CHAMPIONS JET EXAMINATIONS

Kenya Certificate of Secondary Education

233/2 Chemistry (Theory) Paper 2

July, 2024 Time: 2 Hours

Name: ……..…… Adm No: ……

Index. No: ……... Stream: …… School: ……..…….

Instructions to candidates

(a) Write your name, admission number, index number, stream and school in the spaces provided above.

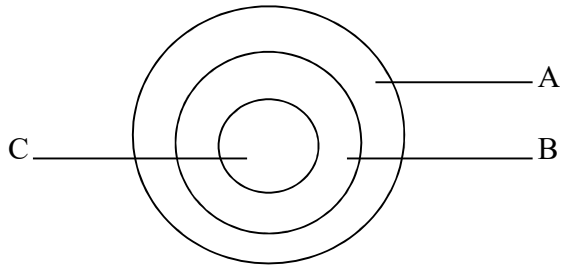
*(b) Answer **ALL** the questions in the spaces provided and calculations **MUST** be clearly shown.*

*(c)This paper consists of **13 printed pages**; please check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.*

FOR EXAMINER'S USE ONLY

Questions	Maximum Score	Candidate's Score
1	11	
2	13	
3	14	
4	11	
5	10	
6	08	
7	13	
TOTAL	80	

1. The diagram below represents a cross section of the apparatus used to extract sulphur from its deposits. Study it and answer the questions that follow.



(i) Name the material passing through the part marked C. (1 mark)

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(ii) State the role of the substances that pass through the part labeled A. (1 mark)

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(iii) Give **two** reasons as to why the shown method of sulphur extraction is possible. (2 marks)

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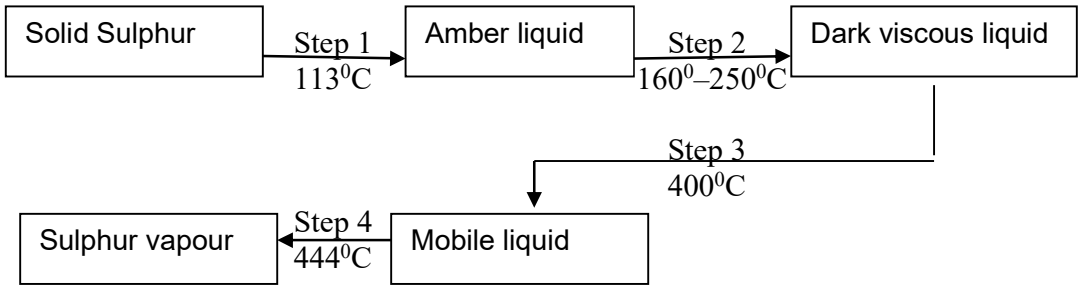
(b) Study the scheme below and answer the questions that follow:-



(i) Explain the observations made in:-

a) Step 1 (2 marks)

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b) Step 3 (2 marks)

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c) Represent the information in the flow-chart using a graph of viscosity against temperature when solid sulphur heated. (2 marks)

d) State **<u>two</u>** uses of sulphur. (1 mark)

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2. The table below shows properties of some elements. The letters do not represent the actual symbols of the elements. Study the information in the table and answer the questions that follow.

Element	Atomic Number	Melting Point ^{0}C	Boiling Point ^{0}C
P	13	660	2470
Q	9	-220	-188
R	19	63.7	774
S	17	-101	-34.1
T	12	650	1110
U	14	1410	2360
V	11	97.8	890
W	18	-189	-186

(a) Select the element with the highest ionization energy. (1 mark)

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(b) How do the atomic radii of the following elements compare. Explain your answer.

(i) S and T. (2 marks)

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(ii) R and V. (2 marks)

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(c) How do the reactivities of Q and S with V compare. Explain your answer. (2 marks)

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(d)

(i) Write the formula of the compound formed between P and S (1 mark)

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(ii) Write an equation for the reaction between V and S (1mark)

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(iii) State and explain how the boiling points of the compounds formed in d (i) and (ii) above compare. (2 marks)

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(e) What would be the effect of aqueous solution of compounds formed in d (i) and (ii) above on litmus papers. Explain. (2 marks)

