**NAME………………………………………………INDEX NO:.…ADM NO………**

**SCHOOL**……………………………………**…SIGNATURE**…….…. **DATE**………

**233/1**

**CHEMISTRY Paper 1**

**THEORY**

**JULY 2024**

**2 HOURS**

**FORM 4**

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

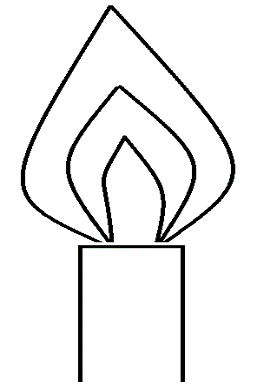
***INSTRUCTIONS TO CANDIDATES***

* Write your name and index in the **spaces** provided.
* Sign and write the date the examination is done.
* Answer **all** the questions in the spaces provided.
* Mathematical tables and **electronic calculators** may be used.
* ALL workings **MUST** be clearly shown where necessary.
* **This paper contains 12 printed pages.**
* **Candidates should check the question paper to ascertain that all pages are printed as indicated and that no question is missing.**
* **Candidates should answer questions in English.**

**For Examiner’s Use Only**

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| **Question** | **Maximum score** | **Candidates score** |
| 1-27 | 80 |  |

1. Below is a Bunsen burner flame. Study it and answer the questions that follow.



1. How is this type of flame is produced? (1 mark)

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1. Label on the diagram the least hot part of the flame. (1 mark)
2. Name the gas produced by a burning candle that is a non-pollutant. (1 mark)

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1. a) A hydrocarbon consists of 92.3% carbon. Its molecular mass is 26. Calculate its molecular formula. (2 marks)

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b) Draw the structure of the hydrocarbon. (1 mark)

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1. Hydrogen sulphide gas is slightly soluble in water. The reaction is given by equation below.

 H+(aq)+HS-(aq)

State and explain the effect of addition of Potassium hydroxide pellets on the concentration of hydrogen sulphide. (3 marks)

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1. In the presence of U.V light, ethane gas undergoes substitution reaction with chlorine.
2. What is meant by the term Substitution reaction? (1 mark)

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1. Give the structural formula and the name of the organic product formed when equal volumes of ethane and chlorine react together. (2 marks)

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1. The diagram below shows the bonding between aluminium chloride and ammonia.

H Cl

H N Al Cl

H Cl

1. Name the types of bonds that exist in the molecule (1 mark)

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1. How many electrons are used for bonding in the molecule? (1mark)

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1. State one commercial use of dry ice (1 mark)

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1. a) Give one advantage of universal indicator over other indicators. (1 mark)

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1. Describe how a mixture of barium sulphate and lead (II) chloride be separated in to pure solids. (2 marks)

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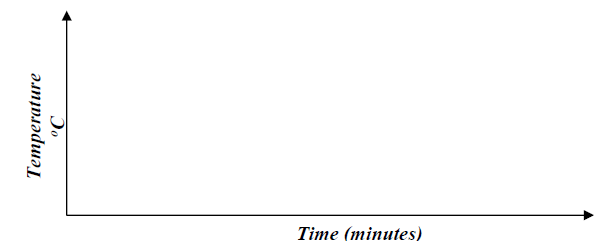
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1. Substance Qhas a melting point of 15oC and boiling point of 70oC.
2. On the same axes, draw the heating curve for Q if temperature started rising from 0oC.

(2 marks)

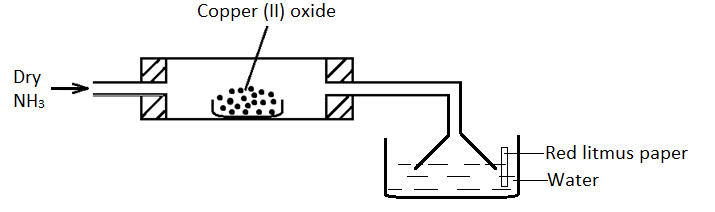


1. State the physical state of substance **Q** at room temperature (room temperature =25oC)

(1 mark)

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1. The set-up below is used to investigate the properties of ammonia.



i) On the diagram, indicate what should be done for the reaction at the combustion tube to occur. (**½** mark)

ii) Name another gas that can be used instead of ammonia gas. (**½** mark)

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iii) State and explain what happens to the red litmus paper. (1 mark)

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iv) Explain the observation made in the combustion tube. (1 mark)

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1. a) What is a binary electrolyte? (**½** mark)

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1. In an experiment, the quantity of electricity passed to deposit 1.2g of metal Q from its salt, was 3860 coulombs. (RAM of Q=120, 1 faraday = 96500 coulombs)
2. How many faradays of electricity are required to deposit 1mole of Q? (2 marks)

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1. One of the ions present in the solutions of the salt of Q has the formula Q**y+**. What is the numerical value of y? (**½** marks)

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1. Study the diagram below which shows an energy level diagram.

