MARANDA HIGH SCHOOL

The Kenya Certificate of Secondary Education

EXAM 2 FORM 4

233/1

Chemistry (Theory) Paper 1

FEB, 2024 Time: 2 Hours

Name: Marking guide ..... Adm No: .....

Stream: ..... Signature: .....

233/1 Chemistry PP1 - Theory
Monday, 19th Feb, 2024
Mid-Morning
Time: 10.45 am-12.45pm

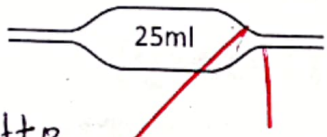
Instructions to Candidates

a) *Write your name and Admission number in the spaces provided above.*
b) *Sign and write the date of examination in the spaces provided above*
c) *Answer **ALL** the questions in the spaces provided below each question.*
d) *Mathematical tables and silent electronic calculators may be used.*
e) *All working **MUST** be clearly shown where necessary.*
f) ***This paper consists of 13 printed pages***

For Examiner's Use Only

Questions	Max. Score	Candidate's Score
1 – 27	80	

1.(a) Name the apparatus shown below. (1 mark)



Pipette. 1

(b) Sate **one** safety measure to be taken while using the apparatus shown. (1 mark)

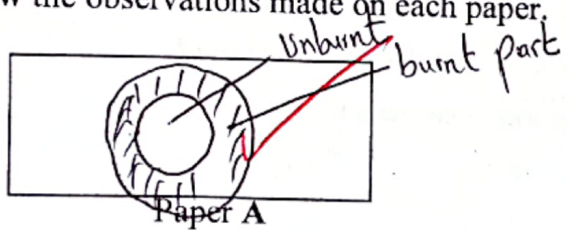
- Use of pipette filler 1 3

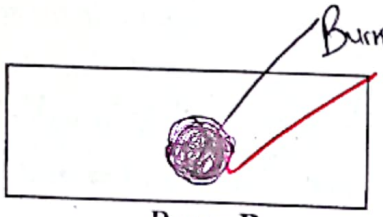
(c) State the use of this apparatus in the laboratory. (1 mark)

- Measuring exact volume of liquids 1

2.Two papers **A** and **B** were placed at different levels of a non-luminous flame. Paper **A** was placed at the lowest part of the flame while **B** was placed at the tip.

(a) Indicate **below** the observations made on each paper. (2 marks)





(b) Explain the observations made on paper **A**. (1 mark)

Unburnt in contact with almost colorless which is not hottest 3
part of the flame // incomplete combustion. Part in contact with pale blue burnt.

3.The pH values of some solutions labeled **E** to I are given in the table **below**. Use the information to answer the questions that follow.

pH	14.0	1.0	8.0	6.5	7.0
Solution	E	F	G	H	I

(a) Identify the solution with the highest concentration of hydroxide ions. Give a reason for your answer. (1 mark)

Solution E Strongly basic 1

Dr Getrude.

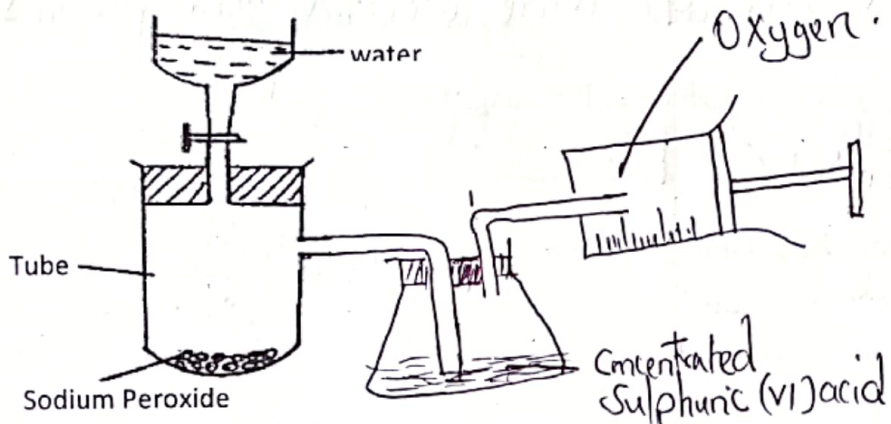
(c) Which solution can be used as a remedy for acid indigestion in the stomach? (1 mark)

G ✓1

(d) Which solution would react most vigorously with magnesium metal? (1 mark)

F ✓1 2

4. The diagram below represents part of a set-up for preparing and collecting a dry sample of oxygen gas.



Drying – 1mk
Collection – 1mk

(a) Complete the diagram. (2 marks)

(b) State **one** commercial use of oxygen gas. (1 mark) 3

– Air enriched with oxygen used in hospitals with patients with breathing difficulty ✓1

– ~~Air~~ Mixture of oxygen and acetelyne used in welding and cutting of metals

Accept @ 1mk.

