**BSJE 2021**

**Kenya Certificate of Secondary Education (KCSE)**

**233/2 - CHEMISTRY - Paper 2**

**(Theory)**

**Nov/Dec. 2021 – 2 Hours**

**Name: …………………………………..… Index No: ……….………...Stream ……..**

**School**: ………..…………………………………………………………………………...

**Candidate’s** **Signature**: ..………………………………...…. **Date**:……………………

**Instructions To Candidates**

1. *Write your name and index number in the spaces provided above*
2. *Sign and write the name of your school in the spaces provided*
3. *Answer* ***all*** *the questions in the spaces provided*
4. ***Non-programmable*** *silent electronic calculators and KNEC mathematical tables may be used*
5. *All working* ***must*** *be clearly shown where necessary*
6. *This paper consists of* ***16 printed pages***
7. ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***
8. ***Candidates should answer the questions in English.***

**For Examiner's use only**

|  |  |  |
| --- | --- | --- |
| **Question** | **Max. Score** | **Score** |
| **1** | **11** |  |
| **2** | **11** |  |
| **3** | **12** |  |
| **4** | **12** |  |
| **5** | **11** |  |
| **6** | **12** |  |
| **7** | **11** |  |
| **TOTAL SCORE** | **80** |  |

1. The table **below** shows the ions of elements **W, X, Y**, **Z,** and their electron arrangement.

The letters do not represent the actual symbols of the element.

|  |  |
| --- | --- |
| **Ion** | **Electron configuration** |
| **W -** | **2.8.8** |
| **X2+** | **2.8.8** |
| **Y3+** | **2.8** |
| **Z2-** | **2.8** |

1. Which **two** elements belong to the same period? Give a reason. (2 marks)

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1. In which group of the periodic table does **Y** belong? (1 mark)

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1. Write the formula of the compound formed between **W** and **X** (1 mark)

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1. What type of bond is formed between **W** and **X**. Explain. (2 marks)

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1. What is a coordinate bond? (1 mark)

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1. Draw a dot (**•**) cross (×) diagram to show bonding in the Ammonium ion (NH4+)

(N = 7, H = 1) (2 marks)

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1. Aluminum chloride and sodium chloride are both chlorides of period 3 elements.

Use this information to explain the following observations.

1. A solution of **A1CI3** in water turns blue litmus paper red while that of **sodium chloride** does not (1 mark)

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1. The melting point of **sodium chloride** (801°C) is higher than that of **AlC13** (180°C).   
    (1 mark)

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1. Give the names of the following compounds:
2. **CH3COOCH2CH3** (1 mark)

………………………………………………………………………………………………

1. **CH3CHCHCH2CH3**  (1 mark)

………………………………………………………………………………………………

1. Study the information in the table below ad answer the questions that follow.

|  |  |
| --- | --- |
| **No. of carbon atoms per molecule** | **Relative molecular mass of hydrogen** |
| 2 | 28 |
| 3 | 42 |
| 4 | 56 |

1. Write the general formula of the hydrocarbons in the table. (1 mark)

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1. Predict the relative molecular mass of the hydrocarbon with *5* carbon atoms. (1 mark)

