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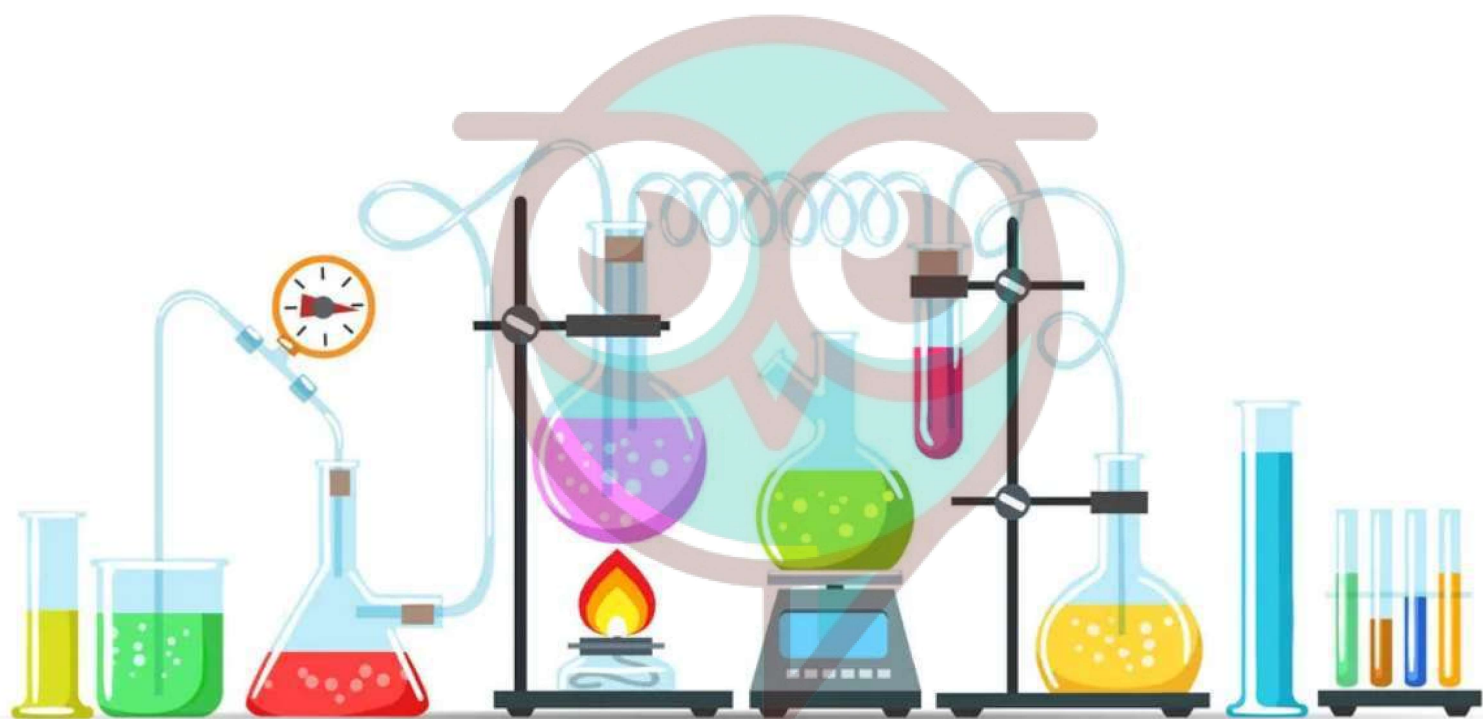
Important Questions

Multiple Choice questions-

Question 1.A first order reaction has a half life period of 34.65 seconds. Its rate constant is

(a) 2×10^{-2} s^{-1}

(b) 4×10^{-4} s^{-1}

(c) 20 s^{-1}

(d) 2×10^{-4} s^{-1}

Question 2.If a graph is plotted between In k and 1/T for the first order reaction, the slope of the straight line so obtained is given by

(a) $-\dfrac{E_a}{R}$

(b) $\dfrac{E_a}{2.303R}$

(c) $\dfrac{2.303}{E_a.R}$

(d) $\dfrac{E_a}{2.303}$

Question 3.The unit of rate constant for a zero order reaction is

(a) mol L^{-1}s^{-1}

(b) s^{-1}

(c) L mol^{-1}s^{-1}

(d) L2mol^{-2}s^{-1}

Question 4.A catalyst increases the speed of a chemical reaction by

(a) increasing activation energy

(b) decreasing activation energy

(c) increasing reactant energy

(d) decreasing threshold energy

Question 5.The units of the rate constant for the second order reaction are:

(a) mol^{-1} litre s^{-1}

(b) mol $litre^{-2}$ s^{-1}

(c) s^{-1}

(d) mol $litre^{-1}$ s^{-1}

Question 6.The value of k for a reaction is 2.96×10^{-30} $s^{-1.}$ What is the order of the reaction?

