NAME………………………………………………………………………………………index no........................................

Candidates signature ……………………………………………………………Date…………………………

**233/2**

**CHEMISTRY**

**PAPER 2**

**(THEORY)**

**DECEMBER 2021**

**TIME: 2 HOURS**

**MOMALICHE 4, CYCLE 8**

***Kenya Certificate of Secondary Education (K.C.S.E.)***

**INSTRUCTIONS TO CANDIDATES**

* Write your name and Index number in spaces provided above.
* Sign and write the date of examination in the spaces provided above
* Answer all the questions in the spaces provided above.
* KNEC Mathematical tables and silent electronic calculators may be used.
* All working must be clearly shown where necessary.
* Candidates should answer the questions in English.

**FOR EXAMINERS USE ONLY**

|  |  |  |
| --- | --- | --- |
| **Question** | **Maximum score** | **Candidate’s score** |
| 1 | 14 |  |
| 2 | 10 |  |
| 3 | 12 |  |
| 4 | 12 |  |
| 5 | 12 |  |
| 6 | 10 |  |
| **7** | 10 |  |
| **Total score** | **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 a section of the periodic table. The letters do not represent the actual symbols of the elements.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | |  | |  | |  | |  | |  | |  |
| **K** | **L** |  | |  | |  | | **M** | |  | | **N** | **P** |
|  | **Q** |  | | **R** | | **S** | |  | | **T** | | **V** |  |
| **W** |  |  | |  | |  | |  | |  | |  |  |

1. Name the family into which element P belongs to **( 1mk)**

**………………………………………………………………………………………………………………………………………………..**

**……………………………………………………………………………………………………………………………………………....**

1. Which two elements form the most stable carbonates **( 2mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. With a reason ,identify elements in period 3 with largest atomic radius **( 2mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. Write the formula of the compound formed between Q and M **( 1mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. State two uses of element **R** and for each use , state property of element **R** that makes its possible for the use
2. Use ( **1mk**)

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

Property (**1 mk)**

………………**………………………………………………………………………………………………………………………………**

1. Use **( 1mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

Property **(1mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. Using dots **(.)** and cross **(X),** show bonding in the compound formed between **R** and oxygen ( **2 mks)**
2. In terms of structure and bonding explain why the oxides of element T has relatively low boiling points ( **2mks**)

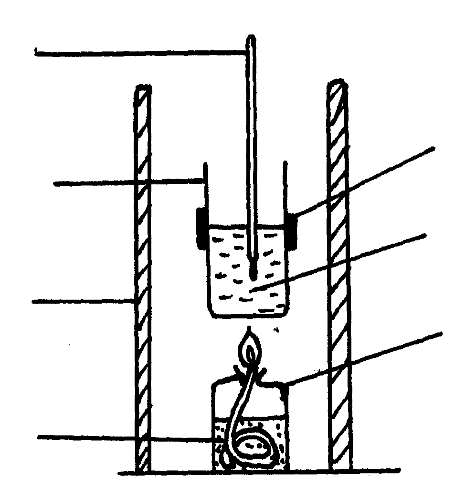
**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. The diagram below shows the set-up of the apparatus used by a student to determine the enthalpy change of combustion of ethanol. The heat produced by burning fuel warms a known mass of water.



**Thermometer**

**Metal calorimeter**

**Clamp**

**Spirit burner**

**Water**

**Draught shield**

**Liquid fuel**

Results

Volume of water in the beaker = 500 cm3

Initial temperature of water= 120C

Final temperature of water = 31.50C

Mass of ethanol burnt = 1.50g

Density of water = 1 g/cm3

Specific heat capacity = 4.2 Jg-1K-1

1. Define molar heat of combustion. ***(1* MK*)***

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. (i) Calculate the heat required to raise the temperature of the water from 120C to 31.50C. *(***2 mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

(ii) Find the molar enthalpy of combustion of ethanol. **(2 mks***)*

1. An accurate value for ΔHC of ethanol is -1368 kJmol-1. State **two** sources of errors for the low figure obtained. **(2 mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**……………………………………………………………………………………………………………………………………………**

1. Draw an energy level diagram for the combustion of ethanol. **(2 mks***)*
2. State one factor that one may consider when choosing kerosene as a fuel in Eldoret town. **(1 mk)**

