Name.....Adm No.....

School.....Marking scheme.....Class.....

Index Number.....

233/1
CHEMISTRY
Paper 1
THEORY)
JULY 2023
Time: 2 Hours

NYAHOKAKIRA CLUSTER II - 2023

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

233/1
CHEMISTRY
Paper 1
THEORY)
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INSTRUCTIONS TO CANDIDATES

- Write your name and index No. in the spaces provided above.
- Sign and write the date of the examination in space provided.
- Answer ALL the questions in the spaces provided.
- Mathematical tables and electronic calculators may be used for calculations
- All working must be clearly shown where necessary

FOR EXAMINER'S USE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1-28	80	

1. a) Distinguish between ionization energy and electron affinity. (2mks)

Ionization energy - minimum energy required to remove an electron from the outermost energy level of an atom in gaseous state while electron affinity energy released when when an atom gains an electron in gaseous state. lost/given out/produced

(tied)

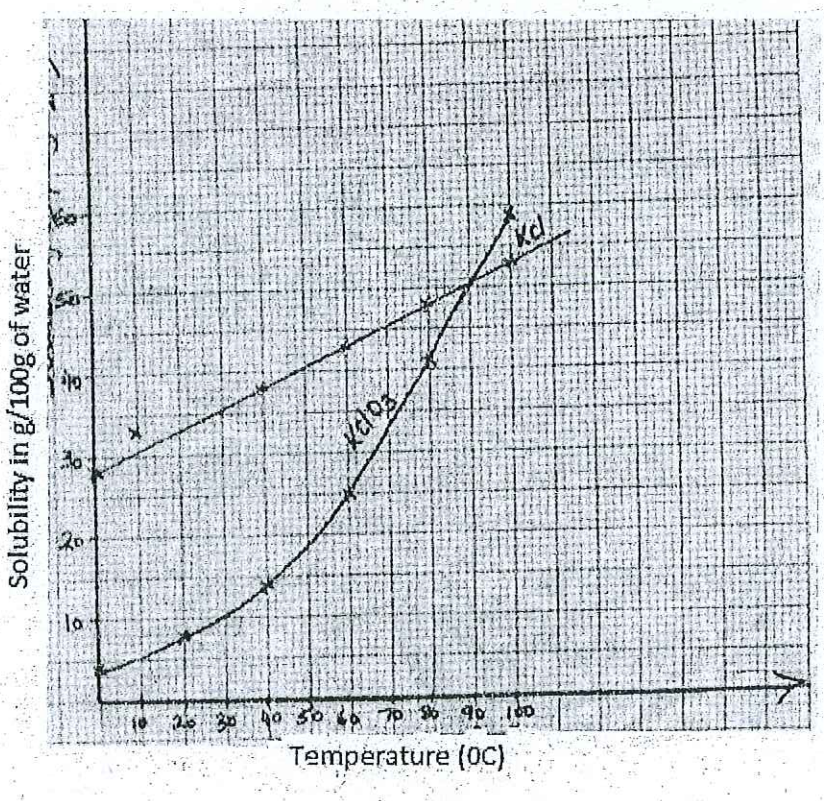
b) The atomic number of A and B are 9 and 17 respectively. Compare the electron affinity of A and B. Explain . (1mk)

A - 2.7
B - 2.8.7

A - has higher electron affinity because has smaller atomic size with stronger nuclear attraction

B lower e. affinity

2. The graph below shows the solubility of potassium chloride and potassium chlorate (V) against temperature on the same axes. Use the graph to answer the question that follow:



Determine

i) the temperature when the solubility of potassium chloride equals the solubility of potassium chlorate (V). (½ mark)

90°C ½ 89 90 91 ±1

ii) the solubility of potassium chlorate(V) at 50°C (½ mark)

19g/100g of water ½ 18 19 20 ±1

iii) the mass of potassium chloride that will crystallize out when its saturated solution at 70°C is cooled to 30°C. (1marks)

70°C — 45g/100g of water ½
30°C — 35g/100g of water ½ (tied)
10g ½

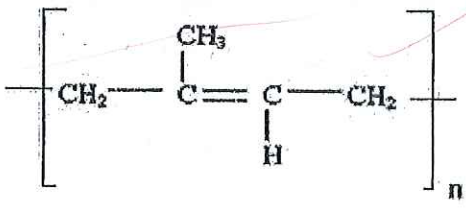
±1

reading both ½
answer ½

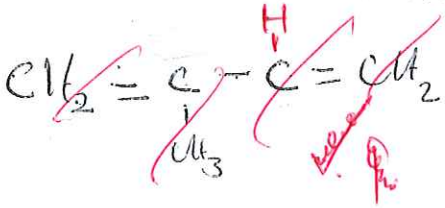
9 10 or 11

6

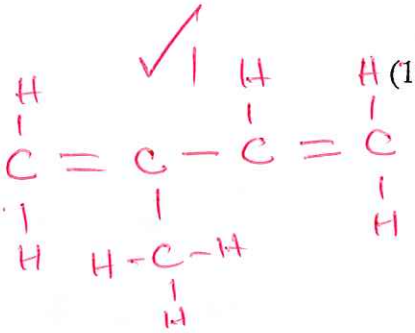
3. Natural rubber has the formula



a) Draw the structure of the monomer of rubber. (1mark)



OR



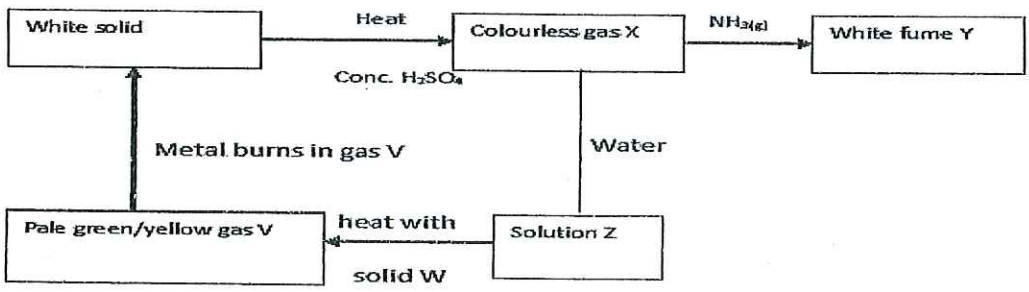
b) The rubber has a molecular of 102,000. Calculate the number of monomeric units which make up the natural rubber. (C = 12, H = 1) (1mark)

$$\frac{102,000}{68} = 1500$$

4. Carbon (IV) oxide was bubbled through concentrated sodium hydroxide solution and no visible change was observed but when bubbled through calcium hydroxide solution for a short time, a white precipitate was formed. Explain. (2marks)

When bubbled through conc NaOH soluble sodium carbonate is formed but when bubbled through calcium for short time insoluble calcium carbonate is formed.

5. Study the scheme below and answer the questions that follow.



04

a) Write an equation for the formation of white fumes Y. (1 mark)

B.e ✓½ S.S ✓½

$HCl + NH_3 \rightarrow NH_4Cl$ (g) (g) (s) /1

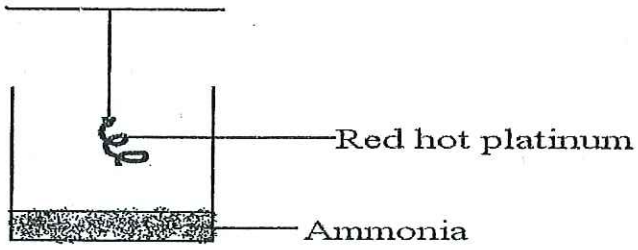
b) What is the function of solid W in the reaction? (1 mark)

oxidizing agent ✓ – oxidizes HCl to chlorine (removes H_2 from HCl)

c) Identify gas V. (1 mark)

chlorine gas ✓ / Cl_2

6. The set-up below shows the catalytic oxidation of ammonia in the laboratory



a) State and explain the observation made. (2 marks)

Brown fumes evolved – nitrogen II oxide formed is oxidized by air to nitrogen IV oxide ✓ / ✓

OR glows ✓

rxn is highly exothermic ✓

b) Write a chemical equation for the first reaction taking place in the beaker. (1 mark)

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ (g) (g) (g) (g)

S.S ✓½ B.e ✓½

reject $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

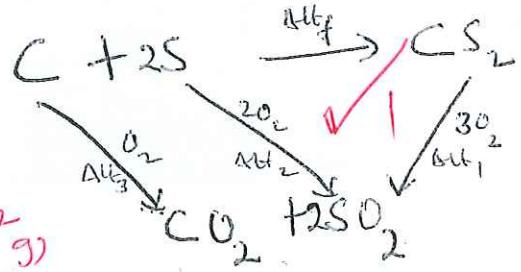
06

7. Using an energy cycle diagram, calculate the standard enthalpy change of formation of carbon disulphide. (3 marks)

$S_{(s)}+O_2 \longrightarrow SO_{2(g)}$ $\Delta H=-294KJ/mol$

$CS_{2(l)}+3O_{2(g)} \longrightarrow CO_{2(g)}+2SO_{2(g)}$ $\Delta H=-1072KJ/mol$