(a) Zero

(b) 3

(c) 2

(d) 1

Question 7.A reaction is found to be of second order with respect to concentration of carbon monoxide. If concentration of carbon monoxide is doubled, the rate of reaction will

(a) triple

(b) increase by a factor of 4

(c) double

(d) remain unchanged

Question 8. If the concentrations are expressed in mol litre-1 and time in s, then the units of rate constant for the first-order reactions are

(a) mol $litre^{-1}$ s^{-1}

(b) mol^{-1} litre s^{-1}

(c) s^{-1}

(d) mol^2 $litre^{-2}$ s^{-1}

Question 9.The half life of a first order reaction having rate constant 200 s-^{1} is

(a) 3.465 × 10^{-2} s

(b) 3.465 × 10^{-3} s

(c) 1.150 × 10^{-2} S

(d) 1.150 × 10^{-3} S

Question 10.The rate of a reaction is 1.209 × 10^{-4}L^2 mol^{-2}s^{-1}. The order of the reaction is:

(a) zero

(b) first

(c) second

(d) third

Very Short Question:

Question 1. Is rate of reaction always constant?

Question 2. Can order of reaction be zero? Give example.

Question 3. What do you understand by rate law expression?

Question 4. Is it possible to determine or predict the rate law theoretically by merely looking at the equation?

Question 5. Define the term chemical kinetics?

Question 6. Define – Rate of reaction and the factors affecting the rate of reaction.

Question 7. What is average rate of a reaction? How is it determined?

Question 8. What are the units of rate of a reaction?

Question 9. Identify the reaction order for from each of the following rate constant –

(a) $k = 2.3 \times 10^{-5} L\ mol - 1\ s^{-1}$

(b) $k = 3.1 \times 10^{-4} s^{-1}$

Question 10. Consider the equation $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$

The rate law for this equation is first order with respect to H_2 and second order with respect to NO. write the rate law for this reaction.

Short Questions:

Question 1 For the reaction A+B $\rightarrow$ C+D, the rate of reaction doubles when the concentration of A doubles, provided the concentration of B is constant. To what order does A enter into the rate expression?

Question 2. . A chemical reaction 2A $\Leftrightarrow$ 4B+C in gas phase occurs in a closed vessel. The concentration of B is found to be increased by $5 \times 10^{-3} mole\ L^{-1}$ in 10 second. Calculate (i) the rate of appearance of B (ii) the rate of disappearance of A?

Question 3. For the following reactions, write the rate of reaction expression in terms of reactants and products?

$4NH_3(g) + 5O_2(g) 4 \rightarrow NO(g) + 6H_2O(g)$

ii) $2N_2O_5\ 2NO_2 + O_2$
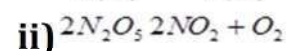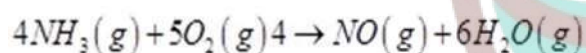
Question 4. . The reaction $2N_2O_5(g) \rightarrow 2NO_2(g) + O_2(g)$ was studied and the following data were collected:

S.no (mol/L/min)	$[N_2O_5]\ mol\ L^{-1}$	Rate of disappearance of $[N_2O_5]$ (mol/L/min
1.	1.13×10^{-2}	34×10^{-5}
2.	0.84×10^{-2}	25×10^{-5}
3.	0.62×10^{-2}	18×10^{-5}

Determine

i) **The order**
 ii) **The rate law.**
iii) **Rate constant for the reaction.**

Question 5. The following experimental data was collected for the reaction:

$Cl_2(g) + 2NO(g) \rightarrow 2NOCl(g)$
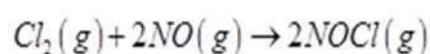
Trial	Intial conc. Of $Cl_2 (mol/L)$	NO mol/L	Initial Rate,(mol/L/s)
1	0.10	0.010	1.2×10^{-4}

2	0.10	0.030	10.8×10^{-4}
3	0.20	0.030	21.6×10^{-4}

Construct the rate equation for the reaction.

Question 6. Draw a graph for

a) Concentration of reactant against time for a zero order reaction.
b) Log Ro/ R against time for a first order reaction.

