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Sr. No. of Question Paper : 1699

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Roll No.....

Unique Paper Code : 219256

Name of the Course : B.Sc. (H) Geology

Name of the Paper : GEHT 203 – Physical Chemistry

Semester : II

Duration : 3 Hours

Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions.
3. Each question carry **15** marks.

1. (a) What is  $(n + 1)$  rule ? Explain with two examples.  
(b) What is the significance of  $\Psi$  and  $\Psi^2$  ?  
(c) What are Eigen values ?  
(d) Which of the following sets of orbitals are degenerate ?
  - (i)  $2p_x, 2p_y, 2p_z$ , orbitals in N atom
  - (ii)  $3s, 3p, 3d$  orbitals in H atom
  - (iii)  $1s$  and  $2s$  orbitals in Be atom  
(e) Name the three quantum numbers of an electron which are yielded during the solution of Schrodinger wave equation.
2. (a) Which of the orbitals are not possible  $1p, 2s, 3p, 3f$ ? Give reasons.  
(b) Draw radial probability function for  $n = 3$  for hydrogen atom.

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- (c) How many degenerate d-orbitals are present in 3d-subshell ?
- (d) Explain Heisenberg's Uncertainty Principle.
- (e) List the quantum numbers of electrons in the following orbitals :  
(i) 4s      (ii) 3d      (iii) 4f
3. (a) An electron is in 4d orbital. What possible values for the quantum number  $n$ ,  $l$  and  $m$  ?
- (b) Derive Schrodinger's wave equation and explain various terms involved in it.
- (c) What do you understand by Hund's rule of maximum multiplicity ? Apply this rule in writing the electronic configurations of oxygen and nitrogen.
- (d) Write the possible values of  $l$  and  $m$  for the electron in 3p orbital.
- (e) Draw radial probability distribution curves for 3s and 3p orbitals and state the following in each case.
- (i) Number of high probability regions.
- (ii) Number of nodes.
4. (a) What are normalized and orthogonal wave functions ?
- (b) What do you mean by extensive and intensive property ?
- (c) What is the physical significance of enthalpy ?
- (d) Explain why  $C_p$  is always greater than  $C_v$ .
- (e) State and explain enthalpy of neutralization. Why it is less than  $-57.32 \text{ kJ mol}^{-1}$  when either acid or the base is weak ?
5. (a) What is thermodynamic basis of Hess's law ?
- (b) Justify the 'Second Law of Thermodynamics' which states that "The net entropy of the universe tends to increase."

- (c) Write expressions for the entropy change in the following cases :
- Temperature changes from  $T_1$  to  $T_2$  and volume changes from  $V_1$  to  $V_2$  for 1 mole of an ideal gas.
  - Temperature changes from  $T_1$  to  $T_2$  and pressure changes from  $P_1$  to  $P_2$  for 1 mole of an ideal gas.
- (d) Why is the increase in entropy of the system greater for the vaporization of a substance than for its melting ?
- (e) Consider the process of dissolving a lump of salt in a beaker of water. What is the sign of the entropy change for this process ?
6. (a) The dipole moment of HX is 1.92D and bond distance 1.2 Å. Calculate the ionic character of HX.
- (b) Arrange the following acids in increasing order of their percentage ionic character HCl, HBr, HI( Electronegativity of Cl, Br, I, H are 3.00, 2.8, 2.4,2.1 respectively)
- (c) Write notes on the following :
- Fajan's rules
  - Lattice energy
  - Born Haber's cycle
- (d) Calculate the lattice energy of NaCl crystal from the following data by the use of Born Haber cycle
- Sublimation energy(S) = 108.7 kJ/mol  
Dissociation energy for  $\text{Cl}_2(\text{D}) = 225.9 \text{ kJ/mol}$   
Ionization energy for  $\text{Na}(\text{g})(\text{I}) = 489.5 \text{ kJ/mol}$   
Electron affinity for  $\text{Cl}(\text{g})\text{E} = -351.4 \text{ kJ/mol}$   
Heat of formation of  $\text{NaCl}(\Delta H_f) = -414.2 \text{ kJ/mol}$
- (e) What is the relationship between entropy and disorder for a system ?

7. (a) The pH of rainwater collected in a certain region of the Delhi on a particular day was 4.82. Calculate the  $H^+$  ion concentration of the rainwater.
- (b) Calculate the pH of  $2 \times 10^{-4}$  M NaOH solution.
- (c) What is Buffer solution ? Explain how a buffer solution resists change in its pH.
- (d) Define solubility product. How can we predict whether a precipitate will form when two solutions are mixed ?
- (e) Calculate the molar solubility of  $Ag_2CrO_4$  in water at  $25^\circ C$  if  $K_{sp} = 9 \times 10^{-12}$ .