P. P. SAVANI UNIVERSITY

Third Semester of B.Sc. Examination

December-2021

SSCH2130-Concepts in Physical Chemistry-I

11.12.2021, Saturday Time: 09:00 a.m. to 11:30 a.m. Maximum Marks: 60

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

Section-I (Total Marks - 30)

Q.1 Short Questions **[10]**

1.1 Objectives **[05]**

1.1a In a series of reactions, which is the rate-determining step?

- **A the simplest reaction**
- **B the main reaction involving the major reactant**
- **C the slowest reaction**
- **D the fastest reaction**

1.1b All of the following are true statements concerning reaction orders EXCEPT:

- **A the rate of a zero-order reaction is constant**
- **B after three half-lives, a radioactive sample will have one-ninth of its original concentration**
- **C the units for the rate constant for first order reactions are sec−1**
- **D if doubling the concentration of a reactant doubles the rate of the reaction, then the reaction is first order in that reactant**

1.1c A reaction in which all reactants are in the same phase is called

- **A elementary**
- **B bimolecular**
- **C homogeneous**
- **D heterogeneous**

1.1d The half-life of a first-order process

- **A depends on the reactant concentration raised to the first power**
- **B is inversely proportional to the square of the reactant concentration**
- **C is inversely proportional to the reactant concentration**
- **D is totally independent of the reactant concentration**

1.1e Reaction rates can change with

- **A temperature**
- **B the addition of a catalyst**
- **C reactant concentrations**
- **D all of these**

1.1f The reaction A → B is a second-order process. When the initial concentration of A is 0.50 M, the half-life is 8.0 minutes. What is the half-life if the initial concentration of A is 0.10 M?

A 1.6 minutes
B 8.0 minutes
C 40.0 minutes
D 16.0 minutes

1.1g Why do most chemical reaction rates increase rapidly as the temperature rises?

A the fraction of the molecules with kinetic energy greater than the activation energy increases rapidly with temperature
B the average kinetic energy increases as temperature rises
C the activation energy decreases as temperature rises
D more collisions take place between particles so that the reaction can occur

1.1h Which concentration plot is linear for a first-order equation? (A is one of the reactants).

A [A] versus time
B square root of [A] versus time
C In [A] versus time
D $[A]^2$ versus time

1.1i Rate laws for chemical reactions are determined

A by examining the coefficients in the balanced chemical equation
B from the equilibrium constant
C from the rates of the forward and reverse reactions of the system at equilibrium
D by experiment

1.1j Why is a minimum energy needed for an effective collision?

A energy is needed to break bonds
B energy is needed to orient the particles correctly
C a minimum energy is needed, so that the particles will collide many times per second
D enough energy is needed to give off heat in a reaction

1.2 Answer the Following: (MCQ/Short Question/Fill in the Blanks) **[05]**

1.2a What is a complex reaction?

1.2b If the potential energy of the reactants is smaller than the products, the reaction is ____.

1.2c The half-life of a second order reaction depends on initial concentration of the reactants. (True/False)

1.2d Define instantaneous rate?

1.2e Give Arrhenius equation.

Q.2 Short Notes (Attempt any two) **[06]**

A What are Psuedo order reactions? Explain giving examples.

B Describe the transition theory of reaction rate.

C State the differences between molecularity and order of a reaction.

Q.3 **Explain in detail (Attempt any two)** [14]

A What are Parallel reactions? Explain in detail.

B Discuss different methods used to determine the order of a reaction.

C Describe the collision theory of reaction rates and explain the effect of temperature on the rate of reactions

Section-II (Total Marks - 30)

Q.1 **Short Questions** [10]

1.1 **Objectives** [05]

1.1a **A catalyst can be described as a substance that:**

- A **undergoes change to accelerate the rate of the reaction**
- B **increases the kinetic energy of the reactants**
- C **provides a path of lower activation energy for the reaction**
- D **lowers the potential energy of the products with respect to the energy of the reactants**

1.1b **All of the following are true statements concerning catalysts except**

- A **a catalyst will speed the rate-determining step**
- B **a catalyst will be used up in a reaction**
- C **a catalyst may induce steric strain in a molecule to make it react more readily**
- D **a catalyst will lower the activation energy of a reaction**

1.1c **Which of the following reactions occurs at the fastest rate?**

- A **one which is exothermic by 15 kcal/mole and has an activation energy of 20 kcal/mole**
- B **one which is endothermic by 5 kcal/mole and has an activation energy of 30 kcal/mole**
- C **one which is exothermic by 30 kcal/mole and has an activation energy of 15 kcal/mole**
- D **one which is exothermic by 20 kcal/mole and has an activation energy of 20 kcal/mole**

1.1d **The minimum amount of energy required to start a chemical reaction is called**

- A **entropy**
- B **enthalpy**
- C **free energy**
- D **activation energy**

1.1e **Which statement is not correct regarding the function of a catalyst?**

- A **it affects the rate of a chemical reaction**
- B **it lowers the energy of the product, causing the reaction to be more exothermic**
- C **it changes the mechanism of a reaction**
- D **it lowers the activation energy**

1.1f **The collision frequency of a gas is**

- A **directly proportional to the square root of absolute temperature**
- B **directly proportional to the absolute temperature**

C inversely proportional to the pressure of the gas
D inversely proportional to the absolute temperature

1.1g For one mole of a gas the kinetic energy is given by
A $E = 1/2\ RT$
B $E = 3/2\ RT$
C $E = 5/2\ RT$
D $E = 7/2\ RT$

1.1h Mathematically, Boyle's law can be represented as
A $V \alpha 1/P$
B $V = k/P$
C $V P = k$
D All of these

1.1i The average kinetic energy of the gas molecules is
A inversely proportional to its absolute temperature
B directly proportional to its absolute temperature
C equal to the square of its absolute temperature
D directly proportional to the square root of its absolute temperature

1.1j At constant temperature, the pressure of the gas is reduced to one third, the volume
A reduces to one third
B increases by three times
C remains the same
D cannot be predicted

1.2 Answer the Following: (MCQ/Short Question/Fill in the Blanks) **[05]**

1.2a Give relationship between RMS velocity and most probable velocity.

1.2b Change of temperature alters the rate of a catalytic reaction as it would do for the same reaction without a catalyst. (True/False)

1.2c A substance which, though itself not a catalyst, promotes the activity of a catalyst is called an autocatalyst.. (True/False)

1.2d What is coenzyme?

1.2e Define Activation energy.

Q.2 Short Notes (Attempt any two) **[06]**

A Write a note on Acid Catalysis.

B Derive the Kinetic Gas Equation.

C Write a note on Catalytic Poisoning.

Q.3 Explain in detail (Attempt any two) **[14]**

A Discuss Maxwell's theory of Molecular distribution of velocities.

B What is Enzyme catalysis? Explain in the detail about its mechanism.

C Discuss the adsorption theory by giving an example of hydrogenation of ethene.