Question 7. In general it is observed that the rate of a chemical reaction doubles with every 10^0 rise in temperature. If this generalization holds for a reaction in the temperature range 295K to 305K, what would be the activation energy for this reaction? $\left(R = 8.314 Jk^{-1}mol^{-1}\right)$

Question 8. The rate constant for a reaction is $1.5 \times 10^7 s^{-1}$ at $50^0 C$ and $4.5 \times 10^7 s^{-1}$ at $100^0 C$. Calculate the value of activation energy for the reaction $R = 8.314 \ JK^{-1}mol^{-1}$?

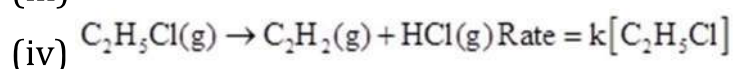Question 9. Plot a graph showing variation of potential energy with reaction. coordinate?
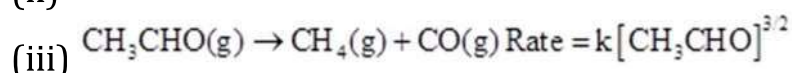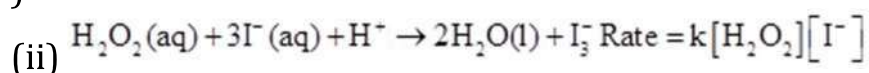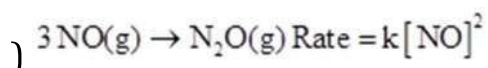
Question 10. The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times how will it affect the rate of formation of Y?

Long Questions:

Question 1. .The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate E_a

Question 2. The activation energy for the reaction $2HI_{(g)} \rightarrow H_2 + I_{2(g)}$ is $209.5 kJ mol^{-1}$ at 581K. Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy?

Question 3. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.

)
$3 NO(g) \rightarrow N_2O(g) \ Rate = k[NO]^2$

(ii)
$H_2O_2 (aq) + 3I^- (aq) + H^+ \rightarrow 2H_2O(l) + I_3^- \ Rate = k[H_2O_2][I^-]$

(iii)
$CH_3CHO(g) \rightarrow CH_4(g) + CO(g) \ Rate = k[CH_3CHO]^{3/2}$

(iv)
$C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g) \ Rate = k[C_2H_5Cl]$

Question 4. The decomposition of NH_3 on platinum surface is zero order reaction. What are

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the rates of production of N_2 and H_2 if $k = 2.5 \times 10^{-4} \, mol^{-1} L \, s^{-1}$?

Question 5. The decomposition of dimethyl ether leads to the formation of CH_4, H_2 and CO and the reaction rate is given by Rate = $k[CH_3OCH_3]^{3/2}$. The rate of reaction is followed by increase in pressure in a closed vessel, so the rate can also be expressed in terms of the partial pressure of dimethyl ether, i.e., $Rate = k\left(P_{CH_3OCH_3}\right)^{3/2}$ If the pressure is measured in bar and time in minutes, then what are the units of rate and rate constants?

Assertion and Reason Questions:

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
   b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
   c) Assertion is correct statement but reason is wrong statement.
   d) Assertion is wrong statement but reason is correct statement.

Assertion: The rate ofreaction is always negative.

Reason: Minus sign used in expressing the rate shows that concentration of product is decreasing.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
   b) Assertion and reason both are correct statements but reason is not correct explanation for assertionss.
   c) Assertion is correct statement but reason is wrong statement.
   d) Assertion is wrong statement but reason is correct statement.

Assertion: Kinetics explains the reaction mechanism.

Reason: Kinetics explains the formation of products.

Case Study Questions:

1. In a reaction, the rates of disappearance of different reactants or rates of formation of different products may not be equal but rate of reaction at any instant of time has the same value expressed in terms of any reactant or product. Further, the rate of reaction may not depend upon the stoichiometric coefficients of the balanced chemical equation. The exact powers of molar concentrations of reactants on which rate depends are found experimentally and expressed in terms of 'order of reaction'. Each reaction has a characteristic rate constant depends upon temperature. The units of the rate constant depend upon the order of reaction.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) The rate constant of a reaction is found to be 3×10^{-3} mol^{-2} L^2 sec^{-1}. The order of the reaction is:

   a) 0.5
   b) 2
   c) 3
   d) 1

(ii) In the reaction, $A + 3B \rightarrow 2C$, the rate of formation of C is:

   a) The same as rate of consumption of A.
   b) The same as the rate of consumption of B.
   c) Twice the rate of consumption of A.
   d) 3232 times the rate of consumption of B.

