FORM FOUR CHEMISTRY TOPICAL QUESTIONS



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ACIDS, BASES AND SALTS

1. Study the reaction below and answer the questions that follow

$$NH_{3\,(g)} + H_2O_{\,(l)} \rightarrow NH_4^{+}{}_{(aq)} + OH^{-}{}_{(aq)}$$

(a) Define the term acid

(b) Identify an acid in the above reaction

(c) Explain your answers in (b) above

2. A student mixed equal volumes of Ethanol and butanoic acid. He added a few drops of concentrated Sulphuric (VI) acid and warmed the mixture

(i) Name and write the formula of the main products

Name

Formula

(ii) Which homologous series does the product named in (i) above belong?

3. A sample of water from a village in Trans Mara East District was divided into equal Portions and each mixed with equal volume of soap solution. The observations made are tabulated below:

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Sample of water	Treatment before adding soap	Observations made on shaking with soap
I	Boiled	Lather form immediately
II	No treatment	Slight lather form slowly
III	Treatment with washing soda	Lather formed immediately

(a) What type of hardness is present in water from the village. Explain

(b) State **one** advantage of hard water

4. The solubility of Iron (II) Sulphate crystals are 22^{o}C is 15.65g per 100g of water. Calculate the mass of iron(II) sulphate crystals in 45g of saturated solution at the same temperature

5. Hardness of water may be removed by either boiling or addition of chemicals:

(a) Write an equation to show how boiling removes hardness of water

(b) Name **two** chemicals that are used to remove hardness of water

6. State **one** advantage of drinking hard water rather than soft water.

7 Given this reaction

$$RNH_2 + H_2O \rightarrow RNH_3^+ + OH^-$$

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a) Identify the acid in the forward reaction. Explain

b) Dilute nitric acid can react with a solution of sodium carbonate. Write an ionic equation for the reaction

8. Magnesium hydrogen carbonate is responsible for the temporary hardness of water. This type of hardness can be removed by addition of ammonia solution

(a) Describe how temporarily hard water is formed

b) Write an equation to show the softening of temporarily hard water by the addition of aqueous ammonium solution

9. When 2M potassium hydroxide solution was added to solution **R**, a white precipitate **T** was formed which dissolved in excess potassium hydroxide solution to form solution **L** solution **R** forms a white precipitate with sodium chloride solution:

(a) Identify the cation in solution **R**

(b) Name precipitate **T** .

(c) Write the molecular formula of the compound in solution **L**

10. Below is a table showing the solubilities of salts **Q** and **R** at different temperatures.

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Temperature ^oC		0	10	20	30	40	50
Solubilities in grammes per 100g of water	Salt **Q**	3.0	5.0	7.4	10.0	14.0	19.0
	Salt **R**	15.0	17.0	20.7	25.7	28.7	33.0

(a) Define the term "Solubility of salt"

(b) If both salts **Q** and **R** are present in 100cm^3 of saturated solution at 50^{o}C, what will be the total mass of crystals formed if the solution was cooled to 20^{o}C?

11. The following results were obtained during an experiment to determine the solubility of potassium chlorate(V)in water at 30^{o}C.

Mass of evaporating dish =15.86g

Mass of evaporating dish + saturated solution at 30^{o}C = 26.8g

Mass of evaporation dish +solid potassium chlorate (v) after evaporation to dryness=16.86g

Calculate the mass of the saturated solution containing 60.0g of water at 30^{o}C

12. (a) What is meant by the term solubility of salts?

(b) Calculate the solubility of salt given that 15g of the salt can saturate 25cm^3 of water

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(c) The table below gives the solubility of salt **X** in grams per 100g of water at different temperatures

Temp ^oC	10	20	30	40	50	60	70	80	90	100
Solubility (g/100g) water	5.0	7.5	10.5	14.0	18.5	24.0	30.0	38.0	46.0	50.1

(i) Plot a solubility curve for salt **X** (solubility in g /100g water Y- axis) (temp ^oC (X –axis)

(ii) What is meant by the points plotted in (i) above?

(iii) From your graph determine the solubility of salt **X** at the following temperatures

I 44^oC

II 62^oC .

(iv) What mass of crystals of the salt will be formed if the solution was cooled from 62^oC to 44^oC

(v) Name **two** areas where knowledge of solubility curves is applied

13. You are given a mixture of Lead (II) Chloride, Iodine, ammonium chloride and sodium Chloride. Explain how you would separate all the four solids using methylbenzene, a source of heat and water

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14. (a) The table below shows the solubility of potassium chlorate at different temperatures

Temperature (^oC)	10^o	20^o	30^o	40^o	50^o	60^o	70^o
Solubility g/100g water	27	30	36	55	80	110	140

(i) Plot a graph of solubilities of potassium chlorate against temperature

(ii) Using your graph:

(I) Determine the solubility of potassium chlorate at 47^oC

(II) Determine the concentration in moles per litre of potassium chlorate at 47^oC (K= 39, Cl = 35.5, O= 16) density of solution = $1g/cm^{3)}$

(III) Determine the mass of potassium chlorate that would crystallize if the solution is cooled from 62^oC to 45^oC

(b) In an experiment to determine the solubility of sodium hydroxide, $25cm^3$ of a saturated solution of sodium hydroxide weighing 28g was diluted in a volumetric flask and the volume made to $250cm^3$ mark. $20cm^3$ of this reacted completely with $25cm^3$ of 0.2M hydrochloric acid according to the equation.

$$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

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Calculate:

(i) The number of moles of hyrdrochloric acid used

(ii) The number of moles of sodium hydroxide in $20cm^3$

(iii) The moles of sodium hydroxide in $250cm^3$ of solution

(iv) The mass in grams of sodium hydroxide in $250cm^3$ of solution

(v) The solubility of sodium hydroxide in g/100g water

15. a) Define the **term solubility of a substance**

b) The table below shows the solubilities of two salts **L** and **M** at different temperatures.

Temperature(°C)		10	20	30	40	50
Solubility in g/100g of water.	**L**	11.0	14.0	20.1	28.0	36.0
	M	15.0	17.0	19.0	21.2	25.0

i) Name the method that can be used to separate the two salts

ii) Plot on the same axes a graph of solubilities of **L** and **M** against temperature

iii) From the graph determine:-

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The temperature at which solubilities are equal

The solubility at the temperature mentioned above

iv) If the relative formula mass of **M** is 132, determine the concentration of **M in** moles per litre in **(iii)** II above

16. A compound whose general formula is $M[OH]_3$ reacts as shown by the equation shown below

$$M(OH)_3(s) + OH_4^-(aq) \rightarrow M(OH)_4^-(aq)$$

$$M(OH)_3(s) + 3H^+(aq) \rightarrow M^{3+}(aq) + 3H_2O(l)$$

[a]What name is given to compounds which behave like $M[OH]_3$ in the two reactions

[b]Name two elements whose hydroxides behave like that of M

[c]The hardness of water may be removed by either boiling or addition of chemicals

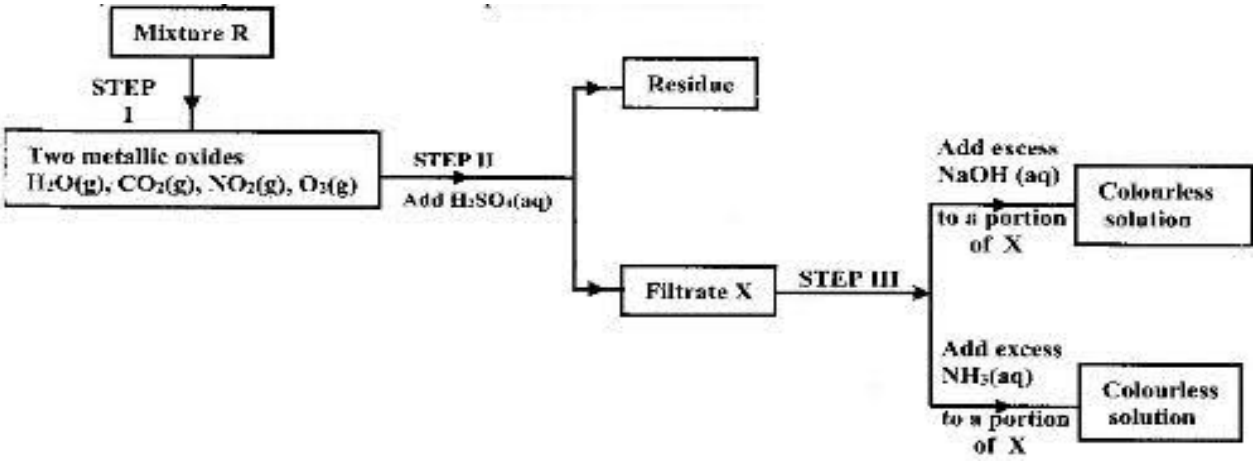
[i] Write an equation to show how boiling removes hardness of Water

[ii]Name two chemicals that are used to remove hardness of water

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17. The flow charts below show an analysis of a mixture **R** that contains two salts. Study the analysis and answer the questions that follow:-

(a)



(i) State:-

(I) The condition in **step I**

(II) The process in **step II**

(ii) A small portion of mixture **R** is added to dilute nitric (V) acid in a test-tube. What would be observed?

(iii) Write an equation for the reaction between the cation in filtrate **X** and sodium hydroxide solution

(iv) Explain how water vapour in **step I** could be identified

(b) (i) State and explain the conclusion that can be made from **step IV** only

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(ii) Name the anion present in residue **U**. Explain

(iii) From the flow chart in **(a)** and **(b);**

(I) Write the formulae of cations present in mixture **R**

18. a) Define the term solubility of a substance.

b) The table below shows the solubilities of two salts **L** and **M** at different temperatures.

Temperature (ºC)	**Type of salt**	10	20	30	40	50
Solubility g/100g of water	**L**	11.0	14.0	20.1	28.0	36.0
	M	15.0	17.0	19.0	21.2	25.0

(i) Name the method that can be used to separate the two salts.

(ii) Plot on the same axes a graph of solubilities of **L** and **M** against temperature

(iii) From the graph, determine:

I. The temperatures at which solubilities are equal

II. The solubility at the temperature mentioned above

(iv) If the relative formula mass of **M** is 132, determine the concentration of

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M in moles per litre in (**iii**) II above.

v) A solution contains 38g of **L** and 22g of **M** at 50°C. Calculate the total mass of crystals obtained in cooling this solution to 30°C.

19. a) Define:

(i) A saturated solution.

(ii) Solubility of a solute.

b) In an experiment to determine solubility of sodium chloride, 10.0 cm^3 of a saturated solution of sodium chloride weighing 10.70g were placed in a volumetric flask and diluted to a total of cm^3. 25.0 cm^3 of the diluted solution of sodium chloride reacted completely with 24.0 cm^3 of 0.1M silver nitrate solution. The equation for the reaction is

$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

I. Calculate;

(i) Moles of silver nitrate in 24.0 cm^3 of solution.

(ii) Moles of NaCl in 25.0 cm^3 of solution.

(iii) Moles of NaCl in 500 cm^3 of solution.

(iv) Mass of NaCl in 10.0 cm^3 of saturated sodium chloride (Na = 23, Cl = 35.5)

(v) Mass of water in 10.0cm^3 of saturated solution.

(vi) The solubility of NaCl in g/100g of waters.

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20. Describe how you would prepare a dry sample of crystals of potassium sulphate starting with $100cm^3$ of 1M sulphuric (VI) acid.

21. The table shows solubility of potassium chlorate **V**

Temp (^oC)	45^oC	80^o
Solubility	39	63

(a) Calculate the mass of solute and solvent in 90g of the saturated solution of the salt at 45^oC

(b) A solution of the salt in 100g water contains 63g at 95^oC. At what temperature will the solution start forming crystals when cooled

22. Two samples of hard water **C** and **D** were boiled. When tested with drops of soap, sample **D** formed lather easily while **C** did not:-

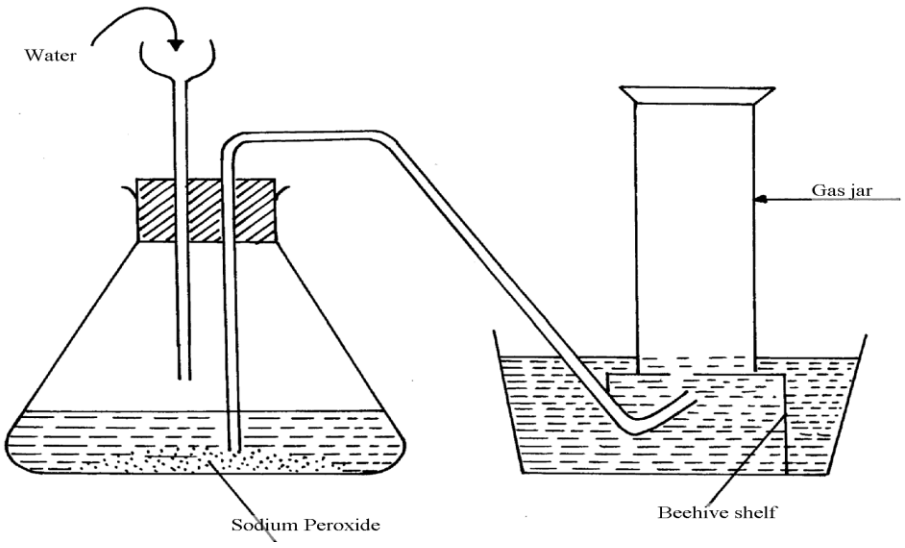
(a) Name the possible salt that caused hardness in sample **D**

(b) Explain how distillation can remove hardness in sample **C**

(c) Give **one** advantage of hard water

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23. A student attempted to prepare a gas using the set-up below. She could not collect any gas



(a) Give **two** reasons why no gas was collected

(b) Which gas did the student intend to prepare?

24. Water from a town in Kenya is suspected to contain chloride ions but not sulphate ions.

(a) Describe how the presence of chloride ions in the water can be shown

(b) State **one** advantage of drinking hard water rather than soft water

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25. Study the following tests and observation and answer the questions that follow:-

	TEST	**OBSERVATION**
I	- Add few drops of acqueous ammonia to copper (II) nitrate solution	- Light blue precipitate is formed
II	- Add excess of ammonia to copper (II) nitrate	- Deep blue solution
III	- Add cold dilute hydrochloric acid to substance E1 and warm gently	- Gas evolved, smells of rotten eggs and blackens lead acetate paper

Identify:-

(a) Substance responsible for:

I. Light blue precipitate

II. Deep blue solution

(b) Gas evolved in **test III** above

26. (i) What is meant by the term solubility of salts?

(ii) Calculate the solubility of a salt given that 15g of the salt can saturate 25cm^3 of water.

27. (a) Draw a well labeled diagram to show how to prepare an acqueous solution of hydrogen chloride gas

(b) Name **one** other gas whose aqueous solution can be prepared in the same way

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28. In an experiment to determine the solubility of solid Y in water at 30°C the following results were obtained;

MAT

Mass of empty evaporating dish = 26.2g

Mass of evaporating dish + saturated solution = 42.4g

Mass of evaporating dish + dry solid Y = 30.4g

(a) Use the data to calculate the solubility of solid **Y** at 30°C

(b) State **one** application of solubility curves and values

29. Study the table below showing the solubility of substance **K** at various temperatures

Temperature (°C)	**Solubility (g/100g water)**
0	30
30	24
70	19
100	14

(a) What would happen if a sample of a saturated solution of the substance at 30°C is heated to 70°C. Explain.

(b) What is the most likely state of substance **K**

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30. In the equilibrium given below:-

$Fe^{3+}_{(aq)} + SCN_{(aq)} \rightarrow [Fe(SCN)]^{2+}_{(aq)}$

Brown Red

What would be observed when Iron (III) Chloride is added to the equilibrium mixture.

Explain

31. Sodium Carbonate Decahydrate crystals were left exposed on a watch glass for two days.

a) State the observations made on the crystals after two days.

b) Name the property of salts investigated in the above experiment

32. The label on a bottle of mineral; water had the information below.

Ions present	**Concentration (g/litre)**
Ca^{2+}	0.10
Mg^{2+}	0.20
Na+	0.01
K+	0.01
SO_4^{2-}	0.14
HCO_3^-	0.26

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(a) Name the compound that causes temporary hardness in the mineral water.

(b) Using an equation, describe how the water can be made soft by adding sodium carbonate solution.

(c) Give **one** advantage of drinking mineral water such as the one above

33. A solution of hydrogen chloride gas in methylbenzene has no effect on calcium carbonate. A solution of hydrogen chloride in water reacts with calcium carbonate to produce a gas. Explain

34 (i) Is concentrated sulphuric acid a weak acid or a strong acid?

(ii) Explain your answer in (i) above.

35. When water reacts with potassium metal the hydrogen produced ignites explosively on the surface of water.

(i) What causes this ignition?

(ii) Write an equation to show how this ignition occurs

36. In an experiment, soap solution was added to three samples of water. The results below show the volume of soap solution required to lather with 500cm3 of each water sample before and after boiling

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	Sample 1	**Sample 2**	**Sample3**
Volume of soap used before water boiled	26.0	14.0	4.0
Volume of soap after water boiled	26.0	4.0	4.0

(i) Which water samples are likely to be soft?

(ii) Explain the change in volume of soap solution used in sample 2

37. How does the pH value of 0.25M $KOH_{(aq)}$ compare with that of 0.25M ammonia solution

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ENERGY CHANGES IN PHYSICAL AND CHEMICAL PROCESSES

1. 6g of Potassium nitrate solid was added to 120cm^3 of water in a plastic beaker. The mixture was stirred gently and the following results were obtained.

   Initial temperature = 21.5^{o}C

   Final temperature = 17.0 ^{o}C

   (a) Calculate the enthalpy change for the reaction

   (Density =1g/cm^3, C= 4.2jg^{-1}K^{-1})

   (b) Calculate the molar enthalpy change for the dissolution of potassium nitrate

   (K=39, N= 14, O =16)

2. (a) The heat of combustion of ethanol, C_2H_5OH is 1370KJ/mole.

   (i) What is meant by heat of combustion?

   (ii) Calculate the heating value of ethanol

   (H = 1.0, C = 12.0, O = 16.0)

3. Use the information below to answer the questions that follow:-

   $Ca_{(s)} + ½\ O_{2(g)} \longrightarrow CaO_{(s)}$ ΔH =-635KJ/mol

   $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ ΔH= -394KJ/mol

   $Ca_{(s)} + C_{(s)} + {}^3/_2O_{2(g)} \longrightarrow CaCO_3$ ΔH = -1207KJ/mol

   Calculate the enthalpy change for the reaction:

   $Ca_{(s)} + CO_{2(g)} \longrightarrow CaCO_{3(s)}$

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4. 0.92g of ethanol were found to burn in excess air producing a temperature rise of 32.5ºC in 200cm^3 of water. C=12.0 H=1.0 O=16.0

Density of water 1g/cm^3

Specific heat capacity of water 4.2kj $kg^{-1}k^{-1}$

a) Write the equation for combustion of ethanol

b) Determine the molar heat of combustion of ethanol

5. Study the information in the following table and answer the questions that follow. The Letters do not represent the actual chemical symbols of the elements.

ELEMENT	**U**	**V**	**W**	**X**	**Y**	**Z**
NUMBER OF PROTONS	18	20	6	16	19	17
NUMBER OF NEUTRONS	22	20	8	16	20	20

Which of the above elements are:

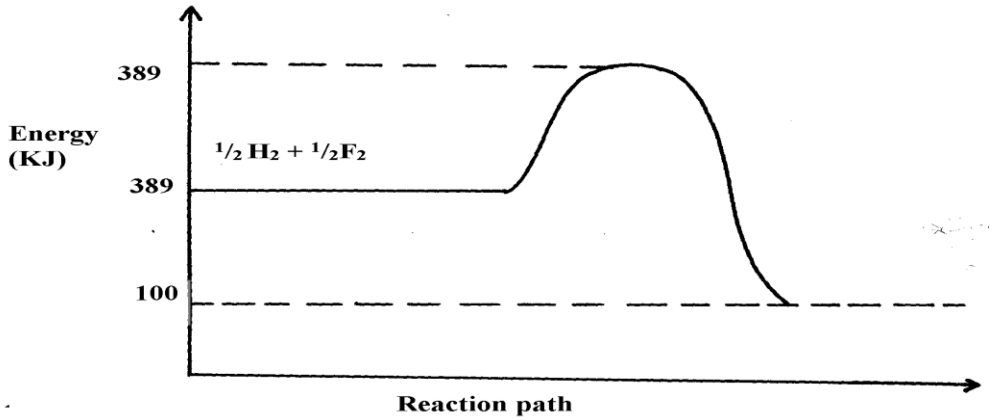
(i) Likely to be radioactive?

