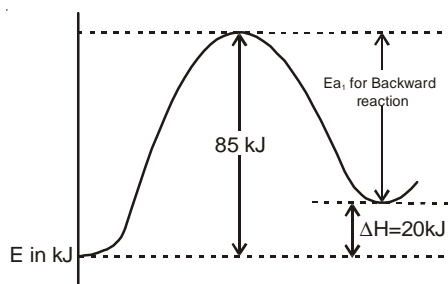


# Solved Example

**Ex.1** For  $A + B \rightarrow C + D$ ;  $\Delta H = 20 \text{ kJ mol}^{-1}$ ; the activation energy of the forward reaction is  $85 \text{ kJ/mol}$ . Calculate activation energy of the reverse reaction.

**Sol.**



$\Delta H$  of forward reaction =  $20 \text{ kJ mol}^{-1}$ .

Energy of activation for forward reaction ( $E_a$ ) =  $85 \text{ kJ mol}^{-1}$

$$\begin{aligned} \therefore \text{Energy of activation for backward reaction} &= E_a - \Delta H \\ &= 85 - 20 \\ &= \mathbf{65 \text{ kJ mol}^{-1}} \end{aligned}$$

**Ex.2**  $\text{N}_2\text{O}_5$  decomposes according to equation,  $\text{N}_2\text{O}_5 \rightarrow 2\text{NO}_2 + \frac{1}{2}\text{O}_2$

(a) What does  $\frac{-d[\text{N}_2\text{O}_5]}{dt}$  denote ?

(b) What does  $\frac{d[\text{O}_2]}{dt}$  denote ?

(c) What is the units of rate of this reaction ?

**Sol.** (a) Rate of decomposition of  $\text{N}_2\text{O}_5$ .

(b) Rate of formation of  $\text{O}_2$ .

(c) Unit of rate =  $\text{mol litre}^{-1} \text{ time}^{-1}$ .

**Ex.3** In a reaction,  $2A \rightarrow \text{Products}$ , the concentration of A decreases from  $0.5 \text{ mol litre}^{-1}$  to  $0.4 \text{ mol litre}^{-1}$  in 10 minute. Calculate rate during this interval.

**Sol.** Rate of reaction =  $\frac{1}{2} \times$  rate of disappearance of A

$$= \frac{1}{2} \left( -\frac{d[A]}{dt} \right) = \frac{1}{2} \left[ \frac{0.5 - 0.4}{10} \right] = \mathbf{0.005 \text{ mol litre}^{-1} \text{ minute}^{-1}}$$

**Ex.4** For a reaction  $3A \rightarrow \text{Products}$ , it is found that the rate of reaction doubles if concentration of A is increased of A is increased four times, calculate order of reaction.

**Sol.** Rate =  $K [\text{Reactant}]^n$                       if  $[\text{Reactant}] = a$ ;                      rate =  $r_1$   
 $r_1 = K[a]^n$     if  $[\text{Reactant}] = 4a$ ;                      rate =  $2r_1$   
 $2r_1 = K[4a]^n$

$$\therefore \frac{1}{2} = \left[ \frac{1}{4} \right]^n \quad \therefore n = \frac{1}{2}$$

**Ex.5** In a reaction, the decreases in reactant's concentration is 20% in 20 minute and 40% in 40 minute. Calculate order of reaction and rate constant.

**Sol.** For zero order reaction :  $t = \frac{x}{K}$  or  $K = \frac{x}{t}$

If  $t = t_{20\%} = 20$  minute,  $x = 20$

Then  $K = \frac{20}{20} = 1 \text{ mol litre}^{-1} \text{ time}^{-1}$

If  $t = t_{40\%} = 40$  minute,  $x = 40$

Then  $K = \frac{40}{40} = 1 \text{ mol litre}^{-1} \text{ time}^{-1}$  ; Thus, reaction is of zero order.

**Ex.6** Calculate the order of reaction for which rate becomes half if volume of container having same amount of reactant is doubled. (Assume gaseous phase reaction)

**Sol.** Rate =  $K[a]^n$

**For Case I :** Let a mole of reactant in vessel of V litre

$$\therefore r_1 = K \left[ \frac{a}{V} \right]^n \quad \dots(1)$$

**For Case II :** The volume is doubled, rate becomes half

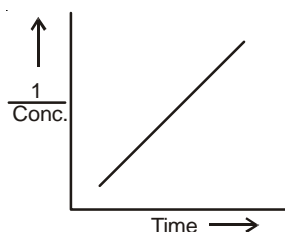
$$\therefore \frac{r_1}{2} = K \left[ \frac{a}{2V} \right]^n \quad \dots(2)$$

$\therefore$  By Eqs. (1) and (2),

$$\text{or} \quad 2 = (2)^n$$

$$\therefore n = 1$$

**Ex.7** In the decomposition of  $N_2O_5$ , the plot between the reciprocal of concentration of the reactant and the time was found to be linear as shown in figure. Determine the order of reaction.



**Sol.** The reaction is of second order, because for II order,

$$K = \frac{1}{t} \cdot \frac{x}{a(a-x)} \quad \text{or} \quad t = \frac{1}{K} \cdot \frac{x}{a(a-x)}$$

or time (t) vs.  $\frac{1}{\text{conc.}}$  graph is linear

**Ex.8** A first order reaction takes 69.3 minute for 50% completion. How much time will be needed for 80% completion ?

**Sol.**  $\therefore K = \frac{0.693}{t_{1/2}} = \frac{0.693}{69.3} \text{ minute}^{-1}$  ( $\because t_{1/2} = 69.3 \text{ min}$ )

Now  $K = \frac{2.303}{t} \log_{10} \frac{100}{20}$  ;  $K = \frac{2.303}{t} \log \frac{100}{100-x}$  [if  $a = 100$ ,  $x = 80$  and  $a - x = 20$ ]

$$\frac{0.693}{69.3} = \frac{2.303}{t} \log_{10} 5 \quad ; \quad t = 160.97 \text{ minute}$$

**Ex.9** Show that for a first order reaction, time required for 99% completion is twice for the time required for the completion of 90% of the reaction.

**Sol.**  $t_{99\%} = \frac{2.303}{K} \log_{10} \frac{100}{100-99}$  .....(1)

( $\because a = 100$ ;  $x = 99$ )

$$t_{90\%} = \frac{2.303}{K} \log_{10} \frac{100}{100-90}$$
 ..... (2)

( $\because a = 100$ ;  $x = 90$ )

$\therefore$  By Eqs. (1) and (2),

$$\frac{t_{99\%}}{t_{90\%}} = \frac{\log_{10} 100}{\log_{10} 10} = 2$$

$\therefore t_{99\%} = 2 \times t_{90\%}$

**Ex.10** For the non-equilibrium process,  $A + B \rightarrow \text{Products}$ , the rate is first order with respect to A and second order with respect to B. If 1.0 mol each of A and B are introduced into a 1 litre vessel, and the initial rate were  $1.0 \times 10^{-2}$  mol/litre-sec, calculate the rate when half of the reactants have been used.

**Sol.**  $\text{Rate}_I = K [A] [B]^2$

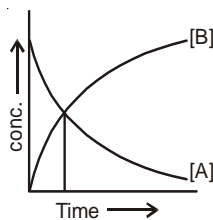
$\therefore 10^{-2} = K [1] [1]^2$

or  $K = 10^{-2} \text{ litre}^2 \text{ mol}^{-2} \text{ sec}^{-1}$

Now  $\text{Rate}_{II} = 10^{-2} \times 0.5 \times (0.5)^2$

or  $\text{New rate} = 1.2 \times 10^{-3} \text{ mol/litre-sec}$

**Ex.11** The accompanying figure depicts the change in concentration of species A and B for the reaction  $A \rightarrow B$ , as a function of time the point of inter section of the two curves represents.



[1]  $t_{1/2}$

[2]  $t_{3/4}$

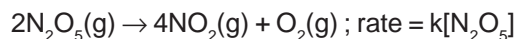
[3]  $t_{2/3}$

[4] data insufficient to predict

**Sol.** The intersection point indicates that half life of the reactant A is converted into B.

Hence the answer is [1].

**Ex.12** The first order decomposition reaction of  $N_2O_5$  are written as :



Which of the following fact is true ?

- [1]  $k = k'$                       [2]  $k > k'$                       [3]  $k > 2k'$                       [4]  $2k = k'$

**Sol.** Since the concentration in the first reaction is more therefore the rate of reaction would be more.

Hence the answer is [4].

**Ex.13** The half life period  $t_{1/2}$  is independent of initial concentration of reactant when the order of reaction is

- [1] Negative                      [2] 0                      [3] 1                      [4] Fractional

**Sol.**  $t_{1/2}$  of a reaction of an order  $n$  is related to initial concentration by the expression

$$t_{1/2} \propto \frac{1}{C_0^{n-1}} \quad (\text{Here, } n = \text{order of reaction})$$

for  $n = 1$ ,  $t_{1/2}$  is independent of concentration term. Hence the answer is [3].

