FORM 4 ENTRANCE EXAMS 2024

NAME………………………………………..………...INDEX NUMBER…………………..

CLASS…………CANDIDATE'S SIGNATURE……………..…… DATE………………………

233/2
CHEMISTRY
THEORY
Paper 2
Time: 2 Hours

Kenya Certificate of Secondary Education

233/2
CHEMISTRY
THEORY
Paper 2
Time: 2 Hours

INSTRUCTIONS TO CANDIDATES:
- *Write your **name** and **index number** in the spaces provided above.*
- ***Sign** and write the **date** of examination in the spaces provided.*
- *Answer **all** the questions in the spaces provided.*
- *All working **must** be clearly shown where necessary.*
- *Mathematical tables and electronic calculators may be used.*

For Examiner's Use Only:

Question	Maximum score	Candidate's score
1	12	
2	12	
3	11	
4	11	
5	13	
6	10	
7	11	
Total	80	

*This paper consists of **13 printed pages**. Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing.*

1.   The grid below shows part of the periodic table. Use it to answer the questions that follow. The letters do not represent actual symbols.

						S	U	V
P	R					T	X	W
Q								

(a)   Which of the elements has the highest atomic radius? Explain.   (2 marks)

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(b)   Identify the most reactive Oxidizing agent. Explain.   (2 marks)

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(c)   Compare the atomic radius of P and R. Explain   (2 marks)

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……..

(d)Give the formula of one stable ion with an electron arrangement of 2.8 which is:

(i)   A Negatively charged divalent ion.   (2 marks)

…………………………………………………………………………………………………

(ii)   A Positively charged monovalent.

…………………………………………………………………………………………………

(e)   Given that the mass number of W is 40. Write down the composition of its nucleus.
          (2 marks)

....

....

....

(f) Write the formula of the compounds formed between.

 (i) Element **R** and **X**.   (1 mark)

....

 (ii) Give **one** property of the structure formed when R and X bond.   (1 mark)

....

....

2.   a)   Sodium hydroxide pellets were accidentally mixed with sodium chloride-18.2g of the mixture was dissolve in water to make one liter of solution. 100cm3 of the solution was neutralized by   50cm^3 of 0.45M Sulphuric acid.

i) Write an equation for the reaction that took place.   (1mark)

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....

ii) Calculate the;

I. Number of moles of the substance that reacted with sulphuric acid.   (1 mark)

II. Number of moles of the substance that would react with sulphuric acid in the one litre of solution.   (1 mark)

III. Mass of the unreacted substance in the one litre of solution.   (2 marks)

   (H = 1.0, Na 23.0, Cl 35.5, 0 = 16.0)

b) The diagram below shows an incomplete set-up used to prepare and collect ammonia gas.

Solid P + Potassium
hydroxide
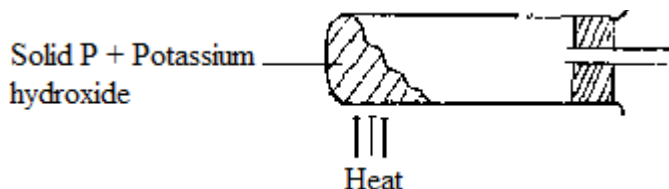
Heat

    i) Name solid P. (1mark)

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    ii) Complete the diagram to show how a dry sample of ammonia gas can be collected.

(3 marks)

c) In an experiment, excess ammonia gas was passed over heated copper (II) oxide in a combustion tube.

  i) State the observation that was made in the combustion tube at the end of the experiment.

(1 mark)

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ii) What property of ammonia is shown in the above reaction? (1mark)

…………………………………………………………………………………………

iii) Give **one** use of ammonia. (1mark)

…………………………………………………………………………………………

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

$$Fat \xrightarrow[\text{Step I}]{NaOH_{(aq)}/\ Boil} \text{Solution of cleansing agent and an alcohol} \xrightarrow{\text{Step II}} \text{Solid cleansing agent}$$
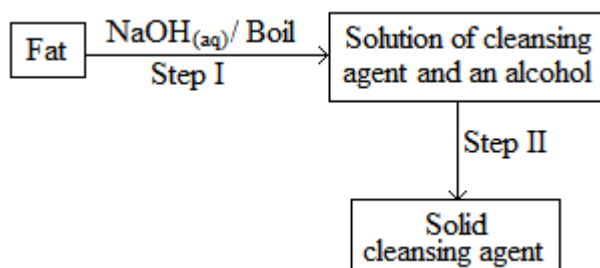
(i) What name is given to the type of cleansing agent prepared by the method above?

(½ mark)

…………………………………………………………………………………………

(ii) Name one chemical substance added in step II. (1 mark)

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(iii) What is the purpose of adding the chemical substance named in a (ii) above? (1 mark)

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………………………………………………………………………………………………..

(iv) Name any other suitable substance that can be used in step I. (1 mark)

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(v) Explain how an aqueous solution of the cleansing agent removes oil during washing.

