

SOLVED QUESTION BANK

Objective / Very Short Answer Type Questions [1 Mark]

1. The half life period of first order reaction is 1386 seconds. The specific rate constant of the reaction is

- (a) $0.5 \times 10^{-2} \text{ s}^{-1}$ (b) $0.5 \times 10^{-3} \text{ s}^{-1}$
(c) $5.0 \times 10^{-2} \text{ s}^{-1}$ (d) $5.0 \times 10^{-3} \text{ s}^{-1}$

Ans. (b) $t_{1/2} = \frac{0.693}{k}$
 $\Rightarrow k = \frac{0.693}{1386} = 0.5 \times 10^{-3} \text{ s}^{-1}$

2. The rate constant of a reaction $A \longrightarrow B$ is 0.6×10^{-3} mole per second. If the concentration of [A] is 5 M, then what will be concentration of [B] after 20 minutes?

- (a) 0.36 M (b) 0.72 M
(c) 1.08 M (d) 3.60 M

Ans. (b) $k = \frac{[R]_0 - [R]}{t}$ for zero order.
 $\Rightarrow 0.6 \times 10^{-3} \times 20 \times 60 = [R]_0 - [R]$
 $\Rightarrow 0.72 \text{ M}$

Amount of [B] produced = $[R]_0 - [R] = 0.72 \text{ M}$

3. Which of the following is affected by catalyst?

- (a) ΔH (b) ΔS
(c) ΔG (d) E_a

Ans. (d) Catalyst affects activation energy. It does not affect, ΔH , ΔS , ΔG .

4. A first order reaction has specific reaction rate 10^{-2} s^{-1} . How much time it will take for 20g of reactant to reduce to 5g?

- (a) 138.6 s (b) 346.5 s
(c) 693.0 s (d) 238.6 s

Ans. (a) $t_{3/4} = \frac{1.386}{k} = \frac{1.386}{10^{-2}} = 138.6 \text{ s}$

5. The activation energy of a reaction can be determined from the slope of which of the following graph:

- (a) $\ln k$ Vs $\frac{1}{T}$ (b) $\frac{T}{\ln k}$ Vs $\frac{1}{T}$
(c) $\ln k$ Vs T (d) $\frac{\ln k}{T}$ Vs T

Ans. (a) When we plot $\ln k$ Vs $\frac{1}{T}$, slope of line = $-\frac{E_a}{R}$.

6. Mechanism of a hypothetical reaction $X_2 + Y_2 \longrightarrow 2XY$ is given below:

- (a) $X_2 \rightleftharpoons X + X$ (fast)
(b) $X + Y_2 \longrightarrow XY + Y$ (slow)
(c) $X + Y \longrightarrow XY$ (fast)

The overall order of reaction is

- (a) 2 (b) 0 (c) 1.5 (d) 1

Ans. (c) rate = $k[X][Y_2]$, $K = \frac{[X]^2}{[X_2]} \Rightarrow [X] = \sqrt{K[X_2]}$
rate = $k \times K^{1/2} [X_2]^{1/2} [Y_2] = k^1 [X_2]^{1/2} [Y_2]^1$
Order = $\frac{1}{2} + 1 = \frac{3}{2} = 1.5$

7. The rate of first order reaction is $0.04 \text{ mol L}^{-1} \text{ s}^{-1}$ at 10 sec, and 0.03 mol L^{-1} at 20 seconds after initiation of the reaction. $t_{1/2}$ of reaction is

- (a) 44.1 s (b) 54.1 s (c) 24.1 s (d) 34.1 s

Ans. (c) $k = \frac{2.303}{20 - 10} \log \frac{0.04}{0.03} = \frac{2.303}{10} \log \frac{4}{3}$
 $= \frac{2.303}{10} (\log 4 - \log 3)$
 $= \frac{2.303}{10} (0.6021 - 0.4771) = \frac{2.303}{10} \times 0.1249$
 $t_{1/2} = \frac{0.693}{k} = \frac{0.693 \times 10}{2.303 \times 0.1249} = \frac{3.010}{0.1249} = 24.1 \text{ s}$

8. If the initial concentration of reactant is doubled $t_{1/2}$ is also doubled, the order of reaction is

- (a) zero (b) 1 (c) 2 (d) 3

Ans. (a) In zero order of reaction $t_{1/2} \propto [R]_0$

9. For a reaction taking place in three steps, the overall rate constant $k = \frac{k_1 k_2}{k_3}$. If E_{a1} , E_{a2} and E_{a3} are 40, 50 and 60 kJ mol⁻¹, the overall E_a is

- (a) 30 (b) 40 (c) 60 (d) 50

Ans. (a) $k = A e^{-E_a/RT}$
 $k = \frac{k_1 k_2}{k_3}$
 $\Rightarrow A e^{-E_a/RT} = \frac{A e^{-E_{a1}/RT} \times A e^{-E_{a2}/RT}}{A e^{-E_{a3}/RT}}$
 $e^{-E_a/RT} = \frac{e^{-E_{a1}/RT} \times e^{-E_{a2}/RT}}{e^{-E_{a3}/RT}}$

Taking \ln on both side we get

$$\frac{E_a}{RT} = -E_{a1} - E_{a2} + E_{a3}$$

$$E_a = E_{a1} + E_{a2} - E_{a3}$$

$$E_a = 40 + 50 - 60 = 30 \text{ kJ mol}^{-1}$$

10. If conc. of reactant 'A' is increased 10 times and rate of reaction becomes 100 times. What is order with respect to 'A'?

- (a) 1 (b) 2 (c) 3 (d) 4

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