(ii) Able to form a compound with the highest ionic character?

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6. The diagram below shows energy levels for the reaction

$\frac{1}{2} H_{2(g)} + \frac{1}{2} F_{2(g)} \quad HF_{(g)}$



(a) Work out the activation energy for the reaction

(b) Calculate the heat of formation of **HF**

(c) Is the reaction endothermic or exothermic?

7. Using the heats of combustion of the following substances, calculate the heat of formation of ethanol

$C_{(s)} + O_{2\,(g)} \rightarrow CO_{2\,(g)}$; $\Delta H = -393 KJmol^{-1}$

$H_{2\,(g)} + \frac{1}{2} O_{2\,(g)} \rightarrow H_2O_{(l)}$; $\Delta H = -286 KJmol^{-1}$

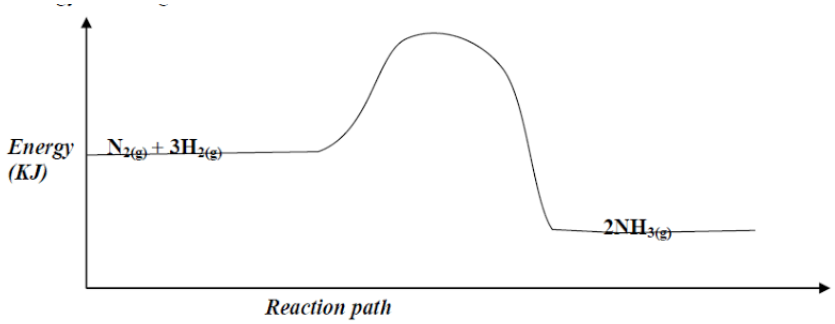
$CH_3CH_2OH_{(l)} + O_{2\,(g)} \rightarrow 2CO_{2\,(g)} + 3H_2O_{\,(l)}$; $\Delta H = 1386 KJmol^{-1}$

8. Nitrogen and hydrogen react reversibly according to the equation:-

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g);}\ {}_{\Delta}H = -92 kjmol^{-1}$

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The energy level diagram for the above reaction is shown below:-



(a) How would the yield of ammonia be affected by:

(i) A decrease in temperature

(ii) An increase in pressure

(b) How does a catalyst affect reversible reaction already in equilibrium?

(c) On the above diagram, sketch the energy level diagram that would be obtained when iron catalyst is added to the reaction

9. Study the table below and answer the questions that follow

Bond type	**bond energy kJmol^{-1}**
C-C	346
C = C	610
C-H	413
C-Br	280
Br-Br	193

a) Calculate the enthalpy change for the following reaction

$C_2H_{4(g)} + Br_{2(g)} \rightarrow C_2H_4Br_{2(g)}$

b) Name the type of reaction that took place in **(a)** above

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10. Bond energies for some bonds are tabulated below:-

BOND	BOND ENERGY KJ/mol
H – H	436
C = C	610
C- H	410
C - C	345

Use the bond energies to estimate the enthalpy for the reaction

$C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_{6(g)}$

11. The able shows the results obtained when 20.2g of potassium nitrate was added in $50cm^3$ of water.

Time in (min)	0.0	0.3	1.0	1.3	2.0	2.3	3.0	3.3	4.0
Temperature (^oC)	25.0	25.0	25.0	25.0	17.0	17.0	20.0	20.0	20.0

(i) Draw the graph of temperature against time

(ii) Using the graph, determine the temperature change

(iii) Calculate the heat change

(iv) Find the molar heat of solution of potassium nitrate

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12. When 1.6g of ammonium nitrate were dissolved in 100cm^3 of water, the temperature dropped by 6ºC. Calculate its enthalpy change. (Density of water = 1g/cm^3, specific heat capacity is 4.2kJ $kg^{-1}K^{-1}$)

13. Sodium hydrogen carbonate was strongly heated.

a) Write an equation for the reaction

b) The grid below shows part of the periodic table. Use it to answer the questions that follow. The letters are not the actual symbols.

A								
B				C			D	E
L	F		G	H			J	
						K		

i) Write the equation for the reaction that occurs between elements **L** and **D**

ii) The oxide of **G** reacts with both hydrochloric acid and sodium hydroxide. What is the nature of the oxide of **G**?

iii) Explain why elements **H** has a higher boiling points than element **D**.

iv) State **one** use of element **E**

v) Compare and explain the atomic radius of **B** and **C**

vi) 11.5g of **L was** completely burnt in oxygen .Calculate the volume of gas that was used.

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(L = 23, molar gas volume at room temperature is $24dm^3$)

14. A student has been provided with sodium hydroxide solution of 2M and hydrobromic acid of 4M. He was asked to investigate the equation for the reaction between these two substances and hence determine the molar enthalpy of neutralization. He carried out the reaction and obtained the following results:-

Vol. of 4M Hydrobromic acid added to $20cm^3$ of 2M NaOH	**Temperature of the mixture (^oC)**
4.0	26.8
6.0	30.0
8.0	33.2
10.0	36.0
12.0	35.2
14.0	34.4
20.0	30.8

(a) Draw a graph of the temperature of the mixture (vertical axis against the volume of the acid added)

(b) Using the graph estimate the temperature of the mixture when $17cm^3$ of the acid was added

(c) Both solutions were at room temperature at the start of the experiment. Use your graph to estimate the room temperature (½mk)

(d) What is the significance of the highest temperature of the solution mixture?

(e) The temperature of the mixture increased during the first additions of the acid. Why did the temperature increase?

(f) Suggest a reason why the temperature decreased during the latter part of the experiment

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(g) Use your graph to determine the volume of 4M Hydrobromic acid which just neutralize $20cm^3$ of 2M NaOH

(h) How many moles of Hydrobromic acid are present in your answer in (**g**) above?

(i) How many moles of NaOH are present in $20cm^3$ of 2M of NaOH solution?

(j) Use your answers in (**h**) and **(i)** above to write an equation of the reaction taking place in the experiment. Explain clearly how you have used your answers (1½mks)

(k) Determine the molar enthalpy of neutralization of hydrobromic acid (1½mks)

15. (a) The following results were obtained in an experiment to determine the enthalpy of solution of sodium hydroxide

Mass of plastic beaker = 8.0g

Mass of plastic beaker + distilled water = 108.15g

Mass of plastic beaker + distilled water + sodium hydroxide = 114.35g

The table below shows the temperature at fixed times after mixing

Time/seconds	0	30	60	90	120	150	180	210
Temperature (^oC)	15	21	29	28	27	26	26	25

(i) Plot a graph of temperature (y-axis) against time (x-axis)

(ii) From your graph, determine the maximum temperature attained

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(iii) Determine the temperature change of the reaction

(iv) Calculate the number of moles of sodium hydroxide used in the experiment

(Na = 11, H = 1, O = 16)

(v) Use your results to determine the molar enthalpy solution of sodium hydroxide. (Density of solution is 1g cm^{-3} , specific heat capacity of solution = 4.18 $KJ^{-1}K^{-1}$)

(vi) Is the reaction in **(iii)** above exothermic or endothermic?

16.

(a) [i] Distinguish between molar latent heat of fusion and molar latent heat of vaporization

(ii) In an experiment to determine molar enthalpy of neutralization of hydrochloric acid using potassium hydroxide, the data below was obtained. The concentration of potassium hydroxide used was 0.5M

Volume of 0.5M KOH (cm^3)	0	5	10	15	20	25	30	35
Total volume of acid + Base	20	25	30	35	40	45	50	55
Temperature (^oC)	24	26	27	28	29	29	28	27

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(i) Plot a graph of temperature (y-axis) against volume of potassium hydroxide used

(ii) From your graph:

(a) Determine the temperature change

(b) Find the volume of potassium hydroxide which completely neutralized $20cm^3$ of the acid

(iii) Calculate the heat change for the reaction ($C = 4.2Jg^{-1}K^{-1}$ density of solution = $1g/dm^3$)

(iv) Calculate the molar enthalpy of neutralization of hydrochloric acid with potassium hydroxide

17. A typical electrolysis cell uses a current of 40,000 amperes. Calculate the mass (in Kg of aluminium produced in one hour). (Al = 27) (Faraday = 96500 Coloumbs)

18. (a) Biogas is a mixture of mainly Carbon (IV) Oxide and methane.

(i) Give a reason why biogas can be used as a fuel

(ii) Other than fractional distillation, describe a method that can be used to determine the percentage of methane in biogas

19. Consider the following equilibrium reaction.

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g) \qquad \Delta H = -74.4KJ$

a) State and explain the effect of formation of hydrogen chloride if pressure was increased in the equation above

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20. Turning of fossil fuels has adverse environmental effects:-

a) Name **two** pollutants from the burning of petroleum products

b) Give **one** precaution taken to minimise the pollution by fossil fuels

21. (a) Define molar heat of neutralization

(b) The rise in temperature when $50cm^3$ of sodium hydroxide is reacted with two acids is given in the table below:-

Acid	**$50cm^3$ of HCl**	**50cm of Oxalic acid**
Temp rise (^oC)	7	4

(i) Explain the difference in the temperature.

22. Calculate the latent heat of vaporization of water

$H_2O_{(l)} \longrightarrow H_2O_{(g)}$

Given the following thermo chemical equations:-

$H_{2(g)} + ½O_{2(g)} \longrightarrow H_2O_{(g)}\ \Delta H^{\theta} = -242KJ/Mol$

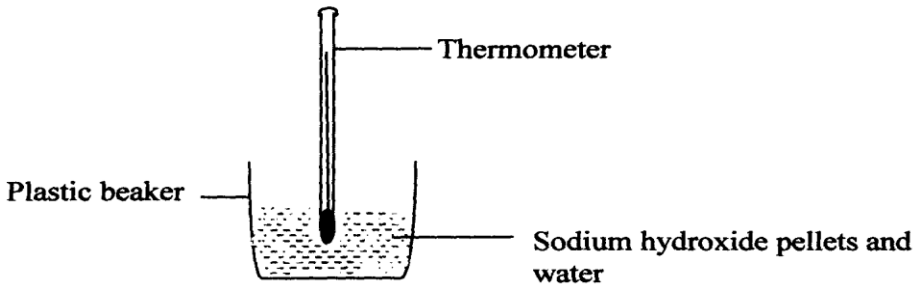
$H_{2(g)} + ½O_{2(g)} \longrightarrow H_2O_{(l)}\ \Delta H^{\theta} = -286KJ/Mol$

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23. (a) Define the term fuel

(b) State **four** reasons why wood fuel is chosen for domestic cooking

24. The setup bellow was used to investigate the changes that take place when sodium Hydroxide pellets dissolve in water.



a) Why is a plastic beaker used instead of a metallic beaker?

b) State and explain the observations made in the above reaction

25. (a) What is a fuel?

(b)Other than the cost, state **two** other factors to consider when choosing a fuel.

26. The equation below represents changes in the physical state of ions metal:

$Fe_{(s)} \rightarrow Fe_{(l)} \longrightarrow DH = +15.4 kjmol^{-1}$

$Fe_{(l)} \rightarrow Fe_{(g)} \longrightarrow DH = +354 kjmol^{-1}$

a) Calculate the amount of heat energy required to change 10kg of solid iron to gaseous iron [Fe = 56]

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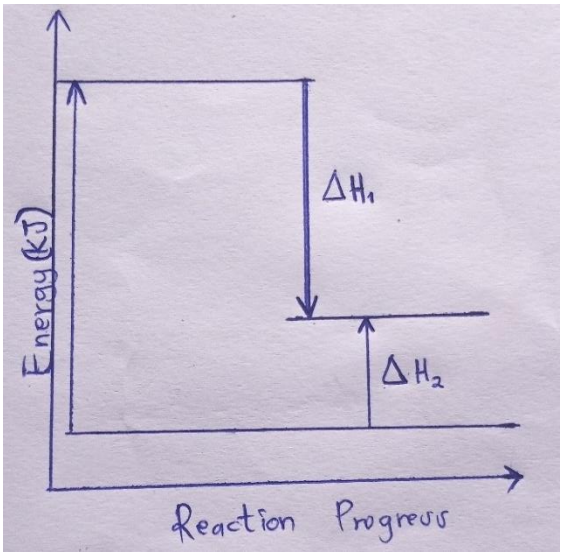
b) Iodine can react with chlorine as shown below:-

$I_{2(g)} + Cl_{(g)}$ $2lcl_{(s)}$ DH= -68kJ

Determine the molar enthalpy change for this reaction

b) Draw an energy level diagram for the reaction in **(b)** above

27. Study the diagram below and answer the questions that follow:



a) What do ΔH_1 and ΔH_2 represent?

ΔH_1 …….

ΔH_2 ……..

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REACTION RATES & REVERSIBLE REACTIONS

1.Study the following equilibrium reaction and answer the questions that follow:-

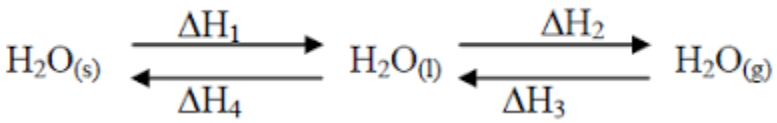
$$HL_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+(aq)\ L^-(aq)$$

Given that in an acid solution, $H_3O^+_{(aq)}$ act in place of hydrogen ions, H^+, according to the equation.

$$H_3O_{(aq)} + OH^-_{(aq)} \rightarrow 2H_2O_{(l)}$$

Explain what would be observed when potassium hydroxide solution is added to the above equilibrium mixture

2. The scheme below shows the energy changes that take place between ice, water andsteam. Study it and answer the questions that follow:-



(a) What name is given to the energy change ΔH_4?

(b) What is the sign ΔH_3, give a reason

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3. The table below gives bond energies for three covalent bonds

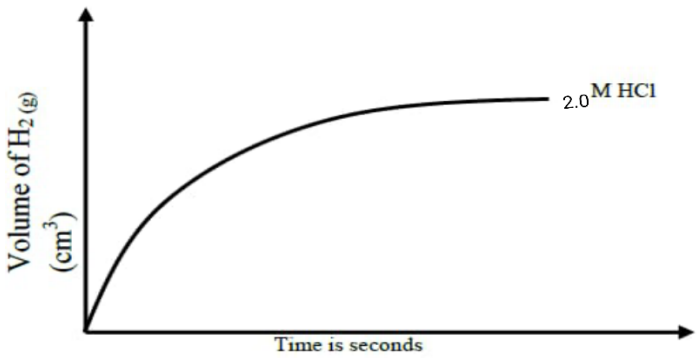
Bond	**Bond energy (KJmol-1)**
H –H	435
Cl – Cl	240
H – Cl	430

(a) Calculate the energy change for the following reaction:

$$H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$$

(b) Sketch an energy level diagram for the reaction in **(a)** above

4. The sketch below was obtained when 2g of magnesium was reacted with excess of 2M hydrochloric acid. The volume of hydrogen evolved was then plotted against time as shown below:



(a) On the same axis plot the graph that would be obtained if 1M hydrochloric acid was used instead of 2M hydrochloric acid. Explain

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(b) Explain the significance of the flat portion **BC** of the curve

5. In a closed system an equilibrium exists between Nitrogen (IV) Oxide and dinitrogen tetraoxide as shown in the equation below:

$$N_2O_{4\,(g)} \rightarrow 2NO_{2\,(g);}\ \Delta H = +\ 27.5KJ$$

(a) State and explain the observation when a glass syringe containing the equilibrium mixture is immersed in ice-cold water

[b]If the piston of the syringe is pushed, state the effect on the position of the equilibrium

6. The table below gives the volumes of the gas produced when different volumes of 2M hydrochloric acid were reacted with 1.0g of a lump of an alloy of Magnessium and copper at room temperature

Volume of 2M hydrochloric acid (cm^3)	**Volume of gas (cm^3)**
0	0
10	240
20	480
30	600
40	600
50	600

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(a) Write an equation for the reaction that occurred

(b) On the grid provided below, plot a graph of the volume of the gas produced (vertical axis) against the volume of acid added (Note that before the reaction comes to completion, the volume of the gas produced is directly proportional to the volume of the acid added)

(c) From the graph, determine:

(i) The volume of the gas produced if 13.0cm^3 of 2M hydrochloric acid had been used

(ii) The volume of 2M hydrochloric acid required for the reaction to go to completion

(d) State and explain the effect on the rate of production of the gas if:

(i) 1.0g of the lump of the alloy were replaced by 1.0g powder of the alloy

(ii) The reaction was carried out at 35^oC.

7. In a series of experiments in which magnesium ribbon of uniform width reacted with 2.0M .hydrochloric acid, the rates of evolution of hydrogen gas were found to be as follows:-

Length of ribbon (cm	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Rate of Evolution of hydrogen (cm^3/min)	1.1	1.8	2.7	3.6	4.6	5.4	6.1

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(I) (a) Draw a graph of rate of evolution of hydrogen gas against length of ribbon*

(b) What conclusion can you make from this graph? *

(c) Determine the rate of evolution of hydrogen gas from a piece of magnesium ribbon 12cm long under the same conditions *

(d) With dotted line, sketch on the same axis the graph that would be obtained if all the ribbons were ground into powder *

8. A typical electrolysis cell uses a current of 40,000 amperes. Calculate the mass (in Kg of aluminium produced in one hour). (Al = 27) (Faraday = 96500Coloumbs)

9. The table below shows the volumes of nitrogen (IV) oxide gas produced when different volumes of 1M nitric acid were each reacted with 0.635g of copper at room temperature.

Volume of 1M nitric acid (cm^3)	**Volume of Nitrogen (IV) oxide gas(cm^3)**
5	60
15	180
25	300
35	420
45	480
55	480

a) Give a reason why hydrochloric acid can not be used instead of nitric acid

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b) Explain how the rate of the reaction between copper and nitric acid would affect if the temperature of the reaction mixture was raised

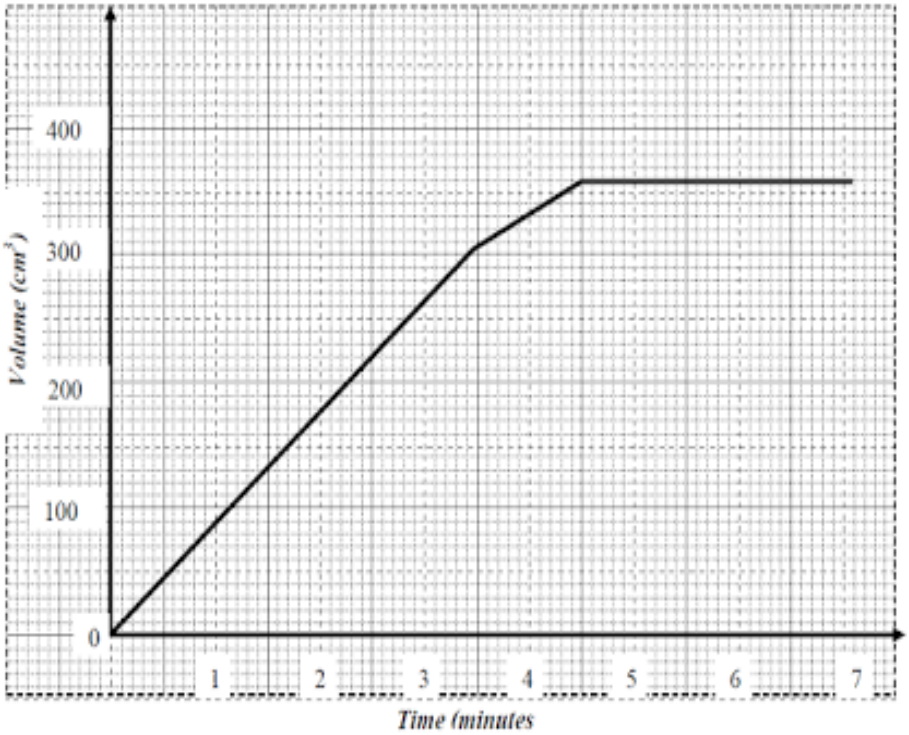
c) On the grid provided below, plot a graph of the volume of the gas produced (vertical axis) against volume of acid

d) Using the graph, determine the volume of:

(i) Nitrogen (IV) oxide produced when $30cm^3$ of 1M nitric acid were reacted with 0.635g of copper

(ii) 1M nitric acid which would react completely with 0.635g of copper

10. The graph below represents the volume of gas collected against time when dilute sulphuric acid is reacted with Zinc granules:-



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(a) Determine the rate of reaction between the 1st and 3rd minute

(b) When did the reaction stop?