(iii) Rate of a reaction can be expressed by following rate expression, Rate = $k[A]^2 [B]$, if concentration of A is increased by 3 times and concentration of B is increased by 2 times, how many times rate of reaction increases?

   a) 9 times
   b) 27 times
   c) 18 times
   d) 8 times

(iv) The rate of a certain reaction is given by, rate = $k[H^+]^n$. The rate increases 100 times when the pH changes from 3 to 1. The order (n) of the reaction is:

   a) 2
   b) 0
   c) 1
   d) 1.5

(v) In a chemical reaction A + 2B → products, when concentration of A is doubled, rate of the reaction increases 4 times and when concentration of B alone is doubled rate continues to be the same. The order of the reaction is:

    a) 1
    b) 2
    c) 3
    d) 4

2. The progress of the reaction, $A \rightleftharpoons nB$ with time is represented in the following figure:
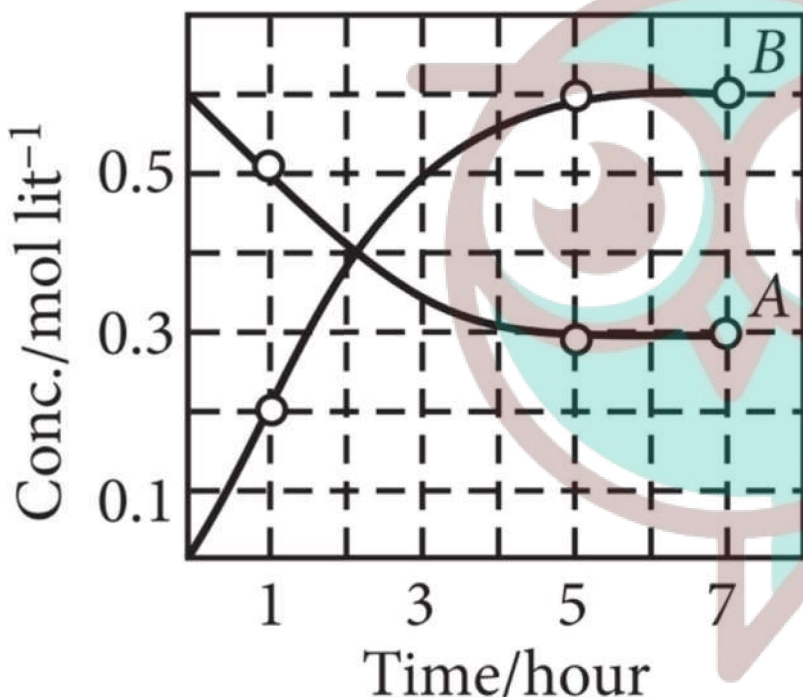
The following questions are multiple choice questions. Choose the most appropriate answer:

(i) What is the value of n?

    a) 1
    b) 2
    c) 3
    d) 4

(ii) Find the value of the equilibrium constant.

    a) 0.6M
    b) 1.2M
    c) 0.3M
    d) 2.4M

(iii) The initial rate of conversion of A will be:

a) 0.1 mol L^{-1}hr^{-1}
b) 0.2 mol L^{-1}hr^{-1}
c) 0.4 mol L^{-1}hr^{-1}
d) 0.8 mol L^{-1}hr^{-1}

(iv) For the reaction, if $\frac{d[B]}{dt} = 2 \times 10^{-4}$, value of $\frac{d[A]}{dt}$ will be:

a) 2×10^{-4}
b) 10^{-4}
c) 4×10^{-4}
d) 0.5×10^{-4}

(v) Which factor has no effect on rate of reaction?

a) Temperature.
b) Nature of reactant.
c) Concentration of reactant.
d) Molecularity.

Answers key

MCQ Answer:

1. Answer: (a) 2×10^{-2} s^{-1}

2. Answer: (a) $-\frac{E_a}{R}$

3. Answer: (a) mol L^{-1}s^{-1}

4. Answer: (b) decreasing activation energy

5. Answer: (a) mol^{-1} litre s^{-1}

6. Answer: (d) 1

7. Answer: (b) increase by a factor of 4

8. Answer: (c) s^{-1}

9. Answer: (b) 3.465×10^{-3} s

10. Answer: (d) third

Very Short Answers:

1. No. rate of a reaction is not always constant. It depends on many factors such as concentration, temperature etc.

2. Yes, decomposition of ammonia on a hot platinum surface is a zero order of reaction at high pressure

3. Answer: The rate law is the expression in which rate is given in terms of molar concentration of reactants with each term raised to some power, which may or may not be same as the stoichiometric coefficient of the reacting species in a balanced chemical equation.

