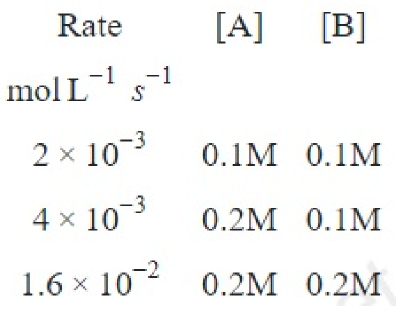
Chemical Kinetics

Question1

Following data is for a reaction between reactants A and B :



Rate $mol\,L^{-1}\,s^{-1}$	[A]	[B]
2×10^{-3}	0.1M	0.1M
4×10^{-3}	0.2M	0.1M
1.6×10^{-2}	0.2M	0.2M

The order of the reaction with respect to A and B, respectively, are

[NEET 2024 Re]

Options:

A.

1,0

B.

0,1

C.

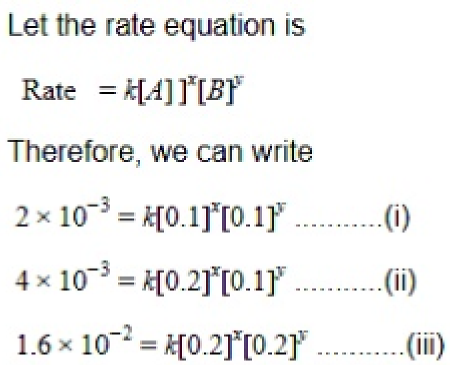
1,2

D.

2,1

Answer: C

Solution:



Let the rate equation is

$$\text{Rate} = k[A]^x[B]^y$$

Therefore, we can write

$$2 \times 10^{-3} = k[0.1]^x[0.1]^y \text{ ....(i)}$$

$$4 \times 10^{-3} = k[0.2]^x[0.1]^y \text{ ....(ii)}$$

$$1.6 \times 10^{-2} = k[0.2]^x[0.2]^y \text{ ....(iii)}$$

(ii) ÷ (i);

$$\frac{4\times10^{-3}}{2\times10^{-3}}=\frac{k[0.2]^x[0.1]^y}{k[0.1]^x[0.1]^y}$$

$$\Rightarrow\quad \frac{2}{1}=\frac{(0.2)^x}{(0.1)^x}=\left(\frac{2}{1}\right)^x$$

$\therefore\quad x=1$

(ii) ÷ (iii);

$$\frac{4\times10^{-3}}{1.6\times10^{-2}}=\frac{k[0.2]^x[0.1]^y}{k[0.2]^x[0.2]^y}$$

$$\Rightarrow\quad \frac{1}{4}=\frac{(0.1)^y}{(0.2)^y}=\left(\frac{1}{2}\right)^y$$

$\therefore\quad y=2$

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

First order with respect to A while second order with respect to B.

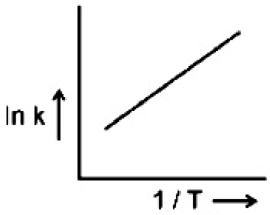
Question2

Which of the following plot represents the variation of In k versus 1/T in accordance with Arrhenius equation?

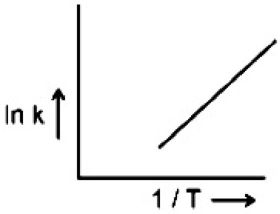
[NEET 2024 Re]

Options:

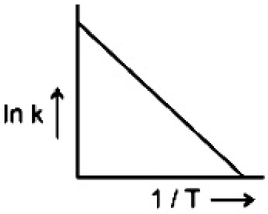
A.



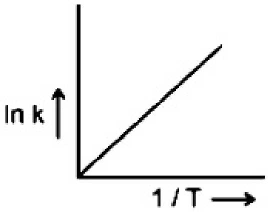
B.



C.



D.



Answer: C

Solution:

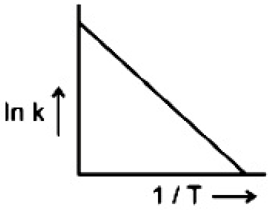
Using Arrhenius equation,

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

$$\ln k = \ln A - \frac{E_a}{RT}$$

$$y = c + mx, \quad \text{slope } (m) = -\frac{E_a}{R}$$

$$\text{Intercept } = \ln A$$



Question3

Rate constants of a reaction at 500 K and 700 K are 0.04 s^{-1} and 0.14 s^{-1} , respectively; then, activation energy of the reaction is :

(Given: log 3.5 = 0.5441, R = 8.31$JK^{-1}mol^{-1}$)

[NEET 2024 Re]

Options:

A.

182310 J

B.

18500 J

C.

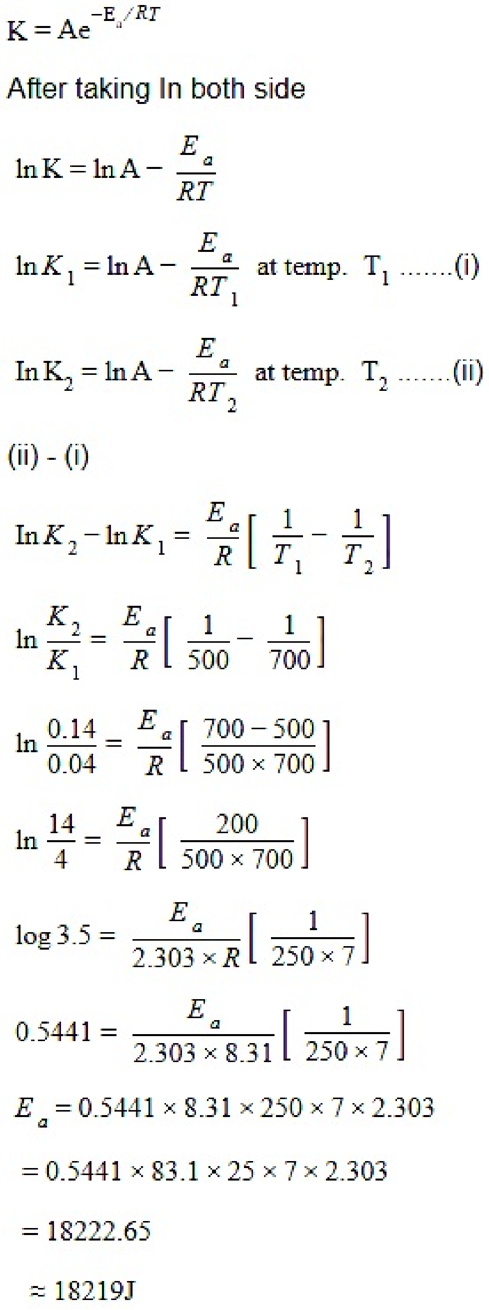
18219 J

D.

18030 J

Answer: C

Solution:



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

After taking In both side

$$\ln K = \ln A - \frac{E_a}{RT}$$

$$\ln K_1 = \ln A - \frac{E_a}{RT_1} \text{ at temp. } T_1 \text{ ....(i)}$$

$$\ln K_2 = \ln A - \frac{E_a}{RT_2} \text{ at temp. } T_2 \text{ ....(ii)}$$

(ii) - (i)

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

$$\ln \frac{K_2}{K_1} = \frac{E_a}{R}\left[\frac{1}{500} - \frac{1}{700}\right]$$

$$\ln \frac{0.14}{0.04} = \frac{E_a}{R}\left[\frac{700-500}{500 \times 700}\right]$$

$$\ln \frac{14}{4} = \frac{E_a}{R}\left[\frac{200}{500 \times 700}\right]$$

$$\log 3.5 = \frac{E_a}{2.303 \times R}\left[\frac{1}{250 \times 7}\right]$$

$$0.5441 = \frac{E_a}{2.303 \times 8.31}\left[\frac{1}{250 \times 7}\right]$$

$$E_a = 0.5441 \times 8.31 \times 250 \times 7 \times 2.303$$

$$= 0.5441 \times 83.1 \times 25 \times 7 \times 2.303$$

$$= 18222.65$$

$$\approx 18219 J$$

Question4

Activation energy of any chemical reaction can be calculated if one knows the value of

[NEET 2024]

Options:

A.

rate constant at standard temperature

B.

probability of collision

C.

orientation of reactant molecules during collision

D.

rate constant at two different temperatures

Answer: D

Solution:

To calculate value of E_a

Equation used is

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Hence E_9 can be calculated if value of rate constant k is known at two different temperatures T_1 and T_2.

