

1904/104  
CHEMISTRY TECHNIQUES I  
Oct./Nov. 2021  
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;*

*Non-programmable scientific calculator.*

*This paper consists of TWO sections; A and B.*

*Answer ALL questions in section A and any TWO questions from section B in the answer booklet provided.*

*Each question in section A carries 4 marks while each question in section B carries 20 marks.*

*Maximum marks for each part of a question are indicated.*

*Candidates should answer the 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 questions in this section.

1. Figure 1 shows the relationship between the physical states of matter.

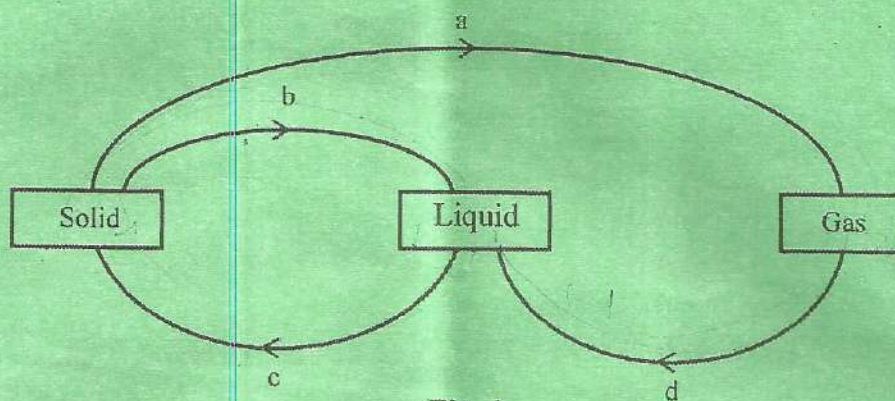


Fig. 1

Identify the processes labelled a, b, c and d.

(4 marks)

2. (a) Define the term 'isotope'. (1 mark)
- (b) An element consists of two isotopes. One has a relative abundance of 69.09% and relative atomic mass of 62.93, while the other has a relative abundance of 30.91% and relative atomic mass of 64.93. Calculate the relative atomic mass of the element. (3 marks)

3. The electronic arrangements of ions  $A^{3+}$  and  $B^{2-}$  are 2.8 and 2.8.8 respectively.

(a) Write the:

(i) electronic arrangement of the atoms of elements A and B; (2 marks)

(ii) formula of the compound formed when A and B react. (1 mark)

(b) Name the type of bond in a(ii). (1 mark)

4. Write the spdf electronic configuration of:

(a)  ${}_{11}^{23}\text{Na}$  (1 mark)

(b)  ${}_{20}^{40}\text{Ca}$  (1 mark)

(c)  ${}_{6}^{12}\text{C}$  (1 mark)

(d)  ${}_{2}^{4}\text{Be}$  (1 mark)

5. (a) Write the structural formula of the two isomeric forms of  $C_4H_{10}$ . (2 marks)
- (b) Give the IUPAC names of the structures in (a). (2 marks)
6. (a) List three factors which affect the chemical equilibrium in a reversible reaction. (3 marks)
- (b) State the effect of a catalyst on the position of a chemical equilibrium. (1 mark)
7. Name four types of sampling techniques. (4 marks)
8. Calculate the mass of potassium carbonate required to prepare 0.1M solution in a one litre volumetric flask. (K = 39, C = 12, O = 16). (4 marks)
9. 20 cm<sup>3</sup> of a 0.1 M sodium hydroxide solution was neutralised by 8 cm<sup>3</sup> of dilute sulphuric acid. Calculate the number of moles of the acid. (4 marks)
10. Describe how a solid sample of zinc (II) carbonate can be prepared starting with zinc oxide. (4 marks)
11. Calculate the pH of 0.01M sulphuric acid solution. (4 marks)
12. The melting point of phosphorous trichloride is -91°C while that of magnesium chloride is 715°C. Explain the differences in their melting points. (4 marks)
13. Explain why:
- (a) there is a general increase in the first ionization energies of the elements in period 3 from left to right. (2 marks)
- (b) anhydrous aluminum chloride is soluble in organic solvents while anhydrous magnesium chloride is insoluble. (2 marks)
14. (a) Describe how sodium carbonate can be used to distinguish between a sample of ethanol from a sample of ethanoic acid in the laboratory. (3 marks)
- (b) State the observation that would be made when a piece of sodium metal is placed in a sample of pentanol. (1 mark)
15. (a) State the Le Chatelier's principle. (1 mark)
- (b) Carbon monoxide reacts with steam according to the following equation:
- $$CO_{(g)} + H_2O_{(g)} \rightleftharpoons H_2_{(g)} + CO_{2(g)}$$
- Explain the effect of increasing the pressure of the system at equilibrium. (3 marks)

SECTION B (40 marks)

Answer any TWO questions from this section.

