(PART-B : Descriptive)

Time : 2 hrs. 40 min. **Marks : 50**

[Answer question no.1 & any four (4) from the rest]

1. i. Derive the Braggs' equation in X- ray crystallography for X- ray diffraction. 5+5=10
   ii. Show that the entropy of a system is given by $S = k_B \ln W$, the symbols have their usual meanings.

2. i. Determine radius ratio for trigonal compound. 4+2+2+2 =10
   ii. Calculate Millar indices of crystal plane which cut through the crystal axes at 2a, -3b, -6c.
   iii. Draw the structure of NaCl and write its co-ordinate ratio.
   iv. What is color centres? How do they arise?

3. i. Write short notes on N – type and P- type semiconductor. 6+4 =10
   ii. Describe the free electron theory of metallic structure. Explain how this theory accounts for high conductivity of metal.

4. i. What is primary salt effect? Derive the suitable relation connection rate constant and ionic strength of the solution. 6+4 =10
   ii. compare the rate constants as given by Arrhenius equation and and the activated complex theory and show that
   $$E_a = E_0 + \frac{1}{2}RT$$

5. Mention the important postulates of activated complex theory and derive the rate constant of a gaseous bimolecular reaction in terms of thermodynamic parameters. 10

6. i. Show that for monoatomic gases, the translational partition function is given by 4+2+4 =10
   $$q_t = V\left(\frac{2\pi mkT}{h^2}\right)^{3/2}$$ The symbols have their usual meaning.
   ii. Calculate the characteristic rotational temperature for N_2 molecule. Given the internuclear distance of N_2 is 109.76 pm.
   iii. Derive an expression for the equilibrium distribution of particles following Fermi-Dirac statistics.

7. i. Discuss briefly Langmuir's bimolecular theory of adsorption. 5+5=10
   ii. Derive an expression for Young-Dupre equation. From this equation how can you derive wetting property of a liquid?

8. i. What is CMC? Write the factors affecting CMC. 5+2+3 =10
   ii. What is the difference between micelle and reverse micelle.
   iii. What do you mean by electro-osmosis of a colloidal solution.

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REV-00 2018/06
MSC/99/135

M. Sc. CHEMISTRY
SECOND SEMESTER
PHYSICAL CHEMISTRY II
MSC – 204

(Use Separate Answer Scripts for Objective & Descriptive)

Duration : 3 hrs. **Full Marks : 70**

(PART-A : Objective)

Time : 20 min. **Marks : 20**

Choose the correct answer from the following: ***1×20=20***

1. The % of free space in bcc unit cell is
   a. 20% b. 28%
   c. 32% d. 38%

2. The appearance of color in solid alkaline metal halides is generally due to
   a. Schottky defect b. Frenkel defect
   c. Interstitial position d. F – centre

3. A compound formed by elements X and Y in a cubic structure in which atoms X are at the corners of the cube and atoms Y are at the face centres. The formula of the compound is
   a. X_3Y b. XY
   c. XY_2 d. XY_3

4. When a pentavalent impurity is added to a pure semiconductor, it becomes
   a. An insulator b. An intrinsic semi conductor
   c. An N – type semiconductor d. A P- type semiconductor

5. In semiconductor, current conduction is due to
   a. Only hole b. Only free electrons
   c. Hole and free electrons d. None of the above

6. At absolute zero temperature, an intrinsic semiconductor has
   a. A few free electrons b. Many holes
   c. Many free electrons d. No holes or free electrons

7. The stability of lyophobic colloidal particles in solution is due to
   a. Repulsion between electrical double layer
   b. Due to Brownian movement
   c. Presence of charge on the colloidal particle
   d. All of the above

8. $AgNO_3$ in presence of excess NaI, form a
   a. Positive sol b. Negative sol
   c. Neutral sol d. No sol is formed

9. The efficiency of Al^{3+} ion is _________ times more than Mg^{2+} ion in a negative sol
   a. 9
   b. 4
   c. 9/4
   d. 3/2

10. In enzyme kinetics, V represents the reaction velocity and S is the substrate. In a Lineweaver-Burk treatment of data, which of the following plots would give you a straight line of gradient K_M/V_{max} where K_M is the Michaelis constant and V_{max} is the maximum velocity?
   a. V against 1/[S]
   b. V against [S]
   c. 1/V against [S]
   d. 1/V against 1/[S]

11. The frequency factor in collision theory is
   a. Inversely proportional to T
   b. Directly proportional to T
   c. Directly proportional to √T
   d. Inversely proportional to √T

12. The relaxation time (τ) for the following reaction is

$$A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} B$$

   a. $\frac{1}{k_1 + k_{-1}}$
   b. $\frac{1}{k_1 - k_{-1}}$
   c. $k_1 + k_{-1}$
   d. $k_1 - k_{-1}$

13. Which one of the following is NOT a key concept of the collision theory?
   a. Particles must collide inorder to react
   b. particles must move slowly when they collide, otherwise they simply "bounce off" one another
   c. particles must collide with the proper orientation
   d. particles must collide with sufficient energy to reach the activated complex in order to react

14. Which of the following statements are true regarding enzyme inhibition?
   a. It may be reversible or irreversible
   b. Reversible can be competitive or non-competitive
   c. Both (a) and (b)
   d. It is always reversible

15. The indistinguishability correction in the Boltzmann formulation is incorporated in the following way: (N=total number of particles; f= single-particle partition function)
   a. Replace f by f/N!
   b. Replace f^N by $f^N/N!$
   c. Replace f by f/ln(N!)
   d. Replace f^N by f^N/ln(N!)

16. If g_i and n_i are respectively, the degeneracy and occupation number of the ith energy level, then the conditions under which M-B, F-D and B-E statistics give identical result is
   a. $g_i/n_i << 1$
   b. $g_i/n_i >> 1$
   c. g_i/n_i is intermediate
   d. $g_i/n_i < 0$

Contd...

17. The possible number of ways of distributing 2 Bosons among 4 energy states is
   a. 4
   b. 16
   c. 10
   d. 6

18. An ensemble with constant V, T and μ is
   a. canonical
   b. microcanonical
   c. grandcanonical
   d. macrocanonical

19. Molar rotational energy of all linear molecules at a given temperature T is
   a. 0.5RT
   b. RT
   c. 1.5RT
   d. 2.0RT

20. The rotational partition function of a diatomic molecule with energy levels corresponding to J=0 and 1, is (where, ε is a constant)
   a. $1 + e^{-2\epsilon}$
   b. $1 + 3e^{-2\epsilon}$
   c. $1 + e^{-3\epsilon}$
   d. $1 + 3e^{-3\epsilon}$

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P.T.O.