

2915/I04  
ORGANIC AND INORGANIC CHEMISTRY I  
Oct./Nov. 2022  
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL  
DIPLOMA IN ANALYTICAL CHEMISTRY  
MODULE I

ORGANIC AND INORGANIC CHEMISTRY 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 THREE questions from section B.*

*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.*

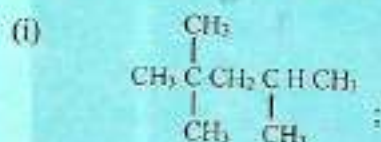
*Candidates should answer the questions in English.*

**This paper consists of 8 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 (40 marks)**  
*Answer ALL questions in this section.*

1. (a) Give the IUPAC names of the following hydrocarbons:



(1 mark)



(1 mark)

(b) Draw the structures of the following compounds.

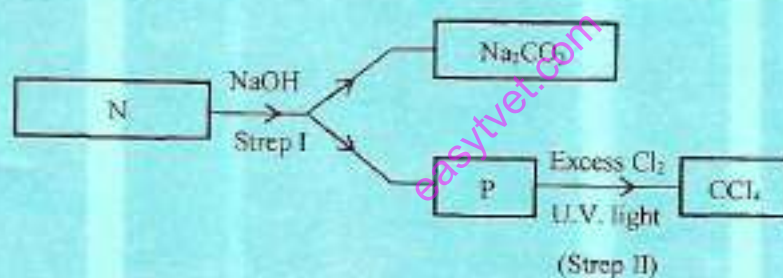
(i) 3-bromo-3-methylpentane.

(1 mark)

(ii) But-2-ene.

(1 mark)

2. Study the following flowchart and answer the questions that follow.



(a) Identify compound:

(i) N;

(1 mark)

(ii) P.

(1 mark)

(b) Write an equation for the reaction between N and sodium hydroxide.

(1 mark)

(c) State one use of compound P.

(1 mark)

3. Complete the following equations and name the organic products formed:

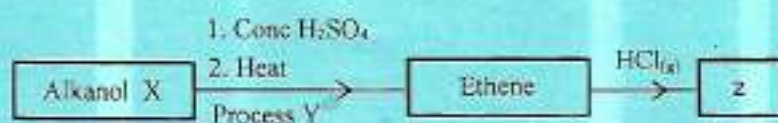


(2 marks)



(2 marks)

4. The following scheme shows reactions starting with alkanol X



- (a) Write the formula of:
- (i) alkanol X; (1 mark)
  - (ii) compound z. (1 mark)
- (b) Name:
- (i) process Y; (1 mark)
  - (ii) compound z. (1 mark)
5. A sample of ethanol was heated in the presence of concentrated sulphuric acid and a solution of potassium permanganate in distilled water. The mixture was allowed to cool before it was distilled.
- (a) Name the main compound collected as a distillate. (1 mark)
- (b) State the colour of the solution mixture:
- (i) before heating; (1 mark)
  - (ii) after heating. (1 mark)
- (c) Explain the observations in (b). (1 mark)
6. (a) Write the full spdf electronic configuration of the following elements:
- (i) potassium; (1 mark)
  - (ii) lithium. (1 mark)
- (b) Name the elements whose electronic configurations are:
- (i)  $1S^2 2S^2 2P^6 3S^2 3P^6 4S^2$ ; (1 mark)
  - (ii)  $1S^2 2S^2 2P^6 3S^2$ . (1 mark)

7. Table I gives information on elements A, B, C and D which are in the same group of the periodic table. Use the information to answer the questions that follow.

Table I

Element	First ionization energy ( $\text{KJmol}^{-1}$ )	Atomic radius (nm)
A	520	0.15
B	500	0.19
C	420	0.23
D	400	0.25

- (a) Arrange the elements in order of reactivity starting with the most reactive. (2 marks)
- (b) State and explain the relationship between the variations in the first ionization energies and the atomic radii. (2 marks)
8. Table 2 gives information about elements I, II, III and IV which belong to the same period of the periodic table.

Table 2

Element	I	II	III	IV
Atomic radii (nm)	0.117	0.186	0.099	0.143
Electrical conductivity	Poor	Good	Poor	Good

- (a) Arrange the elements in the order they would appear in the period. Give a reason. (2 marks)
- (b) Select the element which is the better conductor of electricity. Give a reason. (2 marks)
9. List any **four** diagonal relationships between lithium and magnesium. (4 marks)
10. Name the elements associated with the following flame colours:
- (a) red; (1 mark)
- (b) golden yellow; (1 mark)
- (c) orange; (1 mark)
- (d) green. (1 mark)

**SECTION B (60 marks)**

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

- H. (a) State the Markonikov's rule. (2 marks)
- (b) Outline a **three** step reaction mechanisms for acid catalysed hydration of ethene. (8 marks)
- (c) When a hydrocarbon was completely burnt in oxygen, 4.2 g of carbon (IV) oxide and 1.71 g of water were formed. Determine the empirical formula of the hydrocarbon (C = 12, H = 1, O = 16). (10 marks)
12. (a) Draw the structure of the second member of the alkyne homologous series. (1 mark)
- (b) Study the following chart and answer the questions that follow.



- (i) state the conditions and reagents necessary for the reaction in steps:
- (I) I; (1 mark)
- (II) II. (3 marks)
- (ii) Give the names of:
- (I) products A and B; (2 marks)
- (II) processes in steps II, III and IV. (3 marks)
- (iii) State the industrial application of the process in step II. (2 marks)

- (c) Table III gives the formulae of four components W, X, Y and Z.

