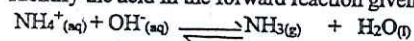


1. a) State and explain the observation made when sodium carbonate powder is added to Aluminum Chloride solution. (2 marks)

Effervescence of a colourless gas; sodium carbonate dissolves; colourless solution formed
 $AlCl_3$ is hydrolysed in water forming an acidic solution

- b) Identify the acid in the forward reaction given the equation below explain. (1 mark)

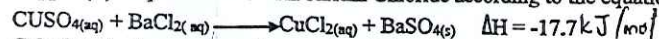


NH_4^+ proton donor

2. Describe how you would prepare a sample of Barium Sulphate using the following reagents; Dilute Sulphuric (VI) acid, dilute Hydrochloric acid and Barium Carbonate. (3 marks)

Add excess $BaCO_3(s)$ to dil. HCl while stirring. Filter to obtain $BaCl_2(aq)$ as filtrate.
 Add $BaCl_2(aq)$ to $H_2SO_4(aq)$. Filter to obtain $BaSO_4(s)$ as residue.
 Rinse with distilled water and dry between filter papers.

3. Copper (II) Sulphate reacts with barium Chloride according to the equation below.



Calculate the temperature change when 900 cm³ of 1M copper(II) Sulphate is added to 600 cm³ of 1M barium Chloride. (C=4.2 J K⁻¹, density of solution 1g/cm³) (3 marks)

$CuSO_4$ is in excess.
 Moles of $BaCl_2 = \frac{600 \times 1}{1000} = 0.6 mol$
 $1000 \times 10.62 = 1500 \times 4.2 \times \Delta T$
 $\Delta T = 1.7 K$
 Heat evolved = $0.6 \times 17.7 = 10.62 kJ$
 Temperature rose 1.7°C

4. An element T forms a divalent cation with electronic arrangement of 2,8,8.

- a) i) To what period does it belong? (1 mark)

4

Name Class Adm. No.

233/1
 CHEMISTRY
 THEORY
 PAPER 1
 TIME 2 HOURS



ALLIANCE HIGH SCHOOL
 KENYA CERTIFICATE OF SECONDARY EDUCATION
 TRIAL EXAM SEPTEMBER 2022
 CHEMISTRY PAPER 1

Instructions

- Write your name and index number in the spaces provided above
- Answer ALL the questions in the spaces provided.
- Mathematical tables and electronic calculators may be used.
- All working must be clearly shown where necessary.
- This paper consists of 11 printed pages

For Examiner's Use Only

Question	Maximum score	Candidate's score
1-27	80	

a) Define basicity. (1 mark)
 The number of replaceable hydrogen atoms per molecule of an acid.

b) Propose an explanation for the observations made. (1 1/2 mks)
 L - a weak acid, higher concentration of H⁺ ions faster rate of reaction. M is a strong acid.

c) Give one possible identity of M. (1/2 mk)
 HCl, H₂SO₄, HNO₃

7. An organic compound N with the molecular formula C₄H₁₀O reacted with a piece of sodium metal to produce hydrogen gas and a colourless solution.

a) To which homologous series does N belong? (1 mark)
 Alkanols

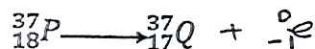
b) State the observations made. (1 mark)
 Na₂ sinks to the bottom. Colourless gas bubbles produced.

c) Write a chemical equation for the reaction that occurred. (1 mark)
 $2C_4H_9OH + 2Na \rightarrow 2C_4H_9ONa + H_2$

8. 48cm³ of methane was ignited with 212cm³ of oxygen and the mixture allowed to attain room temperature. Determine the total volume of the resultant gaseous mixture. (3 marks)

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
 48cm³ 96cm³ 48cm³
 Excess O₂ = 212 - 96 = 116cm³
 Total = 48 + 116 = 164cm³

a) Complete the nuclear equation for the reaction below. (1 mark)



b) i) State one use of radioisotopes in agriculture. (1 mark)

Radioactive P-32 to determine rate of absorption of phosphate fertilizer.
 Radioactive C-14 used in monitoring photosynthesis.

