

**2023**

( Held in 2024 )

**CHEMISTRY**

Paper : CHMMAJ1014

( **Fundamentals of Chemistry—I** )

Full Marks : 50

Pass Marks : 20

Time : 2 hours

*The figures in the margin indicate full marks  
for the questions*

1. Choose the correct answer : 1×5=5

(a) According to de Broglie's concept, the correct relationship is

(i)  $\lambda = cv$

(ii)  $h = m\nu\lambda$

(iii)  $E = h\nu$

(iv)  $E = \frac{hc}{\lambda}$

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- (b) The shape of s-orbital is
- (i) dumbbell
  - (ii) conical
  - (iii) spherical symmetrical
  - (iv) double dumbbell
- (c) The correct expression for root-mean-square velocity is

$$(i) C_{r.m.s.} = \sqrt{\frac{2RT}{M}}$$

$$(ii) C_{r.m.s.} = \sqrt{\frac{8RT}{\pi M}}$$

$$(iii) C_{r.m.s.} = \sqrt{\frac{3RT}{\pi M}}$$

$$(iv) C_{r.m.s.} = \sqrt{\frac{3RT}{M}}$$

- (d) Which of the following is an electrophile?
- (i)  $\text{AlCl}_4^-$
  - (ii)  $\text{BCl}_3$
  - (iii)  $\text{NH}_3$
  - (iv)  $\text{CH}_3\text{OH}$

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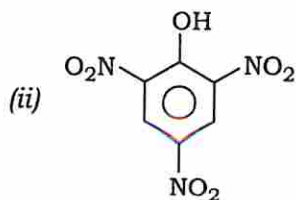
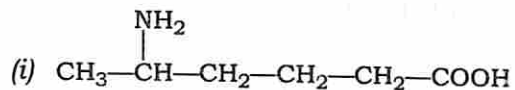
- (e) The most stable carbocation is
- (i)  $(\text{C}_6\text{H}_5)_3\text{C}^+$
  - (ii)  $(\text{C}_6\text{H}_5)_2\text{CH}^+$
  - (iii)  $\text{C}_6\text{H}_5\text{CH}_2^+$
  - (iv) tropylium cation

2. Answer any five of the following questions :  
2×5=10

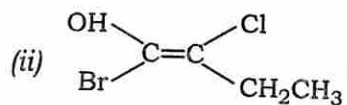
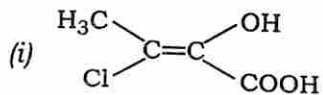
- (a) State Hund's rule of maximum multiplicity and apply it to the electronic configuration of oxygen atom.
- (b) Define ionization enthalpy. Write an application of ionization enthalpy.
- (c) Calculate the most probable speed of oxygen molecule at 27 °C.
- (d) What is meant by compressibility factor? Write the names of two gases showing positive deviation at all pressures.
- (e) What are nucleophiles? Give two examples of it.

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- (f) Write the IUPAC names of the following compounds :



- (g) Assign *E* and *Z* configurations for the following compounds :



3. Answer any *five* of the following questions :

5×5=25

- (a) Define racemic mixture. What is meant by the resolution of a racemic mixture? Describe the chemical method for resolving a racemic mixture. 1+1+3=5
- (b) Write short notes on the following :  $2\frac{1}{2}\times 2=5$
- (i) Carbenes
- (ii) Meso compounds

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- (c) What is meant by the law of equipartition of energy? Show that the kinetic energy for each degree of freedom is  $\frac{1}{2}kT$  per molecule. 2+3=5

- (d) Calculate  $P_c$ ,  $T_c$  and  $V_c$  for real gases from van der Waals' equation. Prove that for a gas obeying van der Waals' equation

$$\frac{P_c V_c}{RT_c} = \frac{3}{8} \quad 3+2=5$$

- (e) Derive van der Waals' equation of state for real gases.

- (f) Write the postulates of Bohr's theory. Write two limitations of Bohr's theory. 3+2=5

- (g) What is meant by ionic radius? Describe an experimental method to determine ionic radii. 1+4=5

- (h) Describe Slater's rule for the calculation of effective nuclear charge and shielding constant.

4. Answer any *one* of the following questions : 10

- (a) Write the postulates of kinetic theory of gases. Derive the kinetic gas equation. 3+7=10

- (b) (i) What are carbocations? How are they generated? Explain the structure of carbocation. Write the factors on which relative stabilities of carbocations depend.  $1+1+2+3=7$
- (ii) What are enantiomers and diastereomers? Explain. 3

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