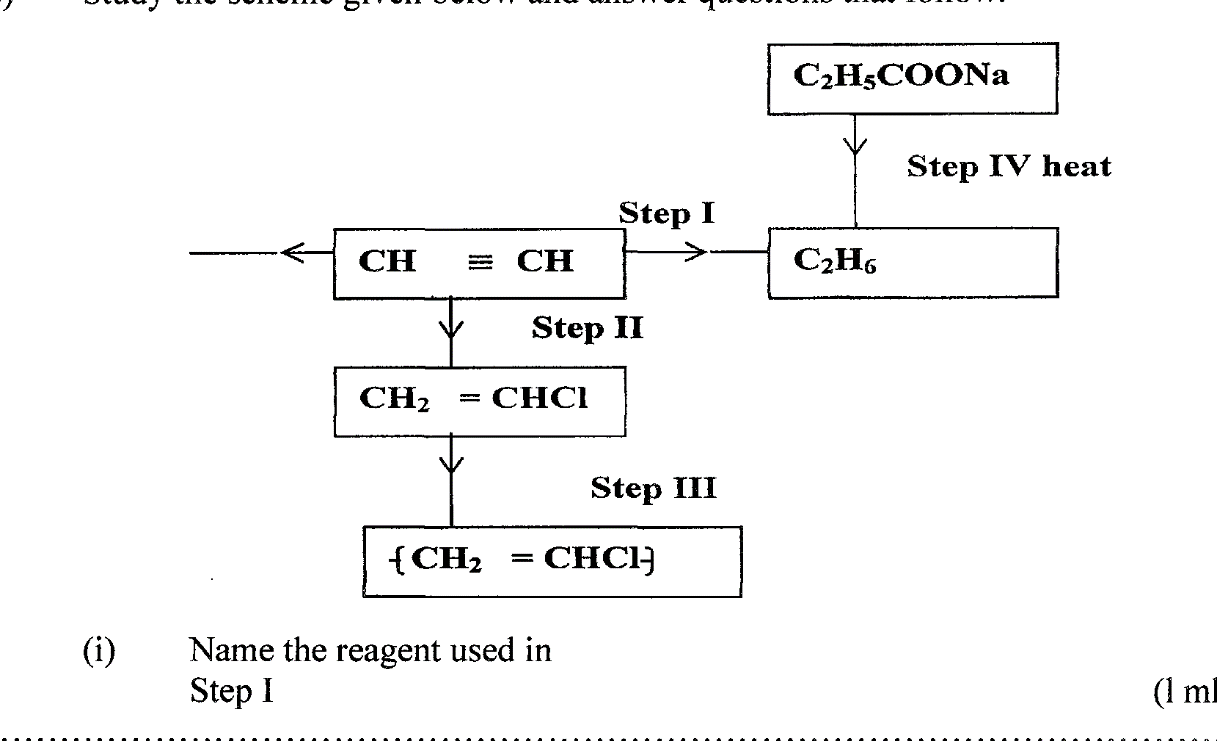
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1. Determine the molecular formula of the hydrocarbon in **ii)** above and draw its structural formula. (2 marks)

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1. Study the scheme given below and answer questions that follow.



1. Name the reagent used in

Step I (1 mark)

………………………………………………………………………………………………  
Step II (1 mark)

………………………………………………………………………………………………  
Step III (1 mark)   
………………………………………………………………………………………………

1. Write an equation for complete combustion of **CH CH** (1 mark)

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1. Explain **one** disadvantage of the continued use of items in **step III**. (1 mark)

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1. The solubilities of potassium nitrate and potassium bromide at different temperatures was determined. The following data was obtained.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Temperature 0C** | | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| **Solubility g/100g H2O** | **KNO3** | 5 | 15 | 26 | 43 | 61 | 83 | 105 | 135 | 165 |
| **KBr** | 50 | 55 | 60 | 65 | 70 | 77 | 85 | 90 | 95 |

1. Plot a graph of solubility against temperature for both salts on the same axis (3 marks)



1. What was the solubility of each salt at 650C (1 mark)

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1. 100g of a saturated solution of potassium nitrate at 700C was cooled to 200C. What mass of the salt will be crystallized? (2 marks)

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1. Study the flow chart below and answer the questions that follow.