**Ex.14** The chemical reaction,  $2O_3 \rightarrow 3O_2$  proceeds as follows :



The rate law expression should be

- [1]  $r = K[O_3]^2$                       [2]  $r = K[O_3]^2 [O_2]^{-1}$                       [3]  $r = K[O_3][O_2]$                       [4] Unpredictable

**Sol.** Rate of reaction  $(r) = k [O] [O_3]$

The rate of formation if  $[O]$  depends on first step

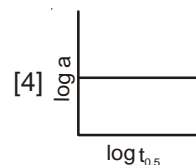
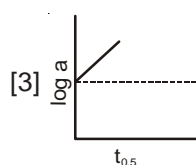
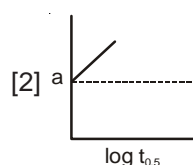
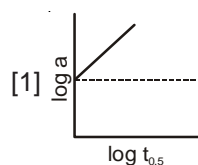
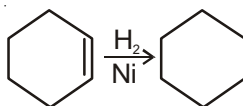
$$\therefore \text{Since } K_{eq} = \frac{[O_2][O]}{[O_3]}$$

$$\therefore [O] = K_{eq} \frac{[O_3]}{[O_2]}$$

$$\text{or } r = r \cdot K_{eq} \frac{[O_3][O_3]}{[O_2]} = K \cdot [O_3]^2 [O_2]^{-1}$$

**Ans (2)**

**Ex.15** Which of the following is correct graph for the reaction ?



**Sol.** As the reaction occurs in the presence of a catalyst and hydrogen gas absorbs on the surface of Nickel, therefore it is a zero order reaction. Hence the answer is [1].

**Ex.16** For a reaction  $A \xrightarrow{k_1} B \xrightarrow{k_2} C$ . If the reactions are of 1st order then  $\frac{d[B]}{dt}$  is equal to

- [1]  $-k_2[B]$                       [2]  $+k[A]$                       [3]  $k_1[A] - k_2[B]$                       [4]  $k_1[A] + k_2[B]$

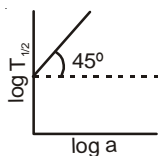
**Sol.** Rate of increase in  $[B] = k_1[A]$

Similarly rate of decrease in  $[B] = k_2[B]$

Thus, 
$$\frac{d[B]}{dt} = k_1[A] - k_2[B]$$

Hence the answer is [3]

**Ex.17** Following is the graph between  $\log T_{1/2}$  and  $\log a$  (a—initial concentration) for a given reaction at 27°C. Hence order is



- [1] 9                      [2] 1                      [3] 2                      [4] 3

**Sol.** See the plots as discussed in Important formulae.

Hence the answer is [3]

**Ex.18** Which curve represents zero order reaction ?

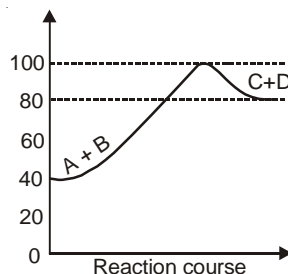


**Sol.** See various plot given in important formulae.

Hence the answer is [3].

**Ex.19** Find the activation energy [kJ/mol] for the reaction,  $A(g) + B(g) \rightarrow C(g) + D(g)$ .

From the plot given below :



- [1] 20                      [2] 60                      [3] 40                      [4] 80

**Sol.**  $E_{af} = 100 - 40 = 60 \text{ kJ mol}^{-1}$

Hence the answer is [2].

# Exercise # 1

- Q.1** Under a given set of experimental conditions, with increase in the concentration of the reactants the rate of a chemical reaction-
- [1] Decreases [2] Increases  
[3] Remains unaltered [4] First decreases and then increases.
- Q.2** The rate at which a substance reacts depends on its-
- [1] Atomic weight [2] Equivalent weight [3] Molecular weight [4] Active Mass
- Q.3** In a reaction involving the synthesis of ammonia by Haber's process,  
 $N_2 + 3H_2 \rightleftharpoons 2NH_3$ , the rate of reaction was measured as  $= 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$ . The rate of change of conc. of  $H_2$  will be
- [1]  $1.25 \times 10^{-4} \text{ mol L}^{-1} \text{ S}^{-1}$  [2]  $2.50 \times 10^{-4} \text{ mol L}^{-1} \text{ S}^{-1}$   
[3]  $7.5 \times 10^{-4} \text{ mol L}^{-1} \text{ S}^{-1}$  [4]  $5.0 \times 10^{-4} \text{ mol L}^{-1} \text{ S}^{-1}$
- Q.4** In the formation of sulphur trioxide by contact process,  $2SO_2 + O_2 \rightleftharpoons 2SO_3$ , the rate of reaction was measured as  $\frac{-d[O_2]}{dt} = 2.5 \times 10^{-4} \text{ mol lit}^{-1} \text{ sec}^{-1}$ . the rate of reaction expressed in terms of  $SO_3$  will be-
- [1]  $-1.25 \times 10^{-4} \text{ mol L}^{-2} \text{ sec}^{-1}$  [2]  $50 \times 10^{-4} \text{ mol L}^{-1} \text{ sec}^{-1}$   
[3]  $-3.75 \times 10^{-4} \text{ mol L}^{-1} \text{ sec}^{-1}$  [4]  $5.00 \times 10^{-4} \text{ mol L}^{-1} \text{ sec}^{-1}$
- Q.5** The rate constant of a reaction is equal to rate of reaction-
- [1] When concentrations of reactants do not change with time  
[2] When concentrations of all reactants and products are equal  
[3] At time,  $t = 0$   
[4] When concentrations of all reactants are unity
- Q.6** Which of the following is an unimolecular reaction ?
- [1]  $2HI \rightarrow H_2 + I_2$  [2]  $N_2O_5 \rightarrow N_2O_4 + \frac{1}{2} O_2$  [3]  $H_2 + Cl_2 \rightarrow 2HCl$  [4]  $PCl_3 + Cl_2 \rightarrow PCl_5$
- Q.7** If the surface area of the reactant is increased then the order of reaction :
- [1] Increases [2] Decreases  
[3] Remains unaffected [4] Sometimes increases and sometimes decreases
- Q.8** Which of the following is a first order reaction-
- [1]  $NH_4NO_2 \rightarrow N_2 + 2H_2O$  [2]  $2HI = H_2 + I_2$   
[3]  $2NO_2 \rightarrow 2NO + O_2$  [4]  $2NO + O_2 \rightarrow 2NO_2$
- Q.9** The hydrolysis of ethyl acetate is a reaction of -  $CH_3COOEt + H_2O \xrightarrow{H^+} CH_3COOH + EtOH$
- [1] First order [2] Third order [3] Second order [4] Zero order
- Q.10** For a chemical reaction  $2X + Y \rightarrow Z$ , the rate of appearance of Z is  $0.05 \text{ mol L}^{-1} \text{ per min}$ . The rate of disappearance of X will be :
- [1]  $0.05 \text{ mol L}^{-1} \text{ per hour}$  [2]  $0.05 \text{ mol L}^{-1} \text{ per min}$  [3]  $0.1 \text{ mol L}^{-1} \text{ min}^{-1}$  [4]  $0.25 \text{ mol L}^{-1} \text{ per min}$

- Q.11** For the reaction  $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$   
the rate of change of concentration for hydrogen is  $-0.3 \times 10^{-4} \text{ Ms}^{-1}$ . The rate of change of concentration of ammonia is :
- [1]  $-0.2 \times 10^{-4}$       [2]  $0.2 \times 10^{-4}$       [3]  $0.1 \times 10^{-4}$       [4]  $0.3 \times 10^{-4}$
- Q.12** The unit of rate constant for a zero order reaction is-
- [1] Litre  $\text{sec}^{-1}$       [2] Lit mole $^{-1}$   $\text{sec}^{-1}$       [3] Mol lit $^{-1}$   $\text{sec}^{-1}$       [4] Mol  $\text{sec}^{-1}$
- Q.13** A zero order reaction is one whose rate is independent of-
- [1] The temperature of the reaction      [2] The concentration of the reactants  
[3] Proasence of catalyst      [4] None of these
- Q.14** A reaction is represented by-
- $\text{A} \xrightarrow{\text{K}_1} \text{B}$  (slow) and  $\text{A} + \text{B} \xrightarrow{\text{K}_2} \text{C}$  (fast) where  $\text{K}_1$  and  $\text{K}_2$  and the rate constants of the mechanistic steps.  
The rate of production of C will be given by-
- [1]  $\text{K}_1[\text{A}][\text{B}]$       [2]  $\text{K}_1[\text{A}]$       [3]  $\text{K}_1\text{K}_2[\text{A}]$       [4]  $\text{K}_2[\text{A}][\text{B}]$
- Q.15** The rate law for the reaction :  $2\text{C} + \text{D} \rightarrow \text{A} + \text{E}$  is  $-\frac{d[\text{D}]}{dt} = k[\text{C}]^2[\text{D}]$   
If C is present in large excess, the order of the reaction will be-
- [1] Zero      [2] First      [3] Second      [4] Third
- Q.16** The rate of reaction between A and B increase by a factor of 100, when the concentration of A is increased 10 folds. The order of reaction with respect to A is-
- [1] 10      [2] 1      [3] 4      [4] 2
- Q.17** The half-life of a first order reaction  $\left[ \text{K} = \frac{2.303}{t} \log \left( \frac{a}{a-x} \right) \right]$  is-
- [1] Directly proportional to 'a'      [2] Inversely proportional to 'a'  
[3] Independent of 'a'      [4] Proportional to (a-x)
- Q.18** Which of the following statement is not correct for the reaction-  $4\text{A} + \text{B} \rightleftharpoons 2\text{C} + 2\text{D}$
- [1] The rate of disappearance of B is one fourth rate of disappearance of A  
[2] The rate of appearance of C is one half the rate of disappearance of B  
[3] The rate of formation of D is one half the rate of consumption of A  
[4] The rates of formation of C and D are equal.
- Q.19** The temperature coefficient of most of the reactions lies between-
- [1] 1 and 3      [2] 2 and 3      [3] 2 and 4      [4] 1 and 4
- Q.20** True statement is-
- [1] Positive catalyst increases the rate of a reaction  
[2] During the course of the reaction, specific reaction rate remains constant.  
[3] Rate constant always increases with rise in temperature whether the reaction is endothermic or exothermic  
[4] All are correct