$C_{(s)}+O_{2g)} \longrightarrow CO_{2(g)}$ $\Delta H=-393KJ/mol$



Missing energy cycle – Zero
Wrong energy cycle – Deduct (1 mk)

OR $3O_2$ (9)

$\Delta H_f + \Delta H_1 = \Delta H_2 + \Delta H_3$

$\Delta H_f = 2(-294) + (-393) + 1072$ ✓1

$-588 - 393 + 1072$

$-981 + 1072 = +91 KJ/mol$ ✓1 (wrong sign or units – ½ mk)

8 A bicycle was found to hold a maximum volume of 990 cm^3 at s.t.p. On one hot sunny day the temperature was 30^0C and pressure 800mmHg. The rider inflated the tyre. Explain what happened. (show your calculations Standard temperature and pressure=0^0C and 760mmHg respectively) (3 marks)

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{760 \times 990}{273} = \frac{800 \times V_2}{303}$ ✓1

$V_2 = 1043.85 cm^3$ ✓1

Increase in temperature and decrease in pressure increases the volume occupied by a given mass of a gas. Tyre bursts ✓1

9. A magnesium ribbon sample was heated in separate volumes of pure oxygen and air.

a) In which sample was the mass of the product higher? Explain. (2 Marks)

Sample heated with air – It combines with both oxygen and nitrogen in air ✓1

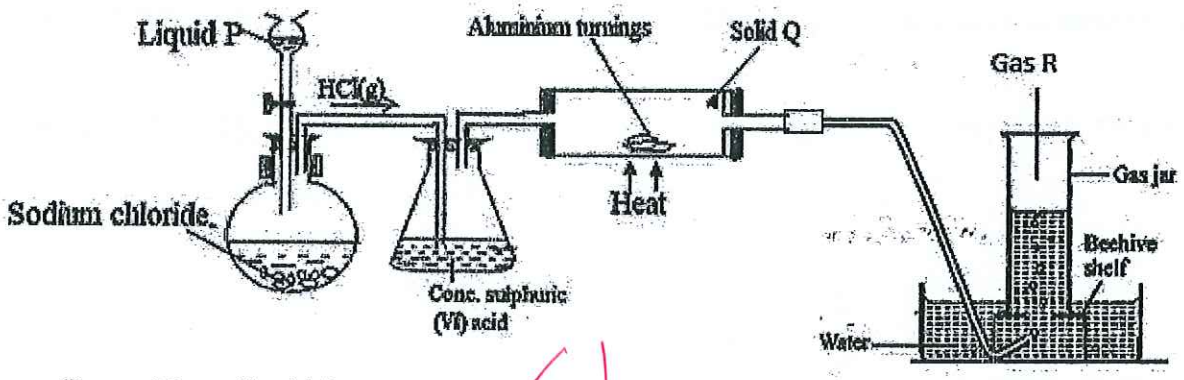
b) Write the equations for the reactions in the sample with air. (2Marks)

$3Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_{2(s)}$ ✓1

$2Mg_{(s)} + O_{2(g)} \longrightarrow 2MgO_{(s)}$ ✓1

10

10.Hydrogen chloride gas was prepared and reacted with aluminium turnings as shown below.



(i) Name liquid P. (1 mark)

concentrated sulphuric VI acid reject formula.

(ii) State the confirmatory test for gas R. (1 mark)

~~Forms white dense fumes with ammonia~~ extinguishes a burning splint with 'pop' sound

(iii) Explain why **solid Q** collects further away from the heated aluminium. (1 mark)

Sublimes and got deposited on cooler parts.

(iv) Sodium chloride also known as rock salt is preferred to any other chloride in the preparation of hydrogen chloride gas. Give a reason. (1 mark)

Readily available / cheap

11.Name and give the formula of:

a) The **chief ore** from which zinc is extracted (1 Mark)

name their formula.

Zinc blende (ZnS) ✓ || Zinc mine ($ZnCO_3$)

b) The **main impurity** in the ore. (1 Mark)

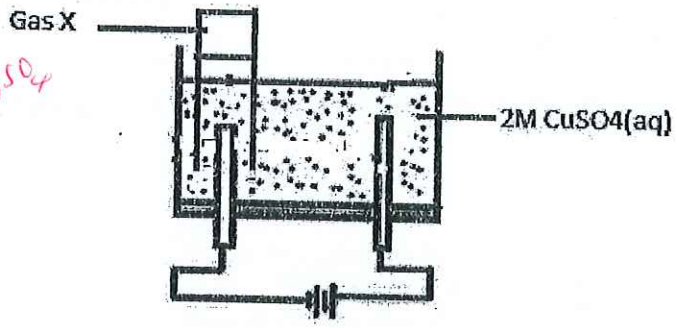
~~galena~~ Lead(II) sulphide PbS

c) The ore is concentrated by froth floatation. What is froth floatation? (1 Mark)

~~Process of separating hydrophobic material from hydrophilic~~ separate solid particles from ore by adding water and air then blow air

07

2. The set-up below was used during the electrolysis of 100cm^3 of 2M copper (II) sulphate solution using inert electrodes.



$Cu^{2+} + 2e \rightarrow Cu$

$Cu^{2+} + SO_4^{2-} \rightarrow CuSO_4$

$Q = \left(4 \times \frac{7}{3} \times 3600\right)$

$33600\,C$

mass of Cu $= \left|\frac{33600 \times 1 \times 63.5}{96500 \quad 2}\right.$

$= 11.055g$

13. A current of 4A was passed through 100cm^3 of 2M copper (II) sulphate solution for 2 hours 20 minutes. Calculate the amount of copper in the remaining solution after the experiment. **(Cu=63.5, 1F=96500C)** (3 marks)

✓ Moles of $CuSO_4$ ✓N

$\frac{100 \times 2}{1000} = 0.2$ moles

✓ Mass of Cu in $CuSO_4$

$0.2 \times 63.5 = 12.7g$ ✓N

Mass deposited

$g = \frac{8400 \times 63.5 \times 4}{2 \times 96500}$ ✓1

$= 11.055g$ ✓1

Remaining mass $= 12.7 - 11.055$ ✓N

$= 1.649g$ ✓N

14. Use the cell represented below to answer the questions that follow.

$$Cr_{(s)} / Cr^{3+}_{(aq)} // Fe^{2+}_{(aq)} / Fe_{(s)}$$

(a) Write the equation for the cell reaction. (1 mark)

$2Cr_{(s)} + 3Fe^{2+} \rightarrow 2Cr^{3+} + 3Fe$ B.e ✓N S.S ✓N

(b) If the e.m.f. of the cell is +0.30 volts and the E^θ value for $Fe^{2+}_{(aq)}/Fe_{(s)}$ is -0.44, find the E^θ of $Cr^{3+}_{(aq)} / Cr_{(s)}$ (2 marks)

$0.30 = -0.44 - x$ ✓1

$x = -0.44 - 0.30$ ✓

$x = -0.74V$ ✓1 (missing or wrong sign penalise -1 mark)

The table below gives some properties of chlorides of period three elements A, B and C. Study it and answer the questions the questions that follow.

Chloride of element	Melting point	Boiling point
A	-101	-35
B	714	1407
C	-7	60

(a) Name the type of bond that most likely exists in the chloride of element A (1mark)

~~Molecular structure~~ ~~Weak Van der Waals forces~~

covalent ✓1 or Van der Waals forces.

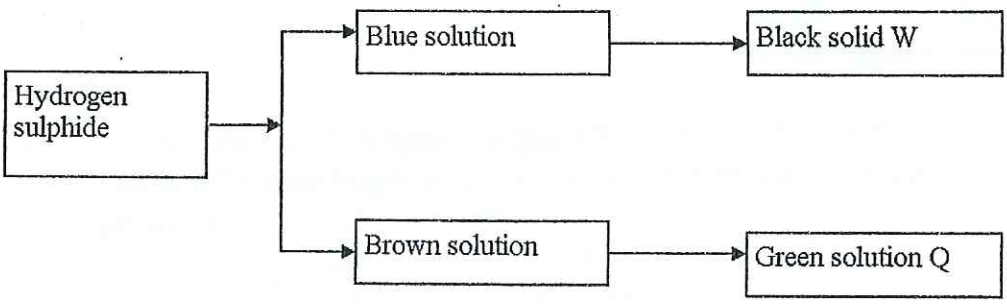
07

.....

(b) What type of bond exists in chloride of element B. (1mark)

ionic / electrovalent ✓

15. Hydrogen sulphide gas is bubbled into two separate solutions of metallic nitrate as represented in the flow chart below.



(a) Identify the cation present in

I. Blue solution (1mark)

$Cu^{2+}_{(aq)}$ / copper(II) ions ✓

II Brown solution (1mark)

$Fe^{3+}_{(aq)}$ / iron(III) ions ✓

(b) Write an ionic equation for the formation of black solid W (1mark)

$Cu^{2+}_{(aq)} + H_2S_{(aq)} \rightarrow CuS_{(s)} + 2H^+_{(aq)}$ ✓

16. Complete the table below (2marks)

Indicator	Colour in	
	$H^+_{(aq)}$	$OH^-_{(aq)}$
phenolphthalein	colourless ½	pink ½
Methyl orange	pink ½	yellow ½

17. The third member of the alkenes is converted to its corresponding saturated hydrocarbon by hydrogenation. Using the bong energy values given below, answer the questions that follow.