**Solid A**

**and**

**Gas B**

**Metal carbonate**

**Heat**

**Dil. HCl**

**Solution**

**C**

**Deep blue solution E**

**Solid D**

**A few drops of NH3(aq)**

**Excess of**

**NH3(aq)**

1. Write an equation for the formation of solid **A** and gas **B**. (1 mark)

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

1. Name:

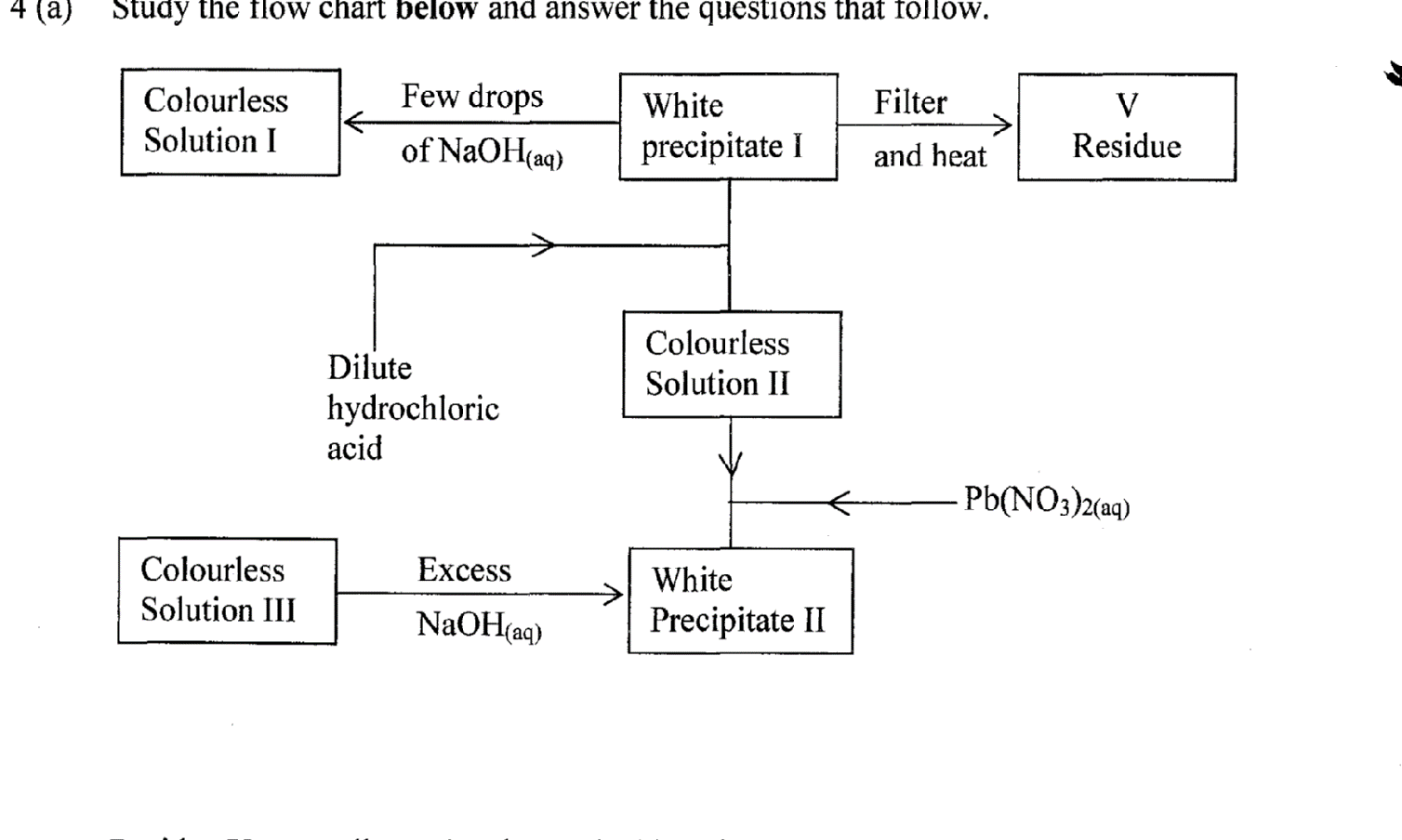
Solution **C** …………………………………………………………...…… (1 mark)

Solid **D** ………………………………………………………….………… (1 mark)