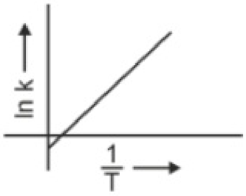
Question5

Which plot of ln k vs 1/T is consistent with Arrhenius equation?

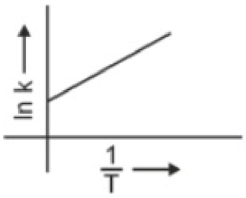
[NEET 2024]

Options:

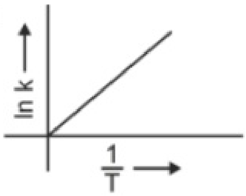
A.



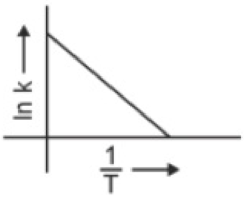
B.



C.



D.



Answer: D

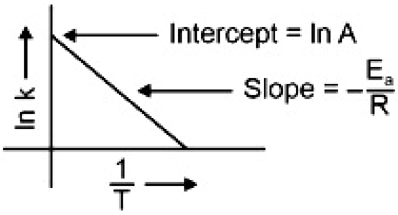
Solution:

The Arrhenius equation is given as

$$k = Ae^{-\frac{E_a}{RT}}$$

$$\therefore \quad \ln k = \ln A - \frac{E_a}{RT}$$

$\ln\ k\ v/s\ \frac{1}{T}$ gives a straight line graph with slope $= -\frac{E_a}{R}$ and intercept $= \ln A$



Question6

The rate of a reaction quadruples when temperature changes from 27°C to 57°C. Calculate the energy of activation.

Given R = 8.314$JK^{-1}mol^{-1}$, log4 = 0.6021

[NEET 2024]

Options:

A.

38.04kJ/mol

B.

380.4kJ/mol

C.

3.80kJ/mol

D.

3804kJ/mol

Answer: A

Solution:

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\log\left(\frac{4}{1}\right) = \frac{E_a}{2.303R}\left(\frac{1}{300} - \frac{1}{330}\right)$$

$$E_a = \frac{(\log(4)) \times 2.303 \times 8.314 \times 300 \times 330}{30}$$

$$= 3.804 \times 10^4 \mathrm{J/mol}$$

$$= 38.04 \mathrm{~kJ/mol}$$

Question7

Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R :
Assertion A : A reaction can have zero activation energy.
Reasons R : The minimum extra amount of energy absorbed by reactant molecules so that their energy becomes equal to threshold value, is called activation energy.
In the light of the above statements, choose the correct answer from the options given below :

[NEET 2023]

Options:

A.

Both A and R are true and R is NOT the correct explanation of A

B.

A is true but R is false

C.

A is false but R is true

D.

Both A and R are true and R is the correct explanation of A

Answer: A

Solution:

- Few reactions can have zero activation energy for example radical reactions.
- Activation energy is defined as the minimum amount of extra energy absorbed by reactants to achieve threshold energy.

Question8

For a certain reaction, the rate = k$[A]^2$[B], when the initial concentration of A is tripled keeping concentration of B constant, the initial rate would

[NEET 2023]

Options:

A.

Increase by a factor of six

B.

Increase by a factor of nine

C.

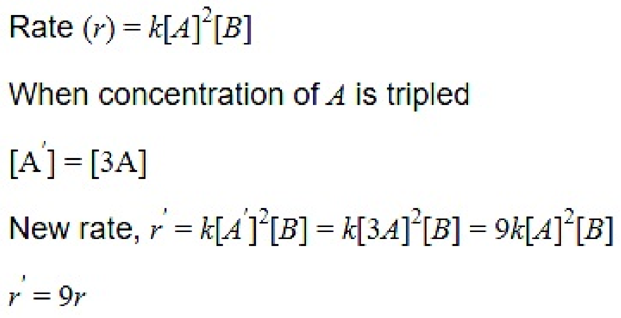
Increase by a factor of three

D.

Decrease by a factor of nine

Answer: B

Solution:



Rate $(r) = k[A]^2[B]$

When concentration of A is tripled

$[A'] = [3A]$

New rate, $r' = k[A']^2[B] = k[3A]^2[B] = 9k[A]^2[B]$

$r' = 9r$

Question9

For a reaction 3A → 2B The average rate of appearance of B is given by Δ[B]/Δt. The correct relation between the average rate of appearance of B with the average rate of disappearance of A is given in option :

[NEET 2023 mpr]

Options:

A.

$$\frac{-\Delta[A]}{\Delta t}$$

B.

$$\frac{-3\,\Delta[A]}{2\,\Delta t}$$

C.

$$\frac{-2\,\Delta[A]}{3\,\Delta t}$$

D.

$$\frac{\Delta[A]}{\Delta t}$$

Answer: C

Solution:

$$3A \rightarrow 2B$$

$$r = -\frac{1}{3}\frac{\Delta[A]}{\Delta t} = +\frac{1}{2}\frac{\Delta[B]}{\Delta t}$$

$$+\frac{\Delta[B]}{\Delta t} = -\frac{2}{3}\frac{\Delta[A]}{\Delta t}$$

Question10

The correct options for the rate law that corresponds to overall first order reaction is

[NEET 2023 mpr]

Options:

A.

Rate = $k[A]^0[B]^2$

B.

Rate = $k[A][B]$

C.

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

D.

Rate = $k[A]^{-1/2}[B]^{3/2}$

Answer: D

Solution:

$r = k[A]^{-1/2}[B]^{3/2}$

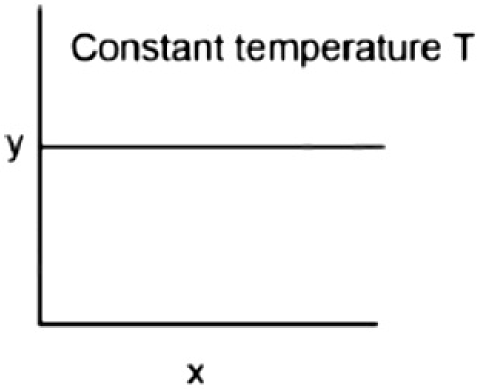
$\text{order} = -\frac{1}{2} + \frac{3}{2}$

$= \frac{2}{2}$

$= 1$

Question11

The given graph is a representation of kinetics of a reaction.



The y and x axes for zero and first order reactions, respectively are [NEET-2022]

Options:

A. zero order (y = concentration and x = time), first order (y = t_1 / 2 and x = concentration)

B. zero order (y = concentration and x = time), first order (y = rate constant and x = concentration)

C. zero order (y = rate and x = concentration), first order (y = t / s and x = concentration)

D. zero order (y = rate and x = concentration), first order (y = rate and x = t / 2)

Answer: C

Solution:

- For zero order reaction

$r = k[A]^0$

$r = k$ (constant)

hence, ' y ' as 'rate' and ' x ' as concentration will give desired graph.

- For first order reaction

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

hence, ' y ' as 't 1 s. and ' x ' as concentration will give desired graph.

Question12

For a first order reaction A→ Products, initial concentration of A is 0.1M , which becomes 0.001M after 5 minutes. Rate constant for the reaction in min^{-1} is
[NEET-2022]

Options:

A. 1.3818

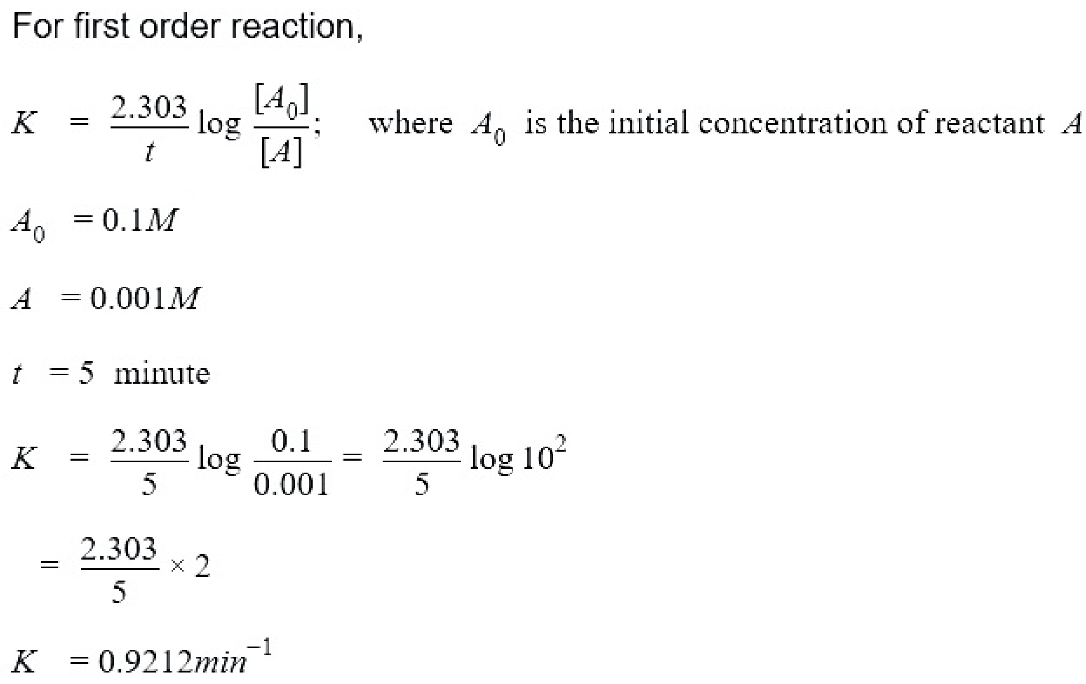
B. 0.9212

C. 0.4606

D. 0.2303

Answer: B

Solution:



For first order reaction,

$K = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$; where A_0 is the initial concentration of reactant A

$A_0 = 0.1M$

$A = 0.001M$

$t = 5$ minute

$K = \frac{2.303}{5} \log \frac{0.1}{0.001} = \frac{2.303}{5} \log 10^2$

$= \frac{2.303}{5} \times 2$

$K = 0.9212 min^{-1}$

Question13

The half life of a first order reaction is 2000 years. If the concentration after 8000 years is 0.02M, then the initial concentration was:
[NEET Re-2022]

Options:

A. 0.04M

B. 0.16M

C. 0.32M

D. 0.08M

Answer: C

Solution:

$$n = \frac{t}{t_{1/2}} = \frac{8000}{2000} = 4, \text{ (no. of half lives)}$$

$$\frac{[A_0]}{[A_t]} = 2^n, [A_0] = 0.02 \times 2^4 = 0.32\text{M}$$

Question14

For a chemical reaction $4A + 3B \rightarrow 6C + 9D$ rate of formation of C is 6×10^{-2} mol L^{-1} s^{-1} and rate of disappearance of A is 4×10^{-2} mol L^{-1} s^{-1}. The rate of reaction and amount of B consumed in interval of 10 seconds, respectively will be : [NEET Re-2022]

Options:

A. 10×10^{-2} mol L^{-1} s^{-1} and 30×10^{-2} mol L^{-1}

B. 1×10^{-2} mol L^{-1} s^{-1} and 30×10^{-2} mol L^{-1}

C. 10×10^{-2} mol L^{-1} s^{-1} and 10×10^{-2} mol L^{-1}

D. 1×10^{-2} mol L^{-1} s^{-1} and 10×10^{-2} mol L^{-1}

Answer: B

Solution:

$$4A + 3B \longrightarrow 6C + 9D$$

$$r = -\frac{1}{4}\frac{d[A]}{dt} = +\frac{1}{6}\frac{d[C]}{dt}$$

$$r = \frac{1}{6} \times 6 \times 10^{-2} = 1 \times 10^{-2} \text{ mol L}^{-1}\text{ s}^{-1}$$

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

$$\frac{-d[B]}{dt} = 3 \times 10^{-2} \text{ mol L}^{-1}\text{ s}^{-1}$$

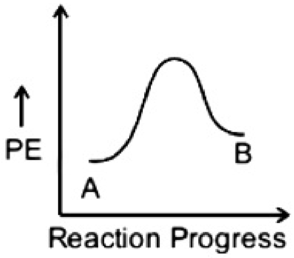
B consumed in 10 sec $= 3 \times 10^{-2} \times 10 = 30 \times 10^{-2}$ mol L^{-1}

Question15

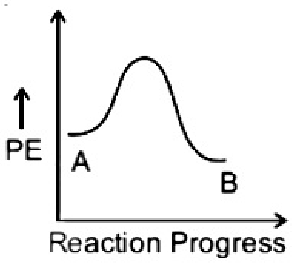
For a reaction A → B, enthalpy of reaction is $-4.2\mathrm{kJ\ mol}^{-1}$ and enthalpy of activation is $9.6\mathrm{kJ\ mol}^{-1}$. The correct potential energy profile for the reaction is shown in option.
[NEET 2021]

Options:

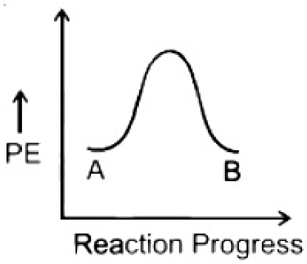
A.



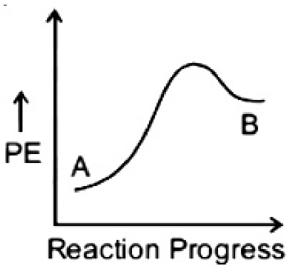
B.



C.



D.



Answer: B

Solution:

● $\Delta H_{rxn} = (E_a)_f - (E_a)_b$
$-4.2 = (E_a)_f - (E_a)_b$

$-4.2 = 9.6 - (E_a)_b$
$(E_a)_b = 9.6 + 4.2 = 13.8 \text{kJ mol}^{-1}$

- Since reaction is exothermic, so possible graph is (2) only.
- Also $(E_a)_f < (E_{ab}$, so answer is option (2)

Question16

The slope of Arrhenius plot $\left(\ln k \, v / s \frac{1}{T}\right)$ of first order reaction is -5×10^3K. The value of E_a of the reaction is. Choose the correct option for your answer.
[Given R = 8.314J $K^{-1}mol^{-1}$]
[NEET 2021]

Options:

A. 41.5 kJ mol^{-1}

B. 83.0 kJ mol^{-1}

C. 166 kJ mol^{-1}

D. −83 kJ mol^{-1}

Answer: A

Solution:

Arrhenius equation
$k = Ae^{-E_a / RT}$
$\ln k = \ln A + \ln e^{-E_a / RT}$
$\ln k = \ln A - \frac{E_a}{R}\left(\frac{1}{T}\right)$ ....(1)
Slope of $\ln k$ vs $\frac{1}{T}$ curve,
$m = -\frac{E_a}{R} -5 \times 10^3 = -\frac{E_a}{R}$
$E_a = 5 \times 10^3 \times 8.314 \text{ J / mol}$
$= 41.57 \times 10^3$ J/mol
$\simeq$ 41.5 kJ/mol

Question17

The rate constant for a first order reaction is $4.606 \times 10^{-3} s^{-1}$. The time required to reduce 2.0 g of the reactant to 0.2g is :
(2020)

Options:

A. 200s

B. 500s

C. 1000s

D. 100s

Answer: B

Solution:

First order rate equation is

$$k = \frac{2.303}{t}\log\frac{[A_0]}{[A]}$$

$$\Rightarrow 4.606 \times 10^{-3} = \frac{2.303}{t}\log\frac{2}{0.2}$$

$$\Rightarrow t = \frac{2.303}{4.606 \times 10^{-3}} \times \log 10 = \frac{10^3}{2} = 500\text{sec}$$

Question18

An increase in the concentration of the reactants of a reaction leads to change in
[2020]

Options:

A. heat of reaction

B. threshold energy

C. collision frequency

D. activation energy

Answer: C

Solution:

Solution:
The number of collisions per second per unit volume of the reaction mixture is known as collision frequency (Z) . collision frequency μno. of reacting molecules or atoms. Higher the concentration of reactant molecules higher is the probability of collision and so the collision frequency.

