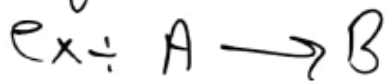


There are two types of rate:-

① Average Rate

The rate of reaction over a certain measurable period of time during the course of reaction is called Avg. rate. it is denoted by \bar{r} .

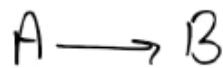


$$\bar{r}_A = -\frac{\Delta[A]}{\Delta t}; \bar{r}_B = \frac{\Delta[B]}{\Delta t}$$

(2) Instantaneous Rate

The rate of reaction over a certain at any particular instant of time during the course of reaction. it is denoted by r_{inst} .

$r_{inst} = (r_{avg})_{\Delta t \rightarrow 0}$



$$(r_{inst})_A = (\bar{r}_A)_{\Delta t \rightarrow 0}$$

$$(r_{inst})_A = \left(-\frac{\Delta[A]}{\Delta t}\right)_{\Delta t \rightarrow 0}$$

$$(r_{inst})_A = -\frac{d[A]}{dt}$$

As it is -

$$(r_{inst})_B = \frac{d[B]}{dt}$$

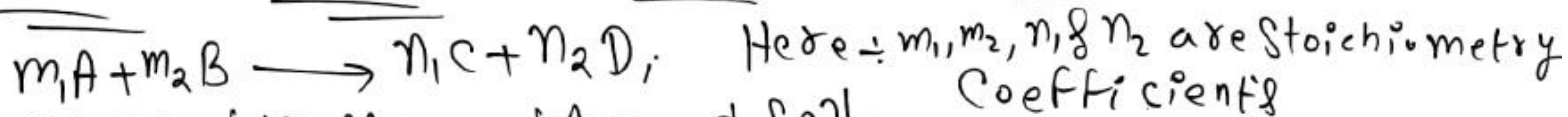


r_A & $r_B = ?$

$r_A = -\frac{1}{2} \frac{d[A]}{dt} = -2 \frac{d[A]}{dt} \times \frac{1}{2}$

$r_A = -\frac{d[A]}{dt}$; $r_B = \frac{d[B]}{dt}$

Rate of reaction in terms of Stoichiometry Coefficients :



\Rightarrow Rate of A / Rate of disappearance of A = $-\frac{d[A]}{dt}$

- || - B / - || - || - B = $-\frac{d[B]}{dt}$

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

- || - D / - || - of D = $\frac{d[D]}{dt}$

Rate of Reaction (r.o.r.)

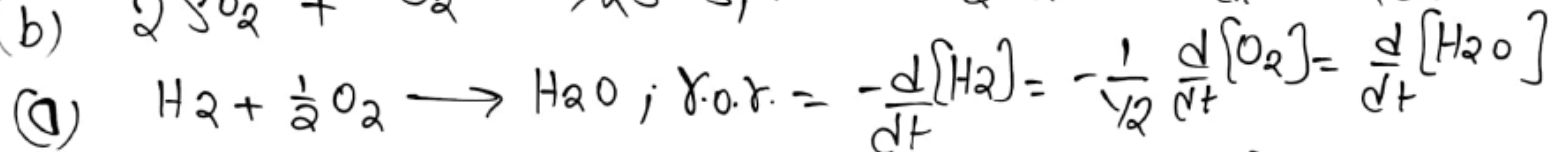
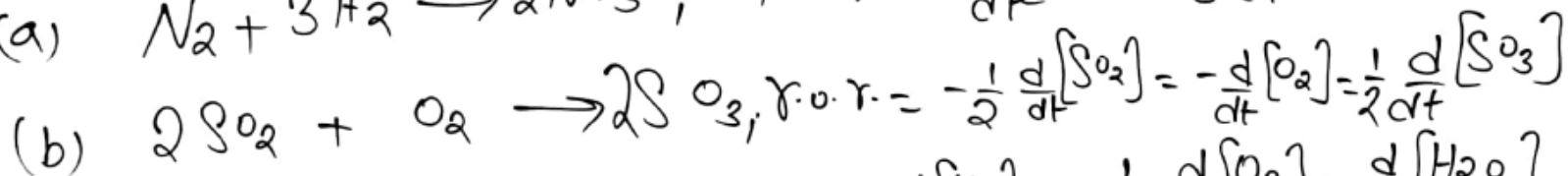
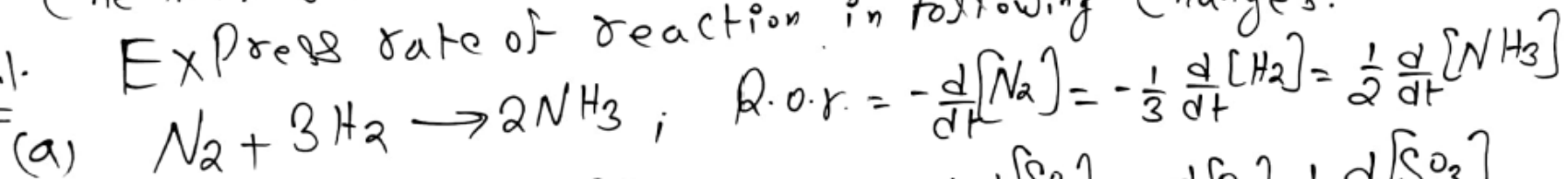
$= -\frac{1}{m_1} \frac{d[A]}{dt} = -\frac{1}{m_2} \frac{d[B]}{dt} = \frac{1}{n_1} \frac{d[C]}{dt}$