Bond	**Bond energy kJ/mol**
H- H	432
C= C	610
C- C	346
C- H	413

610 + 432 = 1042

1172

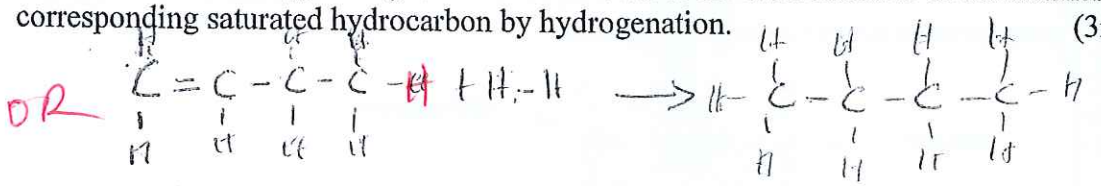
06

Bond break = C=C
~~2(C-H)~~
H-H
+1042 ✓

Bond formation = 2C(-H) + C-C
-1172 ✓1 ✓1
= -130kJ/mole

Determine the enthalpy change for the conversion of the third member of the alkenes to its corresponding saturated hydrocarbon by hydrogenation. (3marks)

OR



8(C-H) + 2(C-C) + (C=C) + (H-H)
8X413 + 2X346 + 610 + 432
3304 + 692 + 610 + 432
+5038 ✓

3(C-C) + 10(C-H)
3(346) + 10(413)
1038 + 4130
-5168 ✓

5038 - 5168
= -130kJ/mol ✓

8. Consider the chromate (VI) /dichromate (VI) equilibrium system described by the ionic equation below.

$2CrO_4^{2-}{}_{(aq)} + 2H^+_{(aq)} \rightleftharpoons Cr_2O_7^{2-}{}_{(aq)} + H_2O_{(l)}$

Yellow Orange

(a) What is meant bythe term dynamic equilibrium (1mark)

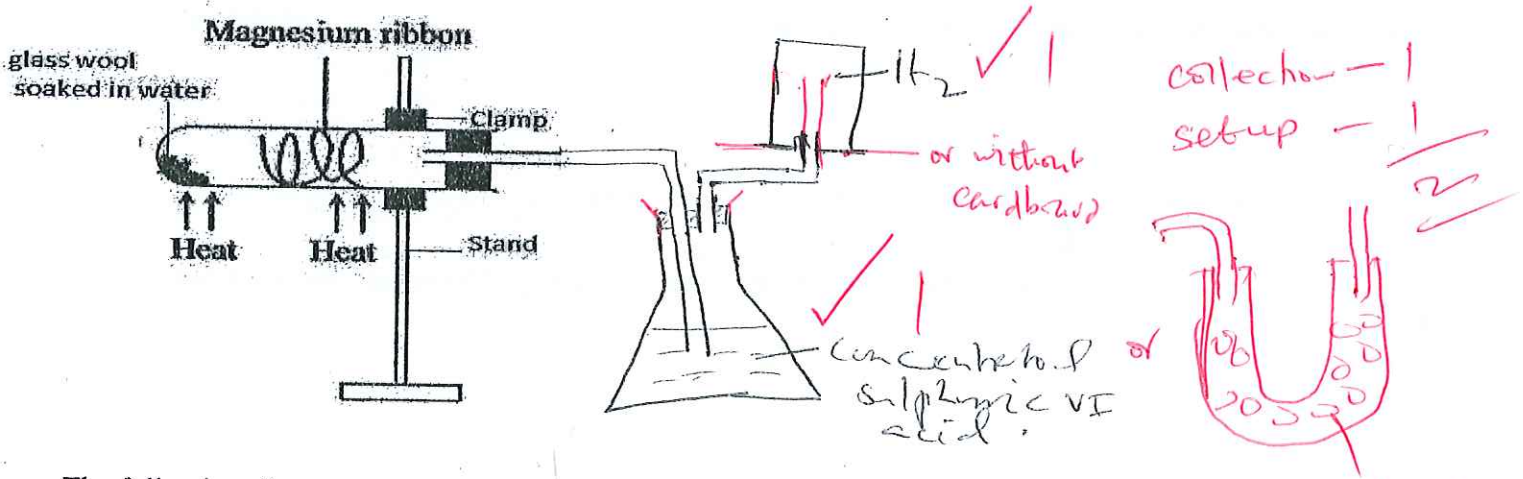
Type of equilibrium where the rate of forward reaction is equal to rate of backward reaction (reverse) ✓1

(b) What observation would be made when $NaOH_{(aq)}$ solution is added to the mixture above?

Explain (2marks)

yellow colour intensity - all ions from NaOH react with H^+ ions reducing H^+ concentration favouring the backward reaction ✓1 more yellow ✓1 reduces $[H^+]$ ✓1 reverse ✓1

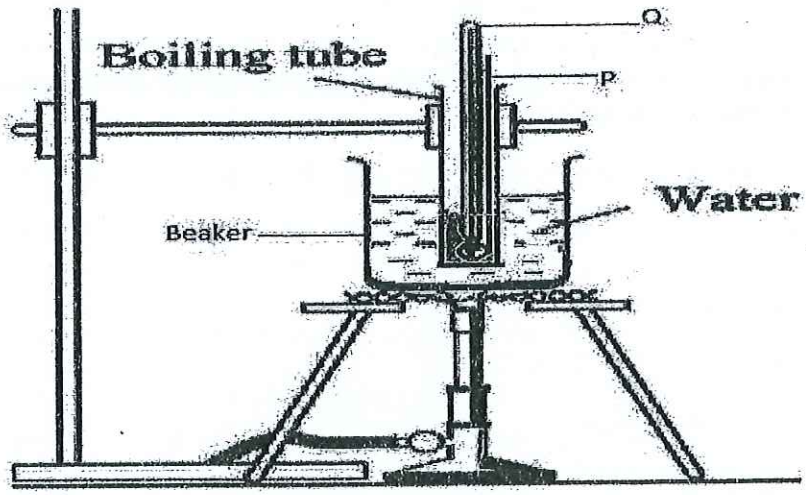
9. A student used the reaction between steam and heated magnesium metal to collect a dry sample of hydrogen gas. Complete the diagram to collect the gas. (2 marks)



collection - 1
setup - 1
2 ✓

The following diagram represents a set-up showing how changes of state from solid to liquid ould be investigated.

08



Identify the apparatus P and Q and state their uses. (2 marks)

P..... stirring rod / stirrer - stirring the content ..... dissolute heat evenly / stir

.....

Q..... thermometer - measure temperature ..... / monitor / record / determine

.....

21. (a) Complete the following table based on organic compounds. (1 mark)

	Compound	Reagents needed for preparation
(i)	Ethyne	calcium carbide and water $CaC_2 + H_2O$
(ii)	Ethane	Sodium propanoate and sodalime $NaOH/CH_3CH_2COONa$

(b) Write chemical equations to represent the reaction in (a) above. (2 marks)

(i) $CaC_{2(s)} + 2H_2O_{(l)} \rightarrow C_2H_{2(g)} + Ca(OH)_{2(aq)}$

(ii) $C_2H_5COONa + NaOH \rightarrow C_2H_6 + Na_2CO_3$

22. The following grid represents an extract of a periodic table. Use the grid to answer the questions that follow.

							Q	
I								

On the grid above;

a) Indicate by means of an arrow showing an increasing trend in the reducing power of group I elements (1mark)

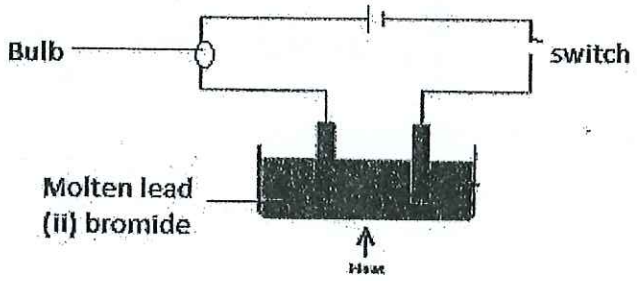
b) Mark element J a metal and element Q a non-metal, such that compound J₂Q, has the highest ionic character. Explain. (2marks)

most reactive metal and most reactive non-metal

23. Describe an experimental procedure that can be used to extract oil from nuts seeds (2marks)

Cut the nuts into small pieces. Then crush them using a mortar and a pestle. Add ethanol/propanone and filter. Collect the filtrate on the surface for propanone to evaporate leaving behind the oil.