- Q.21** The effect of temperature on the rate constant of a reaction is given by-
- [1] Arrhenius Equation [2] Nernst Equation  
[3] van't Hoff Equation [4] Gibbs' Helmholtz Equation
- Q.22** In a certain reaction 10% of the reactant decomposes in one hour, 20% in two hours, 30% in three hours and so on. Dimension of the velocity constant (rate constant) are-
- [1] Hour<sup>-1</sup> [2] Mol litre<sup>-1</sup>hour<sup>-1</sup> [3] Litre mol<sup>-1</sup> sec<sup>-1</sup> [4] Mol sec<sup>-1</sup>
- Q.23** In a reaction, the threshold energy is equal to-
- [1] Activation energy [2] Activation energy - normal energy of reactants  
[3] Activation energy + normal energy of reactants [4] Normal energy of reactants
- Q.24** The decomposition of H<sub>2</sub>O<sub>2</sub> can be followed by titration with KMnO<sub>4</sub> and is found to be a first order reaction. The rate constant is 4.5 × 10<sup>-2</sup>. In an experiment, the initial titre value was 25 ml. The titre value will be 5 ml after a lapse of-
- [1] 4.5 × 10<sup>-2</sup> × 5 minutes [2]  $\frac{\log_e 5}{4.5 \times 10^{-2}}$  minutes [3]  $\frac{\log_e 5/4}{4.5 \times 10^{-2}}$  [4] None of the above
- Q.25** The half-life of decomposition of N<sub>2</sub>O<sub>5</sub> is a first order reaction represented by-
- $$\text{N}_2\text{O}_5 \rightarrow \text{N}_2\text{O}_4 + 1/2\text{O}_2$$
- After 15 minutes the volume of O<sub>2</sub> produced is 9 ml and at the end of the reaction 35 ml. The rate constant is equal to-
- [1]  $\frac{1}{15} \log_e \frac{35}{26}$  [2]  $\frac{1}{15} \log_e \frac{44}{26}$  [3]  $\frac{1}{15} \log_e \frac{35}{36}$  [4] None of the foregoing
- Q.26** The rate constant of a reaction is 1.5 × 10<sup>-3</sup> at 25°C and 2.1 × 10<sup>-2</sup> at 60°C. The activation energy is-
- [1]  $\frac{35}{333} R \log_e \frac{2.1 \times 10^{-2}}{1.5 \times 10^{-3}}$  [2]  $\frac{298 \times 333}{35} R \log_e \frac{21}{1.5}$   
[3]  $\frac{298 \times 333}{35} R \log_e 2.1$  [4]  $\frac{298 \times 333}{35} R \log_e \frac{2.1}{1.5}$
- Q.27** The rate constant (k) for the reaction 2X + Y → Products, was found to be 3.58 × 10<sup>-4</sup> L mole<sup>-1</sup> s<sup>-1</sup> after 15 seconds, 3.6 × 10<sup>-4</sup> L mole<sup>-1</sup> s<sup>-1</sup> after 30 seconds and 3.56 × 10<sup>-4</sup> L mole<sup>-1</sup> s<sup>-1</sup> after 50 seconds. Hence the order of the reaction is-
- [1] Two [2] Three [3] Zero [4] One
- Q.28** 75% of a first order reaction was completed in 32 minutes. When was 50% of the reaction completed.
- [1] 24 minutes [2] 8 minutes [3] 16 minutes [4] 4 minutes
- Q.29** If the concentration of the reactants in the reaction 2A + B → C + D is increased by three folds, the rate of the reaction will be increased by-
- [1] 27 times [2] 9 times [3] 64 times [4] 01 times





**Q.41** The specific reaction rate of a first order reaction is  $0.347 \times 10^{-3} \text{ sec}^{-1}$ . The half life period in seconds will be :  
 [1]  $0.347 \times 10^{-3}$       [2]  $0.694 \times 10^3$       [3]  $0.347 \times 10^3$       [4]  $2 \times 10^3$

**Q.42** For the reaction  $A \rightarrow B$  it is observed that the rate of the reaction doubles when the concentration of A is increased four times. The order of the reaction is :  
 [1] Second      [2] First      [3] Half      [4] Zero

**Q.43** In Arrhenius equation if a graph is plotted between  $\log k$  and  $\frac{1}{T}$ , the slope of the curve will be :

[1]  $-\frac{E_a}{R}$       [2]  $-\frac{E_a}{2.303R}$       [3]  $\frac{E_a}{R}$       [4]  $\frac{E_a}{2.303R}$

**Q.44** The half life period of a chemical reaction is given by  $t_{1/2} \propto \frac{1}{a^{n-1}}$

The order of the reaction is :

[1] n      [2] n - 1      [3] n + 1      [4] None of these

**Q.45** At 290K the rate constant of a reaction is  $3.2 \times 10^{-3}$ . Its value at 310 K will be :

[1]  $1.28 \times 10^{-2}$       [2]  $3.2 \times 10^{-4}$       [3]  $9.6 \times 10^{-4}$       [4]  $6.4 \times 10^{-3}$

**Q.46** For a reaction  $A + 2B \rightarrow C + D$ , the following data were obtained

	Initial concentration (mole litre <sup>-1</sup> )		Initial Rate of formation of D (mole litre <sup>-1</sup> min <sup>-1</sup> )
	[A]	[B]	
1.	0.1	0.1	$6.0 \times 10^{-3}$
2.	0.3	0.2	$7.2 \times 10^{-2}$
3.	0.3	0.4	$2.88 \times 10^{-1}$
4.	0.4	0.1	$2.4 \times 10^{-2}$

The correct rate law expression will be :

[1] Rate = k [A] [B]      [2] Rate = k [A] [B]<sup>2</sup>      [3] Rate = k [A]<sup>2</sup> [B]<sup>2</sup>      [4] Rate = k [A]<sup>2</sup> [B]

**Q.47** For the reaction,  $2A + B \rightarrow \text{Products}$ , the following initial rates were obtained at various initial concentrations :

[A]	[B]	Rate (mol l <sup>-1</sup> sec <sup>-1</sup> )
0.1 M	0.2 M	0.46
0.2 M	0.2 M	1.84
0.2 M	0.1 M	0.92

The rate law for the reaction is :

[1] Rate = k [A]<sup>2</sup> [B]<sup>0</sup>      [2] Rate = k [A] [B]      [3] Rate = k [A]<sup>2</sup> [B]      [4] Rate = k [A] [B]<sup>2</sup>

**Q.48** Form the data given below for the reaction :  $A + B \rightarrow \text{Products}$

[A]	[B]	Rate
0.35 M	1.28 M	0.032 Ms <sup>-1</sup>
0.35 M	0.64 M	0.008 Ms <sup>-1</sup>
0.70 M	0.64 M	0.016 Ms <sup>-1</sup>

the expression for rate law is :

[1] rate = k [A]<sup>0</sup> [B]      [2] rate = k [A] [B]      [3] rate = k [A]<sup>2</sup> [B]      [4] rate = k [A] [B]<sup>2</sup>

**Q.49** Decomposition of  $\text{H}_2\text{O}_2$  was studied by titration against  $\text{KMnO}_4$  solution. It was found that 0.4 mole of  $\text{H}_2\text{O}_2$  was reduced to 0.2 mole in 20 minutes and to 0.1 mole in 40 minutes and to 0.05 mole after one hour. The order of reaction must be :

[1] 0

[2] 1

[3] 2

[4] 3

**Q.50** The following kinetic data are provided for a reaction between A and B :

Concentration of A/(M)	Concentration of B/(M)	Rate of reaction (M min <sup>-1</sup> )
0.50	0.02	$1.15 \times 10^{-4}$
0.50	0.04	$2.30 \times 10^{-4}$
0.01	1.00	$2.30 \times 10^{-6}$
0.02	1.00	$0.92 \times 10^{-5}$

Then value of the rate constant for the above reaction is equal to :

[1]  $1.15 \times 10^{-4} \text{ dm}^3/\text{mol min}$ [2]  $2.30 \times 10^{-4} \text{ dm}^6/\text{mol}^2 \text{ min}$ [3]  $2.30 \times 10^{-2} \text{ dm}^6/\text{mol}^2 \text{ min}$ [4]  $1.15 \times 10^{-2} \text{ dm}^3/\text{mol min}$ 

