4. CHEMICAL KINETICS

PREVIOUS EAMCET BITS

1. For a first order reaction at 27^0C the ratio of time required for 75% completion to 25% completion of reaction is **(2009 E)**

1)3.0 2) 2.303 3)4.8 4) 0.477

Ans : 3

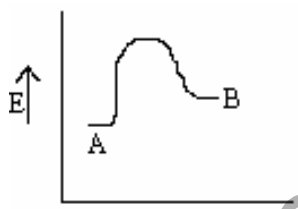
Sol: $K = \frac{2.303}{t}\log\frac{a}{a-x}$

For 75% completion = $t_1 = \frac{2.303}{k}\log 4$

For 25% completion = $t_2 = \frac{2.303}{k}\log\frac{4}{3}$

$\frac{t_1}{t_2} = \frac{\log 4}{\log 4/3} = 0.48$

2. For a reversible reaction $A \rightleftharpoons B$ which one of the following statements is wrong from the given energy profile diagram. **(2008 E)**



1) Activation energy of forward reaction is greater than backward reaction.
2) The forward reaction is endothermic
3) The threshold energy is less than that of activation energy
4) The energy of activation of forward reaction is equal to the sum of heat of reaction and the energy of activation of backward reaction.

Ans : 3

Sol: An inspection of the energy profile diagram indicates that 1,2 and 4 are correct statements 3 is wrong statement

3. The rate constant of a first order reaction is 0.0693min^{-1}. What is the time required (in minutes) for reducing an initial concentration of 20mol lit^{-1} to 2.5 mole lit^{-1} **(2009 M)**

1) 40 2) 30 3) 20 4) 10

Ans : 2

Sol: $t_{y_2} = \frac{0.693}{K} = \frac{0.693}{0.0693} = 10\,\text{min}$

$20 \xrightarrow{t_{y_2}} 10 \xrightarrow{t_{y_2}} 5 \xrightarrow{t_{y_2}} 2.5$

$3 \times t_{y_2} = 3 \times 10 = 30\,\text{min}$

4. **Assertion(A):** A catalyst increases the rate of a reaction.
Reason (R): In presence of a catalyst, the activation energy of the reaction increases. The correct answer is: **[2007 E]**

1. Both A and R are true and R is the correct explanation of A
2. Both A and R are true and R is not the correct explanation of A

3. A is true but R is not true
4. A is not true but R is true

Ans : 3

Sol: A catalyst increases the rate of a reaction by providing an alternate path with lower activation energy.

$\therefore$ A is true R is not true

5. Observe the following reaction $A(g)+3B(g)\rightarrow 2C(g)$ **[2006 E]**

The rate of this reaction $\left(-\frac{d[A]}{dt}\right)$ is 3×10^{-3} mol. lit^{-1}. min^{-1}. What is the value of $\frac{d[B]}{dt}$ in mol. lit^{-1}. min^{-1} ?

1. 3×10^{-3} 2. 9×10^{-3} 3. 10^{-3} 4. 1.5×10^{-3}

Ans : 2

Sol: $A(g)+3B(g)\rightarrow 2C(g)$

$$\left(-\frac{d[A]}{dt}\right) = \frac{-1}{3}\frac{d[B]}{dt}$$

$$\frac{-d[B]}{dt} = 3\times3\times10^{-3}$$

$= 9\times10^{-3}$ mole lit^{-1} mole^{-1}

6. The rate constant of a first order reaction at 27^{0}C is 10^{-3} min^{-1}. The temperature coefficient of this reaction is 2. What is the rate constant (in min-1) at 17^{0}C for this reaction? **[2006 E]**

1. 10^{-3} 2. 5×10^{-4} 3. 2×10^{-3} 4. 10^{-2}

Ans : 2

Sol:

$$\frac{K_{t^0c}+10^0C}{K_{t^0c}}=2$$

$$\frac{10^{-3}\,\text{min}^{-1}}{K_{17^0C}}=2$$

$$K_{17^0C}=\frac{10^{-3}\,\text{min}^{-1}}{2}$$

$= 5\times10^{-4}\,\text{min}^{-1}$

7. Observe the following reaction : $2A+B\rightarrow C$. The rate of formation of C is 2.2×10^{-3} mol. lit^{-1}. min^{-1}.What is the value of $\frac{-d[A]}{dt}$ (in mol. lit^{-1}. min^{-1}) **[2005 E]**

1. 2.2×10^{-3} 2. 1.1×10^{-3} 3. 4.4×10^{-3} 4. 5.5×10^{-3}

Ans : 3

Sol: $2A+B\rightarrow C$

$$\frac{-1}{2}\frac{d[A]}{dt}=\frac{-d[B]}{dt}=\frac{+d[C]}{dt}$$

$$\therefore \frac{-d[A]}{dt}=2\times\frac{d[C]}{dt}$$

$= 2\times2.2\times10^{-3}$ mol. lit^{-1}. min^{-1}

$= 4.4\times10^{-3}$ mol. lit^{-1}. min^{-1}

8. …….. of a reaction cannot be determined experimentally. **[2004 M]**

1) Order 2) Rate 3) Rate constant 4) Molecularity

Ans : 4

Sol: Molecularity of a reaction cannot be determined experimentally

9. Which of the following relations is correct for a first order reaction? (K=rate constant, r = rate of reaction, C = concentration of reactant) **[2004 M]**

