Q-1 - 11045322

The rate constant for the reaction

$$2N_2O_5 \rightarrow 4NO_2 + O_2$$

is $3.0 \times 10^{-5} s^{-1}$. If the rate is $2.40 \times 10^{-5} mol L^{-1} s^{-1}$, then the concentration of N_2O_5 (in $mol L^{-1}$) is

(A) 1.4

(B) 1.2

(C) 0.04

(D) 0.8

CORRECT ANSWER: D

SOLUTION:

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

This reaction is a first order reaction.

Rate $= k[N_2O_5]$

$$2.40 \times 10^{-5} = 3.0 \times 10^{-5} \times [N_2O_5]$$

or $[N_2O_5] = 0.8 mol L^{-1}$

Q-2 - 12659512

The rate constant of the reaction

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

is $3 \times 10^{-3} \min^{-1}$

At what concentration of H_2O_2, the rate of the reaction will be

$2 \times 10^{-4} Ms^{-1}$?

(A) $6.67 \times 10^{-3}(M)$

(B) $2(M)$

(C) $4(M)$

(D) $0.08(M)$

CORRECT ANSWER: C

SOLUTION:

$$-\frac{d[H_2O_2]}{dt}$$
$$= k[H_2O_2]^1$$

$$\therefore 2 \times 10^{-4}$$
$$= \frac{3 \times 10^{-3}}{60}$$
$$\times [H_2O_2]$$

or $[H_2O_2] = 4(M)$

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Q-3 - 12659522

The rate of disappearance of SO_2 in the reaction

$2SO_2 + O_2 \to 2SO_3$ is $1.28 \times 10^{-3} g / \sec$ then the rate of

formation of SO_3 is

(A) $0.64 \times 10^{-3} g / \sec$

(B) $0.80 \times 10^{-3} g / \sec$

(C) $1.28 \times 10^{-3} g / \sec$

(D) $1.60 \times 10^{-3} g / \sec$

CORRECT ANSWER: C

SOLUTION:

The rate of formation of SO_3 is $1.28 \times 10^{-3} g / \sec.$

$$\frac{-d[SO_2]}{dt} = 1.28 \times 10^{-3}$$

$$r = -\frac{1}{2}\frac{d[SO_2]}{dt} = \frac{1}{2}\frac{d[SO_3]}{dt} = -\frac{d[O_2]}{dt}$$

$$\Rightarrow -\frac{1}{2}\frac{d[SO_2]}{dt} = -\frac{1}{2}\frac{d[SO_3]}{dt}$$

$$\Rightarrow \frac{d[SO_3]}{dt} = 1.28 \times 10^{-3}$$

For the reaction $N_2(g) + 2H_2(g) \rightarrow 2NH_3(g)$ under certain conditions of temperature and partial pressure of the reactants , the rate of formation of NH_3 is $0.001 kgh^{-1}$. The rate of conversion of H_2 under the same conditions is

(A) 1.82×10^{-4}kg/hr

(B) 0.0015 kg/hr

(C) 1.52×10^{4} kg/hr

(D) 1.82×10^{-14} kg/hr

CORRECT ANSWER: B

SOLUTION:

$$\frac{-dN_2}{dt} = \frac{-1}{3}\frac{dH_2}{dt}$$
$$= \frac{1}{2}\frac{dNH_5}{dt} \Rightarrow \frac{dH_2}{dt}$$
$$= \frac{3}{2} \times 0.001 = 0.001$$

5 kg $1 hr^{-1}$.

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Q-5 - 16985810

The rate of a reaction is expressed in different ways as follows:

$$+\frac{1}{2}\frac{d[C]}{dt} = -\frac{1}{3}\frac{d[D]}{dt} = +\frac{1}{4}\frac{d[A]}{dt} = -\frac{d[B]}{dt}$$

the reaction is

(A) $4A + B \rightarrow 2C + 3D$

(B) $B + 3D \rightarrow 4A + 2C$

(C) $A + B \rightarrow C + D$

(D) $B + D \rightarrow C + D$

CORRECT ANSWER: B

Q-6 - 12659518

The rate of formation of SO_3 in the following reaction:

$2SO_2 + O_2 \rightarrow 2SO_3$ is $10g\sec^{-1}$. The rate of disappearance of O_2 will be

(A) $5g\sec^{-1}$

(B) $100g\sec^{-1}$

(C) $20g\sec$

(D) $2g\sec^{-1}$

CORRECT ANSWER: D

SOLUTION:

$$2SO_2 + O_2 \rightarrow 2SO_3$$

$$r_{SO_3} = 10g$$

$$/\sec = \frac{10}{80}\text{mol}/\sec$$

Also,

$$\frac{r_{O_2}}{1} = \frac{r_{So_3}}{2} \Rightarrow r_{O_2}$$

$$= \frac{10}{80} \times \frac{1}{2}\text{mol}/\sec$$

$$= \left(\frac{10}{160}\right) \times 32g$$

$$/\sec = 2g/\sec$$

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Q-7 - 12659541

For a reactions $A + B \rightarrow$ product, it was found that rate of reaction increases four times if concentration of $'A'$ is doubled, but the rate of reaction remains unaffected. If concentration of $'B'$ is doubled. Hence, the rate law for the reaction is

(A) rate $= k[A][B]$

(B) rate $= k[A]^2$

(C) rate $= k[A]^2[B]^1$

(D) rate $= k[A]^2[B]^2$

CORRECT ANSWER: B

SOLUTION:

Let the rate of reaction depends on x^{th} power of $[A]$.

Then

$r_1 = k[A]^x$ and $r_2 = k[2A]^x$

$$\therefore \frac{r_1}{r_2} = \frac{[A]^x}{[2A]^x} = \frac{1}{4}$$

$$= \left(\frac{1}{2}\right)^2$$

$(\because r_2 = 4r_1)$

$\therefore x = 2$. As the reaction rate does not depend upon the concentration of B. Hence, the correct rate law will be rate

$= K[A]^2[B]$ or $= K[A]^2$

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Q-8 - 52406347

The reaction

$2NO(g) + O_2(g)$

$\Leftrightarrow 2NO_2(g)$

is of first order . If volume of reaction vessel is reduced to 1/3 , the

rate of reaction would be

(A) 1/3 times

(B) 2/3 times

(C) 3 times

(D) 6 times

CORRECT ANSWER: C

SOLUTION:

For the following reaction , $2NO_{(g)} + O_{2(g)}$ $\rightarrow 2NO_2(g)$

When the volume of vessel change into $\frac{1}{3}$ then concentration of reactant become three times.