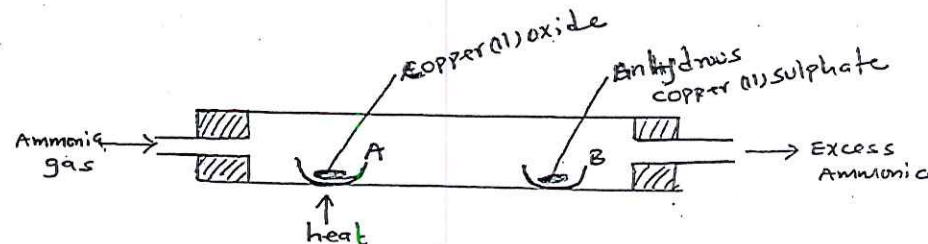
ii) Name the chemical family to which it belongs. (1 mark)

Alkaline earth metals ✓

b) Write the formula of its Nitride. (1 mark)

T₃N₂ ✓

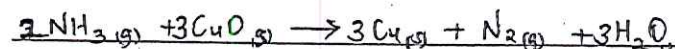
5. The set-up below was used to investigate a property of ammonia gas.



a) Explain the observation made at B. (2 marks)

White powder changes to blue crystals.
 Water formed changes anhydrous copper(II) sulphate to hydrated copper(II) sulphate.

b) Write the chemical equation for the reaction at A. (1 mark)



6. Barium Sulphite was added to Equal volumes of equimolar monobasic acids L and M in separate test tubes.

The table below shows the volumes of gas produced after sometime.

Acid	Volume of gas (cm ³)
L	4
M	10

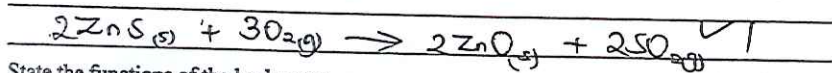
a) Name and write the formula of the chief ore. (1 mark)

Zinc blende \checkmark_2
ZnS \checkmark_2

b) Identify A and B. (1 mark)

A - $\text{SO}_2(\text{g})$ \checkmark_2
B - Coke and limestone \checkmark_2

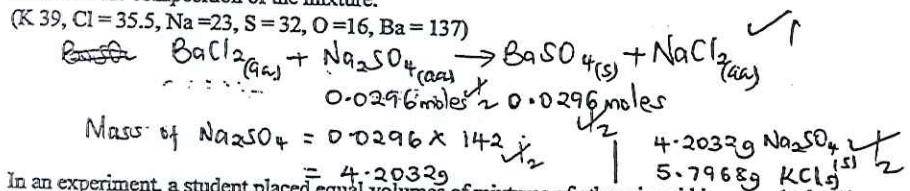
c) Write the equation for the reaction in the roasting furnace. (1 mark)



d) State the functions of the lead spray. (1 mark)

- Cools zinc vapour, to condense to Zn(l) \checkmark_2
- Prevents the Zn from being re-oxidised. \checkmark_2

13. When 10g of a mixture of potassium chloride and anhydrous sodium sulphate is dissolved in water and excess barium chloride solution added. 6.9g of barium sulphate is precipitated. Calculate the composition of the mixture.

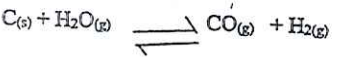


14. In an experiment, a student placed equal volumes of mixtures of ethanoic acid in water (tube A) and ethanoic acid in hexane (tube B). In each test tube, 1g of solid sodium hydrogen carbonate was added. State and explain the observations made. (2 marks)

Tube A \rightarrow Colourless gas bubbles, white solid dissolves to form colourless solution. Acid ionises in water $\rightarrow \text{H}^+(\text{aq})$ \checkmark_2

Tube B \rightarrow No effervescence, white solid does not dissolve. Acid does not ionise in hexane, No $\text{H}^+(\text{aq})$ \checkmark_2

15. The following reaction is in equilibrium in a closed system.



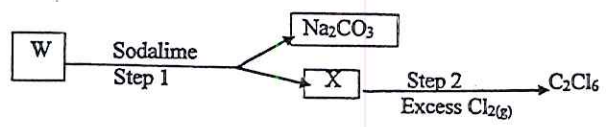
a) What is a chemical equilibrium? (1 mark)

