QB365 Question Bank Software Study Materials

Chemical Kinetics Important 2 Marks Questions With Answers (Book Back and Creative)

12th Standard

Chemistry

Total Marks : 40

2 Marks

20 x 2 = 40

1) Write the rate law for the following reactions.

(a) A reaction that is 3/2 order in x and zero order in y.

(b) A reaction that is second order in NO and first order in Br_2.

Answer : (a) Rate = $k[x]^{3/2}[y]^0 = k[x]^{3/2}$

(b) $2NO + Br_2 \longrightarrow 2NOBr$

Rate = $k[NO]^2[Br_2]$

2) For a reaction x + y + z$\longrightarrow$ products the rate law is given by rate =$k[x]^{3/2}[y]^{1/2}$. What is the overall order of the reaction and what is the order of the reaction with respect to z.

Answer : Reaction rate = $k[x]^{3/2}[y]^{1/2}$

(i) Over all order of reaction = (3/2 + 1/2)=2

i.e., second order reaction.

(ii) Since the rate expression does not contain the concentration of z, the reaction is zero order with respect to z.

3) The decomposition of Cl_2O_7 at 500K in the gas phase to Cl_2 and O_2 is a first order reaction. After 1 minute at 500K, the pressure of Cl_2O_7 falls from 0.08 to 0.04 atm. Calculate the rate constant in s^{-1}

Answer : For the first order reaction

$k = \frac{2.303}{t}\log\frac{A_o}{A}$ (or)

$k = \frac{2.303}{t}\log\frac{P_o}{P_t}$

Here, P_o=0.08 atm (P_t)=0.04 atm; t = 60 s

$k = \frac{2.303}{60}\log\frac{[0.08]}{[0.04]}$

$= 0.0383 \times \log 2$

$= 0.0383 \times 0.3010$

$= 1.152 \times 10^{-2}\ s^{-1}$

4) Identify the order for the following reactions

(i) Rusting of Iron

(ii) Radioactive disintegration of $_{92}U^{238}$

(iii) 2A+3B$\longrightarrow$ products ;rate = $k[A]^{1/2}[B]^2$

Answer : (i) First order reaction

(ii) First order reaction

(iii) $\frac{1}{2} + 2 = 2\frac{1}{2}$; Pseudo first order reaction

5) A gas phase reaction has energy of activation 200 kJ mol^{-1}. If the frequency factor of the reaction is 1.6 x $10^{13}s^{-1}$. Calculate the rate constant at 600 K.($e^{-40.09}$ = 3.8 x 10^{-48})

Answer : Ea = 200 kJ mol^{-1}=200 $\times$ 10^3J mol^{-1}

A = 1.6 $\times$ $10^{13}s^{-1}$; T = 600 K; R = 8.314 JK mol^{-1}

$k = Ae^{-\left(\frac{Ea}{RT}\right)}$

$k = 1.6 \times 10^{13}\, s^{-1} e^{-\left(\frac{200\times10^3}{8.314\times600}\right)}$

$k = 1.6 \times 10^{13}\, s^{-1} e^{-(40.09)}$

$k = 1.6 \times 10^{13} \times 3.8 \times 10^{-18} s^{-1}$

$k = 6.08 \times 10^{-5} s^{-1}$

6) The rate constant for a first order reaction is 1.54 x 10^{-3} s^{-1}. Calculate its half life time.

Answer : K = 1.54 × $10^{-3}s^{-1}$; $t_{1/2}$ = ?

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

$= \frac{0.693}{1.54\times10^{-3}}$

= 450 s

7) A zero order reaction is 20% complete in 20 minutes. Calculate the value of the rate constant. In what time will the reaction be 80% complete?

Answer : (i) Let A = 100M, $[A_0]$ - [A] = 20M,

For the zero order reaction

$k = \left(\frac{[A_0]-[A]}{t}\right)$

(i) 20% completion $k = \left(\frac{20M}{20min}\right)$ = 1 mol L^{-1} min^{-1}

(ii) 80% completion

$\mathrm{K = 1\ mol\ L^{-1}\ s^{-1}; [A_0] = 100M; [A_0] - [A] = 80M; t =?}$

$\therefore t = \left(\frac{[A_O]-[A]}{K}\right) = \frac{80}{1} = 80\mathrm{mins}$

8) The activation energy of a reaction is 22.5 k Cal mol^{-1} and the value of rate constant at 40°C is 1.8 x $10^{-5}s^{-1}$. Calculate the frequency factor, A.

Answer : $\mathrm{k = Ae^{-E_a/RT}}$

$\mathrm{\log k = \frac{-E_a}{2.303RT} + \log A\ (or)\ \log A = \log k + \frac{E_a}{2.303RT}}$

$\mathrm{k = 1.8\times10^{-5}\ s^{-1};}$

$\mathrm{Ea = 22.5kCalmol^{-1} = 22500Calmol^{-1}}$

$\log A = \log\left(1.8\times10^{-5}\right) + \frac{22500}{2.303\times1.987\times313}$

$= \log 1.8 - 5\log 10 + 15.71$

$= 0.2553 - 5 + 15.71$

$\log A = 10.9653$

$A =$ Antilog 10.9653

$= 9.232\times10^{10}$ collisions s^{-1}.

