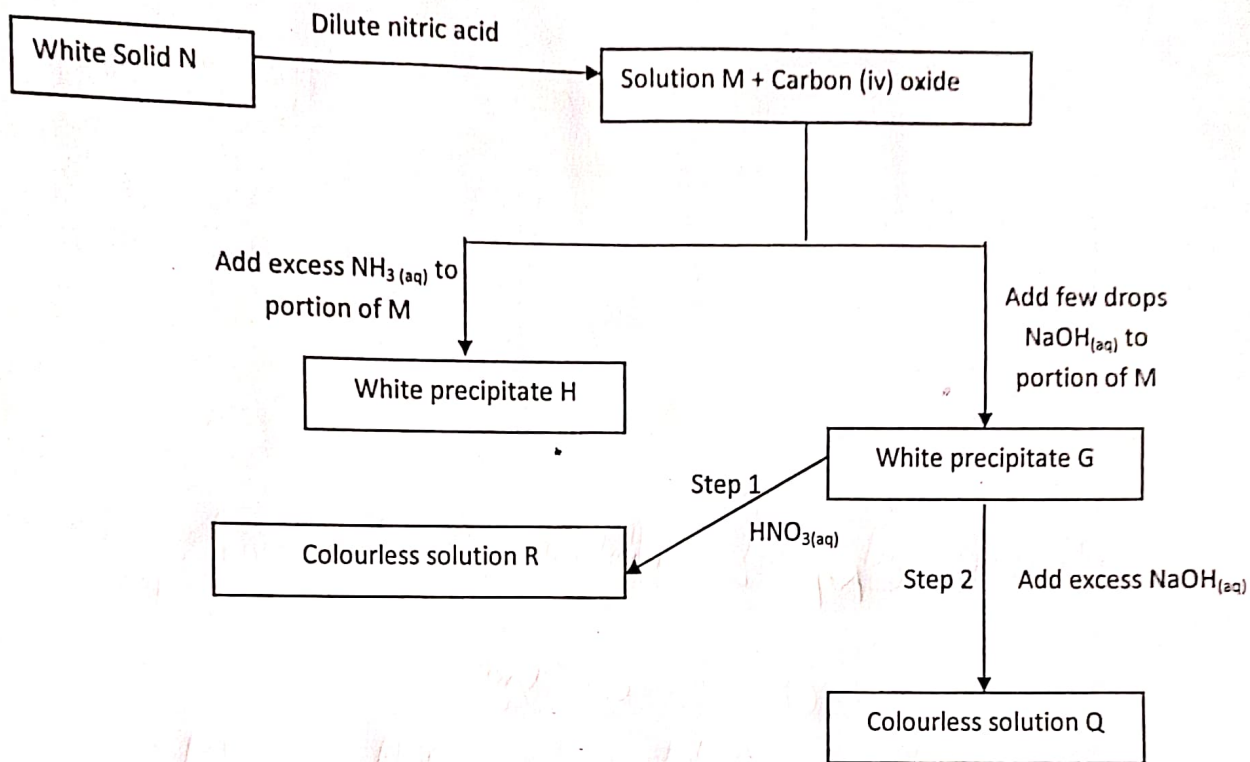
Calculate the empirical formula of the oxide of Iron. (Fe = 56; O = 16.) (3mks)

Element	Fe	O
Mass	1.68	0.64
Atom	56	16
mole	$\frac{1.68}{56} = 0.03$	$\frac{0.64}{16} = 0.04$
mole ratio	$\left(\frac{0.03}{0.03} = 1\right)$	$\left(\frac{0.04}{0.03} = 1.33\right)$
	3	4

Empirical formula



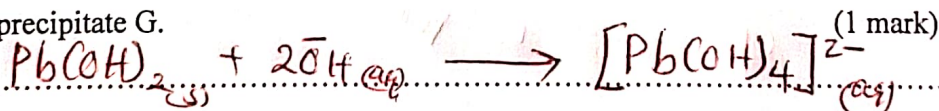
23. Study the flow chart below and answer the questions that follow.



a) Identify solid N

Lead (II) Carbonate // $PbCO_3$ (1 mark)

b) Write down the equation for the reaction that leads to the formation of solution Q from the white precipitate G.



c) State the property of precipitate G that is demonstrated by step 1 and 2. (1 mark)

Amphoteric

24. The table below shows physical properties of some substances. Use the information in the table to answer the questions that follow.