The rate of reaction for first order reaction $\propto$ concentration . So rate of reaction will increases three times .

Q-9 - 43956744

For a reaction $2A + B \rightarrow 2AB$, it is found that doubling the concentration of both the reactants increases the rate to eight times that of initial rate but doubling the concentration of B alone doubles the rate. Then the order of the reaction with respect to A and B is

(A) 0,3

(B) 0,2

(C) 2,1

(D) 2,2

CORRECT ANSWER: C

Q-10 - 12659535

In a reaction $2A + B \to A_2B$, the reactant A will disappear at

(A) Half the rate that B will decrease

(B) The same rate that B will decrease

(C) Twice the rate that B will decrease

(D) The same rate that A_2B will form

CORRECT ANSWER: C

SOLUTION:

$'A'$ will disappear at twice the rate at which $'B'$ will decrease.

Q-11 - 12659513

Observe the following reaction:

$A(g) + 3B(g) \rightarrow 2C(g)$

The rate of this reaction $\left\{\frac{-d[A]}{dt}\right\}$ is 3×10^{-3}mol litre^{-1}min^{-1}. What is the value of $\frac{-d[B]}{dt}$ in mol litre^{-1}min^{-1} ?

(A) 3×10^{-3}

(B) 9×10^{-3}

(C) 10^{-3}

(D) 1.5×10^{-3}

CORRECT ANSWER: B

SOLUTION:

$$\frac{-d[A]}{dt} = -\frac{1}{3}\frac{d[B]}{dt}$$

$$\therefore \frac{-d[B]}{dt}$$

$$= 3\left\{\frac{-d[A]}{dt}\right\} = 3$$

$$\times 3 \times 10^{-3}$$

.

Q-12 - 11045228

For the reaction $NO_2 + CO \rightarrow CO_2 + NO$, the experimental rate expresison is $-dc/dt = k[NO_2]^2$. Find the number of molecules of CO involved in the slowest step.

CORRECT ANSWER: 0

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Q-13 - 12659842

The rate constant of a first-order reaction is 3×10^{-6} per second. If the initial concentration is $0.10m$, the initial rate of reaction is

(A) $3 \times 10^{-5} ms^{-1}$

(B) $3 \times 10^{-6} ms^{-1}$

(C) 3×10

(D) $3 \times 10^{-7} ms^{-1}$

CORRECT ANSWER: D

SOLUTION:

Given: Rate constant of the first-order reaction

$(K) = 3 \times 10^{-6}$ per sec and initial concentration

$[A] = 0.10M$. We know that initial rate constant

$K[A] = 3 \times 10^{-6}$
$\times 0.10 = 3$
$\times 10^{-7} ms^{-1}$

Q-14 - 12659555

The rate of the first-order reaction $X \rightarrow$ products is

$7.5 \times 10^{-4} mol L^{-1} \text{min}^{-1}$. What will be value of rate constant

when the concentration of X is $0.5 mol L^{-1}$?

(A) $3.75 \times 10^{-4} s^{-1}$

(B) $2.5 \times 10^{-5} s^{-1}$

(C) $1.5 \times 10^{-3} s^{-1}$

(D) $8.0 \times 10^{-4} s^{-1}$

CORRECT ANSWER: B

SOLUTION:

Rate of reaction

$$= 7.5 \times 10^{-4} \mathrm{mol\ L}^{-1} \mathrm{min}^{-1}$$

$$= \frac{7.5 \times 10^{-4}}{60} \mathrm{mol\ L}^{-1} s^{-1}$$

$$= 1.25 \times 10^{-5} \mathrm{mol\ L}^{-1}\ \mathrm{sec}^{-1}$$

Rate of reaction

$$= k \left[\text{concentration of react ant X}\right]$$

Or

$$k = \frac{1.25 \times 10^{-5}}{0.5}$$

$$= 2.5 \times 10^{-5} s^{-1}$$

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Q-15 - 12659558

The reaction

N_2O_5 (in CCl_4 solution) $\rightarrow 2NO_2$ (solution) $+\frac{1}{2}O_2(g)$ is of first order in N_2O_5 with rate constant $6.2 \times 10^{-1} s^{-1}$. What is the value of rate of reaction when $[N_2O_5] = 1.25$ mole ?

(A)

$7.75 \times 10^{-1} \text{mole}^{-1} s^{-1}$

(B)

$6.35 \times 10^{-3} \text{mole}^{-1} s^{-1}$

(C)

$5.15 \times 10^{-5} \text{mole}^{-1} s^{-1}$

(D)

$3.85 \times 10 - 1 \text{mole}^{-1} s^{-1}$

CORRECT ANSWER: A

SOLUTION:

Rate

$= K(N_2O_5) = 6.2 \times 10^{-1} \times 1.25$

$= 7.75 \times 10^{-1} mol^{-1} s^{-1}$

Q-16 - 12659553

For the reaction $H_2 + Br_2 \rightarrow 2HBr$ overall order is found to be $3/2$. The rate of reaction can be espressed as:

(A) $[H_2][Br_2]1/2$

(B) $[H_2]^{1/2}[Br^2]$

(C) $[H_2]^{3/2}[Br^2]^0$

(D) All of these

CORRECT ANSWER: D

SOLUTION:

By definition of roder.

Q-17 - 12659554

The rate of the reaction

$CCl_3CHO + NO \rightarrow CHC_3$
$+ NO + CO$

is given by Rate $= K[CCl_3CHO][NO]$. If concentration is

expressed in moles/litre, the units of K are

(A) $\text{litre}^2\text{mole}^{-2}\text{sec}^{-1}$

(B) mole $\text{litre}^{-1}\text{sec}^{-1}$

(C) $\text{litre mole}^{-1}\text{sec}^{-1}$

(D) sec^{-1}

CORRECT ANSWER: C

SOLUTION:

It is a second-order reaction and the unit of k for second order reaction is litre $\text{mol}^{-1}\text{sec}^{-1}$.

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Q-18 - 12659613

The rate for a first order reaction is $0.6932 \times 10^{-2} molL^{-1}\text{min}^{-1}$ and the initial concentration of the reactants is $1M, T_{1/2}$ is equal to

(A) 6.932 min

(B) 100 min

(C) $0.6932 \times 10^{-3} \text{ min}$

(D) $0.6932 \times 10^{-2} \text{ min}$

CORRECT ANSWER: B

SOLUTION:

$$r = k[\text{reactant}]^{-1}$$

$$\therefore K = \frac{0.693 \times 10^{-2}}{1}$$

also

$$t_{1/2} = \frac{0.693}{k}$$

$$= \frac{0.693}{0.693 \times 10^{-2}}$$

$$= 100 \text{ min}$$

Q-19 - 12659615

$99\ \%$ at a first order reaction was completed in $32\ \text{min}$. When will $99.9\ \%$ of the reaction complete.

