

Total No. of Printed Pages—12

6 SEM TDC CHM M 1 (N/O)

2018

(May)

CHEMISTRY

(Major)

Course : 601

(**Physical Chemistry**)

*The figures in the margin indicate full marks
for the questions*

(New Course)

Full Marks : 48

Pass Marks : 14

Time : 2 hours

1. Choose the correct answer : 1×5=5

(a) Intersystem crossing refers to

- (i) transition between two states of a system
- (ii) radiationless transition between states of different spin multiplicities
- (iii) transition between excited and ground states with same multiplicity
- (iv) All of the above

(2)

- (b) A sample of polyacrylonitrile has number average molecular weight of 106000. Its number average degree of polymerization is
- (i) 2000
 - (ii) 1000
 - (iii) 3000
 - (iv) 200
- (c) The number of components, phases and degrees of freedom for I_2 distributed between $CHCl_3$ and H_2O are
- (i) 3, 2, 2
 - (ii) 3, 2, 1
 - (iii) 3, 1, 2
 - (iv) 2, 2, 1
- (d) Which of the following is the wrong statement?
- (i) A catalyst can start a reaction in some cases.
 - (ii) Enzymes are the examples of micro-heterogeneous catalysis.
 - (iii) Enzymes can act only in the presence of coenzymes.
 - (iv) A positive catalyst reduces the activation energy of a reaction.

8P/799

(3)

- (e) At absolute zero, the value of molecular partition function is
- (i) 0
 - (ii) 1
 - (iii) greater than one
 - (iv) less than zero

2. Answer the following questions : $2 \times 5 = 10$

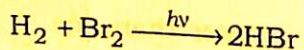
- (a) The photochemical dissociation of gaseous HI to form normal H_2 and I_2 requires radiation of 4040 Å. Determine the molar heat of dissociation of HI.
- (b) What is glass transition temperature? How is it important?
- (c) Explain the actions of catalytic promoters and catalytic poisons.
- (d) "A mixture of Sn and Pb is used for soldering." Explain giving proper reason.
- (e) Define canonical and grand-canonical ensembles.

(Continued) 8P/799

(Turn Over)

3. Answer any two questions from the following : $3\frac{1}{2} \times 2 = 7$

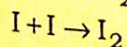
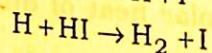
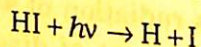
- (a) Discuss the rate expression for the reaction



assuming steady-state approximation for H and Br. How would you account for the low quantum yield for this reaction?

$$3 + \frac{1}{2} = 3\frac{1}{2}$$

- (b) The decomposition of HI takes place by the following mechanisms :



Deduce the expression for the rate of this reaction. What is the quantum efficiency of the reaction?

$$3 + \frac{1}{2} = 3\frac{1}{2}$$

- (c) What is quantum yield of a photochemical reaction? Mention any three reasons for showing low quantum yield of a reaction.

$$\frac{1}{2} + 3 = 3\frac{1}{2}$$

4. Answer any one question from the following : 5

- (a) (i) Define weight average and number average molecular weight of a polymer sample. 2

- (ii) Write Carothers equation. In a polymerization reaction, hexamethylenediamine reacts with adipic acid in equimolar concentration to form Nylon-6,6. Calculate the molecular weight of Nylon-6,6 when the conversion is 90%. (Molecular weight of the polymer repeat unit is 226.) $1 + 2 = 3$

- (b) (i) Discuss the kinetics of free radical chain polymerization. 3

- (ii) Briefly discuss about living polymers. 2

5. Answer any one question from the following : 5

- (a) What is acid-base catalysis? Explain the theories of acid-base catalysis with suitable examples. $1 + 4 = 5$

- (b) (i) Discuss the effect of particle size on the catalytic activity in heterogeneous catalysis. 2

- (ii) What are nanocatalysts? Discuss the efficiency of metal nanoparticles in heterogeneous catalysis. $1 + 2 = 3$

6. Answer any two questions from the following : $4\frac{1}{2} \times 2 = 9$

(a) What do you mean by a phase diagram? Draw and explain the phase diagram of a simple eutectic system. $1 + 3\frac{1}{2} = 4\frac{1}{2}$

(b) Draw the phase diagram of water and label it. Explain it briefly giving the significance of each zone and line. $1\frac{1}{2} + 3 = 4\frac{1}{2}$

(c) Derive Clausius-Clapeyron equation. Mention its two applications. $3\frac{1}{2} + 1 = 4\frac{1}{2}$

7. Answer any two questions from the following : $3\frac{1}{2} \times 2 = 7$

(a) Show that the equilibrium distribution of particles following Boltzmann statistics is given by

$$\frac{n_i}{n} = \frac{g_i e^{-\beta \epsilon_i}}{\sum g_i e^{-\beta \epsilon_i}}$$

where $\beta = \frac{1}{kT}$.

(b) Deduce Sackur-Tetrode equation for molar entropy of an ideal monatomic gas. $3\frac{1}{2}$

(c) What do you mean by partition function? Discuss the physical significance of partition function. Explain the effect of temperature on partition function. $3\frac{1}{2}$