(c) Give a possible reason for the reaction to stop

11. The equation below represents a reaction that takes place in an industrial process

$$4NH_{3(g)} + 5O_{2(g)} \rightarrow 6H_2O_{(g)} + 4NO_{(g)}$$

(a) Name the catalyst used

(b) What are the other conditions for the reaction?

(c) Why are the products cooled before being oxidised?

12. Nitrogen reacts with hydrogen according to the equation below:-

$$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)} \quad \Delta H = -92KJ$$

(a) How would the yield of ammonia be affected by increase in :-

(i) Pressure

(ii) temperature

(b) The ammonia produced is isolated form the other gases from time to time. How does this affect the equilibrium?

(c)

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13. Explain how you would obtain an insoluble salt XSO_4 when you are provided with the following :-

(i) Distilled water

(ii) Solid YSO_4 which is soluble in water

(iii) Solid salt $X(NO_3)_2$

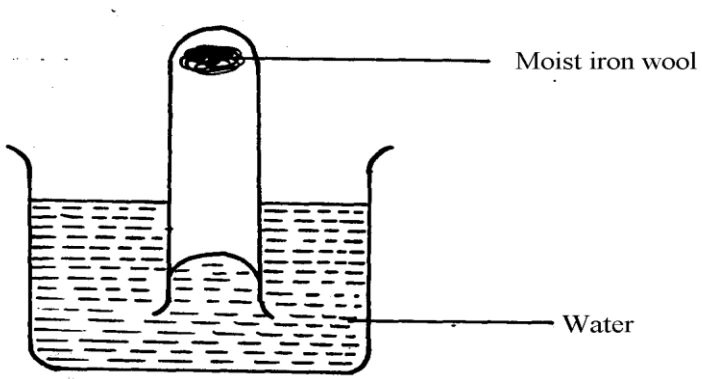
14. Metal **R** and **S** were used to form a cell. The following half equations show the standard electrode potentials of the half cells. (**R** and **S** are not actual symbols of the element)

$R^{2+} + 2e^- \rightarrow R_{(s)}$ $\quad E^\theta = -2.04V$

$S^{2+}_{(aq)} + 2e^- \rightarrow S_{(s)}$ $\quad E^\theta = -0.47V$

Write the full equation for the cell and calculate the e.m.f

15. The apparatus below were used to study the properties of air



(a) State **two** observations made at the end of the experiment

(b) Give **one** simple method that can be used to prevent rusting

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16. Equal volumes of 1M monobasic acids **K** and **L** were each reacted with excess zinc granules. The table below shows the volumes of the gas produced after two minutes

Acid	Volume of gas (cm^3)
K	40
L	100

(a) Explain the difference in the volumes of the gas produced

(b) How can the production of the gas be increased?

17. The following is a thermochemical equation for the reaction between hydrogen and oxygen

$H_{2(g)} + O_2(_{g)} \rightarrow H_2O_{(l)} \quad \Delta H = -287kJmol^{-1}$

Calculate the bond energy between the elements in water given that:

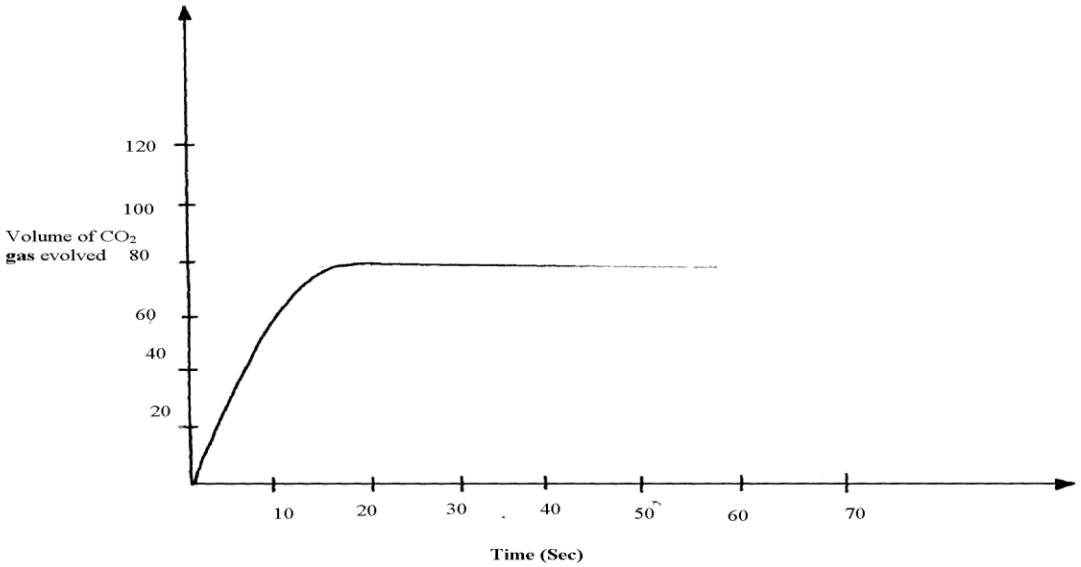
$O = O = +496kJmol^{-1}$ $\qquad$ $H\text{-}H = +435kJmol^{-1}$

18. $AgClO_{2(s)} \rightarrow Ag_{(s)} + ½\ Cl_{2\ (g)} + O_{2\ (g)}\ \Delta H = 0.00KJ/mol$

What is the effect on the position of equilibrium of the above system if temperature is decreased? Give a reason

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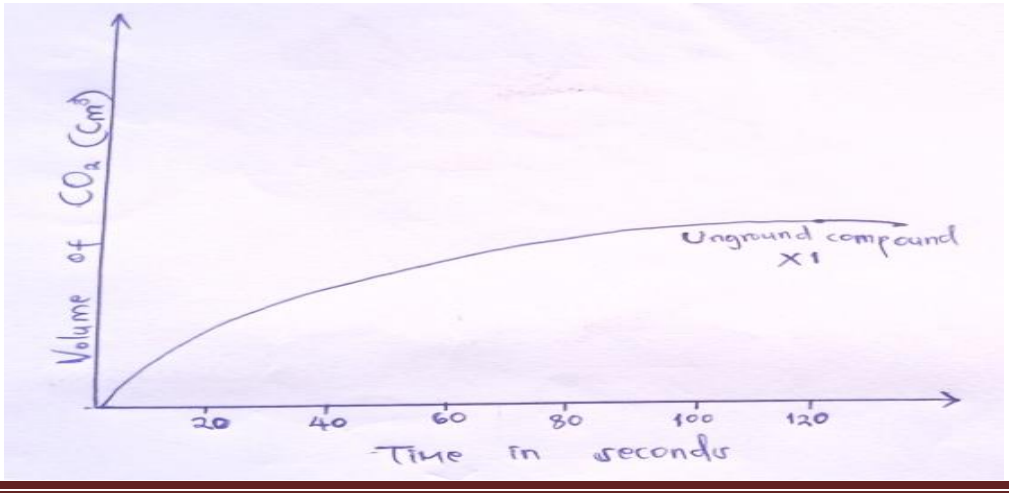
19. Sodium carbonate was reacted with dilute sulphuric (VI) acid at 25°C. The volume of carbon (IV) Oxide gas liberated was recorded at 10seconds interval. Below is a graph of the volume of carbon (IV) Oxide gas evolved against time.



(a) On the same axes, sketch the curve labelled **V** that would be obtained if Barium carbonate was used instead of sodium carbonate. (All conditions remain constant)

20. (a) What is meant by activation energy?

(b) A certain mass of unground compound X1 reacted with excess dilute hydrochloric acid. The volume of carbon (IV) oxide gas liberated was measured after every 20 seconds. The results were presented as shown in the graph below:-

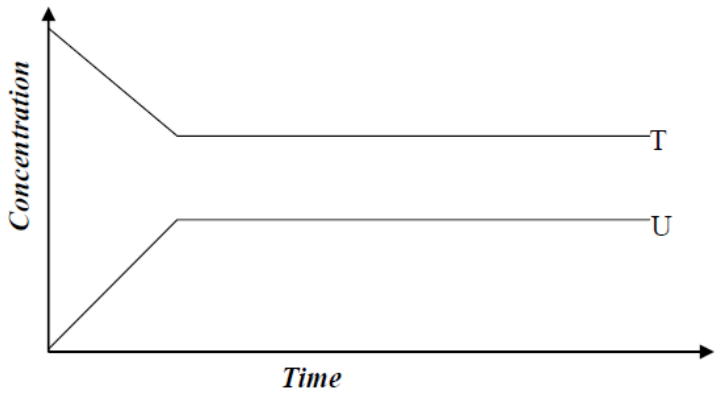


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(i) On the same axis, sketch the curve that would be obtained if the experiment was repeated using ground compound X1

(ii) Explain the shape of your curve in **(b) (i)** above

22. The sketch below shows the rate at which substance T is converted into U. Study it and answer the questions that follows:-



When the equilibrium has been established the two curves become horizontal after sometime. Explain the effect of the amount of the two reactants and products

23. Elements **A, B, C**, and **D** are not actual symbols, have atomic numbers **19, 9, 12** and **10** respectively.

(a) Which **two** elements represent non-metals

(b) Write the formula of the compound formed between elements **B** and **C** and identify the bond present in the compound

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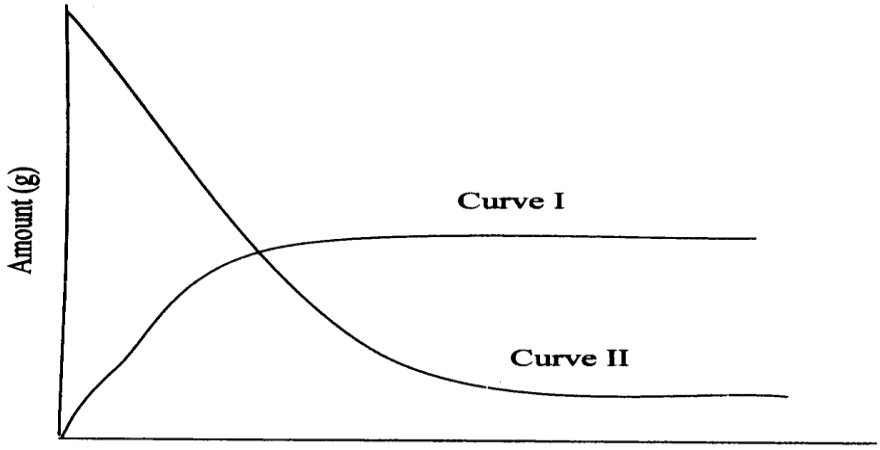
24. An equilibrium is established between nitrogen tetra -oxide and nitrogen (IV) oxide as shown below:State and explain what happens when temperature is increased

$N_2O_{4(l)}$ → $2NO_{2(g)}$

Pale yellow Red-brown fumes

25. The graph below shows the amount of calcium carbonate and calcium chloride varying with time in the reactions:

$CaCO_{3\,(s)} + 2HCI_{\,(aq)}$ $CaCl_{2\,(aq)} + H_20_{\,(g)} + CO_{2\,(g)}$



(a) Which curve shows the amount of calcium chloride varying with time?

(lmk)

(b) Explain why the two curves become horizontal after a given period of time.

(lmk)

(c) Sketch on the graph how curve II would appear if the experiment was repeated using a more dilute hydrochloric acid solution

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26 State the effect on the equilibrium when;

a) Pressure is increased

b) Oxygen gas is added

An equilibrium is established between CrO_4^{2-} and $Cr_2O_7^{2-}$ ions as shown below:

$$2CrO_{4\,(aq)} + 2H^+_{(aq)} \rightarrow Cr_2O_{7(aq)} + H_2O_{(l)}$$

(Yellow) (Orange)

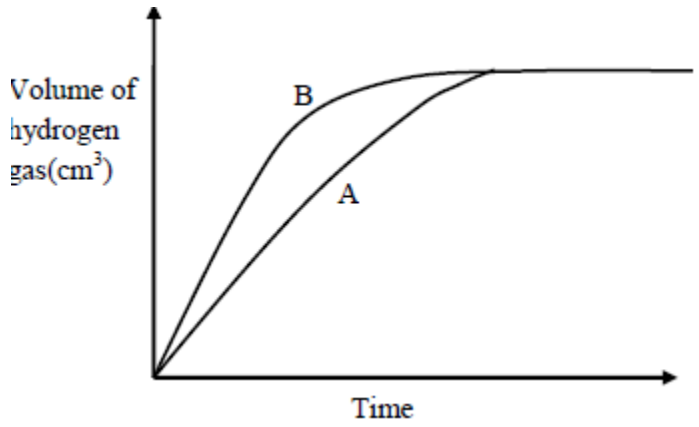
27. State and explain and explain the observation made when aqueous sodium hydroxide is added to the equilibrium mixture

28. Two experiments were carried out as follows and the volume of hydrogen gas evolved measured at intervals of 10seconds for 100seconds.

(i) 8cm of magnesium ribbon was added to 1M hydrochloric acid

(ii) 8cm of magnesium ribbon was added to 0.5M hydrochloric acid

Graphs of volume of hydrogen evolved against time were plotted



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(a) Which of the graph was obtained for reaction (i) above? Explain

(b) Explain the general shape of the graph

29. Bromine dissolves in water forming a brown solution, according to the dynamic equation below.

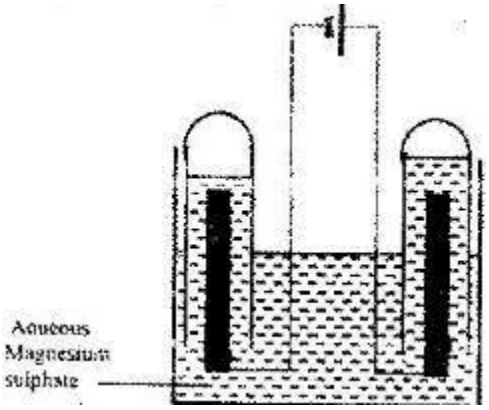
$$Br_{2\ (aq)} + H_2O_{\ (l)} \rightarrow 2H^+_{\ (aq)} + Br^-_{(aq)} + OBr^-_{(aq)}$$

State and explain the observation that could be made if a solution of sodium hydroxide is added to the system

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ELECTROCHEMISTRY II

1. The setup below was used to carry out the electrolysis of Magnesium sulphate solution using inert electrodes.



(i) Name a suitable pair of electrode that can be used in the above process.

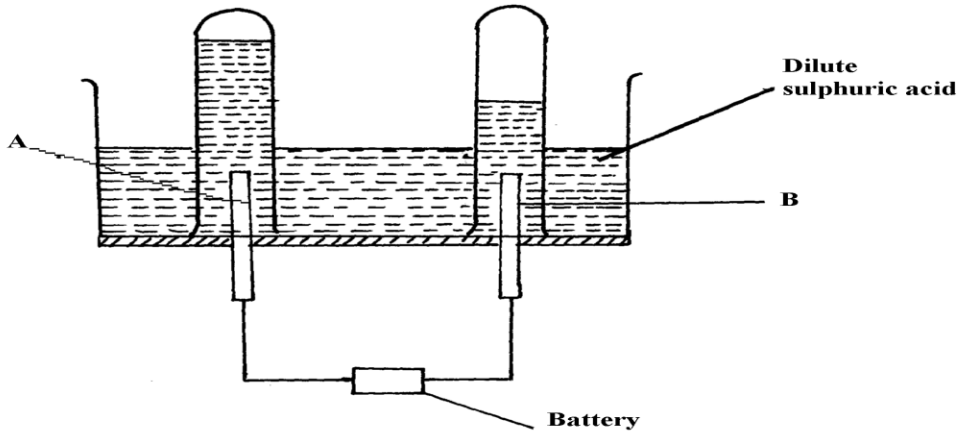
(ii) State and explain the changes on the concentration of magnesium sulphate solution as the process proceeds.

2. During purification of copper by electrolysis, 1.48g of copper were deposited when a current was passed through aqueous copper (II) sulphate for 2 ½ hours. Calculate the amount of current passed.

(Cu = 63.5 1Faraday = 96500C)

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3 The diagram below represents a set-up that can be used for the electrolysis of dilute sulphuric acid



(a) Name the electrodes **A** and **B**

(b) Write an equation for the reaction taking place at electrode **B**

(c) What happens to the concentration dilute sulphuric acid as the reaction continues?

4. In an electrolysis, a current of 200A was passed through molten oxide of metal **Q** for 58 minutes and 64.8g of the metal deposited. Determine;

i) Charge on metal **Q**

ii) The volume of oxygen gas produced at standard temperature and pressure

Q = 27 IF = 96500C, molar gas volume stp =22.4dm^3

5. Consider the reduction potentials below.

$Pb^{2+}_{(aq)} + 2e \rightarrow Pb_{(s)} = -O.13V$

$Mg^{2+}_{(aq)} + 2e \rightarrow Mg_{(s)} = -O.76V$

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a) Write the overall Redox reaction that takes place when the above half cells are connected.

b) Determine the E^{θ} value of the above cell.

(c) Calculate which group of the periodic table is element **F**?

6. An oxide of element **F** has the following formula:- **F_2O_5**

(a) Determine the oxidation state of **F**

Element	Sodium	Magnesium	Aluminium
Atomic number	11	12	13

7. The table below gives elements and their atomic numbers. Answer the questions that follow: Compare the electrical conductivity of sodium and aluminium. Explain

Element	Atomic number	Atomic radius(nm)	Oxide	State at RT	oxide melting point °C
M	11	0.191	M_2O	Solid	1132
N	....	0.160	NO	Solid	2852
P	13	0.130	.....	Solid	2072
Q	14	0.118	QO_2	.....	1610
R	.....	0.110	.....	Solid	580
S	16	0.102	SO_2	.....	-75
T	17	0.099	TO_2	Gas	-60
V	18	0.095	X	X	X

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8. What mass of Zinc will be deposited from a solution of Zinc (II) Chloride when a current of 3A is passed through the Zinc (II) Chloride solution during electrolysis for 50minutes?
(Zn= 65, 1 Faraday = 96500C)

9. Aqueous potassium sulphate was elecrolysed using platinum electrodes in a Cell

[i]Name the products formed at the cathode and anode

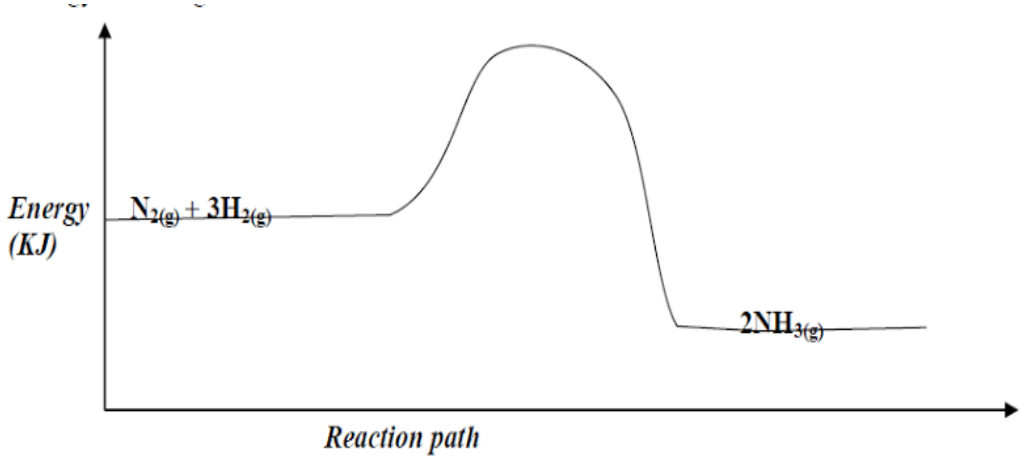
[ii]How does the concentration of the electrolyte change during electrolysis?