1. Write the formula of the complex ion in solution **E.** (1 mark)

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

1. Study the flow chart **below** and answer the questions that follow.

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**Residue V** was yellow when hot and white when cold. Identify:

1. White precipitate **I.**  (1 mark)

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

1. Solution **II.**  (1 mark)

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1. **Residue V**. (1 mark)

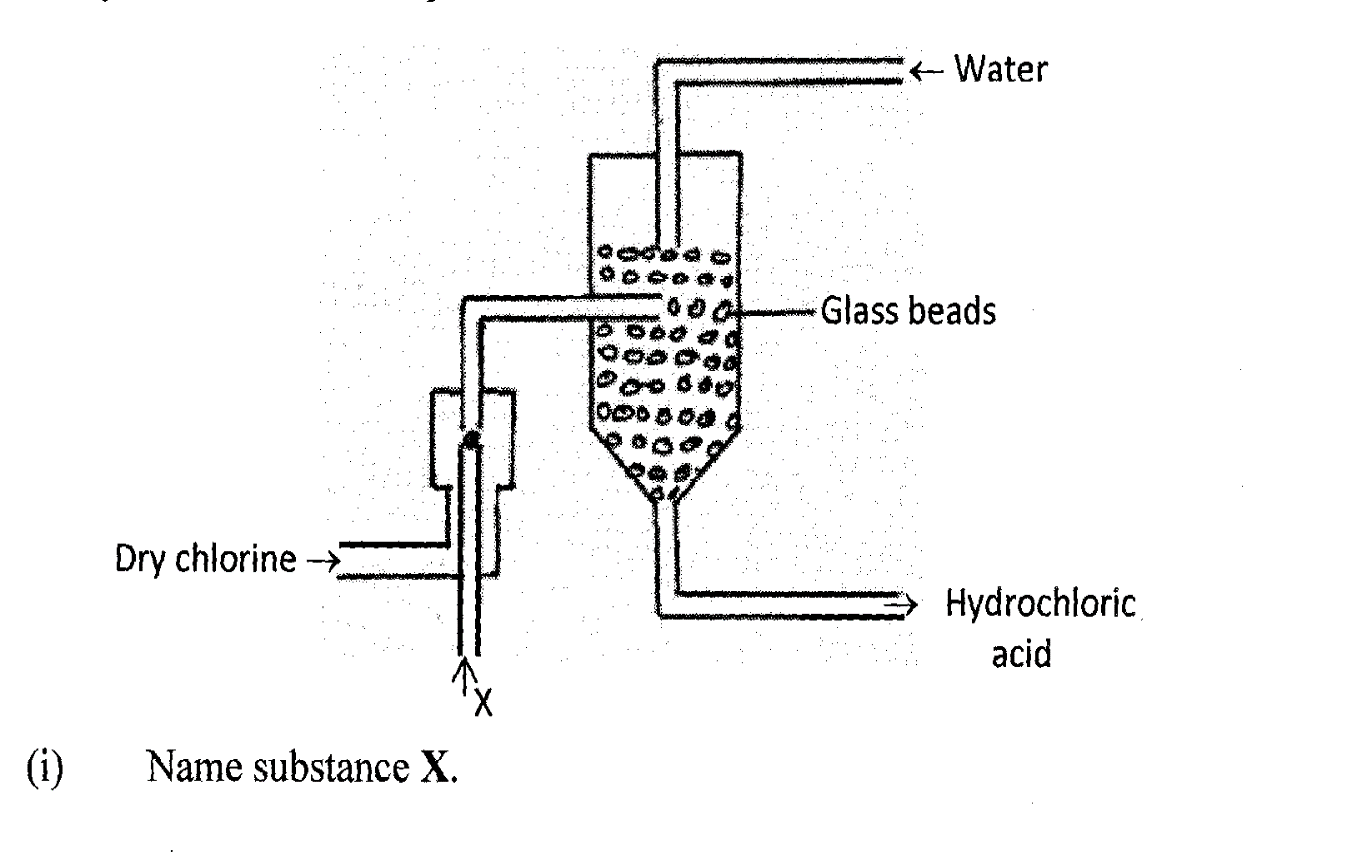
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1. Write an ionic equation for the reaction of **solution** **II** with **Pb(NO3)2 (aq)**  (1 mark)