**………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………**

1. a. Name the following compounds **( 3mks)**
2. **CH3CH2CH2COOH**

**…………………………………………………………………………………………………………………………………......**

1. **H2C Br– CH(CH3) – CH2 – CBr = CH – CH3**

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

1. **CH3CH2COOCH2CH3**

**……………………………………………………………………………………………………………………………………**

**……………………………………………………………………………………………………………………………………**

**b.**  two types of detergents P and Q can be represented as

**P; OSO3-Na+**

**Q**; COONa+

1. Identify each type of the detergent **( 2mks)**

**P………………………………………………………………………………………………………**

**Q……………………………………………………………………………………………………..**

1. Which of the two detergent is the best to use with hard water ,give reason

**( 2mks)**

**………………………………………………………………………………………………………………………………………… …….**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. State one disadvantage of detergent **P ( 1mk)**

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

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

1. State advantage of detergent **Q ( 1mk)**

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

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

c. an hydrocarbon can be represented as follows

**CH2=CH2**

1. Name the hydrocarbon **( 1mk**)

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

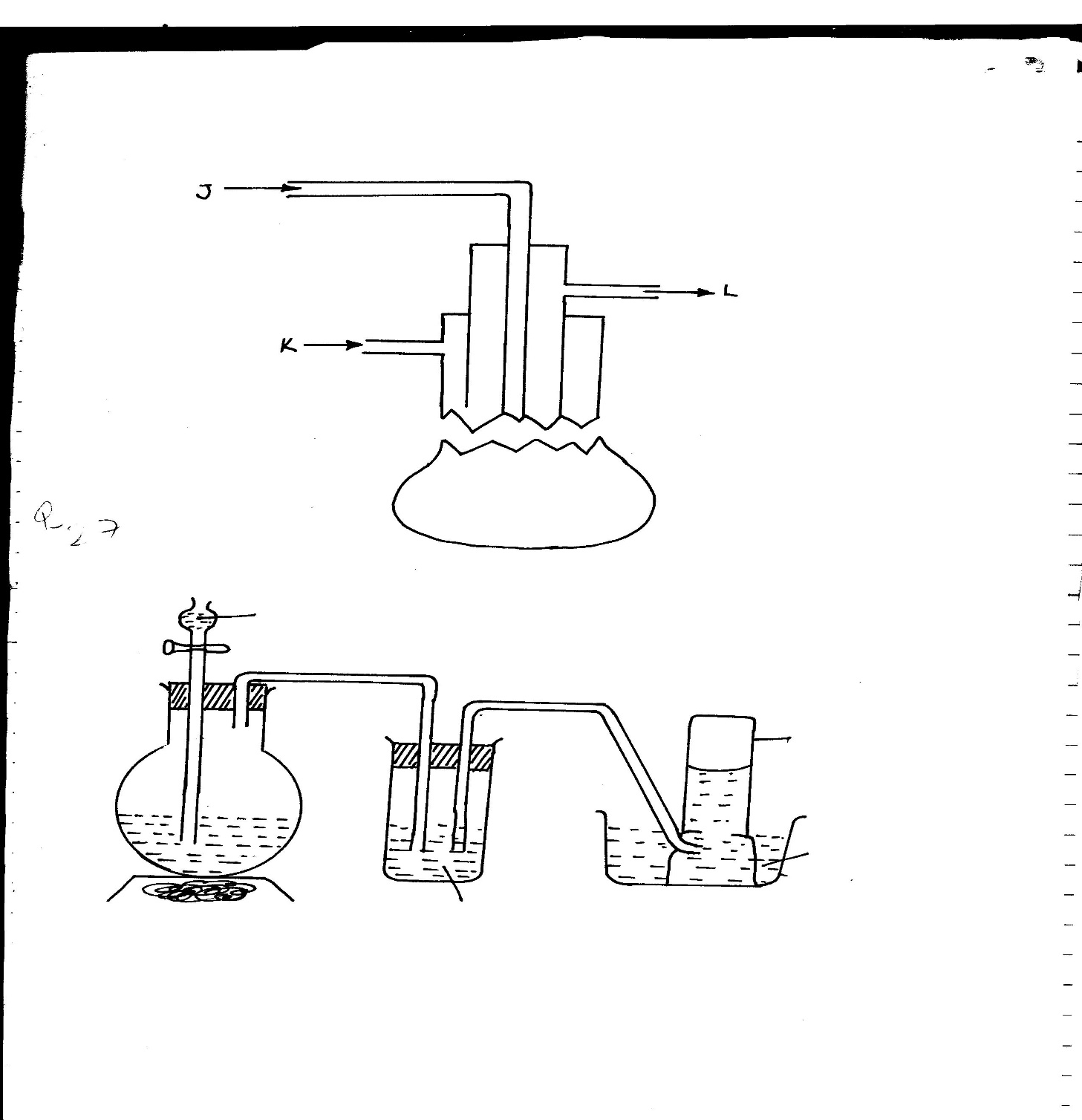
1. Name two reagents that can be reacted together to generate the hydrocarbon **( 2mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. a) Sulphur is extracted from underground deposits by a process in which three concentric pipes are sunk down to the deposits as shown below



