

D. B. College (Jaynagar) Lect-21

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Ex. 28

A hydrogenation reaction is carried out at 500K. If the same reaction is carried out in presence of Catalyst at the same rate, the temperature required is 400K. Calculate the activation energy of the reaction if the Catalyst lowers the activation energy barrier by 40 kJ/mol.

Sol. Let  $E_a$  and  $E_a'$  be the energy of activation in absence and presence of Catalyst for hydrogenation reaction, as  $k = Ae^{-E_a/RT}$

$$k_1 = Ae^{-E_a/RT \times 500} \quad (\text{In absence of Catalyst})$$

$$k_2 = Ae^{-E_a'/RT \times 400} \quad (\text{In presence of Catalyst})$$

Given,  $r_1 = r_2$ , Hence  $k_1 = k_2$

$$e^{-E_a/RT \times 500} = e^{-E_a'/RT \times 400}$$

$$\Rightarrow \frac{E_a}{R \times 500} = \frac{E_a'}{R \times 400} \quad \text{or,} \quad \frac{E_a}{500} = \frac{E_a' - 40}{400} \quad \left( \text{As } E_a - E_a' = 40 \right)$$

19. DETERMINATION OF ORDER OF REACTION:-

### Integration Method

In this method, value of  $k$  is determined by putting values of initial concentration of reactants and change in concentration with time in kinetic equation of first, second and third order reactions. The equation by which constant value of  $k$  is obtained is called order of that reaction.

$$k_1 = \frac{2.303}{t} \log \frac{a}{a-x} \quad \left[ \text{For first order reaction} \right]$$

$$k_2 = \frac{1}{t} \left[ \frac{x}{a(a-x)} \right] \quad \left[ \text{For second order reaction} \right]$$

$$k_3 = \frac{1}{2t} \left[ \frac{x(2a-x)}{a^2(a-x)^2} \right] \quad \left[ \text{For third order reaction} \right]$$

Ex. 29 For a reaction,  $A \rightarrow B$ , it has been found that the order of the reaction is zero with respect to  $A$ . Which of the following

expression correctly describes the reaction?

$$[A]_k = \frac{2.303}{t} \log \frac{[A]_0 [B]_0 - [A]_t [B]_0}{[A]_t [B]_0 - [A]_0 [B]_0} \quad [C]_{t_{1/2}} = \frac{0.693}{k}$$

$$[D]_{t_{1/2}} \propto \frac{1}{[A]_0}$$

Sol<sup>n</sup>  $-\frac{d[A]}{dt} = k[A] - d[A] = kdt$

Integrating from  $t=0$  to  $t=t$   $[A]_0 - [A] = kt$

Ans B

### □ Graphical Method

If a straight line is obtained on drawing a graph between  $\log(a-x)$  and time then it is first order reaction.

If a straight line is obtained on drawing a graph between  $(a-x)^2$  and  $\frac{dx}{dt}$ , then it is second order reaction. □