MANGU HIGH SCHOOL

233/2

CHEMISTRY

PAPER 2

MOCK 2022

TIME: 2 HOURS

NAME: _____

ADM NO: _____ CLASS: _____

Kenya Certificate of Secondary Education

MOCK EXAMINATIONS

Chemistry
Paper 2
2 Hours.

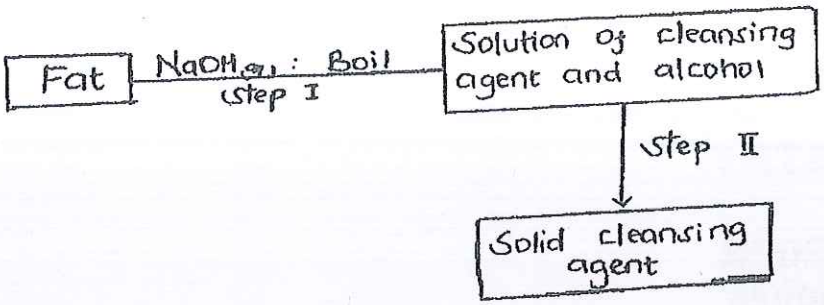
- Answer **ALL** the questions in the spaces provided.

This paper consists of **11 printed pages.**

Make sure that all the pages are printed and that no page is missing.

Turn Over

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



(a) What name is given to the type of cleansing agent prepared by the method above? (1mk)

Soapy detergent

(b) (i) Name one chemical substance added in step II. (1mk)

Sodium chloride.

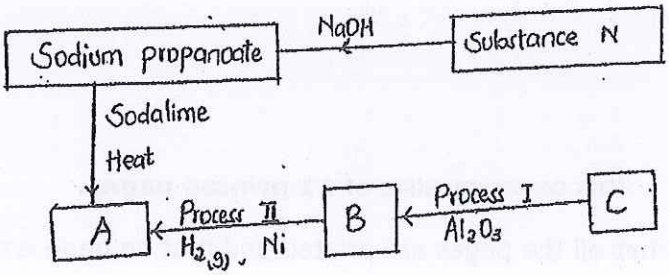
(ii) What is the purpose of adding the chemical substance named in (b) (i) above. (1mk)

To precipitate soap.

(c) Describe the cleansing action of soap on dirt. (2mks)

The soap has a polar head & non-polar tail. The polar head is attracted to the water and the non-polar tail to the grease dirt. After aggitation the dirt/grease is removed from the cloth.

(d)



(i) Identify the following substances. (2mks)

N propanoic acid B ethene

A ethane C ethene

(ii) To which homologous series does substance N belong? (1mk)

Alkanoic acids

(iii) Write the correct name and formula of the organic product formed when compound N reacts with ethanol. (2mks)

$CH_3CH_2COOH_{(aq)} + C_2H_5OH_{(aq)} \longrightarrow CH_3CH_2COOC_2H_{5(aq)} + H_2O_{(l)}$

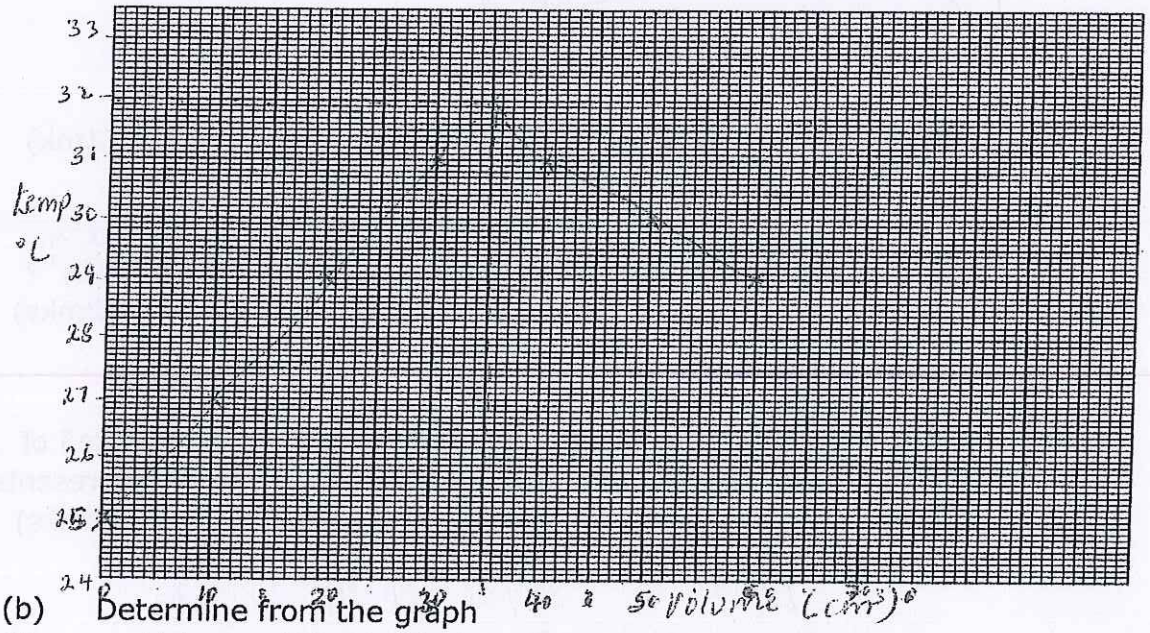
(iv) Explain how you would distinguish between C_2H_5OH and CH_3COOH (1mk)

