

Time : 3 hrs.

MM = 70

General Instructions :

- a) All questions are compulsory.
- b) There are 26 questions in total questions 1 to 5 carry one marks each, questions 6 to 12 carry two marks each question 13 to 24 carry three marks each and question 25 to 27 carry five marks each.
- c) Use of calculator is not permitted.
- d) Use log table if necessary.

(Section – A)

- Q1. How many electron can fit in the orbital for which $n=3$ $l=2$? [1]
- Q2. What is the ratio of wavelengths associated with N_2 and CO moving with same velocity? [1]
- Q3. Decide the position of an element having atomic number 114. [1]
- Q4. O_3 molecule has identical atoms. Even then it is polar, why? [1]
- Q5. Angular momentum of a moving electron in hydrogen atom is $\frac{2h}{\pi}$. What is the principle quantum number of the orbit? [1]

(Section – B)

- Q6. Define : (i) Significant figure (ii) Molality [2]
- Q7. Explain the following: (i) Hess's law (ii) Entropy [2]
- Q8. What is the total number of sigma and pi bonds in the following molecules : [2]
- (i) C_2H_2 (ii) C_2H_4
- Q9. What will be the minimum pressure required to compress 500 dm^3 of air at 1.0 bar to 200 dm^3 at 30°C . [2]
- Q10. Show that the wavelength of a moving particle is related to its kinetic energy (E) as $\lambda = \frac{h}{\sqrt{2m E}}$ [2]
- Q11. What are the name of following principles? [2]
- (i) Two electron with same spin can not be present in the same atomic orbital.
- (ii) Two conjugate properties which can not be measured accurately at the same time.
- Q12. Explain the following observations: [2]
- (i) CH_4 molecule is tetrahedral. Explain why it is not square planar?
- (ii) Why BeH_2 molecule has zero dipole moment although the $Be-H$ bonds are polar?

OR

Draw the lewis structure for the following molecules (i) $HCHO$ (ii) H_3PO_3

P.T.O.

(Section - C)

- Q13. Explain the following terms : [3]
- (i) Diagonal relationship
 - (ii) Ionisation enthalpy
 - (iii) Shielding effect
- Q14. In a reaction, $A + B_2 \longrightarrow AB_2$, Identify the limiting reagent if any, in the following reaction mixtures: [3]
- (i) 300 atoms of A + 200 molecules of B
 - (ii) 2 moles of A + 1.5 moles of B
 - (iii) 100 atoms of A + 100 molecules of B
- Q15. Neon gas is generally used in the sign board. If it emits strongly at 616 nm. Calculate [3]
- (i) Frequency of emission
 - (ii) Distance traveled by this radiation in 30 sec.
 - (iii) Number of quanta present if it produces 2J of energy.
- Q16. Predict the formula of stable binary compounds that would be formed by the combination of the following pairs of elements: (i) Lithium and oxygen (ii) Magnesium and nitrogen (iii) Phosphorous and fluorine. [3]
- Q17. (i) Which type of intermolecular forces exist in the following molecules? [2]
- (a) C_6H_6/He (b) CH_3CN/H_2S
- (ii) Why are H_2O exist as liquid but H_2S exist as gas? [1]
- Q18. Draw the curves obtained at constant temperature between, [3]
- (i) P Vs V (ii) P Vs $1/V$ (iii) P Vs PV
- Q19. The elements A and B combine to form two compounds AB_2 and A_2B_3 . When 0.1 mole of AB_2 weighs 10 gm and 0.05 mole of A_2B_3 weighs 9.0 gm. Calculate the atomic weights of A and B? [3]
- Q20. Starting with thermodynamical relationship $\Delta H = \Delta U + P\Delta V$ and $\Delta U = q + w$. derive the relationship [3]
- (i) $\Delta H = \Delta U + \Delta nRT$
 - (ii) $C_p - C_v = R$
- Q21. What do you understand by? [3]
- (i) Mendeleev's periodic law
 - (ii) Transition elements
 - (iii) Isoelectronic species
- Q22. Pay load is defined as the difference between the mass of displace air and the mass of the balloon. Calculate the pay load when balloon of radius 10 meter, mass 100 Kg is filled with Helium at 1.66 bar at $27^\circ C$. (Given : Density of air = 1.2 Kg m^{-3} and $R = 0.083 \text{ bar dm}^3 \text{ K}^{-1} \text{ mol}^{-1}$) [3]
- Q23. Explain the following terms: [3]
- (i) Rutherford's atomic model (ii) Photoelectric effect (iii) Isotone

OR

Show that enthalpy of sublimation is equal to the sum of the enthalpy of fusion and enthalpy of vaporization.

Q24. Discuss the shape of the following molecules using VSEPR model: [3]

- (i) XeF_4 (ii) PCl_5 (iii) BrF_3

(Given : atomic number of Xe = 54, Br = 35, P = 15)

(Section - E)

Q25. (A) Using s, p, d, f notations, describe the orbitals with the following quantum number. [3]

- (i) $n = 5, l = 0$ (ii) $n = 4, l = 3$ (iii) $n = 3, l = 2$

(B) An electron has speed of 40 m/s accurate upto 99.99%. What is the uncertainty in locating its position? (given $m_e = 9.11 \times 10^{-31} \text{Kg}$). [2]

OR

(A) Write the value of four quantum numbers for all the P^6 electrons. [2]

(B) Calculate the shortest wavelength in Lyman series for H-atom. [2]

Q26. (A) Write molecular orbital configuration of the following species and also calculate their bond order?

- (i) N_2 (ii) N_2^+ (iii) N_2^- [3]

(B) Explain the formation of H_2 molecule on the basis of valence bond theory. [2]

OR

(A) Name two faulty assumptions which lead to Vanderwall's gas equation. [2]

(B) Suppose collisions among the gas molecules are not elastic, then what would be the effect on
(i) pressure of the gas (ii) kinetic energy of the molecules [2]

(C) Under what conditions real gases are expected to behave more closely to an ideal gas? [1]

Q27. (A) Explain the following with suitable example: [3]

- (i) Intensive property (ii) state function (iii) specific heat capacity

(B) For the reaction at 298K, $2\text{A} + \text{B} \longrightarrow \text{C}$, $\Delta H = 400 \text{KJ/mol}$, $\Delta S = 0.2 \text{J K}^{-1} \text{mol}^{-1}$. At what temperature will the reaction become spontaneous considering ΔH and ΔS to be constant over the temperature range? [2]

OR

(A) Predict the feasibility of a reaction, when: [2]

(i) ΔH decreases and ΔS increases

(ii) Both ΔH and ΔS decreases.

(B) The standard free energy change of a reaction is found to be zero. Calculate the equilibrium constant. [2]

(C) Predict whether the following reaction is exothermic or endothermic? [1]


