

Odd Semester, 2020

(Held in March, 2021)

CHEMISTRY

(Elective/Honours)

(Chem-EH-101)

(General Chemistry—I)

Marks : 56

Time : 3 hours

*The figures in the margin indicate full marks
for the questions***UNIT—I****(Inorganic)**

(Marks : 19)

1. (a) State and explain the Heisenberg uncertainty principle. What are its significances? 2+½=2½
- (b) For each energy level K , L , M , N , find out the maximum number of electrons in each shell. 1

- (c) Define nuclear binding energy. Calculate the binding energy in MeV per nucleon of oxygen atom ${}^8\text{O}^{16}$ which has a mass of 15.994910 a.m.u., mass of neutron = 1.008665 a.m.u., mass of proton = 1.007277 a.m.u. and mass of electron = 0.0005486 a.m.u. (Given that 1 MeV = 931.5 a.m.u.) ½+1½=2
- (d) Define ionisation enthalpy. The first ionisation energy of Al is lower than that of Mg. Explain. ½+1½=2
- (e) What is the cause of periodicity in the modern periodic table? 2

OR

2. (a) State Hund's rule of maximum multiplicity. Write down the most stable electronic configuration for Cr and Mn, and explain for their extra stability. 1+1+1=3
- (b) Write down the first-order rate equation of radioactive disintegration. The half-life of radium (molar mass = 226 g mol⁻¹) is 1580 years. Show that 1 gm of radium gives 3.70×10^{10} disintegration per second. 1+2=3
- (c) Mention few important applications of radioactive isotopes in the field of medicine. 1½
- (d) What are the differences between electron gain enthalpy and electro-negativity? 2

(3)

3. (a) Mention in brief the basic concept of the valence bond theory. $1\frac{1}{2}$
- (b) Predict the shape of the following molecules using VSEPR theory and mention the hybridisation of the central atom : (i) BF_3 , (ii) H_2O $1+1=2$
- (c) Define dipole moment. Mention various factors affecting the magnitude of the dipole moment. $\frac{1}{2}+1\frac{1}{2}=2$
- (d) What is radius ratio? Using this concept, write down the possible coordination number and arrangement of BeS . The ionic radii of Be^{2+} and S^{2-} are 59 p.m. and 170 p.m. respectively. $\frac{1}{2}+1\frac{1}{2}=2$
- (e) How does *n*-type semiconductor differ from the *p*-type semiconductor? 2

OR

4. (a) Draw the molecular orbital energy-level diagram for N_2 molecule and calculate its bond order. 2
- (b) Define lattice energy for an ionic solid. Discuss the Born-Haber cycle for the formation of ionic crystal NaCl . $1+2=3$
- (c) Giving reasons, state whether Pb^{2+} or Pb^{4+} will have greater polarizing power. 1
- (d) What is a hydrogen bond? Mention the different types of hydrogen bonding in molecules with examples. 2
- (e) Write a short note on the band theory in solids. $1\frac{1}{2}$

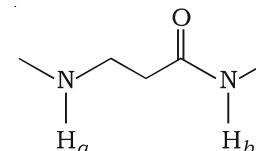
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UNIT—II

(Organic)

(Marks : 19)

5. (a) Draw the molecular orbital picture of methanal indicating the hybridisation, bond angles and shape of the molecule. 2
- (b) Which of the following compounds is expected to have a higher boiling point and why? 2
o-nitrophenol or *p*-nitrophenol
- (c) Account for the following : 2
(i) Formic acid is stronger than acetic acid.
(ii) Benzyl carbanion is more stable than ethyl carbanion.
- (d) Which proton (H_a or H_b) is more acidic and why? Explain on the basis of stability of the conjugate base. $1\frac{1}{2}$



- (e) Define resolution. Explain why racemic tartaric acid can be resolved but not mesotartaric acid. 2

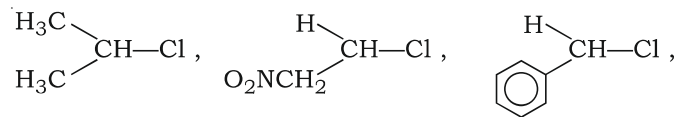
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OR