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1. Write observations that would be made when ammonia solution is added drop-wise till in excess to the colourless **solution II** (l mark)

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1. The diagram **below** represents a set-up for large scale manufacture hydrochloric acid. Study it and answer the questions that follow:
2. Name **substance** **X.**  (1 mark)

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1. What is the purpose of glass beads? (1 mark)

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1. Give **one** source of **substance X** used in the above process. (1 mark)

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1. Give **two** uses of hydrochloric acid. (2 marks)

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1. The table below shows the ammeter readings obtained when two different electrolytes the same concentration was tested.

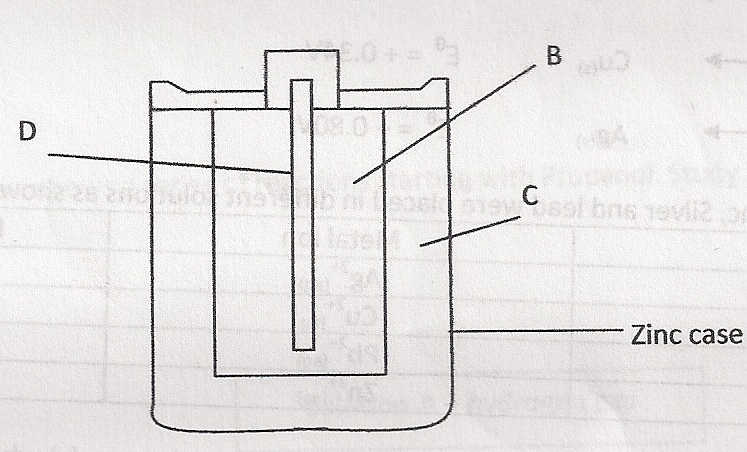
|  |  |
| --- | --- |
| **Electrolyte** | **Ammeter reading (Amps)** |
| Hydrochloric acid | 4.0 |
| Ethanoic acid | 1.2 |

Why does Ethanoic acid give a lower ammeter reading? Explain your answer (2 marks)

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

1. The figure below shows parts of Le’Clanche cell (dry cell).



1. Name:
2. Substance **D** (1 mark)

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

1. Mixture **B** (1 mark)

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

1. Electrolyte **C** (1 mark)

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

1. In the cell, the electrolyte is a paste. Explain. (1 mark)

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1. The following reaction occurs when the cell is in use.

MnO2

Zn(s) + 2NH4+(aq) Zn2+(aq) + 2NH3(aq) + H2O(l)

Given that:

Zn2+(aq) + 2e- Zn(s) EФ = -0.76V

MnO2

2NH+(aq) + 2e- 2NH3(g) + H2O(l) EФ = +0.74V

Calculate the e.m.f. of the cell. (2 marks)

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1. Use the standard reduction electrode potentials given below to answer the questions that follow.

Zn2+(aq) + 2e- Zn(s) EФ = -0.76V

Pb2+(aq) + 2e- Pb(s) EФ = -0.13V

Cu2+(aq) + 2e- Cu(s) EФ = +0.34V

Ag2+(aq) + 2e- Ag(s) EФ = +0.80V

The metal copper, zinc, silver and lead were placed in different solutions as shown:

|  |  |  |
| --- | --- | --- |
| **Metal** | **Metal ion** | **Reaction / No reaction** |
| Cu | Ag2+(aq |  |
| Zn | Cu2+(aq) |  |
| Ag | Pb2+(aq) |  |
| Pb | Zn2+(aq) |  |

