Name _____Index No. _____

Candidate's Signature _____ Date _____

233/2
CHEMISTRY
PAPER 2
THEORY
SEPTEMBER 2021
2 HOURS

KASSU JET 2021
CHEMISTRY PAPER 2
Kenya Certificate of Secondary Education (K.C.S.E)

INSTRUCTIONS TO CANDIDATES

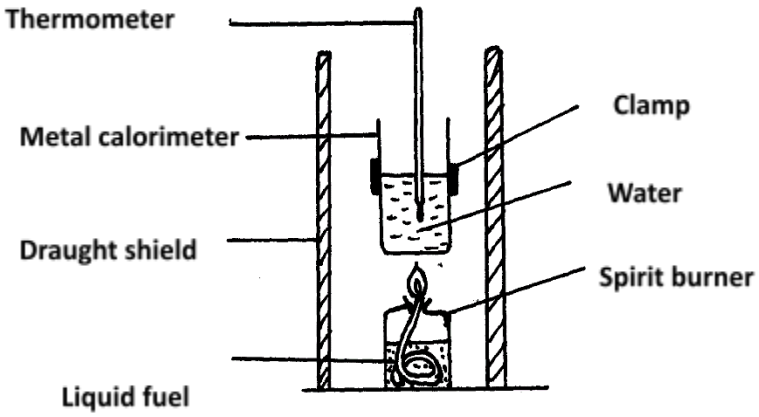
1. Write your name and index number in the spaces provided above.
2. Sign and write the date of examination in the spaces provided above.
3. Answer all the questions in the spaces provided.
4. Mathematical tables and silent electronic calculators may be used.
5. All working **must** be clearly shown where necessary.

FOR EXAMINER'S USE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	12	
2	11	
3	11	
4	16	
5	14	
6	16	
Total score	**80**	

This paper consists of 13 printed pages

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.



Results

Volume of water in the beaker = 500 cm^3
Initial temperature of water= 12^0C
Final temperature of water = 31.5^0C
Mass of ethanol burnt = 1.50g
Density of water = 1 g/cm^3
Specific heat capacity = 4.2 $Jg^{-1}K^{-1}$

(a) Define molar heat of combustion. *(1 mark)*

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(b) (i) Calculate the heat required to raise the temperature of the water from 12^0C to 31.5^0C. *(2 marks)*

(ii) Find the molar enthalpy of combustion of ethanol. *(2 marks)*
($C = 12$, $H = 1$, $O = 16$)

(c) An accurate value for ΔH_C of ethanol is -1368 $kJmol^{-1}$. State **two** sources of errors for the low figure obtained. *(2 marks)*

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(d) Draw an energy level diagram for the combustion of ethanol. *(2 marks)*

(e) Calculate the heating value of ethanol from the above experiment.
($C = 12$, $H = 1$, $O = 16$) *(2 marks)*

(f) State one factor that one may consider when choosing kerosene as a fuel in Eldoret town. *(1 mark)*

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2. Ammonia can be prepared in the lab by reaction of Calcium hydroxide and an ammonium salt.

(a) Write an equation for the reaction that will take place. *(1 mark)*

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(b) Calculate the volume of ammonia produced at room temperature and pressure given that 20g of calcium hydroxide reacted fully.

($Ca = 40$, $H = 1$, $O = 16$, $N = 14$, $MGV = 24dm^3$)

(3 marks)

(c) (i) Write an equation to show how ammonia is used to make phosphate fertilizer. *(1 mark)*

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(ii) Determine the percentage by mass of Nitrogen in the above fertilizer.

($N = 14$, $H = 1$, $P = 31$, $O = 16$) *(1 mark)*

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

(1 mark)

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

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

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3. (a) Define solubility. *(1 mark)*

