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Ex. 12 The rate constant of n^{th} order reaction has units:

[A] $\text{litre}^{1-n} \text{mol}^{1-n} \text{sec}^{-1}$ [B] $\text{mol}^{1-n} \text{litre}^{1-n} \text{sec}$

[C] $\text{mol}^{1-n} \text{litre}^{n-1} \text{sec}^{-1}$ [D] $\text{mol}^{1-n} \text{litre}^{n-1} \text{sec}^{-1}$

Sol.ⁿ [D]

For an n^{th} order reaction: $\text{rate} = k[\text{conc.}]^n$

$$k = \frac{\text{rate}}{[\text{conc.}]^n}$$

$$\text{units of } k = \frac{\text{mol L}^{-1} \text{S}^{-1}}{(\text{mol L}^{-1})^n} = \text{mol}^{1-n} \text{L}^{n-1} \text{S}^{-1}$$

Ex. 13 On which of the following factors, the rate constant does not depend?

[A] Temperature [B] Concentration

[C] Presence of Catalyst [D] Nature of reactants

Sol.ⁿ [B]

Rate constant is independent of the conc. of the reactants.

9. ORDER OF REACTION :

The sum of the power of the concentration terms on which the rate of reaction actually depends as observed experimentally is called the order of the reaction. For example,

$$\text{order of reaction} = x + y$$

Thus, the order of reaction may also be defined as the sum of the exponents (powers) to which the concentration terms in the rate law equation are raised in order to express the observed rate of the reaction. Thus reaction is said to be of the first order if its rate is given by the expression of the type

$$r_1 = k_1 C_A$$

Second order if the rate is given by the expression of the type.

$$r_2 = k_2 C_A^2$$

$$\text{or } r_2 = k_2 C_A C_B$$

third order if the rate is given by the expression of the type

$$r = k_3 C_A^3 \text{ or } r = k_3 C_A^2 C_B \text{ or } r = k_3 C_A C_B^2 \text{ or } k_3 C_A C_B C_C \text{ and soon}$$

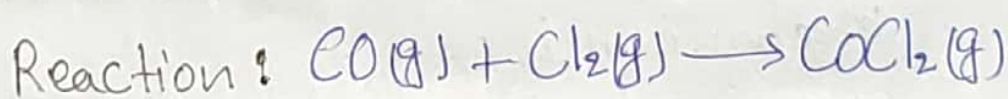
For zero order reaction, the rate equation is written as $R = k_0$. It is to be noted that the order of reaction is essentially an experimental quantity.

Note: Order may be zero, fractional, integer or negative.

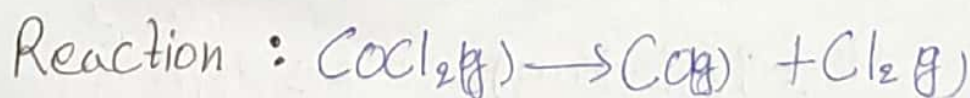
Example:

Reaction	Experimental rate equation	Order
$H_2 + Cl_2 \rightarrow 2HCl$	$V = k$	Zero
$H_2 + Br_2 \rightarrow 2HBr$	$V = k[H_2][Br_2]^{1/2}$	one and half
$H_2 + I_2 \rightarrow 2HI$	$V = k[H_2][I_2]$	two

◆ Examples of fractional order reaction



$$V = k [CO]^2 [Cl_2]^{1/2}, \text{ order} = 2.5$$



$$V = k [COCl_2]^{3/2}, \text{ order} = 1.5$$