24. Study the diagram below and use it to answer the questions that follow



a) Write the equations for the reactions taking place at the;

I. Anode (1mark)

$2Br^-_{(l)} \rightarrow Br_{2(g)} + 2e$

II. Cathode (1mark)

$Pb^{2+}_{(l)} + 2e \rightarrow Pb_{(s)}$

b) Name one application of electrolysis (1mark)

purification of metals / manufacture of chemicals NaOH, H_2, Cl_2 / electroplating / extraction of metals e.g. Al, Na, Mg

25. In a titration experiment, 25cm³ of a solution of sodium hydroxide containing 8 g per litre was required for complete neutralization of 0.245 g of a dibasic acid. Calculate the relative molecular mass of the acid (Na = 23.0, O = 16.0, H = 1) (3marks)

Molar of NaOH

8g ⇒ 1000 cm³

? ⇐ 25 cm³

$\frac{25 \times 8}{1000}$

$\frac{200}{1000} = 0.2g$

$\frac{0.2}{40}$

$= 0.005 mole$

Molarity = $\frac{8}{40} = 0.2M$

mole ratio 2 : 1

0.005 mole : 2

? : 1

0.0025 moles

$0.0025 = \frac{0.245}{2L}$

$2L = \frac{0.245}{0.0025} = 98$

OR $\frac{8}{40} = 0.2M$ molarity

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

moles of acid = $\frac{0.005}{2} = 0.0025$

RMM = $\frac{0.245}{0.0025} = 98$

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

moles acid = $\frac{0.005}{2} = 0.0025$

11

08

26. The electron arrangement of ions of a certain elements represented by letters P, Q, R and S are:

P^{2-} -2.8.8

Q^{2+} -2.8

R^{+} - 2.8

S -2.8.8

a) Explain why S is not represented as an ion (1mark)

It is stable Neither gain nor loss electrons
It has fully filled energy levels

b) Which element has the largest atomic radius? Explain. (2marks)

R - has least number of protons
Na / Sodium

27. W grammes of a radioactive isotope decayed to 5 grammes in 100 days. The half life of the isotope is 25 days.

a) What is meant by half life? (1mark)

Time taken for a radioactive substance to reduce to half the original mass.

b) Calculate the initial mass W of the radioactive isotope (3marks)

$\frac{100}{25} = 4$ half-lives

$5 = \left(\frac{1}{2}\right)^4 \times W$

$5 \times \frac{1}{16} \times W = 80g.$

1st 2nd 2nd 4th
5 — 10 — 20 — 40 — 80

OR $\frac{1}{16} W = 5$

$W = (16 \times 5)g.$

28.a) State the **Gay Lussaic's** law (1mark)

When gases (combine) react they do so in volumes that bear whole number ratio to one another and to the volume of the product if gases at constant temperature and pressure.

a) $10cm^3$ of gaseous hydrocarbon C_2H_X required $30cm^3$ of oxygen for combustion. If 1 mole of steam and $20cm^3$ of carbon (IV) oxide were produced, what is the value of X? (2marks)

$C_2H_X + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

10 : 30 : 20 : 20

1 : 3 : 2 : 2

C_2H_2

$X = 2$

Name.....Index Number...../.....

Adm No:.....Class: ..... Candidates Signature: .....date: .....

233/2
CHEMISTRY
PAPER 2
Theory
JULY/AUGUST2023
2 HOURS

NYAHOKAKIRA CLUSTER 2

Kenya Certificate of Secondary Education
Chemistry paper 2

INSTRUCTIONS TO CANDIDATES

- Write your name and index number in spaces provided above.
- Sing and write the date of examination in the spaced provided above.
- Answer all the questions in the spaces provided.
- KNEC Mathematical tables and silent electronic calculators may be used.
- All working MUST be clearly shown where necessary.
- Candidates should answer the questions in English.

For examiners use only

Question	Maximum score	Candidate's score
1	13	
2	11	
3	11	
4	11	
5	13	
6	11	
7	10	
Total score	80	

1. The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of the element.

A								
				N				
K	Q		O			P	F	M
C								

Identify the elements that belong to the same chemical family (1mk)

Ted K and C Penalise ½ if

a) Write the formula of the compound formed when Q and P combine. (1mk)

QP / MgS

b) Name the type of bond formed in (b) above. Give a reason (1mk)

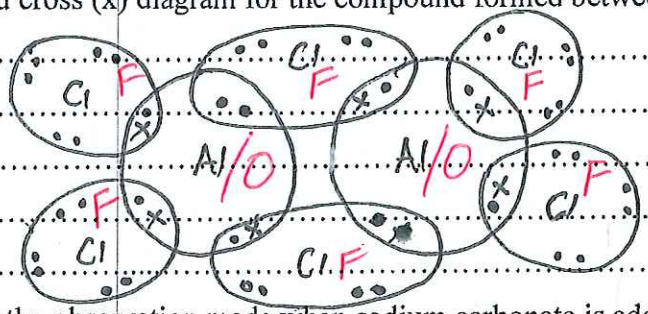
Ionic/Electrovalent bond - complete transfer of electrons.

c) How does the atomic radii of O and P compare? Give a reason. (2mks)

O is larger than P - P has bigger/stronger nuclear charge due to more number of protons hence stronger nuclear force of attractions. Reject by hs

d) Draw a dot (.) and cross (x) diagram for the compound formed between O and F. (1mk)

Al-2.8.3 Cl-2.8.7



e) State and explain the observation made when sodium carbonate is added to a solution of the compound formed in (d) above. (2mks)

Jeff - Fizzing

Production of bubbles - Aluminium chloride hydrolyses to form H^+ ions which attack the carbonate producing carbon(IV)oxide.

HCl

f) Explain how you would obtain a pure sample of the carbonate of K from its mixture with Lead carbonate powder. (2mks)

To the mixture add water for K carbonate to dissolve; Filter to obtain K Carbonate as filtrate and lead carbonate as a residue. Heat to saturation allow to cool & crystalize K carbonate to dryness.

Ref-marking

g) Give one use of element M. (1mk)

- Use to fill florescent bulbs to provide 'inert envt'.
- mix with oxygen in arc welding

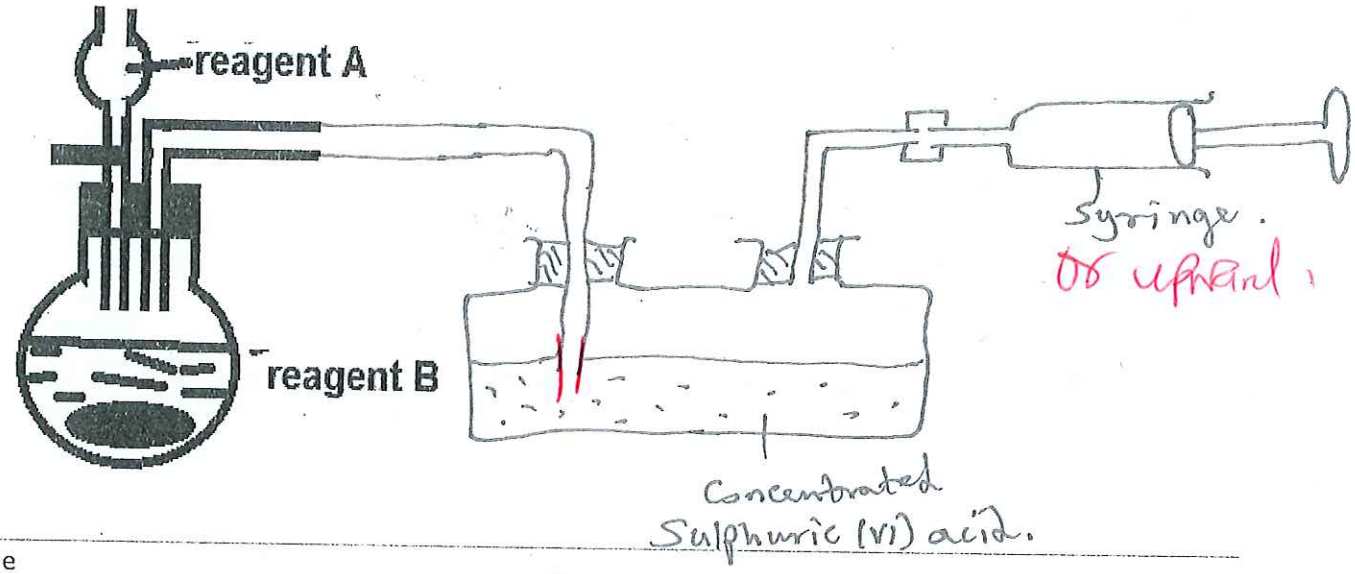
h) The melting point of M is -189°C lower than that of F -102°C. Explain this difference in their melting points. (2mks)

M is monoatomic while F is diatomic having weaker van der Walls forces of attractions.

More/Stronger

2. a) The above apparatus were used in the preparation of various gases in the laboratory. Use the setup to answer the questions that follow.