4. Answer: No, the rate law cannot be predicted by merely looking at the balanced chemical equation but must be determined experimentally.

5. Answer: The branch of chemistry that deals with the study of reaction rates and their mechanis is called chemical Kinetics.

6. Answer: Rate of reaction can be defined as the change in concentration of a reactant or produc per unit time. Factors affecting the rate of reaction are temperature, concentration of reactants and catalyst.

7. Answer: Average rate of a reaction is defined as the change in concentration of a reactant or a product per unit time. It can be determined by dividing the change in concentration of reactant or product by the time interval
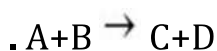
   For the reaction: $A \rightarrow B$ R av

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

8. The units of rate of a reaction are Mol $L^{-1}S^{-1}$ In gaseous reaction the unit of rate of reaction is atm .

9. a) Since the units of rate constant are $Lmol^{-1}s^{-1}$ The reactions is of second order.
   b) Since the units of rate constant are s^{-1}, The reaction is of first order

10. The rate law will be $R = K[NO]^2[H_2]$

Short Answers:

1. **Answer**

   . $A + B \rightarrow C + D$
   $Rate[A]^x$

Rate = 1 when A = 1 ————- 1)
Rate = 2 when A = 2————–2)
Dividing equation 2) by 1)

$$\frac{2}{1} \alpha \frac{(2)^x}{1^x}$$

$$21 \alpha (2)^x$$

$$\therefore x = 1$$

The reaction is first order reaction.

2. Answer:

$$2A \rightarrow 4B$$

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

i)   Rate of disappearance of B

$$= \frac{\frac{5 \times 10^{-3}}{10 \; 5} \text{mol} /L^{-1}}{} = 5 \times 10^{-4} \text{ mol } L^{-1} s^{-1}$$

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

ii) $= \frac{1}{2} \times 5 \times 10^{-4} \text{ mol } L^{-1} s^{-1}$ $= 2.5 \times 10^{-4} \text{ mol } L^{-1} s^{-1}$

3. Answer:

In terms of reactant	In terms of products
i) $R_1 = \frac{-1}{4} \frac{\Delta[NH_3]}{\Delta t}$	$R_3 = \frac{1}{4} \frac{\Delta[NO]}{\Delta t}$
$R_2 = \frac{-1}{5} \frac{\Delta[O_2]}{\Delta t}$	$R_4 = \frac{1}{6} \frac{\Delta[H_2O]}{\Delta t}$

$$\frac{1}{4} R_1 = \frac{1}{5} R_2 = \frac{1}{4} R_3 = \frac{1}{6} R_4$$

$$-\frac{1}{4} \frac{\Delta[NH_3]}{\Delta t} = -\frac{1}{5} \frac{\Delta[O_2]}{\Delta t} = \frac{1}{4} \frac{\Delta[NO]}{\Delta t} = \frac{1}{6} \frac{\Delta[H_2O]}{\Delta t}$$

II) In terms of reactant	In terms of product
R1 = $-\frac{\Delta[N_2O_5]}{\Delta t}$	$R_2 = \frac{\Delta[NO_2]}{\Delta t}$

$$R_3 = \frac{\Delta[O_2]}{\Delta t}$$

$$\frac{1}{2}R_1 = \frac{1}{2}R_2 = R_3 - \frac{\Delta[N_2O_5]}{\Delta t} = \frac{1}{2}\frac{\Delta[NO_2]}{\Delta t} = \frac{\Delta[O_2]}{\Delta t}$$

4. Answer:

Let the order of reaction be x

$Rate = K[N_2O_5]^x$

i) From the data –

$34\times10^{-5} = (1.13\times10^{-2})^x$ ————-1)

$25\times10^{-5} = (0.84\times10^{-2})^x$ ————-2)

$18\times10^{-5} = (0.62\times10^{-2})^x$ ————-3)

Dividing 1) by 2)

$\frac{34\times10^{-5}}{25\times10^{-5}} = (\frac{1.13\times10^{-2}}{0.84\times10^{-2}})^x$

