

D. B. College (Jaynagar) lect - 26

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Ex. 4

For the reaction,  $A + B \rightarrow C$ , the following data were obtained. In the first experiment, when the initial concentrations of both A and B are 0.1 M, the observed initial rate of formation of C is  $1 \times 10^{-4}$  mol litre<sup>-1</sup> minute<sup>-1</sup>. In second experiment when the initial concentrations of (A) and (B) are 0.1 M and (A) and (B) are 0.3 M, the initial rate is  $3.0 \times 10^{-4}$  mol litre<sup>-1</sup> minute<sup>-1</sup>. In the third experiment when the initial concentrations of both A and B are 0.3 M, the initial rate is  $2.7 \times 10^{-3}$  mol litre<sup>-1</sup> minute<sup>-1</sup>.

- Write rate law for this reaction.
- Calculate the value of specific rate constant for this reaction.

Sol<sup>n</sup> Let, Rate =  $k[A]^x[B]^y$

$$R_1 = 1 \times 10^{-4} = k(0.1)^x(0.1)^y \quad \text{--- (1)}$$

$$r_2 = 3 \times 10^{-4} = k(0.1)^x (0.3)^y \quad \text{--- (2)}$$

$$r_3 = 2.7 \times 10^{-3} = k(0.3)^x (0.3)^y \quad \text{--- (3)}$$

By Eqs. (1) and (2)  $\frac{r_1}{r_2} = \frac{1 \times 10^{-4}}{3 \times 10^{-4}} = \left(\frac{1}{3}\right)^y \therefore y = 1$

By Eqs. (2) and (3),

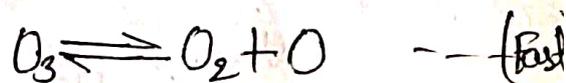
$$\frac{r_2}{r_3} = \frac{3 \times 10^{-4}}{2.7 \times 10^{-3}} = \left(\frac{1}{3}\right)^x \therefore x = 2$$

$$\text{Rate} = k[A]^2[B]^1$$

Also,  $1 \times 10^{-4} = k(0.1)^2(0.1)^1$

$$\therefore k = 10^{-4} = 0.1 \text{ L}^2 \text{ mol}^{-1} \text{ min}^{-1}$$

Ex. 5 The chemical reaction,  $2O_3 \rightarrow 3O_2$  proceeds as follows!



The rate law expression should be

(A)  $r = k[O_3]^2$

(B)  $r = k[O_3]^2 [O_2]^{-1}$

(C)  $r = k[O][O_3]$

(D) Unpredictable

Sol<sup>n</sup> Rate of reaction,  $(r) = k[O][O_3]$

The rate of formation of  $[O]$  depends on first step

$$\text{Since } k_{eq} = \frac{[O_2][O]}{[O_3]}$$

$$[O] = k_{eq} \frac{[O_3]}{[O_2]}$$

$$\text{Or } r = k k_{eq} \frac{[O_3][O_3]}{[O_2]} = k \cdot [O_3]^2 [O_2]^{-1}$$

Ex. 6 Disintegration of radium takes place at an average rate of  $1.42 \times 10^{13}$   $\alpha$ -particles per minute. Each  $\alpha$ -particle takes up 2 electrons from the air and becomes a neutral helium atom. After 420 days, the He gas collected was  $0.5 \times 10^{-3}$  L measured at 300K and 750 mm of mercury pressure, from the above data, calculate Avogadro's number.

Sol<sup>n</sup>

No. of  $\alpha$ -particles (or) He formed =  $1.42 \times 10^{13} \times 60 \times 24 \times 365$

1. No of He particles formed in 420 days =  $1.42 \times 10^{13} \times 420 \times 24 \times 365 = 8.588 \times 10^{18}$

Also at 27 C and 750 mm ; He = 0.5 mL

~~Using at 27 C and 750 mm ; He = 0.5 mL~~  
using  $PV = nRT$

$$\frac{750}{760} \cdot \frac{0.5}{1000} = n \cdot 0.0821 \cdot 300 \Rightarrow n = 2.0 \times 10^{-5} \text{ moles}$$

$2.0 \times 10^{-5}$  moles of He =  $8.588 \times 10^{18}$  particles of He

$\Rightarrow$  1 mole of He =  $\frac{8.588 \times 10^{18}}{2.0 \times 10^{-5}} \Rightarrow 4.294 \times 10^{22}$  particles

1. Avogadro's number =  $4.294 \times 10^{22}$  particles/mol