CBSE Test Paper-05

Class - 12 Chemistry (Chemical Kinetics)

1. E_a for the reaction is $1.18 \times 10^5 J/mol$. The slope of the graph of log k vs. 1/T is
   a. -672.1
   b. -6162
   c. -6721
   d. -1036
2. Which among the following statement is not true for rate constant of a reaction?
   a. Unit of rate constant depend upon the order of reaction
   b. Rate constant depend upon the concentration of the reactants
   c. Rate constant has a definite value at a particular temperature
   d. Rate constant changes with temperature
3. If the reaction 2 A + 3 D $\rightarrow$ product is first order in A and second order in D, then the rate law will have the form: rate =
   a. rate = k[A][D]^2
   b. K [A] [D]
   c. K[A]^2[D]^2
   d. K[A]^2[D]
4. In the catalyzed decomposition of benzene diazonium chloride,

   Half life period is found to be independent of the initial concentration of the reactant. After 10 min, the volume of N_2 gas collected is 10 L and after the reaction is complete, it is 50 L. Hence, the rate constant of the reaction(in min^{-1}) is
   a. $\frac{2.303}{t}\log\frac{50}{10}$
   b. $\frac{2.303}{t}\log\frac{10}{50}$
   c. $\frac{2.303}{10}\log\frac{50}{50-10}$
   d. $\frac{2.303}{t}\log\frac{50}{50-10}$
5. The half life of a reaction is halved as the initial concentration of the reactant is doubled. The order of the reaction is

a. 1
b. 0
c. 2
d. 3

6. What are the units of rate of a reaction?

7. Define order of reaction.

8. Is rate of reaction always constant?

9. Write the integrated rate equation for-
   i. zero order reaction.
   ii. first order reaction.
10. Define the terms -
   i. Order of a reaction
   ii. Molecularity of a reaction.
11. Consider a reaction which is first order in A and second order in B. Then
   i. Write the differential rate equation.
   ii. How is the rate affected on increasing the concentration of B three times?
   iii. How is the rate affected when the concentration of both A and B are doubled?

12. 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 295 K to 305 K, what would be the activation energy for this reaction? $\left(R = 8.314 Jk^{-1} mol^{-1}\right)$

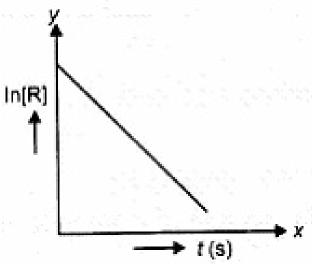
13. What is the rate constant? On what factors it depend?

14. For the decomposition of azoisopropane to hexane and nitrogen at 543 K, the following data are obtained.

t(sec)	P(mm of Hg)
0	35.0
360	54.0
720	63.0

Calculate the rate constant.

15. For a certain chemical reaction variation in the concentration in [R] Vs time (S) plot is given below:



For this reaction write / draw :

i. What is the order of the reactions?

ii. What are the units of rate constant k?

iii. Give the relationship between K and $t_{1/2}$ (half life period)

iv. What does the slope of above line indicate?

v. Draw the plot log $[R_0]$ / $[R]$ Vs time (S)

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Solutions

1. b. -6162

   Explanation: $lnK = lnA - \frac{Ea}{RT}$

   on comparing with y=mx+c

   graph between logK and 1/T is a straight line with negative slope.

   $slope = -\frac{E_a}{2.303R}$

   $slope = -\frac{1.18\times10^5}{2.303\times8.314}$

   slope = -6162.8

2. b. Rate constant depend upon the concentration of the reactants

   Explanation: Rate constant is independent of concentration of reactant for a particular reaction.

3. a. rate = k[A][D]^2

   Explanation: since rate of reaction is first order wrt A reactant and second order wrt d reactant, therefore:

   $rate = \ k[A][D]^2$

4. c. $\frac{2.303}{10}\log\frac{50}{50-10}$

   Explanation: it follows the 1st order reaction,hence

   $k = \ \frac{2.303}{t}\log\frac{a_\circ}{a_\circ - x} \ = \frac{2.303}{10}\log\frac{50}{50-10}$

5. c. 2

   Explanation: For second order reaction, half life is inversely related to concentration of reactant.

