



## DPP –2 [Rate Law]

### Chapter: Chemical Kinetics

*“You don’t rise by thinking... You rise by doing.”*

#### TYPE–1 : Order of Reaction

1. The rate of certain hypothetical reaction  $A + B + C \rightarrow$  products is given by  $r = -\frac{d[A]}{dt} = K[A]^x[B]^y[C]^4$  The order of the reaction –
- (1) 1                      (2)  $\frac{1}{2}$   
(3) 2                      (4)  $\frac{13}{12}$
2. Which of the following rate law has an overall order of 0.5 for reaction involving substances x,y and z ?
- (1) Rate = K (C<sub>x</sub>) (C<sub>y</sub>) (C<sub>z</sub>)  
(2) Rate = K (C<sub>x</sub>)<sup>0.5</sup>(C<sub>y</sub>)<sup>-0.5</sup>(C<sub>z</sub>)<sup>0.5</sup>  
(3) Rate = K (C<sub>x</sub>)<sup>1.5</sup> (C<sub>y</sub>)<sup>-0.5</sup>(C<sub>z</sub>)<sup>0</sup>  
(4) Rate = K(C<sub>x</sub>)(C<sub>y</sub>)<sup>2</sup> / (C<sub>z</sub>)<sup>2</sup>
3. For the reaction  $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ , the experimental data suggests, Rate = K [H<sub>2</sub>] [Br<sub>2</sub>]<sup>1/2</sup>. The order for this reaction is –
- (1) 2                      (2)  $1\frac{1}{2}$   
(3) 1                      (4)  $2\frac{1}{2}$
4. A chemical reaction involves two reacting species. The rate of reaction is directly proportional to the concentration of one of them and inversely proportional to the concentration of the other. The order of reaction is –
- (1) 1                      (2) 2  
(3) Zero                      (4) Unpredictable

#### TYPE–2 : Initial rate method

5. Select the rate law that corresponds to the data shown for the following reaction  $A + B \rightarrow C$

Exp.	[A]	[B]	Initial rate
1.	0.012	0.035	0.10
2.	0.024	0.070	1.6
3.	0.024	0.035	0.20
4.	0.012	0.070	0.80

- (1) Rate = K [B]<sup>3</sup>                      (2) Rate = K[B]<sup>4</sup>  
(3) Rate = K[A][B]<sup>3</sup>                      (4) Rate = K[A]<sup>4</sup>[B]<sup>2</sup>

6. In a certain gaseous reaction between X and Y,  $X + 3Y \rightarrow XY_3$  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)  $r = K[X][Y]^3$                       (2)  $r = K[X][Y]^2$   
 (3)  $r = K[X][Y]$                         (4)  $r = [X]^2[Y]^3$

7. Select the law that corresponds to data shown for the following reaction  $2A + B \rightarrow C + D$  :-

Exp.	[A]	[B]	Initial rate (mol L <sup>-1</sup> min <sup>-1</sup> )
1.	0.1	0.1	$7.5 \times 10^{-8}$
2.	0.3	0.2	$9.0 \times 10^{-7}$
3.	0.3	0.4	$3.6 \times 10^{-1}$
4.	0.4	0.1	$3.0 \times 10^{-2}$

- (1) Rate = K [A]<sup>2</sup>[B]                      (2) Rate = K[A][B]<sup>2</sup>  
 (3) Rate = K[A][B]<sup>3</sup>                        (4) Rate = K[A][B]

8. For a hypothetical reaction :  $A + B \rightarrow C$  the following data were obtained in three different experiments :-

[A] (mol L <sup>-1</sup> )	[B] (mol L <sup>-1</sup> )	Rate of reaction (mol L <sup>-1</sup> min <sup>-1</sup> )
0.01	0.01	$1.0 \times 10^{-4}$
0.01	0.03	$9.0 \times 10^{-4}$
0.03	0.03	$2.70 \times 10^{-3}$

The rate law will be :-

- (1)  $r = K[A]^2[B]$                       (2)  $r = K[A][B]^2$   
 (3)  $r = K[A][B]$                         (4) None of these

9. Calculate the order of the reaction w.r.t. A and B:

[A] (mol L <sup>-1</sup> )	[B] (mol L <sup>-1</sup> )	Rate
0.05	0.05	$1.2 \times 10^{-3}$
0.10	0.05	$2.4 \times 10^{-3}$
0.05	0.10	$1.2 \times 10^{-3}$

- (1) 1 and 0                                  (2) 1 and 1  
 (3) 0 and 1                                (4) None