## Answer Key - 1

Qus.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	2	4	3	4	4	2	3	1	1	3	2	3	2	2	2	4	3	2	2	4
Qus.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	2	3	2	1	4	1	3	1	4	1	2	4	2	4	1	2	3	1	3
Qus.	41	42	43	44	45	46	47	48	49	50										
Ans.	4	3	2	1	1	2	3	4	2	3										

# Exercise # 2

Q.1 The following data pertain to reaction between A and B ;

S.No.	[A] mol. l <sup>-1</sup>	[B] mol. l <sup>-1</sup>	Rate mol. l <sup>-1</sup> . t <sup>-1</sup>
I	1 × 10 <sup>-2</sup>	2 × 10 <sup>-2</sup>	2 × 10 <sup>-4</sup>
II	2 × 10 <sup>-2</sup>	2 × 10 <sup>-2</sup>	4 × 10 <sup>-4</sup>
III	2 × 10 <sup>-2</sup>	4 × 10 <sup>-2</sup>	8 × 10 <sup>-4</sup>

Which of the following inference(s) can be drawn from the above data

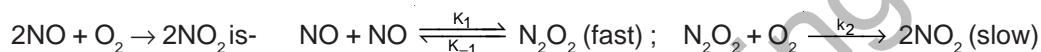
- [a] Rate constant of the reaction is 10<sup>-4</sup>                      [b] Rate law of the reaction is k [A] [B]  
 [c] Rate of reaction increases four times on doubling the concentration of both the reactants

Select the correct answer

Codes :

- [1] a, b and c                      [2] a and b                      [3] b and c                      [4] c alone

Q.2 The mechanism of the reaction :



The rate constant of the reaction is

- [1] k<sub>2</sub>                      [2] k<sub>2</sub>k<sub>1</sub> (k<sub>-1</sub>)                      [3] k<sub>2</sub>k<sub>1</sub>                      [4] k<sub>2</sub>  $\left(\frac{k_1}{k_{-1}}\right)$

Q.3 Following data are obtained for the reaction A + B → product

[A] (mole l <sup>-1</sup> )	[B] (mole l <sup>-1</sup> )	Rate (mole l <sup>-1</sup> s <sup>-1</sup> )
4 × 10 <sup>-2</sup>	4 × 10 <sup>-2</sup>	2 × 10 <sup>-2</sup>
4 × 10 <sup>-2</sup>	8 × 10 <sup>-2</sup>	4 × 10 <sup>-2</sup>
2 × 10 <sup>-2</sup>	8 × 10 <sup>-2</sup>	2 × 10 <sup>-2</sup>

The reaction confirms the rate law

- [1]  $-\frac{d[B]}{dt} = k [A]$                       [2]  $-\frac{d[B]}{dt} = k [A] [B]^2$                       [3]  $-\frac{d[B]}{dt} = k [A] [B]$                       [4]  $-\frac{d[A]}{dt} = k [B]$

Q.4 Kinetic equation for a second order reaction is

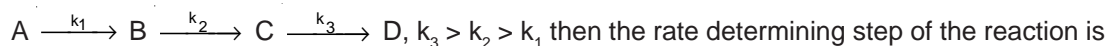
- [1]  $k = \frac{1}{t} \frac{x}{a(a-x)}$                       [2]  $k = \frac{2.303}{t} \log \frac{a}{a(a-x)}$   
 [3]  $k = \frac{2.303}{t} \log \frac{a}{a-x}$                       [4]  $k = \frac{1}{2t} \left[ \frac{1}{(a-x)^2} - \frac{1}{a^2} \right]$

Q.5 Reaction A + 2B + C → product, follows the rate law :  $-\frac{d[c]}{dt} = k [A]^2$

False statement regarding the above reaction is :

- [1] On doubling the conc. of B and C the rate of the reaction remains unaffected  
 [2] Reducing the conc. of A to half, the rate becomes one-fourth  
 [3] Half life period of the reaction depends upon the conc. of B  
 [4] Half life period of the reaction is inversely proportional to the first power conc. of A

**Q.6** In the sequence of reaction :



- [1]  $A \rightarrow B$                       [2]  $C \rightarrow D$                       [3]  $B \rightarrow C$                       [4]  $A \rightarrow D$

**Q.7** Dinitrogen pentaoxide decomposes as  $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$ . the rate can be given in three ways

$$\frac{-d[\text{N}_2\text{O}_5]}{dt} = k_1 [\text{N}_2\text{O}_5], \quad \frac{d[\text{NO}_2]}{dt} = k_2 [\text{N}_2\text{O}_5], \quad \frac{d[\text{O}_2]}{dt} = k_3 [\text{N}_2\text{O}_5]$$

The relation between the rate constants  $k_1$ ,  $k_2$  and  $k_3$  is :

- [1]  $k_2 = 2k_1$  and  $k_3 = 1/2 k_1$                       [2]  $k_1 = 2k_2$  and  $k_3 = 2k_1$   
 [3]  $k_1 = k_2 = k_3$                       [4]  $k_1 = 2k_2 = 3k_3$

**Q.8** Inversion of a sugar follows first order rate equation which can be followed by noting the change in rotation of the plane of polarization of light in the polarimeter. If  $r_\infty$ ,  $r_t$  and  $r_0$  are the rotations at  $t = \infty$ ,  $t = t$  and  $t = 0$ , then, first order reaction can be written as

$$[1] k = \frac{1}{t} \log \frac{r_t - r_\infty}{r_0 - r_\infty} \quad [2] k = \frac{1}{t} \ln \frac{r_0 - r_\infty}{r_t - r_\infty} \quad [3] k = \frac{1}{t} \ln \frac{r_\infty - r_0}{r_\infty - r_t} \quad [4] k = \frac{1}{t} \ln \frac{r_\infty - r_t}{r_\infty - r_0}$$

**Q.9** The rate of a certain reaction increase by 2.3 times when the temperature is raised from 300 K to 310K. If  $K$  is the rate constant at 300K then the rate constant at 310 K will be

- [1]  $K$                       [2]  $3K^2$                       [3]  $2K$                       [4]  $2.3K$

**Q.10** For a certain decomposition, the rate is  $0.30 \text{ M sec}^{-1}$  when the concentration of reactant is  $0.20 \text{ M}$ . If the reaction is second order, the rate (in  $\text{M sec}^{-1}$ ) when concentration is increased 3- times is :

- [1]  $0.30$                       [2]  $0.90$                       [3]  $0.60$                       [4]  $2.70$

**Q.11** When ethyl acetate was hydrolysed in presence of  $0.1 \text{ N HCl}$ , the rate constant was found to be  $5.40 \times 10^{-5} \text{ sec}^{-1}$ , but when  $0.1 \text{ N H}_2\text{SO}_4$  was used for hydrolysis, the rate constant was found to be  $6.20 \times 10^{-5} \text{ sec}^{-1}$  Thus

- [1]  $\text{H}_2\text{SO}_4$  is stronger than  $\text{HCl}$                       [2]  $\text{H}_2\text{SO}_4$  is weaker than  $\text{HCl}$   
 [3]  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  both have the same strength                      [4] None of these

**Q.12** The slope of the line for the graph of  $\log k$  versus  $\frac{1}{T}$  for the reaction,  $\text{N}_2\text{O}_5 \rightarrow 2\text{NO}_2 + \frac{1}{2} \text{O}_2$  is  $-5000$ . Calculate the energy of activation of the reaction - ( $\text{kJ K}^{-1} \text{ mol}^{-1}$ )

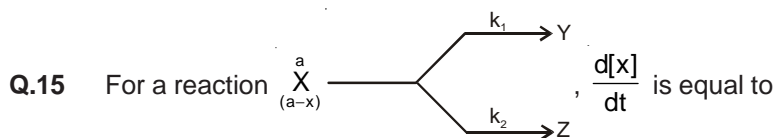
- [1]  $95.7$                       [2]  $9.57$                       [3]  $957$                       [4] None

**Q.13** If  $a$  is the initial concentration of a substance which reacts according to zero order kinetics and  $k$  is rate constant, the time for the reaction to go to completion is :

- [1]  $a/k$                       [2]  $2/ka$                       [3]  $k/a$                       [4]  $a/2k$

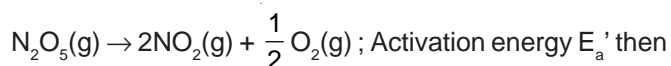
**Q.14** For a reaction  $A \xrightarrow{k_1} B \xrightarrow{k_2} C$ . If the reaction are of 1<sup>st</sup> order then  $\frac{d[B]}{dt}$  is equal to :

- [1]  $-k_2[B]$                       [2]  $+k[A]$                       [3]  $k_1[A] - k_2[B]$                       [4]  $k_1[A] + k_2[B]$



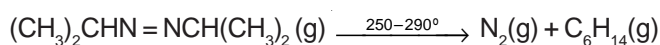
- [1]  $k_1(a-x) - k_2(a-x)$  [2]  $k_2(a-x) - k_1(a-x)$   
 [2]  $k_1(a-x) + k_2(a-x)$  [4]  $-k_1(a-x) - k_2(a-x)$

