**M.Sc. CHEMISTRY**
**THIRD SEMESTER**
**PHYSICAL CHEMISTRY III**
**MSC – 303 [SPECIAL REPEAT]**
[USE OMR FOR OBJECTIVE PART]

**SET A**

Duration : 3 hrs.

Full Marks : 70

[ **Objective** ]

Time : 30 min.

Marks : 20

*Choose the correct answer from the following:*

1X20=20

1. The unit of molar extinction coefficient are usually expressed in
   a. $M. cm^{-1}$
   b. $M. cm$
   c. $M^{-1}. cm^{-1}$
   d. $M^{-1}. cm$

2. Which of the following ways, absorption is related to transmittance?

   a. Absorption is the logarithm of transmittance
   b. Absorption is the reciprocal of transmittance
   c. Absorption is the negative logarithm of transmittance
   d. Absorption is a multiple of transmittance

3. Which of the following are the reactions in which molecules absorbing light do not themselves react but induce other molecules to react?

   a. Photosensitized reaction
   b. Free radical reactions
   c. Chain reactions
   d. Reversible reactions

4. The quantum efficiency of a photochemical reaction is defined as

   a. Ratio of molecules decomposed in a given time to the number of quanta absorbed in the same time
   b. Number of molecules decomposed in a given time
   c. Number of quanta absorbed percent time
   d. Ratio of molecules decomposed in a given time to the number of quanta emitted in the same time

5. Spin inversion of electrons take place in the following process

   a. Internal conversion
   b. Fluorescence
   c. Phosphorescence
   d. None of the above

6. Spin multiplicity can be calculated by using

   a. 2S-1
   b. 2S+1
   c. 2S
   d. 2J+1

7. Which of the following is also known as parallel plat condenser model

   a. Helmholtz-Perrin model
   b. Guoy-Chapmann's model
   c. Stern model
   d. Devanathan model

8. The Devanathan model is also known as
   a. Parallel plat condenser model    b. Diffuse charge model
   c. Water model                      d. Combination model

9. In which type, light is created by a chemical reaction
   a. Incandescence                    b. Fluorescence
   c. Chemiluminescence                d. Phosphorescence

10. Photodynamic therapy:
    a. Involves use of a photosensitiser given    b. Is an oxygen-dependent reaction
       by intravenous injection or orally
    c. Requires exposure to UVA                   d. May cause skin cancer

11. Thermal stability of a catalyst can be studied with
    a. TGA                             b. DSC
    c. SEM                             d. XRD

12. The method used for the determination of surface area is
    a. FT-IR                           b. DSC
    c. TGA                             d. BET

13. Functional group of a catalyst can be studied with the help of
    a. DSC                             b. FT-IR
    c. SEM                             d. TEM

14. Which of the following statements are correct about solid catalyst?
    a. Catalyst does not change $\Delta H$ of reaction    b. Catalyst is required in large quantities
                                                             to catalyse reactions.
    c. Catalytic activity of a solid catalyst    d. None of the above
       does not depend upon the strength of
       chemisorption

15. For random walk model the mean average distance is (where $l$ is the step length)
    a. $<x_N^2> = Nl$                  b. $<x_N^2> = Nl^2$
    c. $<x_N^2> = Nl/2$                d. $<x_N^2> = 2Nl$

16. $Pt/H_2$(1 atm) has a
    a. Non-polarizable interface       b. Polarizable interface
    c. Both a & b                      d. None of them

17. Which of the following is true for approximation of cavity radius in Rashin & Honig model?
    a. Covalent radii for cations      b. Ionic radii for anions
    c. Both a & b                      d. None of them

18. What is the valence factor for $Fe_2(SO_4)_3$?
    a. 3                               b. 4
    c. 5                               d. 6

19. The separation at which the electrostatic interaction between two ions is comparable in magnitude to kT is called
    a. Onsanger length        b. Debye length
    c. Bjerrum length        d. Born length

20. An electrocapillary curve is close to a
    a. Parabola        b. Hyperbola
    c. Circle        d. Straight line

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## ( Descriptive )
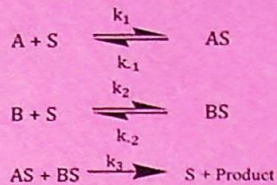
Time : 2 hrs. 30 mins.        Marks : 50

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

1. What is photocatalysis? What are the types of photocatalysis? Discuss the mechanism of each type of photocatalysis with the help of examples. Write a note on chemiluminescence.      10

2. a. Write three differences between Helmholtz-Perrin model and Guoy-Chapmann's model. What are the limitations of Helmholtz-Perrin model?      6+4=10

   b. Explain the electron-exchange and photoinduced electron transfer mechanism of quenching.

3. a. What do you mean by Stokes' shift? Explain why there is Stokes' shift in fluorescence spectroscopy. Explain and give the mechanism of photodynamic therapy of tumor.      7+3=10

   b. Derive Stern-Volmer equation for combined dynamic and static quenching.

4. a. Explain Stern model of electrical double layer. What are the successes of Stern model?      8+2=10

   b. What will be the capacitance at high and dilute concentration in case of Stern model?

[3]          

5. a. What are homogeneous and heterogeneous catalysts? What    6+4=10
   is the role of adsorption in heterogeneous catalysis? In
   between Homogeneous and heterogeneous catalysts which
   one gets significant interest in the area of green chemistry
   and why?

   b. The following mechanism has been proposed for a surface
   reaction,

$$A + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} AS$$

$$B + S \underset{k_{-2}}{\overset{k_2}{\rightleftharpoons}} BS$$

$$AS + BS \overset{k_3}{\longrightarrow} S + Product$$

Where, S is the vacant site on the surface. Using steady state
approximation for the intermediate, show that the rate of the
reaction is,

$$r = \frac{K' p_A p_B}{(K_1 p_A + K_2 p_B + 1)^2}$$

Where, the symbols have their usual meanings. Discuss the rate
when both the reactants are weakly adsorbed.

6. a. How the surface area and pore size of catalyst can be    5+5=10
   determined.

   b. Write the general formula of Zeolite. Give two examples of
   important zeolites. Explain the applications of Zeolites.
   What are effects of zeolites in hard water?

7. a. Derive Einstein Smoluchowski equation. Write down    6+4=10
   Lippmann equation. Show it's significance in electrocapillary
   curve.

   b. Write down the differences between polarizable and non-
   polarizable electrified interfaces.

8. a. Distinguish between structural and non-structural model of    5+5=10
   ion-solvent interactions. What are the advantages of Bontha-
   Pintauro model?

   b. Starting from Poisson equation derive Poisson-Boltzmann
   equation.

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[4]