

Topic :- Chemical Kinetics

1 (c)

$$K_1 = 10^{16}e^{-2000/T}; K_2 = 10^{15}e^{-1000/T}$$

if $K_1 = K_2$ then $10^{16}e^{-2000/T} = 10^{15}e^{-1000/T}$

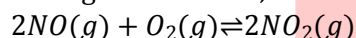
or $\log 10 - \frac{2000}{T} = -\frac{1000}{T}$ or $T = \frac{1000}{2.303}$ K

2 (c)

As we know that, rate of reaction is directly proportional to concentration of reactant and inversely proportional to the volume of vessel.

i.e., concentration $\propto \frac{n}{v}$

For a given reaction,



$$\text{Rate of reaction} = k[NO]^2[O_2]$$

If volume of vessel is reduced by $\frac{1}{3}$ rd of its initial value, then concentration of compound is increase by 3 times. Hence, the rate of reaction will be increased by 27 times.

3 (c)

For a zero order reaction

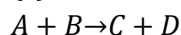
$$k_0 = \frac{[A_0]}{2t_{1/2}}$$

Since, $[A]_0 = 2 \text{ M}, t_{1/2} = 1 \text{ h}$

So, $k_0 = 1$ and

$$k_0 = \frac{\Delta x}{t} \text{ or } t = \frac{0.50 - 0.25}{1} = 0.25 \text{ h}$$

4 (c)



$$\text{Rate } (r) = k[A]^a[B]^b \dots(i)$$

$$2r = k[2A]^a[B]^b \dots(ii)$$

$$3r = k[A]^a[9B]^b \dots(iii)$$

Dividing eq.(ii) by eq.(i)

$$2 = 2^a \text{ or } a = 1$$

Dividing eq (iii) by eq.(i)

$$3 = 9^b \text{ or } 3 = 3^{2b} \text{ or } 2b = 1 \text{ or } b = 1/2$$

$$\text{So order of reaction} = 1 + \frac{1}{2} = \frac{3}{2}$$

5 (a)

$$N = \frac{N_0}{2^n}$$

$$n = \frac{T}{t_{1/2}} = \frac{40}{20} = 2$$

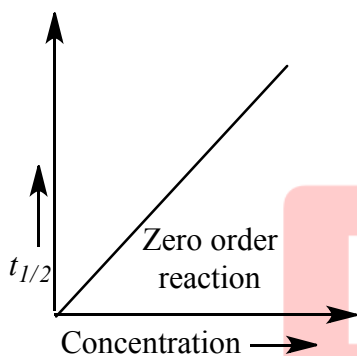
$$\therefore N = \frac{N_0}{2^2} = \frac{N_0}{4}$$

6 (a)

$$p_1 = 80 \text{ kPa}, (t_{1/2})_1 = 350 \text{ s}$$

$$p_2 = 40 \text{ kPa}, (t_{1/2})_2 = 175 \text{ s}$$

$$\frac{80}{40} = \frac{350}{175} = 2$$

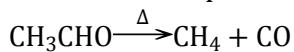


$$\therefore \frac{p_1}{p_2} = \frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{a_1}{a_2}$$

$(t_{1/2}) \propto a$ (zero order reaction)

7 (b)

Thermal decomposition,



$$\frac{dx}{dt} = k[\text{CH}_3\text{CHO}]^{3/2}$$

8 (b)

For the reaction : $A \rightarrow 2B + C$

$$p_1 \quad 0 \quad 0$$

$$\text{After 10 min} \quad p_1 - p \quad 2p \quad p$$

$$\text{After long time} \quad 0 \quad 2p_1 \quad p_1$$

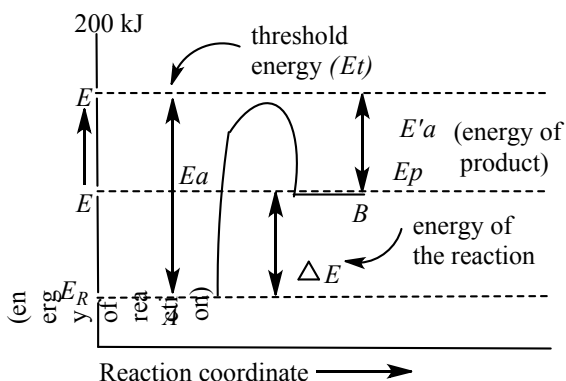
$$\text{Total pressure} = (p_1 - p + 2p + p) = 176 \text{ mm}$$

$$\text{Total pressure after long time}$$

$$= 2p_1 + p_1 = 270 \text{ mm}$$

Calculate the value of p from above two equation and then the difference of p_1 and p will be the pressure of A

9 (c)



Where,

E_a = activation energy of forward reaction

E''_a = activation energy of backward reaction

The above energy profile diagram shows that

$E_a > E''_a$

The potential energy of the product is greater than that of the reactant, so the reaction is endothermic.