(2 marks)

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(b) Study the scheme below and answer the questions that follow.
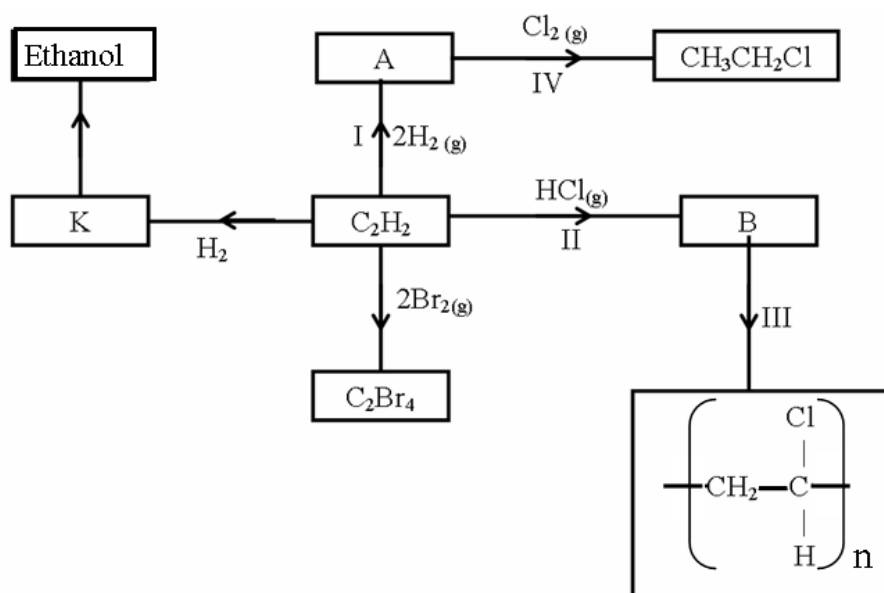
(i)   Identify the catalyst used in step I   (½ mark)

……………………………………………………………………………………………………….

(ii)   Name the compounds A and B   (1 mark)

A…………………………………………….B…………...…………………………………

(iii) Give **one** disadvantage of compound formed in step III   (1 mark)

………………………………………………………………………………………………

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(iv)   Name the reactions taking place at steps: (1 mark)

I………………………………………….IV...

(v)   Describe how substance K is converted to ethanol   (2 marks)

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4.   The set-up below can be used to generate a gas.
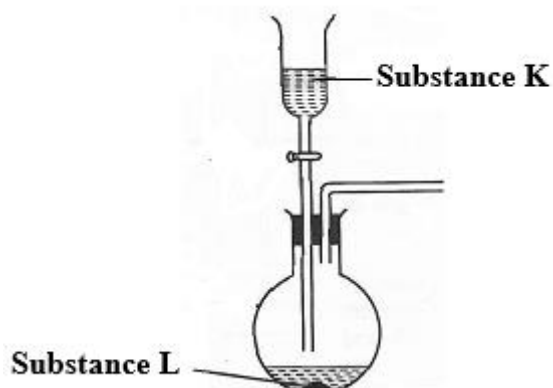
Substance K

Substance L

(a) (i)   Complete the table below giving the names of substance **K** and **L** if the gases
           generated are carbon (IV) oxide and carbon (II) oxide.   (2 marks)

Substance	Carbon (IV) oxide	Carbon (II) oxide
K		
L		

(ii) Complete the diagram to show how a sample of carbon (II) oxide can be collected.
                                                                      (2 marks)

(iii) State **two** ways that can be used to distinguish carbon (IV) oxide from carbon (II)
      oxide?   (2 marks)
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…….
…..………………………………………………………………………………………………….........
……..

(b) (i) In an experiment, carbon (IV) oxide gas was passed over heated charcoal held in a
    combustion tube. Write a chemical equation for the reaction that took place in the
    combustion tube.   (1 mark)

………

(ii) State **one** use of carbon (II) oxide.   (1 mark)

……………………………………………………………………………………………………….

(c) The following set ups were used by Form Two students. Study and use them to answer the questions that follow.

SET I — Bulb

Graphite

SET II — Bulb

Diamond
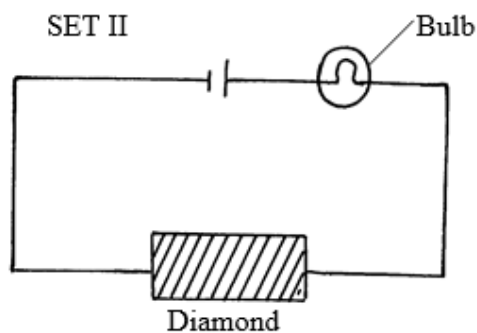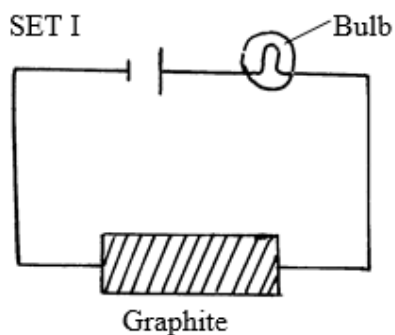
State and explain the difference in observation made in set up I and II above.   (3 marks)

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5.   (a)   Define the term solubility.   (1 mark)

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   (b)   In an experiment to determine the solubilities of two salts X and Y at different temperatures, a candidate recorded her observations as shown below.

Temperature (°C)	0	10	20	30	40	50	60	70	80	90
Solubility of X in g/100 g of H_2O	14.3	17.4	20.7	25.0	28.5	33.3	40.0	47.0	55.0	64.0
Solubility of Y in g/100 g of H_2O	25.0	27.5	30.0	32.5	35.0	37.6	40.1	42.4	45.0	48.0

(b)   From your graph to determine;

    (i)   The solubility of X and Y at 47 °C

        Solubility of X   (1 mark)

        …………………………………………………………………………..

