

Candidate's Name : Kiyimba Huzifa (Dr Huzbrazilian chemist).....

DRAFT
Signature : MARKING GUIDE
Kiyimba

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S45/2

CHEMISTRY

Paper 2

Oct./Nov. 2022

2 hours



UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Certificate of Education

CHEMISTRY

Paper 2

2 hours

INSTRUCTIONS TO CANDIDATES:

Section A consists of 10 structured questions. Answer all the questions in this section.

Answers to these questions must be written in the spaces provided.

Section B consists of 4 semi-structured questions. Answer any two questions from this section. Answers to the questions must be written in the answer booklet(s) provided.

In both sections all working must be clearly shown and must be in blue or black ink.

Any work done in pencil will not be marked except drawings.

Mathematical tables and silent non-programmable calculators may be used.

Where necessary use:

$$[H=1, C=12, O=16, Mg=24]$$

1 mole of gas occupies 24 l at room temperature.

1 mole of gas occupies 22.4 l at s.t.p.

For Examiners' Use Only														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total

1. Carbon exists in different forms.

(a) Giving a reason in each case, name the form of carbon which is used

(i) to make glass cutters. (02 marks)

Name:

Diamond: ✓

⑤

Reason:

Diamond is hard. Allow very hard. ✓ ⑥

(ii) as electrodes. (02 marks)

Name:

Graphite ✓

⑥

Reason:

Graphite has free mobile electrons which conduct electricity ✓ ⑦

(b) Name two elements other than carbon that exist in different forms. (01 mark)

Sulphur ✓

Phosphorus ✓

⑥

2. The atomic numbers of elements Q, T, X, Y and Z are 2, 7, 11, 13 and 16 respectively. QT² Y²

(a) Write a formula for the compound formed if:

(i) Y reacts with Z. (01 mark)

Y₂Z₃ ✓ ⑥

..... Deny Z₃Y₂

(ii) X reacts with T. (01 mark)

X₃T ✓ ⑥

..... Deny TX₃

(b) State the element(s) that:

(i) exist(s) as diatomic gas(es). (½ mark)

..... T I Z

(ii) is/are inert. (½ mark)

..... Q I Z

(iii) is/are metals. (01 mark)

..... X Y I

-I, If one of the elements stated is wrong.

o If both wrong.

(c) Which one of the elements belongs to group I in the Periodic Table? (01 mark)

..... X I

3. Zinc reacts with steam to give a solid Y and a gas Z.

(a) Identify;

(i) solid Y. (01 mark)

..... Zinc oxide. ✓ Allow ZnO (Reject wrong symbol written)

(ii) gas Z.

..... Hydrogen. ✓ Accept H_2 (Deny H_2 , H_2 and many others
Deny wrong symbol if formulas used.)

(b) State how gas Z can be tested in the laboratory. (01 mark)

..... When a mixture of hydrogen and air is lit, it explodes
with a pop sound. Allow burning splint lowered

..... in a gas jar containing a mixture of hydrogen and oxygen.
it explodes with a pop sound; Reject burning with a pop sound.
Z was passed over heated triiron tetraoxide (Fe_3O_4). Write an
equation for the reaction that took place. (1½ marks)

..... $Fe_3O_4(s) + 4H_2(g) \rightarrow 3Fe(s) + 4H_2O(l)$ ✓ I ½

..... Reject unbalanced equation (Award 0)

-I, ³ for any missing states symbol. Turn Over

Follow this for ^{all} equations written/answered in this paper

- (d) Write an equation for the reaction that would take place if solid Y was added to warm dilute nitric acid. (1½ marks)



Reject for any incorrect symbol.

Reject for any incorrect state.

4. A hydrocarbon Q consists of 85.7% carbon by mass.

- (a) Determine the simplest formula of Q. (02 marks)

$$\text{Percentage of hydrogen} = 100 - 85.7 = 14.3 \quad \checkmark$$

Element present C H The simplest

Percentage composition 85.7 14.3 formula is

Moles	85.7	14.3	\times	CH_2	\checkmark
	12	1			

Mole ratio	7.0833	1.43			
	7.1417	7.1417	\times		02
	7.1417	2.0023	\approx	2.0	

- (b) 0.224 g of Q occupies 96 cm³ at room temperature.