Question19

If the rate constant for a first order reaction is k, the time (t) required for the completion of 99% of the reaction is given by
(NEET 2019)

Options:

A. $t = \frac{2.303}{k}$

B. $t = \frac{0.693}{k}$

C. $t = \frac{6.909}{k}$

D. $t = \frac{4.606}{k}$

Answer: D

Solution:

For 1^{st} order reaction,

$$t = \frac{2.303}{k}\log\frac{a}{a-x} = \frac{2.303}{k}\log\frac{100}{100-99}$$

$$= \frac{2.303}{k}\log 10^2 = \frac{2.303}{k}\times 2\times\log 10 = \frac{4.606}{k}$$

Question20

For the chemical reaction, $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ the correct option is

(NEET 2019)

Options:

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

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

C. $-\frac{d[N_2]}{dt} = 2\frac{d[NH_3]}{dt}$

D. $-\frac{d[N_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

Answer: D

Solution:

For the given chemical reaction,

Rate of reaction $= -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

Question21

A first order reaction has a rate constant of $2.303\times10^{-3}s^{-1}$. The time required for 40gof this reactant to reduce to 10g will be [Given that $\log_{10}2 = 0.3010$]
(Odisha NEET 2019)

Options:

A. $230.3s$

B. $301s$

C. $2000s$

D. $602s$

Answer: D

Solution:

For a first order reaction,

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

$$2.303\times10^{-3} = \frac{2.303}{t}\log\frac{40}{10}$$

$$t = \frac{1}{10^{-3}}\log 2^2 = \frac{2}{10^{-3}}\log 2 = \frac{2}{10^{-3}}\times 0.3010 = 602s$$

Question22

For a reaction, activation energy $E_a = 0$ and the rate constant at 200K is $1.6\times10^6s^{-1}$.
The rate constant at 400K will be [Given that gas constant $R = 8.314JK^{-1}mol^{-1}$]
(Odisha NEET 2019)

Options:

A. $3.2\times10^4s^{-1}$

B. $1.6\times10^6s^{-1}$

C. $1.6\times10^3s^{-1}$

D. $3.2\times10^6s^{-1}$

Answer: B

Solution:

According to Arrhenius equation

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

$$\log \frac{k_2}{1.6 \times 10^6} = 0 \; ; \; \frac{k_2}{1.6 \times 10^6} = 1$$

$$k_2 = 1.6 \times 10^6 s^{-1}$$

Question23

The correct difference between first and second order reactions is that (Odisha NEET 2018)

Options:

A. the rate of a first-order reaction does not depend on reactant concentrations; the rate of a second-order reaction does depend on reactant concentrations

B. the half-life of a first-order reaction does not depend on $[A]_0$; the half-life of a second-order reaction does depend on $[A]_0$

C. a first-order reaction can be catalysed; a second-order reaction cannot be catalysed

D. the rate of a first-order reaction does depend on reactant concentrations; the rate of a second-order reaction does not depend on reactant concentrations.

Answer: B

Solution:

Solution:

For the first order reaction, $t_{1/2} = \frac{0.693}{k}$ which is independent of initial concentration $[A]_0$.

For second order reaction, $t_{1/2} = \frac{1}{k[A]_0}$

Half-life depends on initial concentration of reactant.

Question24

When initial concentration of the reactant is doubled, the half-life period of a zero order reaction (NEET 2018)

Options:

A. is halved

B. is doubled

C. is tripled

D. remains unchanged.

Answer: B

Solution:

$(t_{1/2})_{zero} = \frac{[A]_0}{2k}$

As the half-life of a zero order reaction is directly proportional to initial concentration.

∴ If $[A_0] =$ doubled then, $t_{1/2} =$ doubled.

Question25

Mechanism of a hypothetical reaction $X_2 + Y_2 \rightarrow 2XY$, is given below :

(i) $X_2 \rightleftharpoons X + X$ (fast)

(ii) $X + Y_2 \rightarrow XY + Y$ (slow)

(iii) $X + Y \rightarrow XY$ (fast)

The overall order of the reaction will be

(NEET 2017)

Options:

A. 2

B. 0

C. 1.5

D. 1

Answer: C

Solution:

$X_2 \rightleftharpoons X + X$ (fast)

$X + Y_2 \rightarrow XY + Y$ (slow)

Slow step is the rate determining step.

Rate $= k[X][Y_2]$ ...(i)

Equilibrium constant for fast step, $K = \frac{[X]^2}{[X_2]}$

$[X] = \sqrt{K[X_2]}$

By substituting $[X]$ in equation (i), we get

Rate $= k\sqrt{K[X_2]}[Y_2] = k'[X_2]^{\frac{1}{2}}[Y_2]$

∴ Order of reaction $= \frac{1}{2} + 1 = \frac{3}{2} = 1.5$

Question26

A first order reaction has a specific reaction rate of $10^{-2}sec^{-1}$. How much time will it take for 20g of the reactant to reduce to 5g ?
(NEET 2017)

Options:

A. 138.6 sec

B. 346.5 sec

C. 693.0 sec

D. 238.6 sec

Answer: A

Solution:

For a first order reaction,

$$k = \frac{2.303}{t}\log\frac{[A]_0}{[A]_t} \text{ or } 10^{-2} = \frac{2.303}{t}\log\frac{20}{5}$$

$$10^{-2} = \frac{2.303 \times 0.6020}{t} \text{ or } t = 138.6\,\text{sec}$$

Question27

The decomposition of phosphine (PH_3) on tungsten at low pressure is a first-order reaction. It is because the
(NEET-II 2016)

Options:

A. rate is proportional to the surface coverage

B. rate is inversely proportional to the surface coverage

C. rate is independent of the surface coverage

D. rate of decomposition is very slow.

Answer: A

Solution:

Solution:
At low pressure, rate is proportional to the surface coverage and is of first order while at high pressure, it follows zero

order kinetics due to complete coverage of surface area.

Question28

The rate of first-order reaction is $0.04\,\mathrm{mol\,L^{-1}\,s^{-1}}$ at 10 seconds and $0.03\,\mathrm{mol\,L^{-1}\,s^{-1}}$ at 20 seconds after initiation of the reaction. The half-life period of the reaction is
(NEET-I 2016)

Options:

A. 44.1s

B. 54.1s

C. 24.1s

D. 34.1s

Answer: C

Solution:

Solution:
For a first order reaction, A → Products and for concentration of the reactant at two different times,

$$k = \frac{2.303}{t_2 - t_1}\log\frac{[A]_1}{[A]_2}$$

$$\therefore k = \frac{2.303}{t_2 - t_1}\log\frac{(\text{rate})_1}{(\text{rate})_2} \ (\because \text{rate} \propto [A])$$

$$k = \frac{2.303}{(20-10)}\log\left(\frac{0.04}{0.03}\right) = 0.0287\text{sec}^{-1}$$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.0287\text{sec}^{-1}} = 24.14\,\text{sec}$$

Question29

The addition of a catalyst during a chemical reaction alters which of the following quantities?
(NEET-I 2016)

Options:

A. Enthalpy

B. Activation energy

C. Entropy

D. Internal energy

Answer: B

Solution:

Solution:
A catalyst provides an alternate path to the reaction which has lower activation energy.

Question30

The rate constant of the reaction A→B is $0.6 \times 10^{-3} \mathrm{mol\,L^{-1}s^{-1}}$ If the concentration of A is 5 M, then concentration of B after 20 minutes is (2015)

Options:

A. 3.60 M

B. 0.36 M

C. 0.72 M

D. 1.08 M

Answer: C

Solution:

Reaction is of zero order as the unit of rate constant is mol $\mathrm{L^{-1}s^{-1}}$
∴Concentration of B = $\mathrm{k} \times \mathrm{t}$
$= 0.6 \times 10^{-3} \times 20 \times 60$
$= 0.72\mathrm{M}$

Question31

When initial concentration of a reactant is doubled in a reaction its half-life period is not affected. The order of the reaction is (2015 Cancelled)

Options:

A. Second

B. more than zero but less than first

C. zero

D. first.

Answer: D

Solution:

Half-life period of a first order reaction is independent or initial concentration,

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

Question32

The activation energy of a reaction can be determined from the slope of which of the following graphs? (2015 Cancelled)

Options:

A. $\ln k \text{ vs.} \frac{1}{T}$

B. $\frac{T}{\ln k} \text{vs.} \frac{1}{T}$

C. $\ln k \text{ vs } T$

D. $\frac{\ln k}{T} \text{vs. } T$

Answer: A

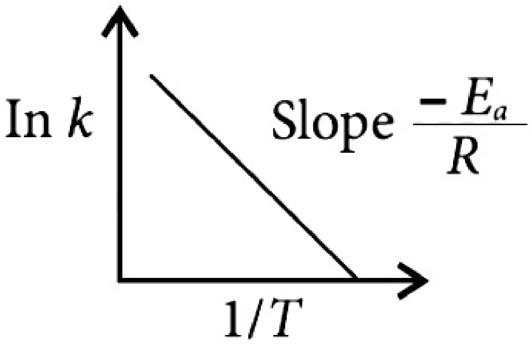
Solution:

According to Arrhenius equation

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

$\ln k = \ln A - \frac{E_a}{RT}$

Hence, if In k is plotted against 1/T,slope of the line will be $-\frac{E_a}{R}$



Question33

What is the activation energy for a reaction if its rate doubles when the

temperature is raised from 20°C to 35°C?
(R = $8.314\mathrm{I\ mol^{-1}K^{-1}}$)
(2013 NEET)