   $t_{1/2}$ for second order reaction $\alpha \frac{1}{[R]}$

6. The units of rate of a reaction are mol L^{-1} s^{-1}. In gaseous reaction the unit of rate of reaction is atm s^{-1}.
7. Order of reaction is the sum of exponents of the concentration of reactant in experimentally determined rate law expression. It can be 0, 1,2, 3 and even fractional. For example:

Rate = k $[A]^2$ $[B]^1$

so, order of reaction is 2+1 = 3

8. No, the rate of a reaction is not always constant. It depends on factors such as concentration, temperature etc.
9. i. Zero order reaction $k{=}\frac{[R_0]-[R]}{t}$

   ii. First order reaction $k = \frac{2.303}{t}\log\frac{[R_0]}{[R]}$

   Where R_0 is the initial concentration, and R is concentration at time t.
10. i. Order of a reaction: the sum of powers of the concentration of the reactants in the rate law expression is called order of that reaction. It can be zero, fraction or integer. For example:

    Rate = k $[A]^x$ $[B]^y$, then order of reaction = x+y

    ii. Molecularity of a reaction: The number of reacting species which must collide simultaneously in order to bring about a chemical reaction is called molecularity of a reaction. It is always an integer.
11. i. As the rate is first order in A and second order in B, so the differential rate equation is given as

    $Rate = \frac{dx}{dt} = k\,[A]\,[B]^2$

    where k=rate constant

    ii. If concentration of B is increased three times

    $Rate' = \frac{dx}{dt} = k\,[A]\,[3B]^2 = 9k[A][B]^2 = 9Rate$

    So the rate will increase to 9 times the original rate.

    iii. When concentration of both A and B are doubled,

    $Rate'' = \frac{dx}{dt} = k\,[2A]\,[2B]^2 = 8k[A][B]^2 = 8Rate$

    So the rate will increase to 8 times the original rate.
12. $T_1 = 295K,\ T_2 = 305K$

    $Ea = 2.303R\,\left[\frac{T_2T_1}{T_2-T_1}\right]\,\left[\log\frac{k_2}{k_1}\right], where k_2 = 2k_1$

    $E_a = 2.303 \times 8.314 \times \left[\frac{305\times295}{305-295}\right]\log\frac{2k_1}{k_1}$

    $= 2.303 \times 8.314 \times 8997.5\,log2 = 51855.2J/mol$
13. Rate constant is equal to rate of the reaction when concentration of each of the reactants is unity. Thus rate constant is also known as specific reaction rate.

    Suppose A and B are two reactants in a reaction. The rate depends on concentration of

$[A]^x$ and $[B]^y$, then rate equation is

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

where k is called the rate constant or specification rate.

The value of rate constant k is independent of concentration of the reactant but it dependent upon the (i) Temperature, (ii) Nature of Reactant, (iii) Presence of catalyst.

14. The decomposition of azoisopropane to hexane and nitrogen at 543 K is represented as:

$$\underset{\substack{At\ t=0\\At\ t=t}}{}(CH_3)_2CHN=NCH(CH_3)_{2(g)} \rightarrow N_{2(g)} + C_6H_{14(g)}$$

$$\begin{array}{lccc} & P_0 & 0 & 0 \\ & P_0-p & p & p \end{array}$$

After time, t, total pressure, $P_t = (P_0 - p) + p + p$

$P_t = P_0 + p$

$p = P_t - P_0$

Therefore, $P_0 - p = P_0 - (P_t - P_0) = 2P_0 - P_t$

For a first order reaction,

$k = \frac{2.303}{t} \log \frac{P_0}{P_0 - p}$

$= \frac{2.303}{t} \log \frac{P_0}{2P_0 - P_t}$

When t = 360 s, $k = \frac{2.303}{360\ s} \log \frac{35.0}{2 \times 35.0 - 54.0}$

$= 2.175 \times 10^{-3} s^{-1}$

When t = 720 s, $k = \frac{2.303}{720\ s} \log \frac{35.0}{2 \times 35.0 - 63.0} = 2.235 \times 10^{-3} s^{-1}$

Hence, the average value of rate constant is

$k = \frac{(2.175 \times 10^{-3}) + (2.235 \times 10^{-3})}{2} s^{-1}$

$= 2.21 \times 10^{-3} s^{-1}$

15. i. First order because the formula for first order is ln[R]= -kt + ln$[R_0]$; y= mx + c slope= -k

ii. $time^{-1}\left(s^{-1}\right)$

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

iv. Rate constant k of reactions

v.