# THE ROYAL EXAM SERIES

Kenya Certificate of Secondary Education

## 233/2 — CHEMISTRY — Paper 2

## THEORY

## FORM 4

## TERM 2

## DECEMBER 2021- 2 HOURS

---

Name……. Index Number:…….....

School ……..

Candidate's Signature……. Date……...……...

**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.
- This paper contains **11 printed pages.**
- 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 | 12 | |
| 2 | 07 | |
| 3 | 11 | |
| 4 | 13 | |
| 5 | 14 | |
| 6 | 11 | |
| 7 | 12 | |
| Total score | 80 | |

1. Below is part of the periodic table. The letters are not the actual symbols of the elements. Study it and answer the questions that follow.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | Q |
| C | E | | G | | | L | N | |
| D | F | | | | | | | |
| | | | | | | | | |

a. i. State and explain the difference in the melting points of D and F (2mks)

……
……
……

ii. Explain the difference in the atomic radii of G and N. (2mks)

……
……
……

iii. Select the element that is the strongest reducing agent. Explain. (2mk)

……
……
……

iv. Compare the nature of the aqueous solution of the oxide of C and that of L. explain. (2mks)

……
……
……

b. Study the table below and answer the questions that follow.

| SUBSTANCE | M.P(K) | B.P(K) | ELECTRICAL CONDUCTIVITY | |
|---|---|---|---|---|
| | | | SOLID | MOLTEN |
| J | 365 | 463 | NIL | NIL |
| K | 1323 | 2773 | GOOD | GOOD |
| L | 1046 | 1680 | NIL | GOOD |
| M | 2156 | 2776 | NIL | NIL |

c. Which of the substances J, K, L and M represent the following;

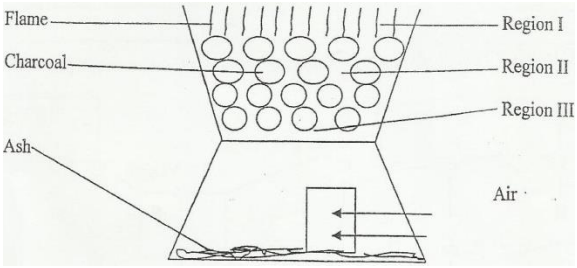
i. Silicon (IV) oxide……
(1mk)

ii. Barium sulphate……
(1mk)

d. In terms of structure and bonding, explain why silicon (IV) Chloride ($SiCl_4$) is a liquid at room temperature while Magnesium ($MgCl_2$) is a solid.
(2mks)

……
……
……

2. The diagram below represents a charcoal burner. Study it and answer the questions that follow.




a. Write equations for the reactions taking place at (3mks)

I……

II……

III……

b. State the color of the flame. (1mk)

……

c. The ash that collects in the lower compartment was dissolved in water and filtered.
i. Suggest the PH of the solution. (1mk)
……

d. Carbon (II) oxide can be prepared in the laboratory by a process represented below.

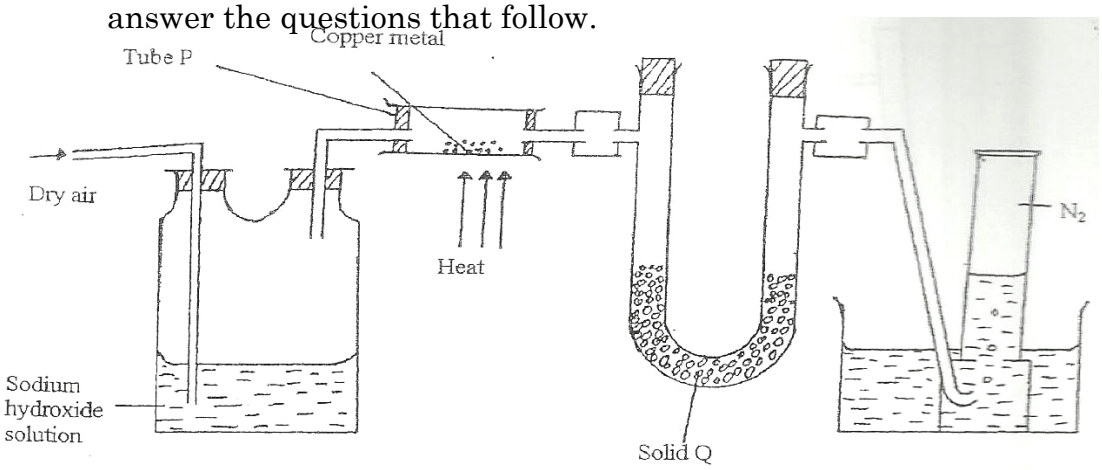
$$(COOH)_2 \xrightarrow{Con H_2SO_4} CO_{2g)} + CO_{(g)} + H_2O_{(l)}$$