- (i) Determine the molecular formula of Q. (03 marks)

96 cm³ of Q contain

Accept other 96 cm³ of Q is occupied by 0.224 g \checkmark

correct 24000 cm³ of Q is occupied by $\frac{0.224 \times 24000}{96}$ \checkmark

format such as = 56 \checkmark

such as 96 cm³ of Q contain 0.224 g $(CH_2)_n = 56$ Molecular formula is C_4H_8 \checkmark

$$(12+2)n = 56$$

$$14n = 56$$

$$\frac{14}{14} = \frac{56}{14}$$

$$n = 4 \quad \checkmark$$

5. (a) State what is observed and write an ionic equation for the reaction that takes place when excess dilute sodium hydroxide solution is added to copper(II) chloride solution.

- (i) Observation (½ mark)

Pale blue precipitate insoluble in NaOH .

emphasize (pale) and (insoluble).

- (ii) Ionic equation (1½ marks)



Reject molecular equation written.

- (b) (i) Name the reagent that can be used to identify the anion in copper(II) chloride. (½ mark)

Silver nitrate solution. \checkmark (Reject someone without solution)

Accept lead(II) nitrate solution and warm.

- (ii) State what would be observed if the anion was treated with the reagent you have named. (½ mark)

White precipitate. \checkmark

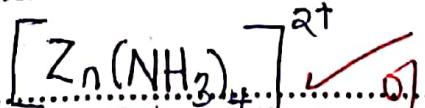
for lead(II) nitrate solution and warm, observation white precipitate that dissolves on warming and reappears on cooling.

When aqueous ammonia was added dropwise until in excess to a solution containing zinc ions, a white precipitate was formed which dissolved afterwards into a colourless solution.

- (i) Give a reason why the precipitate dissolved. (01 mark)

White precipitate which is zinc hydroxide dissolved in excess forming a complex soluble in water. \checkmark (01)

- (ii) Write the formula of the cation in the colourless solution. (01 mark)



Award (00) for incorrect symbols of elements.

Award 0 mark for wrong chemical formula of the cation

Turn Over

6. (a) State what is meant by the term heat of combustion. (01 mark)

Heat of combustion is the one evolved or given out when 1 mole of a substance is completely burnt in oxygen. (emphasize one mole)
Allow [heat change]

- (b) When 0.4 g of an alcohol X was burnt completely, it raised the temperature of 100 g of water by 21.5°C . Calculate the heat of combustion of X.

(Formula mass of X = 32, specific heat capacity of water = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$). (2½ marks)

$$\begin{aligned}\text{Heat of combustion} &= \frac{\text{mass} \times \text{specific heat capacity} \times \text{temperature raise}}{100 \times 4.2 \times 21.5} \\ &= 9030 \text{ J}\end{aligned}$$

0.4 g of an alcohol X evolve 9030 J

$$32 \text{ g of an alcohol X evolve } \frac{9030 \times 32}{0.4}$$

$$= 722,400 \text{ J mol}^{-1}$$

∴ Heat of combustion is $-722,400 \text{ J mol}^{-1}$ or $-722.4 \text{ kJ mol}^{-1}$

Reject answer without sign and units.

- (c) (i) State how the heat of combustion of X that you have calculated in (b) would compare with the theoretical value. (01 mark)

Heat calculated would be less than theoretical value.

- (ii) Give a reason for your answer in (c) (i). (½ mark)

..... Some heat was given out to the surrounding.

7. Impure copper is purified by electrolysis.

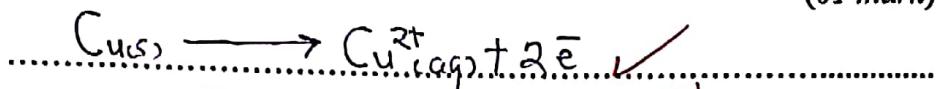
- (a) Name the electrolyte used during the purification of copper. (01 mark)

..... Copper(II) sulphate solution.