[iii]Why would it not be advisable to electrolyse aqueous potassium sulphate using potassium metal electrodes

10. Nitrogen and hydrogen react reversibly according to the equation:-

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)};\ \Delta H = -92kjmol^{-1}$

The energy level diagram for the above reaction is shown below:-



(a) How would the yield of ammonia be affected by:

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(i) A decrease in temperature

(ii) An increase in pressure

(b) How does a catalyst affect reversible reaction already in equilibrium?

(c) On the above diagram, sketch the energy level diagram that would be obtained when iron catalyst is added to the reaction

11. Study the electrode potentials in the table below and answer the question that follow:

(Letters are not the actual symbols of elements)

	(E^{θ} /Volts)
$H^{2+}_{(aq)} + 2\ e^-$	$H_{(s)}$ +0.34
$Z^{2+}_{(aq)} + 2e^-$	$Z_{(s)}$ -2.38
$G^{+}_{(aq)} + e^-$	$G_{(s)}$ +0.80
$T^{2+} + 2e^-$	$T_{(s)}$ - 2.87

(a) Which **one** is the strongest reducing agent?

(b) Write the ionic equation for the reaction that takes place when **Z** is dipped in a solution of G^+ ions

(b) Calculate the E^{θ} cell value of the reaction in **11.(b)** above

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12. When a hydrocarbon was completely burnt in oxygen, 4.2g of Carbon (IV) oxide and 1.71g of water were formed. Determine the empirical of the hydrocarbon. (H=10 C=12.0 O=16.0)

13. During electrolysis of aqueous copper (II) sulphate 144,750 coulombs of electricity were used. Calculate the mass of copper metal that was obtained (Cu =64 1Faraday = 96,5000 coulombs)

14. Sodium metal reacts with oxygen according to the following equation:-

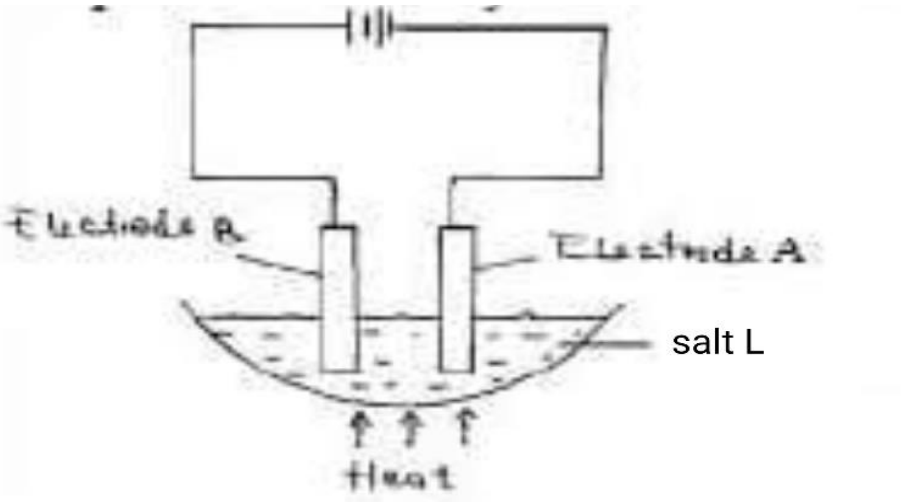
$$6Na_{(s)} + 2O_{2(g)} \xrightarrow{\textbf{Heat}} Na_2O_{2(s)} + 2Na_2O_{(s)}$$

State **one** physical and **one** chemical difference between Na_2O_2 and Na_2O

Physical difference

Chemical difference

15. The diagram below shows an electrochemical cell:



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(a) Give the formula of the possible salt **L**

(b) On the diagram show the direction of movement of electrons

(c) Write the cell representation

16. The reaction blow is a redox reaction

$MnO_4^-{}_{(aq)} + 8H^+_{(aq)} + 5Fe^{2+}_{(aq)}$

(a) Identify the species reduced. Explain

(b) Write the equation for the oxidation reaction

17. Consider the cell diagram below

$Cr_{(s)}/Cr^{3+}_{(aq)}$ // $Fe^{2+}_{(aq)}/Fe_{(s)}$ $\quad E^\theta = +0.30V$

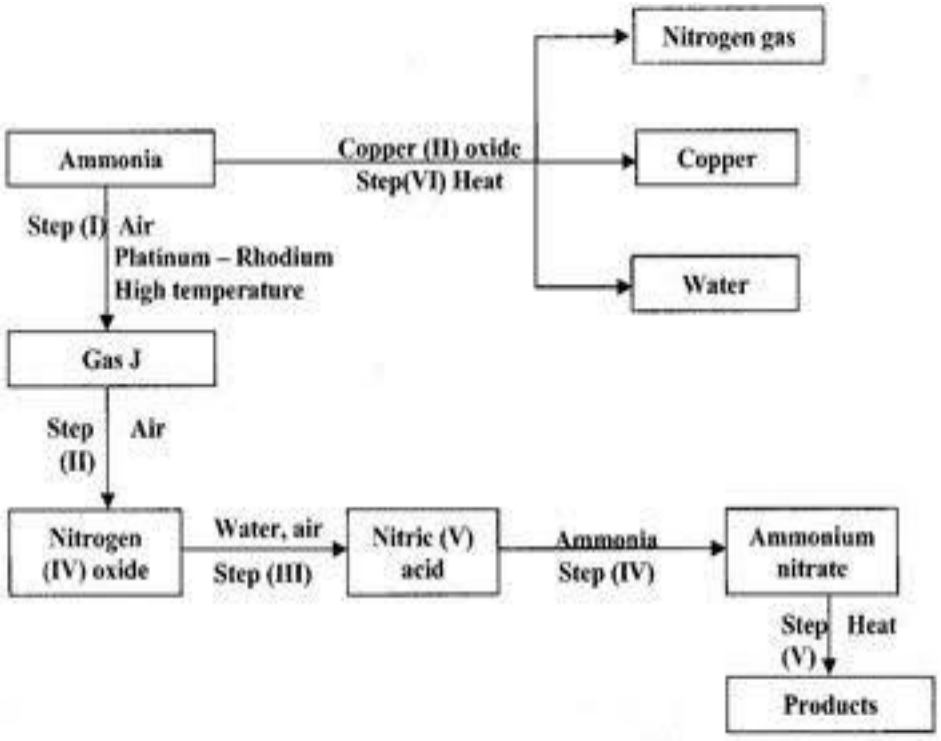
i) Write the overall cell reaction for the above electrochemical cell

ii) Given that E^θ value for $Fe^{2+}_{(aq)}/Fe_{(s)}$ is -0.40V,calculate the E^θ value for $Cr^{3+}_{(aq)}/Cr_{(s)}$

18. (a) Describe the process by which Trichloro fluoromethane Nitrogen is obtained from air on a large scale

(b) Study the flow chart below and answer the questions that follow

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(i) Identify gas **J**

(ii) Using oxidation numbers, show that ammonia is the reducing agent in step **VI**

(iii) Write the equation that occurs in step **V**

(iv) Give **one** use of ammonium nitrate

(b) The table below shows the observations made when aqueous ammonia was added to cations of elements **E, F** and **G** until in excess

Cation of	**Addition of a few drops of aqueous ammonia**	**Addition of excess aqueous ammonia**
E	White precipitate	Insoluble
F	No precipitate	No precipitate
G	White precipitate	Dissolves

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(i) Select the cation that is likely to be Zn^{2+}

(ii) Given that the formula of the cation of element **E** is $\mathbf{E}^{2+}$, write the ionic equation for the reaction between $\mathbf{E}^{2+}$ and aqueous ammonia

19. a) Study the standard electrode potential for the half-cells given below and answer the questions that follow.(The letter do not represent the actual symbols of the elements)

		E^{θ} Volts
$N^{+}_{(aq)} + e^{-}$	$N_{(s)}$;	-2.92
$J^{+}_{(aq)} + e^{-}$	$J_{(s)}$;	+0.52
$K^{+}_{(aq)} + e^{-}$	$\frac{1}{2} K_{2(g)}$;	0.00
$\frac{1}{2} G_{2(g)} + e^{-}$	$G^{-}_{(aq)}$;	+1.36
$M^{2+}_{(aq)} + 2e^{-}$	$M_{(s)}$;	-0.44

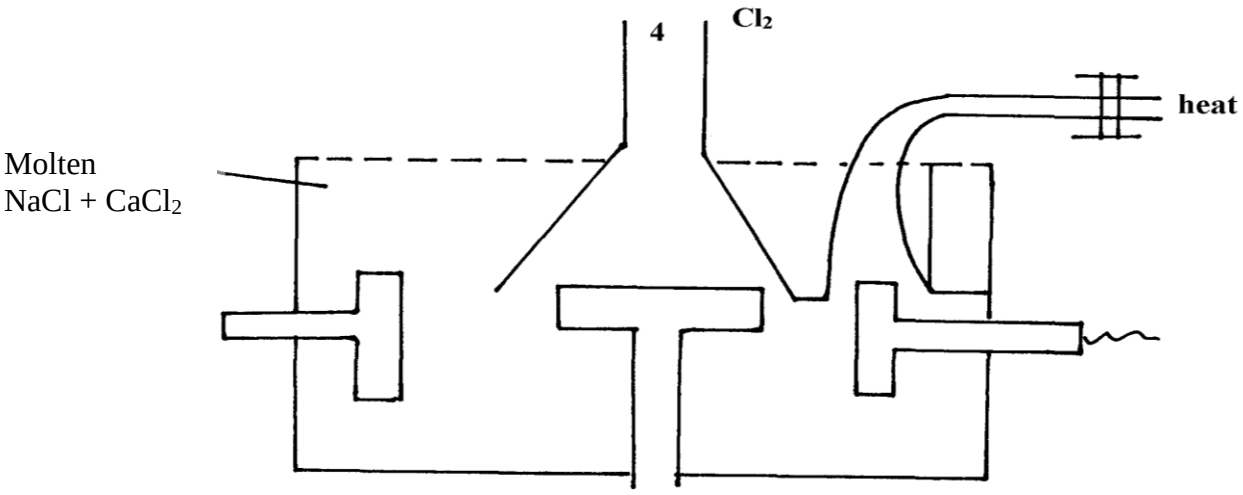
i) Identify the strongest oxidizing agents. Give a reason for your answer

ii) Which two half-cells would produce the highest potential difference when combined?

iii) In the space below draw a complete electro chemical cell of the two-half cells mentioned in (ii) above

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20. Below is a simplified diagram of the Down's cell for the extraction of sodium. Study it and answer the question that follow:-



(i) From which substances are the electrodes made?

Cathode

Anode

(ii) State and explain why sodium chloride is mixed with calcium chloride

(iii) What is the role of the iron gauze

(iv) Write equations for the reaction at :-

cathode

anode

(v) Which property of sodium makes it possible to collect it as shown?

(c) When a current of 6.42 **A** was passed through an electrolyte Y^{2+} ions for 10minutes, 2.74 of **Y** were deposited

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(i) Calculate the quantity of electricity passed in the experiment

(ii) Determine the relative atomic mass of **Y** (1Faraday = 96000 coulombs)

21. (a) The table gives the standard redox potentials for a number of half reactions. Use it to answer the questions that follow:-

		(E^{θ}/Volts)
$Zn^{2+}_{(aq)} + 2e^-$	$Zn_{(s)}$	-0.76
$Fe^{2+}_{(aq)} + 2e^-$	$Fe_{(s)}$	-0.44
$I^{2+}_{(l)} + 2e^-$	$2I^-_{(aq)}$	+0.54
$Fe^{3+}_{(aq)} + e^-$	$Fe^{2+}_{(aq)}$	+0.77
$Ag^+ + e^-$	$Ag_{(s)}$	+0.88

(i) Relative to which half-cell reaction are the above electrode potentials expressed?

(ii) Calculate the e.m.f of the cell made up by combining the $I_{2(l)}/2I^-_{(aq)}$ electrode and

$Zn^{2+}_{(aq)}/Zn_{(s)}$ electrode

(iii) Which of the substances listed in the above table is :-

I. The strongest oxidising agent

II. The strongest reducing agent

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(iv) Which substances could be used to convert iodide ions to iodine? Write balanced equations for any possible conversions

22. a) The standard electrode potential for the elements chlorine and magnesium are:-

$Cl_{2(g)} + 2e^- \rightarrow 2Cl^-_{(aq)}$ E^θ + 1.36V

$Mg^{2+}_{(aq)} + 2e^- \rightarrow Mg_{(s)}$ E^θ - 2.36V

i) Which one of the two elements will act as an oxidizing agent? Explain.

ii) Calculate the electromotive force of a cell where the overall reaction is:-

$Cl_{2(g)} + Mg_{(s)} \quad MgCl_{2(s)}$

b) The table below gives the reduction standard electrode potentials for divalent metals.

The letters are not their actual symbols. Use them to answer the questions that follow:-

Metal	**E^θ (volts)**
P	+1.50
Q	-0.44
R	+0.34
S	+0.76

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i) Select **two** metals whose half cells can produce the highest voltage when connected.

ii) Draw a well labelled diagram of electrochemical cell formed by half-cells of metals **P** and **Q**

iii) Calculate the voltage produced by the cell in **(ii)** above

c) When nitrate solution of a certain metal **X** was electrolysed, 1.174g of metal **X** was deposited by a current of 4 amperes flowing for 16minutes. Determine the formula of the metal nitrate. (1F= 96,500, R.A.M of **X**= 59)

23. Study carefully the information given below and answer the questions that follow:-

Substance	**Physical state at e.t.p**	**Solubility in water**	**Other information**
A	Solid	- Soluble - Blue solution	- solution conducts electricity forming two products **B** and **C** - **B** is solid and **C** is a greenish – yellow gas
D	Gas	- Soluble - Colourless solution	- Solution forms pale blue precipitate with **A** and then deep blue solution in excess
E	Solid	- Insoluble	- With a solution of **A** forms B and a colourless solution at E^{2+}ions

(a) Identify the substances represented by the letters

(b) Give equations for the reactions in which:-

(i) Substance **B** is formed from the solution of **A** on electrolysis

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(ii) Substance **B** is formed from solution **A** when reacted with **E**

(c) Give **one** use of gas **C**

(d) Name the ion responsible for the deep blue solution

24. (a) Study the standard electrode potentials for the elements given below and answer the questions that follow. The letters do not represent the actual symbols of the elements

		E^{θ}
$Q_{2(g)} + 2e^-$	$2Q^-_{(aq)}$	+2.87
$R_{2(g)} + 2e^-$	2R-(aq)	+1.36
$S^{2+}_{(aq)} + 2e^-$	S (s)	+ 1.23
$2T^+_{(aq)} + 2e^-$	$T_2(g)$	0.00
$U^{2+}_{(aq)} + 2e^-$	U(s)	-0.13
$V^{2+}_{(aq)} + 2e^-$	V(s)	-0.76

(i) What is the E^{θ} value of the weakest reducing agent?

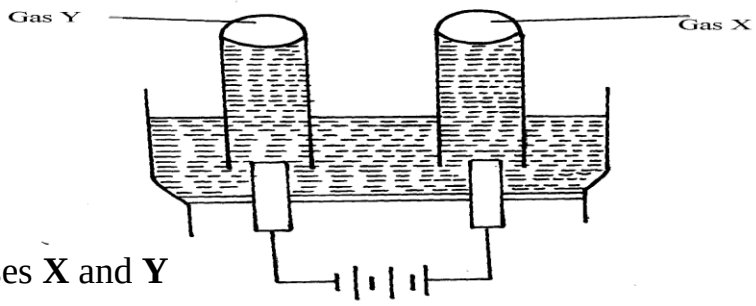
(ii) Which element is likely to be hydrogen? Give a reason for your answer

(iii) Draw a diagram for the cell that would be obtained when the half cell of elements **S** and **V** are combined

(iv) Calculate the e.m.f of the electrochemical cell in a (iii) above

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(c) The diagram below represents the electrolysis of dilute sulphuric (VI) acid



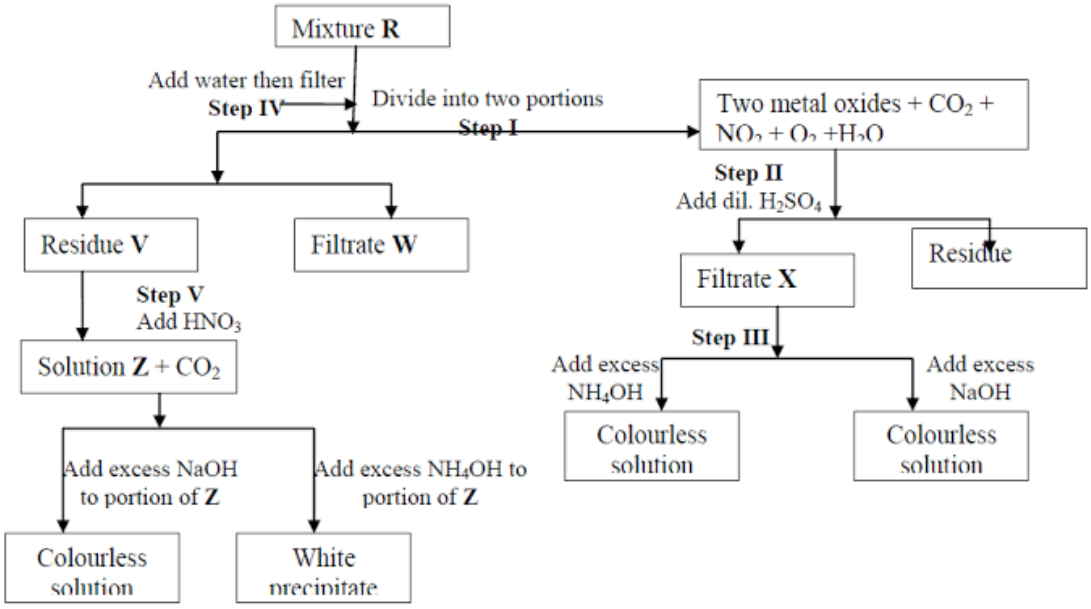
(i) Name the gases **X** and **Y**

(ii) Write ionic equation for the formation of gas **X**

(iii) At what electrode does reduction take place? Explain your answer

(iv) Name the most suitable electrodes for this experiment. Explain your answer

25. The flow chart below shows an analysis of **mixture R** that contains two salts. Study it and answer the questions that follow:-



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(i) Writ**e two** ionic equations for the reactions between the cation in filtrate **X** and aqueous ammonia (Ammonium hydroxide)until in excess

(ii) What conclusion can be drawn from **Step IV** only? Explain

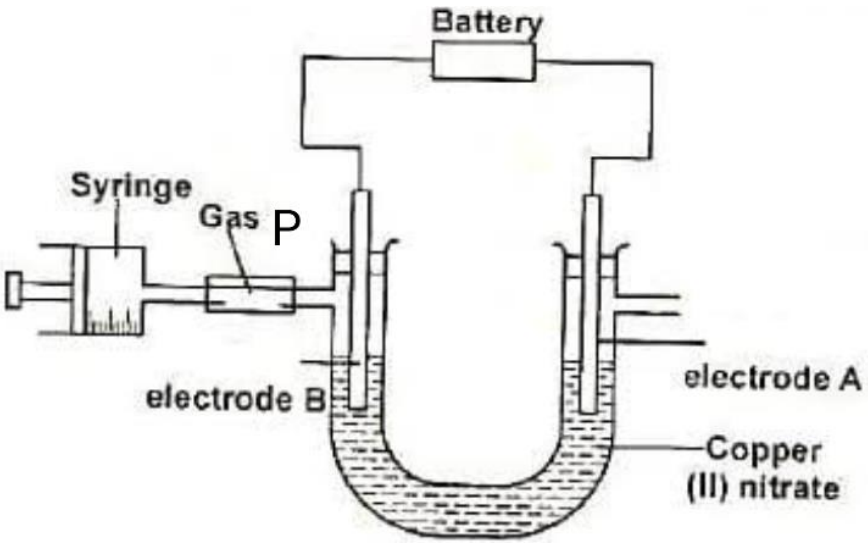
(iii) What observation would indicate the presence of a NO_3^- ion in **step I**?