        Solubility of Y   (1 mark)

        …………………………………………………………………………

    (ii)   The temperature at which the two salts are soluble in water.   (1 mark)

        …………………………………………………………………………

(c)   If 60g of X is dissolved in 100 g of water and heated to 90°C, calculate the amount of

salt that crystallized out if cooled to 20 °C.   (1 mark)

…………………………………………………………………………………

…………………………………………………………………………………..

…………………………………………………………………………………

(d)   State what would happen if a mixture salt X in 100 g of water and 30 g of Y in 100 g
of water were cooled from 90 °C to 70 °C.   (3 marks)

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(e)   State **one** application of solubility.   (1 mark)

…………………………………………………………………………………

6.   (a)   An ore is suspected to contain Lead metal. Describe the process that can be used to
confirm the presence of Lead in the ore.   (3 marks)

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(b)   The diagram below shows students set-up for the preparation and collection
      oxygen Gas
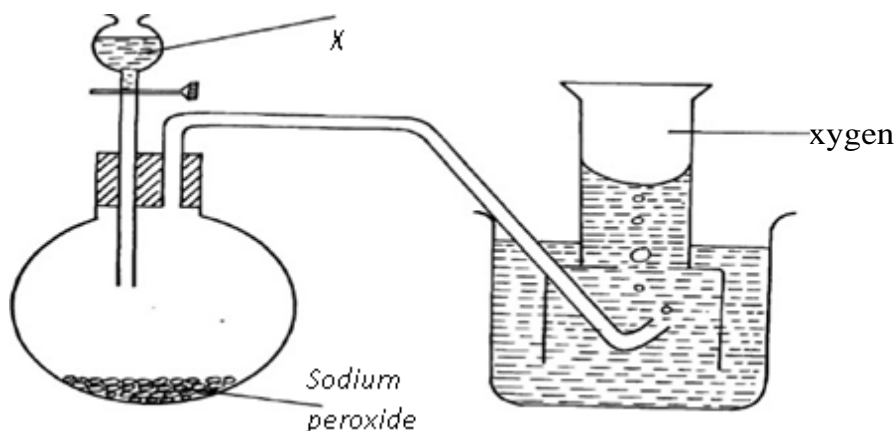
(i)   Name substance **X** used   (1mark)

      …………………………………………………………………………………………………

      …………………………………………………………………………………………………

(ii)   Write an equation to show the reaction of sodium peroxide with the substance named
                                                                                   (1mark)

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      …………………………………………………………………………………………………

(iii) Name a two other reagents that can be used to prepare oxygen gas in the laboratory
       using the apparatus shown above.   (1 mark)

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      …………………………………………………………………………………………………..

(iv)   How would you confirm that the gas produced was oxygen.   (1 mark)

      …………………………………………………………………………………………………..

      …………………………………………………………………………………………………

(c)   Apiece of cleaned magnesium ribbon was burnt in air to form a residue **P** which was
      then dissolved in water to form solution Q and a colourless gas R. A blue and red
      litmus paper was

      (i) State the components of residue P.   (1 mark)

....

....

(ii)   Identify colourless gas R ……………………………………….....................

(1 mark)

(iii)   Write an equation for the formation of solution **Q** and gas **R**.

(1mark)

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7. The diagram below shows a set-up of apparatus that can be used to prepare nitrogen (IV) oxide. Study it and use it to answer the questions that follow
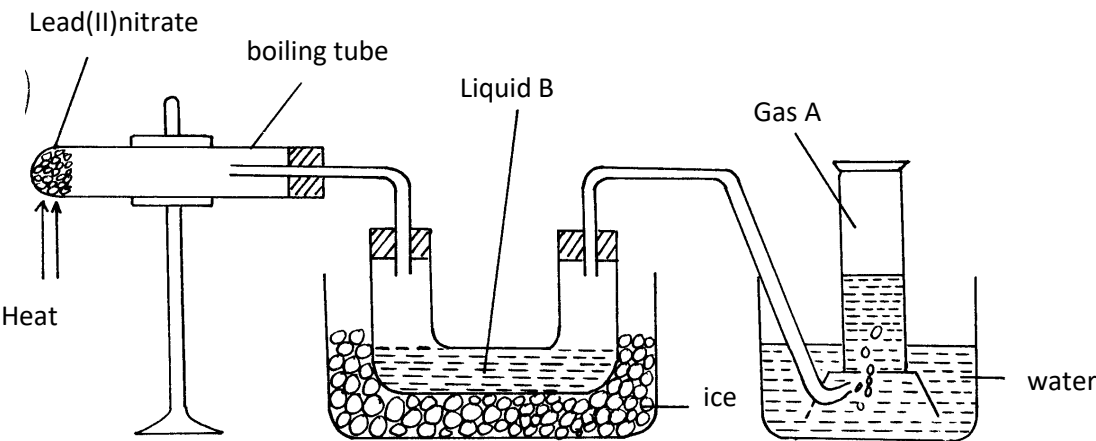
(a)   (i) Write the equation for the reaction that takes place in the boiling tube. (1 mark)

....