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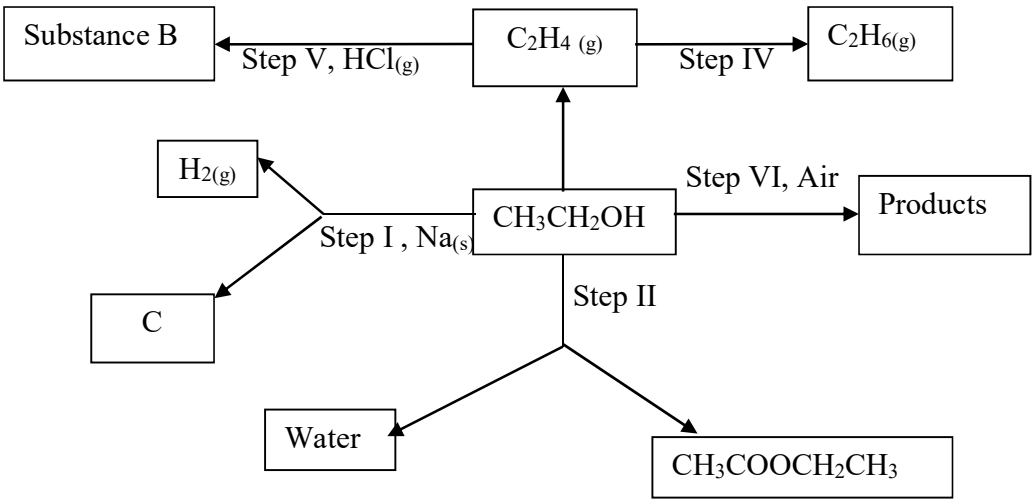
3. a) Study the flow chart below and answer the questions that follow



(i) Describe how the reaction in **step II** is carried out in the lab. (2 marks)

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(ii) Substance B (1 mark)

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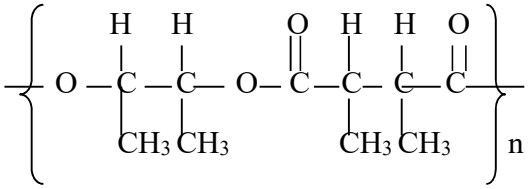
(iii) Name and draw the structural formula of substance C. (2 marks)

(iv) Give the reagent and condition in step IV (1 mark)

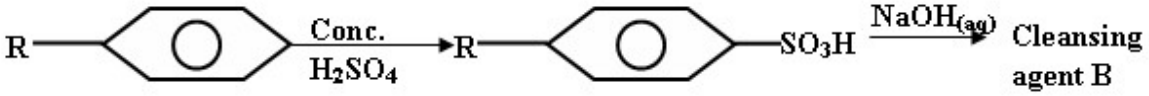
Reagent.....condition.....

(b) The repeating unit of a polymer P is shown below



Draw the structures of two compounds which react together to form polymer P (2 marks)

(c) The scheme below represents the manufacture of a cleansing agent.



i) Draw the structure of B and state the type of cleansing agent for which it belongs.

Structure ……. (1 mark)

Type …… (1 mark)

ii) State one disadvantage of using B as a cleansing agent. (1 mark)

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iii) Describe how a cleansing agent removes dirt from linen (3 marks)

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4. a) Use the standard electrode potential for elements A, B, C, D and F given below to answer the questions that follow. The elements do not represent the actual symbols of the elements.

	$E^{Ø}_{Volts}$
$A^{2+}_{(aq)} + 2e \rightleftharpoons A_{(s)}$	-2.90
$B^{2+}_{(aq)} + 2e \rightleftharpoons B_{(s)}$	-2.38
$C_{2(g)} + 2e \rightleftharpoons 2C^{-}_{(aq)}$	+ 0.91
$D^{2+}_{(aq)} + 2e \rightleftharpoons D_{(s)}$	+0.34
$F_{2(g)} + e \rightleftharpoons 2F^{-}_{(aq)}$	+2.87

i) Identify the element which is the weakest oxidizing agent. (1 mark)

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ii) Write the cell representation for the electrochemical cell that would give the least e.m.f. (1 mark)

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iii) Determine the e.m.f for element D if B is used as the reference electrode. (1mark)

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iv) Can a solution of D be stored in a container of A? Show your working. (2 marks)

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b) The standard reduction potentials of two half –cells are:

