

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC
BRANCH: CHEMISTRY

SEMESTER : VI
SESSION : SP/19

SUBJECT: IMC6003-PHYSICAL CHEMISTRY-III

TIME: 3 Hours

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
 2. Candidates may attempt any 5 questions maximum of 60 marks.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
-

- Q.1(a) Write down the molecular orbital wave function for H_2^- molecule anion. [2]
- Q.1(b) What will be the wave function for BMO of a heteronuclear diatomic molecule AB, given the electron spends 70% of its time on the nucleus of A and 30% of its time on the nucleus of B. [4]
- Q.1(c) Derive the energy equation for the MO's in the case of H_2^+ . [6]
- Q.2(a) What are the conditions for effective linear combination of atomic orbitals? [2]
- Q.2(b) Draw and explain the potential energy diagrams for bonding and antibonding MO's of H_2 molecule. [4]
- Q.2(c) Explain the formation of σ and π bonding and antibonding MO's from 1s and 2p atomic orbitals with suitable diagrams. [6]
- Q.3(a) Comment on the free energy change of the photochemical reaction with reasons. [2]
- Q.3(b) Explain very high and very low quantum efficiencies for photochemical reactions. [4]
- Q.3(c) Describe the mechanism of energy transfer in a photosensitized reaction. Explain with the help of reactions the processes of photosensitization and quenching. [6]
- Q.4(a) How is the dipole moment calculated for a molecule AB_2 with bond angle θ ? [2]
- Q.4(b) Explain the dependence of polarizability on frequency with the help of polarization versus $\log \nu$ graph. [4]
- Q.4(c) Write down the Maxwell relation and the Lorentz-Lorentz equation. State their significance. What is polarizability volume (α')? Why is it high in case of alkali metal atoms? [6]
- Q.5(a) *p*-chlorobenzene has a zero dipole moment while *p*-dihydroxy benzene has a definite value. Explain. [2]
- Q.5(b) Discuss (only) the polarization of a molecule in an electric field. [4]
- Q.5(c) For a gaseous hydrocarbon C_nH_{2n+2} , the refractive index at STP is 1.00138. Determine the formula of the hydrocarbon, given that the R_m values for H and C are 1.10 and 2.42 $cm^3 mol^{-1}$ respectively and $V_m = 22.414 cm^3 mol^{-1}$. [6]
- Q.6(a) State Raoult's law for the lowering of vapour pressure. [2]
- Q.6(b) How is it used for determining the molar mass of a nonvolatile solute? [4]
- Q.6(c) A 5.0% aqueous solution by mass of a nonvolatile solute boils at 100.15°C. Calculate the molar mass of the solute. [Given: $k_b = 0.52 K kg mol^{-1}$] [6]
- Q.7(a) How is relative lowering of vapour pressure related to the osmotic pressure? [2]
- Q.7(b) 0.1M solution of KNO_3 has an osmotic pressure of 4.5 atm at 300K. Calculate the apparent degree of dissociation of the salt. [4]
- Q.7(c) Explain the conditions under which abnormal molar masses of solutes are obtained from the measurement of colligative properties of their solutions. [6]

:::::24/04/2019 E:::::