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MARKING SCHEME CLASS ----------

ADM NO ----------

SIGNATURE ----------

DATE ----------

233/1
FORM 4
CHEMISTRY
PAPER 1
PRE MOCK 1 2015
TIME: 2 HOURS

SUNSHINE SECONDARY SCHOOL
PRE MOCK 1
MARCH 2015

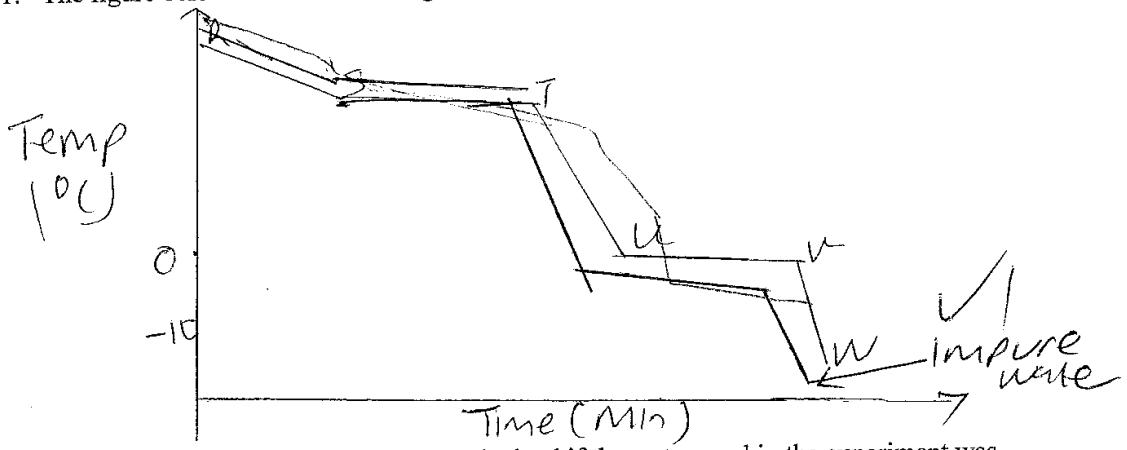
INSTRUCTIONS

- Answer all the questions in the spaces provided
- Mathematical tables and silent electronic calculators may be used
- All working must b e clearly shown where necessary

For examiners use only

	P	Q	R	S	T	U
Nyangi	2,3	4,5	6,7	8,9	10,11	12,13,14
Kamau	4,5	6,7	8,9	10,11	12,13,14	2,3
Ambose	6,7	8,9	10,11	12,13,14	2,3	4,5
Munya	8,9	10,11	12,13,14	2,3	4,5	6,7
OVKD	10,11	12,13,14	2,3	4,5	6,7	8,9
Shelai	12,13,14	2,3	4,5	6,7	8,9	10,11

1. The figure below shows the cooling curve for water is gaseous state.



i) Using the same axis draw a curve obtained if the water used in the experiment was impure.

(1mk)

ii) Name the process taking place between

S and T (1mk)

Condensation

U and V (1mk)

freezing

3

2. On addition of a few drops of aqeous sodium hydroxide to solution M a white precipitate forms which dissolves on a addition of excess sodium hydroxide. A white precipitate forms when solution M is reacted with sodium chloride solution. Suggest the identity of the cation present and explain. (2mks)

Pb^{2+} ✓1 When Pb^{2+}_{aq} react with NaOH it forms insoluble lead(II) hydroxide which dissolves in excess to form complex ions ✓½ . When reacted with Chloride ions there is formation of $PbCl_2$ ✓½

3. 1g of sodium hydroxide is added to 30cm³ of 1M HCl. How many cm³ of 0.1M KOH solution will be needed to neutralize the excess acid. (H=1 O=16 Na=40) (3mks) ✓1

$NaOH_{(s)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$ ✓1

Moles of NaOH = $\frac{1}{40} = 0.025$ moles ✓½

Moles of HCl = $\frac{1 \times 30}{1000} = 0.03$ moles ✓½

Moles of HCl to react with KOH

$0.03 - 0.025 = 0.005$ moles

$HCl_{(aq)} + KOH_{(aq)} \rightarrow KCl_{(aq)} + H_2O_{(l)}$ ✓1

Moles of KOH used = 0.005 moles

0.1 moles → 1000cm³ ✓½

0.005 moles → ?

$\frac{1000 \times 0.005}{0.1} = 50cm^3$ ✓1½ (4mks)

4. Describe how you can prepare crystals of magnesium chloride starting with 50cm³ of 2M magnesium hydroxide. (3mks)

Take 1000cm³ of 2M HCl ✓1 (or 2000cm³ of 1M HCl) and add to 50cm³ of 2M $MgCl_2$ in a beaker to form Magnesium Sulphate solution ✓½ . Heat the solution to saturation and allow it to cool ✓½ for crystals to form. Filter ✓½ and dry the crystals between filter papers ✓½.

9

5.Use the following information to answer the questions that follow

$\Delta H_{lattice}$ $MgCl_2$ = -2489 KJ/ mol^{-1}

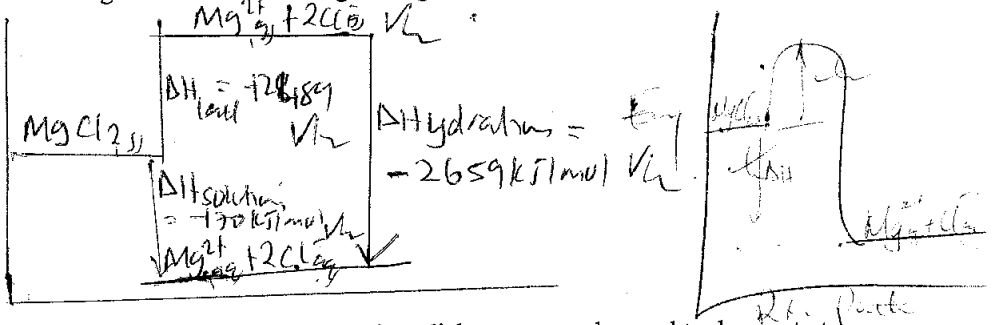
$\Delta H_{hydration}$ Mg^{2+} = - 1891 kJ/ mol

$\Delta H_{hydration}$ Cl^- = -384 kJ/ mol

a) Calculate the heat of solution of magnesium chloride. (2mks)

Heat of Solution = ΔH lattice + ΔH hydration.
= +2489 + (-1891 + 2(-384)) = ✓1
+2489 - 2659 = -170 KJ/mol ✓1
Penalise for sign and unit

b)Draw an energy level diagram for the dissolving of magnesium chloride. (2mks)



6.The reaction between hydrochloric acid and potassium dichromate can be used to demonstrate a reversible reaction. The ionic equation is given below

$2CrO_4^{2-}$ (aq) + $2H^+$ (aq) ⇌ $Cr_2O_7^{2-}$ (aq) + H_2O (l)

Yellow orange

Explain the observation that would be made when dilute hydrochloride acid is added to the equilibrium mixture. (2mks)

The orange colour intensifies ✓1 because the added H^+ makes the equilibrium to shift to the right ✓1

6//

7.The table below gives the rate of decay for a sample of a radioactive element P

Mass of P (g)	number of days
48	0
18	90
6	180

a)Determine its half-life (2mks)