5. Study the table and answer the questions that follow. The letters are not actual symbols of the elements or ion.

Particle	Number of		
	Protons	Electrons	Neutrons
L	18	18	12
M	17	18	18
N	20	20	20
O	9	9	10
P	19	18	22

Rose.

05

(a) With reasons, choose the letters that represent

(i) A cation. (1 mark)

P Has lost electron / More protons than electrons

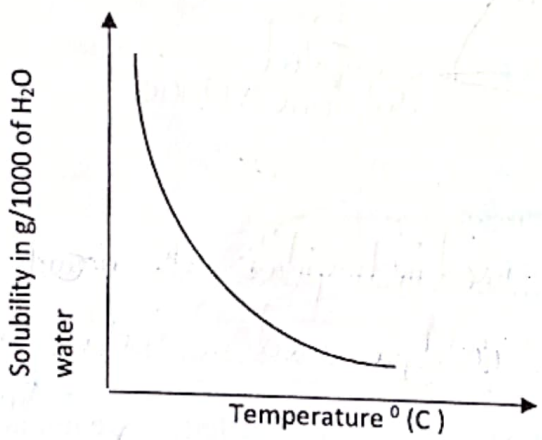
(ii) An anion. (1 mark)

M Has gained / More electrons than protons

(c) Name the chemical family to which element P belongs to (1 mark)

Alkali metals

6. The graph below represents the solubility curve of a gas in water



(a) State the conclusion that can be drawn from the curve about the solubility of the gas. (1 mark)

Solubility decrease with increase in temperature

(b) The solubility of potassium chlorate at 80°C is 40g per 100g of water. What mass of potassium chlorate will saturate 65g water at 80°C. (2 marks)

Solubility = $\frac{\text{Mass of solute} \times 100}{\text{Mass of solvent}}$

Mass of solute = $\frac{40 \times 65}{100}$ = 26g

Obonyo

2

7.(a) State Graham's law of diffusion. (1 mark)

Under the same condition of temperature and pressure, the rate of diffusion of a given mass of a gas is inversely proportional to the square root of its density.

(b) Two gases L and M ~~have~~ relative densities 1.98 and 2.90 respectively. They diffuse under similar conditions. If the relative molecular mass of M is 64, determine the relative molecular mass of L. (2 marks)

$$\frac{d_M}{d_L} = \frac{M_M}{M_L}$$

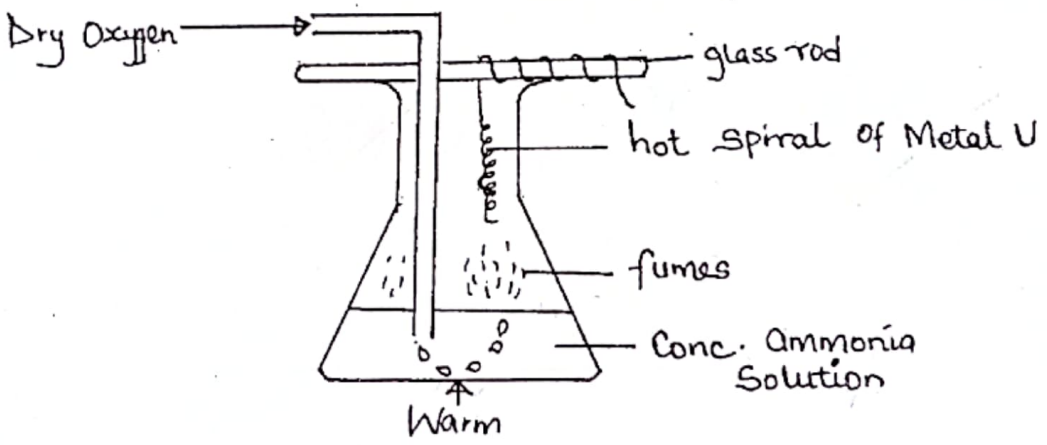
$$\left(\frac{2.90}{1.98}\right)^2 = \left(\frac{64}{M_L}\right)^2$$

$$= \frac{2.90}{1.98} = \frac{64}{M_L}$$

$$M_L = 43.7$$

2

8. Study the diagram **below**:



(a) Give the most likely identity of metal **U**. (1 mark)

