QB365 Question Bank Software

12th Chemistry CBSE Case Study Questions Chemical Kinetics For - 2024

12th Standard

Chemistry

SECTION-A 2 x 4 = 8

1) **Read the passage given below and answer the following questions :**

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 x 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) 3/2 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

Answer : (i) (c) : Unit of k for nth order = $(mol\ L^{-1})^{1-n}$ sec^{-1}.

Here,k = 3 x 10^{-3} mol^{-2} L^2 sec^{-1} ...(i)

Unit of $k = mol^{-2}L^2\sec^{-1} \Rightarrow \left(molL^{-1}\right)^{-2}\sec^{-1}$ ...(ii)

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

(ii) (c) : $\text{Rate} = -\frac{d[A]}{dt} = -\frac{1}{3}\frac{d[B]}{dt} = \frac{1}{2}\frac{d[C]}{dt}$

(iii) (c) : Given $R_1 = k[A]^2$ [B]

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

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

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

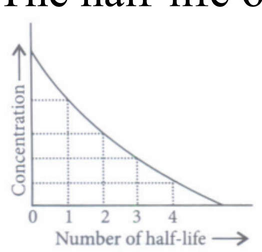
When pH = 3 ; $[H^+] = 10^{-3}$ and when pH = 1 ; $[H^+] = 10^{-1}$.

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

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

2) **Read the passage given below and answer the following questions :**

The half-life of a reaction is the time required for the concentration of reactant to decrease by half, i.e.,



$[A]_t = \frac{1}{2}[A]$

For first order reaction,

$t_{1/2} = \frac{0.693}{k}$ this means $t_{1/2}$ is independent of initial concentration. Figure shows that typical variation of concentration of reactant exhibiting first order kinetics. It may be noted that though the major portion of the first order kinetics may be over in a finite time, but the reaction will never cease as the concentration of reactant will be zero only at infinite time

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

(i) A first order reaction has a rate constant k = 3.01 x 10^{-3} is. How long it will take to decompose half of the reactant?

(a) 2.303 s (b) 23.03 s (c) 230.3 s (d) 2303 s

(ii) The rate constant for a first order reaction is 7.0x 10^{-4} s^{-1}. If initial concentration of reactant is 0.080 M, what is the half life of reaction?

(a) 990 s (b) 79.2 s (c) 12375 s (d) 10.10 x 10^{-4} s

(iii) For the half-life period of a first order reaction, which one of the following statements is generally false?

(a) It is independent of initial concentration. **(b) It is independent of temperature.**

(c) It decreases with the introduction of a catalyst **(d) None of these**

(iv) The rate of a first order reaction is 0.04 mol L^{-1} s^{-1} at 10 minutes and 0.03 mol L^{-1} s^{-1} at 20 minutes after initiation. The half-life of the reaction is

(a) 4.408 min (b) 44.086 min (c) 24.086 min (d) 2.408 min

Answer : (i) (c) : For a first order reaction :

$$t_{1/2} = \frac{0.693}{k}, k = 3.01 \times 10^{-3}\ \mathrm{s}^{-1}$$

$$\therefore \quad t_{1/2} = \frac{0.693}{3.01 \times 10^{-3}} = 230.3\ \mathrm{s}$$

(ii) (a) : Half life (1/2) of a first order reaction is given as :

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{7.0 \times 10^{-4}} = 990\ \mathrm{s}$$

(iii) (b) : For a first order reaction $t_{1/2} = \frac{0.693}{k}$ therefore $t_{1/2}$ depends upon k and hence depends on temperature because rate constant k is a function of temperature.

(iv) (c) : Let the concentrations of the reactant after 10 min and 20 min be C_1 and C_2 respectively.

Rate after 10 min = k,C_2

= 0.03 x 60 mol L^{-1} min^{-1}

$\therefore \frac{C_1}{C_2} = \frac{4}{3}$

Let the reaction starts after 10 minutes.

$$k = \frac{2.303}{10} \log \frac{C_1}{C_2} = \frac{2.303}{10} \log \frac{4}{3} = 0.02878$$

$$\therefore \quad t_{1/2} = \frac{0.6932}{k} = \frac{0.6932}{0.02878} = 24.086\ \mathrm{min}$$