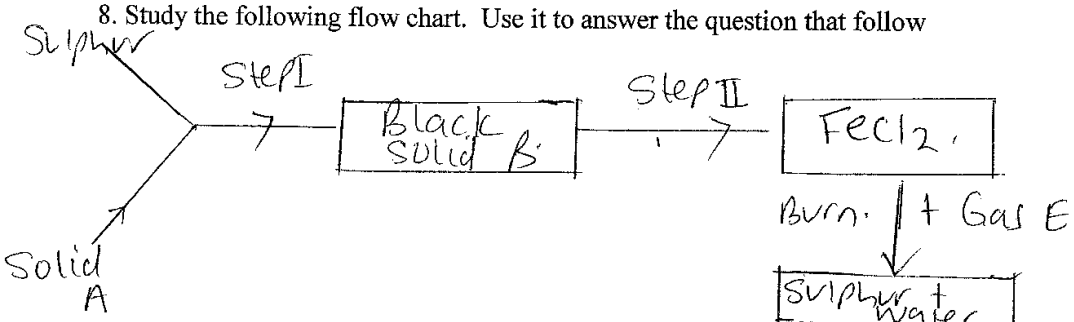
48 → 24 → 12 → 6

$3t_{\frac{1}{2}} = 180 \Rightarrow t_{\frac{1}{2}} = 60$ days

b)Complete the following nuclear equation. (1mk)

$$^{233}_{91}Pa + {}^{0}_{-1}e \longrightarrow {}^{233}_{90}Y + {}^{0}_{-1}e$$

8. Study the following flow chart. Use it to answer the question that follow



a)Identify (3mks)

i) Solid A Iron

ii)Solid B Iron (II) sulphide

iii)Gas E hydrogen sulphide

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b)Name the reagents used in step (2mks)

i) I

ii) II dilute hydrochloric acid

9.i)Name two salts responsible for permanent hardness of water. (2mks)

Calcium Sulphate Magnesium Sulphate.

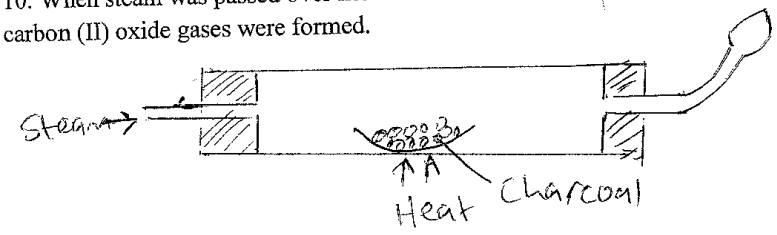
ii)Explain the precipitation method used to remove water hardness. (1mk)

Sodium Carbonate is added to precipitate Ca^{2+} or Mg^{2+} ion.

$Mg^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow MgCO_{3(s)}$ or

$Ca^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow MgCO_{3(s)}$.

10. When steam was passed over heated charcoal as shown in the diagram, below, hydrogen and carbon (II) oxide gases were formed.



a)Write the equation for the reaction which takes place. (1mk)

$H_2O_{(g)} + C_{(s)} \rightarrow CO_{(g)} + H_{2(g)}$

b)Name two uses of carbon (II) oxide gas which are also uses of hydrogen gas. (2mks)

1. As a fuel.
2. As a reducing agent in extraction of metals such as iron from their ore.

Marsa

11.a) State and explain the observations made when a few drops of concentrated Sulphuric (vi) acid is added to sucrose ($C_{12}O_{22}O_{11}$) (2mks)

Black mass of substance is formed.

This is because the concentrated sulphuric (VI) acid removes the atom which form water ie Hydrogen and oxygen leaving from the sucrose behind carbon which is black.

6

9

b)Using an equation show how the above reaction takes place. (1mk)

$C_{12}H_{22}O_{11(s)} \xrightarrow{\text{conc. } H_2SO_4} 12C_{(s)} + 11H_2O_{(l)}$

12.Students from Sunshine Secondary School suspected that some water contained either sulphate or sulphite ions. Explain how the ion present can be determined. (3mks)

- To a certain sample of the water, add few drops of Barium nitrate solution followed by drops of dilute nitric (V) acid. If a white precipitate soluble on addition of the acid is formed the water contains sulphite ion- and if a white precipitate insoluble on addition of the acid is formed the water contains sulphate.

13.A mixture of ethene, oxygen and nitrogen are ignited. On cooling the residual gas occupied 58 cm^3 when shaken with aqeous alkali, the volume was reduced to32 cm^3. A further 18 cm^3 of the product was absorbed by alkaline pyrogallo. Calculate the composition of the original mixture. (C = 12, H = 1, N = 14, O = 16 and molar volume at r.t.p = 24dm3. (4mks)

$2C_2H_4 + 2O_2 \longrightarrow 2CO_2 + 2H_2O$

Volume of O_2 = 58 − 32 = 26 cm³

Volume of O_2 = 18 cm^3 unreacted

Mole ratio of $O_2 : C_2H_4$ = 2 : 2

26 : ?

$\frac{26 \times 2}{2}$ = 26 cm^3

volume of C_2H_4 = 26 cm^3

Volum of O_2 used = 26 cm^3

mole ratio of $O_2 : CO_2$ = 2 : 2

? 26

$\frac{26 \times 2}{2}$ = 26 cm^3 of O_2 used.

Total O_2 present = 26 + 18 = 44 cm³

Original mixture = 44 cm^3 − oxygen

13 cm^3 − Ethene

14 cm^3 − Nitrogen

Residue = Nitrogen + CO_2 + unreacted O_2

58 = N + 26 + 18

58 − 44 = 14 cm³

14 cm^3 − Nitrogen

14.0.24g of a divalent metal x dissolves in 50 cm^3 of 0.25 M sulphuric acid. The resulting solution required 5.0 cm^3 of 1.0 M sodium hydroxide solution to neutralize the excess acid. What is the reactive atomic mass of x. (3mks)

$H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$

5 cm³ 1M

Moles of NaOH = $\frac{0.1}{1000} \times 5 = 0.005$ moles

Mole ratio of NaOH : H_2SO_4

2 : 1

0.005 : 0.0025 moles of H_2SO_4

$X_{(s)} + H_2SO_{4(aq)} \longrightarrow XSO_{4(aq)} + H_{2(g)}$

Available moles of H_2SO_4 = 0.25 × 0.05 = 0.0125 mol

Moles of H_2SO_4 reacted with X = 0.0125 − 0.0025 = 0.01

Mole ratio of X : H_2SO_4

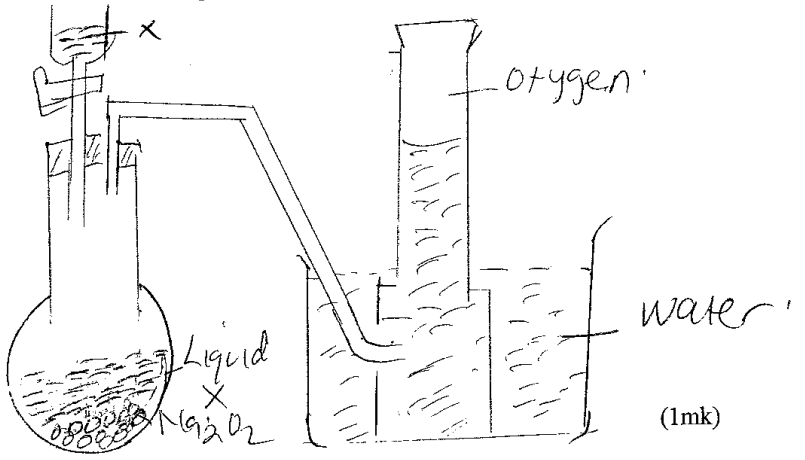
1 : 1

0.01 : 0.01

Moles = $\frac{\text{Mass}}{\text{RFM}} = \frac{0.24}{\text{RFM}} = 0.01$

RFM = $\frac{0.24}{0.01}$ = 24

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



a) Identify liquid x (1mk)

Water

b) Write an equation for the reaction that occurs in the flask. (1mk)

$2Na_2O_{2(s)} + 2H_2O_{(l)} \longrightarrow 4NaOH_{(aq)} + O_{2(g)}$

c) Describe the confirmatory test for oxygen gas. (1mk)

Insert a glowing splint to a gas jar containing the gas, If it relights the gas is confirmed to be oxygen.