A state of a closed chemical system in which the rate at which reactants are converted to products equals the rate at which products are converted to reactants. \checkmark_2

ii) Give one danger associated with exposure of humans to radioisopes. (1 mark)

Gene mutation, cancer, death \checkmark_1

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



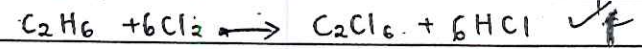
a) Identify the type of reaction in step 1. Decarboxylation \checkmark_2 (1/2 mark)

b) Identify W Sodium propanoate \checkmark_2 (1 mark)

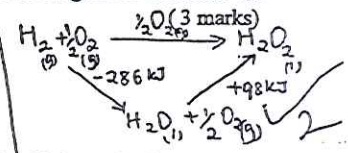
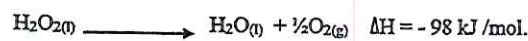
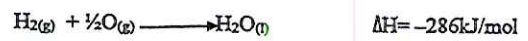
X Ethane \checkmark_2

c) State the condition necessary in step 2 and write the equation for the reaction that occurs (1 1/2 marks)

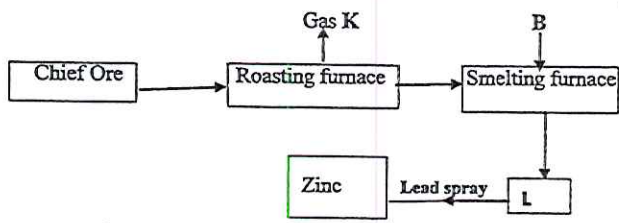
v-v light \checkmark_2



11. Given the following thermochemical equations, use an energy level diagram to determine the enthalpy of formation of hydrogen peroxide.



12. The flow chart below shows the extraction of Zinc metal from its chief ore. Study the flow chart and answer the questions that follow.



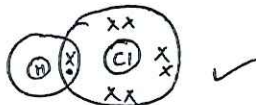
$$\Delta H_f(\text{H}_2\text{O}_2) = (-286) + (+98) = -188 \text{ kJ/mol} \checkmark_2$$

18. The table below shows properties of some chlorides. Study it and answer the questions that follow.

Chloride	Mpt (°C)	Bpt (°C)	Electrical conductivity in aqueous solution	pH of solution
AlCl ₃	-	183	Good	3
NaCl	860	1420	Good	7
PCl ₅	32	75	Good	3
HCl	-146	-29	Good	1

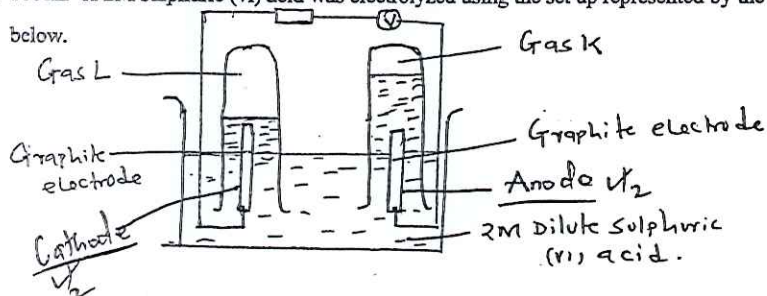
19. a) Explain the high melting and boiling points of sodium chloride. (1 mark)
Giant ionic structure with strong ionic bonds.

- b) Draw the dot (.) and cross (x) diagram to show the bonding in HCl. (1 mark)



- c) Explain the electrical conductivity of the aqueous solutions. (1 mark)
Mobile ions

20. 100cm³ of 2M sulphuric (vi) acid was electrolyzed using the set up represented by the diagram below.



- a) Label the anode and the cathode. (1 mark)

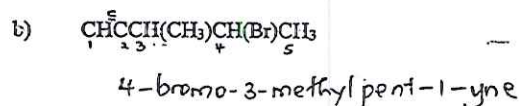
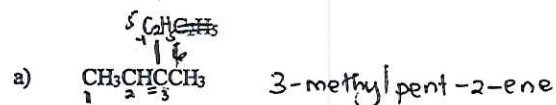
- b) State Le Chatelier's Principle. (1 mark)

When a change in condition is applied to a system in equilibrium, the system moves so as to oppose the change.