Platinum / Nickome / Copper

(b) State **two** observations made in the conical flask. (2 marks)

- Metal U glows red
- Brown fumes of NO_2

3

Joshua

08

9. The reversible reaction represented below is for the equilibrium established in the reaction of hydrogen and iodine.

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$, $\Delta H = -10KJmol^{-1}$

(a) State and explain the effect on the equilibrium of decreasing the pressure. (2 marks)

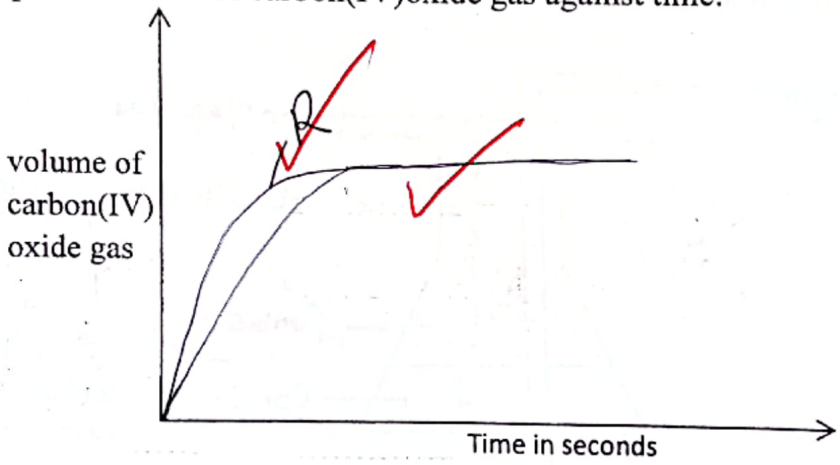
No effect / Equal number of gaseas particles ✓ 2

(b) State the effect on the equilibrium of lowering the temperature. (1 mark)

Shifts to the right ✓ 1

10. Metal carbonate was added to 30cm³ of 1M hydrochloric acid in a beaker.

(a) Sketch a graph of volume of carbon(IV)oxide gas against time. (1 mark)



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(b) On the same axis sketch another graph when 2M of the hydrochloric acid is used with the same mass of the metal carbonate and labeled it R. (1 mark)

(c) State the factor which affect the rate of reaction in this experiment. (1 mark)

Concentration ✓ 1

11. A metal **A** with atomic number 11 burns in chlorine to produce a white solid **B**.

(a) State the following properties of **B**.

(i) Solubility. (1 mark)

Soluble in water ✓ 1 2

Rose | Wechuli

(c) Electrical conductivity. (1 mark)

Conducts electricity in molten state or aqueous state

(b) Write an equation to show the formation of **B**. (1 mark)

$2A(s) + Cl_2(g) \longrightarrow 2ACl(s)$ // $2Na(s) + Cl_2(g) \longrightarrow 2NaCl(s)$

12. a) State **one** observation made when a small piece of sodium metal is put in a trough full of water. (1 mark)

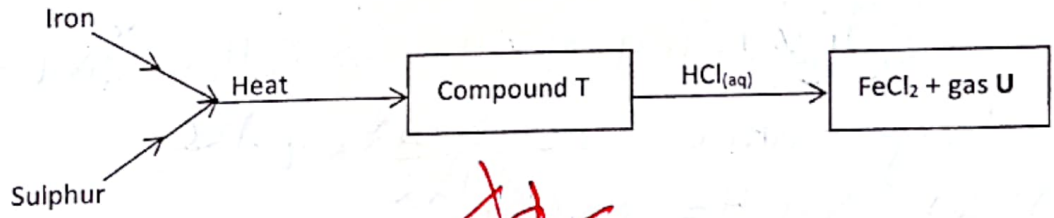
- Darts on water surface / Melts into silvery ball / Produces hissing / fizzing sound

Any one mk

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

$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$

13. Study the flow chart **below** and answer the questions that follow.



(a) Name:

(i) Compound **T** Iron (II) sulphide (½ mark)

(ii) Gas **U** Hydrogen sulphide (½ mark)

(b) Give a chemical test that you could use to identify gas **U**. (1 mark)

- Forms a black precipitate of PbS with lead (II) nitrate or lead (II) acetate

(c) Name a substance that can be used to dry gas **U** (1 mark)

Anhydrous Calcium Chloride

Alago / Jared

07

14.(a) Name the compounds **P** and **T below**.

