NAME .....ADM NO No.....CLASS.....

Candidates Signature.....SCHOOL.....

KALA PRE-TRIAL EXAM 2026

Kenya Certificate of Secondary Education

233/2 CHEMISTRY(THEORY)

TIME 2HRS

INSTRUCTIONS TO CANDIDATES

Write your name, Admission Number,Class,School and Index Number in the spaces provided above.

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

Mathematical tables and silent electronic calculators may be used.

*All workings **MUST** be clearly shown where necessary.*

FOR EXAMINERS ONLY

Questions	Maximum Score	Candidate's Score
1	12	
2	12	
3	12	
4	11	
5	11	
6	12	
7	10	
TOTAL	**80**	

This paper consists of 12 printed pages

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

1. The table below shows the atomic numbers of some elements represented by letters J to Q (letters not their actual symbols). Study it and answer the questions that follow.

Element	J	K	L	M	N	P	Q
Atomic Number	11	17	15	14	12	20	19

(a) Write the electronic configuration of M and P^{2+}. (1mk)

M 2.8.4 ½ P^{2+} 2.8.8 ½

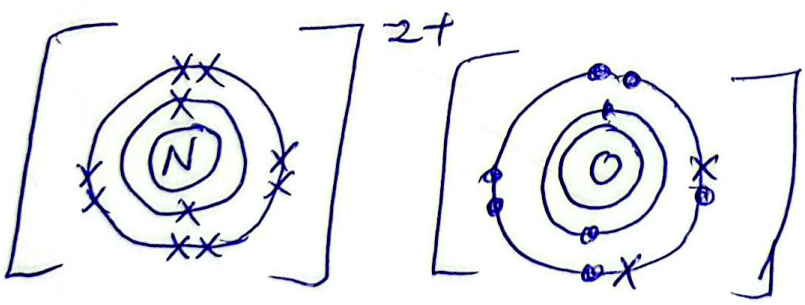
(b) Write the formula of the compound formed when L combines with N. (1mk)

N_3L_2 / Mg_3P_2 ✓1

(c) How would the reactivity of element N and P with chlorine compare? Explain. ✓1 (2mks)

P is more reactive / reacts faster with chlorine than N. P has larger atomic radius than N hence lower nuclear charge ✓1

(d) Element N combines with oxygen to form an oxide. Using dots (•) and crosses (×) to represent the electrons, show how the two elements combine. (1mk)



✓1

1MK or Zero mark

(e) Select the most electropositive and most electronegative element and give reason for your answer in each case. (2mks)

MOST Electropositive – Q ½. Has the largest atomic radius thus looses electrons more easily ½

MOST Electronegative – K ½. Has the smallest atomic radius hence readily gains electrons

(f) State one physical and one chemical property that elements J and Q have in common. (1mk)

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Physical ½
- Has metallic lustre
- less dense than water
- Good conductors of electricity

Chemical ½
Reacts with water to evolve hydrogen
Highly reactive with Chlorine to form metal chloride

(g) What name is given to the group of elements to which element M belong? (1mk)