..... Reject without [solution].

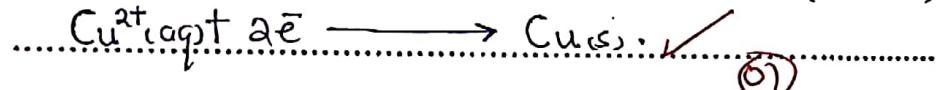
- (b) Write an equation for the reaction at the:

- (i) anode. (01 mark)



..... Reject wrong symbols for (I) and (II).

- (ii) cathode. (01 mark)



- (c) State what is observed at the end of the process. (01 mark)

..... A brown solid is deposited at the cathode.

..... At anode, blue solution remains blue. (01)

- (d) State what would be observed if a clean iron-nail was placed into the electrolyte you have named in (a). (01 mark)

..... Grey solid dissolved, blue solution turned green.

..... solution as a brown solid is deposited or formed.

Q. Fermentation of glucose produces ethanol which is about 10% by volume.

- (a) (i) Name the process by which the percentage of ethanol could be increased. (01 mark)

Fractional distillation

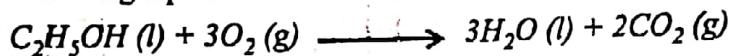
✓ 51

- (ii) State the principle on which the process you have named in (a) (i) works. (01 mark)

Water and ethanol have different boiling points.

emphasize different
boiling points

- (b) Ethanol undergoes complete combustion in oxygen according to the following equation.



- (i) Calculate the heat evolved when 21.6 g of ethanol undergoes complete combustion. (02 marks)

(The enthalpy of combustion of ethanol = $1370.0 \text{ kJ mol}^{-1}$)

$$\begin{aligned} \text{Molar mass of ethanol, } C_2H_5OH &= (2 \times 12) + (1 \times 5) + (1 \times 16) + (1 \times 1) \\ &= 46 \text{ g} \end{aligned}$$

46 g of ethanol produce 1370 kJ

21.6 g of ethanol produce $\frac{1370 \times 21.6}{46}$

$$= 643.30 \text{ kJ}$$

Deny 1% for answer without units.

(ii) State the practical application of combustion of ethanol. (01 mark)
..... Used as fuel when mixed with petrol for car engines. ✓ (01)

9. (a) A clean piece of calcium was dropped into water in a beaker. 1 mark for @ correct application given

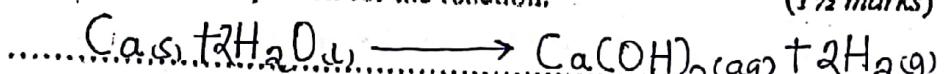
(i) State what was observed.

(2½ marks)

..... Grey solid [sinks] (sinks)

..... dissolves with effervescence of a colourless gas that explodes with a pop sound forming a milky solution suspension or white suspension. (2½)

(ii) Write an equation for the reaction. (1½ marks)



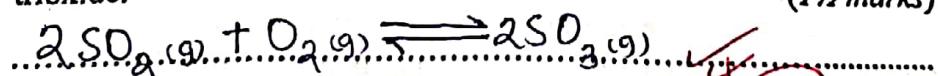
✓ (1½)

- (b) Blue litmus paper was dipped into the resultant solution in (a). State what was observed. (01 mark)

..... Blue litmus paper remains blue. ✓ (01)

10. In the manufacture of sulphuric acid by the contact process, sulphur dioxide reacts reversibly with excess oxygen in the presence of vanadium(V) oxide at a relatively low temperature to form sulphur trioxide.

- (a) Write an equation for the reaction leading to the formation of sulphur trioxide. (1½ marks)



✓ (1½)

- (b) Suggest a reason for the use of:

- (i) excess oxygen. (01 mark)

..... To make a complete reaction with sulphur dioxide gas or making sure that sulphur dioxide gas is used up. (01)

- (ii) low temperature. (1½ marks)

To make high yields of sulphur dioxide gas, since the reaction is exothermic no need of high temperatures. (1½ marks)

- (c) State one reason why vanadium(V) oxide is preferred as a catalyst in the manufacture of sulphuric acid. (01 mark)

Vanadium (V) oxide is cheap. (01 mark)

Award 1 mark at (a) correct reason given

SECTION B: (30 MARKS)

Answer any two questions from this section.
Additional question(s) answered will not be marked.