- $CH_3CH_2CH_2CH_3$ (½ mark)

Butane ½

- $CH_3CHCHCH_3$ (½ mark)

But-2-ene ½

(b) Describe an experiment you would carry out to distinguish T from P. (2 marks)

Burn P and T. P burns with a pale blue non-sooty flame while T burns with a yellow sooty flame. 3

Accept use of $H^+/KMnO_4$

15. 12.5 cm^3 of a sample of sodium hydroxide was required to neutralize 8.3g of benzoic acid (C_6H_5COOH). Calculate the molarity of sodium hydroxide solution. (3 marks)

(C=12,O=16,H=1)

$C_6H_5COOH + NaOH \longrightarrow C_6H_5COONa + H_2O$

Moles of Benzoic acid = $\frac{8.3}{122} = 0.0680$

Moles NaOH = 0.068

Volume = $\frac{0.068 \times 1000}{12.5} = 5.44M$ 3

16.(a) Identify **two** substances that are reacted to regenerate ammonia gas in the Solvay process (2marks)

Ammonium chloride and Calcium hydroxide (tied)

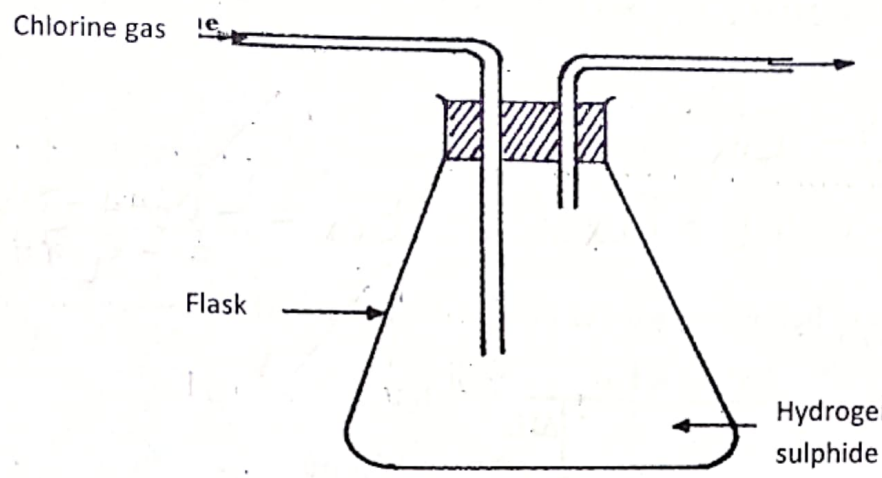
Reject Ammonium bromide and Barium hydroxide

(b) Write down a balanced chemical equation for the reaction above (1mark) 3

$2NH_4Cl(aq) + Ca(OH)_2(aq) \longrightarrow CaCl_2(aq) + 2NH_3(g) + 2H_2O(l)$

Wechuli

17. The figure below was set by a student to investigate the reaction between chlorine gas and hydrogen sulphide gas:



(a) Write an equation for the reaction that took place in the flask (1mark)

$H_2S(g) + Cl_2(g) \longrightarrow S(s) + 2HCl(aq)$ ✓1

(b) What observation was made in the flask? (1mark)

Yellow deposits of sulphur ✓1

(c) What precaution should be taken in carrying out the experiment? (1mark)

H_2S is poisonous; has a smell of rotten eggs and thus carry out experiment in fume chamber. ✓1

18. 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 (1mark)

$2X_{(s)} + 3W^{2+}_{(aq)} \longrightarrow 2X^{3+}_{(aq)} + 3W_{(s)}$ ✓1

Obinyo | Dr. Getrude.

