

1408/313
CHEMISTRY TECHNIQUES
June/July 2018
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
SCIENCE LABORATORY TECHNOLOGY CRAFT

CHEMISTRY TECHNIQUES

3 hours



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.

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SECTION A (60 marks)

Answer ALL the questions in this section.

1. List four types of titrimetric analysis. (4 marks)
2. List the criteria for determination of purity of a substance. (4 marks)
3. 1.5 g of an iron - containing ore were converted to 250 cm³ of acidified iron (II) sulphate solution. 25 cm³ of this solution required 24.4 cm³ of 0.0218 M KMnO₄ for complete reaction. Calculate the mass of iron in the ore (Fe = 56). (4 marks)
4. Draw a labelled diagram of an electrolytic apparatus. (4 marks)
5. List any four qualities of an ideal wash solution in gravimetric analysis. (4 marks)
6. (a) Define the term retardation factor (R_f) as used in chromatography. (2 marks)
(b) List any two factors on which the (R_f) value depends on. (2 marks)
7. Calculate the pH of a 2×10^{-7} M HCl. (4 marks)
8. List any four requirements of a titrimetric reaction. (4 marks)
9. Calcium in a 20 cm³ serum sample required 2.47 cm³ of 1.87×10^{-4} M EDTA to reach end point. Calculate the molarity of the calcium in the blood serum. (Ca = 40) (4 marks)
10. (a) State the Nerst distribution Law. (1 marks)
(b) The distribution coefficient between trichloromethane and water is 86. 1 g of iodine in one litre of water was extracted using 100 cm³ of trichloromethane. Calculate the amount of iodine extracted. (3 marks)
11. A 5×10^{-4} M solution had a transmittance of 8% in 1 cm cell at 520 nm. Calculate its molar absorptivity. (4 marks)
12. When molten Magnesium Chloride was electrolysed by a current of 2A flowing for 1930 seconds, 0.43 g of magnesium were formed. Calculate the charge on a magnesium ion. (Mg = 24, IF = 96,500 C). (4 marks)
13. When 15 g of glucose (C₆H₁₂O₆) was dissolved in 500 g of a solvent of relative molecular mass 200, the freezing point was depressed by 8°C. Calculate the freezing point depression constant for the solvent. (4 marks)

14. 1.5 g of anhydrous Sodium Carbonate was dissolved in water and made up to 250 cm³. Calculate the concentration of sodium, in grammes per litre, in the solution. (Na = 23, O = 16, C = 12) (4 marks)

15. State four methods of visualisation of spots in paper chromatography. (4 marks)

SECTION B (40 marks)

Answer any TWO questions from this section.

16. (a) A solution of Copper (II) Sulphate was electrolysed using copper electrodes with a current of 5A. The mass of the copper deposited was 5 g.

(i) Calculate the time taken to deposit the 5 g of copper. (Cu = 63.5, IF = 96500 C). (5 marks)

(ii) Identify the ions present in the solution before electrolysis. (2 marks)

(iii) Write both the anodic and cathodic half equations. (2 marks)

(iv) Explain the observations made at the electrodes during and after the electrolysis. (3 marks)

(b) The above electrolytic process was repeated using platinum instead of copper electrodes.

(i) Write both the anodic and cathodic half equations. (2 marks)

(ii) Explain the observations made at the electrodes during and after the electrolysis. (4 marks)

(iii) List any two applications of electrolysis. (2 marks)

17. (a) Explain why the conductivity of both weak and strong electrolytes increases on dilution. (4 marks)

(b) Distinguish between Molar Conductivity and Infinite Molar Conductivity. (2 marks)

(c) A 0.1M solution of HCl and 0.1 M solution of KCl were found to have conductances of $5 \times 10^{-2} \Omega^{-1}$ and $1.8 \times 10^{-2} \Omega^{-1}$ respectively at 25°C, when measured in the same electrolytic conditions.

(i) Calculate the electrolytic conductivity of HCl given that the 0.1 M KCl has a conductivity of $1.17 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$. (4 marks)

- (ii) Calculate the molar conductivity of HCl at the given concentration. (2 marks)
- (iii) The limiting ionic molar conductivities of H^+ and Cl^- at $25^\circ C$ are $349.8 \Omega^{-1} cm^2 mol^{-1}$ and $76.3 \Omega^{-1} cm^2 mol^{-1}$ respectively. Calculate the degree of dissociation of hydrochloric acid. (4 marks)
- (d) Calculate the dissociation constant of 0.01 M weak acid of pH 4. (4 marks)
18. (a) When 4.68 g of hydrated $FeSO_4 \cdot xH_2O$ was heated to a constant mass, 2.54 g of the anhydrous salt remained. Calculate the value of x in the hydrated salt. (Fe = 56, S = 32, O = 16, H = 1) (6 marks)
- (b) State the meaning of the following terms:
- molarity;
 - molality;
 - masking reagent;
 - filtration.
- (8 marks)
- (c) Give a reason for each of the following:
- Silver Nitrate is stored in dark bottles in the laboratory. (2 marks)
 - A bottle containing Sodium Hydroxide pellets should not be left open. (2 marks)
 - Magnesium ions are added, during the determination of calcium ions with EDTA using solochrome black -T indicator. (2 marks)
19. (a) List any two sources of errors in volumetric analysis. (2 marks)
- (b) 3.6 g of anhydrous Sodium Carbonate was dissolved in water and made up to $250 cm^3$ in a volumetric flask. $25 cm^3$ of this solution required $25.9 cm^3$ of 0.1M HCl for complete reaction. Calculate the percentage of the Sodium Carbonate in the sample. (Na = 23, C = 12, O = 16) (10 marks)
- (c) List any four qualities of an ideal precipitate in gravimetric analysis. (4 marks)
- (d) List four advantages of gravimetric analysis. (4 marks)

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