CHEMISTRY III

015

06/11/2014 08.30AM - 10.00AM

Code : 010057MCB084

Surname : NYIRABIZIMANA

Other : ISABELLE

REB
Rwanda Education Board

ADVANCED LEVEL NATIONAL EXAMINATIONS, 2014

SUBJECT: CHEMISTRY PAPER III

COMBINATIONS: - BIOLOGY - CHEMISTRY - GEOGRAPHY (BCG)
- MATHEMATICS - CHEMISTRY - BIOLOGY (MCB)
- PHYSICS - CHEMISTRY - BIOLOGY (PCB)
- PHYSICS - CHEMISTRY - MATHEMATICS (PCM)

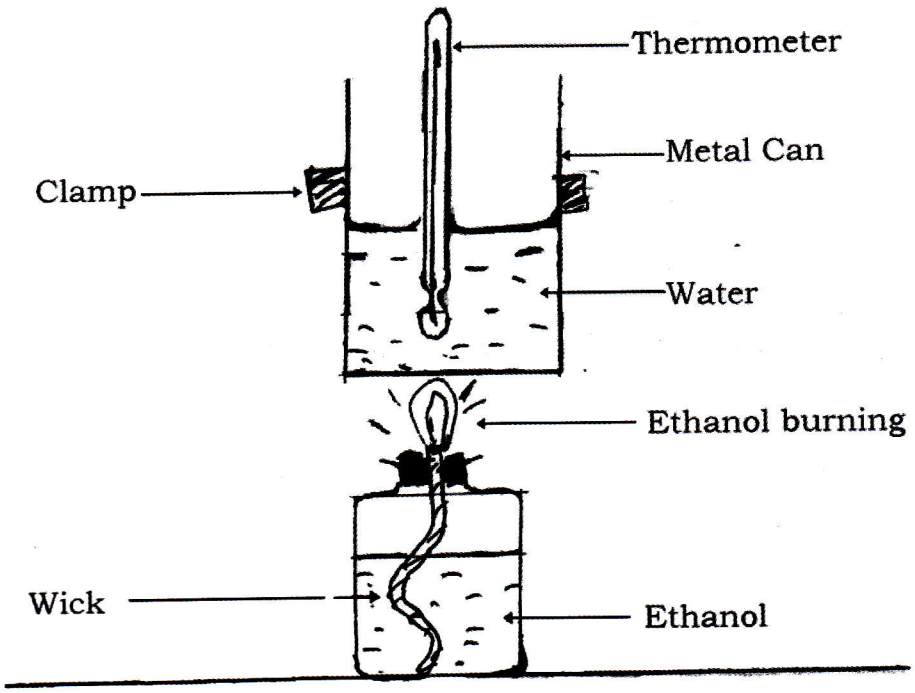
DURATION: 1 HOUR 30 MINUTES

INSTRUCTIONS:

1. Do not open this question paper until you are told to do so.
2. Write your names and index number in the space provided as written on your registration form, and **DO NOT** write your names and index number on additional answer sheets of paper if provided.
3. This paper consists of two questions which are compulsory.
4. All answers should be written in the spaces provided in this question paper
5. Please show all the working in cases which involve calculations.
6. Non-programmable scientific calculators may be used.

1. The enthalpy change of combustion of ethanol (C_2H_5OH) was determined in a chemistry laboratory using the method described below :

- Ethanol from a small burner was used to heat water in a metal can.
- The change in temperature of water as well as the mass of ethanol burnt were determined.
- The set up of the experiment is shown in the diagram below:



The following results were obtained:
Mass of water in a metal can = 500g
Initial temperature of water = 22° C
Final temperature of water = 30°C
Initial mass of the burner + ethanol before burning = 250. 95g
Final mass of burner + ethanol after burning = 250.00g
Assume that the specific heat capacity of water =4.2$Jg^{-1}K^{-1}$

(a) Calculate the heat absorbed by water in the metal can. **(2marks)**
Use the equation: Heat = m x c x ΔT
Where m = mass of water
c = Specific heat capacity of water
ΔT = Temperature change

(b) Calculate the mass of ethanol burnt. **(1mark)**

(c) Calculate the amount in moles of ethanol burnt. **(2marks)**
(Atomic masses : C=12, O= 16, H =1)

(d) Ethanol burns in air/oxygen to form water and carbon dioxide.
Write a balanced chemical equation for the combustion of ethanol. **(2marks)**

(e) Calculate the enthalpy change of combustion per mole of ethanol. **(2marks)**

(f) State one source of error in this experiment. **(1mark)**

2. A student decided to find out the percentage of calcium carbonate in a rock using the method described below:
   - 3.0g of the rock were mixed with $25cm^3$ of 2mol dm^{-3} hydrochloric acid (2M HCl). The acid was in excess to ensure that all the calcium carbonate reacted. The impurities did not react .
   - The whole mixture containing excess acid was titrated by adding 2mol dm^{-3} of sodium hydroxide (2M NaOH) solution from a burette using phenolphthalein indicator.
   - The experiment was repeated 4 times using similar quantities of the rock. Volume of the acidic mixture = $25cm^3$.

Final burette readings (cm^3)	16.50	31.70	15.60	30.90
Initial burette readings (cm^3)	0.00	16.50	0.50	15.60
Volume of 2mol dm^{-3} NaOH(cm^3)				

(e) Calculate the enthalpy change of combustion per mole of ethanol. **(2marks)**

(f) State one source of error in this experiment. **(1mark)**

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Final burette readings (cm^3)	16.50	31.70	15.60	30.90
Initial burette readings (cm^3)	0.00	16.50	0.50	15.60
Volume of 2mol dm^{-3} NaOH(cm^3)				

(a) Complete the above table and calculate the average volume of 2mol dm^{-3} NaOH (2M NaOH) used. (Show the values used to calculate the average volume of NaOH).

(3marks)

(b) Calculate the amount in moles of NaOH used to react with the excess HCl.

(1mark)

(c) Calculate the amount in moles of excess HCl.

(1mark)

(d) Calculate the amount in moles of the original HCl which was mixed with the rock.

(1mark)

(e) Calculate the amount in moles of HCl which reacted with the calcium carbonate in the rock.

(1mark)

(f) Write a balanced chemical equation for the reaction between calcium carbonate and HCl. **(2marks)**

(g) Use the mole ratio in the equation of part (f) to calculate the amount in moles of Calcium carbonate in the rock. **(2marks)**

(h) Calculate the molar mass (relative molecular mass) of calcium carbonate and hence the mass in grams of Calcium Carbonate in the rock. **(2marks)**

Molar mass of $CaCO_3$ =

Mass of $CaCO_3$ in the rock = ... g

(Atomic masses : Ca =40, C=12, O = 16)

(i) Calculate the percentage of $CaCO_3$ in the rock using the formula:

$$\% \text{ of } CaCO_3 = \frac{mass\ of\ CaCO_3}{mass\ of\ the\ rock} \times 100$$

(Give your answer to one decimal place) **(2marks)**