i. What role does concentrate Sulphuric (VI) acid play in the reaction.
(1mk)
……

ii. How would you remove carbon (IV) oxide from carbon (II) oxide?
(1mk)

……

3. The diagram below represents a set-up that was to obtain dry nitrogen from air. Study it and
answer the questions that follow.




i. State the observation in the in the tube P (1mk)

……

……

ii. What is the purpose of $NaOH_{(aq)}$? (1mk)

……

iii. Write an equation for the reaction which took place in tube P
(1mk)

……

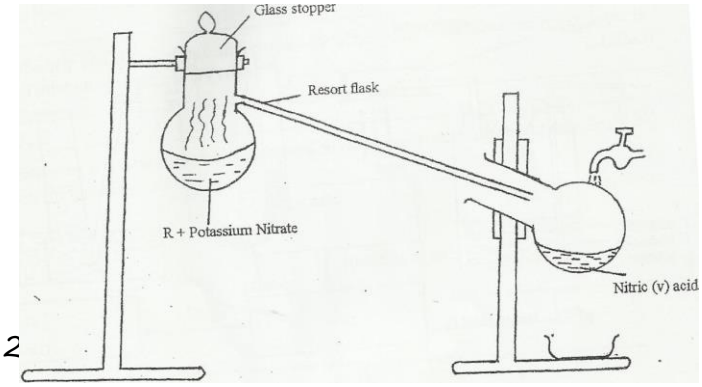
iv. Give the name of one impurity in the nitrogen gas obtained.
(1mk)

……

v. Why is liquid nitrogen used for storage of semen for artificial insemination?
(1mk)

……

b. The set-up below was used to prepare nitric acid



i. Give the name of liquid R (1mk)

.....

ii. Write an equation for the reaction which took place in the glass retort. (1mk)

.....

iii. Explain the following

a. Nitric acid is not stored in transparent glass. (2mks)

.....

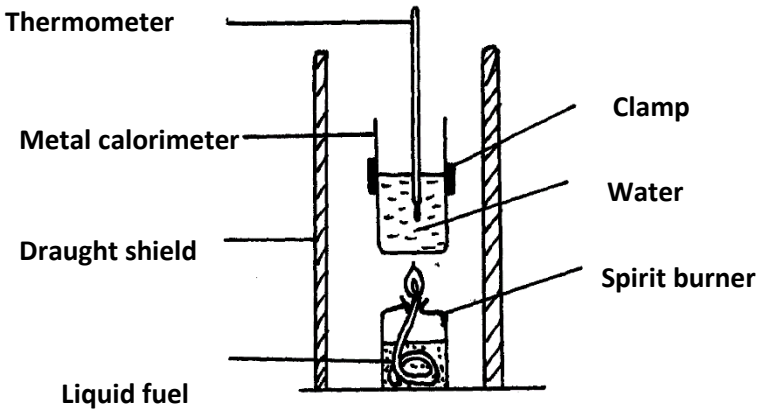
.....

b. The reaction between copper metal with 50% nitric acid (one volume of acid added to an equal volume of water) in an open test tube forms brown fumes. (2mks)

.....