(ii) State the observations made in the boiling tube.   (2 marks)

....

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....

....

(iii) Explain why lead (II) nitrate is preferred over other metal nitrates in this

experiment.   (1 mark)

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(iv)   Describe how gas A can be identified.   (1 mark)

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(b) (i) Name liquid B   (1 mark)

…………………………………………………………………………………………..

   (ii) Write a chemical equation to show how liquid B is formed in this experiment.
                                                                                    (1mark)

(c)   (i) In another experiment, excess aqueous lead (II) nitrate solution was reacted with a
         solution which contained 2.34g of sodium chloride. Calculate the mass of precipitate formed
         in this reaction.   (Pb = 207, Cl = 35.5, Na = 23)   (3 marks)

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   (ii) Write an ionic equation for the reaction that takes place when nitrogen (IV) oxide
         reacts with aqueous sodium hydroxide.   (1 mark)

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FORM 4 ENTRANCE EXAMS 2023

MARKING SCHEME
CHEMISTRY
233/2
THEORY
2 Hours

1.The grid below shows part of the periodic table. Use it to answer the questions that follow. The letters do not represent actual symbols.

						S	U	V
P	R					T	X	W
Q								

(a)Which of the elements has the highest atomic radius? Explain. (2 marks)

Q- ✓¹This is because it has the highest number of energy levels. ✓¹

(b)Identify the most reactive Oxidizing agent. Explain. (2 marks)

U ✓¹– This is because U has the highest nuclear change due to its small atomic radius among the non metals.

(c) Compare the atomic radius of P and R. Explain (2 marks)

P has bigger atomic radius than R ✓. **This is because P has higher nuclear charge than R.** ✓¹

(d) Give the formula of one stable ion with an electron arrangement of 2.8 which is:

    (iv)   A Negatively charged divalent ion.   (2marks)

        S^{2-}

    (v)   A Positively charged monovalent

        P^{+}

(e) Given that the mass number of W is 40. Write down the composition of its nucleus. (2 marks)

P = 18 N = 40 – 18 = 28

    P = 18 ✓½

    N = 22 ✓½

(f) Write the formula of the compounds formed between.

(i) Element R and X.   (1 mark)

    RX_2

(ii) Give one property of the structure formed when R and X bond. (1 mark)

        (a) Compounds with the above structures are soluble in water but insoluble in organic conduct.

        (b) Compounds with the above structure conduct electricity in molten and aqueous state but they are non conductors in solid state.

        (c) Compounds with the above structure exist in crystalline form

Compounds with the above structure have~~ve~~ very high melting and boiling point. 2.   a) i)
$2NaOH(aq) + H_2SO_4(aq)$ $Na_2SO_4(aq) + 22\ H_2O(l)$ ✓ 1 correct symbols, Balancing
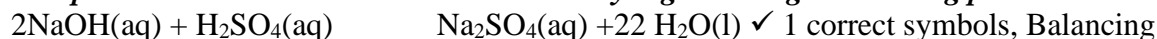
    ii) I. moles of $H_2SO_4 = \dfrac{50}{1000} \times 0.45 = 0.0225$✓ ½

      moles that reacted = 0.0225 x 2 = 0.045✓ ½

    II.

      $\dfrac{1000}{100} \times 0.045 = 0.45$✓ ½

    III. NaOH = 23 + 16 + 1 = 40✓ ½

      0.45 x 40 = 18g✓ ½

      18.2 – 18 = 0.2g ✓ unreacted

b)
i) NH$_4$Cl (s) / any ammonium salt✓ 1

ii)
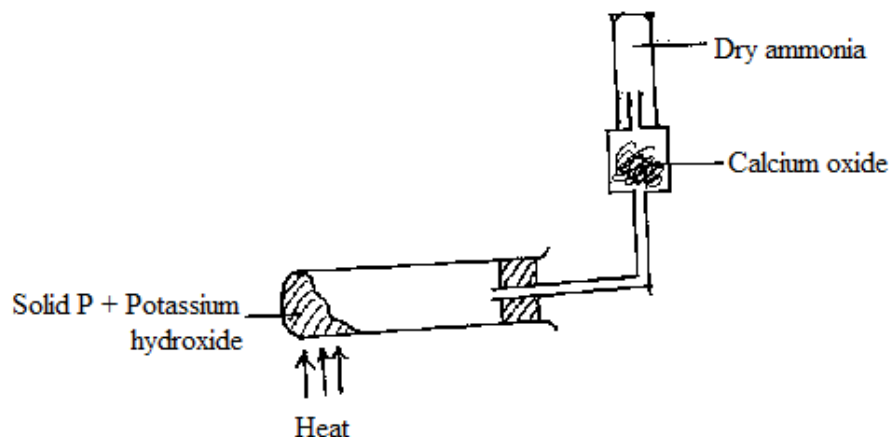
Upward delivery✓1
Drying agent/Cao✓1
Workability✓1

c) i) Brown solid deposited✓ ½ Colourless droplets on the cool sides.✓ ½
ii) Reducing property/reducing agent.
iii) –Manufacture of HNO$_3$✓ 1
- Manufacture of ammonium fertilizers.
- Cleansing agent in laundry.
As a refrigerant in large cold storages.