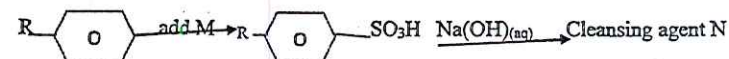
- c) Explain how an increase in pressure would affect the amount of hydrogen gas in the system. (1 mark)

Reduces; reverse reaction produces fewer moles of gas and is favoured.

16. Give the IUPAC names of the following. (3 marks)



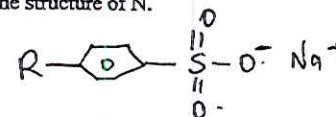
17. The scheme below represents the manufacture of a cleansing agent N.



- a) Name reagent M. Concentrated sulphuric (vi) acid (½ mark)

- b) What type of cleansing agent is N. Sapless detergent (½ mark)

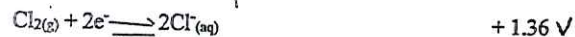
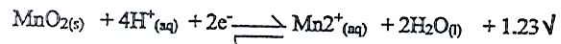
- c) Draw the structure of N. (1 mark)



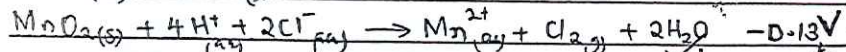
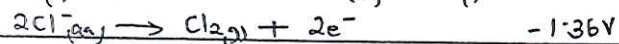
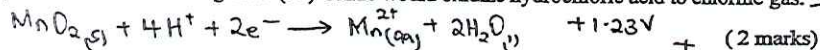
- d) State one advantage of using N as a cleansing agent. (1 mark)

lathers readily with both soft and hard water

23. Below is a list of standard reduction potentials for two half-cells in acidic conditions. Use them to answer the questions that follow.



Predict whether manganese (IV) Oxide would oxidize hydrochloric acid to chlorine gas. NO ✓

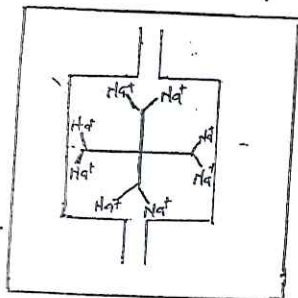


24. Sulphur (IV) Oxide gas was bubbled into water containing litmus solution.

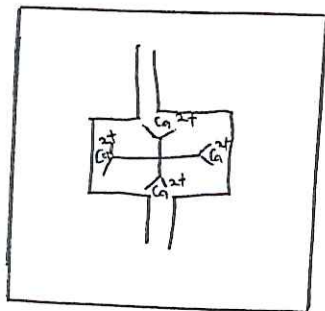
i) State the observation made. (1 mark)

ii) Explain the observation in (i) above with the Grid of equations. (2 marks)

25. Ion exchange is a method used to remove water hardness. Study the diagram below and answer the questions that follow.



Card A: ion exchange
Column before hard
Water is passed through

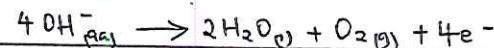


Card B: ion exchange column
after hard water is passed
through

a) What causes water hardness (1 mark)

Presence of Mg²⁺ or Ca²⁺ ions.

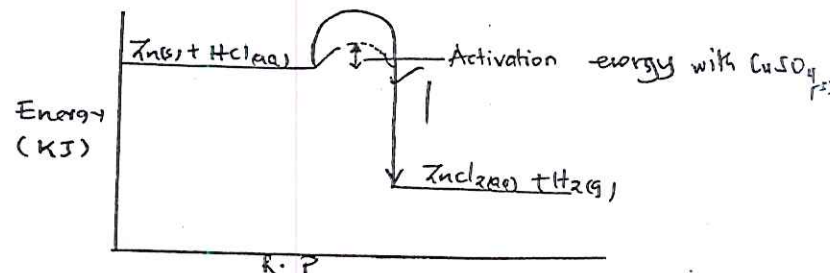
b) Write the equation for the reaction at the anode. (1 mark)



c) Comment on the concentration of the electrolyte as electrolysis continues. (1 mark)

Increases, 2H⁺ and OH⁻ from water are discharged.