11. During laboratory preparation of chlorine from hydrochloric acid, the gas is first passed through water, then through concentrated sulphuric acid before it is collected.

- (a) (i) Name a substance that is reacted with hydrochloric acid to produce chlorine. (01 mark)
- (ii) State the conditions and write an equation for the reaction leading to the formation of chlorine. (2½ marks)
- (iii) Give reasons why chlorine is passed through water and then concentrated sulphuric acid before it is collected. (02 marks)
- (b) A long glass tube filled with chlorine was inverted in a beaker containing water and then allowed to stand in sunlight for sometime. State what was observed and explain your observations. (06 marks)
- (c) To a sample of the solution that was left in the glass tube in (b), silver nitrate solution was added. State what was observed and write an ionic equation for the reaction that took place. (2½ marks)
- (d) State one use of chlorine. (01 mark)

12. (a) Describe how a dry sample of zinc sulphate crystals can be prepared from zinc. (Your description should include equation(s) for the reaction(s) that take(s) place.) (7½ marks)
- (b) To a mixture of zinc sulphate crystals and sufficient sodium carbonate, water was added and the mixture shaken then filtered.
- State what would be observed if acidified barium chloride solution was added to the filtrate. (01 mark)
 - Write an ionic equation for the reaction in (b) (i). (1½ marks)
- (c) The residue in (b) was dried and heated until no further change then allowed to cool.
- State what was observed. (1½ marks)
 - Write an equation for the reaction that took place. (1½ marks)
- (d) To the cooled product in (c) was added dilute sulphuric acid. State what was observed and write the equation for the reaction. (02 marks)
13. (a) State what is meant by the term rate of reaction. (01 mark)
- (b) Table 1 shows volumes of hydrogen gas liberated when 2.0 g of magnesium separately reacted with different volumes of hydrochloric acid of a uniform concentration.

Table 1

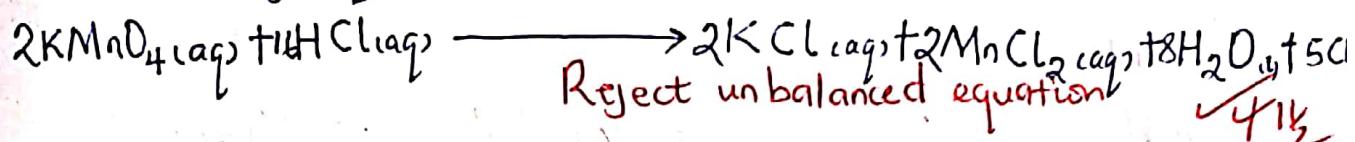
Volume of hydrochloric acid (cm ³)	0	5	15	20	25	35	45
Volume of hydrogen gas (cm ³)	0	120	360	500	600	600	600

- Plot a graph of volume of hydrogen gas formed against volume of hydrochloric acid used. (04 marks)
 - Determine the volume of hydrochloric acid needed to react exactly with the 2.0 g of magnesium. (01 mark)
- (c) (i) Write an equation for the reaction in (b). (1½ marks)
- (ii) Determine the number of moles of magnesium that reacted. (1½ marks)
- (iii) Calculate the concentration of hydrochloric acid in moles dm⁻³. (2½ marks)
- (d) Explain the effect of the following on the rate of reaction:
- Concentration. (02 marks)
 - Surface area. (1½ marks)

(ii) Potassium manganate (VII) or Potassium permanganate ✓(01)

(iii) Concentrated acid (Reject dilute) (01)