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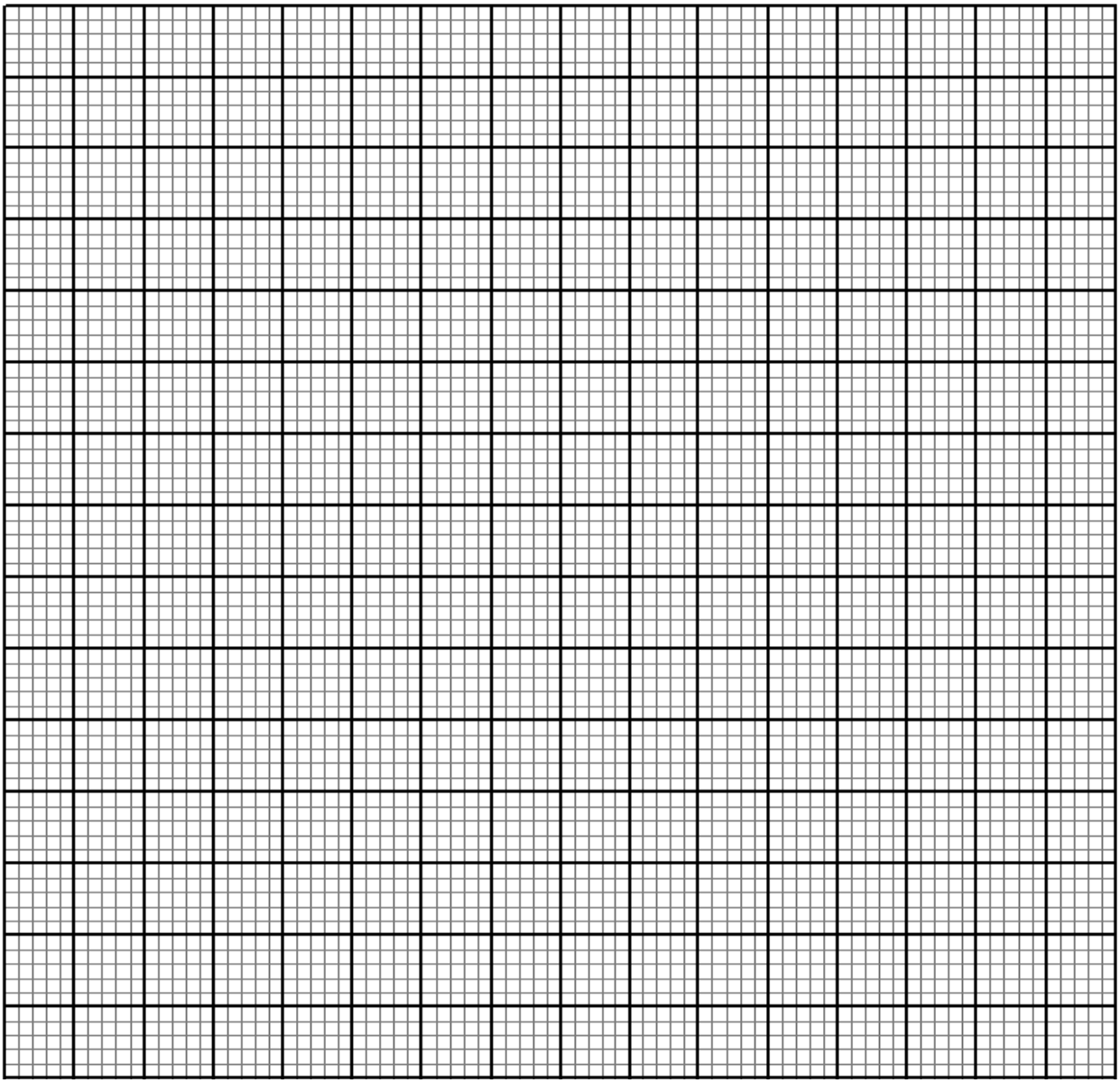
(b) The table below shows solubility of two salts X and Y at varying temperatures.

Temperature (^{0}C)	10	20	30	40	50	60	70	80	90
Solubility of Y (g/100g water)	70.0	66.0	63.0	60.0	59.0	56.5	54.5	53	51
Solubility of X (g/100g water)	12.0	18.0	24.0	31.0	38.0	48.0	51.0	74.0	88.0

(i) Draw the graph of solubility against temperature. *(3 marks)*



(ii) At what temperature is the solubility of both X and Y the same? *(1 mark)*

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(iii) Which of the substances X and Y is likely to be a gas? Explain. *(2 marks)*

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(iv) What is the mass of Y that would dissolve in 50g of water at 48^0C? *(1 mark)*

(v) Determine the solubility of salt X at 55^0C? *(2 marks)*

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

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4. (a) (i) What is meant by isomerism? *(1 mark)*

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(ii) A hydrocarbon sample is found to contain 83.3% carbon and 16.7% hydrogen. If the relative molecular mass of the compound is 72.0, determine its molecular formula. ($C = 12$, $H = 1$) *(3 marks)*

(iii) Draw the structural formula and name the compound whose molecular formula is in (a) (ii) above. *(2 marks)*

(g) Study the chemical equation below and answer the questions that follow.

$$\underset{\textbf{R}}{CH_3CH_2COOH} + \underset{\textbf{W}}{CH_3OH} \longrightarrow CH_3CH_2COOCH_3 + H_2O$$

(i) Name the type of reaction represented by the above equation. *(1 mark)*

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(ii) State two conditions in the reaction above. *(2 marks)*

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(iii) Write an equation for the reaction between the compound labelled **R** and potassium hydroxide solution. *(1 mark)*

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(iv) Name the type of reaction in b (iii) above. *(1 mark)*

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(v) Give three differences between the reactions named in b (i) and b (iv) above. (3 *marks*)

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(h) 4 grams of methanol $\left(CH_3OH\right)$requires 93.5 kJ of heat to vaporise completely.