(A) $48\ \text{min}$

(B) $46\ \text{min}$

(C) $50\ \text{min}$

(D) $45\ \text{min}$

CORRECT ANSWER: A

SOLUTION:

$$K \times 32 = \ln\left(\frac{100}{1}\right) \text{ (i)}$$

$$K \times t = \ln\left(\frac{100}{0.1}\right) \text{ (ii)}$$

eq. $(ii) / (i)$

$$\frac{t}{32}=\frac{3\ln 10}{2\ln 10}$$
$$t=48 \text{ min}$$

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Q-20 - 12659624

The rate constant of reaction $2A+B\rightarrow C$ is

$2.57\times10^{-5}L\text{mole}^{-1}sce^{-1}$ after 10 sec,

$2.65\times10^{-5}L\text{mole}^{-1}\text{sec}^{-1}$ after 20 sec and

$2.55\times10^{-5}L\text{mole}^{-1}\text{sec}^{-1}$ after 30 sec. The order of the reaction is :

(A) 0

(B) 1

(C) 2

(D) 3

CORRECT ANSWER: C

SOLUTION:

$2A + B \rightarrow C$

Unit of k $=$ lit mole^{-1} sec^{-1}

so order of reaction $= 2$.

Q-21 - 52406387

For a first order reaction (A) $\rightarrow$ products the concentration of A changes from 0.1 M to 0.025 M in 40 minutes . The rate of reaction when the concentration of A is 0.01 M is

(A) 1.73×10^{-5} M/min

(B) 3.47×10^{-4} M / min

(C) 3.47×10^{-5} M/min

(D) 1.73×10^{-4} M/min

CORRECT ANSWER: B

SOLUTION:

$$K=\frac{1}{40}\ln\frac{0.1}{0.025}$$

$$=\frac{1}{40}$$

In4

$$R=K[A]^1=\frac{1}{40}$$ In

$$4(0.1)=\frac{2\ln 2}{40}(.01)$$

$$=3.47\times10^{-4}$$

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Q-22 - 52406455

In presence of HCl , sucrose gets hydrolysed into glucose and fructose . The concentration of sucrose was found to reduce form 0.4 M to 0.2 M in 1 hour and 0.1 M in 2 hours . The order of the reaction is

(A) Zero

(B) One

(C) Two

(D) None of these

CORRECT ANSWER: B

SOLUTION:

$t_{1/2} \propto \frac{1}{(C_0)^{n-1}}$ $\therefore$ reaction is of first order .

Q-23 - 12659632

Consider a reaction $A(g) \rightarrow 3B(g) + 2C(g)$ with rate constant is $1.386 \times 10^{-2} \text{min}^{-1}$ in a non-rigid closed container starting with 2 moles of A in $12.5L$ vessel initially, if reaction is allowed to take place at constant pressure and at $298K$ the conc. of after 100 min is

(A) $0.18M$

(B) $0.03M$

(C) $0.09M$

(D) $0.01M$

CORRECT ANSWER: C

SOLUTION:

$$A \rightarrow 3B + 2C$$

$$K = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$$

$$\Rightarrow [A] = 0.0016$$

$$.0016 = \frac{n_A}{\text{Vol}}$$

$$.0016 \times 12.5 = n_A$$

$$n_A = .02$$

x_A decompsed $= 2 - 0.02$

$= 198.$

Moles of A decomposed $= 1.98$

So moles of B formed $= 5.94$

Assuming $n \propto v$ final vol. $= 62L$

So fins conc. of

$B = \frac{5.94}{62} = 0.09mol$

$/L$

.

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Q-24 - 12659637

The time for half-life period of a certain reaction, $A \rightarrow$ products is $1h$. When the initial concentration of the reactant $'A'$ is $2.0 \text{mol} L^{-1}$, how much time does it take for its concentration to come from 0.50 to $0.25 \text{mol} L^{-1}$, if it is zero order reaction ?

(A) $4h$

(B) $0.5h$

(C) $0.25h$

(D) $1h$

CORRECT ANSWER: C

SOLUTION:

Half-life for a zero-order reaction is given by

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

[where $[A_0]=$ initial concentration of reactant]

$$\Rightarrow k_0=k_0=\frac{[A]_0}{2t_{1/2}}$$

$$=\frac{2.0molL^{-1}}{2\times 1h}$$

$$=1.0molL^{-1}h^{-1}$$

Rate constant foe a zero-order reaction is given by

$$k = \frac{1}{t}[(A_0) - (A)]$$

$$\Rightarrow t = \frac{1}{k}[(A_0) - (A)]$$

$$(0.50)$$

$$t = \frac{-(0.25) mol L^{-1}}{1 mol L^{-1} h^{-1}}$$

$$\Rightarrow t = 0.25h$$

Q-25 - 32521858

In a certain reaction, $10\ \%$ of the reactant decomposes in one hour, $20\ \%$ in two hours, $30\ \%$ in theee hours, and so on. The dimenison of the velocity constant (rate constant) are

(A) hour^{-1}

(B) $\text{mole litre}^{-1}\ \text{sec}^{-1}$

(C) $\text{litre mole}^{-1}\ \text{sec}^{-1}$

(D) mole sec^{-1}

CORRECT ANSWER: B

SOLUTION:

It is zero order reaction therefore units of K is mol $L^{-1}s^{-1}$

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Q-26 - 12659645

A certain zero order reaction has $k = 0.025 Ms^{-1}$ for the disappearance of A. What will be the concentration of A after 15 seconds if the initial concentration is $0.5M$?

(A) $0.5M$

(B) $0.32M$

(C) $0.12M$

(D) $0.06M$

CORRECT ANSWER: C

SOLUTION:

$$x = k_1 = 0.025 \times 15$$
$$= 0.375M$$

Remaining conc.

$$= 0.5 - 0.375$$
$$= 0.125M$$

.