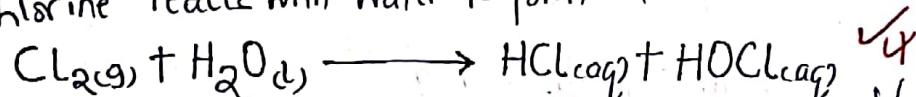
No heating required / Accept Room temperature



(iii) Passed through water to remove traces of hydrogen chloride gas, then through concentrated sulphuric acid to be dried (02)

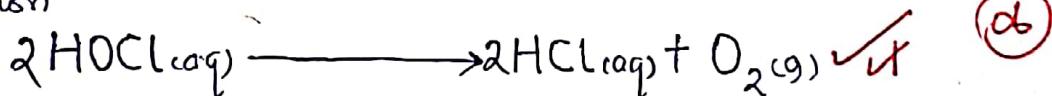
(b) Greenish yellow gas dissolves in water forming a yellowish solution which then turns to a colourless solution. Bubbles of a colourless effluent that relights a glowing splint collects in a long glass tube. Deny effervescence

Explanation] Chlorine reacts with water to form chlorine water

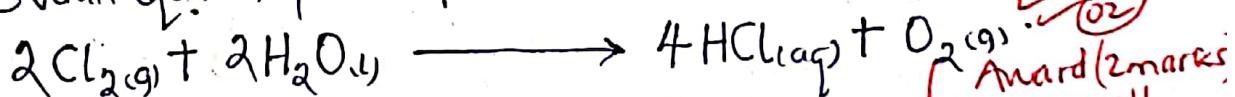


Chlorine water is a mixture of hydrochloric acid and hypochlorous acid.

Hypochlorous acid decomposes to form bubbles of a colourless gas and a colourless solution



Overall equation for the process



✓(02)
Award 2 marks
for overall
equation is
written also

c) White precipitate Deny White ppt



✓(1) Reject molecular equation

(d) Used in manufacture bleaching agents

Used in water treatment

✓(01) Accept any given (But should be one).

12(a) To excess zinc granules in a beaker, add dilute sulphuric acid.

Add a little copper (II) sulphate solution to increase the rate of reaction if slow.

Bubbles of a colourless gas are observed.

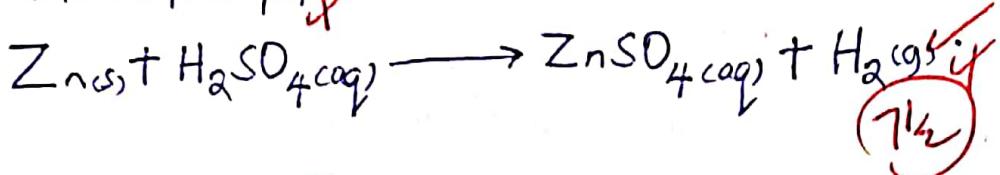
Filter off excess zinc and any other impurities

Colourless filtrate is obtained

To filtrate is put on an evaporating dish and heated to dryness.

The filtrate is then cooled under water
Crystals are then formed;

The crystals are filtered off, washed with cold distilled water and dried between filter papers.

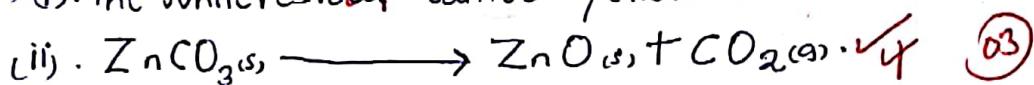


b(ii). White precipitate ✓ (6)

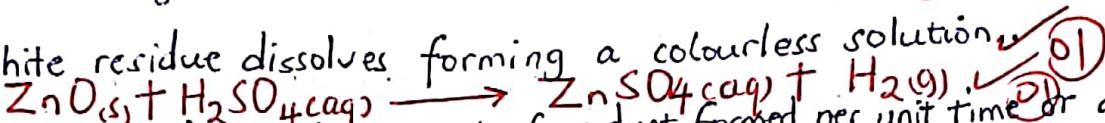


Reject molecular equation

c(i). The white residue turned yellow when hot and white on cooling.