16. When zinc metal is reacted with a solution of hydrogen chloride gas in water there is effervescence. When the experiment is repeated with a solution of hydrogen chloride gas in methylbenzene there is no observable change. Explain this observations. (3mks)

Solution of hydrogen chloride in water ionizes producing hydrogen ions which makes the solution acidic hence reacting with zinc to produce hydrogen gas while a solution of hydrogen chloride in methyl benzene is in molecular form hence no reaction with zinc.

17. Compare the rate of diffusion of carbon dioxide (CO_2) & ozone (O_3) at the same temperature. (C = 12, O = 16) (3mks)

$CO_2 = 12 + 32 = 44$

$O_3 = 16 \times 3 = 48$

$\frac{R_{O_3}}{R_{CO_2}} = \frac{\sqrt{44}}{\sqrt{48}}$ ✓cr

$= 0.957$ times ✓

O_3 diffuses 0.957 times fast CO_2

$\frac{R_{CO_2}}{R_{O_3}} = \frac{\sqrt{48}}{\sqrt{44}}$

1.044

CO_2 diffuses 1.044 times fast than O_3

18. Starting with Lead metal describe how to prepare a solid sample of Lead (II) Sulphate salt. (3mks)

- Heat Lead in air to form PbO. ✓
- React excess PbO with dil HNO_3. ✓
- Filter the excess PbO to get $Pb(NO_3)_2$ as filtrate. ✓
- React $Pb(NO_3)_2$ with Na_2SO_4 / K_2SO_4. ✓
- Filter to get $PbSO_4$ as the ppt. ✓
- Dry between filter paper ✓

19. Given the following reaction

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

T_1 = initial temperature of solutions before additions = 18.0°C

T_2 = final temperature of solution at neutralization = 19.2°C

50 cm^3 1M HCl

50 cm^3 1M NaOH

Calculate Molar enthalpy of neutralization of hydrogen cyanide (3mks)

$\Delta H = MC\Delta T$

$M = (50+50)cm^3 \times 1g/cm = \frac{100}{1000} = 0.1kg$ ✓

$c = 4.2$

$\Delta T = 19.2 - 18.0 = 1.2$

$\Delta H = 0.1 \times 4.2 \times 1.2$

$= 0.504kJ$ ✓

mole of $HCl = \frac{50 \times 1}{1000} = 0.05$ moles ✓

$0.05 \equiv 0.504$

$1m = \frac{0.504}{0.05}$ ✓

$= -10.08 kJmol^{-1}$

Penalize ½ for sign ✓ units

20. Compound K reacts with sodium hydroxide as shown

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a)What type of reaction is represented by the equation. (1mk)

Saponification / Neutralization

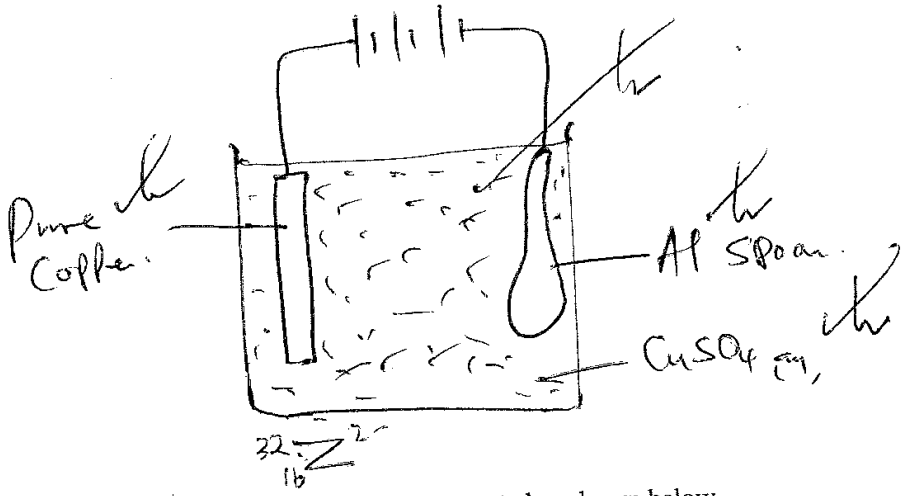
b)To what class of organic compounds does K belong. (1mk)

Carboxylic acids
Alkanoic acid

c)How is M separated from aqueous mixture of L and M. (1mk)

Adding Sodium Chloride, $C_{17}H_{35}COONa$ Precipitates

21.Draw a diagram to show how an aluminium spoon can be electroplated with pure copper. (2mks)



22.An ion of element Z can be represented as shown below,

Use the information to answer the questions that follow

a)Identify the period in which the element belong. (1/2 mk)

Period 3.

b)Write the electron configuration of the ion of Z (½ mk)

2.8.8

c)What would be the nature of the solution of the chloride of Z if dissolved in water. (1mk)

Acidic

23. What is P^H scale (1mk)

Range of values running from 0 — 14 used to distinguish acids from bases and give their strength / weaknesses.

ii) State whether the values of the following solution are strong or weak acids and bases.

P^H = 8 Weak base (~~1/2 mk~~) ½

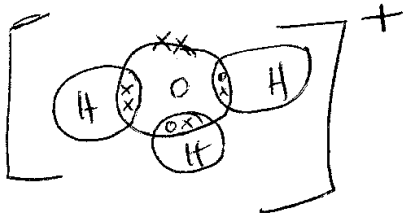
P^H = 5 Weak acid (~~1/2 mk~~) ½

P^H = 2 Strong acid (~~1/2 mk~~) ½

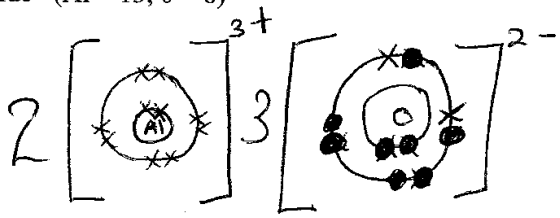
P^H = 13 Strong base (~~1/2 mk~~) ½

24.Draw the structure of;

a) i) Hydroxonium ion H_3O^+ (1mk)



ii) Aluminium oxide (Al = 13, 0 = 8) (1mk)



b) Aluminium chloride has a melting point of 120°C while Aluminium oxide has a melting point of 2977°C. In terms of structure and bonding explain how the differences come about. (2mks)

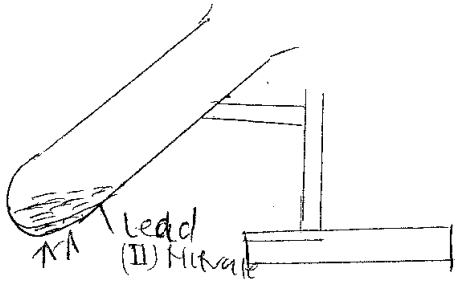
Aluminium chloride forms a dimer with Co-ordinate bonds (Covalent Compound) between the molecules which can easily dissociate with minimum heat. Aluminium oxide forms an ionic compound with strong ionic bonds throughout the structure - giant ionic structure.

25.State the use of the following laboratory apparatus

i)  (1mk) used to deliver liquid substances into vessels.

ii)  (1mk) Delivers liquids drop-wise into vessels.