Metalloids ✓1

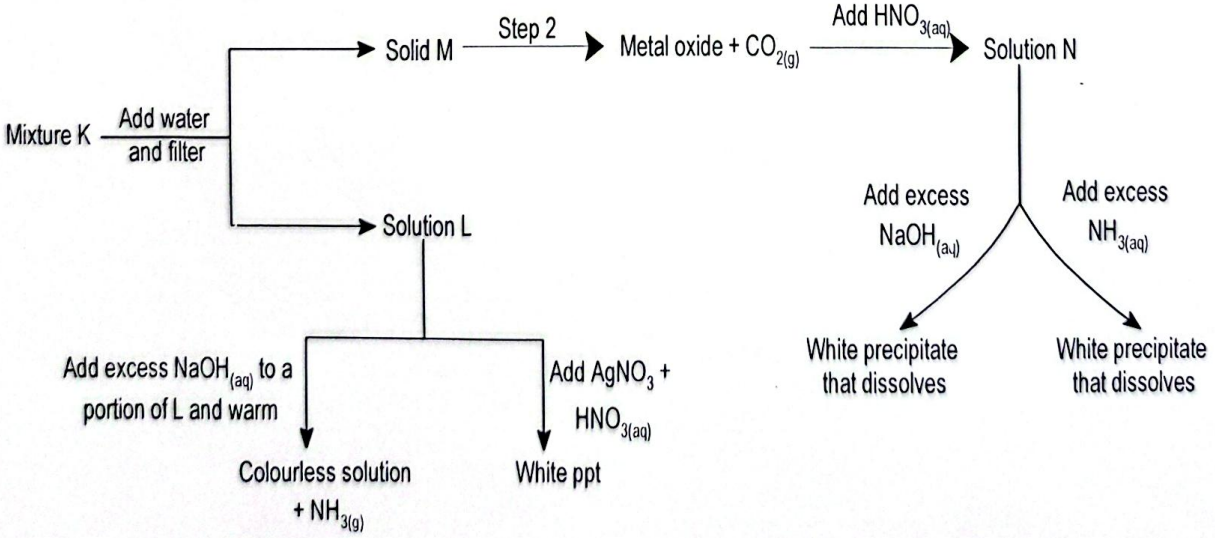
(h) (i) Element K consists of two isotopes with relative abundances 75% and 25% and mass numbers 35 and 37 respectively. Find the relative atomic mass of K. (2mks)

$\frac{(75 \times 35) + (25 \times 37)}{100}$ ✓1 $= 35.5$ ✓1

(ii) Why is the relative atomic mass of K not a whole number? ✓1 (1mk)

It exhibits isotopy / has isotopes

2. The flow chart given below shows an analysis of mixture K that contains two salts. Study it and answer the questions that follow.



* (a) Name substances L and M. (2mks)

Ammonium Chloride ✓1 Zinc Carbonate ✓1

L..... M.....

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(b) What condition is necessary for step 2 to take place? (1mk)

Heat / Accept heating ✓1

(c) State the colour changes that the metal oxide undergoes when hot and cold. (1mk)

Yellow when hot ½, white when cold ½

(d) When sodium hydroxide is added to a solution N, a white precipitate is formed which later dissolves when added in excess. Give the name and formula of the complex ion formed. (2mks)

$[Zn(OH)_4]^{2-}$ ✓1 Tetrahydroxo zinc / zincate ✓1

(e) Explain why it was necessary to add water to mixture K and filter. (1mk)

K is a mixture of soluble and insoluble salt ✓1

(f) 7 grams of a mixture of sodium carbonate and sodium chloride were dissolved in water. The solution was found to neutralize 25.0 cm^3 of a solution of nitric acid containing 63 g/dm^3. Determine:

(i) The molarity of the acid. (H=1, N=14, O=16) (1mk)

$M = \frac{63g/L}{63} = 1.0M$ ✓1

(ii) The moles of sodium carbonate present in the mixture. (2mks)

Moles of acid used ½ Moles of Na_2CO_3 = 0.0125 moles ✓1

$\frac{25 \times 1}{1000} = 0.025$ moles

$Na_2CO_3 : HNO_3$

1 2 ½

(iii) The percentage of sodium carbonate in the mixture. (Na=23, C=12, O=16) (2mks)