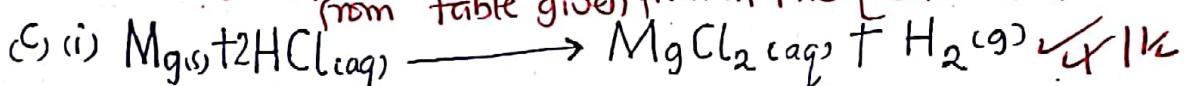
(d) White residue dissolves forming a colourless solution.



13(a) Rate of reaction is the amount of product formed per unit time or amount of reactant used up per unit time ✓ (6)

i) See graph ✓ (4)

ii) 25cm^3 , ✓ Award whether graph used or not because tha value can be got from table given in the question paper



(i) 25cm^3

$$(ii) = \frac{2.0}{24} \quad \text{if}$$

$$= 0.08333 \text{ mole} \quad 1\text{k}$$

(iii) 1 mole of Magnesium reacts with 2 moles of hydrochloric acid ✓
0.0833 moles Magnesium react with $(2 \times 0.0833) = 0.1667$ moles ✓
 $0.0833 \text{ moles} \times \frac{0.1667 \text{ moles}}{25\text{cm}^3 \text{ of hydrochloric acid}} = 0.1667 \times \frac{0.1667 \times 1000}{25\text{cm}^3} = 6.67 \text{ mole di}$

(iv) The higher the concentration of reacting particles the higher the rate of reaction, this is because concentration increases the collision of reacting molecules.

Large

Surface area increases the rate of reaction, this also increases reacting particles colliding per unit area. ✓ (2)

15

di)

Name

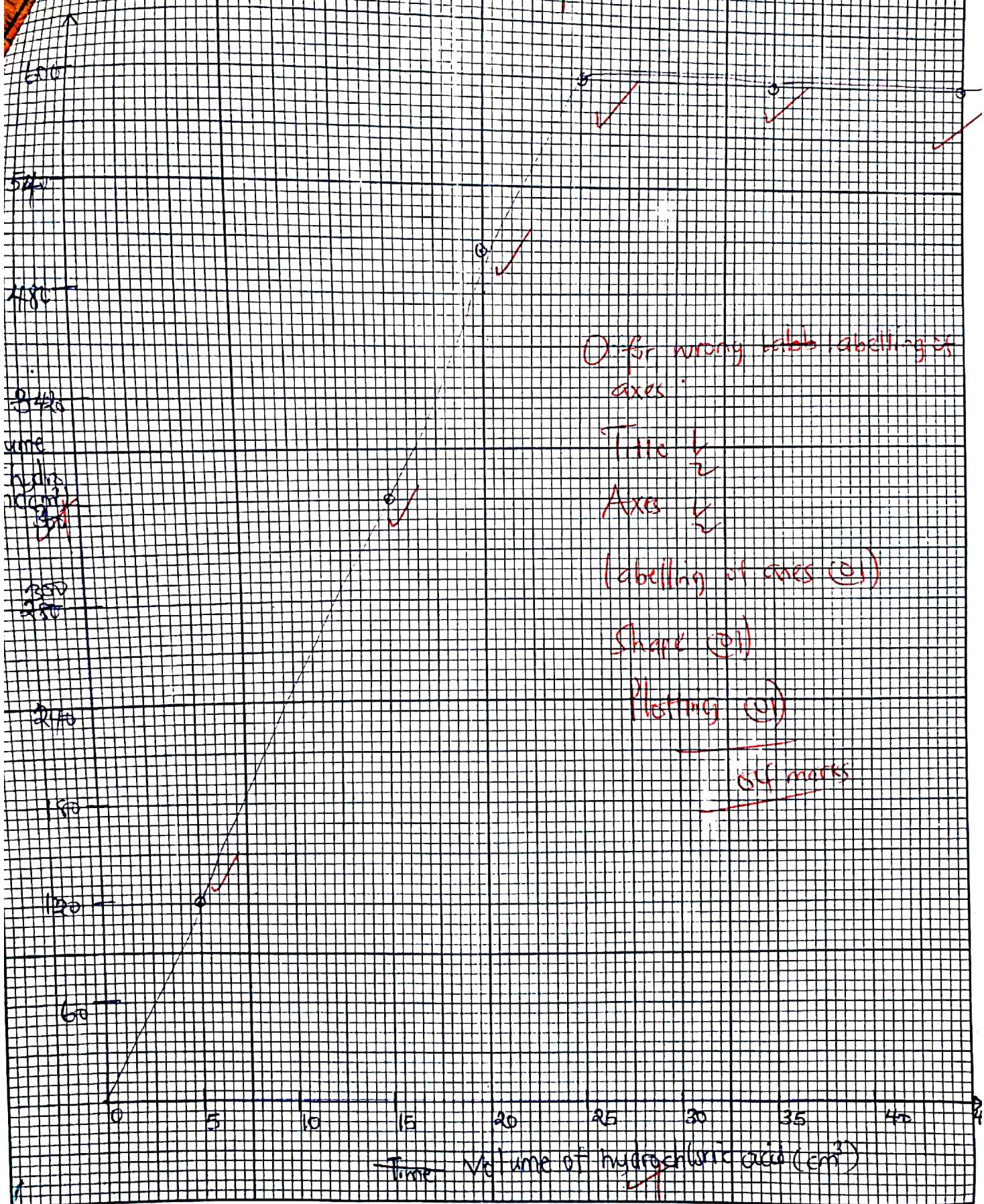
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Name.....

