Class XII

Chemistry

Ch. 4: Chemical Kinetics

Important Formulae & Concepts

1. Instantaneous rate = $\frac{dx}{dt}$, where dx is small change in conc. and dt is the smallest interval of time.

2. Average rate = $\frac{\Delta x}{\Delta t}$, where Δx is change in concentration and Δt is large interval of time.

3. $A + B \rightarrow C + D$

   Rate of disappearance of A $= \frac{-d[A]}{dt}$, where d[A] is small change in conc. of 'A' and dt is small interval of time

   Rate of disappearance of B $= \frac{-d[B]}{dt}$,

   Rate of appearance of C $= \frac{+d[C]}{dt}$

   Rate of appearance of D $= \frac{+d[D]}{dt}$

   Rate $= \frac{-d[A]}{dt} = \frac{-d[B]}{dt} = \frac{d[C]}{dt} = \frac{d[D]}{dt}$

   Unit of rate of reaction = mol $L^{-1}s^{-1}$

4. Order of reaction:

   If rate law expression for a reaction is

   Rate = $k [A]^x [B]^y$

   Order of reaction = x + y

   Remember: Order cannot be determined with a given balanced chemical equation. It can be experimentally determined.

5. Integrated rate law for zero order reaction:

$R \rightarrow P$

$$\frac{dx}{dt} = k[R]^0$$

Unit of 'k' is mol $L^{-1}s^{-1}$

$$k = \frac{[R_o] - [R]}{t}$$

If we plot a graph between concentration of R vs time, the graph is a straight line with slope equal to -k and intercept is equal to $[R_o]$

6. Half- life reaction for a for zero order reaction:

$$t_{½} = \frac{[R_0]}{2k}$$

7. Rate law for 1st order reaction:

$R \rightarrow P$

$$k = \frac{2.303}{t} \log \frac{[R_o]}{[R]}$$

where 'k' is rate constant, $[R_o]$ is initial molar conc., [R] is final molar conc. after time 't'

8. Half- Life for a first order reaction is:

$$t_{½} = \frac{0.693}{k}$$

9. Formula to calculate rate constant for first order gas phase reaction of the type

$A(g) \rightarrow B(g) + C(g)$

$$k = \frac{2.303}{t} \log \frac{p_i}{(2p_i - p_t)}$$

Where:

p_i is initial pressure of A

p_t is total pressure of gaseous mixture containing A , B, C

Remember:

$p_t = p_A + p_B + p_C$

10. Arrhenius equation:

$$k = A e^{-E_a/RT}$$

11. $\log\frac{k_2}{k_1} = \frac{E_a}{2.303\ R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$

12. $\text{Rate} = P\,Z_{AB}.e^{\frac{-E_a}{RT}}$

Where:

Z_{AB} represents the collision frequency of reactants, A and B

P is called the probability or steric factor.