Calculate the heat required to vaporise one mole of methanol completely.
$(C = 12.0, H = 1.0, O = 16.0)$ *(2 marks)*

5. a) Rubidium, atomic number 37 belongs to the same group as sodium.

(i) Explain why the element cannot occur free in nature. *(1 mark)*

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(ii) Suggest how the element would be stored in the laboratory *(1 mark)*

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(iii) Predict one physical property of Rubidium which is the same as that of transition metals such as iron. *(1 mark)*

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(iv) State two observations you expect when Rubidium is added to water. *(2 marks)*

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(v) What safety measure should be taken when adding Rubidium to water? *(1 mark)*

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(vi) 43g of Rubidium was added to 1000cm^3 of water, Calculate the volume of 0.5**M** sulphuric (VI) acid needed to neutralize 25cm^3 of the solution
$(Rb = 86,\ O = 16,\ H = 1, S = 32)$ *(3 marks)*

$$2Rb_{(s)} + 2H_2O_{(l)} \longrightarrow 2RbOH_{(aq)} + H_{2(g)}$$

(b) Describe an experiment you can use to show that chlorine is more reactive than iodine. *(2 marks)*

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(c) Aluminum Oxide is amphoteric and insoluble in water

(i) What do you understand by the term amphoteric oxide? *(1 mark)*

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(ii) Describe how to show that Aluminium oxide is amphoteric. *(2 marks)*

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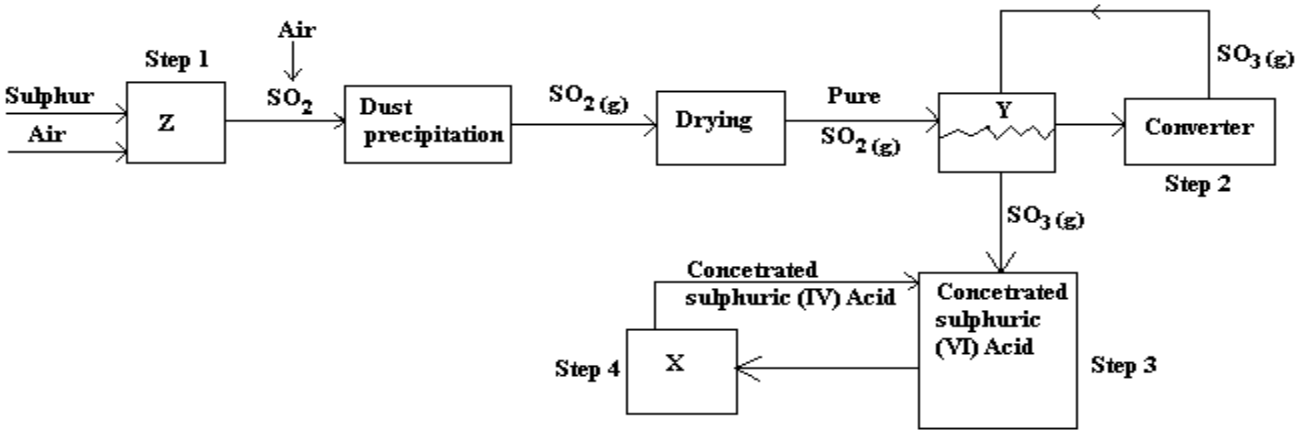
6. (a) Complete the table below to show the observation made and property when concentrated sulphuric (VI)acid is added to the following substances. *(4 marks)*

Substance	Observation	Property of Acid
sugar		
Potassium nitrate crystals		

(b) Below is a flow chart diagram for the contact process for the manufacture of sulphuric (VI) acid.



(i) Other than Sulphur state another substance that can be used *(1 mark)*

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(ii) Both platinum and vanadium (v) oxide can be used as catalyst, explain why vanadium (V) oxide is preferred over platinum in the process *(1 mark)*

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(iii) Give the name of chambers labeled *(1 mark)*

X ……

Y ……

(iv) State two uses of sulphuric(VI) Acid . *(2 marks)*

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(v) State two precautionary measures taken to prevent pollution by the contact process *(2 marks)*

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(vi) Write the balanced equations for the reactions in; *(2 marks)*

Step 2:

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Step 4:

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(vii) Calculate the volume of sulphur (VI) oxide gas in litres that would be required to produce 178kg of Oleum in step 3.

($Molar\ gas\ volume\ at\ s.t.p. = 22.4L,\ H = 1,\ O = 16,\ S = 32$) *(3 marks)*