Options:

A. $34.7\mathrm{kJ\ mol^{-1}}$

B. $15.1\mathrm{kJ\ mol^{-1}}$

C. $342\mathrm{kJ\ mol^{-1}}$

D. $296\mathrm{kJ\ mol^{-1}}$

Answer: A

Solution:

Solution:

$\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$
$k_2 = 2k_1$
$T_1 = 20 + 273 = 293\mathrm{K}$ or $T_2 = 35 + 273 = 308\mathrm{K}$
$R = 8.314\mathrm{J\ mol^{-1}K^{-1}}$
$\log 2 = \frac{E_a}{2.303 \times 8.314}\left(\frac{1}{293} - \frac{1}{308}\right)$
$0.3010 = \frac{E_a}{19.147} \times \frac{15}{293 \times 308}$
$E_a = 34673\mathrm{J\ mol^{-1}}$ or $34.7\mathrm{kJ\ mol^{-1}}$

Question34

Activation energy (E_a) and rate constants (k_1, and k_2) of a chemical reaction at two different temperatures (T_1, and T_2) are related by (2012 Mains)

Options:

A. $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

B. $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

C. $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} + \frac{1}{T_1}\right)$

D. $\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

Answer: D

Solution:

$k_1 = Ae^{-E_a/RT_1}$

$k_2 = Ae^{-E_a/RT_2}$

$\ln k_1 = \ln A - E_a/RT_1$.........(i)

$\ln k_2 = \ln A - E_a/RT_2$.........(ii)

From eq.(i) and (ii), we have

$$\ln k_2 - \ln K_1 = \ln A - \frac{E_a}{RT_2} - \ln A + \frac{E_a}{RT_1}$$

$$\Rightarrow \ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\Rightarrow \ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Question35

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

(2012)

Options:

A. 256 times

B. 512 times

C. 64 times

D. 128 times

Answer: B

Solution:

Solution:
At 10°C rise, rate increases by 2.

$$\frac{r_{100°C}}{r_{10°C}} = 2^{\left(\frac{100-10}{10}\right)} = 2^9 = 512 \text{ times}$$

Question36

In a reaction, A + B —> product, rate is doubled when the concentration of B is doubled, and rate increases by a factor of 8 when the concentration of both the reactants (A and B)are doubled, rate law for the reaction can be written as

(2012)

Options:

A. rate = $k[A][B]^2$

B. rate = $k[A]^2[B]^2$

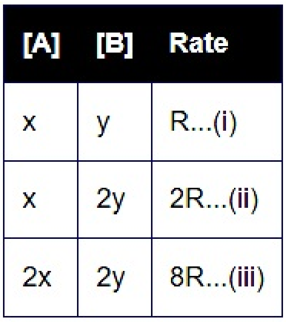
C. rate = $k[A][B]$

D. rate = $k[A]^2[B]$

Answer: D

Solution:

Solution:



[A]	[B]	Rate
x	y	R...(i)
x	2y	2R...(ii)
2x	2y	8R...(iii)

Let the rate of law;rate $= k[A]^a[B]^b$
From the data given,$(x)^a(y)^b = R$....(iv)
$(x)^a(2y)^b = 2R$.....(v)
Dividing eqn. (v) by (iv),
$\frac{(2y)^b}{(y)^b} = \frac{2R}{R}$ or $(2)^b = 2$
Thus b = 1
From data of (iii) experiment,$(2x)^a(2y)^b = 8R$.....(vi)
From eqn. (v) and (vi),
$\frac{(2x)^a}{(x)^a} = \frac{8R}{2R}$ or $(2)^a = 4$
Thus a = 2
By replacing the values of a and b in rate law;
rate = $k[A]^2[B]$

Question37

The unit of rate constant for a zero order reaction is (2011 Mains)

Options:

A. $\mathrm{mol\,L^{-1}s^{-1}}$

B. $\mathrm{L^{-1}mol\,s^{-1}}$

C. $\mathrm{L^2mol^{-2}s^{-1}}$

D. $\mathrm{s^{-1}}$

Answer: A

Solution:

The units are mol $L^{-1}s^{-1}$

Question38

The rate of the reaction : $2N_2O_5 \rightarrow 4NO_2 + O_2$ can be written in three ways

$$\frac{-d[N_2O_5]}{dt} = k[N_2O_5]$$

$$\frac{d[NO_2]}{dt} = k'[N_2O_5]; \frac{d[O_2]}{dt} = k''[N_2O_5]$$

The relationship between k and k' and between k and k" are (2011 Mains)

Options:

A. $k' = 2k; k'' = k$

B. $k' = 2k; k'' = \frac{k}{2}$

C. $k' = 2k; k'' = 2k$

D. $k' = k; k'' = k$

Answer: B

Solution:

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

$$\underset{k}{-\frac{1}{2}\frac{d[N_2O_5]}{dt}} = \underset{k'}{+\frac{1}{4}\frac{d[NO_2]}{dt}} = \underset{k''}{+\frac{d[O_2]}{dt}}$$

$$\frac{1}{2}k = \frac{1}{4}k' = k''$$

$$k' = 2k; k'' = \frac{1}{2}k$$

Question39

Which one of the following statements for the order of a reaction is incorrect? (2011)

Options:

A. Order can be determined only experimentally.

B. Order is not influenced by stoichiometric coefficient of the reactants.

C. Order of a reaction is sum of power to the concentration terms of reactants to express the rate of reaction.

D. Order of reaction is always whole number.

Answer: D

Solution:

Solution:
Order of a reaction is not always whole number. It can be zero, or fractional also.

Question40

The rate of the reaction, $2NO + Cl_2 \rightarrow 2NOCl$ is given by the rate equation rate $= k[NO]^2[Cl_2]$. The value of the rate constant can be increased by
(2010 Mains)

Options:

A. increasing the temperature

B. increasing the concentration of NO

C. increasing the concentration of the Cl_2

D. doing all of these

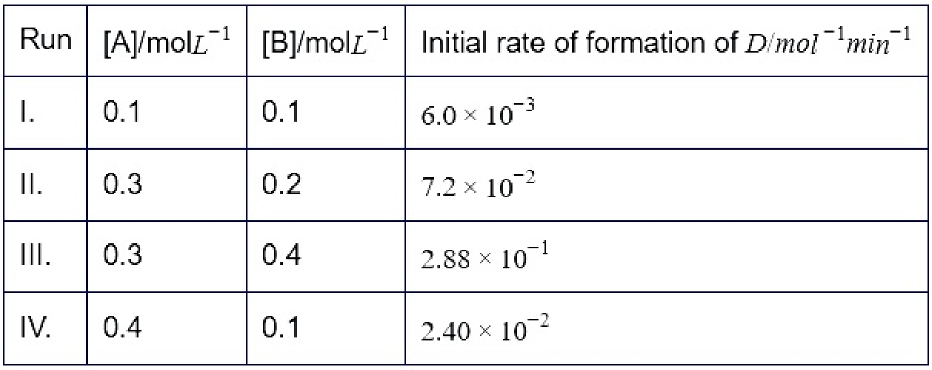
Answer: A

Solution:

Solution:
Rate constant is independent of the initial concentration of the reactants. It has a constant value at fixed temperature. Hence the value of rate constant can be increased by increasing the temperature.

