CHEMISTRY STUDY MATERIALS FOR CLASS 12
(NCERT QUESTION – ANSWERS OF CHAPTER -04)
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CHEMICAL KINETICS

IMPORTANT QUESTIONS

1 MARK QUESTIONS

Q1. How does catalyst alter rate of a reaction?

Ans. It increases rate of reaction by providing a new path having low activation energy.

Q 2. A reaction is 50% complete in 2 hours and 75% completes in 4 hours. What is the order of the reaction?

Ans . Since half life remains constant so it is a first order reaction.

Q 3.Calculate the overall order of a reaction which has the rate expression. Rate = $k\,[A]^{1/2}\,[B]^{3/2}$

Ans. Order of reaction = 1/2 + 3/2 = 2 i.e second order reaction. Q

4.Define the term:activation energy

Ans The additional energy which is required by the molecules of reactants to cause effective collision is called activation energy.

Q5.What is the unit of rate constant for a Pseudo first order reaction?

Ans s^{-1}

Q6.Give an example of pseudo first order reaction.

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

Q7. The rate constant of a reaction is 0.005 mol $L^{-1}s^{-1}$. What is the order of this reaction?

Ans Zero order reaction

ASSERTION -REASON TYPE

A statement of assertion is followed by a statement of reason. Mark the correct choice from the options given below:

(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

1. **Assertion :** Complex reaction takes place in different steps and the slowest step determines the rate of reaction.
   Reason : Order and molecularity of a reaction are always equal. (Ans - c)
2. Assertion : Rate of reaction increases with increase in temperature.
   Reason : Number of effective collisions increases with increase in temperature. (Ans - a)
3. Assertion : Order of a reaction with respect to any reactant or product can be zero, positive, negative and fractional.
   Reason : Rate of a reaction cannot decrease with increase in concentration of a reactant or product. (Ans - c)
4. Assertion : The rate of a reaction sometimes does not depend on concentration.
   Reason : Lower the activation energy faster is the reaction. (Ans - b)
5. Assertion : For a certain reaction, a large fraction of molecules has energy more than the threshold energy, still the rate of reaction is very slow.
   Reason : The colliding molecules must not be properly oriented for effective collisions. (Ans - a)

ONE - WORD ANSWER

1. The magnitude of which parameter changes by the use of a catalyst? Ans - Activation energy)
2. What is the molecularity of pseudo first order reaction? (Ans - 2)

2 MARKS QUESTIONS

In a reaction, $2A \rightarrow$ Products, the concentration of A decreases from 0.5mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the rate during this interval?

Ans Rate = – change in conc. of A/2 x time interval

= – [0.4 0.5]/2X10 = 0.005 mol litre^{-1}min^{-1}

Q2. The rate constant for a first order reaction is 60 s^{-1}. How much time will it take to reduce the initial concentration of the reactant to its 1/16th value?

Ans Given = 60 s^{-1}, $[R]_0$ =1, [R]=1/16, t = ?

$t = 2.303/k \log[R]_o/[R]$

$= 2.303/60 \log 16 = 3.84X10^{-2}$ s

Q3. Define the following terms: i) elementary reaction ii) half life period of a reaction

Ans. (i) Many reactions complete in a number of steps. individual step of a reaction is called elementary step.

(ii) Time during which amount of reactant remains half of its initial amount is called half life period of a reaction.

Q4. Give three important differences between rate of reaction and rate constant of reaction.

S.No.	Rate of reaction	Rate constant of reaction
1	It is the change in concentration of reactant or product in a unit interval of time.	It is the rate of reaction when molar conc. of each of the reactants is unity.
2	Its unit is mol $L^{-1}s^{-1}$.	Its unit depends upon the order of rk^n
3	The rate of reaction at any instant of time depends upon the molar conc. of the reactants at that time.	The rate constant does not depend upon the molar conc. of the reactants.

Q5. Give four important differences between order of reaction molecularity of reaction.

S.No.	order of reaction	molecularity of reaction
1	It is sum of the powers of the concentration of the reactants in the rate law expression	The number of reacting species taking part in an elementary reaction, which must collide to give products, is called molecularity of a reaction.
2	Order of a reaction is an experimental quantity.	It is theoretical value.
3	It can be zero and even a fraction.	It cannot be zero or a non integer.
4	Order is applicable to elementary as well as complex reactions.	Molecularity is applicable only for elementary reactions.

3 MARKS QUESTIONS

Q1. Show that in a first order reaction, time required for completion of 99.9% is 10 times of half life ($t_{1/2}$) of the reaction

Ans When reaction is completed 99.9%, $[R]n = [R]_0 - 0.999[R]_0$

$k = 2.303/t \log R_0/R$

$= 2.303/t \log R_0/[R]_0 - 0.999\ R_0$

$= 2.303/t \log 10^3 t$

$= 6.909/k$

For half life of the reaction $t_{1/2} = 0.693/k$ $t/t_{1/2} = 6.909/0.693 = 10$

Q2. The rate constants of a reaction at 500K and 700K are $0.02s^{-1}$ and $0.07s^{-1}$ respectively. Calculate the values of E_a and A.

