

63(FY) SEM-1/MAJ1/CHMMAJ1014

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

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

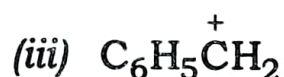
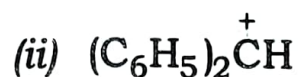
(iii) $C_{r.m.s.} = \sqrt{\frac{3RT}{\pi M}}$

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

(d) Which of the following is an electrophile?

- (i) $AlCl_4^-$
- (ii) BCl_3
- (iii) NH_3
- (iv) CH_3OH

(e) The most stable carbocation is



(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.

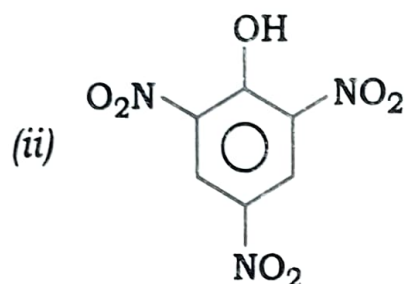
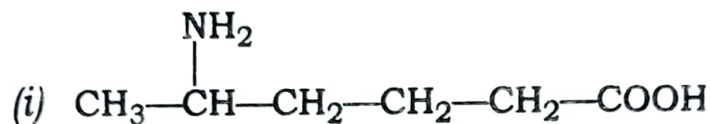
(c) Calculate the most probable speed of oxygen molecule at 27 °C.

(d) What is meant by compressibility factor? Write the names of two gases showing positive deviation at all pressures.

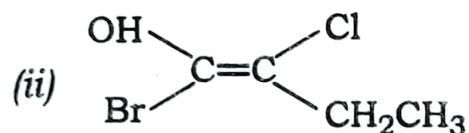
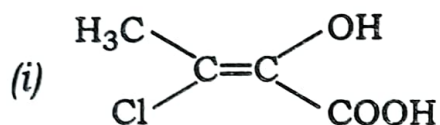
(e) What are nucleophiles? Give two examples of it.

(4)

(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 : 2½×2=5

(i) Carbenes

(ii) Meso compounds

(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

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

(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

(6)

- (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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