



DPP –1 [Differential Rate Law]

Chapter: Chemical Kinetics

“I don't wait to feel ready. I become ready by starting. This chapter ends only when I win.”

TYPE–1 : Stoichiometric Rate Relationships

1. Consider the chemical reaction :



The rate of this reaction can be expressed in terms of concentration of $\text{N}_2(\text{g})$, $\text{H}_2(\text{g})$ or $\text{NH}_3(\text{g})$. Identify the correct relationship amongst the rate expressions.

$$(1) \text{Rate} = -\frac{d[\text{N}_2]}{dt} = -\frac{1}{3} \frac{d[\text{H}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$$

$$(2) \text{Rate} = -\frac{d[\text{N}_2]}{dt} = -\frac{3}{d[\text{H}_2]} \frac{dt}{dt} = \frac{2}{2d[\text{NH}_3]} \frac{dt}{dt}$$

$$(3) \text{Rate} = \frac{d[\text{N}_2]}{dt} = \frac{1}{3} \frac{d[\text{H}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$$

$$(4) \text{Rate} = -\frac{d[\text{N}_2]}{dt} = -\frac{d[\text{H}_2]}{dt} = \frac{d[\text{NH}_3]}{dt}$$

2. In the formation of sulphur trioxide by the contact process $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$; the rate of reaction is expressed as

$$-\frac{d[\text{O}_2]}{dt} = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

The rate of disappearance of (SO_2) will be

$$(1) 5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$(2) -2.25 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$(3) 3.75 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$(4) 50.0 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

3. In a catalytic reaction involving the formation of ammonia by Haber's process $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ the rate of appearance of NH_3 was measured as $2.5 \times 10^{-4} \text{ mole L}^{-1} \text{ s}^{-1}$

The rate of disappearance of H_2 will be –

$$(1) 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$(2) 1.25 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$(3) 3.75 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$(4) 5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

4. Which of the following statement is correct for a reaction $\text{X} + 2\text{Y} \rightarrow \text{Product}$

(1) The rate of disappearance of X = twice the rate of disappearance of Y.

(2) The rate of disappearance of X = $\frac{1}{2}$ rate of appearance of products

(3) The rate of appearance of products = $\frac{1}{2}$ the rate of disappearance of Y

(4) The rate of appearance of products = $\frac{1}{2}$ the rate of disappearance of X

5. Which of the following statement is not correct for the reaction: $4\text{A} + \text{B} \rightarrow 2\text{C} + 2\text{D}$

(1) The rate of disappearance of B is twice the rate of appearance of C

(2) The rate of disappearance of B is one fourth the rate of disappearance of A

(3) The rate of formation of D is one half the rate of consumption of A

(4) The rate of formation of C and D are equal

6. In a reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$ the rate of appearance of NH_3 is $2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$. The Rate of reaction & rate of disappearance of H_2 will be (In $\text{mol L}^{-1} \text{ sec}^{-1}$)

(1) 3.75×10^{-4} , 1.25×10^{-4}

(2) 1.25×10^{-4} , 2.5×10^{-4}

(3) 1.25×10^{-4} , 3.75×10^{-4}

(4) 5.0×10^{-4} , 3.75×10^{-4}

7. In the reaction of formation of sulphur trioxide by contact process $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ the rate of reaction was measured as $\frac{d[\text{O}_2]}{dt} = -2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$. The rate of reaction in terms of $[\text{SO}_2]$ in $\text{mol L}^{-1} \text{ s}^{-1}$ will be :

[JEE(Main) 2014 Online (11-04-14), 4/120]

(1) -1.25×10^{-4}

(2) -2.50×10^{-4}

(3) -3.75×10^{-4}

(4) -5.00×10^{-4}

8. Consider the chemical reaction,



The rate of this reaction can be expressed in terms of time derivatives of conc. of $\text{N}_2(\text{g})$, $\text{H}_2(\text{g})$ or $\text{NH}_3(\text{g})$. Identify the correct relationship amongst rate expressions :

[JEE-2002(S), 3/90]

(A) Rate = $-\frac{d[\text{N}_2]}{dt} = -\frac{1}{3} \frac{d[\text{H}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$

(B) Rate = $\frac{d[\text{N}_2]}{dt} = -3 \frac{d[\text{H}_2]}{dt} = 2 \frac{d[\text{NH}_3]}{dt}$

(C) Rate = $\frac{d[\text{N}_2]}{dt} = -\frac{1}{3} \frac{d[\text{H}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$

(D) Rate = $-\frac{d[\text{N}_2]}{dt} = -\frac{d[\text{H}_2]}{dt} = \frac{d[\text{NH}_3]}{dt}$