$= \frac{1}{n_2} \frac{d[D]}{dt}$

Rate of reaction always a positive quantity;
 But +ve/-ve Sign represent increase/decrease Concentration
 of product / reactant.

For rate of reaction to determine always ^{required} a Balanced
 Chemical reaction.

Q.1. Express rate of reaction in following changes.



$$\Rightarrow -\frac{d}{dt}[H_2] = -2 \frac{d}{dt}[O_2] = \frac{d}{dt}[H_2O]$$

Q.2. In a rxn; $N_2 + 3H_2 \rightarrow 2NH_3$, the rate of appearance of NH_3 is $2.5 \times 10^{-4} \text{ mol l}^{-1} \text{ sec}^{-1}$. The rate of reaction & rate of disappearance of H_2 will be.

Sol. given. $\frac{d[NH_3]}{dt} = 2.5 \times 10^{-4}$ - (i)

(i) $r.o.r. = \frac{1}{2} \left(\frac{d[NH_3]}{dt} \right) \Rightarrow r.o.r. = \frac{1}{2} \times 2.5 \times 10^{-4}$
 $r.o.r. = 1.25 \times 10^{-4} \text{ mol.l}^{-1} \text{sec}^{-1}$ Ans.,

(ii) $r_{H_2} = - \frac{d[H_2]}{dt} \Rightarrow ?$

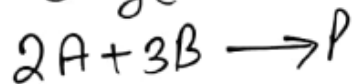
We know that: $r.o.r. = - \frac{1}{3} \frac{d[H_2]}{dt} = \frac{1}{2} \frac{d[NH_3]}{dt}$

$\Rightarrow - \frac{1}{3} \frac{d[H_2]}{dt} = \frac{1}{2} \frac{d[NH_3]}{dt}$

$\Rightarrow - \frac{d[H_2]}{dt} = \frac{3}{2} \frac{d[NH_3]}{dt} \Rightarrow - \frac{d[H_2]}{dt} = \frac{3}{2} \times 2.5 \times 10^{-4}$

$-\frac{d[H_2]}{dt} = 3.75 \times 10^{-4}$ Ans.,

Q.3. For a general Chemical rxn -



the rate of disappearance of A is γ_1 & B is γ_2 . The rate γ_1 & γ_2 are related as -

- (a) $3\gamma_1 = 2\gamma_2$ (b) $\gamma_1 = \gamma_2$ (c) $2\gamma_1 = 3\gamma_2$ (d) $\gamma_1^2 = 2\gamma_2^2$

Sol. given $\div -\frac{d[A]}{dt} = \gamma_1$; $-\frac{d[B]}{dt} = \gamma_2$

We know $\div \left(-\frac{1}{2} \frac{d[A]}{dt} \right) = \left(-\frac{1}{3} \frac{d[B]}{dt} \right)$

$\Rightarrow \frac{1}{2} \cdot \gamma_1 = \frac{1}{3} \cdot \gamma_2 \Rightarrow \boxed{3\gamma_1 = 2\gamma_2}$