10.  $A_2 + B_2 \rightarrow 2AB$ ; R.O.R. =  $k[A_2]^a[B_2]^b$

[A <sub>2</sub> ]	[B <sub>2</sub> ]	Rate of reaction [Ms <sup>-1</sup> ]
0.2	0.2	0.04
0.1	0.4	0.04
0.2	0.4	0.08

order of reaction with respect to  $A_2$  and  $B_2$  are respectively :

- (1)  $a=1, b=1$                       (2)  $a=2, b=0$   
(3)  $a=2, b=1$                       (4) None

11. For a chemical reaction  $A + B \rightarrow$  product, the order is one with respect to each A and B. Value of x and y from the given data is :-

Rate (mol L <sup>-1</sup> s <sup>-1</sup> )	[A]	[B]
0.10	0.20 M	0.05 M
0.40	x	0.05 M
0.80	0.40 M	y

- (1) 0.20, 0.80                      (2) 0.80, 0.40  
(3) 0.80, 0.20                      (4) 0.40, 0.20

12. For a reaction of the type  $A + B \rightarrow$  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 -

- (1) Rate = K [A][B]  
(2) Rate = K [A]<sup>2</sup>  
(3) Rate = K[A]<sup>2</sup>[B]  
(4) Rate = K[A]<sup>4</sup>[B]<sup>2</sup>

13. For a reaction  $A + B \rightarrow$  products, the rate of the reaction was doubled when the concentration of A was doubled, the rate was again doubled when the concentration of A & B were doubled the order of the reaction with respect to A & B are:-

- (1) 1, 1                      (2) 2, 0  
(3) 1, 0                      (4) 0, 1

14. For a chemical reaction  $A \rightarrow B$ , the rate of reaction doubles when the concentration of A is increased 8 times. The order of reaction w.r.t. A is :-

- (1) 3                      (2)  $\frac{1}{2}$   
(3)  $\frac{1}{3}$                       (4) Zero

15. For the reaction  $A + B \rightarrow$  products, it is found that the order of A is 1 and the order of B is  $\frac{1}{2}$ . When the concentration of both A and B are increased four times, the rate will increase by a factor of :-

- (1) 16                      (2) 8  
(3) 6                      (4) 4

16. For  $A(g) + B(g) \rightarrow C(g)$ ; rate =  $k[A]^{1/2}[B]^2$ , if initial concentration of A and B are increased by factor of 4 and 2 respectively, then the initial rate is changed by the factor :-

- (1) 4                      (2) 6  
(3) 8                      (4) None of these

17. For a reaction the initial rate is given as :  $R_0 = k[A_0]^2[B_0]^1$  by what factor, the initial rate of reaction will increase if initial concentration of A is 1.5 times and B is tripled ?

- (1) 4.5                      (2) 2.25  
(3) 6.75                      (4) None of these

18. The rate law for a reaction  $A + B \rightarrow$  product is rate =  $K[A]^1[B]^2$ . Then which one of

**the following statement is false :-**

- (1) If [B] is held constant while [A] is doubled, the reaction will proceed twice as fast
  - (2) If [A] is held constant while [B] is reduced to one quarter, the rate will be halved
  - (3) If [A] and [B] are both doubled, the reaction will proceed 8 times as fast
  - (4) This is a third order reaction
19. **The specific rate constant of a first order reaction depends on the :-**
- (1) Concentration of the reactant
  - (2) Concentration of the product
  - (3) Time
  - (4) Temperature

### TYPE-3 : Rate Law Expressions

20. **For a reaction  $pA + qB \rightarrow$  products, the rate law expression is  $r = k[A]^1 [B]^m$ , then :**
- (A)  $(p+1) \leq (1+m)$                       (B)  $(p+q) > (1+m)$   
(C)  $(p+q)$  may or may not be equal to  $(1+m)$                       (D)  $(p+q) = (1+m)$
21. **If rate constant is numerically the same for the three reactions of first, second and third order respectively. Assume all the reactions of the kind  $A \rightarrow$  products. Which of the following is correct :**
- (A) if  $[A] = 1$  then  $r_1 = r_2 = r_3$                       (B) if  $[A] < 1$  then  $r_1 > r_2 > r_3$   
(C) if  $[A] > 1$  then  $r_3 > r_2 > r_1$                       (D) All
22. **The rate constant for the reaction,  $2N_2O_5 \rightarrow 4NO_2 + O_2$ , is  $3 \times 10^{-5} s^{-1}$ . If the rate is  $2.4 \times 10^{-5} mol L^{-1} s^{-1}$ , then the concentration of  $N_2O_5$  (in  $mol L^{-1}$ ) is :**
- [JEE-2000(S), 1/35]
- (A) 1.4                      (B) 1.2  
(C) 0.04                      (D) 0.8
23. **For the irreversible process,  $A + B \rightarrow$  products, the rate is first-order w.r.t. A and second-order w.r.t. B. If 1.0 mol each of A and B introduced into a 1.0 L vessel, and the initial rate was  $1.0 \times 10^{-2} mol L^{-1} s^{-1}$ , rate when half reactants have been turned into products is :**
- (A)  $1.25 \times 10^{-3} mol L^{-1} s^{-1}$                       (B)  $1.0 \times 10^{-2} mol L^{-1} s^{-1}$   
(C)  $2.50 \times 10^{-3} mol L^{-1} s^{-1}$                       (D)  $2.0 \times 10^{-2} mol L^{-1} s^{-1}$
24. **The rate law for the reaction below is given by the expression  $k [A][B]$   
 $A + B \rightarrow$  Product  
If the concentration of B is increased from 0.1 to 0.3 mole, keeping the value of A at 0.1 mole, the rate constant will be :**
- [JEE(Main) 2016 Online (10-04-16), 4/120]
- (1) 9 k                      (2) 3 k  
(3) k/3                      (4) k
25. **For the reaction,  $2A + B \rightarrow$  products, when the concentration of A and B both were doubled, the rate of the reaction increased from  $0.3 mol L^{-1} s^{-1}$  to  $2.4 mol L^{-1} s^{-1}$ . When the concentration of A alone is doubled, the rate increased from  $0.3 mol L^{-1} s^{-1}$  to  $0.6 mol L^{-1} s^{-1}$ .  
Which one of the following statements is correct?**