Q.16 For the decomposition of  $N_2O_5(g)$ , it is given that  $2N_2O_5 \rightarrow 4NO_2(g) + O_2(g)$ ; Activation energy  $E_a$ ,



- [1]  $E_a = E_a'$  [2]  $E_a > E_a'$  [3]  $E_a < E_a'$  [4]  $E_a = 2E_a'$

Q.17 Azo isopropane decomposes according to the equation :



It is found to be a first order reaction. If initial pressure is  $P_0$  and pressure of the mixture at time  $t$  is ( $P_t$ ) then rate constant ( $k$ ) would be :

- [1]  $k = \frac{2.303}{t} \log \frac{P_0}{2P_0 - P_t}$  [2]  $k = \frac{2.303}{t} \log \frac{P_0 - P_t}{P_0}$   
 [3]  $k = \frac{2.303}{t} \log \frac{P_0}{P_0 - P_t}$  [4]  $k = \frac{2.303}{t} \log \frac{2P_0}{2P_0 - P_t}$

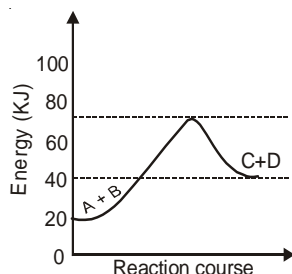
Q.18 Quantum yield of photosynthesis of :

- [1]  $HCl > HBr$  [2]  $HCl < HBr$  [3]  $HCl = HBr$  [4] None

Q.19 When the rate is determined by the change in concentration of two different reactants, then the kinetic equation can be expressed as

- [1]  $k_2 = \frac{2.303}{(a-b)t} \log \frac{(a-x)b}{(b-x)a}$  [2]  $k_2 = \frac{2.303}{(a-b)t} \log \frac{(a-x)}{(a+x)}$   
 [3]  $k_2 = \frac{2.303}{(a-b)} \log \frac{(a-x)}{(b-x)}$  [4]  $k_2 = \frac{1}{t} \times \frac{x}{(a-x)}$

Q.20 The reaction profile diagram of the reaction  $A + B \rightarrow C + D$  is as under



Which of the following is an incorrect statement ?

- [1] The activation energy of backward reaction is 70 kJ  
 [2]  $\Delta H$  for the forward reaction is 20 kJ  
 [3] The forward reaction is endothermic  
 [4] The activation energy for the forward reaction is 50 kJ

- Q.21** In the reaction  $A + B \rightarrow C + D$ , the concentration of A and B are equal and the rate of the reaction is –  
Rate =  $k[A][B]$ . The integrated rate equation for this reaction is :
- [1]  $k = \frac{x}{t(a-x)}$       [2]  $k = \frac{xa}{(a-x)}$       [3]  $k = \frac{1}{t} \cdot \frac{x}{a(a-x)}$       [4]  $k = \frac{1}{t} \cdot \frac{x}{a(x-a)}$
- Q.22** If a graph is plotted between  $\log(a-x)$  and  $t$ , the slope of the straight line is equal to  $-0.03$ . The specific reaction rate will be :
- [1]  $6.9 \times 10^{-2}$       [2] 6.9      [3] 0.69      [4]  $6.9 \times 10^{-4}$
- Q.23** In the Wilhelmy equation of a first order reaction  $C_t = C_0 e^{-kt}$  if the initial concentration  $C_0$  is increased  $m$  times then
- [1] The value of  $k$  will increase  $m$  times      [2] The value of  $k$  will decrease  $m$  times  
[3] The value of  $k$  will remain unchanged      [4] None of these
- Q.24** The data for the dissociation of ammonium nitrate are as under –
- |                           |      |     |       |       |          |
|---------------------------|------|-----|-------|-------|----------|
| Volume of $N_2$ in $cm^3$ | 6.25 | 9.0 | 11.42 | 13.65 | 35.05    |
| Time in min.              | 10   | 15  | 20    | 25    | $\infty$ |
- The reaction is of
- [1] Zero order      [2] First order      [3] Second order      [4] Third order
- Q.25** The half life period of a first order reaction is 15 minute. How much reaction will be completed in 30 min.
- [1] 75%      [2] 80%      [3] 95%      [4] 100%
- Q.26** 99% at a first order reaction was completed in 32 min. When will 99.9% of the reaction complete.
- [1] 48 min      [2] 46 min      [3] 50 min      [4] 45 min
- Q.27** According to collision theory of reaction rate, the rate increases with the increase in temperature because
- [1] The number of collisions increases      [2] The velocity of reactant molecules increases  
[3] More molecules obtain activation energy      [4] None of these
- Q.28** In a second order reaction 20% of a substance is dissociated in 40 minutes. The time taken by the 80% of its dissociation is
- [1] 160 minutes      [2] 640 minutes      [3] 200 minute      [4] 320 minute
- Q.29** The rate constants at  $27^\circ C$  and  $67^\circ C$  for the dissociation of  $N_2O_5$  are  $3.45 \times 10^{-5}$  and  $6.90 \times 10^{-3}$  respectively. What is the activation energy for the dissociation of  $N_2O_5$  ?
- [1] 112.5 kJ      [2] 225 kJ      [3] 448 kJ      [4] None of these
- Q.30** The temperature coefficient of a reaction is :
- [1] The ratio of the rate constants of two reactions at  $25^\circ C$   
[2] The ratio of the rate constants of a reaction at  $25^\circ C$  and  $35^\circ C$   
[3] The ratio of the rate constants at any two different temperature  
[4] None of the above
- Q.31** The half life period of a second order reaction can be expressed as :
- [1]  $t_{1/2} = \frac{0.693}{k}$       [2]  $t_{1/2} = \frac{3}{2k} \cdot \frac{1}{a^2}$       [3]  $t_{1/2} = \frac{1}{k} \cdot \frac{1}{a}$       [4] None of these
- Q.32** The rate constant for a reaction is  $10.8 \times 10^{-5} \text{ mol lit}^{-1} \text{ sec}^{-1}$ . The reaction is -
- [1] Zero order      [2] Half order      [3] First order      [4] Second order

- Q.33** The rate constant of a reaction is about  $3.2 \times 10^{-4}$  at 280 K. What will be its rate constant at 300 K ?  
 [1]  $9.6 \times 10^{-4}$                       [2]  $3.2 \times 10^{-5}$                       [3]  $6.4 \times 10^{-4}$                       [4]  $1.28 \times 10^{-3}$
- Q.34** In acidic medium the rate of reaction between  $(\text{BrO}_3)^-$  and  $\text{Br}^-$  ion is given by the expression  

$$\frac{d(\text{BrO}_3^-)}{dt} = k[\text{BrO}_3^-] [\text{Br}^-] [\text{H}^+]^2$$
 it means  
 [1] Rate constant of overall reaction is  $4 \text{ sec}^{-1}$   
 [2] Rate of reaction is independent of the conc. of acid  
 [3] The change in pH of the solution will not affect the rate  
 [4] Doubling the conc. of  $\text{H}^+$  ions will increase the reaction rate by 4 times
- Q.35** Using the data given below the order and rate constant for the reaction :  $\text{CH}_3\text{CHO}(\text{g}) \rightarrow \text{CH}_4(\text{g}) + \text{CO}(\text{g})$  would be
- | Experiment no. | Initial conc.<br>[mol/l] | Initial rate<br>[mol/l/sec] |
|----------------|--------------------------|-----------------------------|
| a              | 0.10                     | 0.020                       |
| b              | 0.20                     | 0.080                       |
| c              | 0.30                     | 0.180                       |
| d              | 0.40                     | 0.320                       |
- Answer is  
 [1] 2, [k = 2.0 l/mol sec]                      [2] 0, [k = 2.0 mol/l sec]  
 [3] 2, [k = 1.5 l/mol sec]                      [4] 1, [k = 1.5 sec<sup>-1</sup>]
- Q.36** In the reaction :  $\text{A} + 2\text{B} + \text{C} \rightarrow \text{D} + 2\text{E}$ . The rate of formation of D remains unchanged if the conc. of B is doubled and that of A and C is kept constant. What is the order with respect to B  
 [1] 0                      [2] 1/2                      [3] 1                      [4] 3
- Q.37**  $t_{0.5} = \text{constant}$ , confirms the first order of the reaction as one  $a^2 t_{0.5} = \text{constant}$  confirms that the reaction is of  
 [1] Zero order                      [2] First order                      [3] Second order                      [4] Third order
- Q.38** In a certain gaseous reaction between X and Y  
 $\text{X} + 3\text{Y} \rightarrow \text{XY}_3$   
 The initial rates are reported as follows
- | [X]   | [Y]   | Rate                   |
|-------|-------|------------------------|
| 0.1 M | 0.1 M | 0.002 Ms <sup>-1</sup> |
| 0.2 M | 0.1 M | 0.002 Ms <sup>-1</sup> |
| 0.3 M | 0.2 M | 0.008 Ms <sup>-1</sup> |
| 0.4 M | 0.3 M | 0.018 Ms <sup>-1</sup> |
- The rate law is  
 [1]  $r = k [\text{X}] [\text{Y}]^3$                       [2]  $r = k [\text{X}]^0 [\text{Y}]^2$                       [3]  $r = k [\text{X}] [\text{Y}]$                       [4]  $r = k [\text{X}]^0 [\text{Y}]^3$
- Q.39** The rate of reaction between A and B increases by a factor of 100, when the concentration of A is increased by 10 fold, the order of reaction with respect to A is :  
 [1] 10                      [2] 1                      [3] 4                      [4] 2
- Q.40** For a reaction, the rate constant is expressed as,  $k = \text{A} \cdot e^{-40000/T}$ . The energy of the activation is :  
 [1] 40000 cal                      [2] 88000 cal                      [3] 80000 cal                      [4] 8000 cal
- Q.41** The half-life period for a reaction at initial concentration of 0.5 and 1.0 moles litre<sup>-1</sup> are 200 sec and 100 sec respectively. The order of the reaction is  
 [1] 0                      [2] 1                      [3] 2                      [4] 3