(iv) Write the formula of the anion in **residue V**. Explain

(v) Suggest the identity of the cation present in solution **Z**

(vi) Name the **two** salts present in mixture **R**

26. (a) The set-up below was used in the electrolysis of copper II nitrate solution:



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(i) What is electrolysis?

(ii) Show the anode and cathode on the diagram

(iii) Explain how you would confirm gas **P**

(iv) Write the equation for the reaction occurring at

(a) Anode

(b) Cathode

(v) State **two** changes that occur on the electrolyte after the experiment

(b) Below are the standard electrode potentials for electrodes **B** and **D**

$B^{2t}_{(aq)} + 2e^{-} \rightarrow B_{(s)} - 2.92V$

$D^{2t}_{(aq)} + 2e^{-} \rightarrow D_{(s)} + 0.34V$

(i) Identify the electrode which is ;

(a) The least reducing agent

(b) The strongest oxidizing agent

(ii) Calculate the e.m.f of the cell formed when the two electrodes are connected

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(iii) Write a cell representative for the cell above

27. A typical electrolysis cell uses a current of 40,000 amperes. Calculate the mass (in Kg of aluminium produced in one hour). (Al = 27) (Faraday = 96500Coloumbs)

28. A strip of copper metal was immersed into a nitrate solution of metal Q overnight. Use the information below to answer questions that follow

	E^{θ} (Volts)
$Q_{(aq)} + e^-$	+0.80
$Q_{(s)}$	
	+ 0.34
$Cu^{2+}{}_{(aq)} + 2e^-$ $Cu_{(s)}$	

(a) State the observations made at the end of the experiment

(b) Give a reason for the observations made in (a) above

(c) Calculate the e.m.f of the cell above

29. (a) Excess marble chips (Calcium carbonate) was put in a beaker containing $150cm^3$ of dilute hydrochloric acid. The beaker was put on a weighing balance and the total loss in mass recorded after every two minutes as shown in the table below:

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Time (min)	0	2	4	6	8	10
Total loss in mass (g)	0	1.8	2.45	2.95	3.2	3.3

(i) Why was there a loss in mass?

(ii) The average rate of reaction was faster between 0 and 2 minutes than between 6 and 8 minutes. Explain why

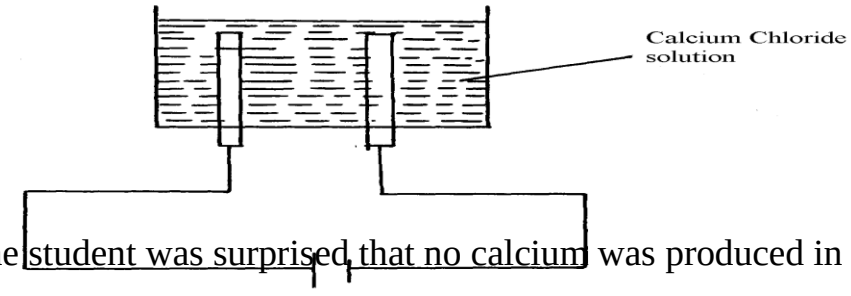
(iii) State **one** way in which the rate of reaction can be increased

(v) When aqueous sodium sulphate was added to contents of the beaker, a white precipitate was formed;

(I) Identify the white precipitate

(II) Name **one** use of the substance named in **(iv) (I)** above

d) A student performed the following experiment with an intention to extract calcium metal



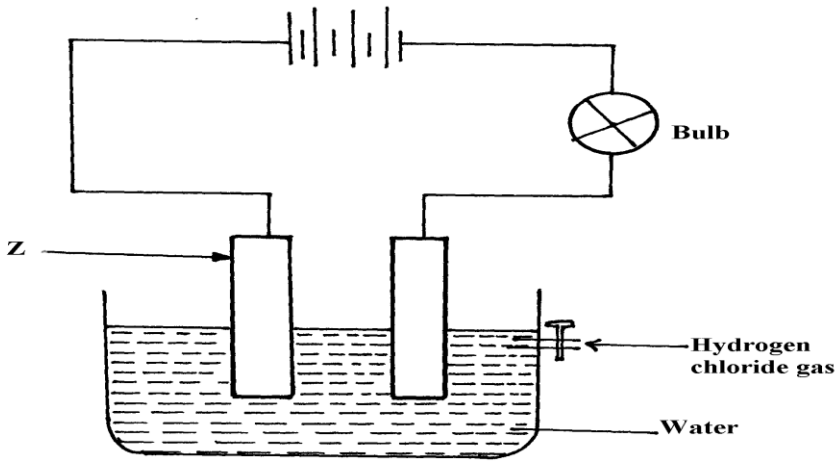
(i) The student was surprised that no calcium was produced in the experiment. Explain why no calcium was produced

Write the equation for the reaction that occurred at the anode if the solution was concentrated

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(iii) The electrolysis involved passing an electric current of 4A for one hour. Calculate the mass of the product at the anode. (1Faraday = 96500C, Cl =35.5, H = 1.0, O =16, Ca = 40)

30. Cheptoo set-up some apparatus as shown in the diagram below:-



At the start of the experiment, the bulb did not light:-

(a) State and explain the observation made when the tap was opened to allow the hydrogen chloride gas through the water for about 20 minutes

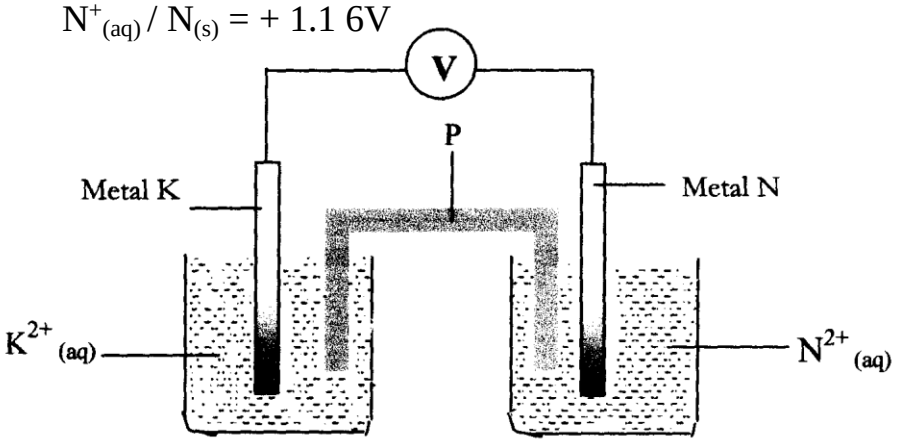
(b) Write the chemical equation for the reaction that took place at the cathode

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31. Metals **K** and **N** were connected to form a cell as shown in the diagram below. Their reduction potentials are as shown below:

$K^{+}_{(aq)} / K_{(s)} \equiv - 0.17V$

$N^{+}_{(aq)} / N_{(s)} = + 1.1\ 6V$



I. Write the equation for the half-cell reaction that occurs at

Metal **K** electrode

Metal **N** electrode

II Identify **P** and state its role in the above setup

(i). Identity of **P**

(ii) . Role of **P** in the setup.

III. On the diagram, show the flow of

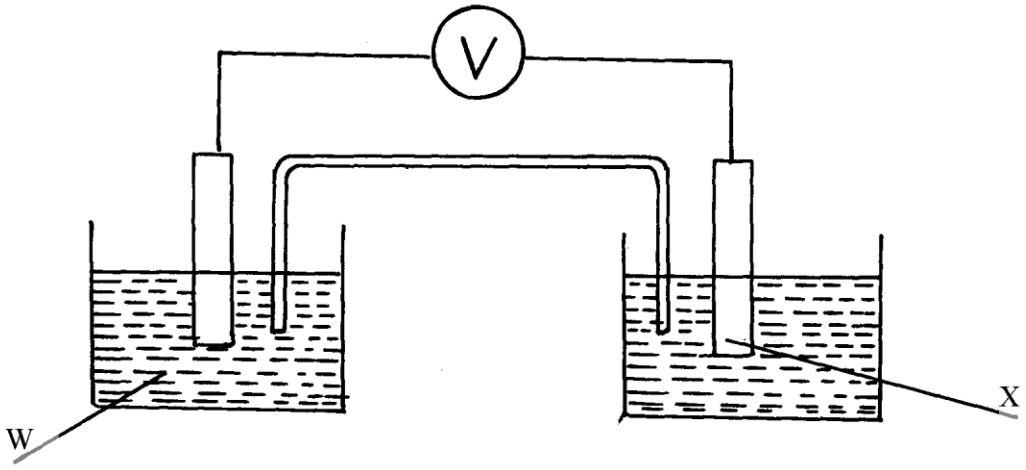
I. Electrons

II. Current.

IV Calculate cell potential (E) for the cell represented in the setup above

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32. (a) The diagram below shows a Zinc –copper cell.



(i) Given the standard electrode potential of Zinc is -0.76V and that of copper is +0.34V, suggest;

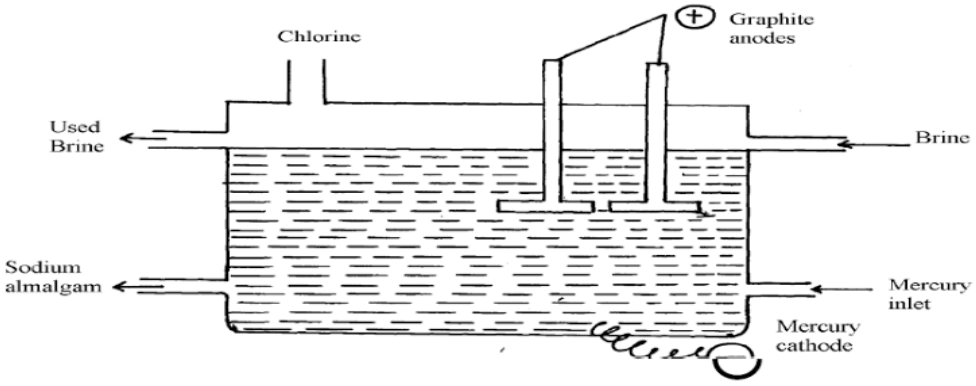
(i)The identity of **W**

(ii) The identity of **X**

(iii) The equation for the overall cell reaction

(iv) The reading on the voltmeter

(c) Sodium hydroxide may be manufactured by the electrolysis of brine as in he diagram below:-



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(i) State the chemical name of brine

(ii) Write the equations for the reactions are the electrodes

Anode

Cathode

(ii) Explain how sodium hydroxide is obtained from the product of this process

33. A typical electrolysis cell uses a current of 40,000 amperes. Calculate the mass (in kilograms) of aluminium produced in one hour (Al=27, 1Faraday=96,500 coulombs)

34. The reaction between ammonia and oxygen to form Nitrogen (II) oxide is highly exothermic

$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

The reaction is carried out in presence of platinium-rhodium catalyst at 1173k and a pressure of 911.952k pa.

i) Explain how each of the following would affect the yield of Nitrogen(II) oxide gas:

a) Reduction in pressure

b) Using a more efficient catalyst

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35. The following table shows the standard reduction potentials of some half cells. Study the table and refer to it to answer the questions that follow;

Half reaction		**E^{θ} volts**
$P^{4+}_{(aq)} + e^- \rightarrow$	$P^{3+}_{(aq)}$	+0.61
$Q^{3+}_{(aq)} + e^- \rightarrow$	$Q^{2+}_{(aq)}$	+0.77
$R_{2(g)} + 2e^- \rightarrow$	$2R^-_{(aq)}$	+0.54
$S^{2+}_{(aq)} + 2e^- \rightarrow$	$S_{(s)}$	-0.44
$T^{2+}_{(aq)} + 2e^- \rightarrow$	$T_{(s)}$	-0.74

a) Identify the strongest oxidizing agent

b) Which substance would be used to oxidize R^- ion to the atom R

c) Study the cell represented below;

$T_{(s)} / T^{2+}_{(aq)} // S^{2+}_{(aq)} / S_{(s)}$

i) Identify the electrodes

ii) Write equations for the reaction taking place in each half- cell

ii) Determine the cell equation and the electromotive force (e.m.f) of the cell represented in (c) above

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iii) In which direction does the electrons flow in the external circuit of the cell whose e.m.f is determined in **(iii)** above

e) A steady current of 2.5A was passed for 15 minutes through a cell containing divalent ions M^{2+}. During this process 0.74g of metal M was deposited (IF = 96500C)

i) Calculate the quantity of electricity passed in this cell

ii) Determine the relative atomic mass of **M**

36. The following table shows the standard reduction potentials of some half cells.Study the table and refer to it to answer the questions that follow;

Half reaction		**E^{θ} volts**
$P^{4+}_{(aq)} + e^{-} \rightarrow$	$P^{3+}_{(aq)}$	+0.61
$Q^{3+}_{(aq)} + e^{-} \rightarrow$	$Q^{2+}_{(aq)}$	+0.77
$R_{2(g)} + 2e^{-} \rightarrow$	$2R^{-}_{(aq)}$	+0.54
$S^{2+}_{(aq)} + 2e^{-} \rightarrow$	$S_{(s)}$	-0.44
$T^{2+}_{(aq)} + 2e^{-} \rightarrow$	$T_{(s)}$	-0.74

a) Identify the strongest oxidizing agent

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b) Which substance would be used to oxidize R^- ion to the atom R

c) Study the cell represented below;

$T_{(s)} / T^{2+}_{(aq)} // S^{2+}_{(aq)} / S_{(s)}$

i) Identify the electrodes

ii) Write equations for the reaction taking place in each half- cell (2 mks)

iii) Determine the cell equation and the electromotive force (e.m.f) of the cell represented in (c) above

iv) In which direction does the electrons flow in the external circuit of the cell whose e.m.f is determined in **(iii)** above

f) A steady current of 2.5A was passed for 15 minutes through a cell containing divalent ions M^{2+}. During this process 0.74g of metal M was deposited (IF = 96500C)

i) Calculate the quantity of electricity passed in this cell

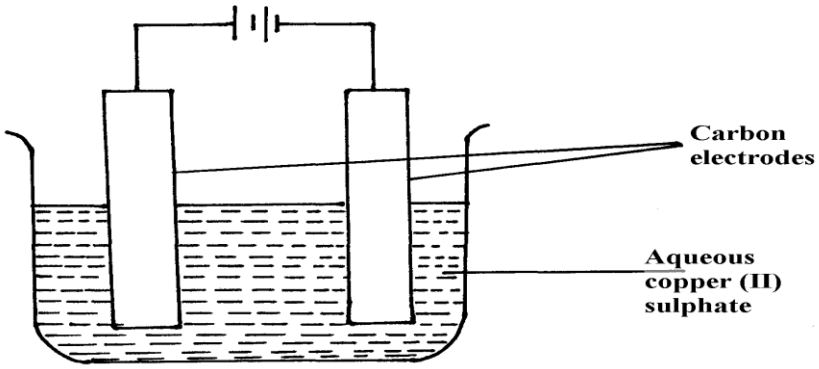
ii) Determine the relative atomic mass of **M**

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37. In the equation below identify the reagent that acts as an acid in the forward reaction.Give a reason for your answer.

$NH_4^+{}_{(aq)} + H_2O_{(l)} \rightarrow NH_{3(aq)} + H_3O^+{}_{(aq)}$

38. A student set up the experiment shown below. Study it and answer the questions that follow.



a) State any **two** observations the student made during the experiment

b) Explain what happens to the pH of the resultant solution at the end of the experiment

39. Copper (II) sulphate solution was electrolysed using copper electrode. A Current of 0.5A was passed for 64.3 minutes and a mass of 0.64g of copper was deposited. (Cu = 63.5)

a) Which electrode decreased in mass during electrolysis? Explain

b) Calculate the quantity of charge needed to deposits 1 mole of copper

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40. State and explain what is observed when crystals of iodine are heated gently

41. (a) State Faradays First Law of Electrolysis

(b) Calculate the volume at s.t.p of hydrogen evolved when 2A of electricity are passed through dilute sulphuric acid for 2hours.

(Molar gas volume at s.t.p = 22.4dm^3, one Faraday= 96500coulombs)

42. The following is an equation for the reaction between ammonia and water

$NH_{3(g)} + H_2O_{(l)} \rightarrow NH^+_{4(aq)} + OH^-_{(aq)}$

(a) Name the base in the backward reaction

43. The common ores of Zinc are zinc blende and calamine:-

(i) Give the chemical formula of Zinc blende

(ii) Explain how the pollution caused by large scale extraction of Zinc can be reduced by having a fertilizer plant close to it

44. The oxides of calcium and phosphorous react as shown below:-

$6CaO_{(s)} + P_4O_{10(s)} \rightarrow 2Ca_3(PO_4)_{2(s)}$

(i) Give a reason why these substances react and yet both are oxides

(ii) Work out the oxidation state of phosphorous in P_4O_{10}

(iii) State **one** use of $Ca_3(PO_4)_2$

45. The standard hydrogen electrode is used as the reference electrode. Some of

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the difficulties in using hydrogen gas as an electrode are:

- Hydrogen is a gas at 25^{o}C
- Hydrogen does not conduct electricity
-The half-cell reaction, $2H^{+}_{(aq)} + 2e^{-}$

$H_{2(g)}$ is slow and takes long to reach equilibrium.

Explain how these difficulties are solved in the standard hydrogen electrode

46. The following are electrode potentials of the half cells

Half cell	**E^{θ} volts**
$M^{2+}_{(aq)} / M_{(s)}$	-0.76
$C^{2+}_{(aq)} / C_{(s)}$	– 0.34

(a) Calculate the potential difference of the following cell.