- (1) Order of the reaction with respect to B is 1  
 (2) Order of the reaction with respect to B is 2  
 (3) Total order of the reaction is 4  
 (4) Order of the reaction with respect to A is 2
26. **Initial rates,  $r_0$ , of the  $A + B \rightarrow P$  at different initial concentrations of A and B ( $[A]_0$  and  $[B]_0$ ) are given below:**

$[A]_0$ (mol L <sup>-1</sup> )	$[B]_0$ (mol L <sup>-1</sup> )	$r_0$ (mol L <sup>-1</sup> s <sup>-1</sup> )
0.1	0.1	0.05
0.2	0.1	0.10
0.1	0.2	0.05

- (a) Write the rate equation.  $K[A]_0$   
 (b) Calculate the rate constant of the reaction. 0.5

[JEE-2004(M), 2/60]

### TYPE-4: Differential Rate Laws & Rate law connection

27. **For the reaction,  $3A + 2B \rightarrow C + D$ , the differential rate law can be written as :**

[JEE(Main) 2014 Online (19-04-14), 4/120]

- (1)  $\frac{1}{3} \frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$   
 (2)  $-\frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$   
 (3)  $+\frac{1}{3} \frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$   
 (4)  $-\frac{1}{3} \frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$
28. **For the reaction,  $2N_2O_5 \rightarrow 4NO_2 + O_2$ , the rate equation can be expressed in two ways  $-\frac{d}{dt} [N_2O_5] = k[N_2O_5]$  and  $+\frac{d}{dt} [NO_2] = k'[N_2O_5]$  k and k' related as P:**

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

- (1)  $k = k'$                       (2)  $2k = k'$   
 (3)  $k = 2k'$                     (4)  $k = 4k'$
29. **For the reaction,  $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$  the rate expression can be written in the following ways:**  
 $\{d [N_2] / dt\} = k_1 [NO][H_2]$  ;  $\{d[H_2O] / dt\} = k[NO][H_2]$  ;  $\{-d[NO] / dt\} = k'_1 [NO][H_2]$  ;  $\{-d[H_2] / dt\} = k''_1 [NO][H_2]$   
**The relationship between k,  $k_1$ ,  $k'_1$  and  $k''_1$  is :**

- (A)  $k = k_1 = k'_1 = k''_1$                       (B)  $k = 2k_1 = k'_1 = k''_1$   
 (C)  $k = 2k'_1 = k_1 = k''_1$                     (D)  $k = k_1 = k'_1 = 2k''_1$
30.  **$aA + bB \rightarrow \text{Product}$ ,  $dx/dt = k [A]^p [B]^p$  . If concentration of A is doubled, rate is four times. If concentration of B is made four times, rate is doubled. What is relation between rate of disappearance of A and that of B ?**

- (A)  $-\{d [A] / dt\} = -\{d [B] / dt\}$   
 (B)  $\{d [A] / dt\} = -\{4 d [B] / dt\}$   
 (C)  $-\{4 d [A] / dt\} = -\{d [B] / dt\}$

(D) None of these

31. **For the elementary reaction  $M \rightarrow N$ , the rate of disappearance of M increases by a factor of 8 upon doubling the concentration of M. The order of the reaction with respect to M is :**

[JEE(Advanced) 2014, 3/120]

(A) 4

(B) 3

(C) 2

(D) 1