$Pb^{2+}_{(aq)} + 2e \longrightarrow Pb_{(s)}$; E = -0.13V

$2H_2O_{(l)} + 2e \longrightarrow H_{2(g)} + 2OH^{-}_{(aq)}$; E = +0.83V

Draw a labelled diagram of an electro chemical cell that can be constructed using the two half – cells (3 marks)

(c) During the electrolysis of molten lead (II) chloride, a current of 1.5 amperes was passed for 49.5 minutes. How many grams of chlorine gas were produced? (Cl=35.5, 1F=96500C).
(3 marks)

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5. a) Define molar heat of fusion (1 mark)

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(b) (i) Study the neutralization reactions below and answer the questions that follow

I. $2KOH_{(s)} + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$; $\Delta H = -180kJ/mol$

II. $2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$; $\Delta H = -98kJ/mol$

State and explain the difference in the heats of neutralization for the two reactions

(2 marks)

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(ii) Study reactions below and answer the questions that follow:

(a) $Mg^{2+}_{(g)} + (aq) \longrightarrow Mg^{2+}_{(aq)}$; $\Delta H = -ve$

(b) $Ca^{2+}_{(g)} + (aq) \longrightarrow Ca^{2+}_{(aq)}$; $\Delta H = -ve$

Which reaction has a higher ΔH value. Explain (2 marks)

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(iii) Methane burns easily and quickly in air. However, it needs to be ignited before it begins to burn. Give a reason (1 mark)

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c) When Zinc is placed in aqueous Copper (II) sulphate solution, Zinc displaces copper. Explain (1 mark)

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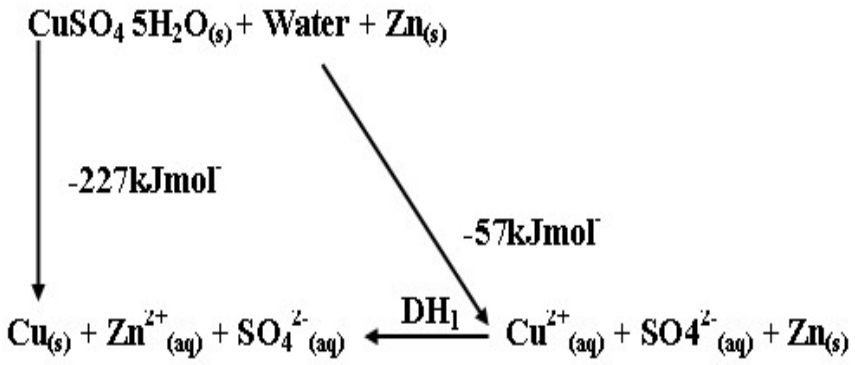
d) The cycle diagram below represents enthalpies of solution and displacement. Study it and answer the questions that follow.



i) Write an ionic equation for the displacement reaction between copper II ions and Zinc atoms (1 mark)

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ii) Calculate ΔH, for the reaction above (2 marks)

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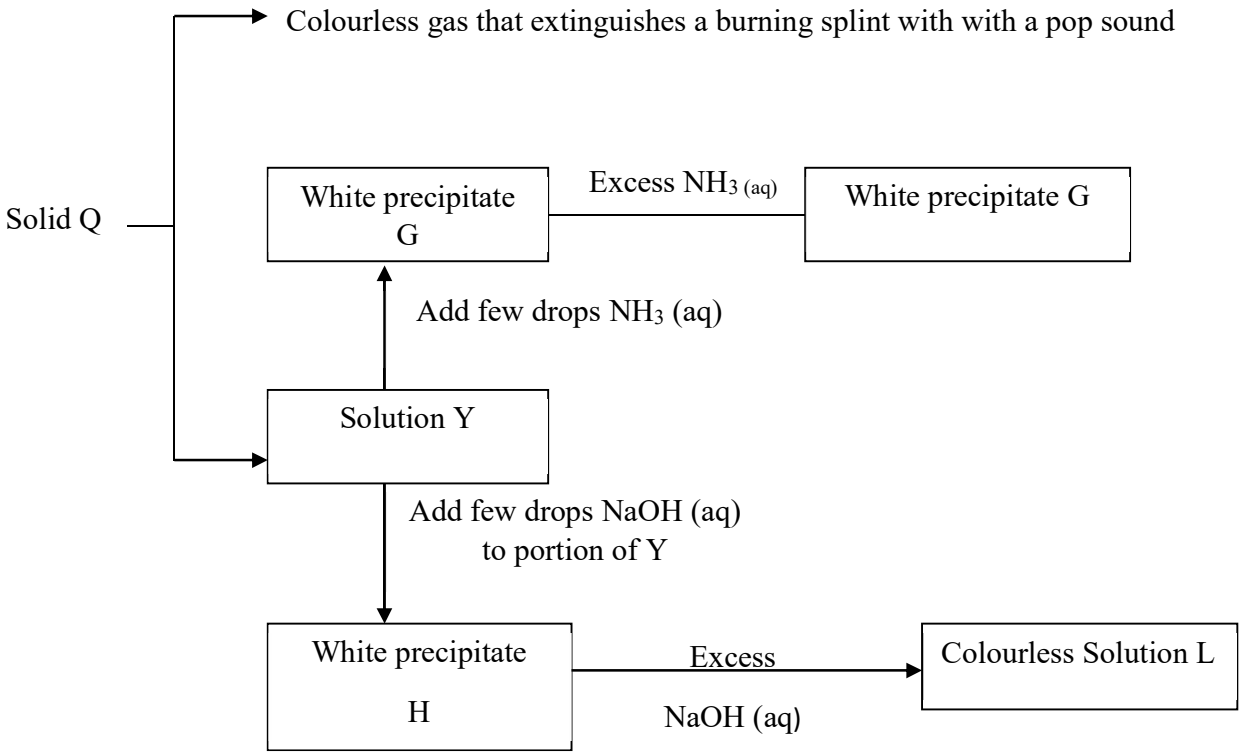
6. (a) Study the reaction scheme below and answer the questions that follow.