Q-27 - 12659634

For the reaction $A + 2B \rightarrow$ products (started with concentration taken in stoichiometric proportion), the experimentally determined rate law is :

$$-\frac{d[A]}{dt} = k\sqrt{[A]}\sqrt{[B]}$$

The half life time of the reaction would be :

(A) $\frac{0.693}{k}$

(B) $\frac{0.693}{1/k}$

(C) $\frac{0.693}{\sqrt{2k}}$

(D) not defined

CORRECT ANSWER: C

SOLUTION:

$$\begin{array}{llll} A & + & 2B \rightarrow & \text{products} \\ a-x & & 2a-2x & \end{array}$$

$$-\frac{d[A]}{dt}=k\sqrt{[A]}\sqrt{[B]}$$

Reactant are in their stoichiometric proportional

$$\Rightarrow \; -\frac{d(a-x)}{dt}=k$$

$$=\sqrt{(a-x)}\sqrt{2(a-x)}$$

$$\frac{dx}{dt} = \sqrt{2}k(a-x)$$

$$t_{1/2} = \frac{0.693}{\sqrt{2}k}$$

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Q-28 - 12659665

Consider a reaction, $2A + B \rightarrow$ Products

When concentration of B alone was doubled, the half-life did not change. When the concentration of A alone was doubled, the rate incresed by two times. The unit of rate constant for this reaction is :

(A) $L\text{mol}^{-1}s^{-1}$

(B) No unit

(C) $\text{mol}L^{-1}s^{-1}$

(D) s^{-1}

CORRECT ANSWER: A

SOLUTION:

$2A + B \rightarrow$ Product

When concentration of B is doubled, the half-life did not change, hence reaction is of first order w.r.t. B. When concentration of A is doubled, reaction rate is doubled, hence reaction is first order w.r.t. A. Hence over all order of reaction is $1 + 1 = 2$

So, unit of rate constant is $\text{mol}^{-1}\text{litre}s^{-1}$.

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Q-29 - 12659656

If a I-order reaction is completed to the extent of 60 % and 20 % in time intevals, t_1 and t_2, what is the ratio, $t_1 : t_2$?

(A) 6.32

(B) 5.58

(C) 4.11

(D) 8.33

CORRECT ANSWER: C

SOLUTION:

$$t_1 = \frac{2.303}{K}\log\left(\frac{100}{40}\right)(1)$$
$$t_2 = \frac{2.303}{K}\log\left(\frac{100}{80}\right)(2)$$

From (1) and (2) $\frac{t_1}{t_2} = 4.11$

Q-30 - 12659662

For the reaction system $2NO(g) + O_2(g) \rightarrow 2NO(g)$ volume is suddenly produced to half its value by increasing the pressure on it. If the reaction is of first order with respect to O_2 and second order with respect to NO. The rate of reaction will

(A) Diminish to one fourth of its initial value

(B) Diminish to one eighth of its initial value

(C) Increase to eighth times of its initial value

(D) (d) Increase to four times of its initial value

CORRECT ANSWER: C

SOLUTION:

$$R = k[NO]^2[O_2], R'$$
$$= k[2NO]^2[2O_2]$$

$$R = k \times 4[NO]^2[O_2]$$
$$= k \times 8[NO]^2[O_2]$$

$$\frac{R'}{R}$$
$$= \frac{k \times 8[NO]^2[O_2]}{k[NO]^2[O_2]}$$
$$= 8$$

Q-31 - 12659675

For the reaction $A+B \rightarrow C$, it is found that doubling the concentration of A increases the rate by 4 times, and doubling the concentration of B doubles the reaction rate. What is the overall order of the reaction ?

(A) 4

(B) $3/2$

(C) 3

(D) 1

CORRECT ANSWER: C

SOLUTION:

$$A+B \rightarrow C$$

On doubling the concentration of A rate of reaction increases by four times, Rate $\propto [A]^2$

However on doubling the concentration of B, rate of reaction increases two times, Rate $\propto [B]$

Thus, overall order of reaction $= 2 + 1 = 3$.

Q-32 - 52406346

For a reaction $2NO(g) + Cl_2(g) \Leftrightarrow 2NOCl(g)$. When concentration of Cl_2 is doubled , the rate of reaction becomes two times of the original . When the concentration of NO is doubled the rate becomes four times . What is the order of the reaction

(A) 1

(B) 2

(C) 3

(D) 4

CORRECT ANSWER: C

SOLUTION:

$$2NO_{(g)} + Cl_{2(g)} \rightarrow 2NOCl_{(g)}$$

Rate = $k[NO]^2[Cl_2]^1, \therefore O.R. = 2 + 1 = 3$

.

Q-33 - 52406476

Rate if a reaction can be expressed by Arrhenius equations as :

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

In this equation , E represents

(A) The energy above which all the colliding molecules will react

(B) The energy below which colliding molecules will not react

(C) The total energy of the reacting molecules at a temperature , T

(D) The fraction of molecules with energy greater than the activation energy of the reaction

---

CORRECT ANSWER: B

SOLUTION:

None of the given options is perfectly correct . The closest choice is option (b) .

Q-34 - 52406509

Which of the following statements is not true according to collision theory of reaction rates

(A) Collision of molecules is a precondition for any reactoni to occur

(B) All collisions result in the formation of the products

(C) Only activated collisions result in the formation of the products

(D) Molecules which have acquired the energy of activation can collide effectively

---

CORRECT ANSWER: B

SOLUTION:

All collisions are not effective and does not result in the formation of the products .

Q-35 - 11045058

The slope of the line graph of $\log k$ versus $1/T$ for the reaction $N_2O_5 \rightarrow 2NO_2 + 1/2O_2$ is -5000.Calculate the energy of activation of the reaction (in $kJK^{-1}mol^{-1}$).

(A) 95.7

(B) 9.57

(C) 957

(D) None

CORRECT ANSWER: A

SOLUTION:

Arrhenius equation :

$$\log k = \log A - \frac{2.303 E_a}{R} \times \frac{1}{T}$$

Slope

$$= \frac{-E_a}{2.303 \times R} = -5000$$

$$\therefore \frac{-E_a}{2.303 \times 8.314 \times 10^{-3} kJ mol^{-1} K^{-1}} = -5000$$

$$\therefore E_a = 95.7 kJ K^{-1} mol^{-1}$$

Q-36 - 12659696

The ΔH value of the reaction $H_2 + Cl_2 \Leftrightarrow 2HCl$ is -44.12 kcal.