W=01



Anhydrous $CaCl_2$ in U-tube
Quick lime in a guard tube

i) Identify reagent A or reagent B used in the preparation of the following gases according to the table below. (2mks)

Gas	Hydrogen	Oxygen	Carbon IV oxide	Sulphur IV oxide
Reagent A	Dilute sulphuric VI acid	Water	Dilute Hydrochloric acid / HNO_3	Dilute sulphuric VI acid
Reagent B	Zinc / Zn / Mg	Sodium peroxide	Calcium carbonate	~~Copper~~ Na_2SO_3 / K_2SO_3

ii) Complete the diagram to show how a dry sample of hydrogen gas is collected (2mks)

iii) Write a balanced equation for the above reaction in the preparation of sulphur (IV) oxide gas (1mk)

$Na_2SO_{3(s)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O_{(l)} + SO_{2(g)}$

~~$Cu_{(s)} + H_2SO_{4(aq)} \rightarrow CuSO_{4(aq)} + H_2O_{(l)} + SO_{2(g)}$~~ K_2SO_3

b) You are provided with solid potassium hydrogen carbonate. Describe how a solid sample of potassium nitrate crystals can be prepared. (3mks)

To ~~some~~ of dilute nitric (V) acid add solid ~~K_2CO_3~~ $KHCO_3$ until effervescence stops. Filter to remove unreacted ~~K_2CO_3~~ $KHCO_3$ Evaporate to remove excess water in filtrate (heat to saturation) and allow to cool at room temperature to form large crystals.

c) Write an equation to show the effect of heat on each of the following;

i. Sodium hydrogen carbonate. (1mk)

$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$

ii. Lead (II) nitrate (1mk)

$2Pb(NO_3)_{2(s)} \rightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

iii. Silver nitrate (1mk)

$2AgNO_{3(s)} \rightarrow 2Ag_{(s)} + 2NO_{2(g)} + O_{2(g)}$

3. Study the electrode potentials in the table below and answer the questions that follow

$U_{aq}^{2+} + 2e^-$	$\rightleftharpoons$ U(s)	- 2.87
$V^+_{aq} + e^-$	$\rightleftharpoons$ V(s)	-2.48
$W^{2+}_{aq} + 2e^-$	$\rightleftharpoons$ $W_{(s)}$	- 0.80
$X^+_{aq} + e^-$	$\rightleftharpoons$ $\frac{1}{2} X_{2(g)}$	0.00
$Y^{2+} + 2e^-$	$\rightleftharpoons$ $Y_{(s)}$	+0.34
$\frac{1}{2} Z_{2(g)} + e^-$	$\rightleftharpoons$ $Z^-_{(aq)}$	+ 2.87

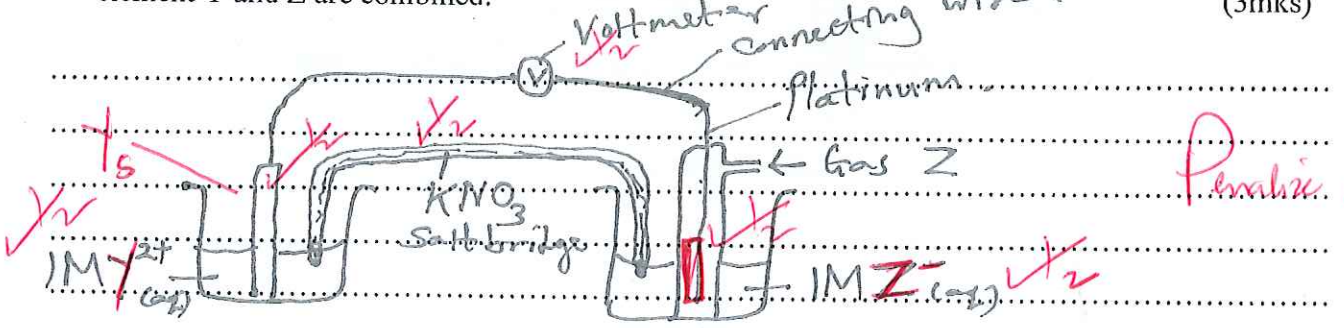
a) State the element which is the strongest reducing agent. (1mk)

U ✓1

b) Which element is likely to be hydrogen? Give a reason for your answer. (2mks)

X - has 0.00V / Reference electrode

c) Draw a labeled diagram of the electro-chemical cell that would be obtained when the half cells of element Y and Z are combined. (3mks)



Porous ½mk

d) Can a solution of W be stored in a container made of U? Calculate the e.m.f to show how you arrive at your answer? (2mks)

e.m.f = -0.80 - -2.87
= +2.07V ✓

No. Reaction will occur / emf is positive ✓1

$U^{2+}_{(s)} + 2e^- \rightarrow U$ +2.87
W^{2+} +0.80

e) During electrolysis of aqueous copper (II) sulphate using copper electrodes:

I. State two observations made when the electrolysis is carried out for 4 minutes. (2mks)

✓ Anode wears out // decreasing in mass ✓1/2e

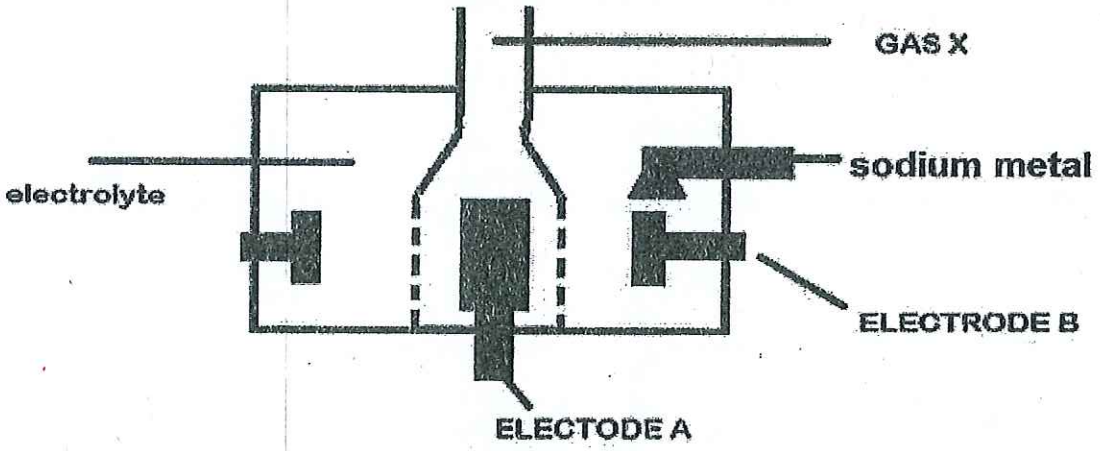
✓ Cathode deposition of brown solid thus increase in mass ✓1/2e

✓ Blue colour remains

II. Write an ionic equation for the reaction that took place at the anode. (1mk)

$Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e^-$ ✓

4. Below is a simplified diagram of the Downs Cell used for the manufacture of sodium from Rock salt. Study it and answer the questions that follow



i. Identify the electrode where reduction takes place in the cell above (1mk)

~~Cathode~~ B

ii. Write an ionic equation for the reaction in which gas X is formed (1mk)

~~$2Cl^-_{(l)} + 2e^- \longrightarrow Cl_{2(g)}$~~

$2Cl^-_{(l)} \longrightarrow Cl_{2(g)} + 2e^-$ ✓

iii. Explain two observations made when a piece of sodium metal is placed on water in a trough (2mks).

- Melts into silvery balls. – exothermic
- Darts on the surface of water → Propelled by H_2 gas
- Produces a hissing sound. → H_2 gas
- Floats – less dense

iv. The main electrolyte is molten Rock salt. Why is it not advisable to use sea water in this process? (2mks)

H^+ ions discharged at the expense of Na^+ ions

v. Substance Y is added to lower the melting point of sodium chloride from about 800^0C to about 600^0C. Identify substance Y (1mk)

Calcium (II) chloride ✓

vi. What precaution is taken to prevent gas X and sodium from recombining? (1mk)

Using steel gauze diaphgram ✓

vii. The above cell ran for one day and 21.4 hours nonstop and a current of 1500 amp was used. Calculate the mass of sodium produced to the nearest Kg (1F=96500C Na= 23, Cl= 37.5) (3mks)

$Q = It$.

$1F = 96500C = 23.0g$.

$Q = (45.4 \times 60 \times 60) \times 1500$

$= (1764000 \times 264 \times 1500)$

$= 264,600,000C$.

245,160,000 C

$M = \frac{I \times RAM}{96500 \times F} = \frac{45.4 \times 60 \times 60 \times 15000 \times 23}{96500 \times 1 \times 1000} = 58.43Kg$

$Mass = \left(\frac{245,160,000 \times 23.0g}{96500}\right)$.

$= 63,065.28g \cdot \frac{58431}{1000}$

$= 63.065kg$. 58.431Kg

viii. To prepare bleaching a agent chlorine gas is bubbled in a solution of sodium hydroxide. Write a balanced equation for the above reaction. (1mk).

