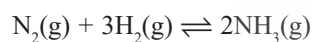


# CHAPTER 3

## Chemical Kinetics

### Rate of Chemical Reactions

1. For the chemical reaction



The correct option is:

(2019)

- a.  $-\frac{1}{3} \frac{d[\text{H}_2]}{dt} = -\frac{1}{2} \frac{d[\text{NH}_3]}{dt}$     b.  $-\frac{d[\text{N}_2]}{dt} = 2 \frac{d[\text{NH}_3]}{dt}$   
c.  $-\frac{d[\text{N}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$     d.  $3 \frac{d[\text{H}_2]}{dt} = 2 \frac{d[\text{NH}_3]}{dt}$

### Factors Influencing Rate of a Reaction & Order of Reaction

2. Mechanism of a hypothetical reaction

(2017-Delhi)

$\text{X}_2 + \text{Y}_2 \rightarrow 2\text{XY}$  is given below:

- (i)  $\text{X}_2 \rightarrow \text{X} + \text{X}$  (fast)  
(ii)  $\text{X} + \text{Y}_2 \rightleftharpoons \text{XY} + \text{Y}$  (slow)  
(iii)  $\text{X} + \text{Y} \rightarrow \text{XY}$  (fast)

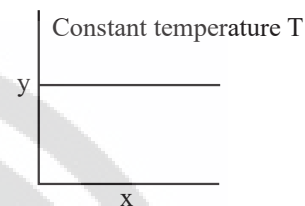
The overall order of the reaction will be

- a. 1.5    b. 1  
c. 2    d. 0
3. The decomposition of phosphine ( $\text{PH}_3$ ) on tungsten at low pressure is a first-order reaction. It is because the: (2016-II)
- a. Rate is proportional to the surface coverage  
b. Rate is inversely proportional to the surface coverage  
c. Rate is independent of the surface coverage  
d. Rate of decomposition is very low

### Integrated Rate Equation & Half Life of Reactions

4. For a first order reaction  $\text{A} \rightarrow \text{Products}$ , initial concentration of A is 0.1 M, which becomes 0.001 M after 5 minutes. Rate constant for the reaction in  $\text{min}^{-1}$  is (2022)
- a. 0.2303    b. 1.3818  
c. 0.9212    d. 0.4606

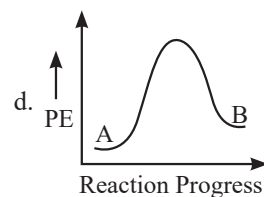
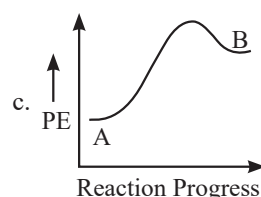
5. The given graph is a representation of kinetics of a reaction.



The y and x axes for zero and first order reactions, respectively are (2022)

- a. zero order ( $y = \text{rate}$  and  $x = \text{concentration}$ ), first order ( $y = \text{rate}$  and  $x = t_{1/2}$ )  
b. zero order ( $y = \text{concentration}$  and  $x = \text{time}$ ), first order ( $y = t_{1/2}$  and  $x = c$  concentration)  
c. zero order ( $y = \text{concentration}$  and  $x = \text{time}$ ), first order ( $y = \text{rate constant}$  and  $x = \text{concentration}$ )  
d. zero order ( $y = \text{rate}$  and  $x = \text{concentration}$ ), first order ( $y = t_{1/2}$  and  $x = \text{concentration}$ )
6. The rate constant for a first order reaction is  $4.606 \times 10^{-3} \text{ s}^{-1}$ . The time required to reduce 2.0 g of the reactant to 0.2 g is: (2020)
- a. 200 s    b. 500 s  
c. 1000 s    d. 100 s
7. The half-life for a zero order reaction having 0.02 M initial concentration of reactant is 100 s. The rate constant (in  $\text{mol L}^{-1} \text{ s}^{-1}$ ) for the reaction is (2020-Covid)
- a.  $2.0 \times 10^{-4}$     b.  $2.0 \times 10^{-3}$   
c.  $1.0 \times 10^{-2}$     d.  $1.0 \times 10^{-4}$
8. If the rate constant for a first order reaction is k, the time (t) required for the completion of 99% of the reaction is given by: (2019)
- a.  $t = 0.693/k$   
b.  $t = 6.909/k$   
c.  $t = 4.606/k$   
d.  $t = 2.303/k$
9. When initial concentration of the reactant is doubled, the half-life period of a zero order reaction (2018)
- a. Is halved  
b. Is doubled  
c. Is tripled  
d. Remains unchanged