Question41

During the kinetic study of the reaction, 2A + B → C + D, following results were obtained



Run	[A]/molL^{-1}	[B]/molL^{-1}	Initial rate of formation of $D/mol^{-1}min^{-1}$
I.	0.1	0.1	6.0×10^{-3}
II.	0.3	0.2	7.2×10^{-2}
III.	0.3	0.4	2.88×10^{-1}
IV.	0.4	0.1	2.40×10^{-2}

Based on the above data which one of the following is correct? (2010)

Options:

A. Rate = $k[A]^2[B]$

B. Rate = $k[A][B]$

C. Rate = $k[A]^2[B]^2$

D. Rate = $k[A][B]^2$

Answer: D

Solution:

Let the rate of reaction be given by :
rate = $k[A]^a[B]^b$
Now consider II and III where [A] is constant

$$\frac{7.2 \times 10^{-2}}{2.88 \times 10^{-1}} = \frac{[0.3]^a[0.2]^b}{[0.3]^a[0.4]^b}$$

$$\frac{1}{4} = \left(\frac{1}{2}\right)^b \Rightarrow b = 2$$

Now consider I and IV

$$\frac{6.0 \times 10^{-3}}{2.4 \times 10^{-2}} = \frac{[0.1]^a[0.1]^b}{[0.4]^a[0.1]^b}$$

$$\frac{1}{4} = \left(\frac{1}{4}\right)^b$$

$a = 1$
∴ Rate = $k[A][B]^2$

Question42

For the reaction $N_2O_5(g) \rightarrow 2NO_2(g) + I/2O_2(g)$ the value of of rate of disappearance of N_2O_5 is given as $6.25 \times 10^{-3} ml\,L^{-1}s^{-1}$.The rate of formation of NO_2 and O_2 is given repectively as
(2010)

Options:

A. $6.25 \times 10^{-3} mol\,L^{-1}s^{-1}$ and $6.25 \times 10^{-3} mol\,L^{-1}s^{-1}$

B. $1.25 \times 10^{-2} \mathrm{mol\,L^{-1}s^{-1}}$ and $3.125 \times 10^{-3} \mathrm{mol\,L^{-1}s^{-1}}$

C. $6.25 \times 10^{-3} \mathrm{mol\,L^{-1}s^{-1}}$ and $3.125 \times 10^{-3} \mathrm{mol\,L^{-1}s^{-1}}$

D. $1.25 \times 10^{-2} \mathrm{mol\,L^{-1}s^{-1}}$ and $6.25 \times 10^{-3} \mathrm{mol\,L^{-1}s^{-1}}$

Answer: B

Solution:

$N_2O_5(g) \rightarrow 2NO_2(g) + \frac{I}{2}O_2(g)$

For the given reaction the rate law may be written as :

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

given that $\frac{-d[N_2O_5]}{dt} = 6.25 \times 10^{-3} \mathrm{mol\,L^{-1}s^{-1}}$

$\therefore \frac{d[NO_2]}{dt} = 2 \times 6.25 \times 10^{-3} = 1.25 \times 10^{-2} \mathrm{mol\,L^{-1}s^{-1}}$ and $\frac{d[O_2]}{dt} = \frac{6.25 \times 10^{-3}}{2} = 3.125 \times 10^{-3} \mathrm{mol\,L^{-1}s^{-1}}$

Question43

For the reaction A + B → products, it is observed that
(i) on doubling the initial concentration of A only, the rate of reaction is also doubled and
(ii) on doubling the initial concentration of both A and B, there is a change by a factor of 8 in the rate of the reaction.
The rate of this reaction is given by
(2009)

Options:

A. rate = $k[A][B]^2$

B. rate = $k[A]^2[B]^2$

C. rate = $k[A][B]$

D. rate = $k[A]^2[B]$

Answer: A

Solution:

$R = k[A]^m[B]^n$.....(i)
$2R = k[2A]^m[B]^n$......(ii)
$8R = k[2A]^m[2B]^n$.....(iii)
from (i), (ii) and (iii)
$m = 1, n = 2$
So,rate = $k[A][B]^2$

Question44

Half-life period of a first order reaction is 1386 seconds. The specific rate constant of the reaction is
(2009)

Options:

A. $0.5 \times 10^{-2} s^{-1}$

B. $0.5 \times 10^{-3} s^{-1}$

C. $5.0 \times 10^{-2} s^{-1}$

D. $5.0 \times 10^{-3} s^{-1}$

Answer: B

Solution:

Given, $t_{\frac{1}{2}} = 1386s$

For a first order reaction,

$t_{\frac{1}{2}} = \frac{0.693}{k}$ (k = rate constant)

$\Rightarrow 1386 = \frac{0.693}{k} \Rightarrow k = 5 \times 10^{-4} s^{-1} = 0.5 \times 10^{-3} s^{-1}$

Question45

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

The rate of appearance of bromine (Br_2) is related to rate of disappearance of bromide ions as
(2009)

Options:

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

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

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

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

Answer: D

Solution:

For the given reaction,
$BrO_3(aq)^- + 5Br^-(aq) + 6H^+ \rightarrow 3Br_{2(l)} + 3H_2O(l)$

Rate of reaction in terms of Br_2, and Br^- is,

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

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

Question46

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

if $\frac{d[NH_3]}{dt} = 2 \times 10^{-4} mol\, L^{-1} s^{-1}$,
the value of $\frac{-d[H_2]}{dt}$ would be
(2009)

Options:

A. $4 \times 10^{-4} mol\, L^{-1} s^{-1}$

B. $6 \times 10^{-4} mol\, L^{-1} s^{-1}$

C. $1 \times 10^{-4} mol\, L^{-1} s^{-1}$

D. $3 \times 10^{-4} mol\, L^{-1} s^{-1}$

Answer: D

Solution:

For reaction $N_2 + 3H_2 \rightarrow 2NH_3$

$$\text{Rate} = \frac{1}{2}\frac{d[NH_3]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = -\frac{d[N_2]}{dt}$$

Given, $\frac{d[NH_3]}{dt} = 2 \times 10^{-4} mol\, L^{-1} s^{-1}$

$$\therefore -\frac{d[H_2]}{dt} = \frac{3}{2}\frac{d[NH_3]}{dt} = \frac{3}{2} \times 2 \times 10^{-4}$$

$$\Rightarrow -\frac{d[H_2]}{dt} = 3 \times 10^{-4} mol\, L^{-1} s^{-1}$$

Question47

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
(2008)

Options:

A. 2000 K

B. $\frac{1000}{2.303}$ K

C. 1000 K

D. $\frac{2000}{2.303}$ K

Answer: B

Solution:

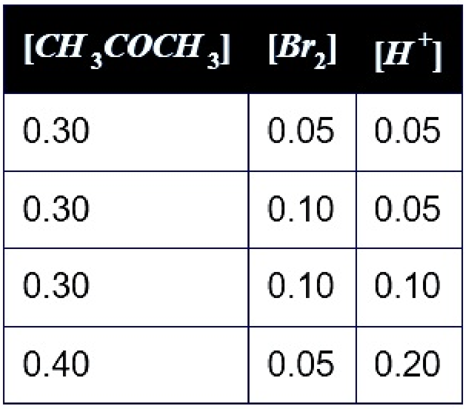
$k_1 = 10^{16}e^{-2000/T}$
$k_2 = 10^{15}e^{-1000/T}$
The temperature at which $k_1 = k_2$ will be
$10^{16}e^{-2000/T} = 10^{15}e^{-1000/T}$
$\Rightarrow \frac{e^{-2000/T}}{e^{-1000/T}} = \frac{10^{15}}{10^{16}}$
$\Rightarrow e^{-\frac{1000}{T}} = 10^{-1} \Rightarrow l\,og_e e^{-\frac{1000}{T}} = l\,og_e 10^{-1}$
$\Rightarrow 2.3.0l\,og_{10}e^{-\frac{1000}{T}} = 2.303\times l\,og_{10}10^{-1}$

$\Rightarrow \frac{-1000}{T}\times l\,og_{10}e = -1$
$\therefore T = \frac{1000}{2.303}K$

Question48

The bromination of acetone that occurs in acid solution represented by this equation.
$CH_3COCH_3(aq) + Br_2(aq) \rightarrow CH_3COCH_2Br(aq) + H^+(aq) + Br^-(aq)$

These kinetic data were obtained for given reaction concentrations.
Initial concentrations, M



$[CH_3COCH_3]$	$[Br_2]$	$[H^+]$
0.30	0.05	0.05
0.30	0.10	0.05
0.30	0.10	0.10
0.40	0.05	0.20

Initial rate, disappearance of Br_2, $M\ s^{-1}$
5.7×10^{-5}
5.7×10^{-5}
1.2×10^{-4}
3.1×10^{-4}
Based on these data, the rate equation is
(2008)

Options:

A. Rate $= k[CH_3COCH_3][Br_2][H^+]^2$

B. Rate $= k[CH_3COCH_3][Br_2][H^+]$

C. Rate $= k[CH_3COCH_3][H^+]$

D. Rate $= k[CH_3COCH_3][Br_2]$

Answer: C

Solution:

Solution:
From the first two experiments, it is clear that when concentration of Br_2 is doubled, the initial rate of disappearance of Br_2 remains unaltered. So, order of reaction with respect to Br_2 is zero. The probable rate law for the reaction will be : $k[CH_3COCH_3][H^+]$

Question49

If 60% of a first order reaction was completed in 60 minutes, 50% of the same reaction would be completed in approximately (log 4 = 0.60,log 5 = 0.69) (2007)

Options:

A. 45 minutes

B. 60 minutes

C. 40 minutes

D. 50 minutes

Answer: A

Solution:

For a first order reaction,

$k = \frac{2.303}{t} \log \frac{a}{a-x}$

$\text{or}, k = \frac{2.303}{60} \log \frac{100}{40} = \frac{2.303}{60} \times \log 2.5 = 0.0153$

$\text{Again}. t_{\frac{1}{2}} = \frac{2.303}{k} \log \frac{100}{50} = \frac{2.303}{0.0153} \times \log 2$

=45.31 min.