16. (a) (i) Calculate the amount of KCl required to prepare 100 ppm chloride ions solution in a 250 ml volumetric flask (K = 39, Cl = 35.5). (8 marks)
- (ii) Outline the procedure for the laboratory preparation of the chloride ions solution in (a)(i). (5 marks)
- (iii) Calculate the amount of the solution prepared in (a)(ii) required to make 20 ml of a 5 ppm chloride ions solution. (3 marks)
- (b) Determine the number of moles present in 25 ml of 0.05M sodium carbonate solution. (4 marks)
17. (a) Name **four** types of volumetric analyses. (4 marks)
- (b) Define the following terms as used in volumetric analysis:
- (i) titre; (1 mark)
- (ii) titrant; (1 mark)
- (iii) titrand. (1 mark)
- (c) A solution of oxalic acid was prepared by dissolving 0.5 g of oxalic acid  $H_2C_2O_4 \cdot 2H_2O$  in a 250 cm<sup>3</sup> volumetric flask. 25 cm<sup>3</sup> of the prepared solution required 30 cm<sup>3</sup> of acidified potassium permanganate for complete titration. Calculate:
- (i) number of moles of oxalic acid solution in 250 ml solution; (H = 1, C = 12, O = 16) (3 marks)
- (ii) moles of oxalic acid in 25 ml solution; (2 marks)
- (iii) moles of permanganate ions; (3 marks)
- (iv) concentration of permanganate ions solution in moles per litre. (3 marks)
- (d) State **two** possible sources of errors in a volumetric analysis. (2 marks)

18. Table I gives information concerning elements A, B, C, D and E.

Table I

ELEMENT	ATOMIC NUMBER	MELTING POINT
A	11	97.8
B	13	660
C	14	1410
D	17	-101
E	19	63.7

- (a) Write the electron arrangement for the ions formed by elements B and D. (2 marks)
- (b) Identify the element which is the most reactive:
- (i) metal; (1 mark)
- (ii) non-metal. (1 mark)
- (c) State the period and the group to which element E belongs. (2 marks)
- (d) Explain why:
- (i) element E loses its outermost electrons more readily than A. (3 marks)
- (ii) melting point of element B is higher than that of A. (2 marks)
- (e) Draw an electronic diagram to show bonding between elements C and D. (4 marks)
- (f) Write an equation for the reaction between element A and  $H_2O$ . (1 mark)
- (g) Describe how a solid mixture of the sulphate of element E and lead sulphate can be separated into solid samples. (4 marks)
19. (a) Identify the functional group in each of the following:
- (i)  $C_2H_6O$  (1 mark)
- (ii)  $C_2H_4O_2$  (1 mark)
- (b) Explain how burning can be used to distinguish between ethane and ethyne. (3 marks)

- (c) Draw the structural formula of the third member of the homologous series of ethyne. (2 marks)
- (d) Figure 2 shows a series of reactions starting with ethanol.

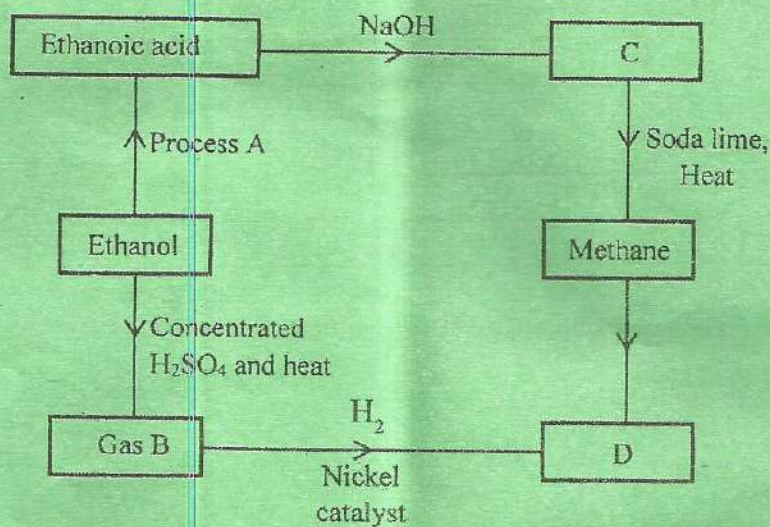


Fig. 2

- (i) Name:
- (I) process A; (1 mark)
- (II) substances B and C. (2 marks)
- (ii) (I) Write a balanced equation for the formation of substance D. (1 mark)
- (II) Identify substance D. (1 mark)
- (iii) State **one** use of methane. (1 mark)
- (e) Calcium in 20 cm<sup>3</sup> blood serum sample required 2.5 cm<sup>3</sup> of 2 × 10<sup>-4</sup>M EDTA for complete reaction. Calculate the concentration of calcium in moles per litre. (7 marks)

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