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3 (Sem-1/CBCS) CHE HC 1

2024

CHEMISTRY

(Honours Core)

Paper : CHE-HC-1016

(Inorganic Chemistry-I)

Full Marks : 60

Time : Three hours

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

1. Answer **all** questions from the following :
1×7=7

(a) Choose the correct answer :

Bohr's radius for the H atom is

(i) $a_0 = \frac{\hbar^2 \epsilon_0}{4\pi^2 e^2}$

(ii) $a_0 = \frac{\hbar^2 \epsilon_0}{2\pi^2 m e^2}$

Contd.



$$(iii) \quad a_0 = \frac{4\pi\epsilon_0\hbar^2}{me^2}$$

$$(iv) \quad a_0 = \frac{\hbar^2\epsilon_0}{8\pi^2me^2}$$

(b) Arrange the following in decreasing order of their electronegativity:
O, S, Se, Te

(c) Mention the hybridisation of central atom in PH_3 .

(d) Name the region of electromagnetic spectrum in which Balmer series lie.

(e) Write the missing term in the following equation to calculate lattice energy in the formation of $NaCl$ compound:

$$\Delta H_f = S + ? + I.E. + E.A. + U_0$$

(f) Which of the following has maximum bond angle?

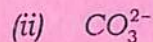


(g) Predict the number of radial nodes for 3s atomic orbital.

2. Answer **all** questions from the following :
 $2 \times 4 = 8$

(a) State and explain Pauli's exclusion principle.

(b) Draw the resonance structures of the following :



(c) Electron affinity of noble gases is positive. Justify the statement.

(d) Draw the shapes of five d -orbitals.

3. Answer **any three** questions from the following : $5 \times 3 = 15$

(a) (i) State giving reason, which will have greater polarising power in the following?



(ii) $CuCl$ is less ionic than $NaCl$. Why? 1

(iii) Explain why dipole moment of NH_3 is greater than NF_3 . 2

(b) What is standard electrode potential? How can it be applied to predict the feasibility of a reaction? $2 + 3 = 5$

(c) Define ionisation enthalpy. Explain the factors on which it depends. Why is first ionisation enthalpy of nitrogen more than that of oxygen? $1 + 3 + 1 = 5$

- (d) Calculate the lattice energy of sodium chloride.

Given,

Born exponent = 9

Madelung constant for NaCl = 1.7475

Ionic radius of Na^+ = 0.95 Å

Ionic radius of Cl^- = 1.81 Å

- (e) (i) State and explain Hund's rule of maximum multiplicity. Why are half and fully filled orbitals most stable? 3

- (ii) 3f orbital does not exist. Why? 1

- (iii) Arrange the following in increasing order of their energies : 1

3p, 3d, 4s, 4p

4. Answer **any three** questions from the following : 10×3=30

- (a) (i) Construct the Hamiltonian operator from the classical expressions for kinetic and potential energies and formulate Schrödinger's wave equation. 6

- (ii) Write Schrödinger wave equation for the H-atom. 2

- (iii) Explain about eigenvalues and eigenfunctions. 2

- (b) (i) Explain about partial ionic character of covalent bond. 4

- (ii) What do you understand by intermolecular and intramolecular hydrogen bonding? Discuss with suitable examples. 2+2=4

- (iii) The shape of H_2O molecule is bent while that of CO_2 is linear. Explain this on the basis of dipole moment. 2

- (c) (i) What is Shielding effect? How is Shielding constant calculated according Slater's rule? 1+3=4

- (ii) Define electronegativity. Discuss the trend of electronegativity of elements along a period and down the group in the periodic table. 1+3=4

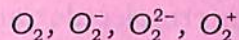
- (iii) What are isoelectronic species? Give examples. 2

- (d) (i) Draw molecular orbital energy level diagram of O_2 molecule. Predict the bond order and magnetic property of the molecule.

3+2=5

- (ii) Arrange the following in increasing order of bond length :

2



- (iii) What do you mean by bonding and antibonding molecular orbital? Which one is more stable and why?

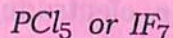
2+1=3

- (e) (i) What is meant by hybridisation of atomic orbitals?

2

- (ii) Explain the structure of *any one* of the following with the help of hybridisation concept :

3



- (iii) Mention the type of *d*-orbitals that are involved in SP^3d^2 hybridisation of SF_6 .

1

- (iv) Write a short note on VSEPR theory.

4

- (f) Write about the following :

- (i) Normalised and orthogonal wave functions 3
(ii) Electronegativity scales 4
(iii) Semiconductors 3

1. Which of the following is not a type of wave?
- Transverse wave
 - Longitudinal wave
 - Surface wave
 - Electromagnetic wave

2. Which of the following is not a type of electromagnetic wave?

- Radio waves
- Visible light
- Gamma rays
- Sound waves

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5. Which of the following is not a type of sound wave?

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