Mass = $0.0125 \times 106 = 1.325$ ✓1

$\% = \frac{1.325}{7} \times 100$ ½ $= 18.93\%$ ½

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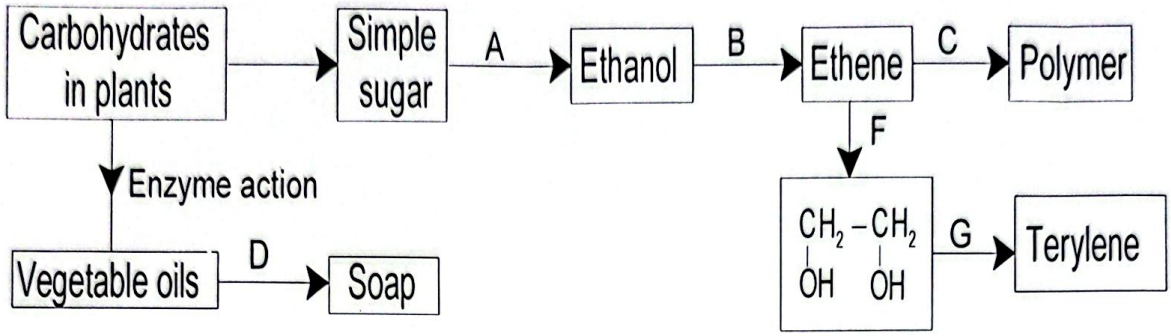
3. The diagram in the figure below shows some natural and industrial processes. Study it and answer the questions that follow.



(a) Identify the processes labelled A, B, C and D. (2 marks)

A. fermentation ½ B. Dehydration ½

C. Addition polymerisation ½ D. Saponification ½

(b) State the reagents and conditions required for the processes B and D. (2 marks)

Process B reagent. concentrated H_2SO_4 ½ condition. 160°C – 180°C ½ (specific value)

Process D reagent. Concentrated NaOH/KOH ½ condition. Heat to boil ½

(c) Describe how process D is carried out. (2 marks)

Mix vegetable oil with conc. NaOH/KOH ½ and stir as it boils. NaCl is added to precipitate out soap. The mixture is then allowed to cool and settle. ½ Soap is rinsed with distilled water ½

(d) State two additives used to improve the quality of soap. (1 mark) (Any 2 correct for ½ mk)

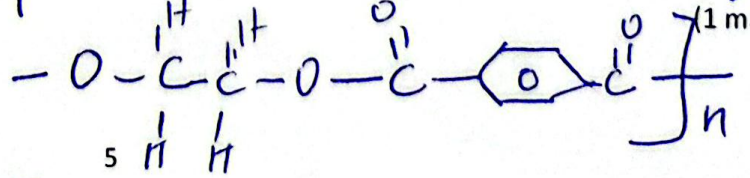
Perfumes ½/ dyes/ antiseptics/ bleaching agents

Builders / tetraoxophosphates

(e) State the reagents required in step F and G. (2 marks)

F. Acidified $KMnO_4$/ Hf/ $KMnO_4$ ✓1 G. Benzene-1,4-dioic acid/ terephthalic acid ✓1

(f) Draw the structure of terylene. (1 mark)



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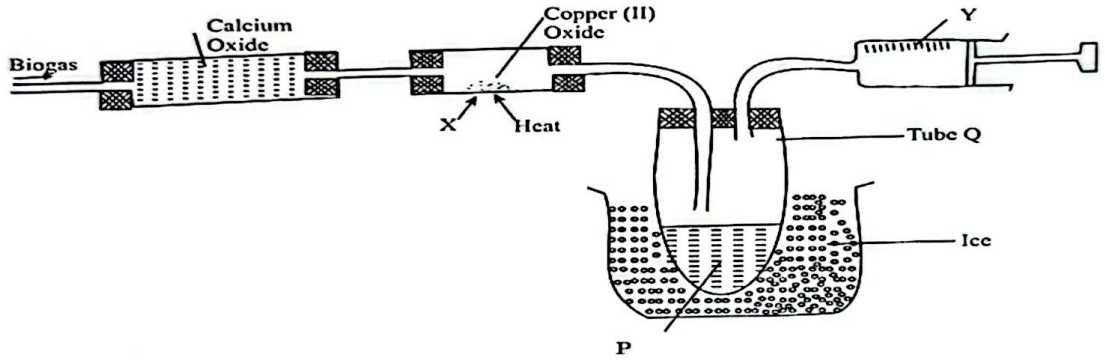
(g) (i) Name the polymer formed in step C. (1 mark)

Polythene ✓1

(ii) State one disadvantage of the polymer named in (g) (i). ✓1 (1 mark)

- Non-biodegradable hence causes pollution
- Produces toxic gases when burnt

4. Crude biogas is made from organic waste. A form four student set up the apparatus below to investigate the composition of the biogas. Study the set up and use it to answer the questions that follow.