14

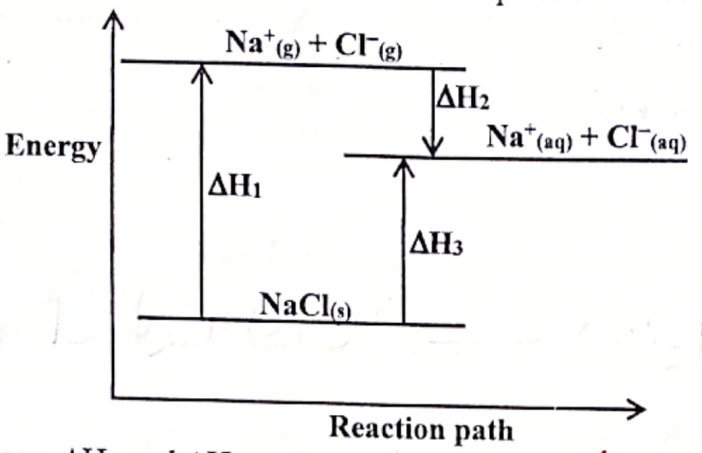
(b) If the e.m.f of the cell is 0.30V and E^{θ} value for W^{2+}/W is -0.44volts, calculate the E^{θ} for $X^{3+}_{(aq)}/X_{(s)}$ (2marks)

$E^{\theta} = E_{red} - E_{ox}$ ✓1

$0.30 = -0.44 - E_{ox}$ ∴ $E_{ox} = -0.44 - 0.30$ ✓1

$= -0.74V$ 2

19. Study the diagram below and answer the questions that follow.



a) What does ΔH_2 and ΔH_3 represent? (2 marks)

ΔH_2 — Hydration Enthalpy ✓1

ΔH_3 — Enthalpy of solution ✓1 3

b) Write an expression relating ΔH_3 to ΔH_1 and ΔH_2 (1mark)

$\Delta H_1 = \Delta H_3 - \Delta H_2$ ✓ // $\Delta H_3 = \Delta H_1 + \Delta H_2$ | $\Delta H_2 = \Delta H_3 - \Delta H_1$

20. During extraction of copper, the ore is first concentrated and roasted to produce copper (I) sulphide.

(a) Name the ore from which copper is commonly extracted. (1mark)

Copper pyrite ✓1 1

(b) Write an equation for the reaction in which copper (I) sulphide is produced by roasting the ore in air. (1mark)

$2CuFeS_2(s) + 4O_2(g) \longrightarrow Cu_2S + 2FeO + 3SO_2(g)$ ✓1

(c) Give **one** use of copper metal. (1mark)

– Making electric cables. 1

Alago Any (a) 1mk.

21. 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 (2marks)

$n = \frac{120}{20} = 6$

224 →(1st) 112 →(2nd) 56 →(3rd) 28 →(4th) 14 →(5th) 7 →(6th) 3.5

ALT

$3.5 = \left(\frac{1}{2}\right)^n \times 0.A$

$n = \frac{120}{20} = 6$

$3.5 = \left(\frac{1}{2}\right)^6 \times 0.A$

$0.A = 3.5 \times 64 = 224g$

2

b) Give **one** application of radioactivity in agriculture. (1mark)

- Monitor rate of absorption of fertilizers
- Monitor photosynthesis

Any (a) 1mk

22. Given the following bond energies.

C – C	(347kJ mol^{-1})
C – H	(413kJ mol^{-1})
C = C	(612kJ mol^{-1})
H – H	(435.9kJ mol^{-1})

Calculate the enthalpy change of hydrogenation of ethene. (3 marks)

$C_2H_4 + H_2 \longrightarrow C_2H_6$

H–C=C–H + H–H ⟶ H–C–C–H

(H H H H)

BBE = 1(C=C) + (C–H)4 + 1(H–H)

= (1 × 612) + (4 × 413) + (1 × 435.9) = +2699.9

BFE = 1(C–C) + 6(C–H)

= (1 × 347) + (6 × 413) = −2825

3

ΔH = +2699.9 − 2825

= −125.1kJ/mol.

ALT

BBE = 1(C=C) + (H–H)

(1 × 612) + (1 × 435.9) = +1047.9

BFE = 1(C–C) + 2(C–H)

(1 × 347) + (2 × 413) = −1173

3

ΔH = +1047.9 − 1173 = −125.1kJ/mol.