1. Indicate in the table with a tick (√) where a reaction occurs and a cross (×) where no reaction occurs. (2 marks)
2. Identify the strongest reducing agent. (1 mark)

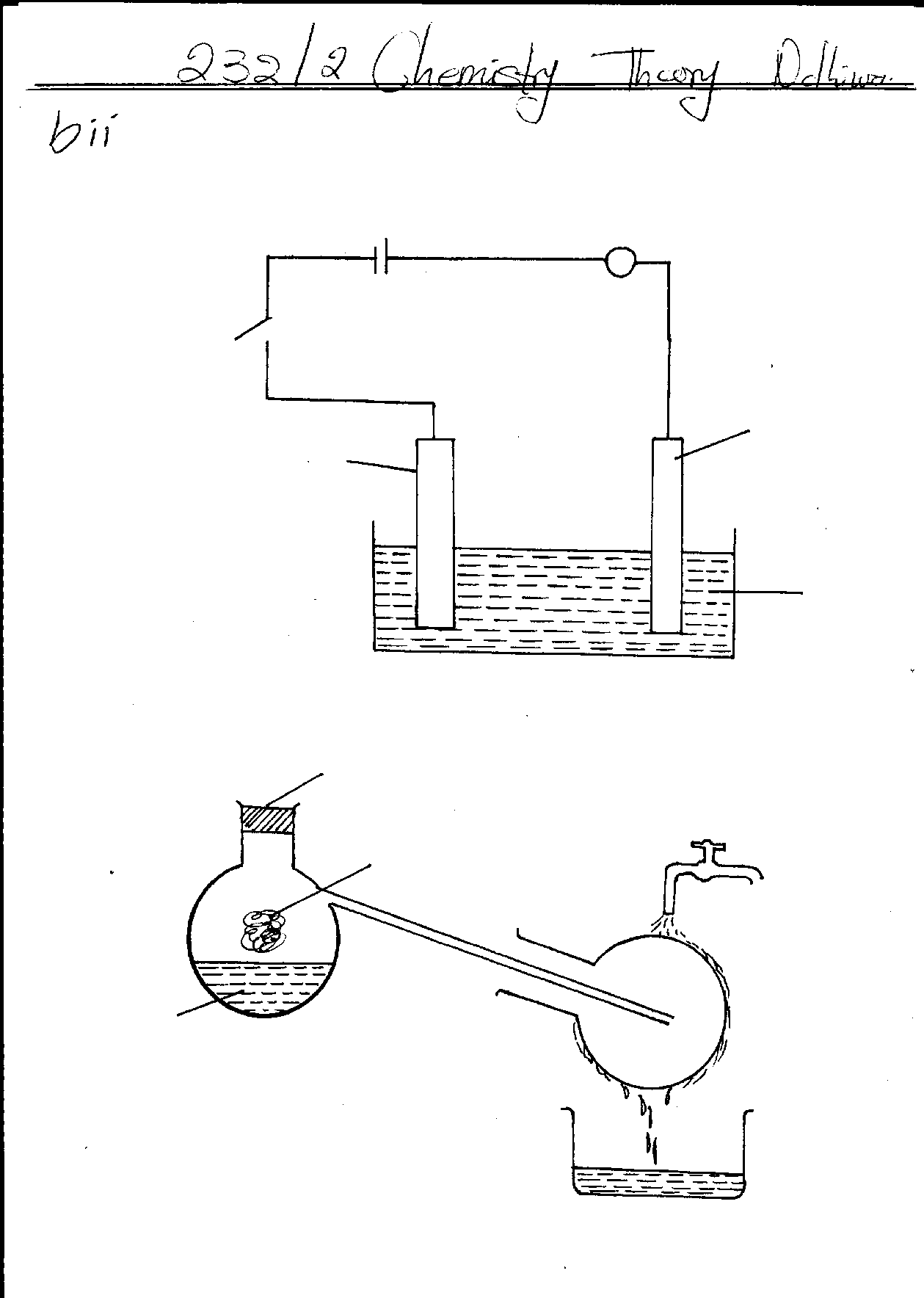
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1. Draw a well labeled diagram of the electrochemical cell when copper and magnesium half cells are connected. (3 marks)