# Exercise # 3

- Q.1** Select the law that correspond to data for the reaction  $A + B \rightarrow$  products [CPMT 1994]
- | Exp. | [A]   | [B]   | Initial rate |
|------|-------|-------|--------------|
| 1    | 0.012 | 0.035 | 0.1          |
| 2    | 0.024 | 0.070 | 0.8          |
| 3    | 0.024 | 0.035 | 0.1          |
| 4    | 0.012 | 0.070 | 0.8          |
- [1] Rate =  $k [B]^3$       [2] Rate =  $k [B]^4$       [3] Rate =  $k [A] [B]^3$       [4] Rate =  $k [A]^2 [B]^2$
- Q.2** The unit of a first order rate constant is : [AFMC 1994]
- [1]  $\text{Mol cm}^{-3} \text{ s}^{-1}$       [2]  $\text{L}^{-1} \text{ mol}^{-1} \text{ s}^{-1}$       [3]  $\text{s}^{-1}$       [4]  $\text{Litre mol}^{-1} \text{ s}^{-1}$
- Q.3** A chemical reaction is catalysed by a catalyst X. Hence X [CPMT 1995]
- [1] Increases activation energy of the reaction      [2] Does not affect equilibrium constant of the reaction  
[3] Decreases the rate constant of the reaction      [4] Reduces enthalpy of the reaction
- Q.4** The decomposition of  $\text{N}_2\text{O}_5$  is a first order reaction represented by :  $\text{N}_2\text{O}_5 \rightarrow \text{N}_2\text{O}_4 + 1/2 \text{O}_2$   
After 15 minutes the volume of  $\text{O}_2$  produced is 9 ml and at the end of the reaction 35 ml. The rate constant is equal to [MPPET 1995]
- [1]  $\frac{1}{15} \ln \frac{35}{44}$       [2]  $\frac{1}{15} \ln \frac{44}{26}$       [3]  $\frac{1}{15} \ln \frac{44}{35}$       [4]  $\frac{1}{15} \ln \frac{35}{26}$
- Q.5** A catalyst only [AFMC 1995]
- [1] Decreases activation energy      [2] Increases activation energy  
[3] Both of them      [4] Comes to equilibrium
- Q.6** The given reaction :  $2\text{FeCl}_3 + \text{SnCl}_2 \rightarrow 2\text{FeCl}_2 + \text{SnCl}_4$  is an example of [CPMT 1996]
- [1] First order reaction      [2] Second order reaction  
[3] Third order reaction      [4] None of these
- Q.7** The free energy change due to a reaction is zero when [KCET 1996]
- [1] The reactants are initially mixed      [2] A catalyst is added  
[3] The system is at equilibrium      [4] The reactants are completely consumed
- Q.8** If the temperature is increased by  $10^\circ\text{C}$  the rate of the reaction becomes [RPET 1997]
- [1] Ten times more      [2] Ten times less      [3] Two times more      [4] Two times less
- Q.9** For a first order reaction, the half-life period is independent of [CPMT 1997]
- [1] Initial concentration      [2] Cube root of initial concentration  
[3] First power of final concentration      [4] Square root of final concentration

- Q.10** What is the value of decay constant of a compound having half life time as 2.95 days **[AFMC 1997]**  
 [1]  $2.9 \times 10^{-5} \text{ s}^{-1}$       [2]  $2.9 \times 10^6 \text{ s}^{-1}$       [3]  $2.9 \times 10^{-6} \text{ s}^{-1}$       [4]  $3 \times 10^5 \text{ s}^{-1}$
- Q.11** In a reaction  $A \rightarrow B$ , the rate of reaction increases two times on increasing the concentration of the reactant four times, then order of reaction is **[AIIMS 1997]**  
 [1] 0      [2] 2      [3] 1/2      [4] 4
- Q.12** Activation energy of a chemical reaction can be determined by **[CPMT 1998]**  
 [1] Evaluating rate constant at standard temperature  
 [2] Evaluating velocities of reaction at two different temperature  
 [3] Evaluating rate constants at two different temperatures  
 [4] Changing concentrations of reactants
- Q.13** If 75% of first order reaction is completed in 32 min, then 50% of the reaction would be completed in **[MPPET 1998]**  
 [1] 16 Min      [2] 24 Min      [3] 10 Min      [4] 40 Min
- Q.14** The Arrhenius equation expressing the effect of temperature on the rate constant of reaction is **[MPPET 1998]**  
 [1]  $k = \frac{E_a}{RT}$       [2]  $k = Ae^{-E_a/RT}$       [3]  $k = \log_e \frac{E_a}{RT}$       [4]  $k = e^{-E_a/RT}$
- Q.15** For a reaction for the type  $A + B \rightarrow \text{products}$ , it is observed that doubling the concentration of A causes the reaction rate to be four times as great, but doubling the amount of B does not effect the rate. The rate equation is **[MPPET 1998]**  
 [1] Rate =  $k [A] [B]$       [2] Rate =  $k [A]$       [3] Rate =  $k [A]^2$       [4] Rate =  $k [A]^2 [B]$
- Q.16** Which of the following kinds of catalysis can be explained by the adsorption theory **[MPPMT 1998]**  
 [1] Homogenous catalysis      [2] Acid-base catalysis  
 [3] Heterogeneous catalysis      [4] Enzyme catalysis
- Q.17** For the following first order reaction :  $\text{N}_2\text{O}_5$  (in  $\text{CCl}_4$  solvent)  $\rightarrow 2\text{NO}_2$  (Solvent) +  $\frac{1}{2} \text{O}_2$  (g) the velocity constant is  $6.2 \times 10^{-4} \text{ s}^{-1}$ . The rate of the reaction at  $[\text{N}_2\text{O}_5] = 1.25$  moles/litre will be **[AFMC 1998]**  
 [1]  $7.75 \times 10^{-4}$  Moles/1/s      [2]  $6.35 \times 10^{-3}$  Moles/1/s  
 [3]  $5.15 \times 10^{-5}$  Moles/1/s      [4]  $3.85 \times 10^{-4}$  Moles/1/s
- Q.18** The rate of a first order reaction was found to be  $0.69 \times 10^{-2}$  mole/litre/minute at the initial concentration 0.2 moles litre<sup>-1</sup>. The half life period of the reaction will be **[AIIMS 1998]**  
 [1] 400 s      [2] 600 s      [3] 800 s      [4] 1200 s
- Q.19** For the first order reaction with rate constant k, which expression gives the half-life period ? **[MPPMT 1998]**  
 (Initial concentration = a)  
 [1]  $\ln 2/k$       [2]  $1/ka$       [3]  $0.693/k$       [4]  $3/2 ka^2$