Ans $\text{Log}k_2/k_1 = E_a/2.303R \log[T_2 - T_1/T_2 \times T_1]$

Log 0.07/0.02 $= E_a/2.303X8.314X \log[700 \cdot 500/700X500]$

$E_a = 18230.8J$

$\log k = \log A - E_a/2.303RT$

$\log 0.02 = \log A - 18230.8/20303X8.314X500$, $A = 1.61$

Q3. A first order reaction takes 40 min for 30% decomposition. Calculate $t_{1/2}$.

Ans. Given t =40min, $[R]_0$ = 100, [R]=100□30=70

$k = 2.303/t \log R_0/R$

$= 2.303/40 \log 100/70$

$= 0.0575(\log 100 \cdot \log 70)$

$= 0.0575(2 \cdot 1.8451)$

$= 0.00890 min^{-1}$

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

$= 0.693/0.00890$

$= 77.86 min$

Q4. The decomposition of hydrocarbon follows the equation $k = (4.5 \times 10^{11} s^{-1})\ e^{-28000K/T,}$ Calculate E_a.

Experiment	[A]/mol L^{-1}	[B]/mol L^{-1}	Initial rate of formation/
			mol$L^{-1}s^{-1}$
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}
Determine i) the rate law ii) order of reaction and iii) the rate constant for the reaction.			

Ans. Let the rate law is $Rate = K[A]^x[B]^y$

Hence, $6.0 \times 10^{-3} = K[0.1]^x[0.1]^y$ .....i..i

i

$7.2 \times 10^{-2} = K[0.3]^x[0.2]^y$ ii

$2.88 \times 10^{-1} = K[0.3]^x[0.4]^y$ iii

$2.40 \times 10^{-2} = K[0.4]^x[0.1]^y$ iv

On dividing eq. (i) by eq. (iv), $1/4 = [1/4]^x$, X=1 on dividing eq. (ii) by eq. (iii) $1/4 = [1/2]^y$, $[1/2]^2 = [1/2]^y$, y=2

Therefore,

i) the rate law is $Rate = K[A]^1\ [B]^2$

ii) order of reaction = X + Y =1+2 = 3

iii) rate constant for the reaction K = $Rate/[A]^1 [B]^2$

$= 6.0 \times 10^{-3} / [0.1]^1 [0.1]^2$

$= 6.0\ mol^{-2}L^2s^{-1}$.

MCQ

1. The role of a catalyst is to change_____.
   (i) Gibbs energy of reaction. (ii) Enthalpy of reaction.
   (iii) Activation energy of reaction. (iv) Equilibrium constant.
2. In the presence of a catalyst, the heat evolved or absorbed during the reaction_____.
   (i) Increases. (ii) Decreases. (iii) Remains unchanged. (iv) May increase or decrease
3. Which of the following statements is not correct about order of a reaction.
   (i) The order of a reaction can be a fractional number.
   (ii)Order of a reaction is experimentally determined quantity.
   (iii)The order of a reaction is always equal to the sum of the stoichiometric coefficients of reactants in the balanced chemical equation for a reaction.
   (iv)The order of a reaction is the sum of the powers of molar concentration of the reactants in the rate law expression.
4. Which of the following statements is correct?
   (i) The rate of a reaction decreases with passage of time as the concentration of reactants decreases.
   (ii) The rate of a reaction is same at any time during the reaction.
   (iii) The rate of a reaction is independent of temperature change.
   (iv) The rate of a reaction decreases with increase in concentration of reactant(s).
5. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion?
   (i) 1.26×10^{15} s (ii) 2.52×10^{14} s (iii) 2.52×10^{28} s (iv) infinite
6. Rate law for the reaction A + 2B ⟶ C is found to be Rate = k [A][B]. Concentration of reactant'B' is doubled, keeping the concentration of 'A' constant, the value of rate constant will be_____.
   (i) the same (ii) doubled (iii) quadrupled (iv) halved
7. Which of the following statements is incorrect about the collision theory of chemical reaction?
   (i) It considers reacting molecules or atoms to be hard spheres and ignores their structural features.
   (ii)Number of effective collision determines the rate of reaction.
   (iii) Collision of atoms or molecules possessing sufficient threshold energy results into the product formation.
   (iv) Molecules should collide with sufficient threshold energy and proper orientation for the collision to be effective
8. Which of the following statements are applicable to a balanced chemical equation of an elementary reaction?
   (i) Order is same as molecularity. (ii) Order is less than the molecularity.
   (iii) Order is greater than the molecularity. (iv) Molecularity can never be zero.
9. In any unimolecular reaction_____.
   (i) only one reacting species is involved in the rate determining step.
   (ii) the order and the molecularity of slowest step are equal to one.
   (iii) the molecularity of the reaction is one and order is zero.
   (iv) both molecularity and order of the reaction are one.
10. For a complex reaction_____.
   (i) order of overall reaction is same as molecularity of the slowest step.
   (ii) order of overall reaction is less than the molecularity of the slowest step.
   (iii) order of overall reaction is greater than molecularity of the slowest step.
   (iv) molecularity of the slowest step is never zero or non integer.

ANSWER KEY:1.(iii) 2.(iii) 3.(iii) 4.(i) 5.(ii) 6.(iii) 7.(iii) 8.(i),(iv) 9.(i),(ii) 10.(i),(iv)

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