Add Mg / Na_2CO_3, in C_2H_5OH; no effervescence in CH_3COOH there is effervescence.

2. I. In an experiment to determine the molar heat of neutralization, 50cm^3 of 1M hydrochloric acid was neutralized by adding dilute sodium hydroxide. During the experiment, the data in the table below was obtained.

Volume of NaOH (cm^3)	0	10	20	30	40	50	60
Temp of the mixture (°C)	25	27	29	31	31	30	29

(a) On the grid provided, plot a graph of temperature against volume of sodium hydroxide. (3mks)



(b) Determine from the graph

(i) Volume of NaOH which completely neutralized the acid. (1mk)

35 cm^3

(ii) Change in temperature when complete neutralization occurred. (1mk)

35 − 25 = 10°C.

(iii) Calculate the molar heat of neutralization of HCl with NaOH (Shc=4.2J/g/k, density of solution =1g/cm^3) (3mks)

$\Delta H = mc\Delta T$

$= 0.085kg \times 4.2 \times 10$

$= 3.5700\ kJ$

50 + 35 = 85

Moles = 1×0.05

$= 0.05$

3570 → 0.05

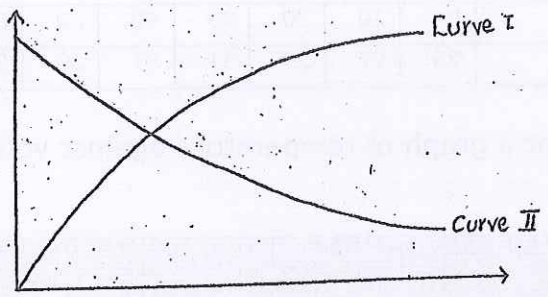
? → 1

$\frac{3570 \times 1}{0.05}$

$= 714\ kJ/mol$

II. Study the graph below which shows how the concentration differ in the following dynamic equilibrium.

$\underbrace{Cr_2O_7^{2-}(aq)}_{\text{Orange}} + H_2O \rightleftharpoons \underbrace{2CrO_4^{2-}(aq)}_{\text{yellow}} + 2H^+(aq)$



(a) Define the term dynamic equilibrium (1mk)

The state at which the forward and the backward reactions rate are taking place at the same rate.

(b) Which of the two curves represents the concentration of $Cr_2O_7^{2-}$? (2mks)

Curve II

(c) State and explain the observation that would be made if 1cm3 of sodium hydroxide was added to the equilibrium mixture represented above. (2mks)

The yellow colour intensifies; equilibrium shifts to the right. This is to replace the H^+ ions that reacted with NaOH.

(d) State and explain how the rate of reaction between zinc granules and steam can be increased. (2mks)

- Increasing the temperature.

This increases the kinetic energy of the reacting particles, increasing the reaction rate.

3. (a) Study the standard reduction potentials below and answer the questions that follow; the letters are not the actual symbols of the elements.

