Name: _____ **Index No:** _____/_____

1408/313
CHEMISTRY TECHNIQUES
June/July 2013
Time: 3 hours

Candidate's Signature: _____

Date: _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

SCIENCE LABORATORY TECHNOLOGY CRAFT

CHEMISTRY TECHNIQUES

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have a Scientific calculator (battery operated) for this examination.
*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.*
Answers to the questions should be written in the spaces provided in this question paper.
Candidates should answer the questions in English.

For Examiner's Use Only

Section	Question	Maximum Score	Candidate's Score
A	1 - 15	60	
B		20	
		20	
		Total Score	

This paper consists of 16 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 pH. (1 mark)

   (b) Given that a solution has a pH of 5.2. Determine the $[OH^-]$ and $[H^+]$. (3 marks)

2. (a) Calculate the $[H^+]$ of a 0.01 M solution of ethanoic acid, CH_3COOH, given that: $[K_a \text{ of } CH_3COOH = 1.8 \times 10^{-5} \text{ Mol dm}^{-3}]$ (3 marks)

   (b) Determine the pH of the solution. (1 mark)

3. A laboratory technician was asked to extract 0.1 g of iodine contained in 50 cm^3 of water. Given that $K_D = 85$, calculate the weight of iodine he found remaining in the aqueous layer after:

   (a) one extraction with 25 cm^3 of carbon tetrachloride. ($2\frac{1}{2}$ marks)

   (b) three extractions with 8.33 cm^3 of carbon tetrachloride. ($1\frac{1}{2}$ marks)

4. State any **four** factors which must be taken in to consideration when choosing an organic solvent for solvent extraction. (4 marks)

5. (a) Define the term chromatography. (1 mark)

   (b) List any **three** advantages of TLC over paper chromatography. (3 marks)

6. (a) Explain the meaning of the term gravimetric analysis. (2 marks)

   (b) (i) Explain the term 'digestion' of precipitates. (1 mark)

   (ii) State the importance of digestion of precipitates in gravimetric analysis. (1 mark)

7. Describe the procedure commonly employed in gravimetric analysis. (4 marks)

8. 100 cm^3 of concentrated hydrochloric acid were diluted to a litre with distilled water. 26.8 cm^3 of this diluted acid were needed to neutralise 25 cm^3 of 0.5 M, sodium carbonate solution. What is the concentration of the original acid in grams/litre? (H = 1, Cl = 35.5) (4 marks)

9. (a) Define a sample. ($\frac{1}{2}$ mark)

(b) Explain the importance of sampling. (2 marks)

(c) Name **three** techniques of sampling. ($1\frac{1}{2}$ marks)

10. Determine how long it will take to deposit 1.00 g of chromium, when a current of 0.120 A flows through a solution of chromium (III) sulphate. (Cr = 52) (4 marks)

11. (a) Define the term electrophoresis. (2 marks)

(b) Name any **two** applications of electrophoresis. (2 marks)

12. Differentiate between one and two dimensional paper chromatography. (4 marks)

13. (a) State the Beer-Lamberts law. (2 marks)

(b) Convert the following transmittance measurements to corresponding absorbance:

(i) 0.35 T;
(ii) 80%.

(2 marks)

14. Explain the following terms as used in chromatography:

(i) multiple development; (1 mark)
(ii) eluate; (1 mark)
(iii) loading; (1 mark)
(iv) resolution. (1 mark)

15. Describe the following purification techniques:

(i) fractional distillation; (2 marks)
(ii) crystallization. (2 marks)

SECTION B (40 marks)

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

16. Preparation of accurate standard solutions in chemical analysis procedures in very important.

(a) How would you prepare 1000 ppm copper solution using pure copper (II) oxide? [Cu = 63.5, O = 16]. (7 marks)

(b) From the stock solution prepared above, explain how you would prepare:

(i) 250 cm^3 of 100 ppm - Cu - standard;

(ii) 100 cm3 of 2 ppm - Cu - standard.

(6 marks)

(c) How many times were your solutions in b(i) and b(ii) above diluted? (4 marks)

(d) If pure copper was used to prepare the 1000 ppm Cu-standard, what weight of copper would be needed? (1 mark)

(e) Why is it important to store stock solutions in plastics, rather than in glass containers? (2 marks)

17. (a) Explain the meaning of the term molar conductivity as applied to an electrolyte? (3 marks)

(b) Illustrate, diagrammatically, how the **molar conductivity** changes with increasing dilution for:

(i) a strong electrolyte; (2 marks)

(ii) a weak electrolyte. (2 marks)

(iii) Account for the changes observed. (8 marks)

(c) The molar conductivity of aqueous ethanoic acid concentration 0.1 mol/litre was 4.6 $cm^2\ \Omega^{-1}\ mol^{-1}$ and at infinity dilution 352 $cm^2\ \Omega^{-1}\ mol^{-1}$.

Calculate the:

(i) degree of dissociation of the acid at this concentration; (2 marks)

(ii) pH of the acid solution. (3 marks)

18. (a) Define the term electrogravimetric analysis. (2 marks)

(b) Draw a diagrammatic set-up of electrogravimetric apparatus. (5 marks)

(c) State the character of the deposit ideal for analytical purposes in electrogravimetry. (2 marks)

(d) State the necessary conditions that will ensure such a deposit as in (c) above is obtained. (2 marks)

(e) 0.936 g of a sample of hydrated $CuSO_4.5\ H_2O$ crystals was dissolved in hot distilled water. Careful addition of sodium hydroxide precipitated copper (II) oxide, which when filtered, washed and dried at constant mass was found to have a mass of 0.298 g.

Calculate:

(i) the percentage of copper in the hydrated ($CuSO_4.5H_2O$) crystals. ($5\frac{1}{2}$ marks)

(ii) the theoretical percentage of copper in the $CuSO_4.5H_2O$ crystals. ($1\frac{1}{2}$ marks)

(iii) Compare the experimental and theoretical percentage of copper in the crystals.
[Cu = 63.5, S= 32, O = 16, Na = 23 H = 1]. (1 mark)

(iv) State any **two** possible sources of experimental errors during gravimetric analysis. (1 mark)

19. (a) An aqueous solution containing 1.68 g of (A.R) grade sodium oxalate in 250 cm^3 volumetric flask was prepared by a laboratory technician. 25.0 cm^3 of this solution was acidified with 2 M sulphuric acid and found to require 25 cm^3 of standard permanganate solution for complete reaction. 25 cm^3 also of a given iron(II) solution acidified with 2 M sulphuric acid required 12.5 cm^3 of the same standard potassium permanganate solution after complete reaction.

Calculate the:

(i) molarity of potassium permanganate solution in mol/litre;

(ii) concentration of Iron(II) solution in g/litre.
[Na = 23, C = 12, O = 16]
[R.M.M Iron(II) solution = 392]

($10\frac{1}{2}$ marks)

(b) Outline the correct procedure used in the determination of sodium metal in a given sample using a flame photometer. (8 marks)

(c) Why is a flame photometer not suitable for the determination of alkaline earth metals?
($1\frac{1}{2}$ marks)