26.The diagram below shows heating of Lead nitrate



i)State the observations made in the above experiment (2mks)

- An orange solid left behind which turns to yellow ~~when~~ after ~~cooling~~ Cooling.
- Brown fumes at the mouth of the boiling tube.

ii) Write an equation for the reaction that takes place. (1mk)

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

27.Give two differences between nuclear reactions and chemical reactions. (2mks)

Nuclear Reactions	Chemical Reactions
1. Takes place within the nucleus & involves protons & neutrons	Takes place within the energy levels and involves electrons ✓1
2. A lot of energy is involved	No much energy ✓1
3. Not affected by environmental factors	Affected by environmental factors ✓1

Any 2

12

$C = \frac{12}{44} \times 4.4 = 1.2$ g $H = \frac{2}{18} \times 3.1 = 0.22$ g

28. 3.1 g of an organic compound containing carbon, hydrogen and oxygen only produced 4.4 g of carbon oxide and 2.0 g of water on complete combustion:

a)Calculate its empirical formulae (2mks)

C	H	O	
1.2	0.22	1.68	½
12	1	16	
0.1	0.22	0.105	
0.1	0.1	0.1	
1	2	1	½

Empirical formulae $= CH_2O$ ✓1

b)Calculate its molecular formulae if its formulae mass is 62. (2mks)

$n = \frac{62}{30} = 2$ ✓1

Molecular formulae $\Rightarrow 2(CH_2O) = C_2H_4O_2$ ✓1

29. Two cleansing agents are represented below

i) $R - COO^-Na^+$ and ii) $R - OSO_3^-Na^+$

a) Name the detergents (2mks)

i) Soap ✓1

ii) Soapless detergents ✓1

b) Select one of the detergents that would be suitable for washing in water containing magnesium chloride. Explain. (2mks)

ii) $R-OSO_3^-Na^+$ ✓1 — Forms a soluble salt of Magnesium ✓1 Does not form Scum

08

30. Use the data below to calculate the enthalpy change for the reaction below (3mks)

$CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)}$

Bond	Energy (KJ)
C – H	314 413
O = O	296 ~~415~~ 489
C = O	149 805
H – O	283 464

O = C = O
(H – O – H)

Bond Breaking

$4(C-H) = 4 \times 314 = 1256$
$2(O=O) = 2 \times 296 = 592$
$+1848KJ$ ✓

Bond formation

$2(C=O) = 2 \times 149 = 298$
$4(H-O) = 4 \times 283 = 1132$
$-1430KJ$ ✓ 1

$\Delta H = +1840 - 1430$
$= +410KJ$ ✓ 1

Bond breaking

$4 + 413 = 1652$
$2 \times 489 = 978$ ✓ 1
$2630KJ$

bond formation

$2 \times 805 = 1610$
$4 + 464 = 1856$
-3466 ✓ 1

3

$2630 - 3466 = -836KJ/mol$ ✓ 1

233/2
CHEMISTRY PAPER 2

MARKING SCHEME

NAME: ……INDEX:…….

CLASS:…….. DATE:……SIGN:……

INSTRUCTIONS
- ✓ Write your name and index number in the spaces provided.
- ✓ Answer all questions in the spaces provided.
- ✓ Mathematical tables and calculators may be used.
- ✓ All working must be clearly shown.

EXAMINERS USE

QUESTION	MAX SCORE	CANDIDATES SCORE
1	14	
2	15	
3	16	
4	11	
5	05	
6	11	
7	08	
Total	80	

Analyse
APPL.

1. **(a) Calculate the oxidation** number of chromium Cr $(H_2O)^{3+}{}_6$ (2 mks)

$x + C(+2-2)6 = +3$

$x + 0 = +3$

$x = +3$

(b) The table below shows the standard reduction potentials for four half-cell. Study it and answer the questions that follow:

Half reaction	**E^0 (volts)**
$Au^{3+} + 3e \longrightarrow Au_{(s)}$	+1.50
$Cu^{+} + e^{-} \longrightarrow Cu_{(s)}$	_0.52
$Pb^{2+} + 2e^{-} \longrightarrow Pb_{(s)}$	-0.13
$Fe^{2+} + 2e^{-} \longrightarrow Fe_{(s)}$	-0.44
$Cr^{3+} + Cr_{(s)} \longrightarrow Cr_{(s)}$	-0.74
$Al^{3+} + 3e^{-} \longrightarrow Al_{(s)}$	-1.66
$Mg^{2+}\ 2e^{-} \longrightarrow Mg_{(s)}$	-2.37
$Rb^{+} + e^{-} \longrightarrow Rb_{(s)}$	-.2.98

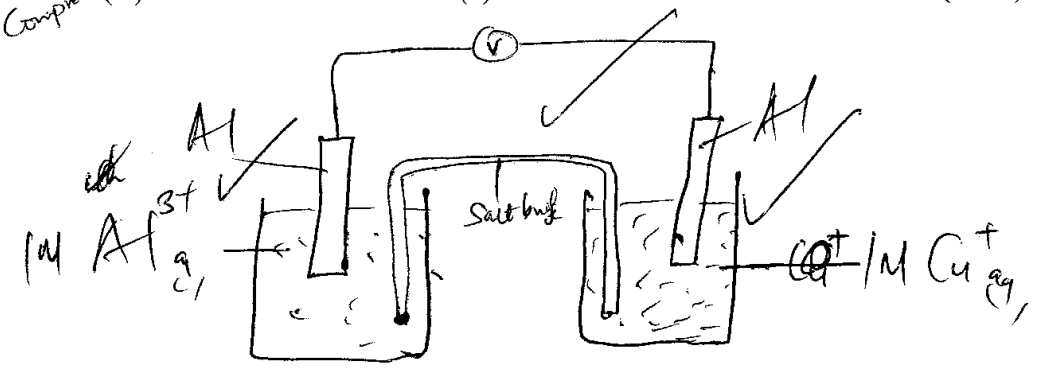
Knowledge (i) Identify the strongest reducing agent. (1 mk)

Rb.

Knowledge (ii) Write the equation for the redox reaction which takes place between (Cu/ Cu^{+}) and (Al/Al^{3+}). (1 mk)

$Al_{(s)} + 3Cu^{+}_{(aq)} \longrightarrow Al^{3+}_{(aq)} + 3Cu_{(s)}$

Comprehension (iii) Draw the cell obtained in (ii) above. (3 mks)



NB Check Cu^{+}.

7

(iv) Calculate the emf for the cell above. (2 mks)

$Emf = E_{red} - E_{ox}$

$= -0.52 - -1.66$

$= -0.52 + 1.66$

$= +1.14\ V$

Applicable (c) A current of 2.75 A is measured during recharging with an external potential of 2.0V using $Cd^{2+}_{(aq)}$ solution. After 5 minutes charging, how many moles of Cadnium will be redeposited. Hence calculate the mass redeposited. (Cd = 112, F = 96500C). (3 mks)

$Q = It$

$t = 5 \times 60 = 300sec$

$Q = 300 \times 2.75$

$= 825\ C$

$Cd^{2+} + 2e^- \rightarrow Cd_{(s)}$

$2F = 2 \times 96500 = 193000C$

$193000C \equiv 1mole$

$825 \equiv \frac{825}{193000}$

$= 0.00427\ moles$

$Mass = 0.00427 \times 112$

$= 0.47889g$

Knowledge (d) State two uses of electrolysis (2 mks)

- Extraction of reactive metals
- Manufacture of Chemicals eg NaOH ag 2
- Refining of metals eg Cu

Okay 2. Petrol (octane) a long hydrocarbon alkane can be converted to ethane and hydrogen gas mixtures as follows.