Half cell	E volts
$P^{2+}_{(aq)} + 2e^- \longrightarrow P_{(s)}$	-0.76
$R^{2+}_{(aq)} + 2e^- \longrightarrow R_{(s)}$	-2.37
$S^{+}_{(aq)} + 1e^- \longrightarrow S_{(s)}$	+0.84
$T^{2+}_{(aq)} + 2e^- \longrightarrow T_{(s)}$	-0.14

(i) Select the element which is the strongest reducing agent. Explain (2mks)

P It is the most negative

(ii) Select two half cells when combined would produce the largest e.m.f. (1mk)

P/P²⁺ and S/S⁺

(iii) Calculate the e.m.f of the electrochemical cell formed when the two half cells in (ii) above are combined. (1mk)

0·84 + 0·76 = 1·60V

(b) 1.9g of a metal F was deposited when its aqueous salt was electrolyzed by passing a current of 0.6A for 1.5hours. Determine

(i) The electrode at which metal F was deposited. (1mk)

Cathode.

(ii) The oxidation state of F (RAM of F =113; IF=96,500C) (2mks)

0·6 × 60 × 60 × 1·5 = 3,240C

1·5g → 3240C

113 → ?

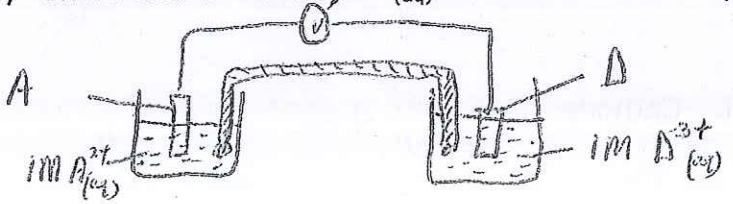
$\frac{113 \times 3240}{1.5}$ = 244,080C.

1F = 96,500C

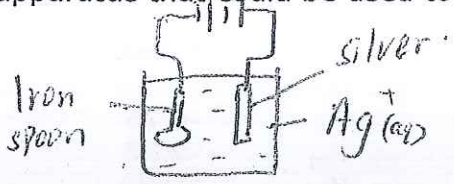
? = 244,080

$\frac{244080}{96,500}$ = 2·5 ≈ 3 +3

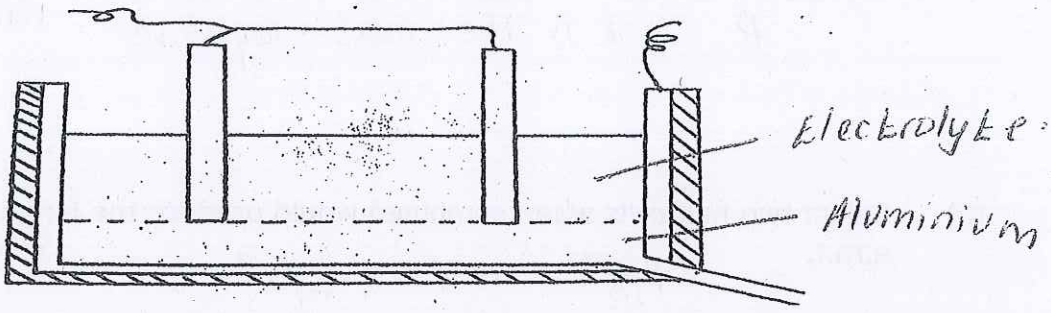
(c) Draw an electrochemical cell comprising of the following half cells $A^{2+}_{(aq)} + 2e^- \rightarrow A_{(s)}$, -0.76V and $D^{3+} + e^- \rightarrow D^{2+}_{(aq)} + 0.77V$ (3mks)



(d) An iron spoon is to be electroplated using silver. Draw a well labeled diagram to represent the apparatus that could be used to carry out this process. (3mks)



4. The extraction of aluminum from its ore takes place in two stages. Purification stage and electrolysis stage. Below is set-up for the electrolysis stage.



