THE KENYA NATIONAL EXAMINATIONS COUNCIL

SCIENCE LABORATORY TECHNOLOGY CRAFT

CHEMISTRY TECHNIQUES

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet
Scientific calculator(battery operated)

This paper consists of TWO sections; A and B.
Answer ALL the questions in section A and any TWO questions from section B.
Each question in section A carries 4 marks, while each question in section B carries 20 marks.

This paper consists of 4 printed pages.

Candidates should check the question paper to ascertain that all the
pages are printed as indicated and that no questions are missing.

Turn over

SECTION A (60 marks)

Answer ALL the questions in this section.

1. (a) Define the term "sample". (1 mark)

   (b) State the procedure of solid sample treatment before analysis. (3 marks)

2. Calculate the volume of 95% Ethanol required to prepare 100 cm³ of 50% Ethanol. (4 marks)

3. State any **four** advantages of volumetric analysis over other methods. (4 marks)

4. Calculate the percentage mass of Barium in the original unknown compound if a sample of 0.6760g of unknown compound containing Barium ions (Ba^{2+}) is dissolved in water and treated with an excess of sodium sulphate (Na_2SO_4). The mass of Barium sulphate ($BaSO_4$) precipitate formed is 0.14105g.
   (Ba = 137,   S=32,   O=16,   Na= 23) (4 marks)

5. Name the following complex ions:

   (a) $[Pb(Cl)_4]^{2-}$ (2 marks)

   (b) $[Fe(NH_3)_6]^{3+}$ (2 marks)

6. Calculate the boiling point of a solution containing 3 g acetamide (CH_3CONH_2) in 100 g Ethanol. (Ebullioscopic constant = 1.15°C/m)
   The boiling point of ethanol is 80°C. (4 marks)

7. Calculate the volume of 0.150 moldm⁻³ Sodium Oxalate ($Na_2C_2O_4$), that will be oxidised by 25.0 cm³ of 0.200 moldm⁻³ potassium manganate VII ($KMnO_4$) in acid solution.
   ($KMnO_4$ reacts with $Na_2C_2O_4$ in the ratio of 2:5). (4 marks)

8. Outline the determination of Nitrogen free extract in maize. (4 marks)

9. (a) Define the term "buffer". (2 marks)

   (b) State the components of a buffer solution. (2 marks)

10. Calculate the amount of Iodine extracted by 50 cm³ of tetrachloromethane (an organic liquid) which was shaken with a solution containing 1 g Iodine dissolved in 25cm³ of Potassium Iodide Solution. (partition coefficient is 85). (4 marks)

11. Calculate the molar mass of copper given that, in electrolysis of copper sulphate solution, a current of 0.750A deposits 0.369 g of copper in 25 minutes. (4 marks)

12. Calculate the concentration of an organic compound in grammes per litre with a relative molecular mass of 110, molar absorptivity (ε) of 10,000 $cm^{-1}mol^{-1}$ L and with an Absorbance (A) of 2 in a 1 cm cell. (4 marks)

13. Calculate the pH of a solution of hypochlorous acid (HClO) of concentration 1.26×10^{-3} M
($K_a = 3.2 \times 10^{-6}$ $moldm^{-3}$) (4 marks)

14. Outline the procedures involved in gravimetric analysis. (4 marks)

15. State, with reasons, an element that is analysed by flame photometry. (4 marks)

SECTION B (40 marks)

Answer any TWO questions from this section.

16. (a) State **three** types of chromatography. (3 marks)

    (b) Describe the separation of the components of a sample using paper chromatography. (17 marks)

17. (a) Define the following terms:

        (i) Calorie (2 marks)

        (ii) Joule (2 marks)

    (b) Draw a labelled diagram of a bomb calorimeter. (10 marks)

    (c) Calculate the calorific value in Kcal/g of a 2 g maize sample which raised the temeprature of 15 kg of water by 10°C in a bomb calorimeter (The specific Heat capacity of water is 4200J/kg°C). (6 marks)

18. (a) Sketch curves on the same axis to show how molar conductivity varies with dilution of:

        (i) a strong electrolyte; (2 marks)

        (ii) a weak electrolyte. (2 marks)

(b) Give an explanation of the curves obtained in a(i) and a(ii) above. (4 marks)

(c) Calculate:

    (i) the conductivity; (6 marks)

    (ii) molar conductivity of a 0.2 M solution measured in 2.5 cm long electrolytic cell of cross sectional area, 1.50 cm² giving a resistance of 14.2 Ω. (6 marks)

19. (a) List the components of a colorimeter. (5 marks)

    (b) State, with reasons, the conditions for a satisfactory colorimetric analysis. (8 marks)

    (c) Outline the sequence of analysis using a colorimeter. (7 marks)