

1904/104
CHEMISTRY TECHNIQUES I
Oct./Nov. 2019
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
CRAFT CERTIFICATE IN SCIENCE LABORATORY TECHNOLOGY

MODULE I

CHEMISTRY TECHNIQUES I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Scientific calculator (battery operated).

The 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 carried 20 marks.

Maximum marks for each part of the question are indicated.

Candidates should answer all questions in English.

This paper consists of 6 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)

Answer ALL the questions in this section.

1. Define the following terms:

(a) Atom;

(b) Element;

(c) Compound;

(d) Isotopes.

- smallest unit of matter
two elements that have the same number of protons but diff number of neutrons

(4 marks)

2. Neon consists of about 90.92% of Ne-20, 0.2% of Ne-21, and 8.82% of Ne-22. Calculate the relative atomic mass of neon.

(4 marks)

3. Calculate the percentage of sulphur in each of the following compounds:

(a) CaSO_4 (Ca = 40, S = 32, O = 16)

(2 marks)

(b) $\text{Al}_2(\text{SO}_4)_3$ (Al = 27, S = 32, O = 16)

(2 marks)

4. Calculate the mass of copper (II) sulphate in 250 cm^3 of 0.5 M solution (Cu = 63.5, S = 32, O = 16).

(4 marks)

5. The atomic numbers of Y and Z are 13 and 9 respectively:

(a) Write the electronic arrangement of:

(i) Y; 2, 8, 3

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

(ii) Z.

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

(b) Draw an electronic diagram showing bonding between Y and Z.

(3 marks)

6. 20 cm^3 of a solution containing 4 g per litre of sodium hydroxide was neutralised by 8 cm^3 of dilute sulphuric acid. Calculate the concentration of sulphuric acid in moles per litre; (Na = 23, O = 16, H = 1).

(4 marks)

7. A compound contains 27.3 % carbon and 72.2% oxygen. Determine the empirical formula (C = 12, O = 16).

(4 marks)

8. List any two differences between physical and chemical changes.

(4 marks)

NO new substance is formed accompanied by one or more new substances
reversible | *irreversible*

9. An element X is represented by ${}^{16}_8\text{X}$. State:

- (a) Atomic number;
- (b) Number of electrons;
- (c) Number of neutrons;
- (d) Mass number.

(4 marks) ✓

10. Write the IUPAC name of each of the following:

- (a) CH_3OH ; *Methanol* ✓
- (b) $\text{CH}_3\text{CH}_2\text{CH}_3$
- (c) $\text{CH}_3\text{CH}_2\text{COOH}$
- (d) $\text{CH}_2 = \text{CH}_2$ *ethene* ✓

(4 marks)

11. Calculate the number of atoms in 0.27 g of silver ($A_r = 108$, $L = 6.02 \times 10^{23}$).

(4 marks)

12. Distinguish between an amphoteric oxide and an acidic oxide giving an example in each case.

(4 marks)

13. Define the following terms:

- (a) Base;
- (b) Alkali;
- (c) Acid;
- (d) Salt.

(4 marks)

14. A magnesium ribbon was completely burned in air to form a white substance. The white substance was dissolved in water to form a colourless solution. Write balanced chemical equations for the formation of:

(a) white substance.

(2 marks)

(b) colourless solution.

(2 marks)

15. Methane reacts with excess chlorine to form a compound Z.

(a) State the condition necessary for the reaction to take place.

(1 mark)

(b) Give the IUPAC name of compound Z.

(1 mark)

(c) Draw the structure of compound Z.

(1 mark)

(d) Name the type of reaction undergone by methane.

(1 mark)

SECTION B: (40 marks)

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

16. (a) Study the information given in table I, and answer the questions that follow.