$$C_8H_{18(l)} \rightarrow 4\ C_2H_{4(g)} + H_{2(g)}$$

Knowledge (a) What do we call the process by which the products are obtained from octane? (1 mk)

Catalytic cracking

8

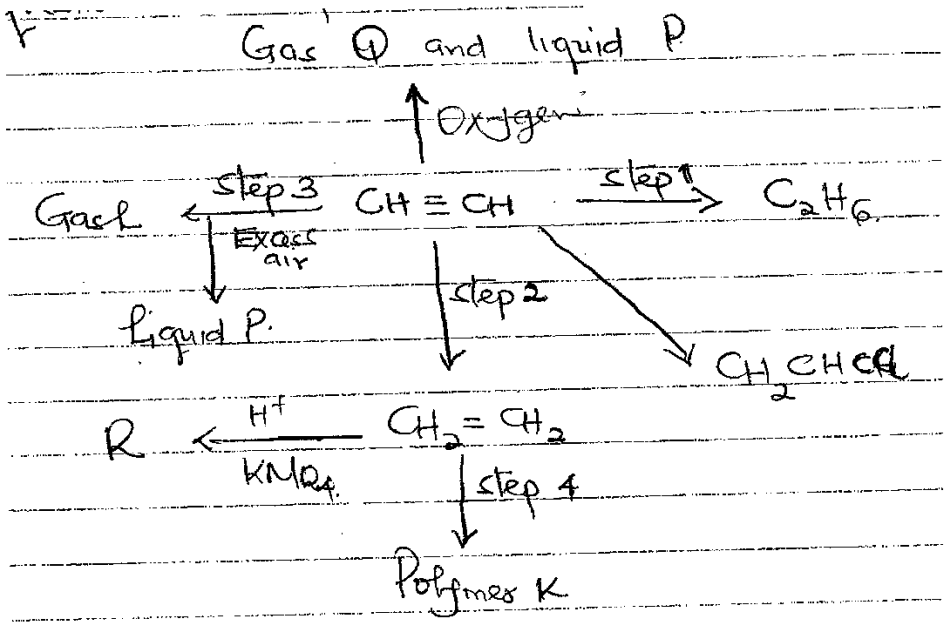
Knowledge

(b) Unleaded fuel is now widely used and has to be used in modern cars fitted with catalytic converters. State the merits of unleaded petrol. (1 mk)

Its less pollutant ✓1

(c) Study the scheme given below and answer the questions that follows:

Synthesis



(i) Name the reagents used in: (4 mks)

Step 1 Excess Hydrogen ✓1

Step 2 Hydrogen ✓1

Step 3 Hydrogen Chloride ✓1

Step 4 Ethene ✓1

(ii) Identify substance. (3 mks)

L Carbon IV Oxide ✓½

P Water ✓½

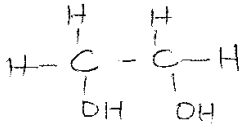
Q Carbon IV oxide ✓½

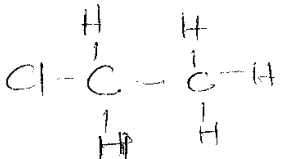
N

K Polyethene ✓½

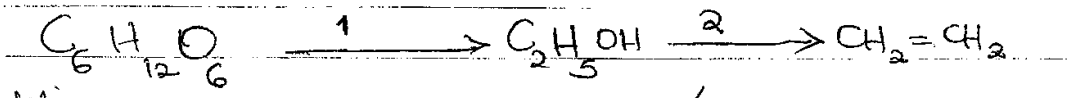
R Ethan-1,2-diol ✓½

(iii) Draw the structural formula of:

R  (1 mk)

K  (1 mk)

(d) Ethanol from glucose can be converted to ethane as shown below:



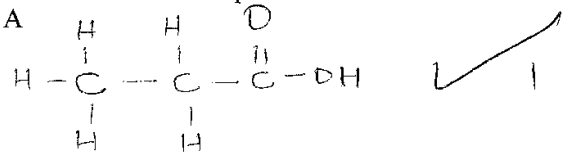
(i) Name the process that takes place in 1. (1 mk)

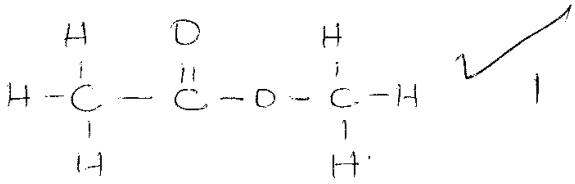
Fermentation

(ii) Name the reagent used in step 2. (1 mk)

Concentrated sulphuric vi acid

(e) Compound A and B have the same molecular formulae $C_3H_6O_2$. Compound A liberates carbon iv oxide on addition of sodium carbonate while compound B doesn't. Compound B has a sweet smell. Draw the possible structures of: (2 mks)

(i) A 

(ii) B 

3. (i) (a) Write the chemical name for rust. (1 mk)

hydrated iron (III) oxide

(b) State any two ways of preventing rusting. (2 mks)

Electroplating

Galvanization

Painting

Alloying

Oiling and greasing.

Knowledge

(c) Give a reason why vehicles based in Mombasa rust faster than those based in Limuru. (1 mk)

Salty solution in Mombasa, but not in Limuru.

salty promotes rusting.

(d) Oxygen to obtained by fractional distillation of liquid air. Name two other gases which are obtained during the distillation. (1 mk)

Knowledge

Nitrogen and argon

(ii) In an experiment to determine the solubility of sodium chloride, 5cm^3 of a saturated solution of sodium chloride of mass 5.35g were placed in a volumetric flask and diluted to a total of 250 cm^3. 25 cm^3 of the dilute solution reacted completely with 24cm^3 of 0.1 moldm^3 silver nitrate solution. Calculate:

Application

(a) Moles of silver nitrate in 24cm^3 of solution. (1mk)

$\frac{24 \times 0.1}{1000} = 2.4 \times 10^{-3}$ moles.

(b) Moles of sodium chloride in 25cm^3 of solution. (1mk)

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

Ratio 1:1 $\therefore = 2.4 \times 10^{-3}$ mole (1mk)

(c) Moles of sodium chloride in 250 cm^3 of solution.

$2.4 \times 10^{-3} = 25cm^3$

X mole $= 250cm^3$

X Mole $= 2.4 \times 10^{-2}$ mole

(d) Mass of sodium chloride in 5 cm^3 of the original saturated sodium chloride solution (1mk)

$NaCl = 23 + 35.5 = 58.5$

Mass $= 58.5 \times 2.4 \times 10^{-2} = 1.404g$.

(e) Solubility of sodium chloride. (1mk)

mass of water $= 5.35 - 1.404 = 3.946g$.

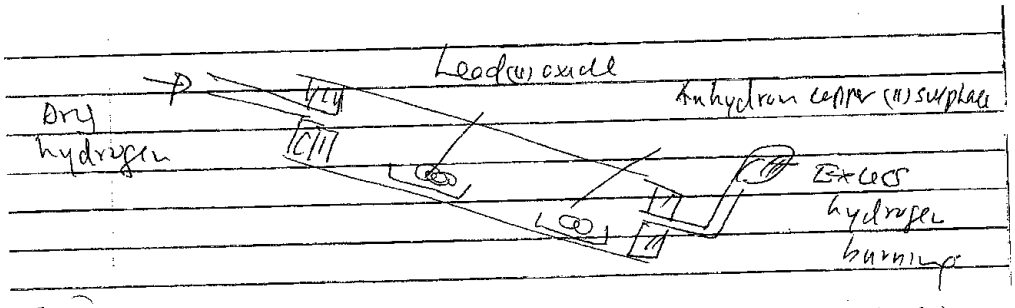
$3.946g \equiv 1.404$

$100g \equiv ?$

$= \frac{100 \times 1.404}{3.946}$

$= 35.58g/100g$ of H_2O

(iii) The appacteatus below was used to investigate the effect of dry hydrogen gas on hot lead (II) oxide.