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1. On the diagram you have drawn in **e i)** above, label the anode and the cathode and show the direction of flow of electrons. (2 marks)
2. The set up below is used to prepare nitric acid



**Glass cork**

**Mixture X**

**Red brown fumes**

1. Name the reagents in **mixture** **X** (1 mark)

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1. Write an equation for the reaction which takes place in the glass retort (1 mark)

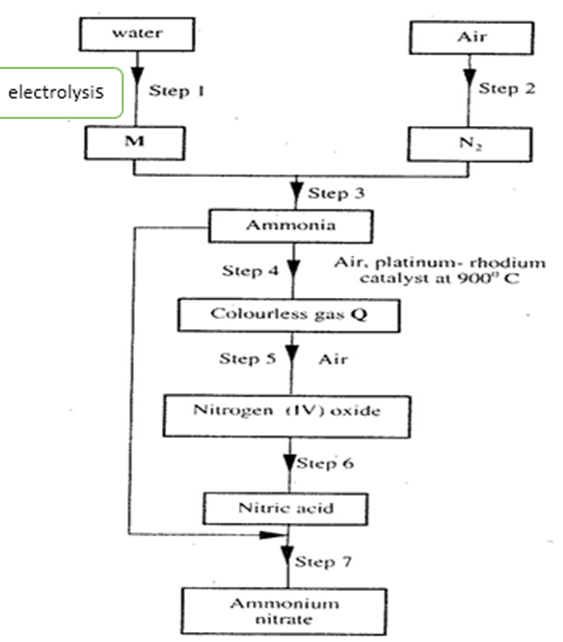
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1. Explain the reason why the apparatus used is all glass and why heating should be gentle as possible. (2 marks)

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1. Study the flow chart below and answer the questions that follow.



1. Name **element M**. (l mark)

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1. Why is it necessary to use excess air in **step 4**? (1 mark)

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1. Identify **gas Q** (l mark)

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1. Write an equation for the reaction in **step 7** (l mark)

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1. Give **one** use of ammonium nitrate. (l mark)

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1. Ammonia can be formed by the reaction shown below

N2 (g) + 3H2 (g)  2NH3 (g) ; ∆H = - 92kJ/mol

State and explain what happens if:

1. The volume of the system is increased (1 mark)

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

1. Cold water is poured over the system (1 mark)

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1. In an experiment to determine the heat of combustion of compound **X**, a pupil used heat from the burning compound of **X** to heat 100cm3 of water in a beaker. He obtained the following results:

Volume of water in the beaker = 100cm3

Initial temperature of water = 17oC

Final temperature of water = 420C

Initial mass of burner + compound X = 10.5g

Final mass of burner + compound X = 10.2g.

1. Determine the mass of the compound burnt? (1 mark)

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

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

1. Calculate the rise in temperature? (1 mark)

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

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

1. Determine the amount of heat produced by the compound (2 marks)

(specific heat capacity 4200Jg-1K-1, density of H2O = 1g/cm3)

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1. Calculate the molar heat of combustions of **compound X** (2 marks)

(R.M.M. of X = 256)

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1. Use the following thermochemical equations below to answer the questions that follow.

C2H6 (g) + 7/2 O2 (g) 2CO2(g) + 3H2O (s) ∆H1, = -1560kJmol-1

C (graphite) + O2(g)  CO2 (g)  ∆H2 = - 394 kJ mol-1

H2 (g) + ½ O2(g) H2O(l) ∆H3 = - 286 kJ mol-1

1. Calculate the molar enthalpy of combustion of C2H6. (2 marks)

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1. Draw an energy level diagram for the reaction represented by the first equation above (3 marks)

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