3.(a)The scheme below was used to prepare a cleansing agent. Study it and answer the questions

that follow.
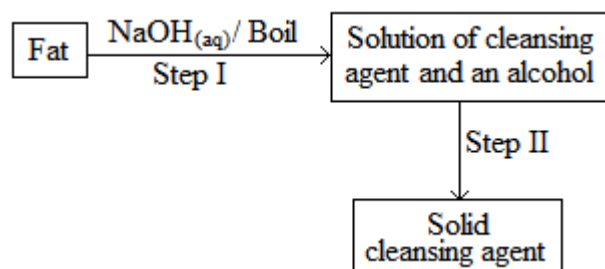
(i)Whatname is given to the type of cleansing agent prepared by the method above?   (½ mark)

Soap. ✔ ½

(ii)Nameone chemical substance added in step II   (1mark)

 Concentrated NaCl/ Brine/ NaCl$_{(l)}$ ✔*1*

(iii)What is the purpose of adding the chemical substance named in a (ii) above?   (1mark)

To precipitate out the soap ✔*1*

(iv)Name any other suitable substance that can be used in step I   (1mark)

potassium hydroxide/ KOH$_{(aq)}$ ✔*1*

(v)Explain how an aqueous solution of the cleansing agent removes oil during washing (2marks)

– Cleansing agent is made up of non- polar (hydrocarbon) and polar (head) ✔ *½*

-When mixed with oil /grease, the hydrocarbon part is attracted to it. ✔ *½ while the polar*

part stays in water ✔ *½*

-The oil particles are broken and carried off to the solution. ✔*1*

(b).Study the scheme below and answer the questions that follow.
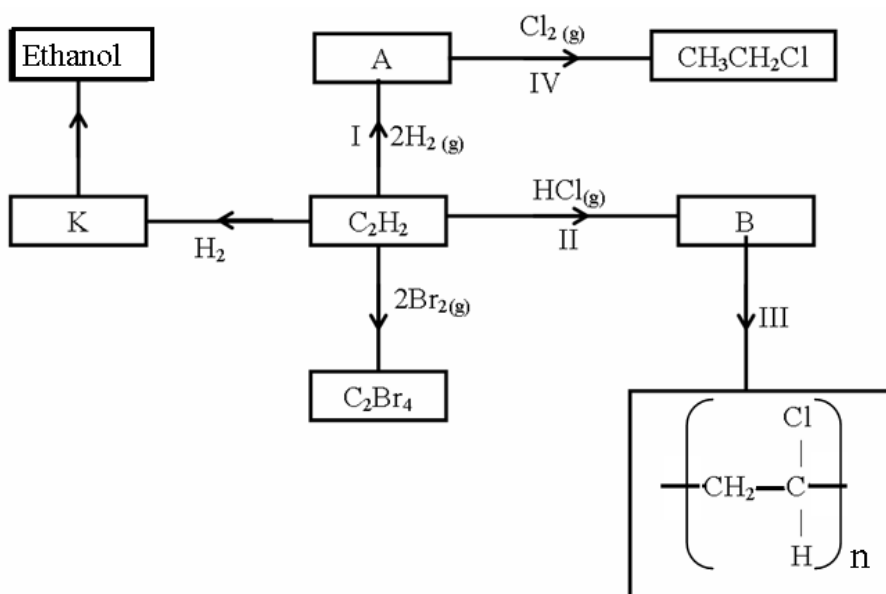
(i)Identify the catalyst used in step I   (½ mark)

Uv light

(ii)Name the compounds A and B   (2 marks)

A   *ethane*   B   *1-chloroethane*

(iii)Give one disadvantage of compound formed in step III   (1mark)

It is non biodegradable hence causes environmental pollution.any one

(iv)Name the reactions taking place at steps: (1mark)

I   *hydrogenation*   IV   *halogenation*

(v)Describe how substance K is converted to ethanol   (2marks)

-add concentrated sulphuric (vi) acid to ethane to form ethylhydrogensuplphate

$C2H4_{(g)} + H2SO4_{(l)} \longrightarrow C2H5OSO3H_{(aq)}\sqrt{}^1$
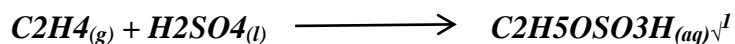
-add water to the mixture.ethylhydrogensulphate is hydrolysed to ethanol
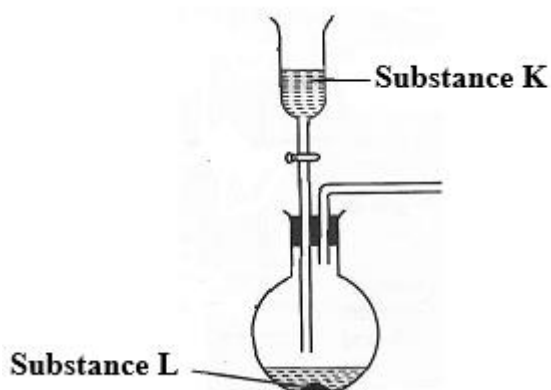
$CH3CH2OSO3H_{(aq)} + H2O_{(l)} \longrightarrow CH3CH2OH_{(aq)} + H2SO4_{(aq)}\sqrt{}^1$

4. The set-up below can be used to generate a gas.

(a) (i) Complete the table below giving the names of substance **K** and **L** if the gases generated
are carbon (IV) oxide and carbon (II) oxide.   (2marks)

Substance	Carbon (IV) oxide	Carbon (II) oxide
K	**Dilute Hydrocloric acid/HCl** $\checkmark$½	**Ethandioic acid/Methanoic acid** $\checkmark$½
L	**Calcium carbonate/CaCO3** $\checkmark$½	**Conc. H2SO4** $\checkmark$½

(ii) Complete the diagram to show how a sample of carbon (II) oxide can be collected.