(a) (i) Name the chief ore from which aluminium is extracted. (1mk)

Bauxite

(ii) Name one impurity which is removed at the purification stage. (1mk)

Iron (III) oxide
Silicon (IV) oxide

(b) (i) Label on the diagram each of the following (1mk)
I. Region containing electrolyte
II. Molten aluminium

(ii) The melting point of aluminium oxide is 2054°C but the electrolysis is carried out between 800°C and 900°C. Explain how this is achieved. (1mk)

Adding an impurity; cryolite

(c) Write balanced half ionic equations for the reactions taking place in the electrode (2mks)

i. Anode $2Al^{3+} \quad 6O^{2-}_{(l)} \longrightarrow 3O_{2(g)} + 12e^-$

ii. Cathode $4Al^{3+}_{(l)} + 12e^- \rightarrow 4Al_{(l)}$

(d) A current of 3A was passed through fused aluminium oxide for 10 minutes. Calculate the mass of aluminium obtained at one electrode (Al =27.0, IF=96500C) (2mks)

$3 \times 10 \times 60 = 1800C$

$3F \rightarrow 1 mole\ of\ Al$

$1 mole \rightarrow 3 \times 96,500$

$27 \rightarrow 289,500C$

$? \rightarrow 1800C$

$\frac{27 \times 1800}{289500} = 0.168g$

5. I. Aluminium oxide is amphoteric and insoluble in water.

(i) What do you understand by the term amphoteric oxide? (1mk)

Has both acidic and basic nature/properties

(ii) Using equations describe how aluminium oxide is amphoteric (2mks)

$Al_2O_{3(s)} + 6HCl_{(aq)} \longrightarrow 2AlCl_{3(aq)} + 3H_2O_{(l)}$

$2NaOH + Al_2O_3 \rightarrow 2Na_{(aq)}AlO_2 + H_2O$ -6

(iii) Two different samples of water (I and II) were tested with soap solution. Sample II was further subjected to two other processes before adding soap. $20cm^3$ of each sample of water was shaken with soap solution in a boiling tube until a permanent lather was obtained. The results are shown in the table below.

Water sample	Volume of soap solution needed (cm^3)	
	Before boiling	After boiling
I	10	5
II	6	6
After filtering	6	6
II after distilling	2	2

(a) Identify the water sample that had temporary hardness. Explain your answer. (1mk)

I

(b) Explain why the results for sample II are different after distilling but remain unchanged after filtering. (1mk)

The ions causing water hardness were removed.

(iv) Study the information in the table below and answer the questions that follow.

Salt	Solubility (g/100g water)	
	At 40°C	At 60°C
$CuSO_4$	28	38
$Pb(NO_3)_2$	79	98

A mixture containing 35g of $CuSO_4$ and 78g of $Pb(NO_3)_2$ in 100g of water at 60°C was cooled to 40°C.

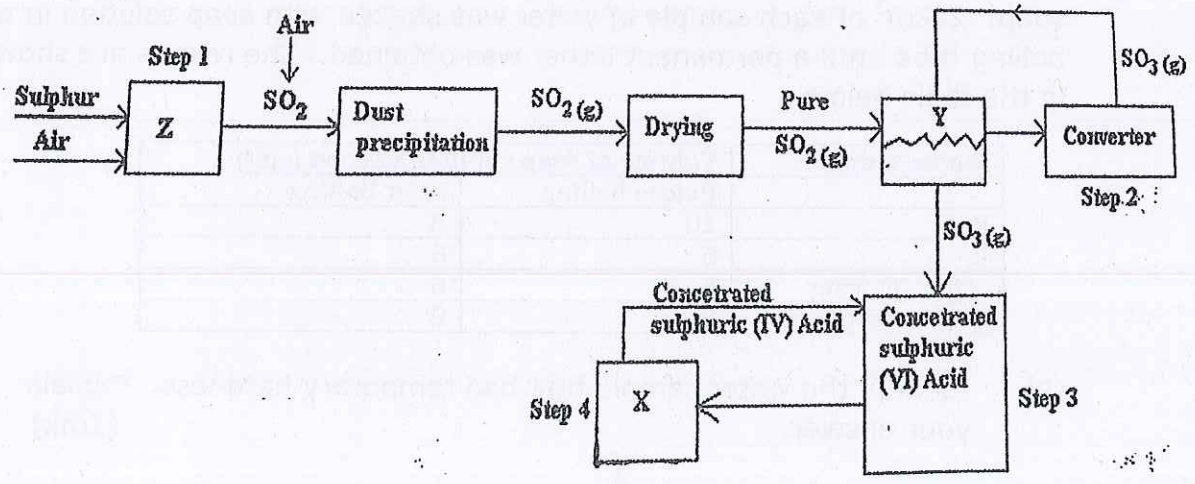
(a) Which salt crystallised out? Give a reason (2mks)

$CuSO_4$
its solubility at 40°C is 28g/100g of water.