$(1.36) = (1.35)^x$

X=1
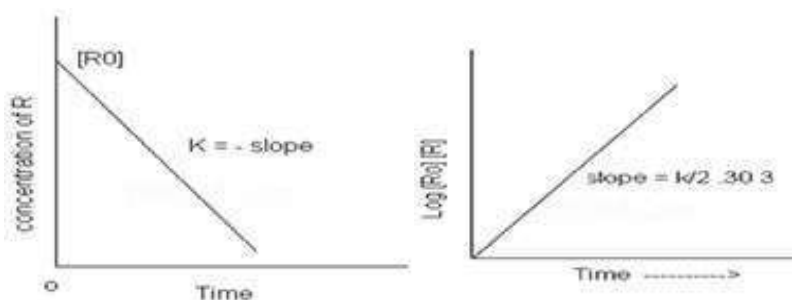
The order of reaction with respect with respect to N_2O_5 is 1

ii) Rate law $R = K[N_2O_5]$

iii) Rate constant , K = $\frac{Rate}{[N_2O_5]}$ = $\frac{18\times10^{-5} \text{ mol/L/min}}{0.62\times10^{-2} \text{ mol/L}}$ = $0.29\ min^{-1}$

5. Answer :

Order of NO is 2

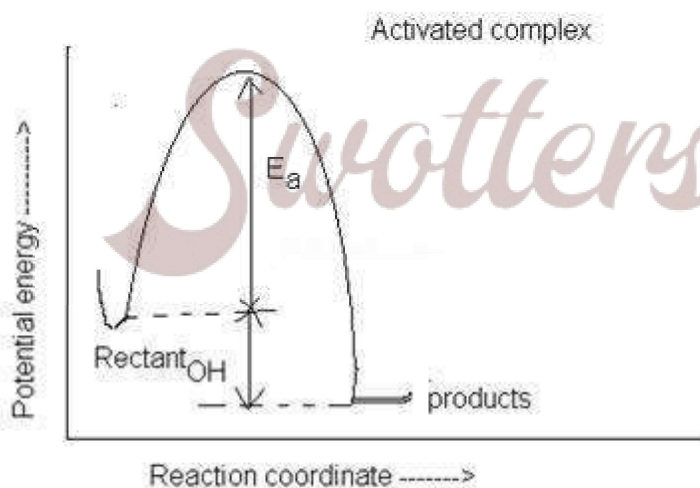Rate law = $K[Cl_2][NO]^2$

6. Answer

(a)   (b)

7. Answer:

$T_1 = 295K \quad T_2 = 305K$

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

$K_2 = 2k_1$

$$E_a = 2.303 \times 8.314 \times \left[\frac{305 \times 295}{305 - 295}\right]\log\frac{2k_1}{k_1}$$

$= 2.303 \times 8.314 \times 8997.5K\ log\,2$

$= 51855.2\ J/mol \quad (log\,2 = 0.3010)$

8. Answer:

$$\log\frac{4.5 \times 10^7}{1.5 \times 10^7} = \frac{Ea}{2.303 \times 3.314}\left(\frac{373 - 323}{373 \times 323}\right)$$

$$\log 1.5 = \frac{Ea}{2.303 \times 3.314}\left(\frac{50}{373 \times 323}\right)$$

$$Ea = \left(\frac{2.303 \times 3.314 \times 373 \times 323}{50}\right) \times \log 1.5$$

$= 22\ KJ/mol$

9. Answer :

10. Answer :

The reaction $X \rightarrow Y$ follows second order kinetics.
Therefore, the rate equation for this reaction will be:

Rate = $k[X]^2$ (1)

Let X = a mol^{-1}, then equation (1) can be written as:

$Rate_1 = k.(a)_2$

$= ka_2$

If the concentration of X is increased to three times, then X = $3a\,mol\,L^{-1}$

Now, the rate equation will be:

Rate = $k(3a)_2$

$= 9(ka^2)$

Hence, the rate of formation will increase by 9 times.

Long Answers:

1. **Answer:**

It is given that $T1 = 298$ K

Therefore, $T_2 = (298+10)K$

= 308 K

We also know that the rate of the reaction doubles when temperature is increased by $10°$.

