

M.Sc. CHEMISTRY
THIRD SEMESTER
PHYSICAL CHEMISTRY III
MSC – 302
(USE OMR FOR OBJECTIVE PART)

2023/12

**SET
A**

Duration: 1:30 hrs.

Full Marks: 35

Time: 15 mins.

(Objective)

Marks: 10

Choose the correct answer from the following:

1X10=10

- The kinetics of gaseous phase reactions are studied using the following mechanism
 - Steady state approximation
 - Lindemann-Hinshelwood mechanism
 - Both (a) and (b)
 - None of the above
- Molecular reaction dynamics provides insights into
 - Reaction mechanisms
 - Energy transfer in reactions
 - Product distributions
 - All of the above
- The isotope effect is said to be normal isotope effect if
 - $K_H/K_D = 1$
 - $K_H/K_D < 1$
 - $K_H/K_D > 1$
 - None of the above
- Flow system in which there is no stirring in the reactor and the flow is called
 - Plug flow
 - Continuous flow
 - Stopped flow
 - Quenched flow
- The relation between the rate constant and viscosity for diffusion controlled reaction is
 - Rate constant is directly proportional to viscosity
 - Rate constant is inversely proportional to viscosity
 - Rate constant is half of the viscosity
 - No relation
- The dimension of a partition function is -
 - 1
 - 2
 - 3
 - None of the above
- For particle in a 1D box, the degeneracy value, g_i is -
 - 2
 - 1
 - 3
 - 4
- The value of symmetry number for Oh type molecule is -
 - 25
 - 26
 - 24
 - 21

9. The ground state electronic partition function for N is -
- a. 3
 - b. 2
 - c. 1
 - d. None of the above
10. Which of the following particles has integral spin value?
- a. Electron
 - b. Phonon
 - c. Neutron
 - d. None of the above

(Descriptive)

Time : 1 hr. 15 mins.

Marks : 25

[Answer question no.1 & any two (2) from the rest]

1. a. Write about the Relaxation Methods to Study the Kinetics of Fast Reactions. Derive the relaxation time equation during the study of Fast reactions. 3+2=5
c. What do you mean by characteristic rotational temperature?

2. a. What is Encounter and Cage effect while studying the reactions in solution? 1+2+4+3
=10
b. What are the factors affecting the rates of Ionic Reaction? Explain.
c. Derive the following Debye- Smoluchowski equation,
$$K_D = \frac{8RT}{3\eta}$$

d. Describe the stopped flow method, pulse methods and flash photolysis for studying kinetics of fast reactions.

3. a. Write the importance of studying the kinetic isotopic effects. What is Primary isotope effect and Secondary isotope effect? Explain. 2+3+2+1
+2=10
b. Discuss the role of potential energy surfaces in reaction kinetics.
c. Discuss the Marcus Theory of electron transfer reactions.
d. What is Molecular reaction dynamics?
e. Write a short note on "Pulse radiolysis".

4. a. Find out the probability of finding the harmonic oscillator in the energy level $n=1$ (neglecting ZPE and assuming $h\nu=K_B T$) 4+2+2+2
=10
b. Find out the residual entropy for FCIO_3 molecule
c. Find the $q_{\text{electronic}}$ value for $3p_2$ term symbol
d. What is Debye modification of specific heat?

5. a. What are differences between Bose-Einstein and Fermi-Dirac statistics? 3+2+3+2
=10
- b. What do you mean by fraction of particle in i^{th} level?
- c. Derive the expression for q at low temperature and high temperature limit.
- d. What do you mean by electronic partition function? What is the g_0 value for O_2 molecule?

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