**J**

**K**

**L**

1. Name the above process used to obtain sulphur from the underground deposits **( 1 mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. Name the substance passed through pipe (**2mks)**

A

**………………………………………………………………………………………………………………………………………………**

**B**

**………………………………………………………………………………………………………………………………………………..**

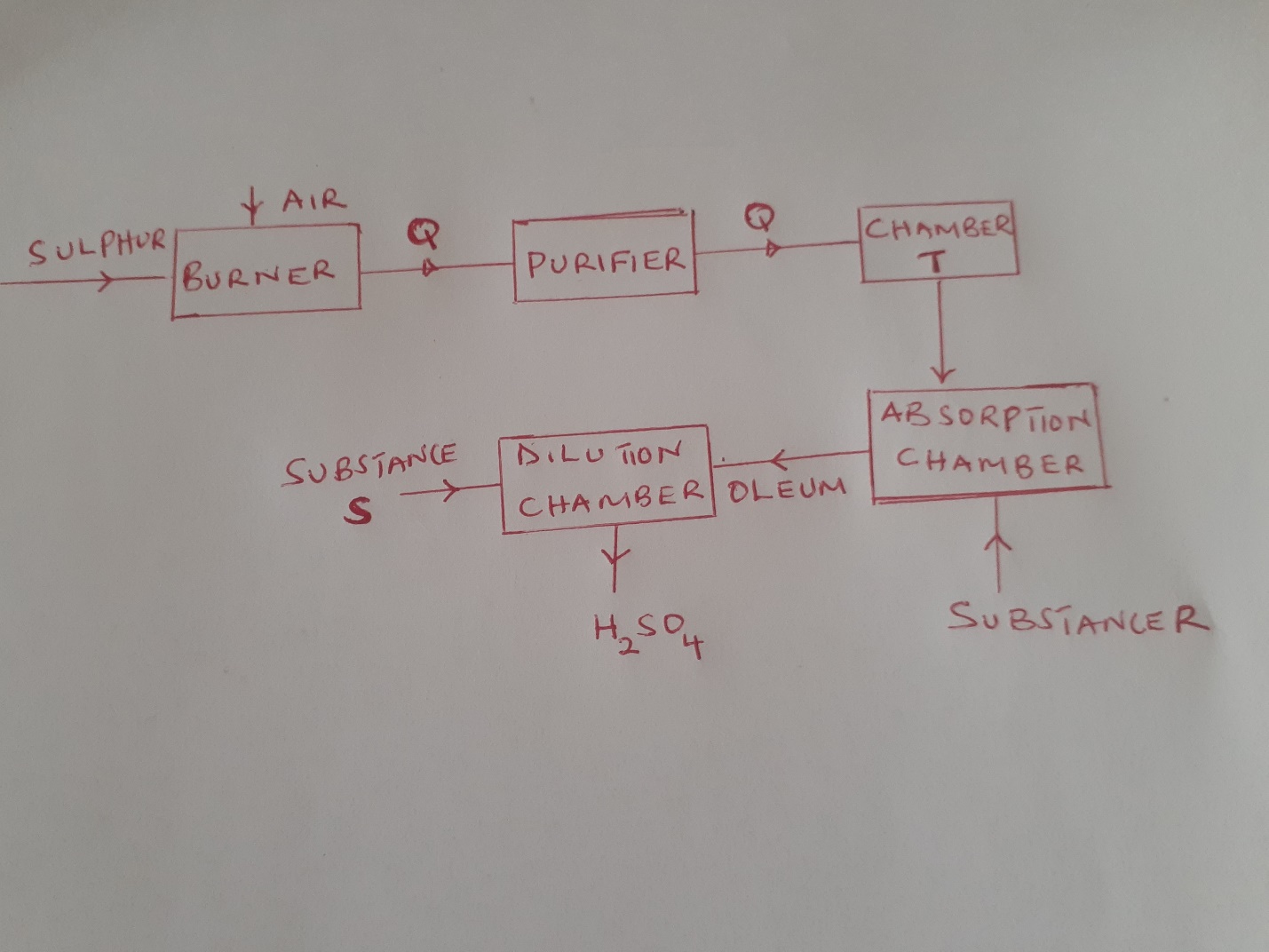
1. State two properties of sulphur that makes it possible to extract using the above process **( 2 mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**b.** Thediagram below shows the contact process used in the manufacture of concentrated sulphuric (VI) acid



1. Identify the following substance; **( 4 mks**)

a) **Q** formed in the burner

**………………………………………………………………………………………………………………………………………………**

1. Formed in Chambe**r** **T**

......................................................................................................................................................