Therefore, let us take the value of $k_1 = k$ and that of $k_2 = 2k$

Also, $R = 8.314\,JK^{-1}\,mol^{-1}$

Now, substituting these values in the equation:

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

We get:

$$\log\frac{2k}{k} = \frac{E_a}{2.303\times8.314}\left[\frac{10}{298\times308}\right]$$

$$\log 2 = \frac{E_a}{2.303\times8.314}\left[\frac{10}{298\times308}\right]$$

$$E_a = \frac{2.303\times8.314\times298\times308\times\log 2}{10}$$

$$= 52897.78\,J\,mol^{-1}$$

$$= 52.9\,kJ\,mol^{-1}$$

2. Answer:

In the given case:

$E_a = 209.5\,kJ\,mol^{-1} = 209500\,J\,mol^{-1}$

$T = 581$ K

$R = 8.314\,JK^{-1}\,mol^{-1}$

Now, the fraction of molecules of reactants having energy equal to or greater than

activation energy is given as:

$x = e^{-E_a/RT}$

$\ln x = -E_a/RT$

$\log x = -\dfrac{E_a}{2.303\,RT}$

$\log x = \dfrac{209500\,J\,mol^{-1}}{2.303 \times 8.314\,J\,K^{-1}mol^{-1} \times 581} = 18.8323$

Now, x = Anti log (18.8323)

= Anti log $\overline{19}.1677$

1.471×10^{-19}

3. Answer:

(i) Given rate = $k[NO]^2$

Therefore, order of the reaction = 2

Dimension of $k = \dfrac{Rate}{[NO]^2}$

$= \dfrac{mol\,L^{-1}s^{-1}}{(mol\,L^{-1})^2}$

$= \dfrac{mol\,L^{-1}s^{-1}}{mol^2 L^{-2}}$

$= L\,mol^{-1}s^{-1}$

(ii) Given rate = $k[H_2O_2][I^-]$

Therefore, order of the reaction = 2

Dimension of $k = \dfrac{Rate}{[H_2O_2][I^-]}$

$= \dfrac{mol\,L^{-1}s^{-1}}{(mol\,L^{-1})(mol\,L^{-1})}$

$= L\,mol^{-1}s^{-1}$

(iii) Given rate = $k[CH_3CHO]^{3/2}$

Therefore, order of reaction = $\dfrac{3}{2}$

Dimension of $k = \dfrac{Rate}{[CH_3CHO]^{\frac{3}{2}}}$

$$= \frac{mol\,L^{-1}s^{-1}}{(mol\,L^{-1})^{\frac{3}{2}}}$$

$$= \frac{mol\,L^{-1}s^{-1}}{mol^{\frac{3}{2}}L^{-\frac{3}{2}}}$$

$$= L^{\frac{1}{2}}mol^{-\frac{1}{2}}s^{-1}$$

(iv) Given rate = $k\left[C_2H_5Cl\right]$

Therefore, order of the reaction = 1

Dimension of $k = \dfrac{Rate}{\left[C_2H_5Cl\right]}$

$$= \frac{mol\,L^{-1}s^{-1}}{mol\,L^{-1}}$$

$$= s^{-1}$$

4. Answer:

The decomposition of NH_3 on platinum surface is represented by the following equation.

$$2NH_{3(g)} \xrightarrow{\;Pt\;} N_{2(g)} + 3H_{2(g)}$$
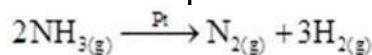
Therefore, $Rate = -\dfrac{1}{2}\dfrac{d[NH_3]}{dt} = \dfrac{d[N_2]}{dt} = \dfrac{1}{3}\dfrac{d[H_2]}{dt}$

However, it is given that the reaction is of zero order.

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

Therefore, $= 2.5 \times 10^{-4} mol\,L^{-1}s^{-1}$

Therefore, the rate of production of N_2 is

$$\frac{d[N_2]}{dt} = 2.5 \times 10^{-4} mol\,L^{-1}s^{-1}$$

And, the rate of production of H_2 is

$$\frac{d[H_2]}{dt} = 3 \times 2.5 \times 10^{-4} mol\,L^{-1}s^{-1}$$

$$= 7.5 \times 10^{-4} mol\,L^{-1}s^{-1}$$

5. Answer:

If pressure is measured in bar and time in minutes, then

Unit of rate = $bar\,min^{-1}$

$$Rate = k\left(P_{CH_3OCH_3}\right)^{\frac{3}{2}}$$

$$k = \frac{\text{Rate}}{\left(P_{CH_3OCH_3}\right)^{3/2}}$$

Therefore, unit of rate constants $(k) = \dfrac{\text{bar min}^{-1}}{\text{bar}^{3/2}}$

$= \text{bar}^{-1/2} \text{min}^{-1}$

Assertion and Reason Answers:

1. (d) Assertion is wrong statement but reason is correct statement.