If E_1 is the activation energy of the products then for the above reaction

(A) $E_1 > E_2$

(B) $E_1 < E_2$

(C) $E_1 = E_2$

(D) ΔH is not related to E_1 and E_2

CORRECT ANSWER: A

SOLUTION:

Because reaction is exothermic

Q-37 - 52406552

The rate of a reaction doubles when its temperature changes from

300 K to 310 K . Activation energy of such a reaction will be : (R = $8.314 JK^{-1} mol^{-1}$ and log2 = 0.301)

(A) $53.6 kJ mol^{-1}$

(B) 48.6 kJ mol^{-1}

(C) 58.5 kJ mol^{-1}

(D) 60.5 kJ mol^{-1}

CORRECT ANSWER: A

SOLUTION:

log

$$\frac{K_2}{K_1} = \frac{-E_a}{2.030R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$\frac{K_2}{K_1} = 2, T_2 = 310K$

$T_1 = 300$

K

$\Rightarrow$ log

2

$= \frac{-E_a}{2.303 \times 8.314}$

$\left(\frac{1}{310} - \frac{1}{300}\right)$

$\Rightarrow E_a = 53598.6$ J/mol = 53.6 KJ/mol

Q-38 - 52406515

Activation energy of a chemical reaction can be determined by

(A) Changing concentration of reactants

(B) Evaluating rate constant at standard temperature

(C) Evaluating rate constants at two different temperatures

(D) Evaluating velocities of reaction at two different temperatures

---

CORRECT ANSWER: C

SOLUTION:

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

Q-39 - 11045084

For a reaction, the rate constant is expressed as $k = Ae^{-40000/T}$.

The energy of the activation is

(A) $40000 cal$

(B) $88000 cal$

(C) $80000 cal$

(D) $8000 cal$

CORRECT ANSWER: C

SOLUTION:

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

$$\therefore \frac{-E_a}{R} = -40000$$

$$\therefore E_a = 40000 \times 2$$

$$= 80000 cal$$

Q-40 - 11044770

For a reaction,

$E_a = 0$ and $k = 3.2 \times 10^4 s^{-1}$

at $300K$. The value of k at $310K$ would be

(A) $6.4 \times 10^4 s^{-1}$

(B) $3.2 \times 10^8 s^{-1}$

(C) $3.2 \times 10^4 s^{-1}$

(D) $3.2 \times 10^5 s^{-1}$

CORRECT ANSWER: C

SOLUTION:

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

When

$$E_a = 0, k = A(\text{Constant})$$

$$k_{310} = k_{300} = 3.2 \times 10^4 s^{-1}$$

Q-41 - 12659740

In the reaction

$NH_4NO_2(aq.) \rightarrow N_2(g)$
$+ 2H_2O(l)$

the volume of N_2 after 20 min and after a long time is $40ml$ and $70ml$ respectively, The value of rate constant is :

(A) $(1/20)In(7/4)\min^{-1}$

(B) $(2.303/1200)\log(7/3)\sec^{-1}$

(C) $(1/20)\log(7/3)\min^{-1}$

(D) $(2.303/20)\log(11/7)\min^{-1}$

CORRECT ANSWER: B

SOLUTION:

$$NH_4NO_2(aq)$$

$$\rightarrow N_2(g) + 2H_2O(1)$$

$$K$$

$$= \frac{2.303}{t}\log$$

$$\left(\frac{V_\infty - V_0}{V_\infty - V_t}\right)$$

$$\Rightarrow V_0 = 0$$

$$\Rightarrow K\frac{2.303}{20}\log$$

$$\left(\frac{70-0}{70-40}\right)$$

$$= \frac{2.303}{20}\log\left(\frac{70}{30}\right)$$

$$\Rightarrow K = \frac{2.303}{1200}\log\frac{7}{3}$$

Q-42 - 18255702

H_2O and O-atom react in upper atmosphere bimolecularly to form two OH radicals. ΔH for the reaction is 72 kJ at 500 K and energy of activation is 77 kJ mol^{-1}. E_a for bimolecular recombination of two OH radicals to form H_2O and O-atom, will be

(A) 5 kJ mol^{-1}

(B) 72 kJ mol^{-1}

(C) 77 kJ mol^{-1}

(D) 149 kJ mol^{-1}

CORRECT ANSWER: A

SOLUTION:

$$H_2O + O \xrightarrow{E_a} 2OH,$$
$$\Delta H = 72kJ$$

$$2OH \xrightarrow{E_b} H_2O + O,$$
$$\Delta H = -72kJ$$

Also

$$E_a - E_b = \Delta H \quad \text{or} \quad 77 - E_b = 72$$

$$\therefore \quad E_b = 5kJ \quad \text{mol}^{-1}$$

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Q-43 - 12659766

Assertion: In a zero order reaction, if concentration of the reactant is doubled, half-life period is also doubled.

Reason: The total time taken for a zero order reaction to complete is double of the half-life period.

(A) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(B) If both assertion and reason are true but the reason is not the correct explanation of the assertion.

(C) If assertion is true but reason is false.

(D) If assertion is false but reason is true.

CORRECT ANSWER: B

SOLUTION:

Correct explanation. For zero order reaction,

$$t_{1/2} = a\left(t_{1/2} = a / 2k\right)$$

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Q-44 - 12659790

The rate of first-order reaction is $1.5 \times 10^{-2} M \text{min}^{-1}$ at $0.5M$ concentration of reactant. The half-life of reaction is

(A) 0.383 min

(B) 23.1 min

(C) 8.73 min

(D) 7.53 min

CORRECT ANSWER: B

SOLUTION:

Rate $= K[A]^1$

$$K = \frac{1.5 \times 10^{-2}}{0.5} \text{min}^{-1}$$

$$\therefore t_{1/2} = \frac{0.693}{K} = \frac{0.693 \times 0.5}{1.5 \times 10^{-2}} = 23.1 \text{ min}$$

Q-45 - 12659805

For the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, if

$\frac{d[NH_3]}{dt} = 2$

$\times 10^{-4}\text{mol L}^{-1}s^{-1}$

, the value of $\frac{-d[H_2]}{dt}$ would be:

(A) $1 \times 10^{-4}\text{mol}L^{-1}s^{-1}$

(B) $3 \times 10^{-4}\text{mol}L^{-1}s^{-1}$

(C) $4 \times 10^{-4}\text{mol}L^{-1}s^{-1}$

(D) $6 \times 10^{-4}\text{mol}L^{-1}s^{-1}$

CORRECT ANSWER: B

SOLUTION:

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

$$\therefore -\frac{d[H_2]}{dt} = \frac{3}{2} \times \frac{d[NH_3]}{dt}$$

$$= \frac{3}{2} \times 2 \times 10^{-4} = 3 \times 10^{-4}$$

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Q-46 - 52406221

In the reaction

$$BrO_3^-(aq) + 5Br^-(aq) + 6H^+ \rightarrow 3Br_2(l) + 3H_2O(l)$$

The rate of appearing of bromine (Br_2) is related to rate of disappearance of bromide ions as following

