

1/EH-23 (i) (Syllabus-2015)

2 0 1 7

(October)

CHEMISTRY

(Elective/Honours)

(**General Chemistry-I**)

(Chem-EH-101)

Marks : 56

Time : 3 hours

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

SECTION—I

(**Inorganic**)

(Marks : 19)

1. (a) Write down the Schrodinger wave equation for an electron propagating in three dimension in space and explain the terms involved. Write down the physical significance of ψ and ψ^2 .

$$1+1\frac{1}{2}+1=3\frac{1}{2}$$

- (b) Derive the de Broglie's equation for the wave-duality of electron.

2

(2)

- (c) Define nuclear binding energy. Calculate the packing fraction, mass defect and energy released in the formation of argon atom ${}^{40}_{18}\text{Ar}$.

[Isotopic mass of Ar = 39.96238 a.m.u.;
mass of proton = 1.007825 a.m.u.;
mass of neutron = 1.008665 a.m.u.;
mass of electron = 9.1×10^{-31} kg]

$$\frac{1}{2} + 1\frac{1}{2} = 2$$

- (d) What is meant by periodicity of elements? Explain why alkali elements have larger radii than alkaline earth elements.

$$1 + 1 = 2$$

OR

2. (a) Write down the complete wave function for s-orbitals and draw the shape of 3s-orbital.

$$1 + 1 = 2$$

- (b) What is the effective nuclear charge felt by a 2p-electron of a nitrogen atom? What will be the effective nuclear charge felt by its 1s-electron?

$$1\frac{1}{2} + 1\frac{1}{2} = 3$$

- (c) Comparatively differentiate between fusion and fission.

$$2$$

- (d) Explain Diagonal Relationship with suitable examples.

$$1\frac{1}{2}$$

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(3)

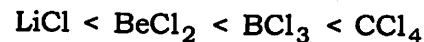
- (e) Write down the electronic configuration of chromium (At. No. = 24) and nickel (At. No. = 28).

1

3. (a) What is VSEPR theory? Write down the main points of this theory.

$$\frac{1}{2} + 2\frac{1}{2} = 3$$

- (b) The covalent character of LiCl, BeCl₂, BCl₃ and CCl₄ is in the order



Explain.

1

- (c) Differentiate between n-type and p-type semiconductors.

2

- (d) What is radius-ratio rule? How can it help to predict the structure of an ionic crystal?

$$1 + 2\frac{1}{2} = 3\frac{1}{2}$$

OR

4. (a) Differentiate between inter- and intra-molecular hydrogen bonding, giving suitable examples.

2

- (b) Explain the metallic properties of elements on the basis of free electron theory.

2

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(Turn Over)

(4)

- (c) Discuss the Born-Haber cycle for experimental determination of lattice energy. 2½
- (d) Discuss the geometry of the molecules having (on the basis of VSEPR theory)—
- (i) two lone pairs and two bond pairs;
 - (ii) one lone pair and three bond pairs;
 - (iii) one lone pair and four bond pairs;
 - (iv) one lone pair and five bond pairs. 2
- (e) On the basis of hybridization, discuss the geometry of PCl_5 . 1

SECTION—II

(Organic)

(Marks : 19)

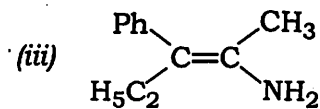
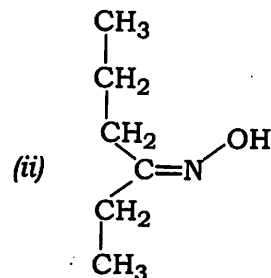
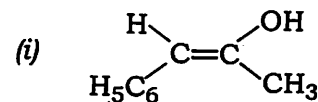
5. (a) Draw the molecular orbital pictures of the following molecules/species, mentioning the types of hybridization, bond angles and shapes in each case : 2
- (i) CH_3^\ominus
 - (ii) $\text{H}_2\text{C}=\text{C}=\text{CH}_2$

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(Continued)

(5)