Question50

In a first-order reaction A → B, if k is rate constant and initial concentration of the reactant A is 0.5 M, then the half-life is (2007)

©

Options:

A. $\frac{\log 2}{k}$

B. $\frac{\log 2}{K\sqrt{0.5}}$

C. $\frac{\ln 2}{k}$

D. $\frac{0.693}{0.5K}$

Answer: C

Solution:

For a 1st order kinetics,

$K = \frac{2.303}{t} \log_{10} \frac{a}{a-x}$

$\text{At } t_{\frac{1}{2}}, k = \frac{2.303}{t_{\frac{1}{2}}} \log_{10} \frac{a}{a - \frac{a}{2}}$

$\text{or}, t_{\frac{1}{2}} = \frac{2.303}{k} \log_{102} = \frac{\ln 2}{k}$

Question51

The reaction of hydrogen and iodine monochloride is given as:
$H_2(g) + 2ICl(g) \rightarrow 2HCl(g) + I_2(g)$
This reaction is of first order with respect to $H_2(g)$ and $ICl(g)$ following mechanisms were proposed.
Mechanism A :
$H_2(g) + 2ICl(g) \rightarrow 2HCl(g) + I_2(g)$
Mechanism B :
$H_2(g) + ICl_2(g) \rightarrow HCl(g) + HI(g)$;slow
$HI(g) + ICl(g) \rightarrow HCl(g) + I_2(g)$;fast
Which of the above mechanism(s) can be consistent with the given information about the reaction?
(2007)

Options:

A. A and B both

B. neither A nor B

C. A only

D. B only

Answer: D

Solution:

Solution:
The slow step is the rate determining step and it involves 1 molecule of $H_2(g)$ and 1 molecule of $ICl(g)$. Hence the rate will be,$r = k[H_2(g)][ICI(g)]$
i.e the reaction is 1st order with respect to $H_2(g)$ and $ICl(g)$,

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Question52

Consider the reaction: $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ The equality relationship between $\frac{d[NH_3]}{dt}$ and $-\frac{d[H_2]}{dt}$ is
(2006)

Options:

A. $\frac{d[NH_3]}{dt} = -\frac{d[H_2]}{dt}$

B. $\frac{d[NH_3]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt}$

C. $+\frac{d[NH_3]}{dt} = -\frac{2}{3}\frac{d[H_2]}{dt}$

D. $+\frac{d[NH_3]}{dt} = -\frac{3}{2}\frac{d[H_2]}{dt}$

Answer: C

Solution:

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
Rate $= \frac{-d[N_2]}{dt} = -\frac{d[H_2]}{3dt} = \frac{d[NH_3]}{2dt}$
Hence $+\frac{d[NH_3]}{dt} = -\frac{2}{3}\frac{d[H_2]}{dt}$

Question53

For the reaction, 2A + B → 3C + D, which of the following does not express the reaction rate?
(2006)

Options:

A. $-\frac{d[A]}{2dt}$

B. $-\frac{d[C]}{3dt}$

C. $-\frac{d[B]}{dt}$

D. $\frac{d[D]}{dt}$

Answer: B

Solution:

$2A + B \rightarrow 3C + D$
Rate $= \frac{-d[A]}{2dt} = -\frac{d[B]}{dt} = \frac{d[C]}{3dt} = \frac{d[D]}{dt}$
Negative sign shows the decrease in concentration.

Question54

The rate of reaction between two reactants A and B decreases by a factor of 4 if the concentration of reactant B is doubled. The order of this reaction with respect to reactant B is
(2005)

Options:

A. 2

B. -2

C. 1

D. -1

Answer: B

Solution:

Rate of reaction $= k[A_0]^{\alpha}[B_0]^{\beta}$
$\alpha \rightarrow$ order of reaction w.r.t. A
$\beta \rightarrow$ order of reaction w.r.t B
$[B] = [2B_0]$

$$\frac{r_1}{r_2} = \frac{k[A_0]^{\alpha}[B_0]^{\beta}}{k[A_0]^{\alpha}[2B_0]^{\beta}}$$

$$\Rightarrow 4 = \left(\frac{1}{2}\right)^{\beta} \Rightarrow \beta = -2$$

Question55

For a first order reaction A → B the reaction rate at reactant concentration of 0.01M is found to be $2.0 \times 10^{-5}\, \text{mol}\, L^{-1}\, s^{-1}$ The half-life period of the reaction is (2005)

Options:

A. 30s

B. 220s

C. 300s

D. 347 s.

Answer: D

Solution:

$A \rightarrow B$
Rate of reaction $= 2 \times 10^{-5}\, \text{mol}\, L^{-1}\, s^{-1}$
$\Rightarrow$ order of reaction is $n = 1$, rate $= k[A]^n$
$k \rightarrow$ rate or velocity constant
$[A] = 0.01M$

$$k = \frac{2 \times 10^{-5}}{0.01} = 2 \times 10^{-3},\ k = \frac{0.693}{t_{1/2}}$$

$$t_{1/2} = \frac{0.693}{2 \times 10^{-3}} = 346.5 \approx 347s$$

Question56

The rate of a first order reaction is 1.5×10^{-2} mol L^{-1} min^{-1} at 0.5 M concentration of the reactant. The half-life of the reaction is
(2004)

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Options:

A. 0.383 min

B. 23.1 min

C. 8.73 min

D. 7.53 min

Answer: B

Solution:

Rate $\left(\frac{dx}{dt}\right) = kC$

i.e., $1.5 \times 10^{-2} = k \times 0.5$ or, $k = \frac{1.5 \times 10^{-2}}{0.5}$

For first order reaction,

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

Question57

The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation, $k = A \times e^{-E^*/RT}$. Activation energy (E^*) of the reaction can be calculated by plotting
(2003)

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Options:

A. k vs T

B. k vs $\frac{1}{\log T}$

C. $\log k$ vs $\frac{1}{T}$

D. $\log k$ vs $\frac{1}{\log T}$

Answer: C

Solution:

On plotting $\log k$ vs $\frac{1}{T}$, we get a straight line, the slope indicates the value of activation energy.

Question58

If the rate of the reaction is equal to the rate constant, the order of the reaction is
(2003)

Options:

A. 0

B. 1

C. 2

D. 3

Answer: A

Solution:

A→ products
If $-\frac{dx}{dt} = k$, it means $-\frac{dx}{dt} = k[A]^0 = k$
Hence, order of reaction must be zero.

Question59

The reaction A → B follows first order kinetics. The time taken for 0.8 mole of A to produce 0.6 mole of B is 1 hour. What is the time taken for conversion of 0.9 mole of A to produce 0.675 mole of B ?
(2003)

Options:

A. 1 hour

B. 0.5 hour

C. 0.25 hour

D. 2 hours

Answer: A

Solution:

Solution:

In case I :

A	→	B
0.8		0
0.1		0.6
1		3

In case II :

A	→	B
0.9		0
0.225		0.675
1		3

The time taken for the completion of same fraction of change is independent of initial concentration.

Question60

The activation energy for a simple chemical reaction A ⇌ B is E_a in forward direction. The activation energy for reverse reaction (2003)

Options:

A. is negative of E_a

B. is always less than E_a

C. can be less than or more than E_a

D. is always double of E_a.

Answer: C

Solution:

Solution:
Activation energy is the minimum amount of energy required to convert reactant into product. It is affected by the presence of catalyst.

Question61

2A → B + C It would be a zero order reaction when (2002)

Options:

A. the rate of reaction is proportional to square of concentration of A

B. the rate of reaction remains same at any concentration of A

C. the rate remains unchanged at any concentration of B and C

D. the rate of reaction doubles if concentration of B is increased todouble.

Answer: B

Solution:

Solution:
$2A \rightarrow B + C$
The rate equation of this reaction may be expressed as $r = k[A]^0$, Order $= 0$, $r = k$
∴ The rate is independent of concentration.

