PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 47

Total Marks : 30

Max. Time : 30 min.

Topic : Chemical Kinetics

Type of Questions | **M.M., Min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.10 (3 marks 3 min.) [30, 30]

1. $2NO + 2H_2 \longrightarrow N_2 + 2H_2O$. The experimental rate law for above reaction is, Rate = k $[NO]^2 [H_2]$. When time is in minutes and the concentration is in moles/L, the units for k are

(A) $\frac{\text{moles}^3}{L^3 - \text{min}}$ (B) $\frac{\text{moles}}{L - \text{min}}$ (C) $\frac{\text{moles}^2}{L^2 - \text{min}}$ (D) $\frac{L^2}{\text{moles}^2 - \text{min}}$

2. The differential rate law equation for the elementary reaction $A + 2B \xrightarrow{K} 3C$, is :

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

(C) $-\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt} = k[A][B]^2$ (D) None of these

3. For the reaction $2A \longrightarrow B + 3C$; if $-\frac{d[A]}{dt} = k_1[A]^2$; $\frac{d[B]}{dt} = k_2[A]^2$; $\frac{d[C]}{dt} = k_3[A]^2$, the correct relation between k_1, k_2, and k_3 is :

(A) $k_1 = k_2 = k_3$ (B) $2k_1 = k_2 = 3k_3$ (C) $4k_1 = k_2 = 3k_3$ (D) $\frac{k_1}{2} = k_2 = \frac{k_3}{3}$

4. Which of the following statement is incorrect?

(A) Unit of rate of disappearance is Ms^{-1} (B) Unit of rate of reaction is Ms^{-1}

(C) Unit of rate constant k is depend on order (D) Unit of k for first order reaction is Ms^{-1}

5. The rate expression for reaction A (g) + B(g) → C(g) is **rate = $k[A]^{1/2}[B]^2$**. What change in rate if initial concentration of A and B increase by factor 4 and 2 respectively ?

(A) 4 (B) 6 (C) 8 (D) None of these

6. Reaction A → B follows second order kinetics. Doubling the concentration of A will increase the rate of formation of B by a factor of :

(A) 1/4 (B) 1/2 (C) 2 (D) 4

7. For the reaction $2NO_2 \longrightarrow N_2O_2 + O_2$, rate expression is as follows

$-\frac{d[NO_2]}{dt} = K[NO_2]^n$, where $K = 3 \times 10^{-3}$ $mol^{-1}\,L\,sec^{-1}$. If the rate of formation of oxygen is 1.5×10^{-4} mol L^{-1} sec^{-1}, then the molar concentration of NO_2 in mole L^{-1} is

(A) 1.5×10^{-4} (B) 0.0151 (C) 0.214 (D) 0.316

8. Sodium (Na = 23) crystallizes in bcc arrangement with the interfacial separation between the atoms at the edge 53.6 pm. The density of sodium crystal is:

(A) 2.07 g/cc (B) 2.46 g/cc (C) 1.19 g/cc (D) none of these

9. $TlAl(SO_4)_2 \cdot xH_2O$ is bcc with 'a' = 1.22 nm. If the density of the solid is 2.32 g/cc, then the value of x is (Given: $N_A = 6 \times 10^{23}$; at. wt. : Tl = 204, Al = 27, S = 32).

(A) 2 (B) 4 (C) 47 (D) 70

10. An atomic solid crystallizes in a body centre cubic lattice and the inner surface of the atoms at the adjacent corner are separated by 60.3 pm. If the atomic weight of A is 48, then density of the solid, is nearly:

(A) 2.7 g/cc (B) 5.07 g/cc (C) 3.5 g/cc (D) 1.75 g/cc

Answer Key

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1.	(D)	**2.**	(C)	**3.**	(D)	**4.**	(D)	**5.**	(C)
6.	(D)	**7.**	(D)	**8.**	(C)	**9.**	(C)	**10.**	(D)

Hints & Solutions

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1. Rate = k $[NO]^2 [H_2]$

$$\frac{\text{conc.}}{\text{time}} = k\,(\text{conc.})^3 \quad \Rightarrow \quad k = \frac{1}{\text{time}(\text{conc.})^2}$$

$$k = \frac{1}{\frac{\text{moles}^2}{L^2}(\text{min})} = \frac{L^2}{\text{moles}^2 - \text{min}}$$

2. $A + 2B \xrightarrow{K} 3C$ (elementary reaction)

$$\text{Rate} = -\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt} = k\,[A]\,[B]^2$$

3. $$\text{Rate} = -\frac{1}{2}\frac{d[A]}{dt} = \frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt}$$

$$\frac{k_1}{2}[A]^2 = K_2[A]^2 = \frac{k_3}{3}[A]^2$$

$$\Rightarrow \quad \frac{k_1}{2} = k_2 = \frac{k_3}{3}$$

4. Unit of k for first order reaction is s^{-1}.

5. Rate $= k[A]^{1/2}[B]^2$

$r_1 = k[a]^{1/2}[b]^2$; $\qquad r_2 = k[4a]^{1/2}[2b]^2$

$$\Rightarrow \quad \frac{r_1}{r_2} = \frac{1}{2 \times 4} = \frac{1}{8}$$

$$\Rightarrow \quad r_2 = 8 \times r_1$$

6. $A \longrightarrow B$

$$\text{rate} = -\frac{d[A]}{dt} = \frac{d[B]}{dt} = k[A]^2$$

$$\frac{\left(\frac{d[B]}{dt}\right)_1}{\left(\frac{d[B]}{dt}\right)_2} = \frac{k(a)^2}{k(2a)^2} = \frac{1}{4}$$

7. From the unit of K, it is evident that it is a second order reaction.

$-\frac{1}{2}\frac{d[NO_2]}{dt} = \frac{d[O_2]}{dt} \Rightarrow \therefore -\frac{d[NO_2]}{dt} = 2 \times \frac{d[O_2]}{dt} = 2 \times 1.5 \times 10^{-4} = 3 \times 10^{-4}$

$3 \times 10^{-4} = K[NO_2]^2 = 3 \times 10^{-3}[NO_2]^2 \Rightarrow \therefore [NO_2] = 0.316.$

8. $a - 2r = 53.6$ pm

also $4r = \sqrt{3}a \Rightarrow a - \frac{\sqrt{3}}{2}a = 53.6$

$\Rightarrow a = \frac{53.6 \times 2}{2 - \sqrt{3}} = 400$ pm

Density $(\rho) = \frac{2 \times 23}{6.023 \times 10^{23} \times 4^3 \times 10^{-24}} = 1.19$ g/cc

9. $2.32 = \frac{2 \times M}{6 \times 10^{23}(1.22)^3 \times 10^{-21}}$

$\Rightarrow M = 1264 \Rightarrow x \approx 47.$

10. Given $a - 2r = 60.3$ and for bcc, $4r = \sqrt{3}a$

$\Rightarrow a - \frac{\sqrt{3}}{2}a = 60.3 \Rightarrow a = 450$ pm

Density $(\rho) = \frac{2 \times 48}{6.023 \times 10^{23} \times (4.5)^3 \times 10^{-24}} = 1.75$ g/cc.