(A)

$$\frac{dBr_2}{dt} = -\frac{3}{5}\frac{d(Br^-)}{dt}$$

(B)

$$\frac{d(Br_2)}{dt} = -\frac{5}{3}\frac{d(Br^-)}{dt}$$

(C) $\frac{d(Br_2)}{dt} = \frac{5}{3}\frac{d(Br^-)}{dt}$

(D) $\frac{d(Br_2)}{dt} = \frac{3}{5}\frac{d(Br^-)}{dt}$

CORRECT ANSWER: A

SOLUTION:

$$\frac{1}{3}(d[Br_2])(dt) = -\frac{1}{5}\frac{d[Br^-]}{dt}$$

$$\Rightarrow \frac{d[Br_2]}{dt} = -\frac{3}{5}\frac{d[Br^-]}{dt}$$

.

Q-47 - 12659809

For the reaction $N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$, the rate of disappearance of N_2O_5 is 6.25×10^{-3}mol L$^{-1}s^{-1}$. The rate of formation of NO_2 and O_2 will be respectively.

(A)

6.25×10^{-3}mol L$^{-1}s^{-1}$

and

6.25×10^{-3}mol L$^{-1}s^{-1}$

(B)

1.25×10^{-2}mol L$^{-1}s^{-1}$

and

3.125×10^{-3}mol L$^{-1}s^{-1}$

(C) 6.25×10^{-3} mol $L^{-1}s^{-1}$ and 3.125×10^{-3} mol $L^{-1}s^{-1}$

(D) 1.25×10^{-3} mol L^{-1} and 6.25×10^{-3} mol $L^{-1}s^{-1}$

CORRECT ANSWER: B

SOLUTION:

$$-\frac{d[N_2O_5]}{dt} = \frac{1}{2}\frac{d[NO_2]}{dt} = \frac{2d[O_2]}{dt} = R$$

Q-48 - 12659807

For an endothermic reaction energy of activation is E_a and enthlpy of reaction is ΔH (both in $kJ\text{mol}^{-1}$). Minimum value of E_a will be

(A) $< \Delta H$

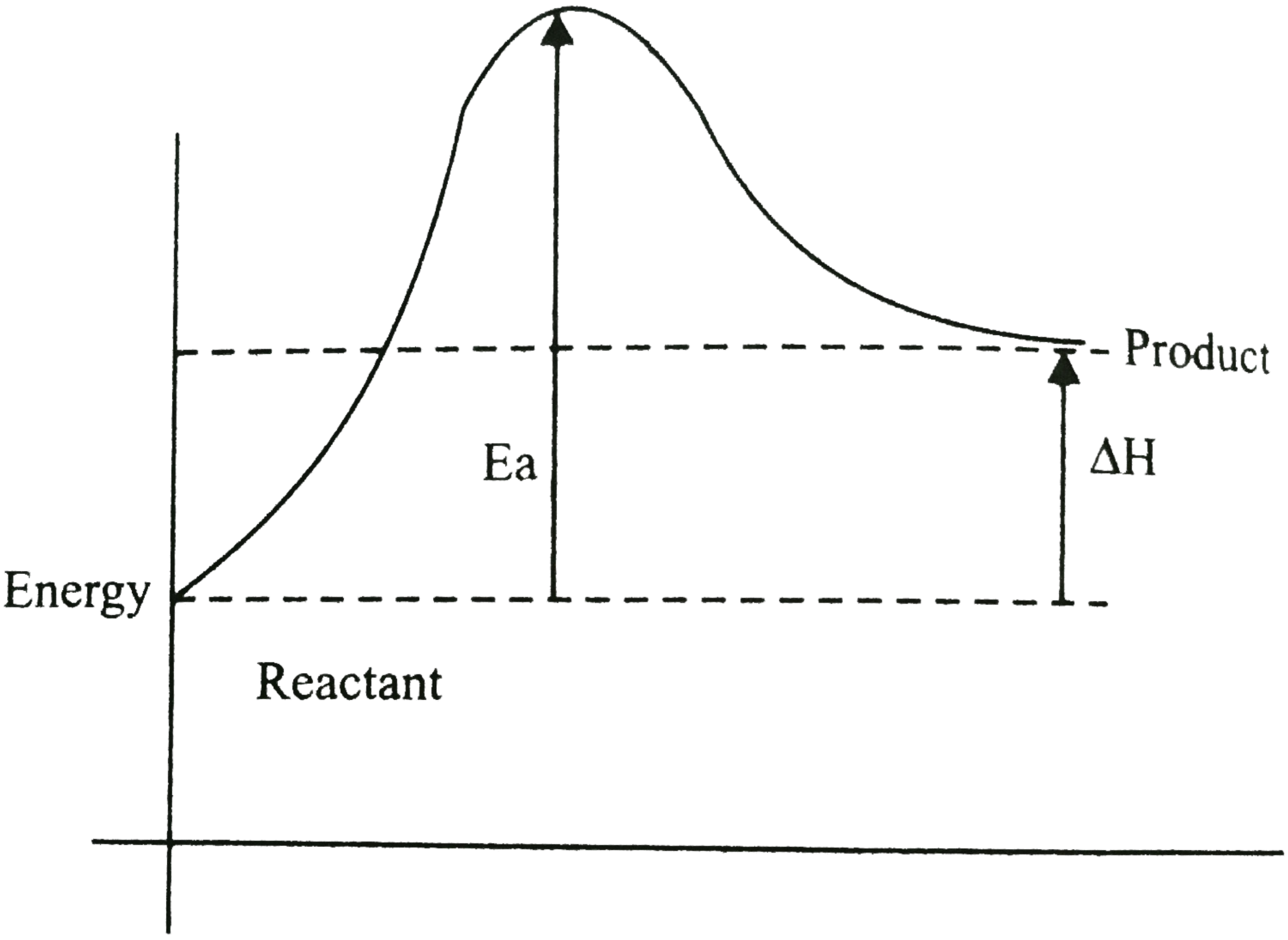
(B) $= \Delta H$

(C) $> \Delta H$

(D) $= 0$

CORRECT ANSWER: C

SOLUTION:



Q-49 - 52406296

A First order reaction is half completed in 45 minutes . How long does it need 99.9 % of the reaction to be completed

(A) 5 hours

(B) 7.5 hours

(C) 10 hours

(D) 20 hours

CORRECT ANSWER: B

SOLUTION:

$$k = \frac{0.693}{45} \min^{-1}$$
$$= \frac{2.303}{t_{99.9\%}} \log \frac{a}{a - 0.999a}$$

or

$$t_{99.9\%}$$
$$= \frac{2.303 \times 45}{0.693} \log 10^3$$
$$= 448$$

min = 7.5 hrs.