- Q.20** For the reaction  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$ , the rate of reaction is expressed as [CPMT 1999]
- [1]  $-\frac{\Delta[\text{I}_2]}{\Delta t} = -\frac{\Delta[\text{H}_2]}{\Delta t} = \frac{1}{2} \frac{\Delta[\text{HI}]}{\Delta t}$       [2]  $\frac{\Delta[\text{I}_2]}{\Delta t} = \frac{\Delta[\text{H}_2]}{\Delta t} = \frac{\Delta[\text{HI}]}{2\Delta t}$
- [3]  $\frac{\Delta[\text{H}_2]}{\Delta t} = \frac{1}{2} \frac{\Delta[\text{I}_2]}{\Delta t} = -\frac{\Delta[\text{HI}]}{\Delta t}$       [4] None of these
- Q.21** The conversion of  $\text{A} \rightarrow \text{B}$  follows second order kinetics. Doubling the concentration of A will increase the rate of formation of B by a factor [MPPET 1999]
- [1] 1/4      [2] 2      [3] 1/2      [4] 4
- Q.22** For a reaction the activation energy  $E_a = 0$  and the rate constant  $k = 3.2 \times 10^6 \text{ S}^{-1}$  at 300 K. What is the value of rate constant at 310 K [MPPMT 1999]
- [1]  $6.4 \times 10^6 \text{ S}^{-1}$       [2]  $6.4 \times 10^{12} \text{ S}^{-1}$       [3]  $3.2 \times 10^6 \text{ S}^{-1}$       [4] 0
- Q.23** Amongst the following chemical reactions, the unimolecular reaction is [MPPMT 1999]
- [1]  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$       [2]  $\text{PCl}_3 + \text{Cl}_2 \rightarrow \text{PCl}_5$       [3]  $\text{N}_2\text{O}_5 \rightarrow \text{N}_2\text{O}_4 + \frac{1}{2} \text{O}_2$       [4]  $2\text{HI} \rightarrow \text{H}_2 + \text{I}_2$
- Q.24** The rate constant of a first order reaction is  $3 \times 10^{-6}$  per sec. If the initial concentration is 0.10 M, the initial rate of reaction is [BHU, AIIMS 99]
- [1]  $3 \times 10^{-5} \text{ Ms}^{-1}$       [2]  $3 \times 10^{-6} \text{ Ms}^{-1}$       [3]  $3 \times 10^{-7} \text{ Ms}^{-1}$       [4]  $3 \times 10^{-8} \text{ Ms}^{-1}$
- Q.25** The unit of rate constant for zero order reaction is [RPET 2000]
- [1] Moles/Litre sec      [2] Litre/Moles sec      [3]  $\text{Sec}^{-1}$       [4]  $\text{Moles}^2/\text{Litre}^2 \text{ sec}$
- Q.26** A radioactive sample decays to half of its initial concentration in 6.93 minutes. If it further decays half in the next 6.93 minutes. The rate constant for the reaction is [CPMT 2000]
- [1]  $0.10 \text{ min}^{-1}$       [2]  $0.01 \text{ min}^{-1}$       [3]  $1.0 \text{ min}^{-1}$       [4]  $0.001 \text{ min}^{-1}$
- Q.27** In the reaction  $2\text{A} + \text{B} \rightarrow \text{A}_2\text{B}$ , if the concentration of A is doubled and that of B is halved, then the rate of reaction will [CPMT 2000]
- [1] Decrease 2 times      [2] Increase 2 times      [3] Increase 4 times      [4] Remain the same
- Q.28** Inversion of sucrose is [MPPET 2000]
- [1] First order reaction      [2] Zero order reaction      [3] Second order reaction      [4] Third order reaction
- Q.29** The rate constant for the forward and backward reactions of hydrolysis of ester are  $1.1 \times 10^{-2}$  and  $1.5 \times 10^{-3}$  per minute respectively. The equilibrium constant of the reaction [AFMC 2000]
- [1] 6.33      [2] 7.33      [3] 7.75      [4] 8.33
- Q.30** Activation energy of a reaction is determined by [DPMT 2000]
- [1] Plotting substrate-time graph
- [2] Plotting rate-time graph
- [3] Calculating rate constant at two different temperatures
- [4] None of these

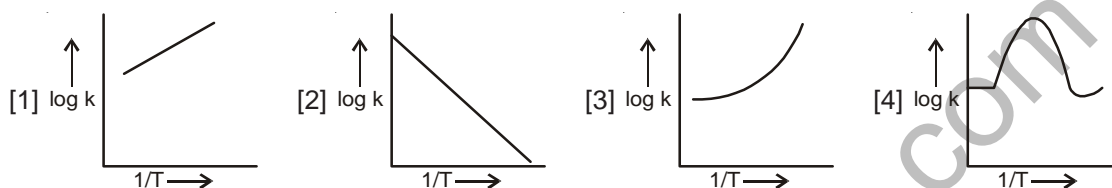
- Q.31** Rate constant depends on [AFMC 2000]  
 [1] Temperature [2] Time [3] Initial concentration [4] None
- Q.32** For a reaction  $2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NOCl}(\text{g})$ , when concentration of  $\text{Cl}_2$  is doubled, the rate of reaction becomes two times of the original. When the concentration of  $\text{NO}$  is doubled, rate becomes four times. What is the order of reaction? [MPPMT 2000]  
 [1] 1 [2] 2 [3] 3 [4] 4
- Q.33** For the reaction  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$  if  $\frac{\Delta[\text{NH}_3]}{\Delta t} = 2 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$ . The value of  $-\frac{\Delta[\text{H}_2]}{\Delta t}$  would be [MPPMT 2000]  
 [1]  $1 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$  [2]  $3 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$  [3]  $4 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$  [4]  $6 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
- Q.34** When  $\text{H}_2$  and  $\text{Cl}_2$  reacts in presence of sunlight to form  $\text{HCl}$  then the order of reaction is (Unit of  $k = \text{mol} \times \text{lit}/\text{sec}$ ) [RPET 2001]  
 [1] 2 [2] 3 [3] 0 [4] 4
- Q.35** The order of a reaction with rate equal to  $k \cdot C_A^{+3/2} \cdot C_B^{-1/2}$  will be [MPPET 2001]  
 [1] 2 [2] 1 [3]  $-1/2$  [4]  $3/2$
- Q.36** For the reaction  $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$  rate and rate constant are  $1.02 \times 10^{-4}$  and  $3.4 \times 10^{-5} \text{ sec}^{-1}$  respectively then concentration of  $\text{N}_2\text{O}_5$  at that time will be [CBSE Med 2001]  
 [1] 1.732 [2] 3 [3]  $1.02 \times 10^{-4}$  [4]  $3.4 \times 10^5$
- Q.37** When a biochemical reaction is carried out in laboratory from outside of human body in absence of enzyme then the rate of reaction obtained is  $10^{-6}$  times, then activation energy of reaction in presence of enzyme is : [CPMT 2001]  
 [1]  $6/RT$  [2]  $P$  is required  
 [3] Different from  $E_a$  obtained in the laboratory [4] Cannot say anything
- Q.38** For the reaction  $\text{A} + \text{B} \rightarrow \text{C} + \text{D}$ , doubling the concentration of both the reactants increases the reaction rate by 8 times and doubling the concentration of only B simply doubles the reaction rate. The rate law is given as [AFMC 2001]  
 [1]  $r = k [\text{A}]^{1/2} [\text{B}]^{1/2}$  [2]  $r = k [\text{A}] [\text{B}]^2$  [3]  $r = k [\text{A}]^2 [\text{B}]$  [4]  $r = k [\text{A}] [\text{B}]$
- Q.39**  $3\text{A} \rightarrow 2\text{B}$ , rate of reaction  $+\frac{d[\text{B}]}{dt}$  is equal to [CPMT 2002]  
 [1]  $-\frac{3}{2} \frac{d[\text{A}]}{dt}$  [2]  $-\frac{2}{3} \frac{d[\text{A}]}{dt}$  [3]  $-\frac{1}{3} \frac{d[\text{A}]}{dt}$  [4]  $+2 \frac{d[\text{A}]}{dt}$
- Q.40** A chemical reaction was carried out at 300 K and 280 K. The rate constants were found to be  $k_1$  and  $k_2$  respectively. Then [KCET 2002]  
 [1]  $k_2 = 4k_1$  [2]  $k_2 = 2k_1$  [3]  $k_2 = 0.25 k_1$  [4]  $k_2 = 0.5 k_1$
- Q.41** Collision theory is applicable to [MPPET 2002]  
 [1] First order reactions [2] Zero order reactions  
 [3] Bimolecular reactions [4] Intermolecular reaction

- Q.42** The time taken for 90% of a first order reaction to complete is approximately [MPPET 2002]  
 [1] 1.1 times that of half-life [2] 2.2 times that of half-life  
 [3] 3.3 times that of half-life [4] 4.4 times that of half-life

- Q.43** The rate constant for the first and zero order reaction in terms of molarity, M units respectively ; [AIEEE 2002]  
 [1]  $\text{sec}^{-1}$ ,  $\text{M sec}^{-1}$  [2]  $\text{sec}^{-1}$ , M [3]  $\text{M sec}^{-1}$ ,  $\text{sec}^{-1}$  [4] M,  $\text{sec}^{-1}$

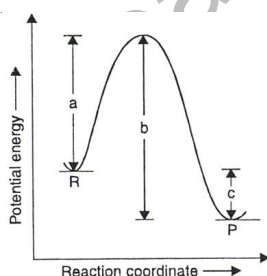
- Q.44** Which of the following is correct for a first order reaction ? [DPMT 2002]  
 [1]  $t_{1/2} \propto a$  [2]  $t_{1/2} \propto 1/a$  [3]  $t_{1/2} \propto a^0$  [4]  $t_{1/2} \propto \frac{1}{a^2}$

- Q.45** A graph plotted between  $\log k$  versus  $1/T$  for calculating activation energy is shown by [MP CET 2002]



- Q.46** For the reaction  $\text{H}_2 + \text{Cl}_2 \xrightarrow{\text{Sun light}} 2\text{HCl}$  taking place on water, the order of reaction is [AIIMS 2002]  
 [1] 0 [2] 1 [3] 2 [4] 3

- Q.47** The potential energy diagram for a reaction  $\text{R} \rightarrow \text{P}$  is given below.  $\Delta H^\circ$  of the reaction corresponds to the energy [AIIMS 2003]



- [1] a [2] b [3] c [4] a + b  
**Q.48** The activation energy for a simple chemical reaction,  $\text{A} \rightarrow \text{B}$ , is  $E_a$  in the forward reaction. The activation energy of the reverse reaction [CPMT 2003]

- [1] is negative of  $E_a$  [2] is always less than  $E_a$   
 [3] can be less than or more than  $E_a$  [4] is always double of  $E_a$   
**Q.49** The reaction  $\text{A} \rightarrow \text{B}$  follows first order kinetics. The time taken for 0.8 mole of A to produce 0.6 mole of B is 1 hour. What is the time taken for conversion of 0.9 mole of A to product 0.675 moles of B ?