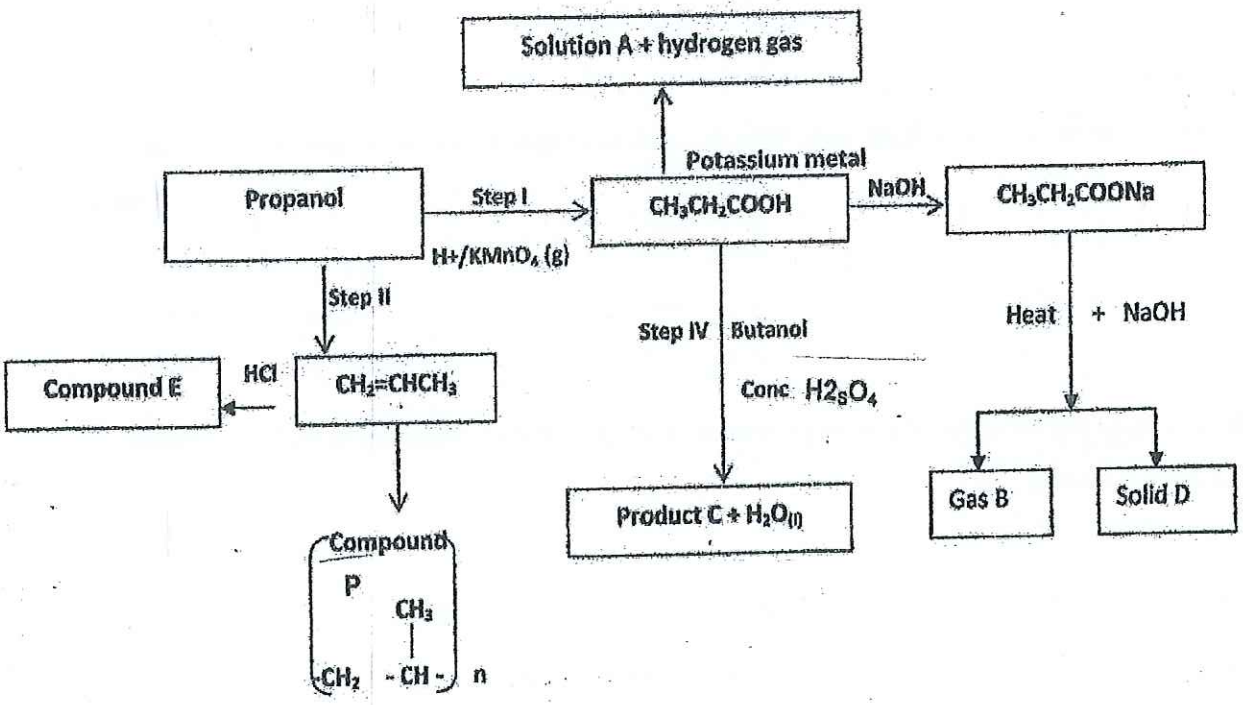
$2NaOH_{(aq)} + Cl_{2(g)} \longrightarrow NaCl_{(aq)} + NaClO_{(aq)} + H_2O_{(l)}$

(Cold)

~~$NaOH_{(l)} + Cl_{2(g)} \longrightarrow NaCl_{(aq)} + NaClO_{3(aq)} + H_2O_{(l)}$~~

(Hot)

5. The scheme below shows a series of reactions starting with Propanol. Study it and answer the questions that follow:-



(a) Name the type of reaction in steps I and II.

Step I ..Oxidation.. ✓1 (1mk)

Step II..Dehydration.. ✓1 (1mk)

(b) Write the formulae of gas B and solid D. (2mks)

B - C_2H_6. ✓1 CH_3CH_3

D - Na_2CO_3. ✓1

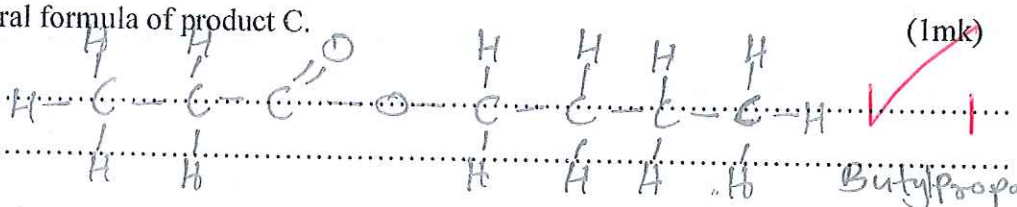
(c) Name the substances labeled A and E. (1mk) 2

A..Potassium ~~propoxide~~ Propanoate ✓ ~~✗~~ ✓1

E..Chloropropane / 2-Chloropropane. ✓ ✓1

1-Chloropropanane / or ~~✗~~ ✓1

(d) Draw the structural formula of product C. (1mk)



Butylpropanoate.

(e) Name the process in Step (IV) (1mk)

Esterification.

(f) Name compound P and state the type of reaction involved in its formation. (1mk)

Name of compound P: Polypropene.

Type of reaction: Self Additional Reaction

(g) If the relative molecular mass of P is 35,700 determine the value of n. (2mks)
(C = 12, H = 1)

$\left[CH_2-CH(CH_3)\right]_n = 35700$

$42n = 35700$

$n = \frac{35700}{42}$

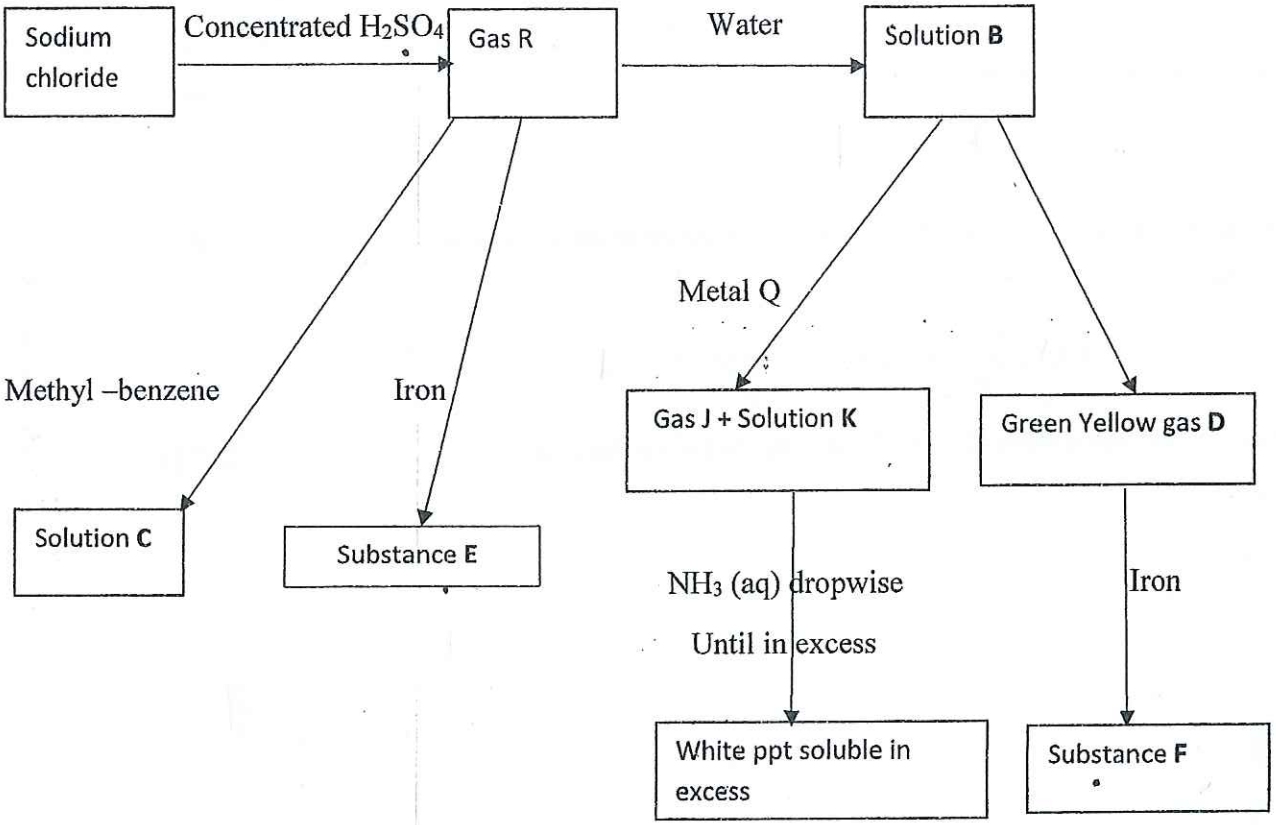
$= 850$ monomers

(a) Explain how you would prepare soap from castor oil in the laboratory. (3mks)

Using a motor and a pestle crush the seeds while adding propanol a little at a time, Using filter paper Decant to obtain a mixture of castor oil and propanol, allow propanol to evaporate the wash the oil with water the separate using a separating funnel run water then remain with oil.

- Add ~~Concentrated~~ NaOH/KOH solution to the oil.
- Heat to boil
- Add Sodium Chloride to ppt ½
- Filter to obtain ½

6. The flow diagram below summarizes the results of a series of chemical reactions. Study it and then answer the questions that follow:



(b) Identify (4mks)

Gas R: Hydrogen chloride / HCl

Solution B: Hydrochloric acid / HCl

Gas D: Chlorine gas / $Cl_{2(g)}$

Substance E: Iron(II) chloride / $FeCl_2$

Substance F: Iron(III) chloride / $FeCl_3$

Gas J: Hydrogen / H_2 ½

Solution K: $ZnCl_2$ ½

Metal Q: Zinc ½

(c) What is the effect of solution B and solution C on dry blue litmus paper? Explain. (2mks)

½ In solution B blue litmus changes to red / Red-White the bleaches / White

½ In solution C blue litmus paper remains blue.

1 Solution B has H^+ responsible for acidity while in C HCl remains as a molecule / no H^+ does not ionize

(d) What would you observe if excess ammonia solution is added to aqueous solution of substances E and F separately. Explain your observation. (2mks)

Formation of pale green ~~solution~~ ppt $Fe(OH)_2$ while in F will be formation of brown precipitate $Fe(OH)_3$

(e) What reagents would you use:

(i) To convert substance E to substance F. (1mk)

Addition of $H^+/KMnO_4$ / $H^+/K_2Cr_2O_7$ then warm / H_2O_2 / HNO_3

(ii) To convert solution B to gas D? (1mk)

~~Oxidizing with~~ $KMnO_4$ or MnO_2 / PbO_2
Reaction with lead(IV) oxide.

