

1408/313
CHEMISTRY TECHNIQUES
June/July 2011
Time: 3 hours



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 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.

SECTION A: (60 marks)
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1. Calculate the mass of NaNO_3 required to prepare 250cm^3 of solution whose concentration is 250ppm with respect to sodium.
(R.F.M of $\text{NaNO}_3 = 85$). (4 marks)
2. Define the following terms as used in titrimetry:
 - (a) Aliquot;
 - (b) Titre;
 - (c) Titrant;
 - (d) Tritrand. (4 marks)
3. List any **four** advantages of complexometric titrations over other types of titrimetry. (4 marks)
4. List any **four** components of a biological material. (4 marks)
5. (a) Define pH. (1 mark)
(b) Calculate the volume of 1M HCl that must be diluted to 500cm^3 so as to make a solution of $\text{pH} = 1$. (3 marks)
6. Differentiate between grab and composite samples. (4 marks)
7. State any **four** optimum conditions for precipitation. (4 marks)
8. In the solvent extraction of iodine with chloroform, the volumes of the aqueous and the organic phases were 25cm^3 and the percentage extraction was 99.8 %.
Calculate the distribution ratio. (4 marks)
9. State any **four** conditions necessary for analysis of a sample by colorimetry. (4 marks)
10. Explain why alkali metals are analysed by Flame Photometry. (4 marks)
11. A 150 ppm solution of $\text{K}_2\text{Cr}_2\text{O}_7$ has a transmittance percentage of 85% in 3.4cm cuvette.
(F.wt of $\text{K}_2\text{Cr}_2\text{O}_7 = 294$). Calculate the molar absorptivity of the solution and give its units. (4 marks)

12. List any **four** advantages of Thin Layer Chromatography over other chromatographic techniques. (4 marks)
13. A constant current of 0.8A is used to deposit copper at the cathode and oxygen at the anode of an electrolytic cell. Calculate the mass of oxygen formed in 15.2 minutes. (IF = 96500C). (4 marks)
14. (a) Define the term electrophoretic mobility. (1 mark)
- (b) List any **three** factors that affect electrophoretic mobility. (3 marks)
15. 25cm³ of 0.1M AgNO₃ was mixed with excess of 50cm³ of 0.2M NaCl. Calculate the mass of the precipitate formed. (Ag = 108, N = 14, O = 16, Na = 23, Cl = 35.5) (4 marks)

SECTION B: (40 marks)

Answer any **TWO** questions from this section.

16. (a) State the Beer-Lambert law. (2 marks)
- (b) State **three** causes of deviation from Beer-Lambert law in colorimetry. (3 marks)
- (c) Tabel I shows the calibration data that were obtained for the determination 1, 10- phenanthralene by colorimetry.

Table I

Concentration of Standard in ppm	2	4	6	8	10
% T	62.4	39.8	26.0	17.6	12.3

- Plot the working calibration curve for this data for analysis. (15 marks)
17. (a) Name **seven** components of a flame photometre. (7 marks)
- (b) State the function(s) of each of the components named in (a) above. (7 marks)
- (c) Outline the process that lead to the production of analytical signal in flame photometry. (6 marks)

18. (a) Name **two** sources of error encountered in volumetric analysis. (2 marks)
- (b) (i) Define the term 'range of an indicator.' (1 mark)
- (ii) State the criteria used in choosing an indicator for an acid-base titration. (1 mark)
- (c) Table II shows the range of some common acid-base indicators.

Table II

Indicator	Range	Colour change (Acid-base)
Methyl orange	3.1 - 4.4	red-orange
Methyl red	4.4 - 6.0	red-yellow
Litmus	4.5 - 8.3	red-blue
Bromothymol blue	6.0 - 7.6	yellow-blue
Phenolphthalein	8.3 - 9.8	colourless-pink

With reasons, select the ideal indicators for titration of;

- (i) A strong acid and a strong base. (2 marks)
- (ii) Weak base and a strong acid. (2 marks)
- (iii) State, with reasons, the indicators used in practice for the titration in (c)(i) above. (2 marks)
- (d) 25cm^3 of a solution containing 38.1gdm^3 of crystals of $\text{Na}_2\text{B}_4\text{O}_7 \cdot n\text{H}_2\text{O}$ were neutralized by 24.8cm^3 of 0.2M HCl . Determine the value of n in $\text{Na}_2\text{B}_4\text{O}_7 \cdot n\text{H}_2\text{O}$. ($\text{Na} = 23, \text{B} = 10.8, \text{O} = 16, \text{H} = 1$) (10 marks)
- Equation of reaction is $\text{B}_4\text{O}_7^{2-} + 2\text{H}^+ + 5\text{H}_2\text{O} \longrightarrow 4\text{H}_3\text{PO}_4$.

19. (a) Name the equipment and reagents used in crude protein determination. (9 marks)
- (b) Outline the basic principles of crude protein determination. (11 marks)