- [1] 1 hour [2] 0.5 hour [3] 0.25 hour [4] 2 hour [CPMT 2003]

- Q.50** The rate of the reaction is equal to the rate constant, the order of the reaction is [CPMT 2003]  
 [1] 0 [2] 1 [3] 2 [4] 3

- Q.51** The rate law for a reaction between the substances A and B is given by rate =  $k[\text{A}]^n [\text{B}]^m$ . On doubling the concentration of A and halving the conc. of B, the ratio of the new rate to the earlier rate of reaction will be

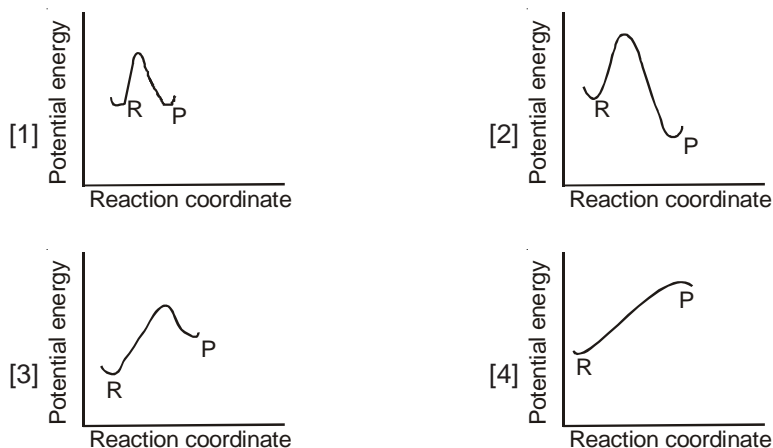
- [1]  $\frac{1}{2^{m+n}}$  [2]  $m + n$  [3]  $n - m$  [4]  $2^{(n-m)}$  [AIEEE 2003]

- Q.52** Consider the chemical reaction,  $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ . The rate of this reaction can be expressed in terms of time derivative of concentration of  $N_2(g)$ ,  $H_2(g)$  or  $NH_3(g)$ . Identify the correct relationship amongst the rate expressions.
- [1] Rate =  $-d[N_2]/dt = -1/3 d[H_2]/dt = 1/2d[NH_3]/dt$  [IIT Scr. 2002]  
 [2] Rate =  $-d[N_2]/dt = -3 d[H_2]/dt = 2d[NH_3]/dt$   
 [3] Rate =  $d[N_2]/dt = 1/3 d[H_2]/dt = 1/2d[NH_3]/dt$   
 [4] Rate =  $-d[N_2]/dt = -d[H_2]/dt = d[NH_3]/dt$
- Q.53** In a first order reaction the concentration of reactant decreases from  $800 \text{ mol/dm}^3$  to  $50 \text{ mol/dm}^3$  in  $2 \times 10^4 \text{ sec}$ . The rate constant of reaction in  $\text{sec}^{-1}$  is [IIT Scr. 2003]  
 [1]  $2 \times 10^4$  [2]  $3.45 \times 10^{-5}$  [3]  $1.386 \times 10^{-4}$  [4]  $2 \times 10^{-4}$
- Q.54** In a first order reaction, the concentration of the reactant, decreases from  $0.8 \text{ M}$  to  $0.4 \text{ M}$  in  $15 \text{ minutes}$ . The time taken for the concentration to change from  $0.1 \text{ M}$  to  $0.025 \text{ M}$  is [AIEEE 2004]  
 [1]  $60 \text{ minutes}$  [2]  $15 \text{ minutes}$  [3]  $7.5 \text{ minutes}$  [4]  $30 \text{ minutes}$
- Q.55** The rate equation for the reaction  $2A + B \rightarrow C$  is found to be : rate =  $k[A][B]$ . The correct statement in relation of this reaction is that the [AIEEE 2004]  
 [1] value of  $k$  is independent of the initial concentrations of  $A$  and  $B$  [2]  $t_{1/2}$  is a constant  
 [3] rate of formation of  $C$  is twice the rate of disappearance of  $A$  [4] unit of  $k$  must be  $\text{s}^{-1}$
- Q.56** Which of these does not influence the rate of reaction [KCET 2005]  
 [1] Nature of the reactants [2] Concentration of the reactants  
 [3] Temperature of the reaction [4] Molecularity of the reaction
- Q.57** In the reaction  $2N_2O_5 \rightarrow 4NO_2 + O_2$ , initial pressure is  $500 \text{ atm}$  and rate constant  $K$  is  $3.38 \times 10^{-5} \text{ sec}^{-1}$ . After  $10 \text{ minutes}$  the final pressure of  $N_2O_5$  is [Orissa JEE 2005]  
 [1]  $490 \text{ atm}$  [2]  $250 \text{ atm}$  [3]  $480 \text{ atm}$  [4]  $420 \text{ atm}$
- Q.58** A reaction involving two different reactants - [AIEEE 2005]  
 [1] Can never be a second order reaction [2] Can never be a unimolecular reaction  
 [3] Can never be a bimolecular reaction [4] Can never be a first order reaction
- Q.59** For reaction  $A \rightarrow xP$ , when  $[A] = 2.2 \text{ mM}$ , the rate was found to be  $2.4 \text{ mM s}^{-1}$ . On reducing concentration of  $A$  to half, the rate changes to  $0.6 \text{ mM s}^{-1}$ . The order of reaction with respect to  $A$  is - [AIIMS 2005]  
 [1]  $1.5$  [2]  $2.0$  [3]  $2.5$  [4]  $3.0$
- Q.60** Which one of the following statement for order of reaction is not correct - [IIT 2005]  
 [1] Order can be determined experimentally  
 [2] Order of reaction is equal to sum of the powers of concentration terms in differential rate law.  
 [3] It is not affected with the stoichiometric coefficient of the reactants  
 [4] Order cannot be fractional
- Q.61**  $t_{3/4}$  can be taken as the time taken for the concentration of a reactant to drop to  $\frac{3}{4}$  of its initial value. If the rate constant for a first order reaction is  $K$ , the  $t_{3/4}$  can be written as - [AIEEE 2005]  
 [1]  $0.10/K$  [2]  $0.29/K$  [3]  $0.69/K$  [4]  $0.75/K$
- Q.62** For a first order reaction  $A \rightarrow B$  the reaction rate at reactant concentration of  $0.01 \text{ M}$  is found to be  $2.0 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$ . The half life period of the reaction is - [CBSE PMT 2005]  
 [1]  $220 \text{ s}$  [2]  $30 \text{ s}$  [3]  $300 \text{ s}$  [4]  $347 \text{ s}$
- Q.63** The rate of reaction between two reactants  $A$  and  $B$  decreases by a factor of  $4$  if the concentration of reactant  $B$  is doubled. The order of this reaction with respect to reactant  $B$  is - [CBSE PMT 2005]  
 [1]  $-1$  [2]  $-2$  [3]  $1$  [4]  $2$

**Q.64** Consider an endothermic reaction  $X \rightarrow Y$  with the activation energies  $E_b$  and  $E_f$  for the backward and forward reactions, respectively, in general [AIEEE 2005]

- [1]  $E_b < E_f$  [2]  $E_b > E_f$   
 [3]  $E_b = E_f$  [4] There is no definite relation between  $E_b$  and  $E_f$

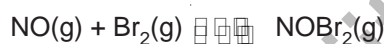
**Q.65** An endothermic reaction with high activation energy for the forward reaction is given by the diagram [AIIMS 2005]



**Q.66** A reaction was found to be second order, with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, with everything else kept the same, the rate of reaction will - [AIEEE 2006]

- [1] Triple [2] Increase by a factor of 4  
 [3] Double [4] Remain unchanged

**Q.67** The following mechanism has been proposed for the reaction of NO with  $Br_2$  to form NOBr -



[AIEEE 2006]

If the second step is the rate determining step, the order of the reaction with respect to NO(g) is -

- [1] 0 [2] 3 [3] 2 [4] 1

**Q.68** Consider the reaction  $2A + B \rightarrow \text{Products}$

When concentration of B alone was doubled, the half-life did not change. When the concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for this reaction is [AIEEE 2007]

- [1]  $\text{molL}^{-1}\text{s}^{-1}$  [2]  $\text{s}^{-1}$  [3]  $\text{L mol}^{-1}\text{s}^{-1}$  [4] No unit

## Answer Key - 3

Qus.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	1	3	2	4	3	3	3	3	1	3	3	3	1	2	3	3	1	4	3	1
Qus.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	4	3	3	3	1	1	2	1	2	3	1	3	2	3	2	2	3	3	2	3
Qus.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	3	1	3	2	1	3	3	1	1	4	1	3	4	1	4	1	2	2	4
Qus.	61	62	63	64	65	66	67	68												
Ans.	2	4	2	1	3	2	3	3												