Na+(g) + Cl-(g)

ΔH2 = - 680kJmol-1

ΔH3 = +20kJmol-1

Na+(aq) + Cl(aq)

ΔH1

NaCl(s)

Enthalpy

Reaction path

1. Name enthalpy (1½ mark)

ΔH1 ………............................................................................................

ΔH2 ………............................................................................................

ΔH3 ………............................................................................................

1. Calculate the ΔH1 from the energy level diagram (1½ mark)

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1. Below is a table of 1st ionization energies for elements A, B, C, and D which are metals.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Elements | A | B | C | D |
| Ionization energies kJmol-1 | 494 | 418 | 519 | 376 |

a) What is meant by 1st ionization energy? (1 mark)

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b) With an explanation, arrange the elements in order of increasing reactivities. (2 marks)

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1. In the manufacture of Sulphuric (VI) acid by contact process Sulphur (IV) oxide is made to

react with air to form Sulphur (VI) oxide as shown: -

2SO2(g) + O2(g) 2SO3(g) ΔH = -196KkJ

(i) Name the catalyst in this reaction (1 mark)

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(ii) State effect of the following changes on the yield of Sulphur (VI) oxide

I. Increasing the pressure (**½** mark)

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II. Using a catalyst (**½** mark)

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(iii) Explain why Sulphur (VI) oxide gas is absorbed in concentrated Sulphur (VI) acid before dilution (1 mark)

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1. a) What are isotopes? (1 mark)

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1. Determine the number of neutrons in (1 mark)

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1. An isotope of element E has 34 neutrons and its mass number is 64. E forms a cation with 28 electrons. Write the formula of the cation formed by the element E. (1 mark)

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1. The standard electrode potentials of four half-reactions are: -

I. Sn2+ (aq) + 2e- → Sn(s) Eθ = -0.14V

II. Fe3+(aq) + e-  → Fe2+(aq) Eθ = + 0.77V

III. V2+(aq) + 2e- → V(s) Eθ = -1.20V

IV. Br2(aq) + 2e-  → 2Br-(aq) Eθ = + 1.07V

1. Identify the strongest oxidizing agent. (1 mark)

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1. Calculate the electrode potential for the electrochemical cell constructed from half-cell III and IV (1 mark)

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1. State two applications of electrolysis (1 mark)

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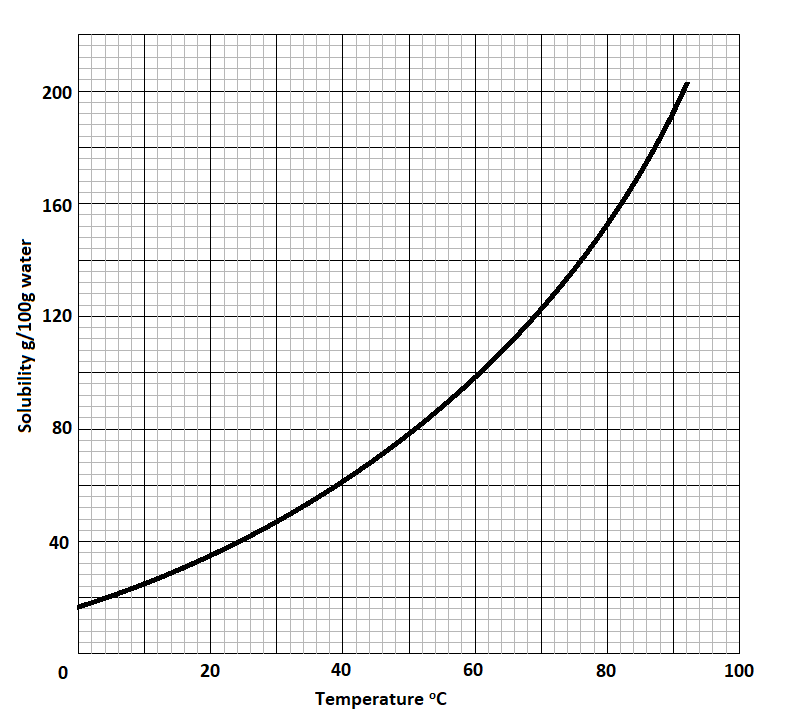
1. A sample of river water is suspected to contain magnesium salt. Describe how the presence of Mg2+ ions can be established. (3 marks)

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1. The solubility curve of potassium nitrate is shown below.