.....

4. 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)*

……

……

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



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

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

……

……

……

(d) Draw an energy level diagram for the combustion of ethanol. *(3 marks)*

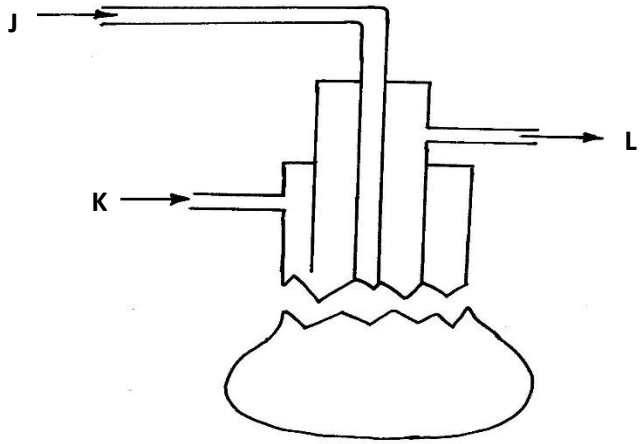
(e) Calculate the heating value of ethanol from the above experiment.
$(C = 12, H = 1, O = 16)$ *(2 marks)*

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

……

……

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




i. Give the name of the process mentioned above ( 1mark)
……

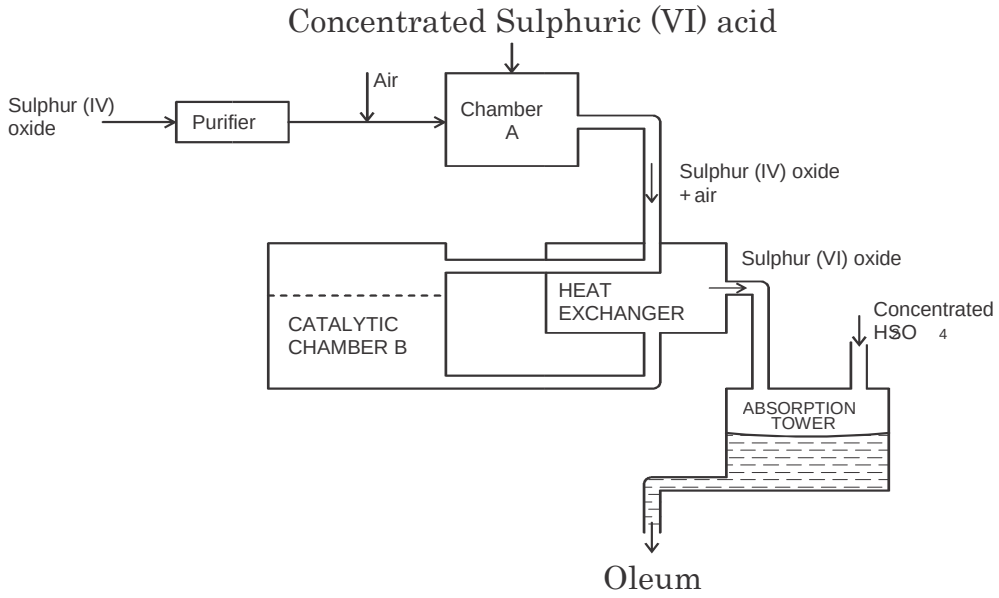
ii. State two physical properties of Sulphur that makes it to be extracted by this method (2marks).
……
……

iii. Why is it necessary to use superheated water in this process (1mark)
……
……

iv. During Frasch process molten sulphur flows out through the middle pipe but not through the outer pipe. Give a reason ( 1mark)

……
……

b. The diagram below shows part of the processes in the manufacture of sulphuric (VI) acid. Study and answer the questions that follow.




i. Write an equation for the formation of Sulphur (IV) oxide from Sulphur. (1mk)

……

ii. What is the role of concentrated sulphuric (VI) acid in chamber A.(1 mark)