1) $K = r \times c^2$ 2) $K = r \times c$ 3) $K = \frac{c}{r}$ 4) $K = \frac{r}{c}$

Ans : 4

Sol: For a first order reaction

Rate of reaction (r) = rate constant (k) X concentration of reactants (c)

$\therefore K = \frac{r}{c}$

10. For a chemical reaction …….can never be a fractional number **[2003 M]**

1) Order 2) Half life 3) Molecularity 4) Rate constant

Ans : 3

Sol: Molecualrity of a reaction is never a fractional value

11. The rate constant of a reaction at temperature 200K is 10 times less than the rate constant at 400K. What is the activation energy (E_a) of the reaction ? (R = Gas constant) **[2003 M]**

1) 1842.4 R 2) 921.2 R 3) 460.6 R 4) 230.3 R

Ans : 2

Sol:

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

$$\log \frac{10}{1} = \frac{E_a}{2.303R}\left[\frac{400 - 200}{400 \times 200}\right]$$

$$1 = \frac{E_a}{2.303R}\left[\frac{200}{400 \times 200}\right]$$

$$\therefore E_a = 2.303R \times 400 = 921.2R$$

12. Which one of the following equations is correct for the reactions ?

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$ **[2003 M]**

1) $\frac{3d(NH_3)}{dt} = \frac{2dt(H_2)}{dt}$ 2) $\frac{2d(NH_3)}{dt} = \frac{3d(H_2)}{dt}$

3) $\frac{2d(NH_3)}{dt} = \frac{-3d(H_2)}{dt}$ 4) $\frac{3d(NH_3)}{dt} = \frac{-2d(H_2)}{dt}$

Ans : 4

Sol: $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(f)}$

$$\frac{-d[N_2]}{dt} = \frac{-1}{3}\frac{d[H_2]}{dt} = +\frac{1}{2}\frac{d[NH_3]}{dt}$$

Multiplying with 6

$$-2\frac{d(H_2)}{dt} + 3\frac{d(NH_3)}{dt}$$

13. Consider the following reaction $N_2(g)+3H_2(g)\Rightarrow 2NH_3(g)$. The rate of this reaction in terms of N2 at T(k) is $\frac{-d(N_2)}{dt}=0.02\,mole-lit^{-1}-\sec^{-1}$. What is the value of $\frac{-d(H_2)}{dt}$ (in units of mole- lit-1-sec-1) at the same temperature. **[2002 E]**

1) 0.02 2) 50 3) 0.06 4) 0.04

Ans : 3

Sol: $N_2+3H_2\rightarrow 2NH_3$

Rate of reaction = $-\frac{d[N_2]}{dt}=\frac{-1}{3}\frac{d[H_2]}{dt}=+\frac{1}{2}\frac{d[NH_3]}{dt}$

$\frac{-d[H_2]}{dt}=3\times\frac{d[N_2]}{dt}=3\times 0.02$

$=0.06\,mole-lit^{-1}-\sec^{-1}$

14. Consider the following reaction, A $\rightarrow$ products.
This reaction is completed in 100 minutes. The rate constant of this reaction at t_1=10 min is 10^{-2} min^{-1}. What is the rate constant (in min^{-1}) at t_2 = 20 minutes? **[2001 E]**

1) 2×10^{-2} 2) 10^{-2} 3) 5×10^{-3} 4) 0.1

Ans : 2

Sol: For a given reaction the rate constant remain constant as long as temperature is kept constant. It does not depend on the time interval.

15. The rate of reaction for A $\rightarrow$ products is 10 mol. $litre^{-1}$. min^{-1} at time t_1 = 2 minutes. What will be the rate (in mol. lit^{-1} min^{-1}) at time t_2= 12min **[2001 M]**

1) more than 10 2) less than 10 3) 10 4) 20

Ans : 2

Sol: At t_1 = 2 min, the rate of reaction A $\rightarrow$ products is 10 mol. $litre^{-1}$. min^{-1} at t_2= 12
As time passes by, the conc. of reactant A decreases.
As per law of mass action rate of reaction decreases as concentration of reactant decreases.
$\therefore$ Rate is less than 10 mol. lit^{-1} min^{-1}

16. What is the rate of reaction for 2A $\rightarrow$ B ? **[2000 M]**

1) $-\frac{1}{2}\frac{d[A]}{dt}$ 2) $-\frac{d[A]}{dt}$ 3) $-\frac{d[B]}{dt}$ 4) $+\frac{d[A]}{dt}$

Ans : 1

Sol: Rate of reaction = $-\frac{1}{2}\frac{d[A]}{dt}$