(i) Name solid Q. (1 mark)

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(ii) Write the formulae of the cation present in solution L. (1 mark)

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(iii)Write an ionic equation for the formation of the white precipitate H. (1 mark)

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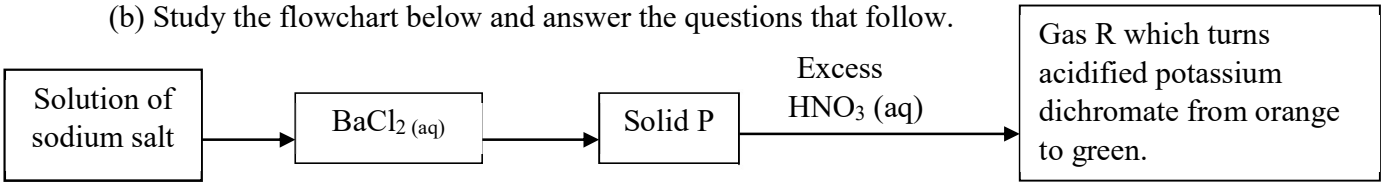
(b) Study the flowchart below and answer the questions that follow.



(i) Name

I. Solid P. (1 mark)

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II. Gas R (1 mark)

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(ii) During the reaction in 480cm^3 of gas R was produced. Calculate the mass of solid P which reacted with excess nitric acid at room temperature and pressure) (Ba = 137.0, S = 32.0, O = 16.0 C = 12.0, molar gas volume at r.t.p. = 24 litres). (3 marks)

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7. The table below shows the volume of nitrogen (IV) oxide produced when different volumes of 1M Nitric (V) acid- were each reacted with 4.14g of lead at room temperature.

Volume of 1M nitric (V) acid	10	30	50	70	90	110
Volume of nitrogen (IV) oxide (cm^3)	120	360	600	840	960	960

(a) Explain how the rate of the reaction between lead and nitric (V) acid would be affected if the temperature of the reaction mixture was lowered. (2 marks)