(f) State the condition required in the formation of substance E or F which is not given in the diagram. (1mk)

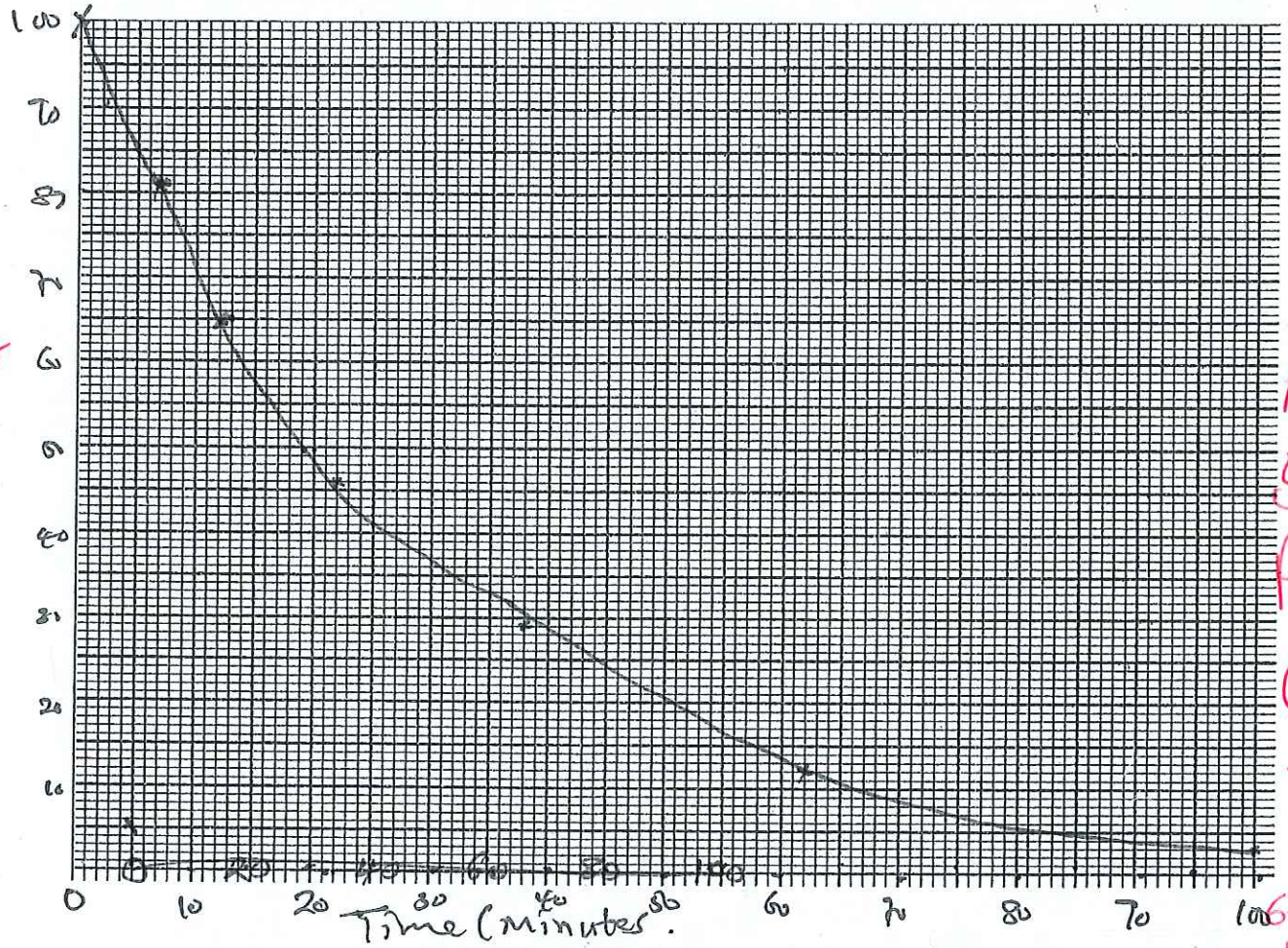
heat / heating

7. a) Draw a labelled diagram to show how alpha, beta and gamma radiations can be distinguished using penetration power (3mks)

b) The table below gives the percentage of a radioactive isotope of Bismuth that remains after decaying at different times

Time (Minutes)	0	6	12	22	38	62	100
Percentage of Bismuth	100	81	65	46	29	12	3

I. On the grid provided, plot a graph of the percentage of Bismuth remaining (vertical axis) against time (3mks)



A ½
S ½
P 1
C 1
3

6-7=1mk
5 = ½
↓ = 0

II. Using the graph, determine the;

ii) Half-life of the Bismuth isotope (1mk)

19 ± 0.2 ±1 Read n=20

70/20 (0.5)

iii) Original mass of the Bismuth isotope given that the mass that remained after 70 minutes was 0.16g (2mks)

$A_{1/2} = (\frac{1}{2}) \quad 0.16g = (\frac{1}{2})^{3.5} \times y$ ✓

0.16 / 0.0884 = 1.809 ✓1

70/20 = 3.5

$Rem = (\frac{1}{2})^n \times mg$

THIS IS THE LAST PRINTED PAGE

KH = 4 3
HB = 4 ✓
R = 4 ✓
Kap = 2 ✓
Nyak = (5) ✓
19, or 18

NAME: ..... Adm.No.....

SCHOOL: ..... Index . NO: ..... CLASS: .....

233/3

CHEMISTRY

PAPER 3 / PRACTICAL

NYAHOKAKIRA JOINT EVALUATION

2¼ HOURS

NYAHOKAKIRA CLUSTER 2

Kenya Certificate of Secondary Education 2023

233/3

CHEMISTRY

INSTRUCTIONS TO CANDIDATES

- *Write your name, school, index number, date and signature in the spaces provided.*
- *You are required to spend 15 minutes of the 2¼hrs reading through the paper and make sure you have all the apparatus and chemicals needed for the practical.*
- *Answer all the questions in the spaces provided after each question*
- *Electronic calculators and mathematical tables may be used*
- *All working **must** be clearly shown where necessary.*

For Examiner's Use Only

Question	Maximum score	Candidate's Score
1	19	
2	13	
3	08	
Total	**40**	

Candidates should check the question paper to ensure that all the 7 pages are printed as indicated and no questions are missing.

Turn over

1. You are provided with:

- Aqueous sulphuric (VI) acid labeled solution **A**
- Solution **B** containing 2.6g in 250cm^3 solution of potassium carbonate
- A clean piece of magnesium ribbon
- Methyl orange indicator

You are required to determine the

a) Concentration of solution A

b) Rate of reaction between magnesium and sulphuric (VI) acid – solution A, at different concentrations.

PROCEDURE I:

i. Using a measuring cylinder, place 25.0cm^3 of solution **A** into a 250ml volumetric flask. Add distilled water to make 250cm^3 of solution. Label this solution **C**.

ii. Place solution **C** in a burette.

iii. Using a pipette and a pipette filler, place 25.0cm^3 of solution **B** into a conical flask.

iv. Add 2 drops of methyl orange indicator provided and titrate with solution **C**.

v. Record your results in table I below.

vi. Repeat the titration two more times and complete the table.

Table I

Titration	I	II	III
Final burette reading (cm^3)	16.9	34.0	17.0
Initial burette reading (cm^3)	0.0	16.9	0.0
Volume of solution C used (cm^3)	16.9	17.1	17.0

(4mks)

CT-1
Dp-1
A-1
P.A-1
F.A-1
05

(a) Calculate the:

(i) Average volume of solution C used. (1mk)

$$\left(\frac{16.9 + 17.1 + 17.0}{3}\right) = 17.0\text{cm}^3$$

2.6
4
10.4

(ii) Concentration of potassium carbonate in solution B (C = 12.0, O = 16.0, K = 39.0) (1mk)

$$\left(\frac{2.6 \times 4}{138}\right) = 0.0754\text{M}$$ Exact.

or 10.49/litre

2

or 2.6g/250cm^3.
0.0188 moles/250cm^3

I

06

(iii) Concentration of sulphuric (VI) acid in solution C. (2mks)

(iv) Concentration of sulphuric (VI) acid in solution A. (1mks)

PROCEDURE B:

(i) Label five test-tubes 1, 2, 3, 4 and 5.

(ii) Empty the burette and fill it with solution A.

(iii) From the burette, place 10cm^3 of solution A into test tube number 1. From the same burette, place 9cm^3 of solution A into test-tube number 2. Repeat the process for test-tube numbers 3, 4 and 5 as shown in table II below.

(iv) Using a 10ml measuring cylinder, measure 1cm^3 of distilled water and add it to test-tube number 2. Repeat the process for test-tube numbers 3, 4 and 5 as shown below.

(v) Cut out five pieces exactly 1cm long of the magnesium ribbon.