(2marks)

Overwater nethod ✓ 1, workability✓ 1

NOTE

- **With ethan dioic pass the gas Potassiun hydroide or Sodium hydroide**

(iii) State two ways that can be used to distinguish carbon (IV) oxide from carbon (II) oxide? (2 mks)

Method 1

- Pass the gas over lime water ✓ 1 forms a white ppt with carbon iv oide ✓½ and no white ppt with carbon ii oide. ✓½

Method 11

-Introduce a burning candle the flame✓ 1 will go off with carbon iv oide ✓½ and not with carbon ii oxide. ✓½

Method II1

-ignite both gases

- Carbon (IV) oxide does **not** burn/ignite

- Carbon (II) oxide burn with a blue non-sooty flame.

(b) (i) In an experiment, carbon (IV) oxide gas was passed over heated charcoal held in a combustion tube. Write a chemical equation for the reaction that took place in the combustion tube. (1 mark)

$$CO_2 (g) + C (g) \longrightarrow CO (g)$$

(ii) State **one** use of carbon (II) oxide. (1 mark)

- **In etraction of metals as a reducing agent**

- **as a fuel in water gas**

(c) The following set ups were used by Form Two students. Study and use them to answer the questions that follow.

SET I   Bulb   SET II   Bulb
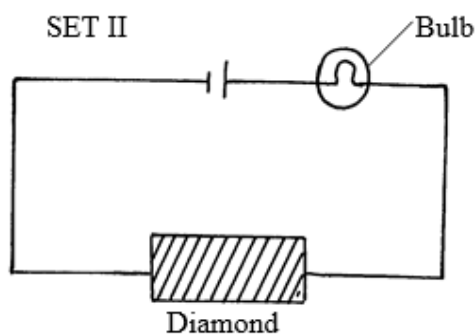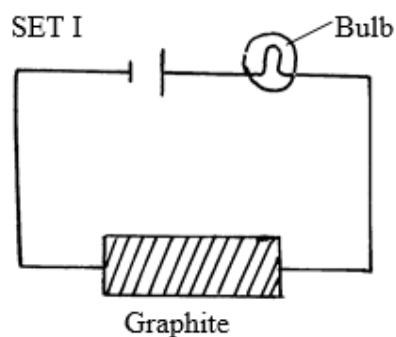
Graphite   Diamond

State and explain the difference in observation made in set up I and II above.(3 marks)

- **Bulb lights in step 1✓ 1 , graphite has delocalized electrons that conducts electricity. ✓½**
- **Bulb does not light in step 11✓ 1 , diamond lacks delocalized electrons. ✓½**

5.(a) Define the term solubility.   (1 mark)
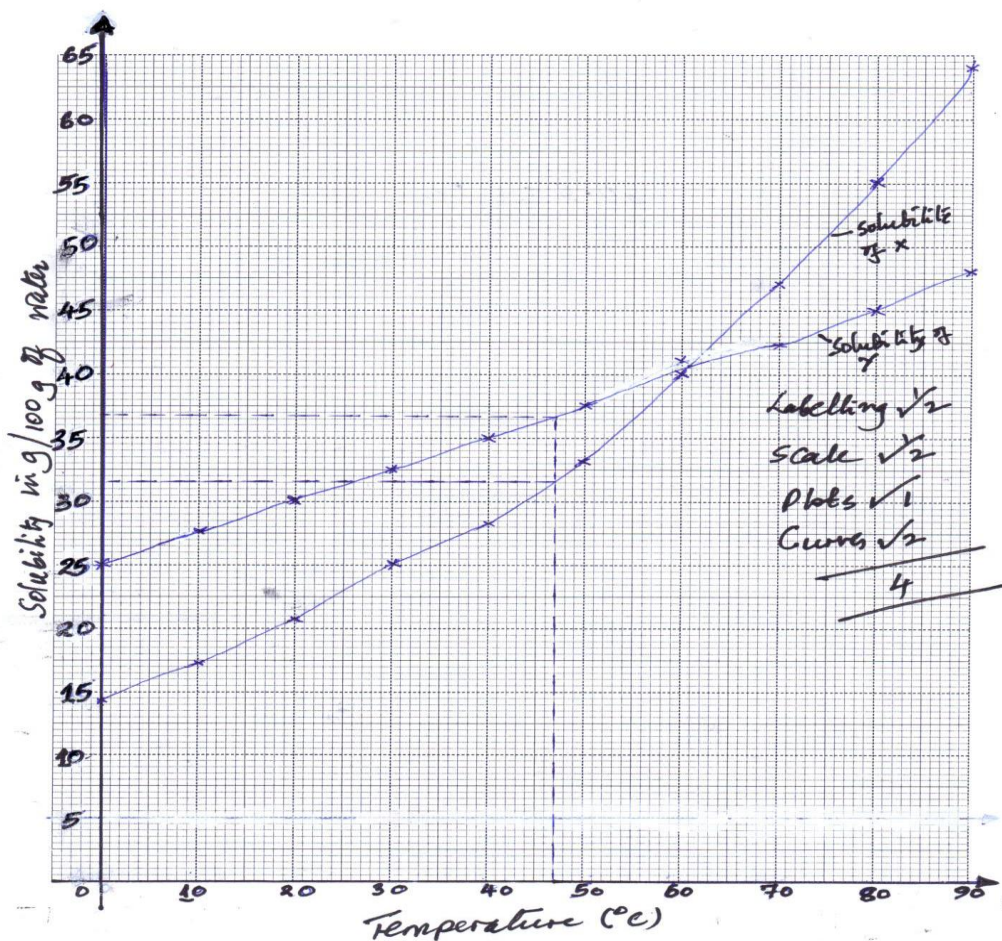
Solubility is the maximum mass of solute that dissolves in 100 g of a solvent at a particular temperature.