21. The diagram below is a sketch of the energy level diagram of the non-catalyzed reaction of zinc powder with dilute hydrochloric acid.



a) State whether the reaction above is exothermic or endothermic. (1 mark)

Exothermic

b) i) On the same axis, sketch the graph for the reaction when copper (II) Sulphate crystals are added. Explain. (2 marks)

Catalyst provides alternative route that requires lower activation energy.

22. a) State Graham's Law of diffusion. Under the same conditions of temperature and pressure, the rate of diffusion of a gas is inversely proportional to the square root of its density. (1 mark)

b) 100cm³ of Sulphur (IV) Oxide takes 20 seconds to diffuse through a porous plate. What volume of oxygen gas would diffuse through the same plate in 30 seconds under similar conditions. (S=32, O=16) (2 marks)

$$\frac{R_{\text{SO}_2}}{R_{\text{O}_2}} = \sqrt{\frac{M_{\text{O}_2}}{M_{\text{SO}_2}}}$$

$$\frac{100/20}{R_{\text{O}_2}} = \sqrt{\frac{32}{64}}$$

$$R_{\text{O}_2} = \frac{100 \times 2}{\sqrt{2}} = 70.71 \text{ cm}^3/\text{s}$$

$$70.71 \times 30 = 212.13 \text{ cm}^3$$

- b) Fill in carb B. (1 mark)
- c) Other than Ion exchange, state two methods used to remove both temporary and permanent water hardness. (1 mark)
- 1. Distillation 2. Addition of Na_2CO_3

26. a) Describe how carbon (IV) Oxide can be distinguished from carbon (II) Oxide using calcium hydroxide solution. (2 marks)

Bubble the gases into CaOH_2 in separate boiling tubes.

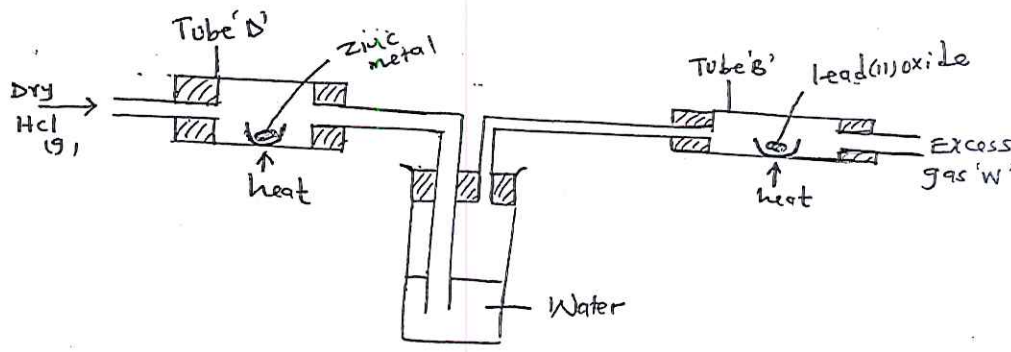
$\text{CO}_2 \rightarrow$ white precipitate ✓

$\text{CO} \rightarrow$ No white precipitate. ✓

b) What is the role of carbon (IV) Oxide in fire extinguishing. (1 mark)

Denser than air, covers the fire cutting off oxygen supply.

27. In an experiment, dry hydrogen chloride gas was passed through heated zinc turnings as shown in the diagram below. The gas produced was then passed through heated lead (II) Oxide.



i) State the function of the water in the flask. (1 mark)

To absorb excess HCl(g) ✓

ii) Write the equations for the reactions that took place in tube D and B. (2 marks)

Tube D $\rightarrow 2\text{HCl(g)} + \text{Zn(s)} \rightarrow \text{H}_2\text{(g)} + \text{ZnCl}_2\text{(s)}$ ✓

B $\text{PbO(s)} + \text{H}_2\text{(g)} \rightarrow \text{Pb(s)} + \text{H}_2\text{O(l)}$ ✓