(b) Calculate the mass of the slat that crystallised out. (1mk)

35 - 28 = 7g.

II. Below is a flow chart diagram for the contact process for the manufacture of sulphuric (IV) acid.



(i) Other than sulphur state another substance that can be used. (1mk)

Iron (II) Sulphide.

(ii) Both platinum and vanadium (V) oxide can be used as catalyst, explain why vanadium (V) oxide is preferred over platinum in the process. (1mk)

It is not easily poisoned by impurities
It is cheap.

(iii) State two precautionary measure taken to prevent pollution by the contact process. (1mk)

- Building / Constructing long chimneys lined with $Ca(OH)_2$
- Recycling SO_2

(iv) Write the balanced equations for the reaction in (2mks)

(a) Step 2 $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

(b) Step 4 $H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(l)}$

(v) Complete the table below to show the observation made and property when concentrated sulphuric (VI) acid is added to the following substances. (2mks)

Substance	Observation	Property of acid
Sugar	~~Turn~~ changes from white to black	dehydrating
Potassium Nitrate crystals	from crystals to powder	dehydration.

6. (i) Define the term half-life. (1mk)

This is the time taken for a given mass of or number of nuclides to decay to half its original mass.

(ii) 50g of a radioisotope $^{233}_{91}Pa$ reduced to 6.25g after 45.5 days. Determine the half-life of $^{233}_{91}Pa$ (2mks)

$50g \xrightarrow{1} 25g \xrightarrow{2} 12.5g \xrightarrow{3} 6.25g$

$45.5 \text{ days} \div 3$

$= 15.167$

$= 15.2 \text{ days}$.

(iii) Complete the nuclear equation below. (1mk)

$^{37}_{18}A \longrightarrow {}^{37}_{19}B + {}^{0}_{-1}e$

(iv) State one danger associated with radioactivity. (1mk)

Causes death.

7. I. Study the information given in the table below and answer the questions that follow.

Element	Atomic No.	Boiling point (K)	Atomic radii
J	11 2,8,1	1163	0.158
K	13 2,8,3	2743	0.126
L	16 2,8,6	718	0.104
M	17 2,8,7	238	0.099
N	19 2,8,8,1	1470	0.231

(a) Write the electron arrangements for the ions formed by K and M. (1mk)

K 2,8

M 2,8,8

(b) Which two elements have similar chemical properties? Explain (1mk)

J & N

(c) Select an element which is in gaseous state at room temperature. (1mk)

M

(d) In terms of structure and bonding, explain why K has a very high boiling point. (2mks)

Strong metallic bonds and giant metallic structure.

(e) Explain why the atomic radius of J is greater than that of K. (2mks)

J has less ~~more~~ protons than K, hence weaker nuclear attraction than K.

III. A carbonate T reacts completely with dilute hydrochloric acid according to the equation below.

$$TCO_{3(s)} + 2HCl_{(aq)} \rightarrow TCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

If 1g of the carbonate reacts completely with $20cm^3$ of 1MHCl, calculate the relative atomic mass of T. (C=12, O=16) (3mks)

moles of HCl

$0.02 \times 1 = 0.02$ moles

moles of TCO_3

$TCO_3 : HCl$

$1 : 2$

$\frac{1 \times 0.02}{2} = 0.01$ mole

molar mass of TCO_3

0.01 moles → 1g

1 mol → ?

$\frac{1 \times 1}{0.01} = 100$

RAM of T

$100 = T + 12 + 16 + 16 + 16$

$= T + 60$

$= 40$

No units

IIII. Two miscibles liquids S and T whose boiling points are 60°C and 84°C respectively got mixed together accidentally.

(a) Suggest a method you would use to separate the two liquids. (1mk)

~~- Use of a seperating funnel~~
~~- Decanting~~
~~- Use of a teat pipette~~
Fractional distillation

(b) Which liquid will be collected first? Give a reason. (1mk)

S lower boiling point than T

(c) Give one industrial application of the method in (a) above. (1mk)

- Seperation of crude oil.
- Obtaing Oxygen from air i