6. (a) Discuss using suitable examples, the effect of sp^3 , sp^2 and sp hybridisations on the C—C bond length and bond energy of molecules. 3

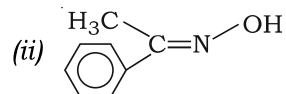
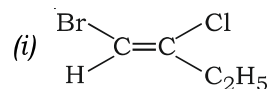
- (b) Define Lewis acids and bases. Give examples. 2

- (c) In which of the following compounds, the C—Cl bond ionisation will give the most stable carbocation and why? 2



- (d) What are carbenes? How are they formed? 1½

- (e) Assign *E*- and *Z*-nomenclature for the following molecules : ½+½=1

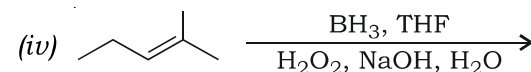
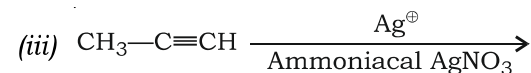
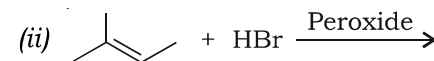
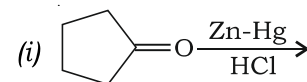


7. (a) "Wurtz reaction cannot be employed for the preparation of methane." Explain. 2

(6)

- (b) What are the limitations of the Baeyer's strain theory? 1½

- (c) Complete the following reactions : 1×4=4



- (d) Starting from benzene, how will you synthesize—

(i) ethyl benzene;

(ii) nitrobenzene? 2

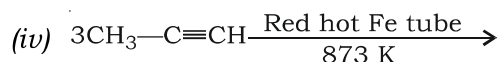
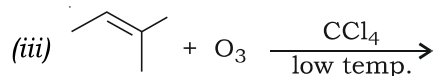
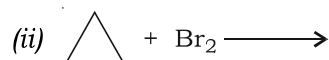
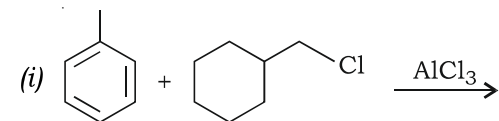
OR

8. (a) Suggest a suitable method for the preparation of propane from a concentrated aqueous solution of sodium salt of butanoic acid. Give equations. 2

- (b) How will you obtain benzaldehyde from benzene? Give reaction. 1½

(7)

(c) Complete the following reactions : $1 \times 4 = 4$



(d) "The presence of any activating group in a benzene ring directs the electrophile to the *ortho*- and *para*-position." Elaborate. 2

UNIT—III

(Physical)

(Marks : 18)

9. (a) Deduce—

(i) Boyle's law from kinetic gas equation;

(ii) Charles' law from kinetic gas equation. $1\frac{1}{2} + 1\frac{1}{2} = 3$

(b) Derive van der Waals equation of state. 4

(c) Define—

(i) Boltzmann constant ;

(ii) compressibility factor. $1 + 1 = 2$

(8)

OR

10. (a) What is meant by coefficient of viscosity? What is the effect of density on viscosity? $2 + 1 = 3$

(b) Mention the different types of liquid crystals. 3

(c) Explain the following terms : $1\frac{1}{2} + 1\frac{1}{2} = 3$
(i) Surface tension
(ii) Molar refraction

11. (a) Explain the following terms : $2 + 2 = 4$
(i) Pseudo-unimolecular reactions
(ii) Energy of activation

(b) Define vacancy defect and interstitial defect in crystals. $1\frac{1}{2} + 1\frac{1}{2} = 3$

(c) State the law of constancy of interfacial angles. 2

OR

12. (a) What is the effect of temperature on the activation energy of a reaction? 2

(b) What is a second-order reaction? Derive an expression for rate constant of a second-order reaction, where the reactants are same. $1 + 3 = 4$

(c) Calculate the Miller indices of the crystal planes having the following intercepts on the three crystallographic axes : $1\frac{1}{2} + 1\frac{1}{2} = 3$

(i) $\frac{1}{2} : 1 : 2$

(ii) $2 : 3 : 6$

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