Evaluation (a) What is observed in the combustion tube at the end of the experiment? (2 mks)

grey element

Anhydrous Copper (II) sulphate white turn blue

Application (b) Write an equation for the reaction between hydrogen gas and lead (II) oxide. (1 mk)

$PbO_{(s)} + H_{2(g)} \longrightarrow Pb_{(s)} + H_2O_{(l)}$

Comprehension (c) Why should the tube be slanting? (1 mk)

To prevent any liquid collecting in the cooler part not coming back and cracking the hot part of the tube

Knowledge (d) State any 2 precautions to be observed when doing this experiment. (2 mks)

(1) hydrogen must be passed first so as to remove air and prevent explosion.

(2) The reduced lead must cool in a stream of hydrogen so as to prevent re-oxidation.

Kamau

4. The table below shows volumes of nitrogen (IV) oxide gas produced when different volumes of 1M nitric (V) acid were reacted with 2.07g of lead at room temperature. (Pb = 207)

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

Application (a) Give a reason why nitric (V) is not used to prepare hydrogen gas. (1 mk)

It is an oxidising agent and Oxidises hydrogen gas to water ✓

Analysis (b) On the grid provided plot a graph of the volume of the gas produced against the volume of the gas produced against the volume of the acid. (3 mks)

(c) Use your graphs to determine:

(i) Volume of nitrogen (IV) oxide produced when 30 cm^3 of 1M nitric (V) acid were reacted with 2.07g of lead. (1 mk)

360cm^3

(ii) Volume of 1M nitric (V) acid that would react completely with one mole of lead. (1 mk)

4500cm^3

Comprehension (d) Calculate the number of moles of:

(i) 1M nitric (V) acid that reacted with one mole of lead. (1 mk)

1mole → 1000cm³ ← 4500cm³ $\frac{4500}{1000} = 4.5$ moles

(ii) Nitrogen (IV) oxide produced when one mole of lead reacted with excess nitric (V) acid. (Molar gas volume = 24000cm^3) (1 mk)

1mole → 24000cm³ ← 48000cm³

$\frac{48000}{24000} = 2$ moles

Application

(e) Use the answers to d above and write the equation for the reaction between lead and nitric(V) acid. (1 mk)

$Pb_{(s)} + 4HNO_{3(aq)} \rightarrow Pb(NO_3)_{2(aq)} + 2NO_{2(g)} + 2H_2O_{(l)}$

Comprehension

(f) Explain how the rate of the reaction between lead and nitric (V) acid would be affected if the temperature of the reaction mixture was raised. (2 mks)

The rate of reaction would increase

Numbers

5. (a) When ammonia gas is passed through copper (II) sulphate solution a blue precipitate is formed which dissolves to give a deep blue solution. Write an ionic equation for the formation of:

Application

(i) The blue precipitate (1 mk)

$Cu^{2+}_{(aq)} + OH^-_{(aq)} \rightarrow Cu(OH)_{2(s)}$ ✓1

(ii) the deep blue precipitate. (1 mk)

$Cu(OH)_{2(s)} + 4NH_{3(aq)} \rightarrow [Cu(NH_3)_4]^{2+}_{(aq)} + 2OH^-_{(aq)}$

(b) Aluminum oxide is amphoteric.

Comprehension

(a) Explain the term amphoteric. (1 mk)

It means it has both acid and basic properties

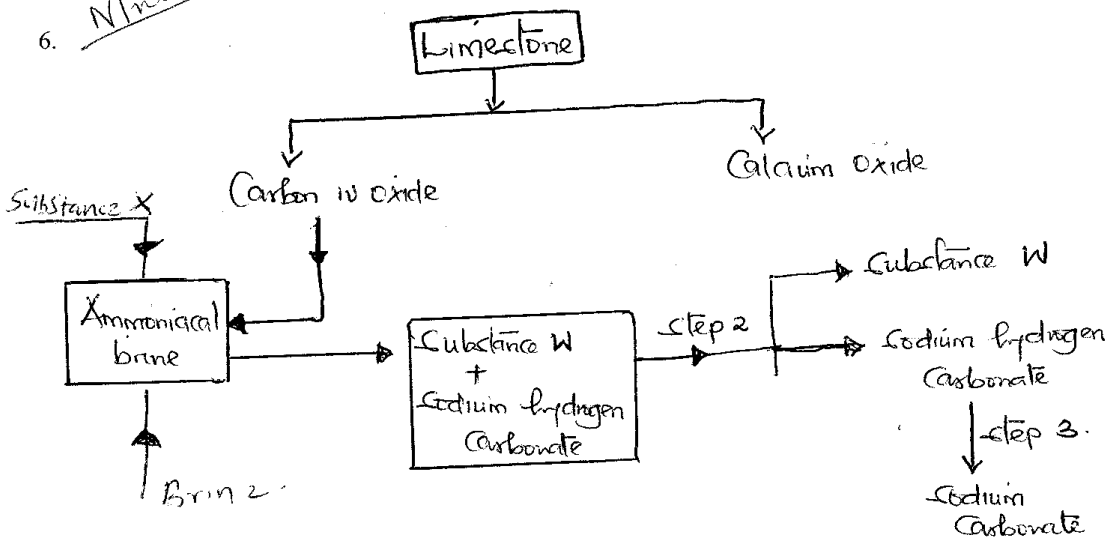
Knowledge

(b) Name and give the formula of other two amphoteric oxides. (2 mks)

Zinc oxide ZnO ✓½ ✓½

Lead(II) oxide PbO ✓½ ✓½

6. Misses



Knowledge

(a) What is the chemical name for limestone ✓ 1 (1 mk)

Calcium carbonate

Knowledge (b) Identify substances: (2 mks)

(i) X - Ammonia gas ✓ 1

(ii) W - ammonium chloride ✓ 1

Knowledge (c) Name the process taking place in: (2 mks)

(i) Step II Filtration ✓ 1

(ii) Step III Thermal decomposition ✓ 1

Knowledge (d) Write a chemical equation for the reaction of:

(i) Leading to formation of substances W and sodium hydrogen carbonate. (1 mk)

$NH_{3(g)} + CO_{2(g)} + H_2O_{(l)} + NaCl_{(aq)} \rightarrow NaHCO_{3(s)} + NH_4Cl_{(aq)}$ ✓ 1

(ii) Taking place in step (III). (1 mk)

$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$ ✓ 1

Application (e) Carbon (V) oxide and ammonia are required during the solvay process. Write equation to show how ammonia is recycled. (1 mk)

$2NH_4Cl_{(s)} + Ca(OH)_{2(aq)} \rightarrow 2NH_{3(g)} + 2H_2O_{(l)} + CaCl_{2(aq)}$

Knowledge (f) Name the other product of solvay process and state one use of it. (1 mk)

Calcium chloride → used as a drying agent. used in extraction of sodium

Knowledge (g) State two uses of sodium carbonate. (2 mks)

1. used in making glass
2. used in making sodium silicate used in making detergents.