(a) What is the function of calcium oxide? (1 mark)

Drying agent of the biogas

(b) Name products P and Y. (1 mark)

P Water ✓ Y carbon(IV) oxide ✓

(c) Give the two observations made in tube X. (2 marks)

Black solid changes to brown ✓1
Droplets of a colourless liquid form on the cooler parts of the tube ✓1

(d) (i) . Name the type of reaction taking place in tube X. (1 mark)

Redox reaction ✓1

(ii) .Write the equation for the reaction named above in (d) (i). (1 mark)

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$4CuO_{(s)} + CH_{4(g)} \rightarrow 4Cu_{(s)} + CO_{2(g)} + 2H_2O_{(l)}$ ✓1

(e) What elements are present in biogas? (1 mark)

carbon ✓½
Hydrogen ✓½

(f) Explain why one tube in boiling tube Q is longer than the other. ✓1 (1 mark)

To prevent back flow of CO_2 and H_2O vapour into the combustion tube

(g) Why was ice used in this experiment? ✓1 (1 mark)

To condense the water vapour to liquid

(h) The volume of gas Y was found to be 240 cm³ at r.t.p. Find the mass of copper (II) oxide that reacted with methane. (Cu=64, O=16, molar gas volume= 24000 cm³) (2 marks)

1 mole → 24000 cm³ CH_4 : CuO
← 240 cm³ 1 : 4

$\frac{240 \times 1}{24000} = 0.01$ moles ✓½ moles of CuO ✓½
$0.01 \times 4 = 0.04$
Mass of CuO = 0.04×80 ✓½
$= 3.2$ g ✓½

5. (a) Define the following terms:

I. Solubility (1 mark

Is the maximum mass of solute that saturates 100g of water at given temperature

II. Saturated solution (1 mark)

A solution in which no more solute can dissolve at that given temperature.

(b) The amount of gas X that can dissolve in water at different temperatures is shown in the table below.

Temperature (°C)	5	10	20	25	35	50	56
Solubility of gas X g/100g water	150	120	75	58	40	24	21

