

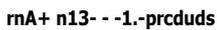
## 9. CHEMICAL KINETICS AND NUCLEAR CHEMISTRY

11. For a general chemical transformation



$$\text{Rate} = -\frac{1}{n} \frac{d[A]}{dt} = -\frac{1}{m} \frac{d[B]}{dt} = +\frac{1}{p} \frac{d[C]}{dt} = +\frac{1}{q} \frac{d[D]}{dt}$$

(2). For elementary chemical reaction



$$\text{Theoretical rate} = \frac{dx}{dt} = k[A]^m[B]^n$$

(3). For a general reaction ;  $\text{Rate} = k[A]^m[B]^n$  Products

$$\text{Rate} = \frac{dx}{dt} = k[A]^m[B]^n$$

Order of reaction w.r.t. A = m overall order of reaction = (m + n)

Order of reaction w.r.t. B = n

(4). Unit of rate constant =  $\text{molar (litre)}^{-n} \text{time}^{-1}$

Where, n = order of reaction

(5) For a zero order reaction ;  $A \rightarrow \text{Products}$

$$\text{Rate} = -\frac{d[A]}{dt} = k[A]^0 \quad (\text{constant})$$

$$\int \frac{d[A]}{[A]} = -kt$$

$$\ln[A] = -kt + \ln[A]_0$$

$$[A] = [A]_0 e^{-kt}$$

(6). For a first order reaction ;  $A \rightarrow \text{Products}$

$$\text{Rate} = -\frac{d[A]}{dt} = k[A]^1$$

$$k = \frac{2.303}{t} \log \frac{[A]_0}{[A]_0 - x}$$

For a zero order reaction,  $t_{1/2} = \frac{[A]_0}{2k}$

For a first order reaction,  $t_{1/2} = \frac{0.693}{k}$

For an n<sup>th</sup> order reaction,  $t_{1/2} = \frac{1}{k(A)^{n-1}}$  for n > 1

(8). For a parallel reaction

**A**

**K<sub>a</sub>**

$$\frac{-d[A]}{dt} = k_1[A] - k_2[AB]$$

For a first order reaction  $A \rightarrow B + C$ , a reagent reacts with all A, B and C

$$k = \frac{-\ln \left( \frac{[A]_t}{[A]_0} \right)}{t} \quad \{V = \text{vol. of reagent}\}$$

{101. Temperature coefficient =  $\frac{E_a}{RT^2}$

Arrhenius Equation,  $k = A e^{-\frac{E_a}{RT}}$

$$\ln \left( \frac{k_2}{k_1} \right) = \frac{E_a}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\log_{10} k = \log A - \frac{E_a}{2.303 RT}$$

**A** = Arrhenius's constant  
**E<sub>a</sub>** = Activation energy

$$\log_{10} k = \log A - \frac{E_a}{2.303 AT}$$

{12}. Binding energy,  $B.E = \Delta m \times 931.5 \text{ MeV}$

$\Delta m$  = mass defect = calculated At. Mass - observed At. Mass

$$\text{B.E. per nucleon} = \frac{E. (\text{total})}{\text{mass number}}$$

$$1 \text{ MeV} = 1.6 \times 10^{-13} \text{ Joule}$$

{13}. Packing fraction,  $P.F. = \frac{\text{Isotopic atomic mass} - \text{mass number}}{\text{mass number}} \times 10^6$

{14}. In a first order decay,  $N_t = N_0 e^{-\lambda t}$

Amount of radioactive substance after  $n$  periods