7. The grid below represents past of the periodic table. Study it and answer the questions.

				B			C	
K	F		D			E	A	Y
	G							

Comprehension Analysis (a) Identify the family name to which element F and G belong. (1 mk)

Alkaline earth metals ✓1

Knowledge (b) Name the type of bond formed when C and F react. (1 mk)

Ionic bond ✓1

Application (c) Write the formulae of the oxide formed when D reacts with oxygen. (1 mk)

D_2O_3 ✓1

Evaluation (d) What type of oxide is formed in (c) above. (1 mk)

Amphoteric Oxide ✓1

Evaluation

(e) Compare the atomic radii of F and D. Explain. (2 mks)

D has a smaller atomic radius than F ✓

D has more protons ✓½ hence stronger nuclear attraction ✓½

Application

(f) Element F burns in air to form two products. Write 2 equations for the two products formed. (2mks)

$2F_{(s)} + O_{2(g)} \rightarrow 2FO_{(s)}$ ✓1

$3F_{(s)} + N_{2(g)} \rightarrow F_3N_{2(s)}$ ✓1

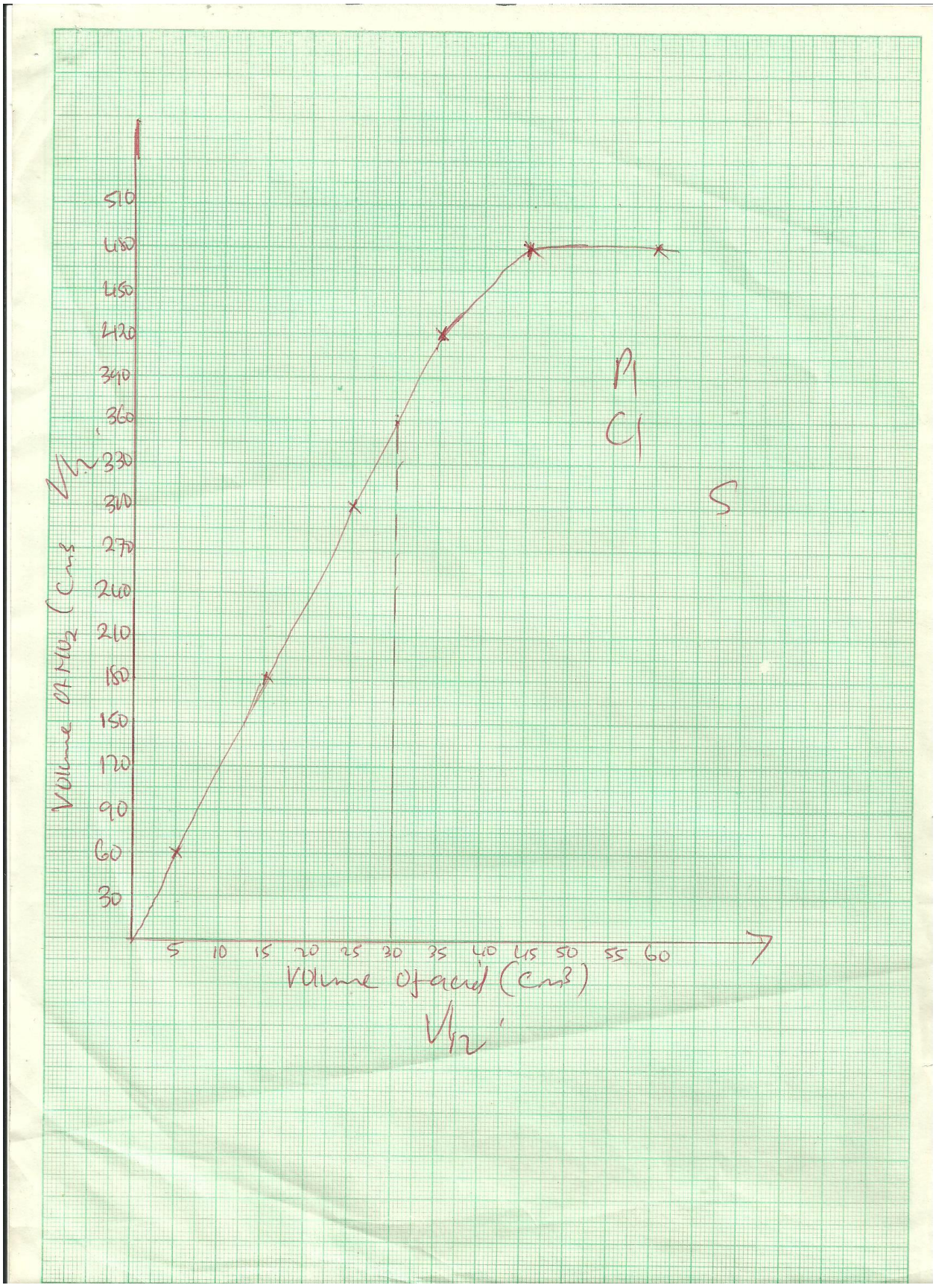
Knowledge

(g) State two uses of element K and its compounds. (2 mks)

- K cyanide is used in extraction of gold ✓1
- Mixture of K and potassium is used as nuclear coolant ✓1

Any 2.

6mks


510
480
450
420
390
360
330
300
270
240
210
180
150
120
90
60
30
Volume of H2 (Cm3)
V1
P
C
S
5
10
15
20
25
30
35
40
45
50
55
60
Volume of acid (Cm3)
V2'

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233/3
CHEMISTRY
PAPER 3
PRE- MOCK – MARCH / APRIL 2015
TIME: $2\frac{1}{4}$HOURS

Name.....Class .....

Index Number ..... **Adm Number.....**

1. ***You are provided with:***

- 4.5g of solid **P** in a boiling tube
- Solution **Q**, 0.2M sodium hydroxide
- Phenophthalein indicator.

You are required to determine:

i) The solubility of solid **P** at different temperatures

ii) The value of **n** in the formula $(HX)_n \bullet 2H_2O$ of solid **P.**

PROCEDURE I

i) a) Fill the burette with distilled water. Using the burette, add 4.0cm^3 of distilled water to solid **P.** in a boiling tube. Heat the mixture in a water bath while stirring with a thermometer to about 70^{0}C until all the solid dissolves.

b) Allow the solution to cool while stirring with the thermometer and note the temperature at which crystals of solid **P** start to appear.Record this temperature in table **1.**

c) Using the burette, add 2.0cm^3 of distilled water to the contents of the boiling tube. Heat the mixture while stirring with the thermometer until all the solid dissolves while in the water bath.

d) Allow the mixture to cool while stirring and note the temperature at which crystals of solid **P** start to appear.

e) Repeat the procedure (c) and (d) four more times, heating the solution in a water bath and record the temperature in the table. ***Retain the contents of the boiling tube for use in procedure II.***

ii) Complete the table by calculating the solubility of solid **P** at the different temperatures. (the solubility of a substance is the mass of that substance that dissolves in $100cm^3$(100g) of water at a particular temperature. (6 MKS)