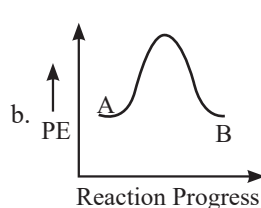
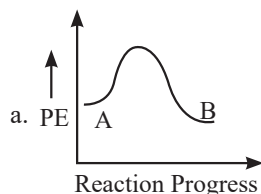
10. The correct difference between first and second order reactions is that: (2018)
- The rate of a first-order reaction does not depend on reactant concentrations; the rate of a second-order reaction does depend on reactant concentrations
  - The half-life of a first-order reaction does not depend on  $[A]_0$ ; the half-life of a second-order reaction does depend on  $[A]_0$
  - The rate of a first-order reaction does depend on reactant concentrations; the rate of a second-order reaction does not depend on reactant concentrations
  - A first-order reaction can be catalyzed; a second-order reaction cannot be catalyzed
11. A first order reaction has a specific reaction rate of  $10^{-2} \text{ s}^{-1}$ . How much time will it take for 20 g of the reactant to reduce to 5 g? (2017-Delhi)
- 693.0 second
  - 238.6 second
  - 138.6 second
  - 346.5 second
12. The rate of a first-order reaction is  $0.04 \text{ mol L}^{-1} \text{ s}^{-1}$  at 10 seconds and  $0.03 \text{ mol L}^{-1} \text{ s}^{-1}$  at 20 seconds after initiation of the reaction. The half-life period of the reaction is: (2016 - I)
- 54.1 s
  - 24.1 s
  - 34.1 s
  - 44.1 s
13. The rate constant of the reaction  $A \rightarrow B$  is  $0.6 \times 10^{-3} \text{ mole per second}$ . If the concentration of A is 5 M, then concentration of B after 20 minutes is: (2015 Re)
- 0.72 M
  - 1.08 M
  - 3.60 M
  - 0.36 M
14. When initial concentration of a reactant is doubled in a reaction, its half-life period is not affected. The order of the reaction is: (2015)
- First
  - Second
  - More than zero but less than first
  - Zero



16. The slope of Arrhenius Plot ( $\ln K$  v/s  $1/T$ ) of first order reaction is  $-5 \times 10^3 \text{ K}$ . The value of  $E_a$  of the reaction is. Choose the correct option for your answer. (2021)  
[Given  $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ ]
- $83.0 \text{ kJ mol}^{-1}$
  - $166 \text{ kJ mol}^{-1}$
  - $-83 \text{ kJ mol}^{-1}$
  - $41.5 \text{ kJ mol}^{-1}$
17. The addition of a catalyst during a chemical reaction alters which of the following quantities? (2016 - I)
- Activation energy
  - Entropy
  - Internal energy
  - Enthalpy
18. The activation energy of a reaction can be determined from the slope of which of the following graphs? (2015)
- $\frac{\ln k}{T}$  vs.  $T$
  - $\ln k$  vs.  $\frac{1}{T}$
  - $\frac{T}{\ln k}$  vs.  $\frac{1}{T}$
  - $\ln k$  vs.  $T$
19. A reaction having equal energies of activation for forward and reverse reactions has: (2013)
- $\Delta S = 0$
  - $\Delta G = 0$
  - $\Delta H = 0$
  - $\Delta H = \Delta G = \Delta S = 0$
20. What is the activation energy for a reaction if its rate doubles when the temperature is raised from  $20^\circ\text{C}$  to  $35^\circ\text{C}$ ? ( $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ) (2013)
- $342 \text{ kJ mol}^{-1}$
  - $269 \text{ kJ mol}^{-1}$
  - $34.7 \text{ kJ mol}^{-1}$
  - $15.1 \text{ kJ mol}^{-1}$

### Temperature Dependence of the Rate of a Reaction & Effect of Catalysts

15. For a reaction  $A \rightarrow B$ , enthalpy of reaction is  $-4.2 \text{ kJ mol}^{-1}$  and enthalpy of activation is  $9.6 \text{ kJ mol}^{-1}$ . The correct potential energy profile for the reaction is shown in option. (2021)



### Collision Theory of Chemical Reactions

21. In collision theory of chemical reaction,  $Z_{AB}$  represents (2020-Covid)
- The collision frequency of reactants, A and B
  - Steric factor
  - The fraction of molecules with energies equal to  $E_a$
  - The fraction of molecules with energies greater than  $E_a$
22. An increase in the concentration of the reactants of a reaction leads to change in : (2020)
- Heat of reaction
  - Threshold energy
  - Collision frequency
  - Activation energy

**Answer Key**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	a	a	c	d	b	d	c	b	b	c	b	a	a	a	d	a
18	19	20	21	22												
b	c	c	a	c												