- (b) Why is Lewis concept of acids and bases more comprehensive than Bronsted-Lowry concept? Explain with suitable example. 2
- (c) Alpha-halogenated carboxylic acids are more acidic than simple carboxylic acids. Explain. 2
- (d) Using sequence rule, designate *E* or *Z* Syn or Anti for the following molecules : ½×3=1½



- (e) Draw the different conformers of ethane. Which conformer is most stable and why? 2

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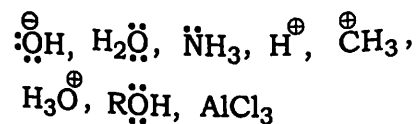
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(6)

OR

6. (a) The melting point *o*-nitrophenol is 44 °C while that of the *para*-isomer is 114 °C. Explain. 2

(b) Classify the following into electrophiles and nucleophiles : 2



(c) Presence of chiral centres is not the necessary condition for the compound to be optically active. Explain with a suitable example. 2

(d) Why is benzyl cation more stable than tertiary butyl cation? 2

(e) Write a note on any one of the following : 1½

(i) Racemic mixture

(ii) Meso-compounds

7. (a) Write the method of preparation of alkanes by Corey-House method. 2½

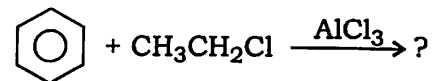
(b) State Markownikov's rule and give an example. 2

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(7)

(c) Complete the following reaction with mechanism : 2

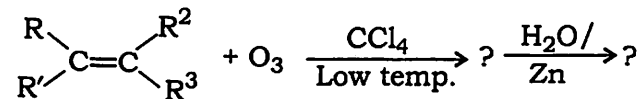


(d) What are activating and deactivating groups? State whether —CHO group is activating or deactivating group and why. 3

OR

8. (a) Explain Baeyer's strain theory of cycloalkanes. 2

(b) Complete the following reactions : 2



(c) Write a stepwise reaction mechanism of induced light chlorination of methane. 2

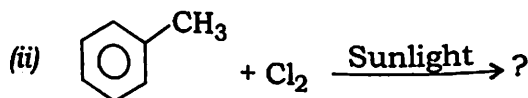
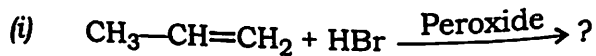
(d) Benzene undergoes electrophilic substitution reactions whereas ethylene undergoes electrophilic addition reactions. Explain. 1½

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(Turn Over)

(8)

(e) Suggest the products of the following reactions : $1 \times 2 = 2$



SECTION—III

(Physical)

(Marks : 18)

9. (a) Mention the conditions under which the real gases tend to obey the ideal gas law. Write down the van der Waals equation of state and explain the terms therein. $1\frac{1}{2} + 1\frac{1}{2} = 3$
- (b) Deduce Boyle's law and Graham's law from the gas law expression obtained from kinetic theory of gases. $1\frac{1}{2} + 1\frac{1}{2} = 3$
- (c) What are liquid crystals? Why are they so called? Classify them. $1 + 1 + 1 = 3$

OR

10. (a) Mention the factors introduced by van der Waals to modify the ideal gas equation. Write down the van der Waals equation for 0.1 mole of a real gas. $2 + 1 = 3$

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(Continued)

(9)

- (b) What is coefficient of viscosity? Express its dimension and its SI unit. $1 + 1 + 1 = 3$
- (c) Mention the factors that affect viscosity and surface tension of a liquid. $1\frac{1}{2}$
- (d) What are the applications of liquid crystals? $1\frac{1}{2}$

11. (a) Define (i) crystal and (ii) unit cell. $1\frac{1}{2} + 1\frac{1}{2} = 3$
- (b) State and explain the laws of constancy of interfacial angles and law of rational indices. $1 + 2 = 3$
- (c) What are the different ways of purifying colloids? Discuss them briefly. $1 + 2 = 3$

OR

12. (a) Discuss briefly the different types of packing in crystals. 3
- (b) A crystal plane has intercepts on the three axes of crystal in the ratio $\frac{3}{2} : 2 : 1$. Find the Miller indices of the plane. 3
- (c) Discuss briefly the peptization and Bredig's method of preparation of colloids. 3

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