1. **R**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. **S**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. Write the chemical equation occurring in the dilution chamber **( 1 mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. Why is it necessary to pass substance g through a purifier **( 1mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. State one use of sulphuric ( VI) acid **( 1 mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. (a) Define the term electrolysis **( 1mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

(b) State two function of the salt bridge during electrolysis ( **2mks**)

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

(c) The reduction potential of elements K,L,M and P are as given below

|  |  |
| --- | --- |
| **Half reaction** | **E0 (volts)** |
| K+ + e - K (s) | -1.46 |
| L2+  + 2e-  L(s) | +0.49 |
| P+ + e-  P(s) | -0.86 |
| M2+ 2e- M(s) | -2.69 |
| N+ + e- N(s) | +0.52 |

1. Which letter represents the, strongest reducing agent , give reason **( 2mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. Which two letters represents elements whose half cell would form an electrochemical cell with largest e.m.f **( 1 mk)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

1. Calculate the e.m.f of the cell formed in (ii) above **( 2mks)**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

(d) During the electrolysis of a molten chloride of metal q , a current of 0.25A was passed through the molten chloride for 2 hours and 10 minute .Given that 0.9 g of metal Q were deposited at the cathode

(i) Calculate the quantity of electricity passed **( 1mk**)

**………………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………………**

(ii) Charge carried by the ions of metal Q given that R.A.M of metal Q is 84 (**3 mks)**

1. Ammonia can be prepared in the lab by reaction of Calcium hydroxide and an ammonium salt.
2. Write an equation for the reaction that will take place. **(1 mk)**

**……………………………………………………………………………………………….......…**

**……………………………………………………………………………………………………...**

1. Calculate the volume of ammonia produced at room temperature and pressure given that 20g of calcium hydroxide reacted fully. )  **(2 mks)**
2. (i) Write an equation to show how ammonia is used to make phosphate fertilizer. **(1 mk)** **……………………………………………………………………………………………….......…**

**……………………………………………………………………………………………………...**

**……………………………………………………………………………………………………...** (ii) Determine the percentage by mass of Nitrogen in the above fertilizer. **(1 mk***)*

(iii) State the importance of using ammonium phosphate over urea as a fertilizer

**(1 mk)**

**……………………………………………………………………………………………….......…**

1. Describe how the presence of nitrate ions can be determined in a solution using concentrated Sulphuric (VI) acid as one of the reagents. **(3 mks)**

**……………………………………………………………………………………………….......…**

**……………………………………………………………………………………………………...**

**……………………………………………………………………………………………………...**

1. State ***one*** danger of continued use of Nitrogenous fertilizers.  **(1 mk)**

**……………………………………………………………………………………………….......…**

**……………………………………………………………………………………………………...**

**……………………………………………………………………………………………………...**

1. 1g of magnesium ribbon was reacted with hydrochloric acid at room temperature in order to investigate how the rate of reaction varies with time. The results obtained were recorded as shown below.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time (seconds) | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 |
| Volume of gas produced (cm3) | 0 | 10 | 20 | 26 | 32 | 35 | 38 | 39 | 40 | 40 |

1. (i) On the graph provided, plot a graph of volume of gas produced against time taken. Label the graph K. **(3 Mrk)**





(ii) From the graph determine the rate of production of the gas at 110 seconds. (**2 Mks)**

**.…………………………………………………………………………………………………………………………………………**

**…………………………………………………………………………………………………………………………………………**

**.……………………………………………………………………………………………………………..........................................................................................................................................................................**

(b) On the same axis sketch the graph you would expect to obtain if:-

(i) The same mass of powdered magnesium was used instead of magnesium ribbon. Label the graph Y. (**1 Mk)**

(ii) If the temperature of the solution mixture was reduced from 250C to 150C. Label the graph Z. **(1 Mk**)

(c) Determine the mass of magnesium ribbon that remained unreated in this experiment (Mg = 24, Molar gas volume = 24dm3 at r.t.p) **(3 Mks)**

**.…………………………………………………………………………………………………………………………………......**

**………………………………………………………………………………………………………………………………………**

**.………………………………………………………………………………………………………………………………………**

**………………………………………………………………………………………………………………………………………**

**.………………………………………………………………………………………………………………………………………**