$M_{(s)}/M^{2t}_{(aq)}$ // $C^{2t}_{(aq)}/C_{(s)}$

47. (a) Name **two** types of isotopes of phosphorous

(b) Explain why phosphorus is stored in water and not in oil like sodium

48. Use the cell representation below to answer the questions that follow:-

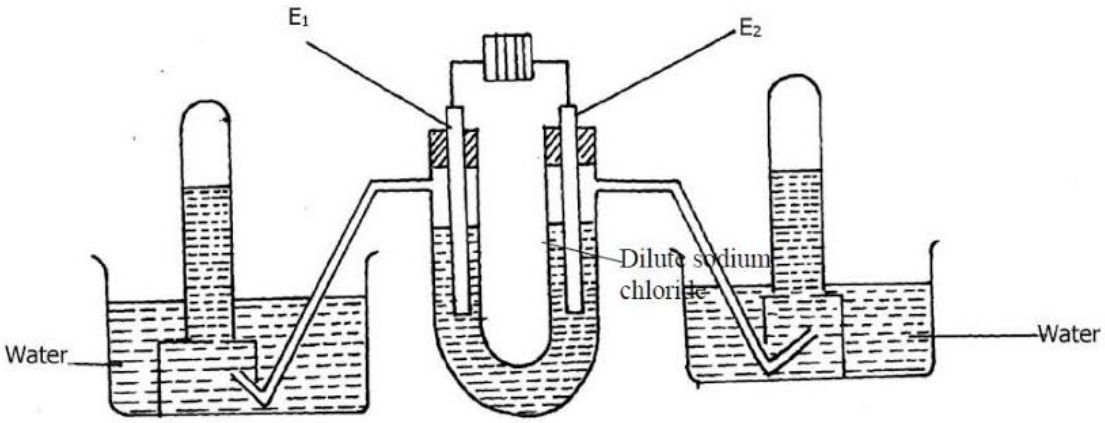
$X_{(s)} /X^{3+}_{(aq)} //W^{2+}_{(aq)} /W_{(s)}$

(a) Write the equation for the cell reaction above

(b) If the e.m.f of the cell is 0.30V and E^{θ} value for W^{2+}/W is -0.44volts, calculate the E^{θ} for $X^{3+}_{(aq)} /X_{(s)}$

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49. The following diagram represents the electrolysis of dilute sodium chloride solution using inert electrodes



Determine the electrode at which different electrolytic products would be produced if the solution is electrolysed for several hours. Explain

50. Complete the following redox equations by adding the correct number of electrons on either reactant or product side of the redox equations:-

(a) $ClO^-_{3(aq)} + 6H^+(aq) \rightarrow \quad Cl_{2(g)} + 3H_2O_{(l)}$

(b) $NO^-_{2(aq)} + H_2O_{(l)} \rightarrow \quad NO^-_{3(aq)} + 2H^+_{(aq)}$

51. The following are standard reduction potentials;

Half-cell	**E^θ/Volts**	**Using iron**
$Al_{(s)} / Al^{3+}_{(aq)}$	-1.66	
$Zn_{(s)} / Zn^{2+}_{aq)}$	-0.76	
$Fe_{(s)} / Fe^{2+}_{(aq)}$	0.44	
$Ni_{(s)} / Ni^{2+}_{(aq)}$	0.25	

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Rewrite the E^{θ} values of the above half-cells using iron as a reference electrode

52. Calculate the mass of metal **J** that would be dissolved at the anode when a solution of **J (III)** nitrite is electrolysed using a current of 1.5amperes for 15minutes (1 Faraday = 96,500C; J = 52)

53. Consider the following standard electrode potentials:

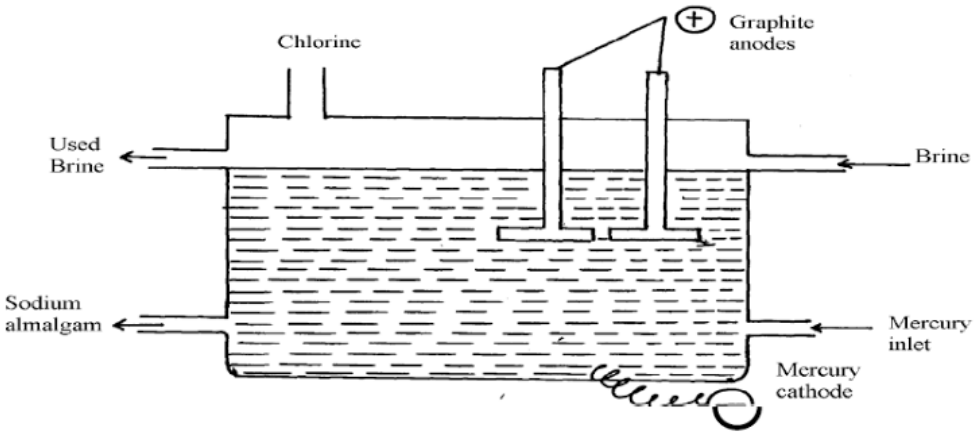
$Sn^{2+}_{(aq)} + 2e^-$	$Sn_{(s)}$	+0.144v
$Fe^{2+}_{(aq)} + 2e^-$	$Fe_{(s)}$	- 0.44v
$Zn^{2+}_{(aq)} + 2e^-$	$Zn_{(s)}$	- 0.76v

Some modern cars are made from steel coated with other metals. Using this data above state and explain the best suited metal for coating steel

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METALS

1. The following diagram represents extraction of sodium by the Down's cell



(a) Why is the anode made of graphite in this case instead of steel which is a better conductor of electricity?

(b) How are the electrolytic products separated from reacting?

(c) Give reasons why large quantities of electricity is required for this process

2. a) Give **one** environmental hazard associated with the extraction of zinc metal

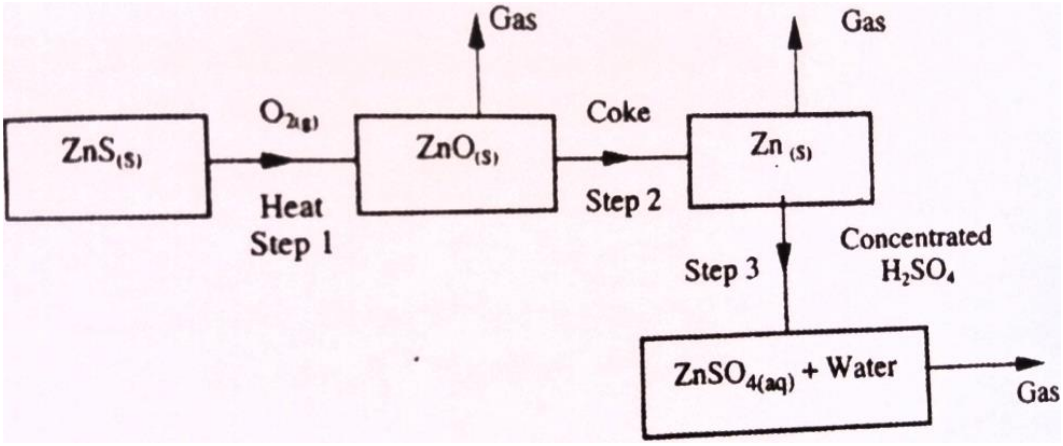
b) Suggest **one** manufacturing plant that can be set up near zinc extraction plant. Give reasons for your answer

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c) What properties of aluminium and its alloys make it suitable for use in making aircraft parts

3. Aluminium is used in making overhead cables. State **two** properties of aluminium that makes it suitable for this use

4. The stages shown in the following diagram can be used to extract zinc from its oxide:-



[a]State the condition necessary for step 2 to occur

[b]Name [i]Gas A

[ii]Use of zinc

5. Dillute sulphuric [vi] acid was electrolysed using platinum electrodes.Name the product formed at the anode and give a eason for your answer

6. Name the following compounds using IUPAC system

(i) CCl_4

(ii) HOCl

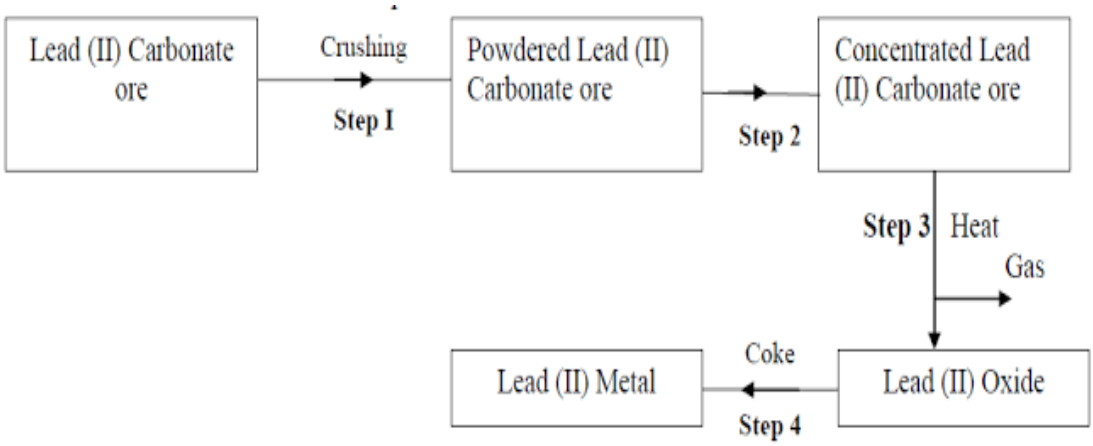
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7. Study the information provided:-

Element	Atomic radius (nm)	Ionic radius (nm)	Melting point of oxide (ºC)
W	0.381	0.418	-117
Y	0.733	0.669	849
Z	0.544	0.489	1399

(a) Explain why the melting point of the oxide of **W** is lower than that of the oxide of **Z**

8. The flow chart below shows steps used in the extraction of lead from one of its ores.



(a) Name the process that is used in **step 2** to concentrate the ore

(b) Write an equation for the reaction which takes place in **step 3**

(c) Name **one** use of lead

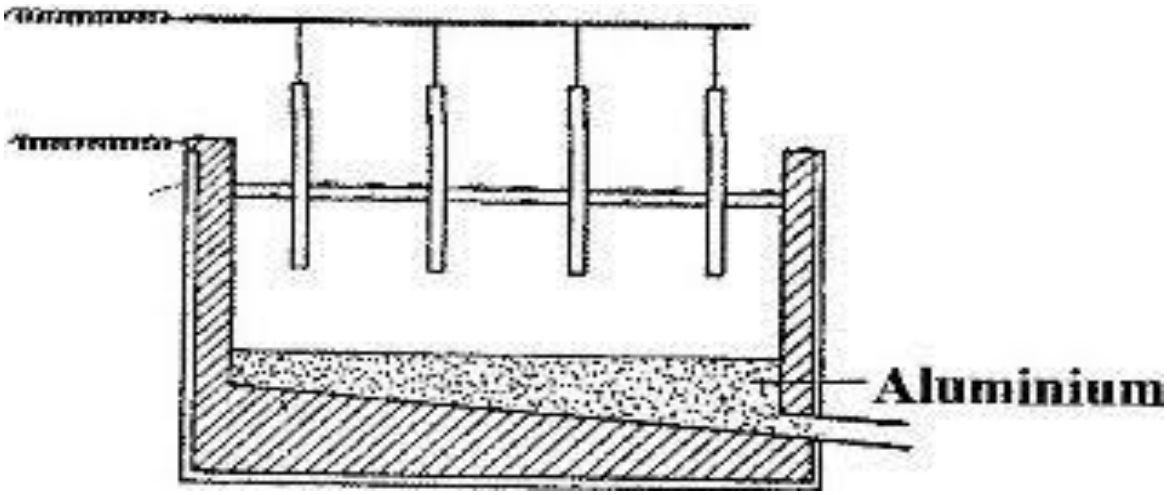
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9. Name the chief ores from which the following metals are extracted

a) Aluminium

b) Copper

10. The diagram below represents the second stage in extraction of aluminium metal



i) On the diagram label the: Anode, cathode and the electrolyte region (s)

ii) The melting point of aluminium oxide is 2054ºC, but the electrolysis is carried out at between 800-900ºC

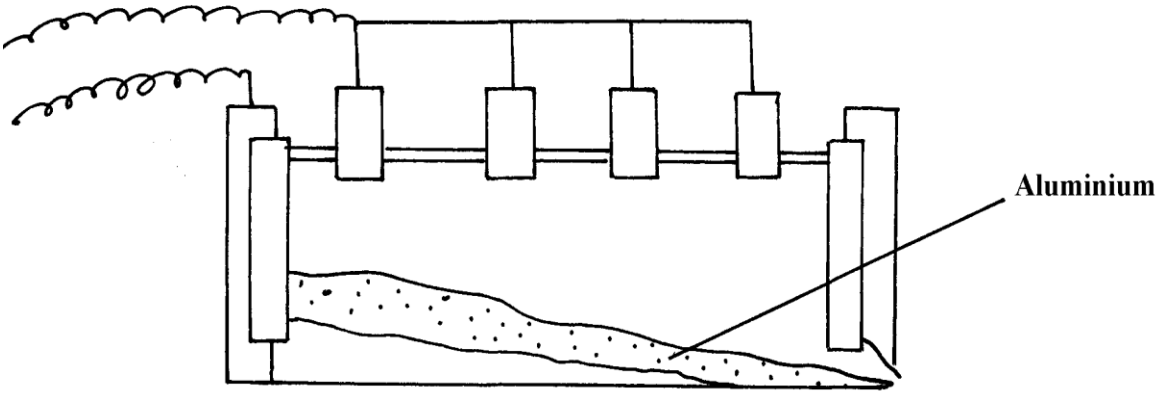
a) Why is the electrolysis not carried out at 2054ºC

b) What is done to lower the temperature?

iii) The aluminium which is produced is tapped off as a liquid .What does this suggest about its melting points?

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11. The extraction of aluminium from its ore takes place in 2 stages. Purification stage and electrolysis stage. Below is set-up for the electrolysis stage:-



(a) (i) Name the chief ore from which aluminium is extracted

(ii) Name **one** impurity which is removed at the purification stage

(b) (i) Label on the diagram each of the following:-

I – Anode

II- Cathode

III- Region containing electrolyte

(iv) The melting point of aluminium oxide is 2054^{o}C but the electrolysis is carried out at between 80^{o}C and 900^{o}C

I. Why is not carried out at 2050^{o}C

II. What is done to lower the temperature

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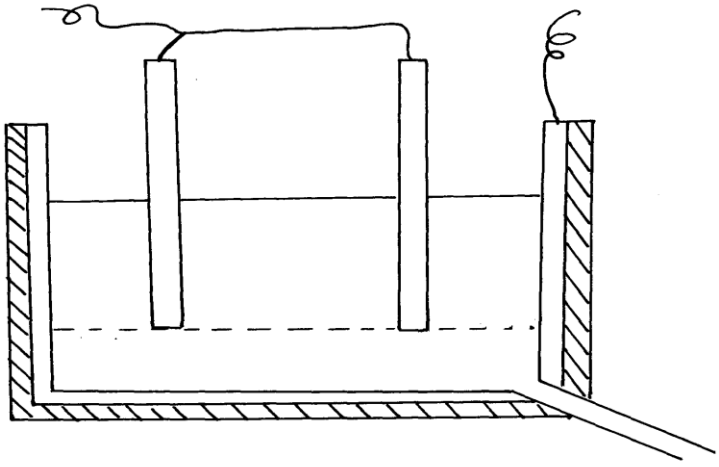
12. Aluminium is the most abundant metal in the earth crust and it is widely extracted for its wide range of uses.

(i) Name **one** major ore of aluminium and give its formula

(ii) Name **two** main impurities found in the ore

(iii)Aluminium oxide is heated first before it is electrolysed. Explain

(iv) Electrolysis of aluminium oxide is done as shown below:



Molten aluminium oxide with cryolite

(a) Identify the anode and cathode on the diagram

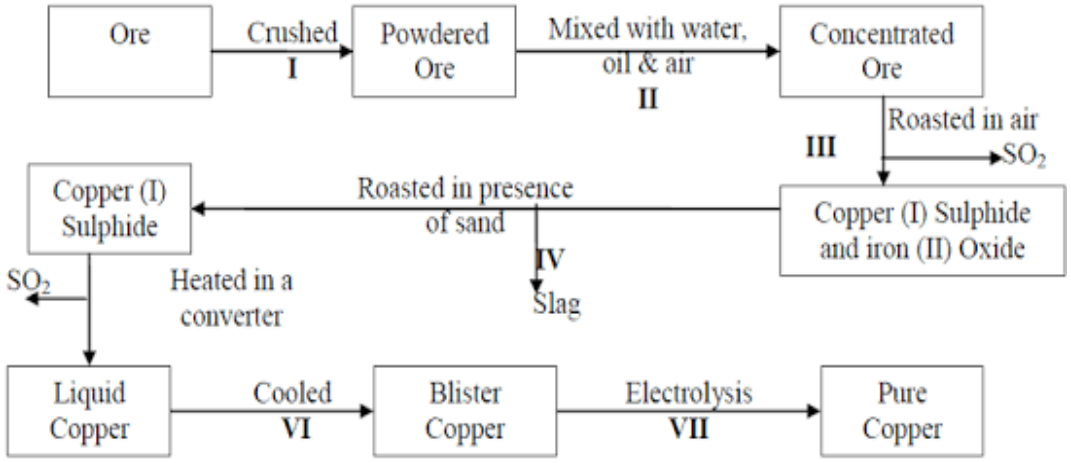
(b) What is the role of electrolyte in the extraction ?

(c) Write half equations for the reactions that occur at the anode and cathode

(d) State **two** uses of aluminium

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13. The diagram below is a flow chart for the extraction of copper. Study it and answer the questions that follow:



(a) Write the formula of the major ore of copper metal

(b) Name **process II**

(c) Give an equation for the reaction that occurs in **stage III**

(d) Explain what happens in stage **IV**

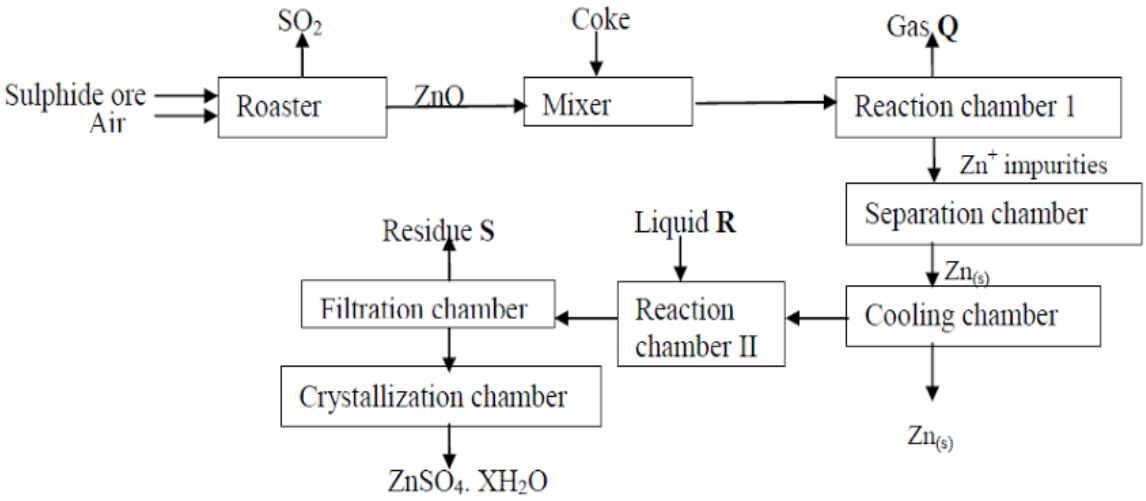
(e) Write half cell equations occurring at the anode and cathode in **stage VII**

(f) Draw a simple diagram showing the set-up that is used in electrolytic Purification of copper

(g) A green rocky materials suspected to be the ore malachite $CuCO_3$. Cu $(OH)_2$.

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14. The flow chart below illustrates the extraction of Zinc. Study it and answer the questions that follow:



a) Name:-

i) Gas **Q** .

ii) Liquid **R**

(iii) Residues **S** .

b) Name the sulphide ore used

c) Before the ore is roasted, it is first concentrated;

(i) Explain why it is necessary to concentrate the ore

(ii) Explain briefly the process of concentrating the ore

d) Write an equation for the reaction that takes place in the:-

(i) Roaster

(ii) Reaction chamber

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(e) (i) Name **one** major impurity present in the sulphide ore used

(ii) Write an equation to show how the impurity in **(e)(i)** above is removed

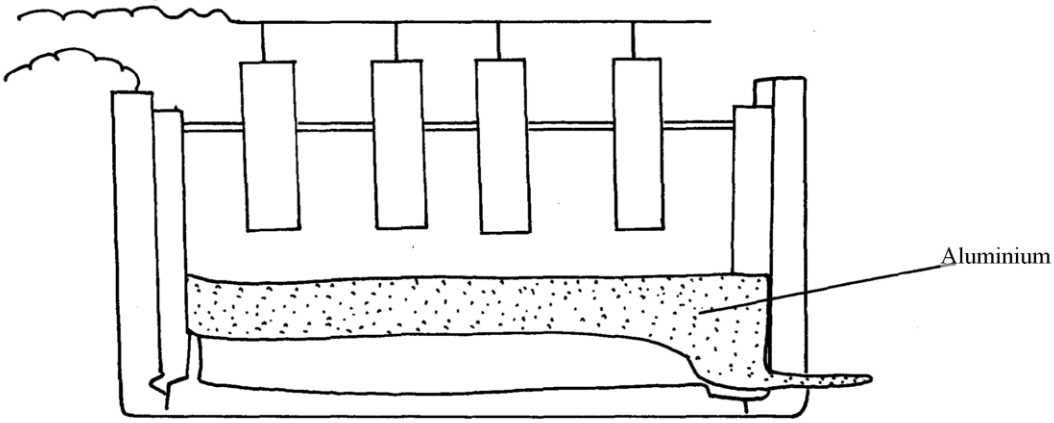
g) Given that the sulphide ore contains only 45% Zinc sulphide by mass, calculate :

(i) The mass in grams of Zinc sulphide that would be obtained from 250kg of the ore.