(vi) Transfer all the solution in test-tube number 1 into a clean 100ml beaker provided. Put one piece of the magnesium ribbon into the beaker and immediately start a stop watch

(vii) Swirl the beaker gently to ensure the magnesium is always inside the solution

(viii) Record in table II below time taken in seconds for magnesium ribbon to disappear.

(ix) Pour away the final contents of the beaker and rinse it with water.

(x) Repeat the procedure from (vi) for each of the remaining test-tube numbers 2, 3, 4 and 5 and complete the table below

Penalties for Complete table:

Table II AC ±2

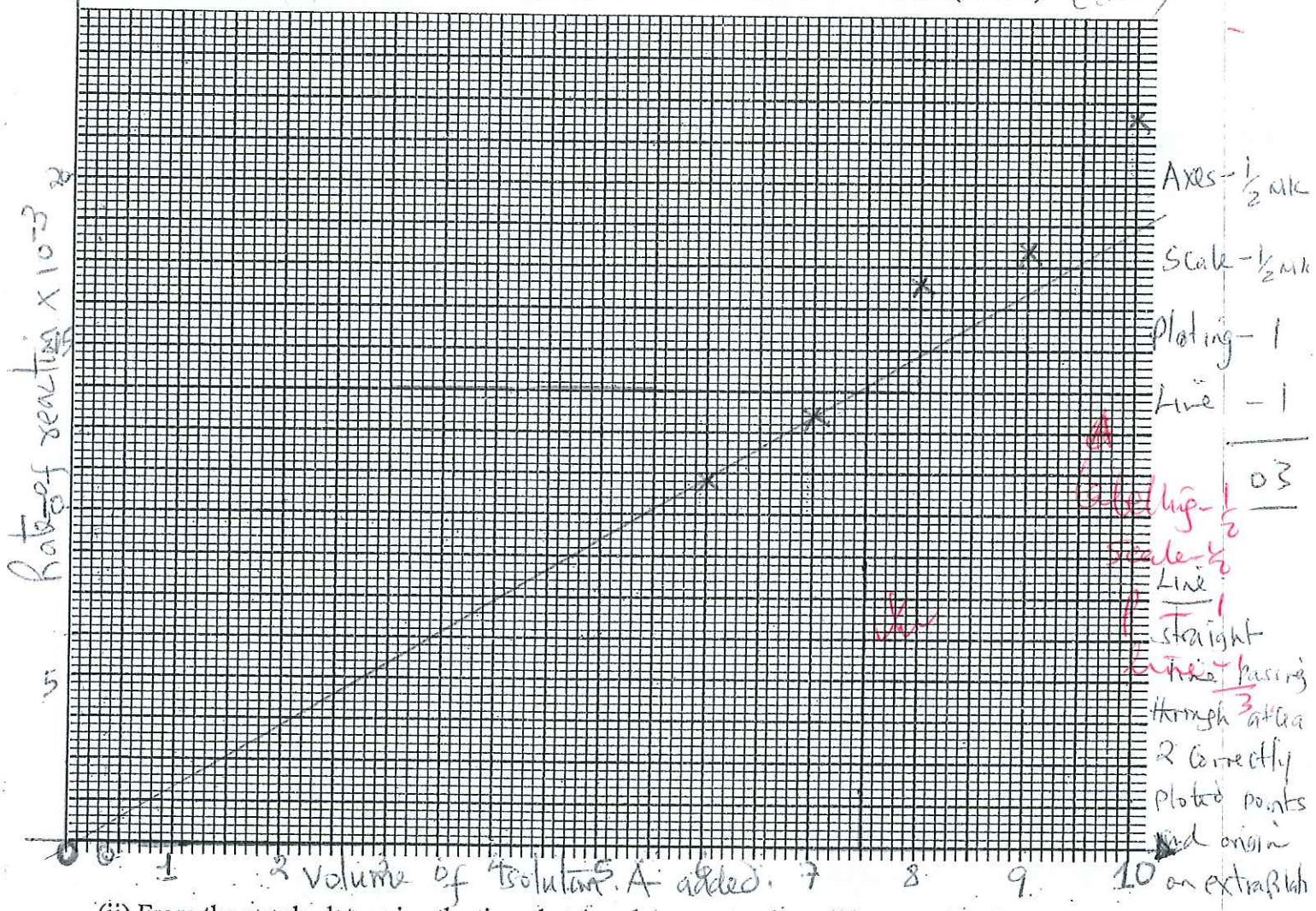
Test tube number	1	2	3	4	5
Volume of solution A added (cm^3)	10	9	8	7	6
Volume of distilled water added (cm^3)	0	1	2	3	4
Time taken (seconds)	46	57	60	78	89
Rate of reaction ($^1/_{time}$)	0·02174	0·01754	0·01667	0·01282	0·01124

CT – 1
Dp – 1
A – 1
Tr – 1

(4mks)

Increasing values $10 \leq X \leq 20$ P4

(i) Plot a graph of rate of reaction ($^1/_{time}$) against volume of solution A added(X-axis) (3 mks)



Axes – ½ mk
Scale – ½ mk
Plotting – 1
Line – 1

03

Labelled y-axis – ½
Scale – ½
Line
1 straight line passing through at least 3 of the 5 correctly plotted points and origin or an extrapolation

(ii) From the graph, determine the time that 1cm long magnesium ribbon would take to react with 7. 5cm^3 of solution A used. (1mk)

$\left(\frac{1}{12.5 \times 10^{-3}}\right)$ = 80 seconds ✓½

(iii) What is the relationship between the concentration of solution A and the rate of reaction? Explain. (2mks)

Increase in Concentration increases the number of successful collisions per unit time increasing the rate of reaction ✓1 1 2

10

Q2. A) You are provided with **solid M.** Carry out the following tests and record your observations and inference in the spaces provided

i) Place all the **solid M** in a dry boiling tube. Add about $8cm^3$ distilled water and shake. Filter the mixture and retain both filtrate and residue. Divide the filtrate into three portions.

Observations	Inferences
Partially dissolves to form a colourless filtrate and white residue (1mk)	Mixture of soluble & insoluble / sparingly soluble (1mk)

ii) To the 1st portion of the filtrate, add sodium hydroxide solution drop-wise then in excess.

Observations	Inferences
White ppt insoluble in excess (1mk)	Ca^{2+}, Mg^{2+} present (1mk)

iii) To the 2nd portion of the filtrate, add ammonia solution drop-wise until in excess.

Observations	Inferences
White ppt insoluble insoluble in excess (1mk)	Mg^{2+} present (1mk)

iv) To the 3rd portion of the filtrate, add 3 drops of Lead (II) nitrate solution.

Observations	Inferences
White ppt formed (1mk)	SO_4^{2-}, CO_3^{2-}, SO_4^{2-} present (1mk)

(V) To the 4th portion of the filtrate, add 3 drops of acidified barium nitrate.

Observations	Inferences
White precipitate formed (1mk)	SO_4^{2-} present (1mk)

Must be inferred correctly in (iv)

B(i) To the residue in the boiling tube, add about $5cm^3$ of dilute nitric (V) acid provided. Test for any gase produced using a burning splint. Divide the resultant solution into two portions.

Observations	Inferences
Effervescence/bubbles, that extinguishes a burning splint (½mk)	CO_3^{2-} present (½mk)

ii) To the first portion, add sodium hydroxide solution dropwise until in excess.

Observations	Inferences
White precipitate formed soluble in excess (1mk)	Zn^{2+}, Pb^{2+} present (Tied) (½mk)

Penalize fully for any contradicting ions

iii) To the second portion add aqueous ammonia dropwise until in excess.

Observations	Inferences
White precipitate formed insoluble in excess (½mk)	Pb^{2+} present (½mk)

Mentioned correctly inferred in (ii) above

5½

Q3. You are provided with liquid **R**. Carry out the tests below and record your observations and inferences in the spaces provided.

(a Put about $1cm^3$ of liquid **R** on a watch glass and ignite it using a burning splint

Observations	Inferences
Burns with a blue non-sooty flame / ½ Non-luminous flame (½mk)	$>C=C<$ / $-C\equiv C-$ absent ½ (½mk)

(b) To about $1cm^3$ of liquid **R** on test tube, add about $1cm^3$ of distilled water and shake.

Observations	Inferences
Miscible / dissolves to form one layer / homogeneous solution (1mk) ½	Polar Compound present ½ (1mk)

(c) To about $1cm^3$ of liquid **R** in a test-tube, add 3 drops of acidified potassium manganate (VI)

Observations	Inferences
Purple H+/ $KMnO_4$ changes to colourless (1mk)	$>C=C<$ / $-C\equiv C-$, ROH. ½ ½ present. (1mk)

(d) To about $1cm^3$ of liquid **R** in a test tube, add 2 drops of acidified potassium dichromate (VI). Warm the mixture gently and allow it to stand for one minute.

Observations	Inferences
Orange H+/ $K_2Cr_2O_7$ changes to green. Reject: turns (1mk)	R-OH present (1mk)

(e) To about $1cm^3$ of liquid **R** in a test tube add about half spatulaful of solid sodium hydrogen carbonate. **Observations**

Observations	Inferences
No effervescence ½ (½mk)	H+ absent / R COOH absent / H_3O^+ (½mk)

Last printed page

Lucrări ~~Bacalaureat~~