

FORMULAS- CHEMICAL KINETICS

Important Terms, Definitions & Formulae

XII Chemistry

CHAPTER 4 - CHEMICAL KINETICS

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 = $\text{mol L}^{-1}\text{s}^{-1}$

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.

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5. Integrated rate law for zero order reaction:



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

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

$$k = \frac{[R_0] - [R]}{t}$$

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 $[R_0]$

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

$$t_{1/2} = \frac{[R_0]}{2k}$$

7. Rate law for 1st order reaction:



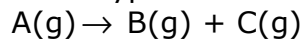
$$k = \frac{2.303}{t} \log \frac{[R_0]}{[R]}$$

where 'k' is rate constant, $[R_0]$ is initial molar conc., $[R]$ is final molar conc. after time 't'

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

$$t_{1/2} = \frac{0.693}{k}$$

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



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

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:

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

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

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

Where:

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

P is called the probability or steric factor.