* 1. Determine the solubility of potassium nitrate at 80°C. (1 mark)

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* 1. Determine the molar concentration of saturated potassium nitrate at 50°C. (K = 39.0, O = 16.0, N = 14.0 and density of water = 1 g/cm3). (2 marks)

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1. Galvanization is an example of the efficient methods used in preventing rusting.
2. What is meant by galvanisation? (1 mark)

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1. Other than galvanisation, name 2 methods of preventing rusting. (1 mark)

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1. State the use of the mixture of hydrazine with oxygen. (1 mark)

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1. a) Name 2 gases that are collected during fractional distillation when the temperature of liquefied air is raised from -200℃ to -185℃of the distillation chamber. (1 mark)

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1. Name 2 gases that are removed at the temperature between 25℃ and -25℃ (1 mark)

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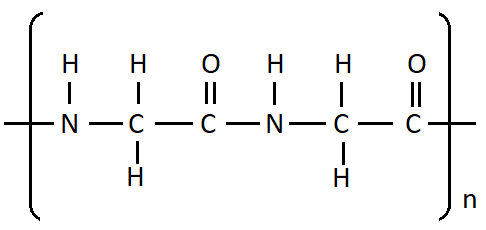
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1. Why is it necessary to remove the gases named in (b) above before the cooling dust free air to -200℃? (1 mark)

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1. The structure of protein is shown below. Study it and answer the questions that follow.



1. Draw the structure of the monomer that undergoes polymerization to form protein.

(1 mark)

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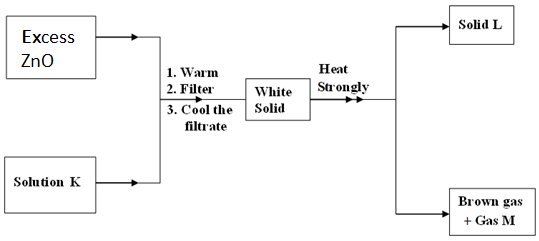
1. Which type of polymerization is the formation of protein? Explain. (2 marks)

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1. Study the flow chart below and answer the question that follows.

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Identify: (3 marks)

a) Solution K

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b) Solid L

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c) Gas M

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1. 50cm3 of oxygen gas diffused through a porous plug in 80 seconds. How long will it take 100cm3 of Sulphur (IV) oxide to diffuse through the same plug? (S = 32, O = 16). (3 Marks)

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1. 15.0cm3 of ethanoic acid (CH3COOH) was dissolved in water to make 500cm3 of solution. Calculate the concentration of the solution in moles per litre. (C=12.0; H=1.0; O=16.0; density of ethanoic acid is 1.05 g/cm3) (3 marks)

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1. When excess chloride gas is bubbled through dilute sodium hydroxide solution the resulting solution acts as a bleaching agent.
2. Write an equation for the reaction between chlorine gas and sodium hydroxide solution.

(1 mark)

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1. Explain how the resulting solution acts as a bleaching agent. (2 marks)

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1. Calcium oxide can be used to dry ammonia gas.

a) Explain why calcium oxide is not used to dry hydrogen chloride gas. (2 marks)

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b) Name one drying agent for hydrogen chloride gas. (1 mark)

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1. a) Explain why it is not advisable to prepare a sample of carbon(IV)oxide using barium carbonate and dilute Sulphuric(VI) acid. (2 marks)

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b) State a method that can be used to collect dry carbon(IV)oxide gas. Give a reason.

(1 mark)

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1. Study the information in Table 3 and use it to answer the questions that follow.

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| **Elements** | **Na** | **Mg** | **Al** | **Si** | **P** | **S** | **Cl** |
| Atomic Numbers | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| Atomic radii(nm) | 0.157 | 0.136 | 0.125 | 0.117 | 0.110 | 0.104 | 0.099 |

* 1. Explain the trend in atomic radii from sodium to chlorine. (1 mark)

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* 1. Explain how the chloride of aluminium differs from those of other metals in the period. (2 marks)

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1. When solid magnesium carbonate was added to a solution of hydrogen chloride in methylbenzene, there was no apparent reaction. On addition of water to the resulting mixture, there was vigorous effervescence. Explain these observations (2 marks)

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