(ii) The volume of Sulphur (IV) oxide that would be obtained from the mass of sulphide ore at room temperature and pressure

(Zn = 65.4, S = 32.0, O= 16.0, I mole of gas occupies 24.0 liters at r.t.p)

15. The diagram below is for extraction of Aluminium from its ore. It takes place in stages.Use it to answer the questions that follow:-



(a) Name the **two** stages mentioned above *

(b) Name:-

(i) The ore from which Aluminium is extracted

(ii) The impurities removed during the extraction of Aluminium*

(c) On the diagram label:-

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(i) The electrodes *

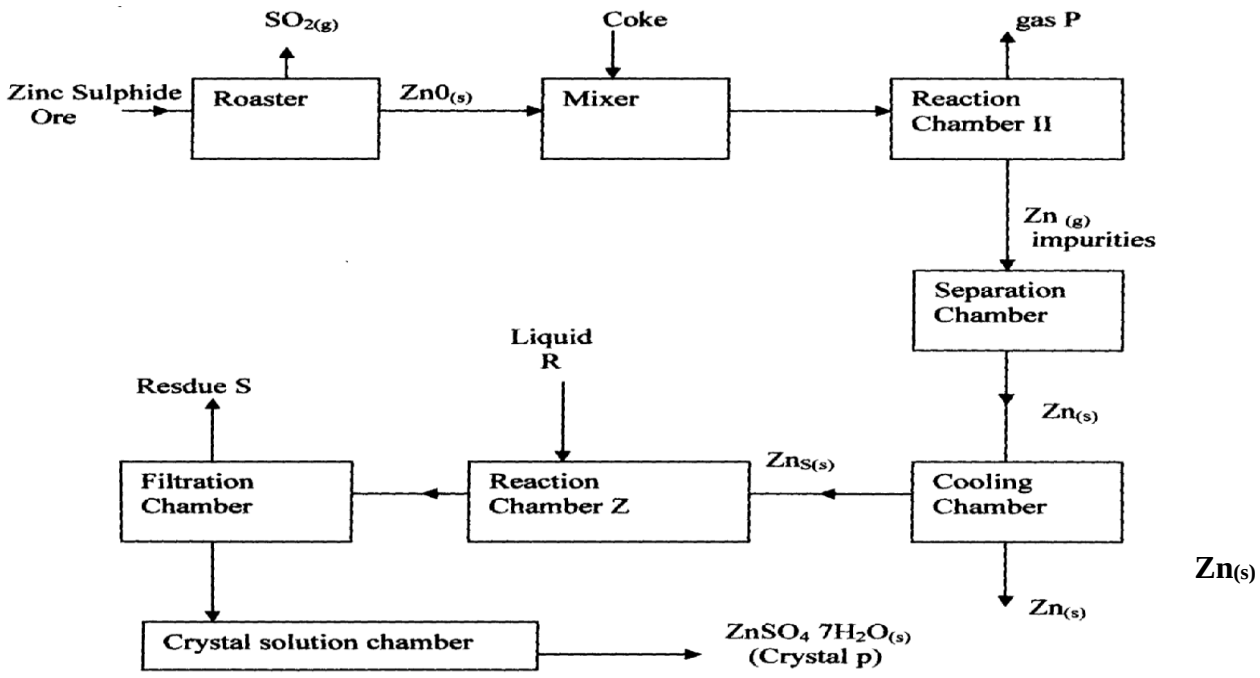
(ii) The region containing the electrolyte *

(d) Molten cryolite is added to Aluminium Oxide during extraction. Explain *

16. A current of 3A was passed through fused aluminium oxide for 10minutes. Calculate the mass of Aluminium obtained at one electrode (Al = 27.0, IF = 96500C) *

17. (a) Name **one** ore that can be used to commercially extract Zinc metal

(b) The flow chart below illustrates the extraction of zinc and preparation of zinc sulphate crystals.



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(i) Name :

(1) Gas **P**

(11) Liquid **R**

(III) Residue **S**

(ii) What is the role of coke in the above process?

(iii)Name the main impurity removed in the separation chamber

(iv) Write an equation for the reaction that takes place in ;

(1). Roaster

(11). Reaction chamber II

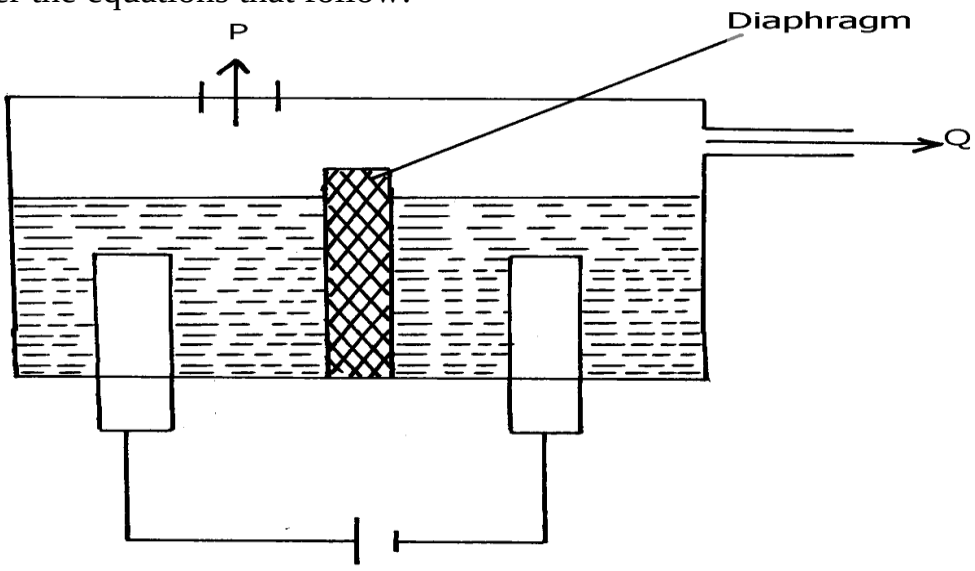
(v) Write an equation for the reaction that takes place between Zinc metal and liquid **R**

(vi) Given that zinc Suiphide ore contains only 45% of zinc Suiphide by mass, calculate the mass in grams of zinc Sulphide that would be obtained from 250kg of the ore .

(vii) Give **one** commercial use of Zinc metal

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18. The diagram below is a simplified apparatus for extraction of sodium. Study it and answer the equations that follow:-

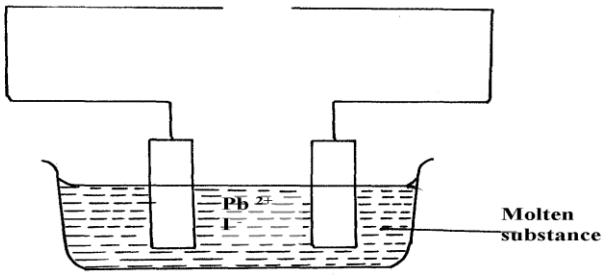


(a) Which substances come out at:- **P** & **Q**

(b) What is the role of the diaphragm

(c) Write the equation of the reaction forming sodium

19. The set-up below was used to investigate electrolysis of a certain molten compound;-



(a) Complete the circuit by drawing the cell in the gap left in the diagram

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(b) Write half-cell equation to show what happens at the cathode

(c) Using an arrow show the direction of electron flow in the diagram above

20. (a) Name **two** ores from which Zinc metal is mostly extracted

(b) One of the steps in the extraction of Zinc metal from its ore is roasting of the ore in excess oxygen. Write equations for the reactions that take place when the ore in **(a)** above is roasted

21. Aluminum metal is mainly extruded from molten Bauxite by electrolysis.

a) Name the main impurity in this ore.

b) Briefly describe how the impurity is removed from the ore before electrolysis process.

22. (a) In the extraction of aluminium form its ore by the use of electrolysis, explain the following observations:-

(i) the graphite anode is replaced from time to time

(ii) the steel tank which can also serve as an electrode is also lined with graphite cathode

(b) Sodium and aluminium metals both conduct electricity, but aluminium is a better conductor of electricity than sodium. Explain

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ORGANIC CHEMISTRY II (ALKANOIC ACIDS AND ALKANOLS)

1. A student mixed equal volumes of Ethanol and butanoic acid. He added a few drops of concentrated Sulphuric (VI) acid and warmed the mixture

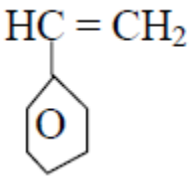
   (i) Name and write the formula of the main products

   Name

   Formula

   ii). Which homologous series does the product named in (i) above belong?

2. The structure of the monomer phenyl ethene is given below:-



   a) Give the structure of the polymer formed when four of the monomers are added together

   b) Give the name of the polymer formed in **(a)** above

3. Explain the environmental effects of burning plastics in air as a disposal method

4. Write chemical equation to represent the effect of heat on ammonium carbonate

5. Sodium octadecanoate has a chemical formula $CH_3(CH_2)_6\ COO^-Na^+$, which is used as soap. Explain why a lot of soap is needed when washing with hard water

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6. A natural polymer is made up of the monomer:

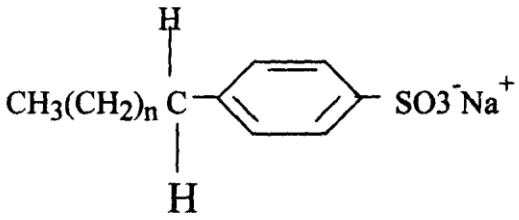
(a) Write the structural formula of the repeat unit of the polymer

(b) When 5.0×10^{-5} moles of the polymer were hydrolysed, 0.515g of the monomer were obtained.

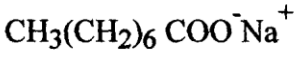
Determine the number of the monomer molecules in this polymer.

(C = 12; H = 1; N = 14; O =16)

7. The formula below represents active ingredients of two cleansing agents **A** and **B**



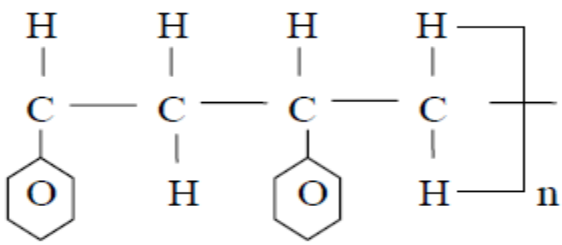
Agent A



Agent B

Which one of the cleansing agents would be suitable to be used in water containing magnesium hydrogen carbonate? Explain

8. Study the polymer below and use it to answer the questions that follow:



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(a) Give the name of the monomer and draw its structures

(b) Identify the type of polymerization that takes place

(c) State **one** advantage of synthetic polymers

9. Ethanol and Pentane are miscible liquids. Explain how water can be used to separate a mixture of ethanol and pentane

10. (a) What is absolute ethanol?

(b) State **two** conditions required for process **G** to take place efficiently

11. (a) (i) The table below shows the volume of oxygen obtained per unit time when hydrogen peroxide was decomposed in the presence of manganese (IV) Oxide. Use it to answer the questions that follow:-

Time in seconds	**Volume of Oxygen evolved (cm^3)**
0	0
30	10
60	19
90	27
120	34
150	38
180	43
210	45
240	45
270	45
300	45

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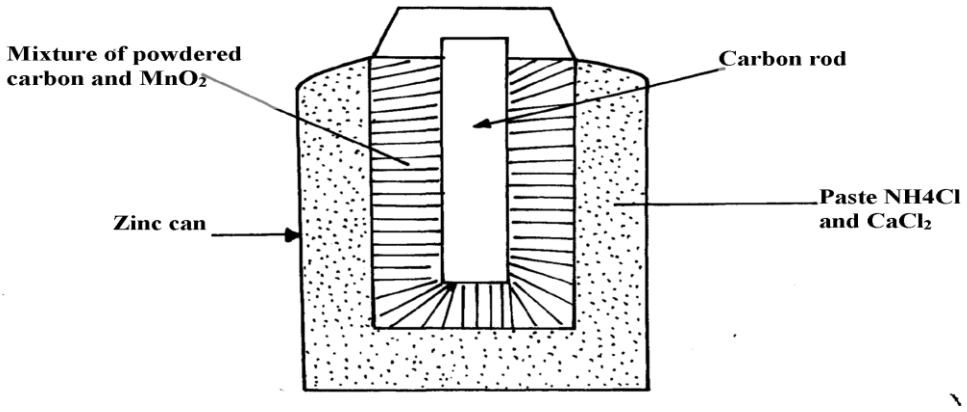
(i) Plot a graph of volume of oxygen gas against time

(ii) Determine the rate of reaction at time 156 seconds

(iii) From the graph, find the time taken for 18cm^3 of oxygen to be produced

(iv) Write a chemical equation to show how hydrogen peroxide decomposes in the presence of manganese (IV) Oxide

(b) The diagram below shows how a Le'clanche (Dry cell) appears:-



(i) What is the function of MnO_2 in the cell above?

(ii) Write the equation of a reaction that occurs at the cathode

(iii) Calculate the mass of Zinc that is consumed when a current of 0.1amperes flows through the above cell for 30minutes

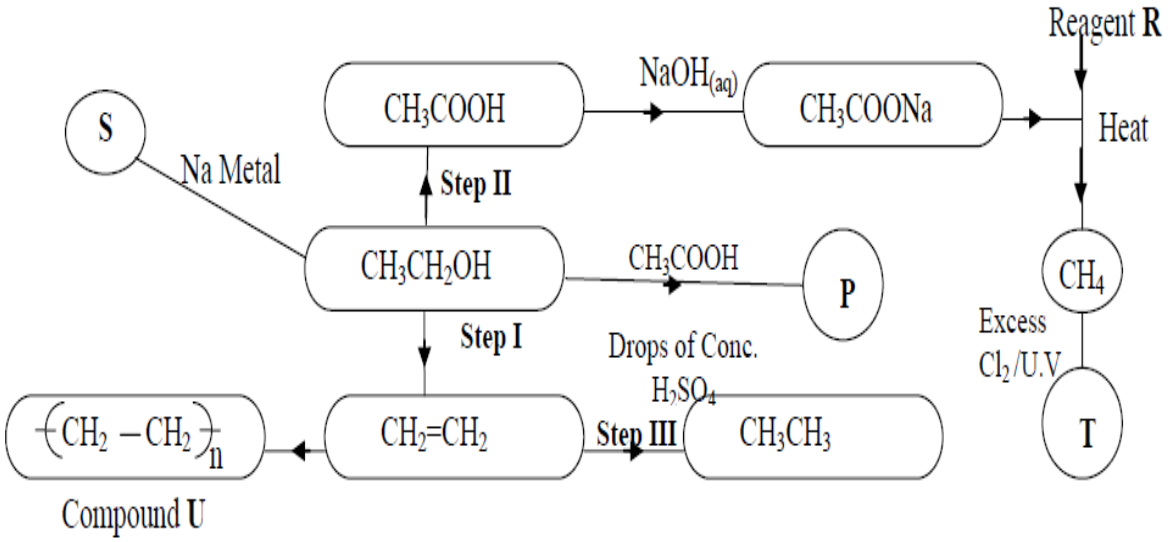
(1F =96500c Z=65)

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12. (a) Give the IUPAC name of the following compound:

(i) $CH_3COOCH_2CH_3$

b). The structure below shows some reactions starting with ethanol. Study it and answer the questions that follow:



(i) Write the formula of the organic compounds **P** and **S**

*

(ii) Name the type of reaction, the reagent(s) and condition for the reactions in the following steps :-

(I) Step I *

(II) Step II *

(III) Step III *

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(iii) Name reagent **R**

(iv) Draw the structural formula of **T** and give its name

*

(v) (I) Name compound

U

(II) If the relative molecular mass of **U** is 42000, determine the value of n (**C**=12, **H**=1)

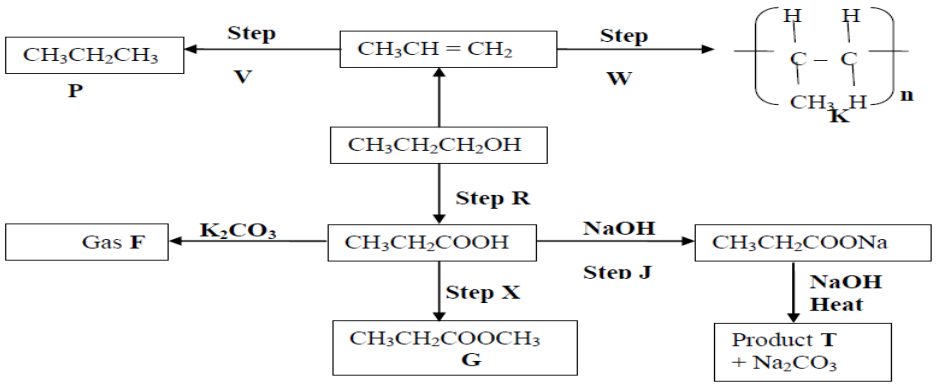
(c) State why C_2H_4 burns with a more smoky flame than C_2H_6 *

13. a) State **two** factors that affect the properties of a polymer

b) Name the compound with the formula below :

$CH_3CH_2CH_2Ona$

c) Study the scheme below and use it to answer the questions that follow:-



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i) Name the following compounds:-

I. Product **T** II. **K**

ii) State **one** common physical property of substance **G**

iii) State the type of reaction that occurred in step **J**

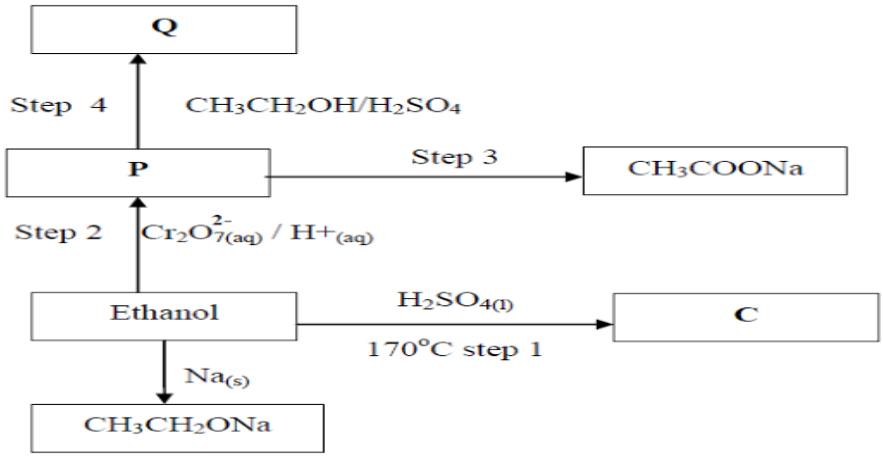
iv) Give **one** use of substance **K**

v) Write an equation for the combustion of compound **P**

vi) Explain how compounds CH_3CH_2COOH and $CH_3CH_2CH_2OH$ can be distinguished chemically

vii) If a polymer **K** has relative molecular mass of 12,600, calculate the value of **n** (H=1 C =12)

14. Study the scheme given below and answer the questions that follow:-



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(a) (i) Name compound **P**

(ii) Write an equation for the reaction between CH_3CH_2COOH and Na_2CO_3

(b) State **one** use of polymer **Q**

(c) Name **one** oxidising agent that can be used in **step II**

d). A sample of polymer **Q** is found to have a molecular mass of 4200.
Determine the number of monomers in the polymer (H = 1, C = 12)

(e) Name the type of reaction in **step I**

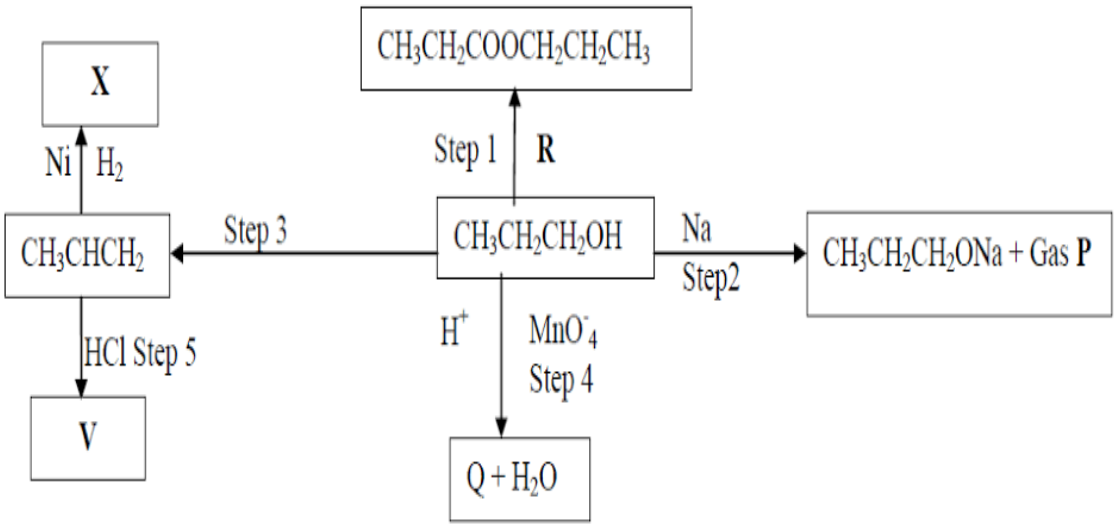
(f) State **one** industrial application of **step III**

(g)State how burning can be used to distinguish between propane and propyne.
Explain your answer

(h) $1000cm^3$ of ethene (C_2H_4) burnt in oxygen to produce Carbon (II) Oxide and water vapour. Calculate the minimum volume of air needed for the complete combustion of ethene (Air contains 20% by volume of oxygen)

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15. (a) Study the schematic diagram below and answer the questions that follow:-



(i) Identify the following:

Substance **Q**

Substance **R**

Gas **P**

(ii) Name:

Step 1.