Table 3

Compound	Formula
W	$C_2H_6O$
X	$C_3H_6$
Y	$C_3H_6O_2$
Z	$C_3H_8$

- (i) name the homologous series to which each compound belongs. (4 marks)
- (ii) giving a reason in each case, select the letter, which represents a compound that:
- (I) decolourises bromine in the absence of U.V light; (2 marks)
- (II) gives effervescence when reacted with aqueous sodium carbonate. (2 marks)
13. (a) Figure 1 shows a sketch diagram of a mass spectrometer. Use it to answer the questions that follow.

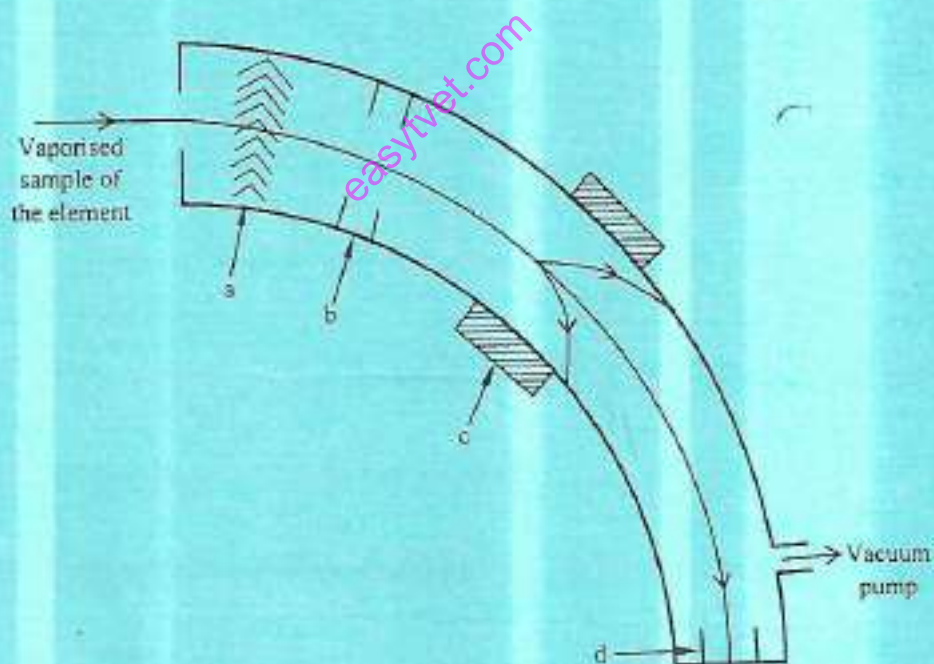


Fig. 1

- (i) name the parts labelled a, b, c and d. (4 marks)
- (ii) explain the purpose of each of the parts named in a (i). (8 marks)

(b) A mass spectrum for the isotopes of lead showed the following relative abundances:

2%  $^{204}\text{Pb}$ ;

25%  $^{206}\text{Pb}$ ;

21%  $^{207}\text{Pb}$ ;

51%  $^{208}\text{Pb}$ .

Calculate the relative atomic mass of lead from this data.

(4 marks)

(c) List four general properties of ionic compounds.

(4 marks)

14. (a) The atomic numbers of elements X and Z are 12 and 14 respectively.

(i) explain the differences between the melting points of their oxides; (4 marks)

(ii) the oxides of elements X and Z were dissolved in water. State whether the resulting solutions were acidic or basic. (2 marks)

(b) Table 4 gives information on some ions of group I and II elements.

Table 4

Ion	Electronic configuration	Ionic radius (nm)
$\text{Na}^+$	2.8	0.095
$\text{K}^+$	2.8.8	0.133
$\text{Mg}^{2+}$	2.8	0.065
$\text{Ca}^{2+}$	2.8.8	0.099

Explain why the ionic radius of:

(i) potassium is greater than that of sodium; (2 marks)

(ii) magnesium is smaller than that of sodium; (2 marks)

(c) Using dots (.) and cross (x) to represent outermost electrons, draw a diagram to show the bonding in the compound formed when calcium reacts with oxygen. (4 marks)

(d) Explain why:

(i) liquid ammonia is a good solvent for alkali metals; (3 marks)

(ii) solutions of alkali metals in liquid ammonia are deep blue in colour. (3 marks)

15. (a) Give the IUPAC names of the following compounds:
- (i)  $C_2H_5OC_2H_5$  ; (1 mark)
- (ii)  $CH_3CH_2CH_2\underset{\substack{| \\ OCH_3}}{CH}CH_2CH_3$  (1 mark)
- (b) State the conditions and the reagents needed in each of the following reactions:
- (i)  $2C_2H_5OH \xrightarrow[\text{(i)}]{\text{(ii)}} C_2H_5OC_2H_5 + H_2O$  ; (2 marks)
- (ii)  $C_2H_5OH \xrightarrow[\text{(i)}]{\text{(ii)}} C_2H_4 + H_2O$  (2 marks)
- (c) State two uses of:
- (i) diethyl ether. (2 marks)
- (ii) ethanol. (2 marks)
- (d) (i) Define the term radioactivity. (1 mark)
- (ii) Arrange the three radioactive radiations in order of:
- (I) penetrating strength starting with the most penetrating; (3 marks)
- (II) ionising strength starting with the most ionising. (3 marks)
- (e) The electronic arrangement of the ion of element Q is 2.8.8. If the formula of the ion is  $Q^{2+}$ . State:
- (i) group and the period to which Q belongs; (2 marks)
- (ii) electronic configuration of the atom of element Q. (1 mark)

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