Jared 06

23. Describe how a dry sample of copper(II) chloride crystals may be prepared starting with solid copper metal. (3 marks)

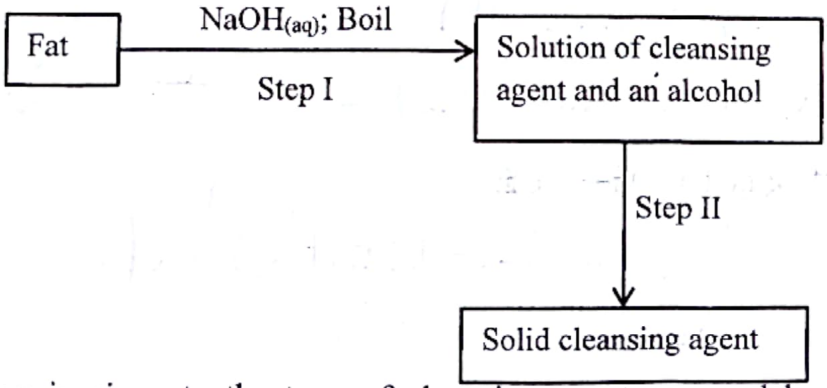
Heat the copper metal in an open crucible to obtain copper(II) oxide. Add excess copper(II) oxide to warm dilute hydrochloric acid and filter to obtain copper(II) chloride solution as a filtrate. Heat the filtrate to saturation and allow to cool for copper(II) chloride crystals to form. Pour out the mother liquor and dry crystals between filter papers.

24. A hydrated salt of copper has the formula $CuSO_4.nH_2O$. About 25g of the salt was heated until all the water evaporated. If the mass of the anhydrous salt is 16.0g. Determine the empirical formula of the hydrated salt. (Cu = 64, S = 32, O = 16) (3 marks)

	$CuSO_4$	H_2O
Moles =	$\frac{16}{160}$	$\frac{9}{18}$
Molar ratio =	$\frac{0.1}{0.1}$	$\frac{0.5}{0.1}$
	1	5

$CuSO_4.5H_2O$

25. The scheme below was used to prepare a cleansing agent. Study it and answer the questions that follow.



i) What name is given to the type of cleansing agent prepared by the method shown in the scheme? (1 mark)

Soapy

Edwine

ii) Name one chemical substance added in step II (1 mark)

Sodium chloride

iii) What is the purpose of adding the chemical substance named in (ii) above? (1 mark)

Salting out / Precipitate the soap

26. A current of 4 A was passed through dilute sulphuric (VI) acid for 6 hours and 24 minutes.

Calculate the volume of oxygen gas produced at the anode.

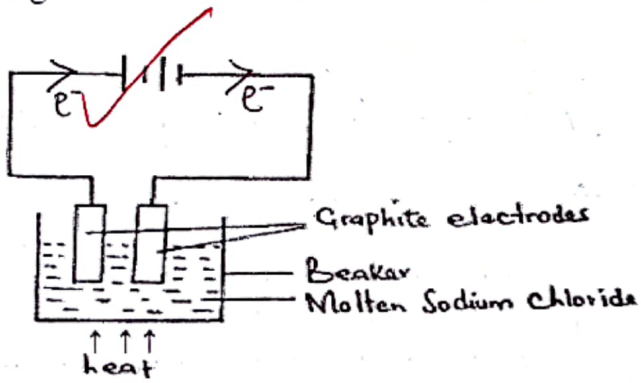
(1 Faraday = 96500C, molar gas volume = 24.0dm^{-3}) (3 marks)

Anode: $4OH^-(aq) \longrightarrow 2H_2O(l) + O_2(g) + 4e^-$

$$\text{Volume} = \frac{24 \times (384 \times 60) \times 4}{4 \times 96,500} = \frac{24 \times 23,040 \times 4}{4 \times 96500} = \frac{24 \times 9216.0}{4 \times 96,500}$$

$$= 5730.16 \text{cm}^3 = 5.73 \text{dm}^3$$

27. The diagram below represents an experiment which was carried out by a student to investigate the effect of passing an electric current on molten sodium chloride.



(a) Molten sodium chloride is a binary electrolyte. State the meaning of the term binary electrolyte. (1 mark)

3

Electrolyte having one kind of anion and one kind of cation.

(b) State one observation made at the anode. (1 mark)

Yellow - green fumes of Chlorine gas

(c) Show the direction of flow of electrons on the set-up. (1 mark)

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Joshua

08