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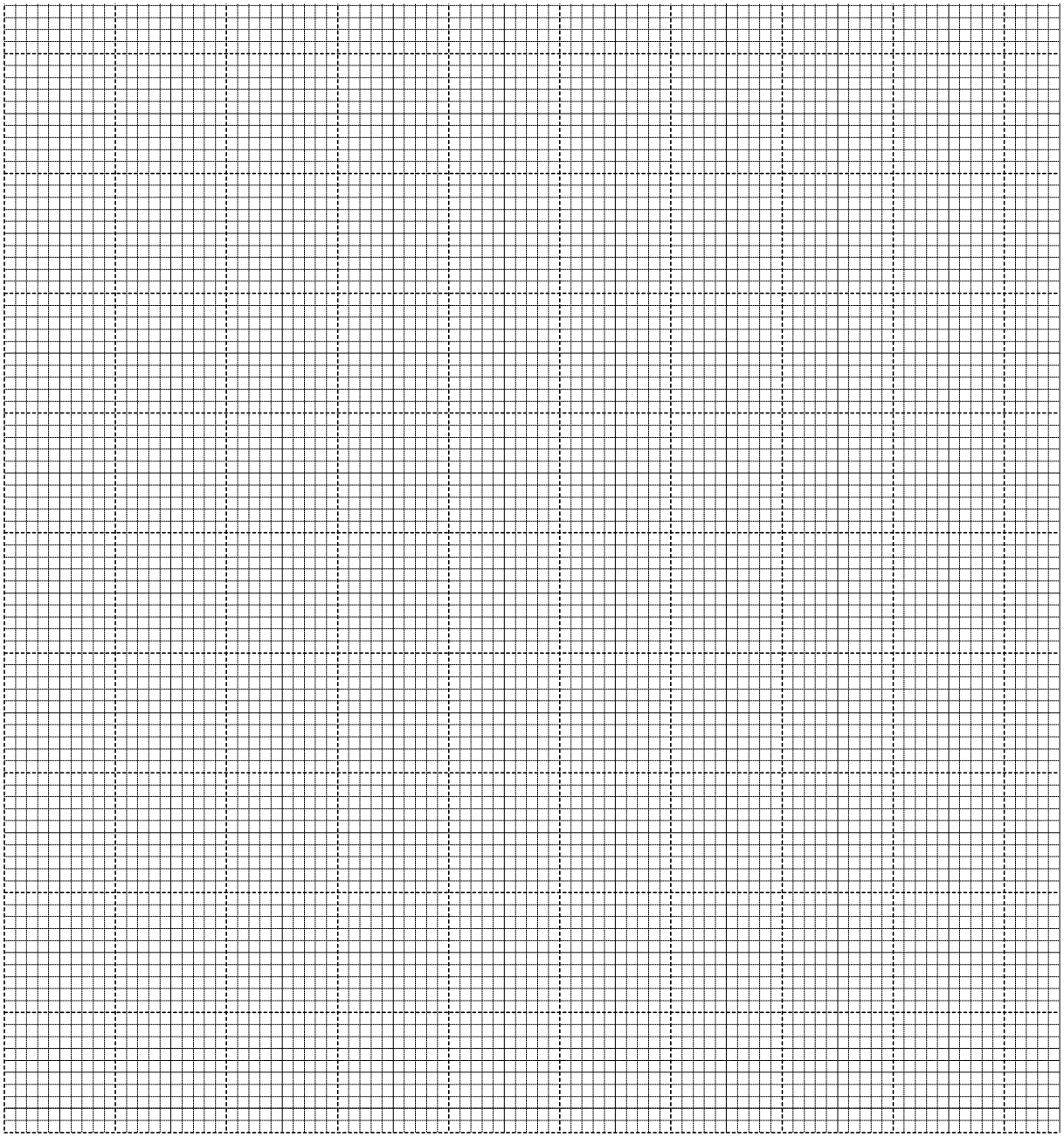
(b) On the grid provided below plot a graph of the volume of the gas produced (vertical axis) against volume of acid. (3 marks)



(c) Using the graph, determine the volume of

(i) Nitrogen (iv) oxide produced when 60cm^3 of 1M Nitric (V)acid were reacted with 4.14g of lead. (1 mark)

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(ii) 1M Nitric (V) acid which would react completely with 4.14g of lead. (1 mark)

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(d) Using the answer in c (ii) above, determine;

(i) the volume of 1M Nitric (V) acid that would react completely with one mole of lead. (Pb = 207) (2 marks)

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(ii) the volume of nitrogen (IV) oxide produced when one mole of lead reacts with excess 1M Nitric (V) and acid at room temperature. (1 mark)

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(e) Calculate the number of moles of

i) 1M Nitric (IV) acid reacted with one mole of lead. (1 mark)

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(ii) Nitrogen (IV) oxide produced when one mole of lead were reacted with excess nitric acid. (Molar gas volume is 24,000cm^3) (1 mark)

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f) using the answers obtained in e (i) and (ii), write the equation for the reaction between lead and nitric acid given that one mole of lead ii nitrate and one mole of water were also produced.

(1 mark)

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