Chapter - 06

Chemical Kinetics

Very Short Answer Type Questions

01. Express the relationship between the rate of production of water and the rate of disappearance of oxygen in the following reaction $2H_2 + O_2 \rightarrow 2H_2O$

02. Why is the instantaneous rate of a reaction does not change when a part of the reacting solution is taken out?

03. Give one example of a first-order reaction.

04. The rate of a reaction is given by the equation: Rate = k $[A]^2$ [B]. What are the units for the rate and the rate constant for this reaction?

05. The rate of decomposition of a substance A becomes eight times when its concentration is doubled. What is the order of this reaction?

06. Give an example of a pseudo-first-order reaction.

07. A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of the reaction?

08. Define the activation energy of a reaction.

09. Express the rate of the following reaction in terms of disappearance of hydrogen in the reaction:

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

10. Identify the order of reaction from the following unit for its rate constant: L mol^{-1} s^{-1}.

Short Answer Type Questions

11. For the first-order reaction $R \rightarrow P$, deduce the integrated form of rate law.

12. Show graphically how the rate of a first-order reaction with only one reactant depends upon the concentration of the reactant.

13. State the role of activated complex in a reaction and state its relation with activation energy.

14. A reaction is first order in A and second order in B. (i

(ii) How is the rate affected by increasing the concentration of B three times?

(iii) How is the rate affected when the concentration both A and B are become doubled.

15. (i) Write the rate law for a first-order reaction.

(ii) Justify the statement that the half-life of a first-order reaction is independent of the initial contact. of the reactant.

16. Define the following terms giving an example for each:

(i) The order of a reaction (ii) The molecularity of a reaction.

17. What is meant by the 'rate constant, k' of a reaction? If the concentration be expressed in mol L^{-1} units and time in seconds, what would be the units for k

(i) for a zero-order reaction and (ii) for a first-order reaction.

18. Define the following:

(i) Elementary step in a reaction. (ii) Rate of a reaction.

19. Explain the term 'order of a reaction.' Derive the unit for the first-order rate constant.

20. A reaction is second order concerning a reactant. How is the rate of reaction affected if the concentration of reactant is :

(a) Doubled (ii) Reduced to half

21. A first-order reaction is 75% complete in 60 minutes. Find the half-life of this reaction.

22. The slope of the line for the graph of log k $Vs\frac{I}{T}$ for the reaction $N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$ is -5000. Calculate the energy of activation of the reaction.

23. A certain reaction is 50% complete in 20 minutes at 300 K and the same reaction is again 50% complete in 5 minutes at 350 K. Calculate the activation energy if the reaction is of the first order.

24. The rate constant for a first-order reaction is 60 s^{-1}. How much time will it take to reduce the initial concentration of the reactant to 1/16th of its initial value?

25. A first-order reaction in 50% completed in 40 min at 300 K and in 20 min at 320 K, calculates the activation energy of the reaction.

26. A first-order reaction takes 20 min for 25% decomposition; calculate the time when 75% of the reaction will complete.

27. The thermal decomposition of HCO_2H is a first-order reaction with a rate constant of 2.4 x 10^{-3} s^{-1} at a certain temperature. Calculate how long will it take for three-fourths of the initial quantity of HCO_2H to decompose (log 0.25 = -0.6021)

Long Answer Type Questions

28. (a) Derive the general form of the expression for the half-life of a first-order reaction.

(b) The decomposition of NH_3 on the platinum surface is a zero-order reaction. What are the rates of production of N_2 or H_2 if k = 2.5 x 10^{-4} mol^{-1} L s^{-1}?

29. (a) List the factors on which the rate of a chemical reaction depends.

(b) The half-life for the decay of radioactive ^{14}C is 5730 years. An archaeological artifact containing wood has only 80% of the ^{14}C activity as found in living trees. Calculate the age of the artifact.

30. (a) A reaction is of first-order in A and of second order in B. Write the differential rate equation for this reaction. How will its initial rate be affected if the concentrations of both A and B are together doubled?

(b) The rate constant k of a reaction increases fourfold when the temperature changes from 300 K to 320 K. calculate the activation energy for the reaction. (R = 8.314 J K^{-1} mol^{-1}).