9) Consider the oxidation of nitric oxide to form NO_2

$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

(a). Express the rate of the reaction in terms of changes in the concentration of NO,O_2 and NO_2.

(b). At a particular instant, when $[O_2]$ is decreasing at 0.2 mol $L^{-1}s^{-1}$ at what rate is $[NO_2]$ increasing at that instant?

Answer : a) $Rate = \frac{-1}{2}\frac{d[NO]}{dt} = \frac{-d[O_2]}{dt} = \frac{1}{2}\frac{d[NO_2]}{dt}$

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

$\frac{d[NO_2]}{dt} = 2\times\left(\frac{-d[O_2]}{dt}\right) = 2\times0.2\ mol\ L^{-1}s^{-1}$

= 0.4 mol $L^{-1}s^{-1}$

10) The rate of the reaction X + 2y→ product is 4 x 10^{-3} mol $L^{-1}S^{-1}$, if [X] = [Y] = 0.2M and rate constant at 400K is 2 x $10^{-2}s^{-1}$, What is the overall order of the reaction.

Answer : Rate = $K[X]^n[y]^m$

4 x 10^{-3} mol $L^{-1}s^{-1}$= 2 x $10^{-2}s^{-1}(0.2mol\ L^{-1})^n(0.2mol\ L^{-1})^m$

$\frac{4\times10^{-3}mol\quad L^{-1}s^{-1}}{2\times10^{-2}s^{-1}} = (0.2)^{n+m}(\mathrm{mol\ L^{-1}})^{n+m}$

$0.2(\mathrm{mol\ L^{-1}}) = (0.2)^{n+m}(\mathrm{mol\ L^{-1}})^{n+m}$

Comparing the powers on both sides

The overall order of the reaction n + m = 1

11) Rate of chemical reaction is not uniform throughout. Justify you answer:

Answer : Rate of a reaction at any time depends on the concentration of the reactants which keeps on decreasing with time.

12) $H_{2(g)} + Cl_{2(g)} \xrightarrow{h\nu} 2HCl(g)$. The reaction proceeds with a uniform rate throughout. What do you conclude?

Answer : The reaction is a zero order reaction whose rate is independent on the concentration of reactants.

13) Why is instantaneous rate preferred over average rate?

Answer : Rate decreases with time as the reaction proceeds and the average rate cannot be used to predict the rate of the reaction at any instant. The rate of the reaction, at a particular instant during the reaction is called the instantaneous rate. So instantaneous rate in prepared over average rate.

14) The decomposition reaction of ammonia gas on platinum surface has a rate constant R = 2.5 x 10^{-4}mol L^{-1}. What is the order of the reaction.

Answer : The order of the reaction is zero.

15) Write the units of zeroth, first, second and third order rate constants.

Answer :

NO.	ORDER	UNIT OF K
1.	0	mol lit^{-1} s^{-1}
2.	1	s^{-1}
3.	2	mol^{-1} lit s^{-1}
4.	3	mol^{-2} lit^2 s^{-1}

16) A first order reaction has a specific reaction rate of 10^{-3} S^{-1}. How much time will it take for 10gm of the reactant to reduce to 2.5 gm?

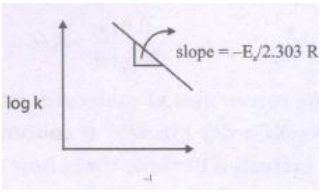
Answer : $k = 2.303 \log \frac{[A_0]}{[A]}$

$t = \frac{2.303}{10^{-3}} \log \frac{10}{2.5}$

t = 2303 x 0.301 x 2 = 1386 s.

17) Explain how will you find activation energy of a reaction by graphical method.

Answer : A plot of log k against $\frac{1}{T}$ values gives a straight line with slope value equal to - E_a/ 2.303R and intercept value equals to log A.



(ii) The plot gives a negative slope straight line also.

(iii) From the slope of straight line, E_a can be calculated.

18) What are the factors affecting rate of reaction?

Answer : (i) Nature and state of the reactant

(ii) Temperature of the reaction

(iii) Concentration of the reactant

(iv) Presence of a catalyst

(v) Surface area of the reactant

19) Define Activation energy.

Answer : (i) Activation energy is defined as the colloiding molocules must possess a minimum energy to lead the reaction.

(ii) Activation energy = [Threshold energy] - [Average energy of the reactant molecules]

20) What is a photochemical reactions? Give an example.

Answer : The reactions which complete in presence of light are called photo chemical reactions.

(a) $H_2 + Cl_2 \xrightarrow{hv} 2HCl$

(b) Photo synthesis

$6CO_2 + 12H_2O \xrightarrow{hv} C_6H_{12}O_6 + 6O_2$