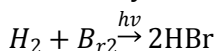
$E_a = E''_a + \Delta E$

$E_t = E_a$ or $E_t > E''_a$

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(d)

Combination of H_2 and Br_2 to give HBr is zero order reaction as the rate of reaction is not affected by the concentration of reactants.



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(a)

$$\begin{aligned} \text{Rate of reaction} &= \frac{1}{4} \frac{d(NO_2)}{dt} = \frac{5.2 \times 10^{-3}}{4 \times 100} \\ &= 1.3 \times 10^{-5} \text{ Ms}^{-1} \end{aligned}$$

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(d)

$$9 = \left(\frac{3.24 \times 10^{-2}}{1.2 \times 10^{-3}} \right)^n$$

$$9 = (3^3)^{2/3}$$

order of the reaction is = 2/3

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(b)

For zero order reaction

$$k = \frac{a}{2t_{1/2}} = \frac{a}{2 \times 100} = \frac{a}{200}$$

When 80% completion take place

$$k = \frac{x}{t}$$

$$\frac{a}{200} = \frac{0.80a}{t}$$

$$t = 200 \times 0.8 = 160 \text{ min}$$

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(a)

$2A + B \rightarrow \text{product}$

[B] is doubled, half-life didn't change

Half-life is independent of change in concentration of reactant i.e., first order

First order w.r.t. to B

When [A] is doubled, rate increased by two times

\Rightarrow First order w.r.t. A

Hence, net order of reaction = $1+1=2$

Unit for the rate constant = $\text{conc.}^{(1-n)}t^{-1}$

$$= (\text{mol}^{-1})^{-1} \cdot \text{s}^{-1}$$

L. $\text{mol}^{-1}\text{s}^{-1}$

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(c)

$\text{H}_2\text{O} + \text{O} \rightarrow 2\text{OH}; \Delta H = 72\text{kJ}$ at 500 K;

Given $E_a = 77 \text{ kJ mol}^{-1}$

$2\text{OH} \rightarrow \text{H}_2\text{O} + \text{O}; E_{a_{B,R}}$

For a reaction $E_{a_{F,R}} = \Delta H + E_{a_{B,R}}$

$$\therefore 77 = 22 + E_{a_{B,R}}$$

$$\therefore E_{a_{B,R}} = 55 \text{ kJ mol}^{-1}$$

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(d)

According to Arrhenius equation, the relationship between the activation energy and temperature is

$$k = Ae^{-E_a/RT}$$

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

\therefore Activation energy decreases with rise in temperature, thereby increasing the rate of the reaction.

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(d)

$$\text{rate} = K[A]^1$$

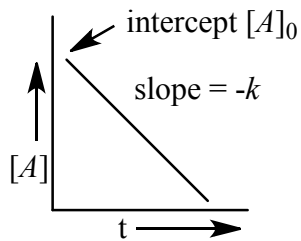
$$K = \frac{2.0 \times 10^{-5}}{0.01} = 2.0 \times 10^{-3} \text{ s}^{-1}$$

$$\therefore t_{1/2} = \frac{0.693}{2 \times 10^{-3}} = 347 \text{ s}$$

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(c)

For a zero order reaction, the plot of concentration of reactant vs time is a straight line (linear) with a negative slope and non-zero intercept.



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(b)

$$r = K[A]^m[B]^n;$$

$$\text{Also, } \frac{r}{4} = K[A]^m[2B]^n$$

$$4 = \left(\frac{1}{2}\right)^n \text{ or } 2^2 = 2^{-n}$$

$$\therefore n = -2$$

PE

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	C	C	C	C	A	A	B	B	C	D
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	D	B	A	B	C	D	D	C	B

PE