Substance	Melting Point $^{\circ}\text{C}$	Boiling Point $^{\circ}\text{C}$	Electrical conductivity	
			Solid	Liquid
M	1083	2595	Good	Good
N	801	1413	Poor	Good
O	5.5	80.1	Poor	Poor
P	-114.8	-84.9	Poor	Poor
Q	3350	4827	Poor	Poor

Which substance is likely to be

(I) a Metal?

M ✓ 1/2mk

(1/2mk)

(II) a Liquid at room temperature?

O ✓ 1/2mk

(1/2mk)

Which substance is likely to have the following structures

(I) Simple molecular?

P ✓ 1mk

(1mk)

(II) Giant atomic?

Q ✓ 1mk

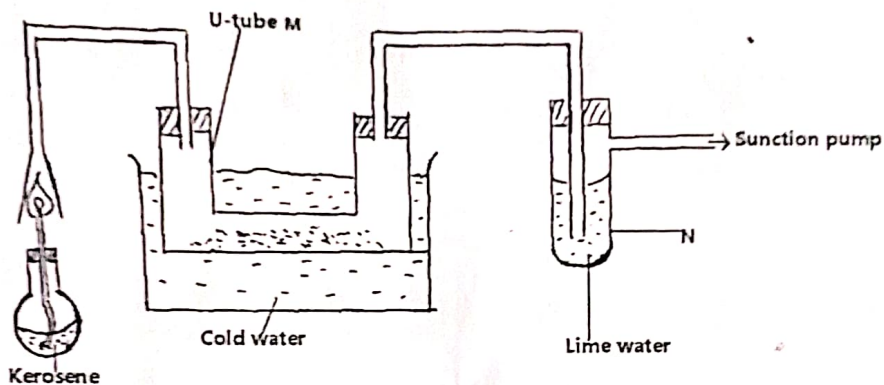
(1mk)

25. A mixture contains Iron (III) Chloride, calcium chloride and iron filings. Describe how one can separate and recover the substances in the mixture. (3marks)

Into a glass beaker covered with evaporating dish with cold water, heat the mixture to collect Iron (III) chloride as a sublimate, pass a bar magnet over the remaining mixture to collect iron filings and remain with calcium chloride ✓ 3mk

Key The two process are independent
ie sublimation can be done before
or after use of magnet.

26. The diagram below represents a set-up that was used to collect the products of burning kerosene.



(a) Describe a chemical test for substance in M (1mk)

- ✓ Changes blue anhydrous Cobalt (II) chloride Pink
- ✓ Changes white anhydrous Copper (II) Sulphate blue

Any one ✓ 1mk

(c) What observation would be made in N? Explain your answer (2mks)

- white precipitate dissolve after a while to form a colourless solution. ✓ 1mk
 Lime water react with CO_2 to form insoluble CaCO_3 which dissolve in excess forming soluble $\text{Ca}(\text{HCO}_3)_2$ (aq) ✓ 1mk

27. Element K has two isotopes ^{20}K and ^{22}K with relative abundance of 90% and 10% respectively.

a) What are isotopes? (1 mark)

Atoms of the same element with the same atomic number but different mass number ✓ 1 mark

b) Determine the relative atomic mass of element K. (2 marks)

$$\begin{aligned}
 \text{RAM} &= \frac{20 \times 90 + 22 \times 10}{100} = \frac{1800 + 220}{100} \\
 &= \frac{2020}{100} = 20.20 \quad \checkmark \quad 1\text{mk}
 \end{aligned}$$