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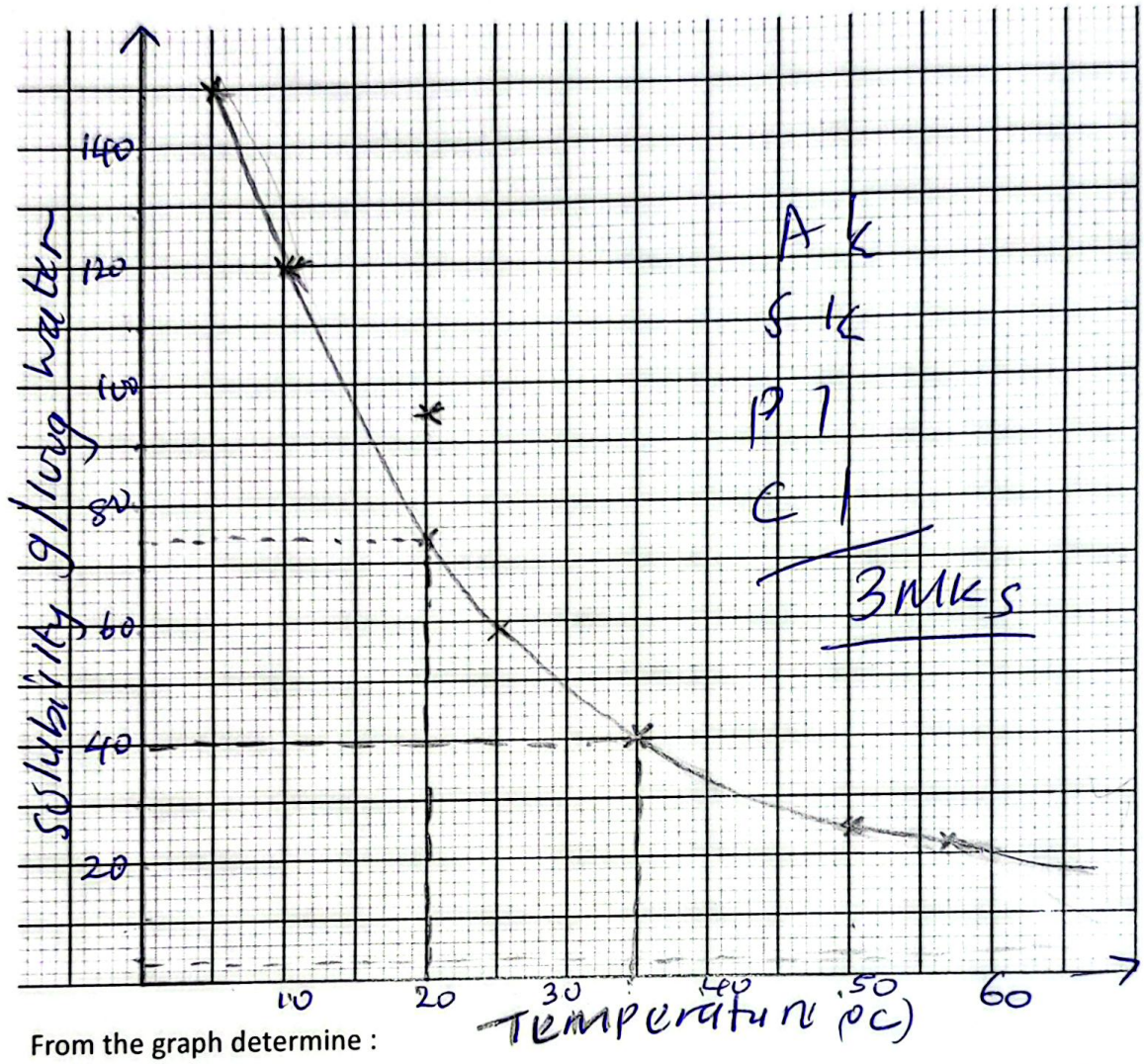
Plot a graph of solubility (mass of gas X) against the temperature in the grid provided below (3 marks)



I. From the graph determine :

a) The mass of gas X that would dissolve in one litre of solution at 20° (2 marks)

From graph 74g ✓½

74g → 100g ✓½ $\frac{74 \times 1000}{100}$ = 740g/L ✓1

→ 1000g

400g

b) The temperature at which a litre of solution contains ~~40~~g of gas X. (2 marks)

40g → 1000g ✓½

→ 100g ✓1

$\frac{400 \times 100}{1000}$ = 40.0g/100g water

Reading from graph 35°C ✓½

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c) The table below shows solubilities of two salts A and B at various temperatures.

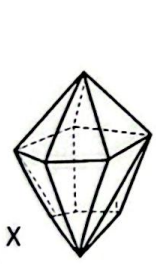
SALT	SOLUBILITY AT 20°C	SOLUBILITY AT 50°C
A	30	70
B	14	25

A mixture containing 10g in 100g of water of salt A and 22g in 100g of water of salt B was cooled from 50°C to 20°C. Name the salt that will crystalize out and determine the mass of the crystals (2 marks)

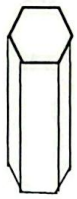
Salt B ✓1

Mass of crystals = 22 − 14 = 8·0g ✓1

6. (a) The following diagrams show allotropes of sulphur. Study them and answer the questions that follows.