Q-50 - 12659858

The chemical reaction, $2O_3 \to 3O_2$ proceeds as follows

$\text{Step1} : O_3 \Leftrightarrow O_2 + O \quad (\text{fast})$

Step 2: $O + O_3 \rightarrow 2O_2 \quad \text{(slow)}$

The rate law expression should be

(A) $r = K'[O_3][O_2]$

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

(C) $r = K'[O_3]^2$

(D) unpredictable

CORRECT ANSWER: B

SOLUTION:

Acc.to slowest step

$r = k[O][O_3]$.(i)

as $'O'$ intermediate its conc. is calculated as

$$K = \frac{[O_2][O]}{[O_3]}, \quad [O]$$

$$= \frac{K[O_3]}{[O_2]}$$

Subtitute in(i)

$$r = \frac{kK[O_3][O_3]}{[O_2]} \Rightarrow r$$

$$= K'[O_3]^2[O_2]^{-1}$$

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Q-51 - 12659861

If reaction A and B are given with same temperature and same concentration but rate of A is double than B. Pre exponential factor is same for both the reaction then difference in activation energy $E_A - E_B$ is ?

(A) $-RT\ln 2$

(B) $RT\ln 2$

(C) $2RT$

(D) $\frac{RT}{2}$

CORRECT ANSWER: A

SOLUTION:

$$\frac{r_A}{r_B} = \frac{A_1 e^{-E_A/RT}}{A_2 e^{-E_a/RT}}$$
$$\frac{2}{1} = \frac{e^{-E_A/RT}}{e^{-E_B/RT}}$$

$$\ln 2 = E_B - E_A/RT$$

$$E_B - E_A - RT \ln 2$$
$$E_A - E_B = -RT \ln 2$$

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Q-52 - 11044766

On introfucing a catalyst at $500K$, the rate of a first order reaction increases by 1.718 times. The activation energy in the presence of a catalyst is $4.15 KJ mol^{-1}$. The slope of the polt of $k(s^{-1})$ against $1/T$ in the absence of catalyst is

(A) $+1$

(B) -1

(C) $+1000$

(D) -1000

CORRECT ANSWER: D

SOLUTION:

$$\frac{\text{Rate in the presence of catalyst}}{\text{Rate in the absence of catalyst}} = \text{Antilog}\left[\frac{+\Delta E}{2.303RT}\right.$$

$$1.78 = \text{Antilog}$$

$$= \frac{E_a - E_P}{2.303 \times 8.314 \times 500}$$

Where E_a and E_p are energy of activation in absenced

and presence of catalyst.

$$E_a - E_p = 8.3 \times 500$$

$$\times 10^{-3}$$

$$E_a = E_p + \left(8.3 \times 500 \times 10^{-3}\right)$$

$$E_a = E_p + \left(8.3 \times 500 \times 10^{3}\right)$$

$$= 4.15 + \left(8.3 \times 500 \times 10^{-3}\right)$$

$$= 8.3 KJmol^{-1}$$

In $k = InA = \frac{E_a}{R} \times \frac{1}{T}$

Slope $= \frac{-E_a}{R} = \frac{-8.3 \times 1000}{8.3} = -1000$

Q-53 - 12659891

The rate constant is doubled when temperature increases from $27C$ to $37C$. Activation energy in kJ is

(A) 34

(B) 54

(C) 100

(D) 50

CORRECT ANSWER: B

SOLUTION:

$$\log\frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

If $\frac{K_2}{K_1} = 2$
$\log 2$

$$= \frac{E_a}{2.303 \times 8.314}$$

$$\left[\frac{1}{300} - \frac{1}{310}\right]$$

$$Ea = .3010 \times 2.303$$

$$\times 8.314\left(\frac{300 \times 310}{10}\right)$$

$$= 53598.9 Jmol^{-1}$$
$$= 54 kJ$$

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Q-54 - 12659877

75% of a first-order reaction was completed in 32 minutes. When was 50% of the reaction completed

(A) 24 min

(B) 4 min

(C) 16 min

(D) 8 min

CORRECT ANSWER: C

SOLUTION:

Let original amount, $N_0 = 100$

Since $75\ \%$ completed, so final amount

$N = 100 - 75 = 25$

As we know

$\frac{N_0}{N} = 2^n$, where $n =$ no. of half lives

or, $\frac{100}{25} = 2^n$

or, $4 = 2^n$ or, 2^2 or, $2^2 = 2^n$

$\therefore n = 2$

Since total time $= n \times t_{1/2}$

32 minutes $= 2 \times t_{1/2}$

$\therefore t_{1/2} = 16$ minutes

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Q-55 - 12659867

Assertion: Order of reaction can never be fractional for an elementary reaction.

Reason: An elementary reaction takes place by one step mechanism.

(A) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(B) If both assertion and reason are true but the reason is not the correct explanation of the assertion.

(C) If assertion is true but reason is false.

(D) If assertion is false but reason is true.

CORRECT ANSWER: A

SOLUTION:

AN elementary reaction is one step reaction and in such reaction order of reaction and molecularity are same. Note that molecularity can never be fractional.