Question62

$3A \rightarrow 2B$, rate of reaction $\frac{+d[B]}{dt}$ is equal to
(2002)

Options:

A. $-\frac{3}{2}\frac{d[A]}{dt}$

B. $-\frac{2}{3}\frac{d[A]}{dt}$

C. $-\frac{1}{3}\frac{d[A]}{dt}$

D. $+2\frac{d[A]}{dt}$

Answer: B

Solution:

Solution:
$3A \rightarrow 2B$,
Rate of the reaction $= \frac{1}{2}\frac{d[B]}{dt} = -\frac{1}{3}\frac{d[A]}{dt}$
$\Rightarrow \frac{d[B]}{dt} = -\frac{2}{3}\frac{d[A]}{dt}$

Question63

When a biochemical reaction is carried out in laboratory, outside the human body in absence of enzyme, then rate of reaction obtained is 10^{-6} times, the activation energy of reaction in the presence of enzyme

is
(2001)

Options:

A. 6 / RT

B. P is required

C. different from E $_a$ obtained in laboratory

D. can't say anything

Answer: C

Solution:

Solution:
For a given chemical reaction,
$k = Ae^{-E_a/RT}$ (Arrhenius equation)

Question64

For the reaction; $2N_2O_5 \rightarrow 4NO_2 + O_2$ rate and rate constant are 1.02 times 10^{-4} and $3.4 \times 10^{-5} sec^{-1}$ respectively, then concentration of N_2O_5 at that time will be

(2001)

Options:

A. 1.732

B. 3

C. 1.02×10^{-4}

D. 3.4×10^{5}

Answer: B

Solution:

$2N_2O_5 \rightarrow 4NO_2 + O_2$
This is a first order reaction.
$\therefore$ rate $= k[N_2O_5]$

$$[N_2O_5] = \frac{\text{rate}}{k} = \frac{1.02 \times 10^{-4}}{3.4 \times 10^{-5}} = 3$$

Question65

How enzymes increases the rate of reactions? (2000)

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Options:

A. By lowering activation energy

B. By increasing activation energy

C. By changing equilibrium constant

D. By forming enzyme substrate complex

Answer: A

Solution:

Solution:
Enzymes act like catalyst in biochemical reactions. Presence of an enzyme increases the rate of reaction by lowering the activation energy of the reactant.

Question66

For the reaction, $H^+ + BrO_3^- + 3Br^- \rightarrow 5Br_2 + H_2O$ which of the following relations correctly represents the consumption and formation of products? (2000)

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Options:

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

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

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

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

Answer: A

Solution:

$-\frac{1}{3}\frac{d[Br^-]}{dt} = +\frac{1}{5}\frac{d[Br_2]}{dt}$ = rate of reaction

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

Question67

For a first-order reaction, the half-life period is independent of (1999)

Options:

A. first power of final concentration

B. cube root of initial concentration

C. initial concentration

D. square root of final concentration.

Answer: C

Solution:

For the first order reaction, rate constant is given by, $k_1 = \frac{1}{t}\ln\frac{a}{a-x}$
a = initial concentration, $(a-x) =$ concentration at t time
At $t = t_{1/2}$, $x = \frac{a}{2}$
$\Rightarrow k_1 = \frac{1}{t_{1/2}}\ln\frac{a}{a-\frac{a}{2}}$
$\Rightarrow k_1 = \frac{1}{t_{1/2}}\ln 2$
$\Rightarrow k_1 = \frac{0.693}{t_{1/2}}$
Therefore, $t_{1/2}$ is independent of initial concentration.

Question68

Activation energy of a chemical reaction can be determined by (1998)

Options:

A. evaluating rate constants at two different temperatures

B. evaluating velocities of reaction at two different temperatures

C. evaluating rate constant at standard temperature

D. changing concentration of reactants.

Answer: A

Solution:

According to Arrhenius equation :

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_2T_1}\right]$$

where $E_a =$ activation energy

$R =$ gas constant $= 8.314 JK^{-1} mol^{-1}$

k_1 and k_2 are rate constants of the reaction at two different temperatures T_1 and T_2 respectively.

Question69

The experimental data for the reaction, $2A + B_2 \rightarrow 2AB$ is

Experiment	[A]	[B_2]	Rate(mole s^{-1})
1	0.50	0.50	1.6×10^{-4}
2	0.50	1.0	3.2×10^{-4}
3	1.0	1.0	3.2×10^{-4}

The rate equation for the above data is (1997)

Options:

A. rate $= k[A]^2[B]^2$

B. rate $= k[A]^2[B]$

C. rate $= k[B_2]$

D. rate $= k[B_2]^2$

Answer: C

Solution:

For the reaction, $2A + B_2 \rightleftharpoons 2AB$,

Rate $\propto [A]^x[B_2]^y$.

On substituting the given data, we get

From experiment 1

$1.6 \times 10^{-4} \propto [0.50]^x[0.50]^y$ ...(i)

From experiment 2 ,

$3.2 \times 10^{-4} \propto [0.50]^x[1.00]^y$...(ii)

From experiment 3 ,

$3.2 \times 10^{-4} \propto [1.00]^x[1.00]^y$ ...(iii)

On dividing equation (iii) by (ii), we get,

$$1 = \left[\frac{1.00}{0.50}\right]^x \Rightarrow 1 = 2^x \Rightarrow 2^0 = 2^x \Rightarrow x = 0$$

Now, divide equation (ii) by equation (i) we get,

$$2 = \left[\frac{1.00}{0.50}\right]^y \Rightarrow 2 = 2^y \Rightarrow y = 1$$

Thus rate equation is :

Rate = $k[A]^0[B_2]^1 = k[B_2]$

Question70

For the reaction $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ the rate of reaction is expressed as (1997)

Options:

A. $\frac{\Delta[H_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[I_2]}{\Delta t} = -\frac{\Delta[HI]}{\Delta t}$

B. $-\frac{\Delta[H_2]}{\Delta t} = -\frac{\Delta[I_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[HI]}{\Delta t}$

C. $\frac{\Delta[H_2]}{\Delta t} = \frac{\Delta[I_2]}{\Delta t} = \frac{\Delta[HI]}{\Delta t}$

D. none of these.

Answer: B

Solution:

For $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$, the rate of reaction is

$-\frac{\Delta[H_2]}{\Delta t} = -\frac{\Delta[I_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[HI]}{\Delta t}$

Negative sign shows disappearance of reactant and positive sign shows the appearance of product.

Question71

The given reaction, $2FeCl_3 + SnCl_2 \rightarrow 2FeCl_2 + SnCl_4$ is an example of (1996)

Options:

A. third order reaction

B. first order reaction

C. second order reaction

D. none of these.

Answer: A

Solution:

For a general reaction
$xA + yB + zC$ rightarrow product, the order of reaction is $x + y + z$.
since three molecules undergo change in concentration, therefore it is a third order reaction.

Question72

The data for the reaction $A + B \rightarrow C$, is

Exp.	$[A]_0$	$[B]_0$	Initial rate
1	0.012	0.035	0.10
2	0.024	0.070	0.80
3	0.024	0.070	0.80
4	0.012	0.070	0.80

The rate law corresponds to the above data is (1994)

Options:

A. rate $= k[A][B]^3$

B. rate $= k[A]^2[B]^2$

C. rate $= k[B]^3$

D. rate $= k[B]^4$

Answer: C

Solution:

$A + B \rightarrow C$
Let rate $= k[A]^x[B]^y$
where order of reaction is $(x + y)$.
Putting the values of exp. 1, 2, and 3, we get following equations.
$0.10 = k[0.012]^x[0.035]^y$...(i)
$0.80 = k[0.024]^x[0.070]^y$ ...(ii)
$0.10 = k[0.024]^x[0.035]^y$ ...(iii)
Dividing (ii) by (iii), we get
$\frac{0.80}{0.10} = \left(\frac{0.070}{0.035}\right)^y$
$\Rightarrow 2^y = 8 \Rightarrow y = 3$
Keeping [A] constant, [B] is doubled, rate becomes 8 times.
Dividing eq. (iii) by eq. (i), we get
$\frac{0.10}{0.10} = \left(\frac{0.024}{0.012}\right)^x$
$\Rightarrow 2^x = 1 \Rightarrow x = 0$
Keeping [B] constant, [A] is doubled, rate remains unaffected.
Hence, rate is independent of [A]
rate $\propto [B]^3$.

Question73

By the action of enzymes, the rate of biochemical reaction

(1994)

Options:

A. does not change

B. increases

C. decreases

D. either (a) or (c).

Answer: B

Solution:

since the enzymes are regarded as biological catalysts, therefore their action increases the rate of biological reaction.