9. Rate of formation of SO_3 according to the reaction $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ is $1.6 \times 10^{-3} \text{ kg min}^{-1}$ Hence rate at which SO_2 reacts is :-

(1) $1.6 \times 10^{-3} \text{ kg min}^{-1}$

(2) $8.0 \times 10^{-4} \text{ kg min}^{-1}$

(3) $3.2 \times 10^{-3} \text{ kg min}^{-1}$

(4) $1.28 \times 10^{-3} \text{ kg min}^{-1}$

10. Rate of formation of SO_3 in the following reaction $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ is 100 g min^{-1} . Hence rate of disappearance of O_2 is :

(A) 50 g min^{-1}

(B) 40 g min^{-1}

(C) 200 g min^{-1}

(D) 20 g min^{-1}

11. For a general chemical change $2\text{A} + 3\text{B} \rightarrow \text{products}$, the rate of disappearance of A is r_1 and of B is r_2 . The rates r_1 and r_2 are related as :-

(1) $3r_1 = 2r_2$

(2) $r_1 = r_2$

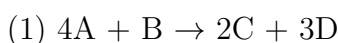
(3) $2r_1 = 3r_2$

(4) $r_1^2 = 2r_2^2$

12. The rate of a reaction is expressed as :

$$-\frac{1}{2} \frac{\Delta[\text{C}]}{\Delta t} = \frac{1}{3} \frac{\Delta[\text{D}]}{\Delta t} = \frac{1}{4} \left(-\frac{\Delta[\text{A}]}{\Delta t} \right) = \left(-\frac{\Delta[\text{B}]}{\Delta t} \right)$$

Then reaction is



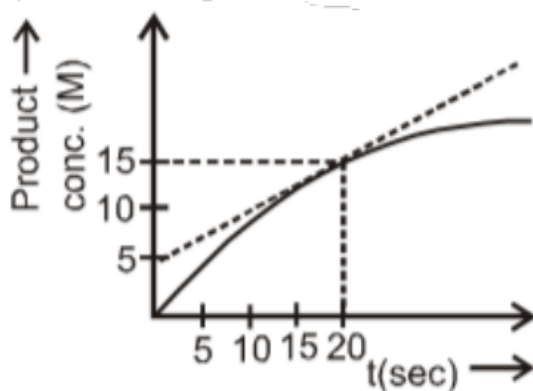


13. In the reaction, $A + 2B \rightarrow 6C + 2D$ if the initial rate $(-\frac{\Delta[A]}{\Delta t})$ at $t = 0$ is $2.6 \times 10^{-2} \text{ M s}^{-1}$, what will be the value of $(-\frac{\Delta[B]}{\Delta t})$ at $t = 0$?
- (1) $8.5 \times 10^{-2} \text{ M s}^{-1}$ (2) $2.6 \times 10^{-2} \text{ M s}^{-1}$
 (3) $5.2 \times 10^{-2} \text{ M s}^{-1}$ (4) $7.5 \times 10^{-2} \text{ M s}^{-1}$

14. In the following reaction, how is the rate of appearance of the underlined product related to the rate of disappearance of the underlined reactant $\underline{\text{BrO}_3^-}(\text{aq}) + 5\underline{\text{Br}^-}(\text{aq}) + 6\underline{\text{H}^+}(\text{aq}) \rightarrow 3\underline{\text{Br}_2}(\text{l}) + 3\underline{\text{H}_2\text{O}}(\text{aq})$

(1) $(-\frac{\Delta[\text{BrO}_3^-]}{\Delta t}) = \frac{\Delta[\text{Br}_2]}{\Delta t}$ (2) $(-\frac{1}{3} \frac{\Delta[\text{BrO}_3^-]}{\Delta t}) = \frac{\Delta[\text{Br}_2]}{\Delta t}$
 (3) $(-\frac{\Delta[\text{BrO}_3^-]}{\Delta t}) = \frac{1}{3} \frac{\Delta[\text{Br}_2]}{\Delta t}$ (4) None of these

15. Graph showing product concentration vs time:



Rate of formation of product at $t = 20 \text{ s}$ is

- (A) 0.5 M s^{-1} (B) 1 M s^{-1}
 (C) 1.5 M s^{-1} (D) 2 M s^{-1}

16. In the following reaction : $x\text{A} \rightarrow y\text{B}$

$$\log \left[-\frac{d[A]}{dt} \right] = \log \left[\frac{d[B]}{dt} \right] + 0.3$$

where -ve sign indicates rate of disappearance of the reactant. Thus, $x : y$ is :

- (A) 1 : 2 (B) 2 : 1
 (C) 3 : 1 (D) 3 : 10