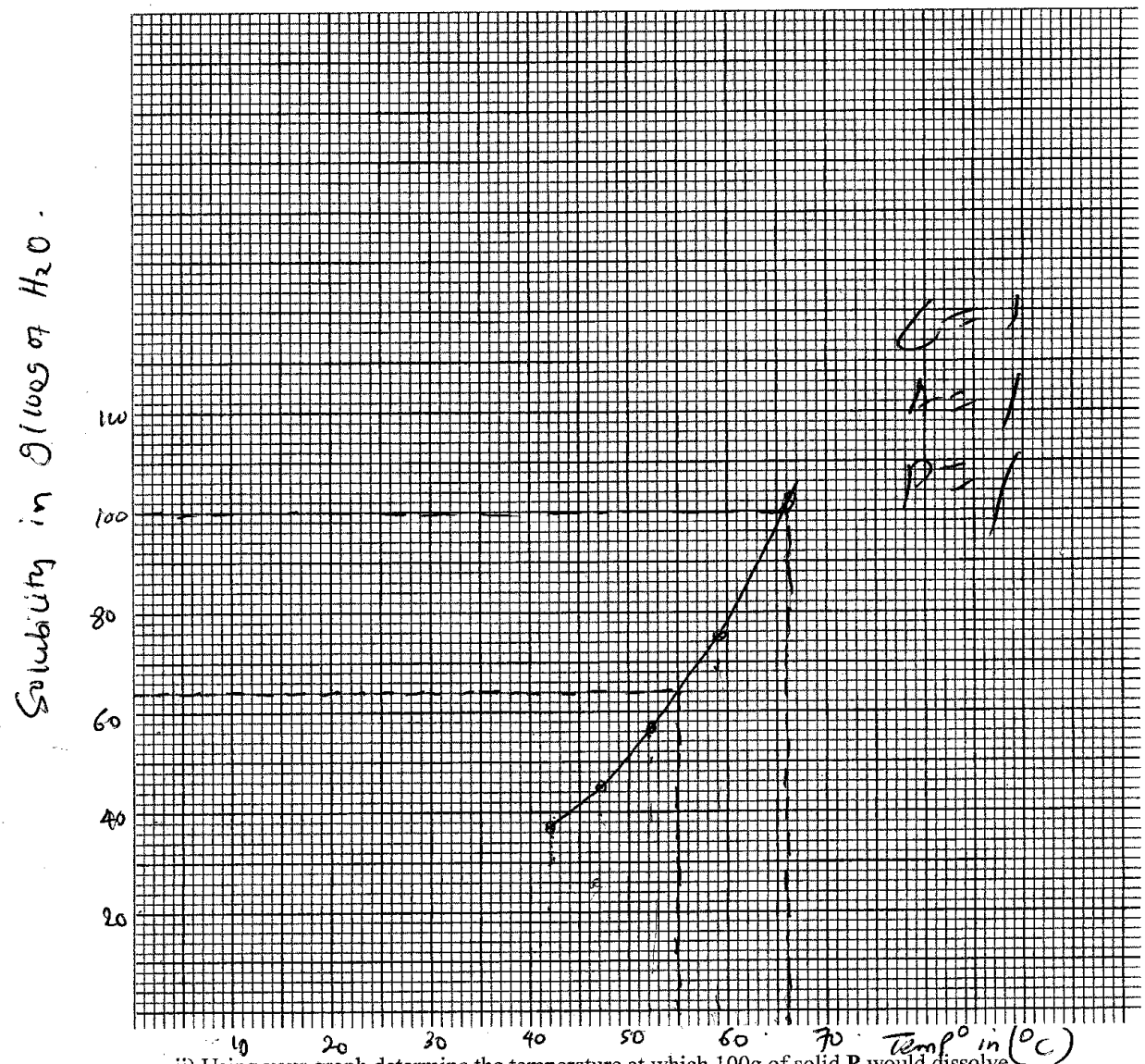
Table I

Volume of water in the boiling tube (cm^3)	**Temperature at which crystals of solid P first appear (^0C)**	**Solubility of solid P (g/100g) of water**
4	66·0	112·5
6	59·0	75·0
8	52·0	56·3
10	47·0	45·0
12	42·0	37·5

G=2
A=2
D=1
C=1

i) On the grid provided plot a graph of the solubility of solid **P** against temperature.(3mks)

OK



ii) Using your graph determine the temperature at which 100g of solid **P** would dissolve in 100cm^3 of water. (1mk)

66°C ✓1

iii) Determine the solubility of solid **P** at 55^0C (1mk)

64g/100g of H_2O 1

iv) Other than temperatures give two other factors which affect solubility. (2mks)

- Size of the particle
- Stirring.
- Pressure for gases. 2

PROCEDURE II

1. Transfer the contents of the boiling tube into a 250ml volumetric flask. Rinse the boiling tube and the thermometer with distilled water and add to the volumetric flask. Add more distilled water to make up to the mark. Label this solution **P**.
   Fill the burette with solution **P**. using a pipette and pipette filler place $25.0cm^3$ of solution **Q** into a conical flask. Titrate solution **Q** with solution **P**. Using phenolphthaline indicator.

Table II

	I	II	III
Final burette reading cm^3	17.0	17.0	17.0
Initial burette reading cm^3	0.0	0.0	0.0
Volume of solution **P** used cm^3	17.0	17.0	17.0

CT=1 A=2 C=1

(4mks)

Calculate the;

i) Average volume of solution **P** used in the experiment. (1mk)

$\frac{17.0 + 17.0 + 17.0}{3} = 17.0\ cm^3$ 2

08

95 66 94
21 28

ii) Number of moles of sodium hydroxide used in solution **Q**. (2mks)

0·2 ⟶ 1000 cm³
25 cm³

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

iii) Number of moles of solution **P** reacted with the sodium hydroxide given that the relative formula mass of **P**, $(HX)_n \bullet 2H_2O$ is 126. (3mks)

$\frac{4.5}{126} = 0.03571$ moles

0.03571 ⟶ 250
17·0

$\frac{17.0 \times 0.03571}{250} = 0.002429$ moles

iv) The number of moles of sodium hydroxide required to react with one mole of **P**. Hence find the value of **n** in the formula $(HX)_n \bullet 2H_2O$ (3mks)

[redacted]. moles of NaOH : Acid
0.005 0.002429
? 1

$\frac{1 \times 0.005}{0.002429} = 2.05$

Mole ratio of Acid is to base = 1 : 2

Hence basicity of the acid = 2 n = 2

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2 a) You are provided with solid M carry out the tests below and record your observations and inferences.

Place a spatula of solid M in a boiling tube, add 10 cm^3 of distilled water and shake well until all the solid dissolves.

Observations	Inference
Solid dissolves forming a colourless solution ✓ 1 1mk	Absence of coloured ions Fe^{2+}, Fe^{3+}, Cu^{2+} ✓ 1 mk

i) To about 1 cm^3 of the solution add 2 M sodium hydroxide drop wise until in excess.

Observations	Inference
White precipitate ✓ insoluble in excess ✓ ✓ 1mk	Presence of Ca^{2+}, Mg^{2+} ✓ ✓ 1 mk

ii) Place 1cm^3 of the solution in a test tube and add 2 to 3 drops of 2 M sulphuric (VI) acid.

Observations	Inference
White precipitate ✓ 1mk	Presence of Ca^{2+} ✓ 1 mk

iii) To about 1 cm^3 of the solution add 4-5 drops of lead (II) nitrate solution.

Observations	Inference
White precipitate ✓ 1mk	Presence of Cl^- ✓, CO_3^{2-}, SO_4^{2-} 1 mk

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b) You are provided with solid **Q**. Carry out the test in (a) and (b)and fill the table below.

i) Place one third of **Q** in a metallic spatula and burn in a non- luminous flame.

Observations	Inference
Burns in a yellow sooty flame ✓ 1mk	Presence of $\geq C = C -$ ½ ✓ $\geq C \equiv C$ ½ ✓ 1 mk

ii) Dissolve all of the remaining **Q** in about 10 cm^3 distilled water in a boiling tube.

a) Place $2cm^3$ of solution in a test tube and add 2 drops of acidified potassium manganate (VII)

Observations	Inference
Purple Potassium manganate (VII) is not decolourised. ✓ 1mk	Presence of [illegible] ½ ✓ R-OH ½ ✓ 1 mk

b) To 2 cm^3 of the solution, add all the solid sodium hydrogen carbonate.

Observations	Inference
Effervescence ½ ✓ a colourless ½ ✓ gas 1mk	Presence of R-COOH ✓ 1 mk

06