Explanation:

The rate reaction is never negative. Minus sign used in expressing the rate only shows that the concentration of the reactant is decreasing.

2. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation:

Kinetics deals with the reaction mechanism i.e., how the atoms rearrange themselves in the reactant molecules in a single step or a number of steps, finally leading to the product molecules.

Case Study Answers:

1. Answer :

i. (c) 3

Explanation:

Unit of k for n^{th} order $= (\text{mot L}^{-1})^{1-n} \sec^{-1}$

Here, $k = 3 \times 10^{-3} \text{ mol}^{-2} \text{ L}^2 \sec^{-1}$

Unit of $k = \text{mol}^{-2} \text{ L}^2 \sec^{-1} \Rightarrow (\text{mol L}^{-1})^{-2} \sec^{-1}$

Comparing (i) and (ii) we get, $1 - n = -2 \Rightarrow n = 3$

ii. (c) twice the rate of consumption of A.

Explanation:

$$\text{Rate} = \frac{d[A]}{dt} = -\frac{1}{3}\frac{d[B]}{dt} = \frac{1}{2}\frac{d[C]}{dt}$$

iii. (c) 18 times

Explanation:

Given, $R_1 = k[A]^2[B]$

According to question, $R_2 = k[3A]^2[2B]$

$= k \times 9[A]^2 \times 2[B] = 18 \times k[A]^2[B] = 18 R_1$

iv. (c) 1

Explanation:

Rate $(r) = k[H^+]^n$

When pH = 3 ; $[H^+] = 10^{-3}$

and when pH = 1 ; $[H^+] = 10^{-1}$

$$\therefore \frac{r_1}{r_2} = \frac{k(10^{-3})^n}{k(10^{-1})^n} \Rightarrow \frac{1}{100} = \left(\frac{10^{-3}}{10^{-1}}\right)^n \quad (\because r_2 = 100 r_1)$$

$$\Rightarrow (10^{-2})^1 = (10^{-2})^n \Rightarrow n = 1$$

v. (b) 2

Explanation:

Let the order of reaction w.r.t. A is x and w.r.t. B is y.

$$r_1 = k[A]^x[B]^y$$

$$r_2 = k[2A]^x[B]^y$$

$$r_3 = k[A]^x[2B]^y$$

$$\frac{r_1}{r_2} = \frac{k[A]^x[B]^y}{k[2A]^x[B]^y}$$

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

Similarly, $\dfrac{r_1}{r_3} = \dfrac{k[A]^x[B]^y}{k[A]^x[2B]^y}$

$$\Rightarrow 1 = \left(\frac{1}{2}\right)^y \Rightarrow \left(\frac{1}{2}\right)^0 = \left(\frac{1}{2}\right)^y \Rightarrow y = 0$$

Hence the rate law equation is

Rate = $k[A]^2[B]^0 \Rightarrow$ Order of reaction = 2

2. Answer :

i. (b) 2

Explanation:

According to the figure,

in the given time of 4 hours (1 to 5) concentration of A falls from 0.5 to 0.3M,

while in the same time concentration of B increases from 0.2 to 0.6 M.

Decrease in concentration of A in 4 hours

= 0.5 - 0.3 = 0.2M

Increase in concentration of B in 4 hours

= 0.6 - 0.2 = 0.4M

Thus, increase in concentration of B in a given time is

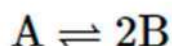twice the decrease in concentration of A. Thus, n = 2.

ii. (b) 1.2M

Explanation:

$$K = \frac{[B]^2}{[A]} = \frac{(0.6)^2}{0.3} = 1.2M$$

iii. (a) 0.1 mol $L^{-1}hr^{-1}$

Explanation:

From t = 0 to t = 1hr,

For A, dx = 0.6 - 0.5 = 0.1 mol L^{-1}

$\therefore$ Initial rate of conversion of $A = \frac{dx}{dt}$

$$= \frac{0.1 \text{ mol } L^{-1}}{1hr} = 0.1 \text{ mol } L^{-1}hr^{-1}$$

iv. (b) 10^{-4}

Explanation:

$$A \rightleftharpoons 2B$$

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

$$= \frac{1}{2} \times 2 \times 10^{-4} = 10^{-4}$$

v. (d) Molecularity.

Explanation:

The number of reacting species (atoms, ions or molecules)

taking part in an elementary reaction is called molecularity

and it has no influence on the rate of reaction.