……

iii. Name two catalyst that can be used in the catalytic chamber B.(2 marks)

……

iv. Give **two** reasons why during the manufacture of sulphuric (VI) acid, Sulphur (VI) Oxide, is dissolved in concentrated Sulphuric (VI ) acid instead of dissolving in water (2 marks)

……

……

c. Explain one way in which Sulphur (IV) oxide is a pollutant. (1mark)

……

……

d. What observation will be made when a few drops of concentrated sulphuric (VI) acid are added to crystals of sugar? Explain your answer. (2marks)

……

……

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

……

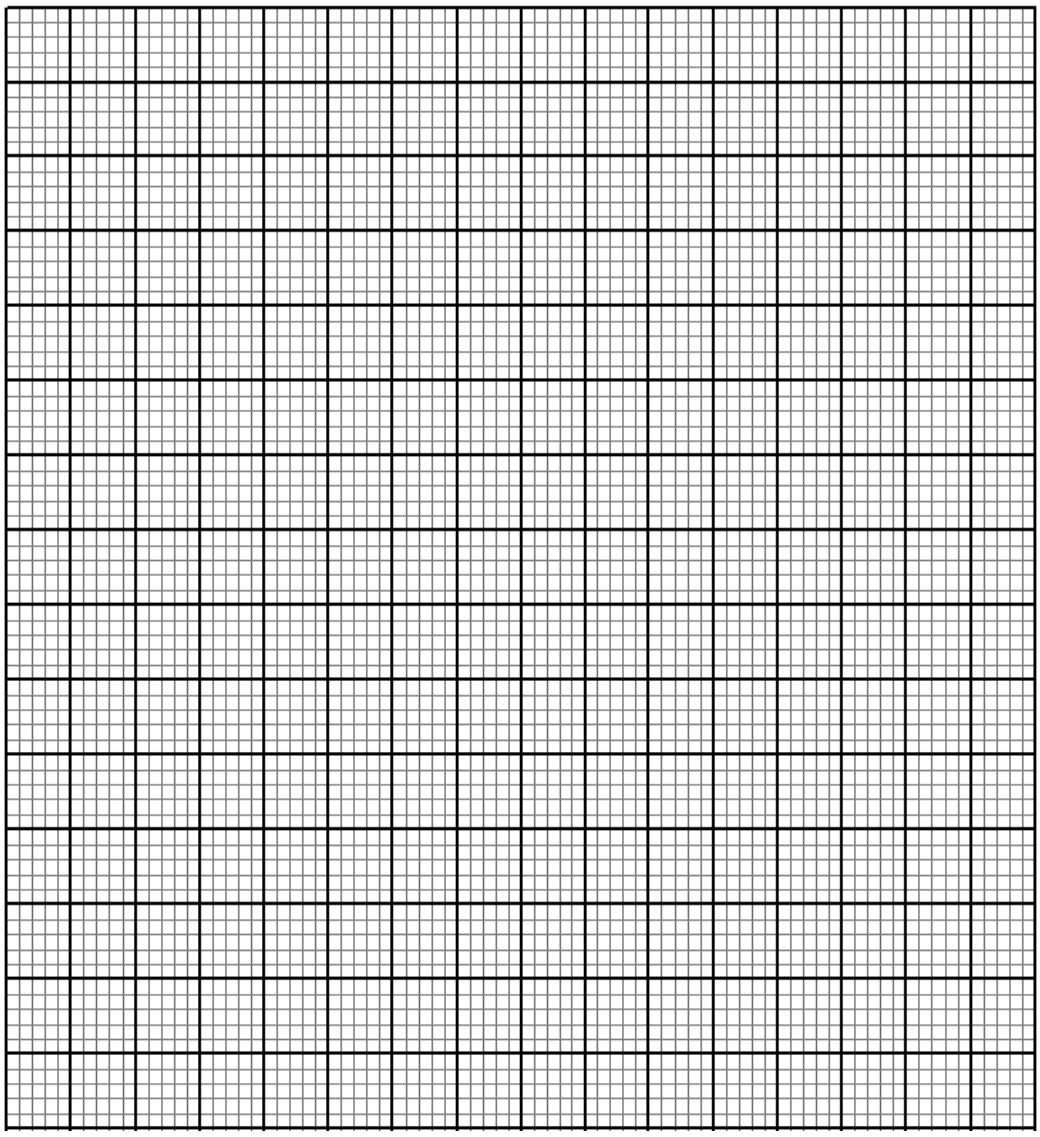
……

……

(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)*

……

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

……

……

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

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

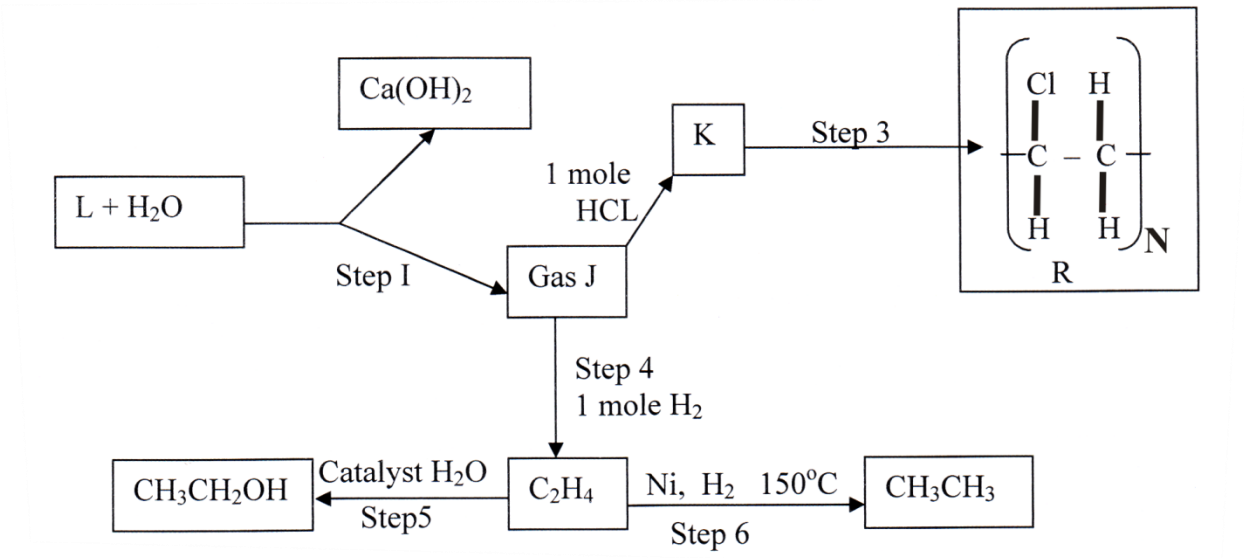
……

……

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

……

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




i) Identify reagent L (1mk)

……

ii) Name the catalyst used in step 5 (1mk)

……

iii) Draw the structural formula of gas J (1mk)

iv) What name is given to the process that takes place in step 5 (1mk)

……

v) State:

a) One use of product R (1mk)

……..

b) (i) Write the equation for the reaction between aqueous sodium hydroxide and aqueous ethanoic acid (1mk)

……..

(ii) Explain why the reaction between 1g of sodium carbonate and 2M hydrochloric acid is faster than the reaction between 1g of sodium carbonate and 2M ethanoic acid. (2mks)

……

……

(c) Larger alkanes can be broken down into smaller molecules

i) Give the name for the process (1mk)

……

ii) Apart from smaller chain alkanes mention the other two smaller molecules (1mk)

……

(d) Give the systematic names of the following compounds:

i) $CH_2 = C(CH_3)-CH_3$ …… (1mk)

ii) $CH_3CHCH$…… (1mk)