X



Y

I. Identify allotropes X and Y (1 mark)

X Rhombic ✓½

Y Monoclinic ✓½

II. Identify the allotrope stable (2 marks)

i) Below 96°C X accept rhombic if correctly identified above ✓1

ii) Above 96°C Y accept monoclinic ✓1

III. Which name is given to the temperature of 96°C? (1 mark)

Transition temperature. ✓

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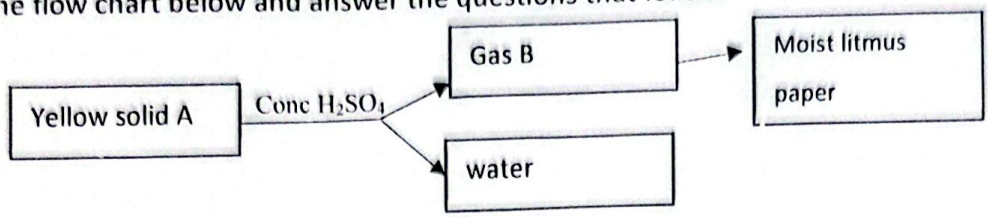
(b) Study the flow chart below and answer the questions that follow.



I. Name

Solid A ..Sulphur ✓1..... (1 mark)

Gas B ..Sulphur (IV) oxide ✓1..... (1 mark)

II. Write an equation for the reaction between solid A and concentrated sulphuric (VI) acid.(1 mrk)

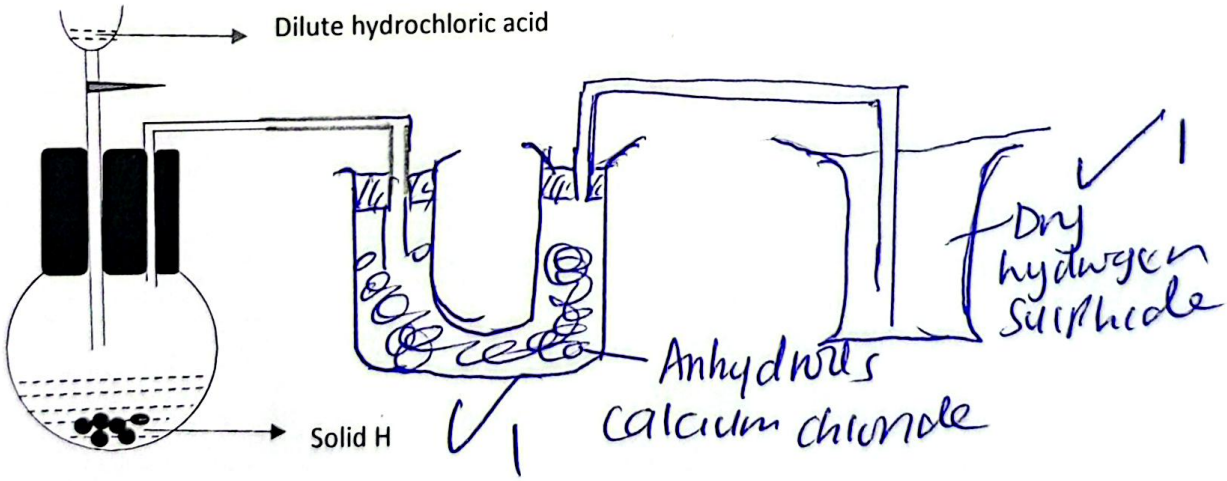
$S_{(s)} + 2H_2SO_{4(l)} \rightarrow 3SO_{2(g)} + 2H_2O_{(l)}$ ✓1

III. State and explain the observation made on the moist blue litmus paper. ✓1 (2 marks)

Turns red then bleached / turns white ✓1

SO_2 gas dissolves to form acidic solution and SO_3^{2-} has bleaching property ✓1

(c) The set up below was used by a student to prepare and collect dry hydrogen sulphide gas. Study it and answer the questions that follow.



✓1

I. Complete the set up above to show how hydrogen sulphide is collected. (2 marks)

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II. Give the identity of solid H and write its formula. (1 mark)

Iron (II) sulphide / FeS

7. a) i) Define enthalpy of displacement (1 mark)

Is the enthalpy change that occurs when one mole of a substance is displaced from a solution of its ions