Table I

| Number of carbon atoms per molecule | Relative molecular mass of hydrocarbon |
|-------------------------------------|--|
| 2 | 28 |
| 3 | 42 |
| 4 | 56 |

- (i) State the general molecular formula of the homologous series in the table. (1 mark)
alkanes
- (ii) Give the general name of the compounds in the table. (1 mark)
Alkanes
- (iii) Give the IUPAC name of the fifth member of the above series of compounds. (1 mark)
Pentane
- (b) The equation below represents the thermal decomposition of a hydrocarbon.
- $$\text{C}_6\text{H}_{14} \longrightarrow \text{X} + \text{C}_3\text{H}_8$$
- (i) Draw the structure of compound X and give its IUPAC name. (2 marks)
C₃H₆
- (ii) Explain the observation that would be made if a few drops of bromine water were added to a sample of X. (2 marks)
C₃H₆ + Br₂ → C₃H₅Br + HBr
- (iii) Write the equation for the complete combustion of C₃H₈. (2 marks)
C₃H₈ + 5O₂ → 3CO₂ + 4H₂O
- (c) A hydrated salt has the following composition by mass, iron = 20.2%, sulphur = 11.5%, oxygen = 23%, water = 45.3%. If its relative molecular mass is 278, determine its molecular formula. (Fe = 56, S = 32, O = 16, H = 1) (7 marks)
- (d) Distinguish between neutralisation and double decomposition. (4 marks)

| | | | | |
|-------|-------------------|-------------------|-----------------|-------------------|
| % Com | Fe | S | O | H ₂ O |
| RAE | 20.2 | 11.5 | 23 | 45.3 |
| Moles | $\frac{20.2}{56}$ | $\frac{11.5}{32}$ | $\frac{23}{16}$ | $\frac{45.3}{18}$ |
| Ratio | 0.361 | 0.359 | 1.438 | 2.516 |

17. (a) Table II below shows four elements represented by letters X, L, M and N.

Table II

| Element | Electronic arrangement | Atomic radius (nm) | Ionic radius (nm) |
|---------|------------------------|--------------------|-------------------|
| K | 2.8.2 | 0.136 | 0.065 |
| L | 2.8.7 | 0.099 | 0.181 |
| M | 2.8.8.1 | 0.203 | 0.133 |
| N | 2.8.8.2 | 0.174 | 0.099 |

- (i) From the table, identify the **two** elements with similar chemical properties. Give reasons. (3 marks)
- (ii) Name an element which is a non-metal. (1 mark)
- (iii) Identify the most reactive metal. (1 mark)
- (iv) Explain why the ionic radius of N is less than that of M. (2 marks)
- (v) Explain why the ionic radius of L is bigger than its atomic radius. (2 marks)
- (b) (i) List any **three** properties of covalent compounds. (3 marks)
- (ii) Using an electronic diagram show the bonding between carbon and chlorine atoms. (C = 12, Cl = 17). (4 marks)
- (iii) List **four** methods of sample storage in a chemistry laboratory. (4 marks)
18. (a) List **six** properties of primary standards. (6 marks)
- (b) Outline the preparation of a 0.05 M solution of Na_2CO_3 in a 250 cm^3 volumetric flask. (Na = 23, O = 16, C = 12) (7 marks)
- (c) A sample of concentrated hydrochloric acid has a density of 1.16 g/cm^3 and contains 32% of the pure acid. Calculate the concentration of the acid in moles per litre. (7 marks)

kg H₂ O₂ mg @ cgms

atomic number
20
20 x 2 + 1

19. (a) (i) Define the term pH. (1 mark)
- (ii) Calculate the pH of a 0.01 M potassium hydroxide. K_3H (3 marks)
- (iii) Give **three** conditions under which back titration is applied in volumetric analysis. (3 marks)
- (b) 100 cm³ of 2M nitric acid reacted with 12.5 g of a carbonate, MCO_3 , of metal, M. Calculate the relative atomic mass of M. (C = 12, O = 16) (6 marks)
- (c) (i) Distinguish between a normal and an acid salt giving an example in each case. (4 marks)
- (ii) Name any **three** types of titrimetric analysis. (3 marks)

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Add base
titrimetric

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