(b)In an experiment to determine the solubilities of two salts X and Y at different temperatures, a candidate recorded her observations as shown below.

Temperature (ºC)	0	10	20	30	40	50	60	70	80	90
Solubility of X in g/100 g of H_2O	14.3	17.4	20.7	25.0	28.5	33.3	40.0	47.0	55.0	64.0
Solubility of Y in g/100 g of H_2O	25.0	27.5	30.0	32.5	35.0	37.6	40.1	42.4	45.0	48.0

(a)On the same axes plot the solubility curves of X and Y.   (4 marks

The graph shows solubility curves with y-axis "Solubility in g/100 g of water" ranging from 5 to 65, and x-axis "Temperature (°C)" ranging from 0 to 90. Two curves are plotted: "Solubility of X" and "Solubility of Y". Marking notes on the graph read: Labelling ½, Scale ½, Plots 1, Curve ½, total 4.

(b) From your graph to determine;

(i) The solubility of X and Y at 47 °C

Solubility of X   (1 mark)

X: 31.5 (±0.2) g/100g of water

Solubility of Y   (1 mark)

Y: 36.6 (± 0.2 g/100g of water

(ii) The temperature at which the two salts are soluble in water. (1 mark)

60.5 ±1 °C

(c) If 60g of X is dissolved in 100 g of water and heated to 90°C, calculate the amount of salt that crystallized out if cooled to 20 °C. (1 mark)

60-20.7 = 39.3 g

(d) State what would happen if a mixture of 55g of salt X in 100 g of water and 30 g of Y in 100 g of water were cooled from 90 °C to 70 °C. (3 marks)

13 g (1 mk) of X will crystallize, salt Y will be in solution (1 mk) . The solubility of X is lower than the mass dissolved while that of N is higher than the mass dissolved.(1 mk)

(e)State one application of solubility.(1 mark)

Fractional crystallization (any one)

6. a) a) An ore is suspected to contain Lead metal. Describe the process that can be used to confirm the presence of Lead in the ore. (3mks)

- ***Crush the ore to fine powder to increase surface area/reduce particle size. ✓½***
- ***Add nitric(V) acid to free the ions. ✓½***
- ***Filter. Retain the filtrate✓½***
- ***Add excess aqueous ammonia to a sample of filtrate. ✓½***
- ***A white precipitate insoluble in ecess confirms presence of either Al^{3+} or Pb^{2+}.✓½***
- ***Add sodium sulphate,dilute sulphuric(VI)to another portion of filtrate. White precipitate confirms presence of Pb^{2+}. ✓½***

Or

Add potassium iodide to another portion of filtrate.

yellow precipitate confirms presence of Pb^{2+}.

(b) The diagram below shows students set-up for the preparation and collection oxygen Gas
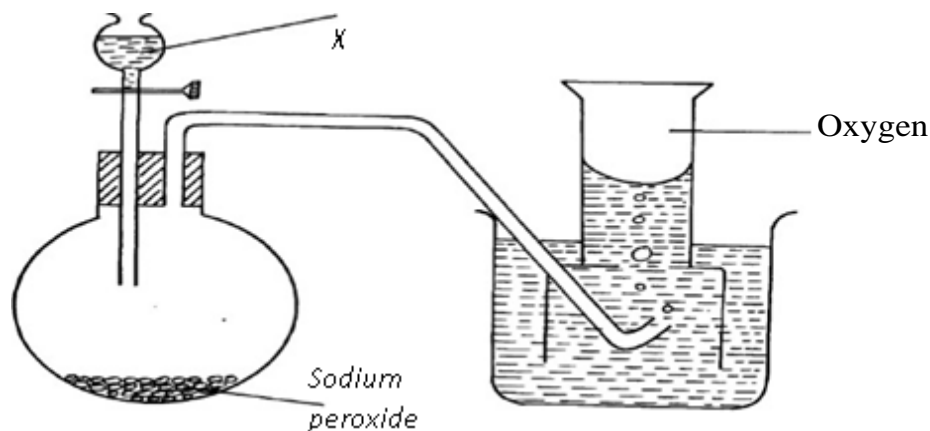
(i) Name substance X used *(1mark)*