Random No.

B(b) A graph of volume of hydrogen gas against time. Volume of hydrochloric acid used /

Personal Number



(0) for wrong slab labelling of axes.

Title (1)

Axes (1)

(Labelling of axes (0))

Shape (2)

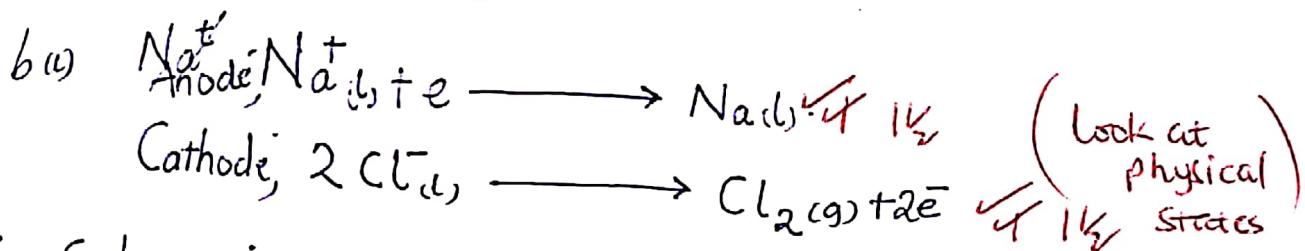
Plotting (2)

64 marks

(a) i) To lower the melting point of Sodium chloride

ii) Iron cathode ✓

Carbon anode ✗

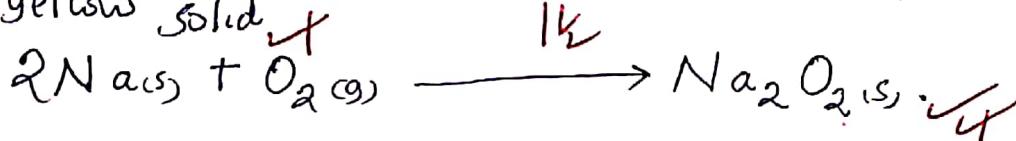


(ii) Sodium is collected under dry nitrogen because it is a highly reactive element and nitrogen is generally

(iii) Potassium ✓, Calcium ✓

Allow eat Magnesium or Aluminium.

c) Sodium Burns with a bright yellow flame forming a yellow solid ✓



d) Yellow solid dissolves with bubbles of a colourless gas that re-lights a glowing splint forming a colourless solution that turns red litmus paper blue. ✓



e) Shores near Lake Katwe. ✓

Reject Lake Katwe

END

Courtesy of Dr Huz (Brazilian chemist)

Kittappa