

(39 & A-14)

SEAT No. \_\_\_\_\_

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SARDAR PATEL UNIVERSITY  
B.Sc. (Semester - VI) Examination  
Physical Chemistry  
US06CCHE05

Date: - 04/04/2018

Time: 10:00 am to 1:00 pm.

Day: - Wednesday

Total Marks: 70

Note: - 1. Figure to the write indicates the full marks.  
2. All questions are to be attempt.

Q.1. Choose the correct option and rewrite the following. [10]

- The total degree of freedom possessed due to vibrational motion of the linear molecule is \_\_\_\_\_.  
(a)  $3N-5$  (b) 2  
(c) 3 (d)  $3N-6$
- The \_\_\_\_\_ spectra involve transitions of electrons from one electronic level to another.  
(a) Molecular (b) Atomic  
(c) Nuclear (d) NMR
- Which of the following substance possess dipole moment?  
(a)  $O_2$  (b)  $N_2$   
(c) HF (d)  $CH_4$
- The ratio of the sines of angle of incidence, I and that of angle of refraction r is called \_\_\_\_\_.  
(a) Dipole Moment (b) Viscosity  
(c) Diffraction (d) Refractive Index
- The value  $76.57 + 12.47 \ln M + 20.79 \ln T$  is for \_\_\_\_\_ entropy.  
(a) Translational (b) Linear Rotational  
(c) Non Linear Rotational (d) Vibrational
- If  $\Delta G$  is zero the reaction can proceed \_\_\_\_\_.  
(a) Spontaneously  
(b) Reversibly  
(c) reverse reaction can proceed spontaneously  
(d) All the above
- The statement of \_\_\_\_\_ law, "the entropy of all the perfect crystalline pure substance must be the same at absolute zero of temperature".  
(a) First (b) Second (c) Third (d) Zeroth
- Milk is example of \_\_\_\_\_.  
(a) sol (b) True Solution  
(c) Gel (d) Emulsion
- In true solutions, the diameter of the dispersed particles is in the range from \_\_\_\_\_.  
(a)  $1A^0$  to  $10A^0$  (b)  $10A^0$  to  $100A^0$   
(c)  $100A^0$  to  $200A^0$  (d)  $200A^0$  to  $500A^0$

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(C.P.T.O.)

10. A gel is a colloidal system in which a \_\_\_\_\_ is dispersed in a \_\_\_\_\_ medium.

- (a) Solid, liquid (b) liquid, solid (c) liquid, liquid (d) liquid, gas

**Q.2 Answer the following. [Any Ten] [20]**

1. What is selection rule? Define Forbidden transition n and Allowed transition.
2. Differentiate between IR spectroscopy and microwave spectroscopy.
3. Define : (a) Scissoring (b) Wagging
4. HCL molecule having dipole moment 1.03D and the inter nuclear separation is  $1.275 \text{ \AA}$ . Calculate the percent ionic character of the bond.
5. Explain the Laevo and Dextro rotatory isomers of lactic acid with suitable diagram.
6. Explain the concept of refractive index with suitable diagram.
7. Derive the expression for the rotational entropy for linear molecule.
8. What is free energy? Write the criteria for spontaneous process.
9. Give the limitations of Trouton's rule.
10. The coagulation of 100ml a colloidal sol of gold is completely prevented by addition of 0.25gm of starch to it before adding 1ml of 10% NaCl solution. Find out the gold number of Starch.
11. What are the Lyophilic sols? Give suitable example.
12. Define : (a) Peptization (b) Reversible sol

**Q.3 (a)** From the definition of the centre of mass and moment of inertia I, Show that for a diatomic molecule moment of inertia is equal to product of reduced mass and the square of the bond length of a rigid rotor model and prove that  $2B = h^2/4\pi^2 Ic$ . [05]

**(b)** Calculate the theoretical number of Vibrational degree of freedom in (a) HCN (b) CO<sub>2</sub> (c) CH<sub>4</sub> (d) C<sub>6</sub>H<sub>5</sub>CH<sub>3</sub> (e) N<sub>2</sub>O [05]

**OR**

**Q.3 (a)** Sketch and explain P-Q-R bands observed in IR spectra. [05]

**(b)** In the rotational spectra of CO, the first absorption line appears at  $3.842 \text{ cm}^{-1}$ . Calculate the moment of inertia and the bond length of CO molecule. [05]

[Given:  $h = 6.626 \times 10^{-27} \text{ erg.sec}$ ,  $C = 3 \times 10^{10} \text{ cm}$ ]

Q.4. (a) Describe the Principle, Construction and Working Abbe's Refractometer. [05]

(b) Explain that the p-dichlorobenzene ( $\mu=0$ ) is non-polar while p-dihydroxy benzene ( $\mu=1.64D$ ) is polar in character. [05]

OR

Q.4. (a) Derive the Clausius -Mosotti equation for the relationship between the polarizability of a molecule and the dielectric constant of the medium. [05]

(b) Calculate the refractive index of Acetic acid at a temperature at which its density is  $1.046 \text{ gm.cm}^{-3}$  and compare it with experimental value, 1.372. [05]

[ Given :  $R_m$  value for C= $2.591 \text{ cm}^3/\text{mole}$ , H= $1.028 \text{ cm}^3/\text{mole}$ , O in  $>C=O$  = $2.573 \text{ cm}^3/\text{mole}$ , O in  $-OH$ = $1.518 \text{ cm}^3/\text{mole}$  ]

Q.5 (a) Show how the equilibrium constant is related to the standard free energy change by relation  $\Delta G^0 = - RT \ln K^0$  [05]

(b) Calculate the free energy function based on  $0^\circ\text{C}$  for  $\text{Cl}_2$  gas at  $1000^\circ\text{K}$  at 1 bar pressure. No electric states other than ground states are populated at  $1000^\circ\text{K}$ . [05]

Given:  $q^0_{\text{trans}}=2.94 \times 10^{32}$

$q^0_{\text{vib.}}=1.82$

$q^0_{\text{rot.}}=1427.75$

OR

Q.5 (a) Derive the equation for molecular basis of entropy. Give its limitations. [05]

(b) Calculate the total entropy of one mole of  $\text{Cl}_2$  gas at 1 bar pressure and  $25^\circ\text{C}$  the moment of inertia of Cl molecule is  $1.15 \times 10^{-45} \text{ Kg.m}^2$  and vibrational energy level spacing is  $565 \text{ cm}^{-1}$ . [05]

[Atomic weight of Cl is  $35.45 \text{ gm/mole}$  and  $\sigma=2$ ]

Q.6 Discuss in detail the importance and application of colloids. [10]

OR

Q.6 Give the differences between Lyophilic Colloids and Lyophobic Colloids. [10]

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