- ***Water ✓1***

(ii) Write an equation to show the reaction of sodium peroxide with the substance named

$$2Na_2O_2 \text{ (s)} + 2H_2O(l) \longrightarrow 4 NaOH(aq) + O_{2(g)} \checkmark 1$$
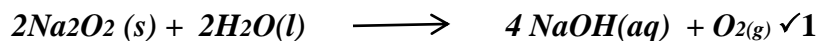
(iii) Name a two other reagents that can be used to prepare oxygen gas in the laboratory using the apparatus shown above. (1 mark)

- *Hydrogen peroide* $\checkmark$½
- *Manganese iv oxide* $\checkmark$½

(iv) How would you confirm that the gas produced was oxygen. (1mark)

- Introduce a glowing splint into the gas jar $\checkmark$½

- It rekindles / produces a flame $\checkmark$½

(c) Apiece of cleaned magnesium ribbon was burnt in air to form a residue **P** which was then dissolved in water to form solution Q and a colourless gas R. A blue and red litmus paper was

(i) State the components of residue P. (1m)

- Magnesium oxide $\checkmark$½

- Magnesium nitride $\checkmark$½

(vi)   Identify colourless gas R ……………………………………….....................(1mark)
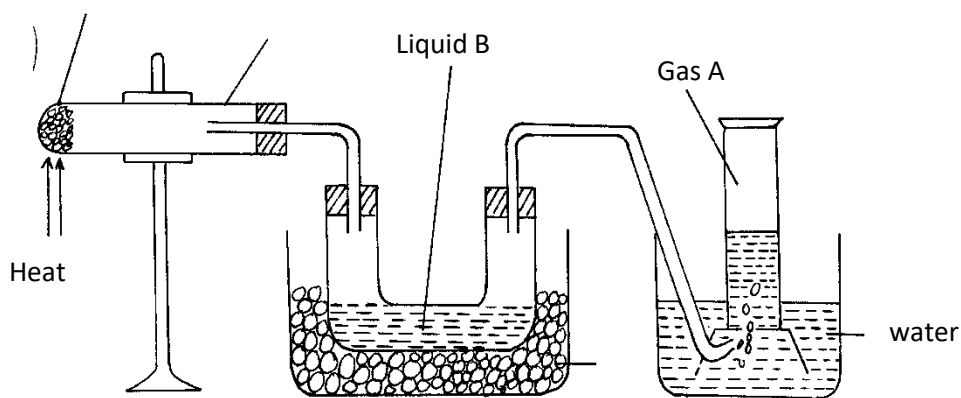
(vii)   Write an equation for the formation of solution Q and gas R. (1mark)
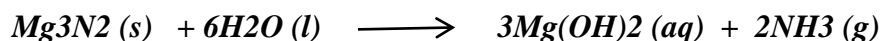
$$Mg_3N_2 \text{ (s)} + 6H_2O \text{ (l)} \longrightarrow 3Mg(OH)_2 \text{ (aq)} + 2NH_3 \text{ (g)}$$

7. The diagram below shows a set-up of apparatus that can be used to prepare nitrogen (IV) oxide. Study it and use it to answer the questions that follow

Lead(II)nitrate   boiling tube

(a) (i) Write the equation for the reaction that takes place in the boiling tube.　　(1 mark)

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

(ii) State the observations made in the boiling tube.　　　　　　(2 marks)

- brown fumes of NO_2

-solid residue is red when hot but on cooling it becomes yellow

(iii) Explain why lead (II) nitrate is preferred over other metal nitrates in this experiment.

Lead (II) nitrate crystalises without water of crystalisation that would interfere with the NO_2 formed

(iv) Describe how gas A can be identified.　　　　　　(1 mark)

By using a glowing splint. Gas A relights a glowing splint
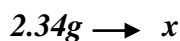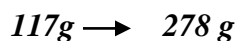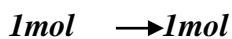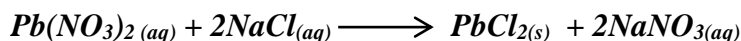
(b) (i)Name liquid B　　　　　　(1 mark)

dinitrogentetraoxide

(ii) Write a chemical equation to show how liquid B is formed in this experiment.　　(1mark)

$2NO_{2(q)} \xrightarrow{\ cool\ } N_2O_{4(l)}$

(c) 　　(i) In another experiment, excess aqueous lead (II) nitrate solution was reacted with a solution which contained 2.34g of sodium chloride. Calculate the mass of precipitate formed in this reaction.　　　　　　(3 marks)

(Pb = 207, Cl = 35.5, Na = 23)

$Pb(NO_3)_{2\ (aq)} + 2NaCl_{(aq)} \longrightarrow PbCl_{2(s)} + 2NaNO_{3(aq)}$

1mol $\longrightarrow$1mol

117g $\longrightarrow$ 278 g

2.34g $\longrightarrow$ x

$x = \underline{2.34} \times 378$

$\qquad 117$

$\qquad = 5.56g \text{ of } PbCl_2$

(ii) Write an ionic equation for the reaction that takes place when nitrogen (IV) oxide reacts with aqueous sodium hydroxide. (1 mark)

$2OH^-_{(aq)} + Cl_{2(g)} \longrightarrow Cl^-_{(aq)} + OCl^-_{(aq)} + H_2O_{(l)}$

Penalise fully if wrong state symbols or state symbols are missing.

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