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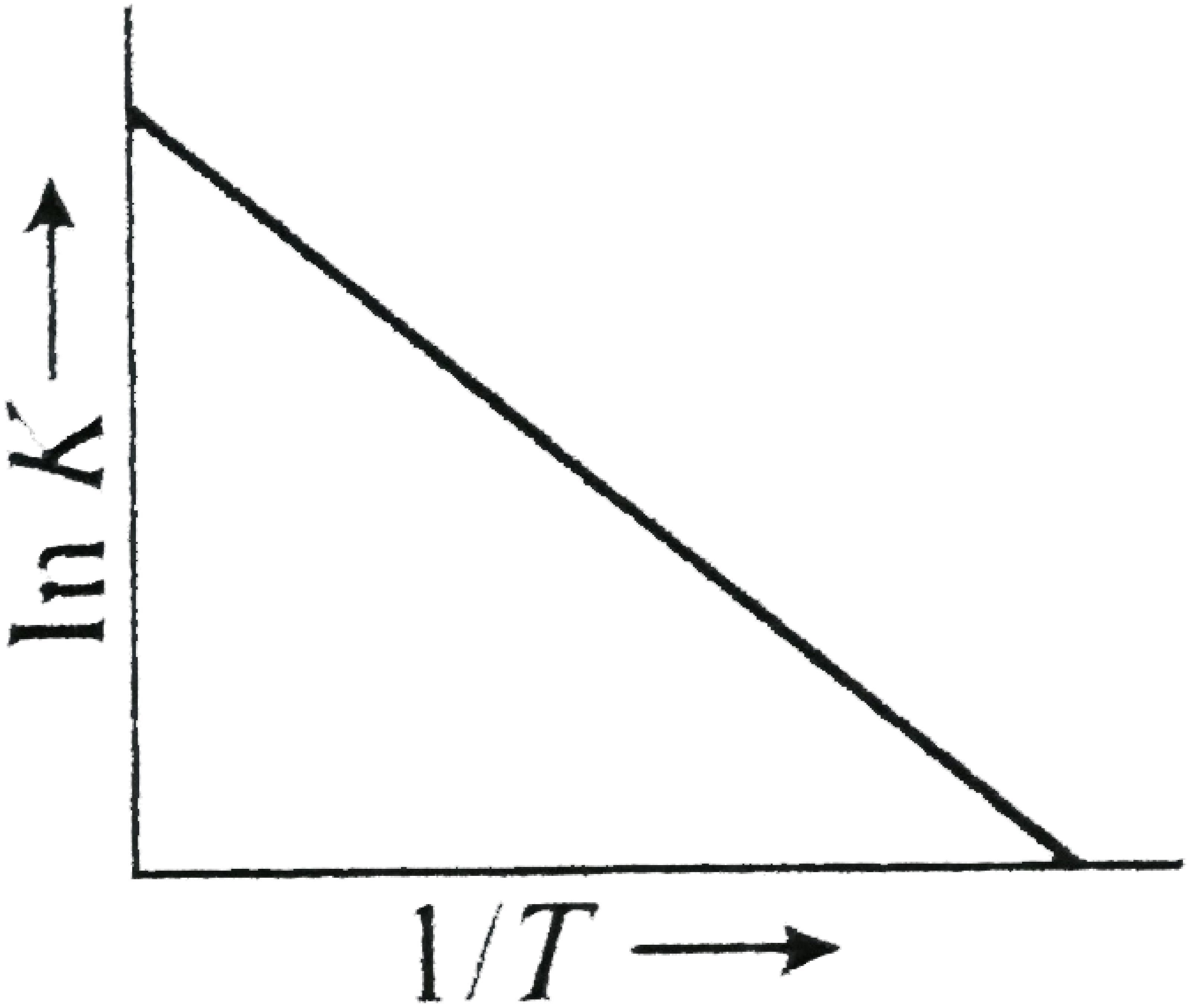
Q-56 - 12659859

The temperature dependence of a reaction is represented by the Arrhenius euqation

$$\text{In } k = \frac{E_a}{RT} + InA$$

Which among the following is wrong conclusion about the given plot?



(A) Intercept of the line $= InA$

(B) Slope $= -\dfrac{E_a}{RT}$

(C) Reaction with high activation energy is more

temperature sesitive than thatof low activation energy (E_a)

(D) Slope $= -\dfrac{E_a}{R}$

CORRECT ANSWER: B

SOLUTION:

$$Ink = \ln A - \frac{E}{RT}$$

In

$$k = \; - \frac{E_a}{R} \times \frac{1}{T}$$
$$+ InA$$

$$y = mx + C$$

(a) $C = InA$ correct

(b) is wrong

$$m = slope = \; - \frac{E_a}{R}$$

Q-57 - 11045036

The rate constant, the activation energy, and the Arrhenius parameter of a chemical reaction at $25C$ are

$3.0 \times 10^{-4} S^{-1}$,
$104.4 KJmol^{-1}$
, and $6.0 \times 10^{14} S^{-1}$, respectively. The value of the rate constant as

$T \rightarrow \infty$ is

(A) $2.0 \times 10^{8} s^{-1}$

(B) $6.0 \times 10^{14} s^{-1}$

(C) ∞

(D) $3.6 \times 10^{30} s^{-1}$

CORRECT ANSWER: B

SOLUTION:

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

When $t \rightarrow \infty$

$k \rightarrow A$

$A = 6 \times 10^{14} s^{-1}$

Q-58 - 12659837

The inversion of cane sugar is represented by

$$C_{12}H_{22}O_{11} + H_2O \\ \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

It is a reaction of

(A) second order

(B) unimolecular

(C) pseudo unimolecular

(D) none of the three

CORRECT ANSWER: C

SOLUTION:

Inversion of cane sugar is a pseudo unimolecular reaction.

Q-59 - 12659816

In a zero-order reaction for every 10 rise of temperature, the rate is doubled. If the temperature is increased from $10C$ to $100C$, the rate of the reaction will become

(A) 64 times

(B) 512 times

(C) 256 times

(D) 128 times

CORRECT ANSWER: B

SOLUTION:

$$\frac{r+(r+100)}{r_t} = 2 \text{ for each } 10 \text{ rise in temperature}$$

$$\therefore \frac{r_{100}}{r_{10}} = (2)^9 = 512$$

Q-60 - 52406280

The rate constants k_1 and k_2 for two different reactions are $10^{16} \cdot e^{-2000/T}$ and $10^{15} \cdot e^{-1000/T}$, respectively . The temperature at which $k_1 = k_2$ is

(A) 2000 K

(B) $\frac{1000}{2.303}K$

(C) 1000 K

(D) $\frac{2000}{2.303}K$

CORRECT ANSWER: B

SOLUTION:

$$10^{16}e^{\frac{-2000}{T}} = 10^{15}e^{\frac{-1000}{T}}$$

$$10 = \frac{e^{\frac{-1000}{T}}}{\frac{e^{-2000}}{T}}$$

$$\Rightarrow 10e^{\frac{1}{T}} \times 1000 \Rightarrow \ln 10$$

$$= \frac{1000}{T}$$

$\Rightarrow 2.303$ log 10 = $\dfrac{1000}{T} \Rightarrow T = \dfrac{1000}{2.303}K$.

or $\frac{dy}{dx} = \frac{y}{2y-x}$

Illustration 4.32 If $\sqrt{x} + \sqrt{y} = 4$, then find $\frac{dx}{dy}$ at $y = 1$.

Sol. Differentiating both sides of the given equation w.r.t. x, we get