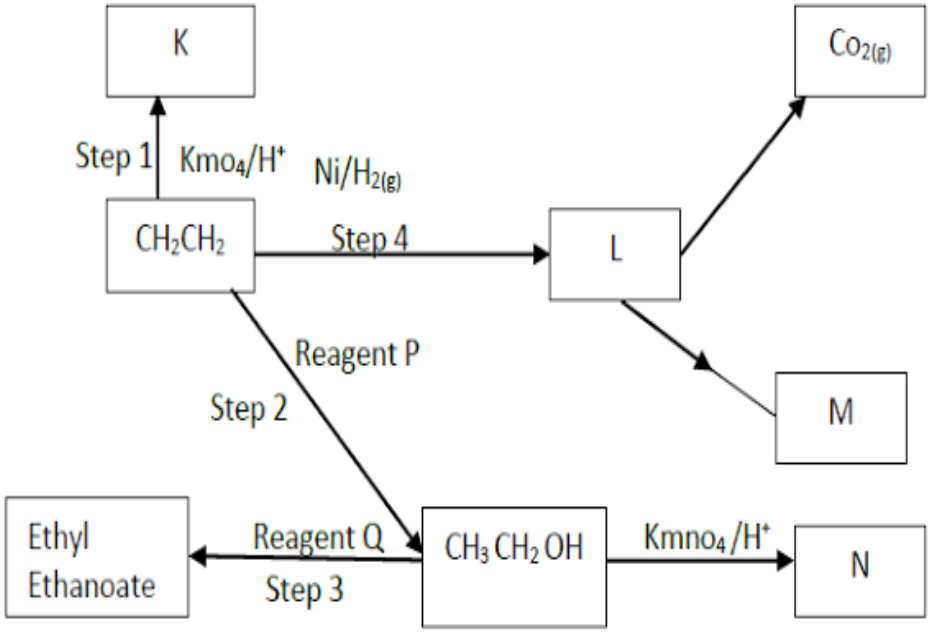
Step 4.

(iii) Draw the structural formula of the major product of step **5**

(iv) State the condition and reagent in step **3**

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



(a) (i) Name the following organic compounds:

M

L

(ii) Name the process in step:

Step 2

Step 4

(iii) Identify the reagent **P** and **Q**

(iv) Write an equation for the reaction between $CH_3CH_2CH_2OH$ and sodium

17. a) Give the names of the following compounds:

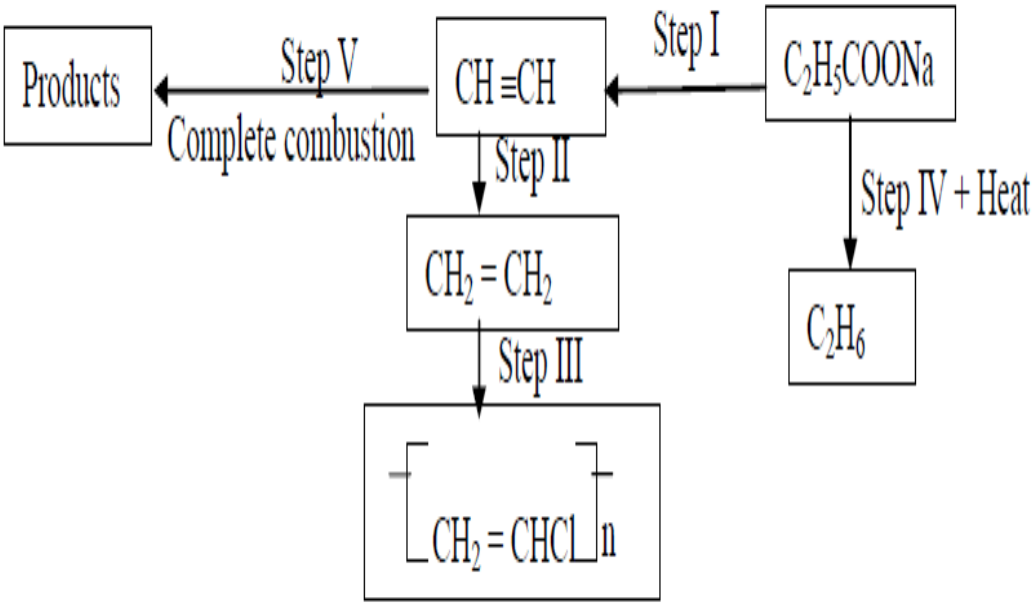
i) $CH_3CH_2CH_2CH_2OH$

ii) CH_3CH_2COOH

iii) $CH_3C - O- CH_2CH_3$

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18. Study the scheme given below and answer the questions that follow;



i) Name the reagents used in:

Step I:

Step II

Step III

ii) Write an equation to show products formed for the complete combustion of CH = CH

iii) Explain **one** disadvantage of continued use of items made form the compound formed in step III

19. A hydrated salt has the following composition by mass. Iron 20.2 %, oxygen 23.0%, sulphur 11.5%, water 45.3%

i) Determine the formula of the hydrated salt (Fe=56, S=32, O=16, H=11)

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ii) 6.95g of the hydrated salt in **c(i)** above were dissolved in distilled water and the total volume made to $250cm^3$ of solution. Calculate concentration of the resulting salt solution in moles per litre. (Given that the molecula mass of the salt is 278)

20. i) Write an equation to show products formed for the complete combustion of

CH = CH

ii) Explain **one** disadvantage of continued use of items made form the compound formed in step III

21. Give the IUPAC name for each of the following organic compounds;

i) $CH_3 - CH - CH_2 - CH_3$

|

OH

ii) $CH_3 – CH – CH_2 – CH_2 - CH_3$

|

C_2H_5

iii) $CH_3COOCH_2CH_2CH_3$

22. The structure below represents a cleansing agent.

O

||

$R – S – O^-Na^+$

||

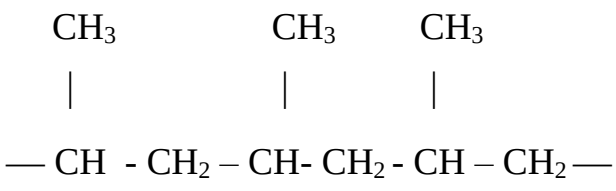
O

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a) State the type of cleansing agent represented above

b) State **one** advantage and one disadvantage of using the above cleansing agent.

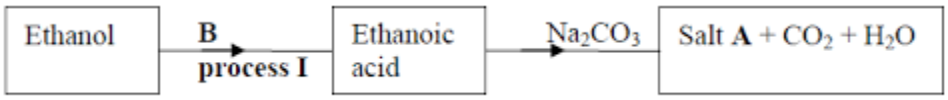
23. The structure below shows part of polymer .Use it to answer the questions that follow.



a) Derive the structure of the monomer

b) Name the type of polymerization represented above

24. The flow chart below represents a series of reactions starting with ethanoic acid:-



(a) Identify substances **A** and **B**

(b) Name the process **I**

25. a) Write an equation showing how ammonium nitrate may be prepared starting with ammonia gas

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(b) Calculate the maximum mass of ammonium nitrate that can be prepared using 5.3kg of ammonia (H=1, N=14, O=16)

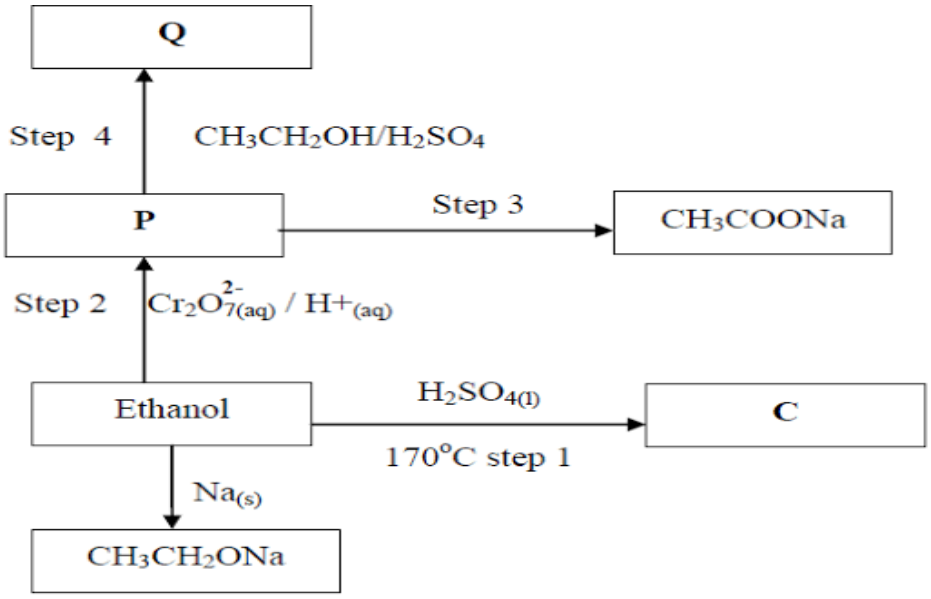
26. (a) What is meant by the term, esterification?

(b) Draw the structural formulae of **two** compounds that may be reacted to form ethylpropanoate

27. (a) Draw the structure of pentanoic acid

(b) Draw the structure and give the name of the organic compound formed when ethanol reacts with pentanoic acid in presence of concentrated sulphuric acid

28. The scheme below shows some reactions starting with ethanol. Study it and answer the questions that follow:-



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(i) Name and draw the structure of substance **Q**

(ii) Give the names of the reactions that take place in **steps 2** and **4**

(iii) What reagent is necessary for reaction that takes place in step 3

29. Substances **A** and **B** are represented by the formulae **ROH** and **RCOOH** respectively.They belong to two different homologous series of organic compounds. If both A and B react with potassium metal:

(a) Name the common product produced by both

(b) State the observation made when each of the samples **A** and **B** arereacted with sodium hydrogen carbonate

(i) **A**

(ii) **B**

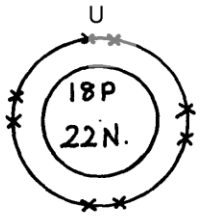
30. Below are structures of particles. Use it to answer questions that follow. In each case only electrons in the outermost energy level are shown

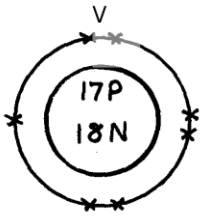
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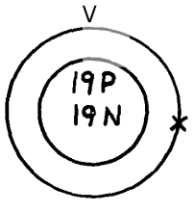
P = Proton

N = Neutron

X = Electron







(a) Identify the particle which is an anion

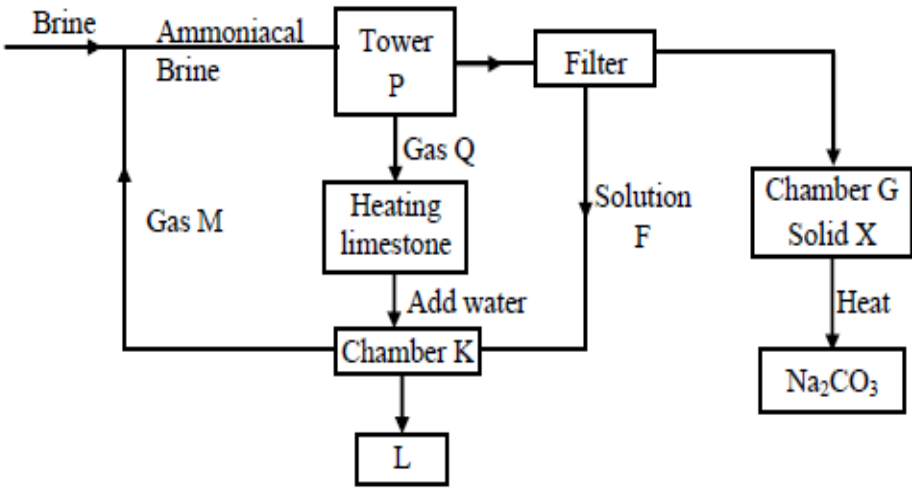
31. Plastics and rubber are extensively used to cover electrical wires.

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(a) What term is used to describe plastic and rubbers used in this way?

(b) Explain why plastics and rubbers are used this way

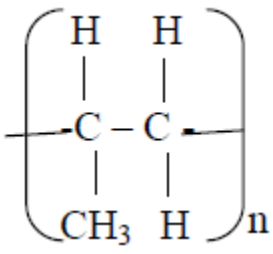
32. The scheme below represents the manufacture of a cleaning agent **X**



(a) Draw the structure of **X** and state the type of cleaning agent to which **X** belong

(b) State **one** disadvantage of using **X** as a cleaning agent

33. The structure below represents a polymer. Study and answer the questions that follow:-



(i) Name the polymer above.....

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(ii) Determine the value of **n** if giant molecule had relative molecular mass of 4956

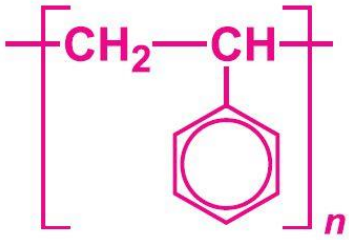
34. $RCOO^-Na^+$ and $RCH_2OSO_3^-Na^+$ are two types of cleansing agents;

i) Name the class of cleansing agents to which each belongs

ii) Which one of these agents in **(i)** above would be more suitable when washing with water from the Indian ocean. Explain

iii) Both sulphur (IV) oxide and chlorine are used bleaching agents. Explain the difference in their bleaching properties

35. The formula given below represents a portion of a polymer



(a) Give the name of the polymer

(b) Draw the structure of the monomer used to manufacture the polymer

36. Substances **A** and **B** are represented by the formulae **ROH** and **RCOOH** respectively. They belong to two different homologous series of organic compounds. If both A and B react with potassium metal:

(a) Name the common product produced by both

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(b) State the observation made when each of the samples **A** and **B** are reacted with sodium hydrogen carbonate

(i) **A**

(ii) **B**

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RADIOACTIVITY

1. Complete the following equation by determining the values of **U** and **V**.

$$^{234}_{90}\mathbf{Th} \longrightarrow {}^{u}_{v}\mathbf{Pa} + {}^{0}_{-1}\mathbf{e}$$

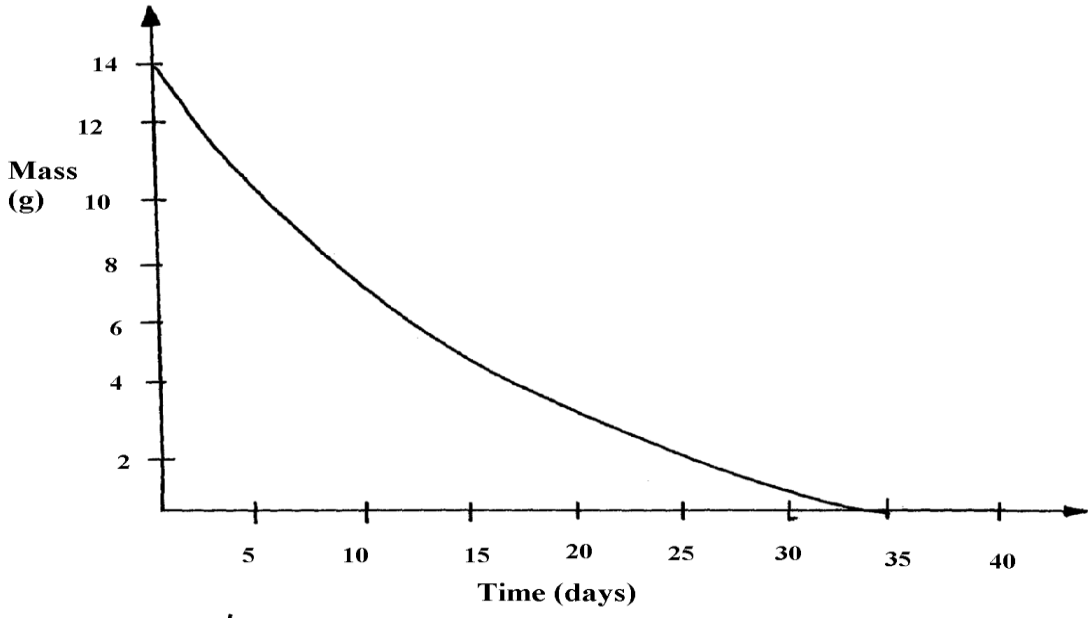
U…… V……..

2. Distinguish between nuclear fusion and fission

3. Uranium -238 disintegrates by emitting an alpha particle to form substance **Y**. Nuclide **Y** emits a beta particle to form substance **Z**. Write down nuclear equations to show how substance **Y** and **Z** are formed (U=At No. 92)

4. (a) What is a nuclide?

   (b) The graph below shows the radioactive decay of a certain nuclide. Determine the half-life of the nuclide



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(c) What effect do excessful exposures of radiation have on metals?

5. (a) State **two** ways in which nuclear reactions differ from ordinary chemical reactions

[b] If the activity of Thorium -234 is reduced to 25% in 48hours, find its half life

6. **Y** grams of a radioactive isotope take 120days to decay to 3.5grams. The half-life period of the isotope is 20days

(a) Find the initial mass of the isotope

(b) Give **one** application of radioactivity in agriculture

7. Study the nuclear reactions given and answer the questions that follow:

$$^{12}_{6}\mathbf{X} \xrightarrow{\text{Step I}} {}^{14}_{6}\mathbf{Y} \xrightarrow{\text{Step II}} {}^{14}\mathbf{Z}$$

(a) Write an equation for the nuclear reaction in step II

(lmk)

(b) Give **one** use of **Y**

(lmk)

8. Give **two** uses of radioactive isotopes in medicine.

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9. Study the information in the following table and answer the questions that follow. The letters do not represent the actual chemical symbols of the elements.

ELEMENT	**U**	**V**	**W**	**X**	**Y**	**Z**
NUMBER OF PROTONS	18	20	6	16	19	17
NUMBER OF NEUTRONS	22	20	8	16	20	20

Which of the above elements are:

(i) Likely to be radioactive?

(ii) Able to form a compound with the highest ionic character?

10. The isotope decays by Beta, β -emission to a stable nuclide. The half-life of the isotope is 15hours 2.0g of is allowed to decay. Determine the mass of left after 90hours

11. (a) Complete the following nuclear equation

Cr Mn + _____

(b) 100g of a radioactive substance was reduced to 12.5g within 15.6 years. Determine the half-life of the substance

12. **Y** grams of a radioactive isotope take 120days to decay to 3.5grams. The half-life period of the isotope is 20days

(a) Find the initial mass of the isotope

(b) Give **one** application of radioactivity in agriculture

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