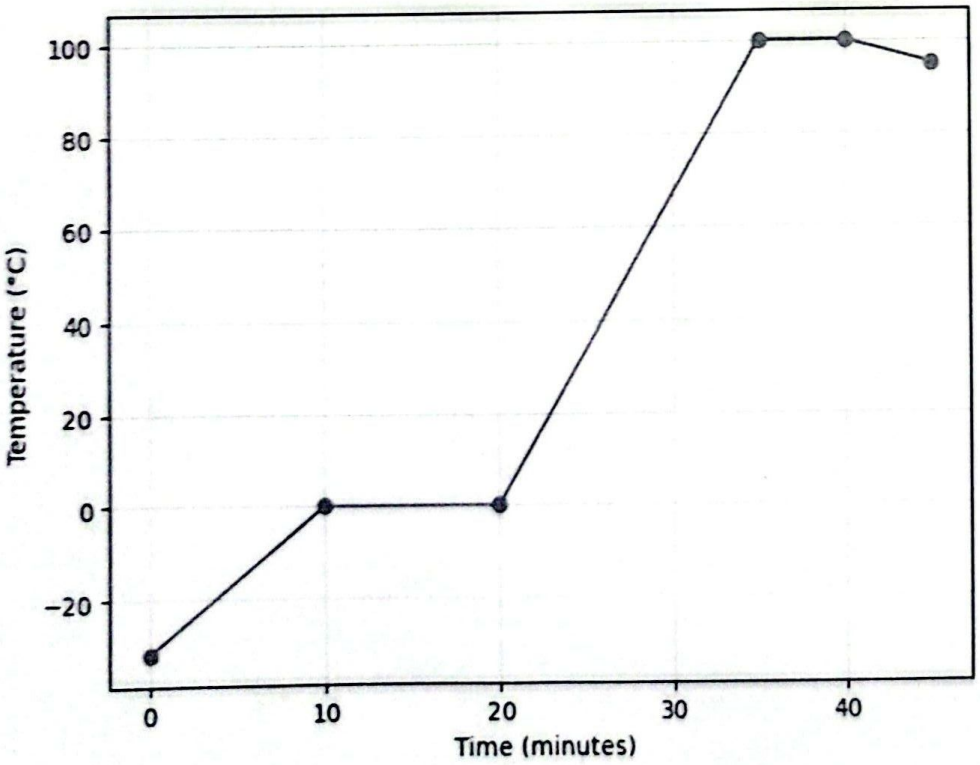
ii) In an experiment to determine the molar heat of reaction when magnesium displaces copper, 1.5g of magnesium powder were added to 25.0cm^3 of 2.0M copper (ii) chloride solution. The temperature of copper (II) chloride solution was 25^{0}C while that of the mixture was 43^{0}C. Given (SHC=4.2j/g/k and the density of the solution=1g/cm^3 Mg=24), determine the molar heat of displacement of copper by magnesium. (3 marks)

$\Delta H = mc\Delta T$
$= 25 \times 4.2 \times 18$
$= 1890J$

Moles of Mg $= 1.5/24$
$= 0.0625$
Moles of Cu^{2+} (excess) $= \frac{25 \times 2}{1000} = 0.05$ mol

0.05 mol → 1.89 KJ
1 mol → ?
$\frac{1 \times 1.89}{0.05} = -37.8$ KJ/mol

b) The graph below shows the energy changes that occur when ice at -10^{0}C is heated until it boils.



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I From the graph determine:

i) Temperature at which ice changes into liquid. (1 mark

0°C ✓1

ii) Temperature at which liquid changes into steam. (1 mark

100°C ✓1

II Define:

i) Molar latent heat of fusion. ✓1 (1 mark)

Amount of heat required to convert 1mole of a solid substance into liquid at fixed/ constant temperature/ at its melting point

c) Hydrogen bromide is formed from hydrogen gas and bromine gas in the following reaction.

$H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$

Calculate the enthalpy of formation of hydrogen bromide using the bond energies in the table below.

(3 marks)

Bond	Bond energies, Kj/mol
H-H	436
Br-Br	192
H-Br	368

Bond breaking
H-H Br-Br
436 + 192 ✓1
+ 628

Bond formed
2H-Br
−368×2 ✓1
−736

+628 − 736 = −108 ✓1
−108/2 = −54kJ/mol
(must express per mole. to score (1mk))

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