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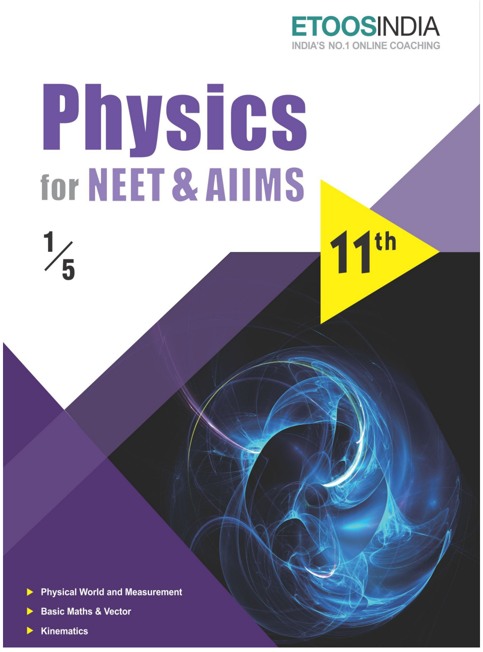
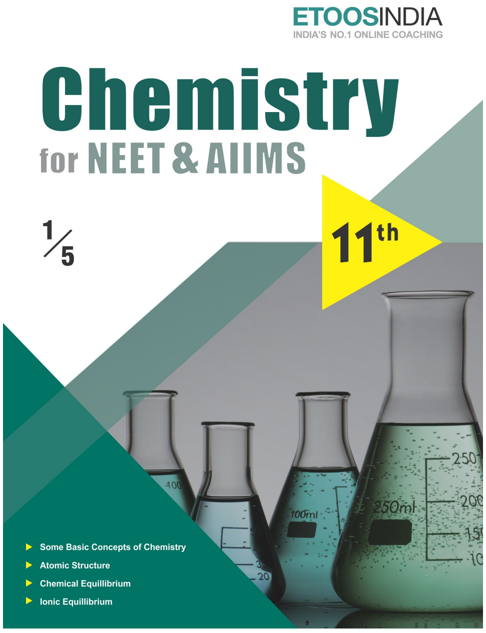
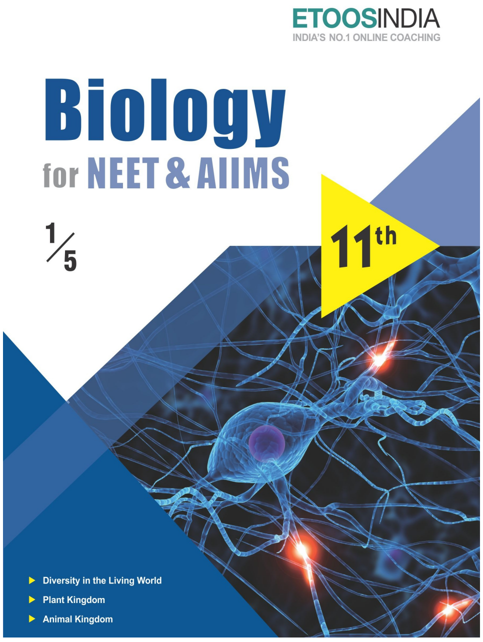
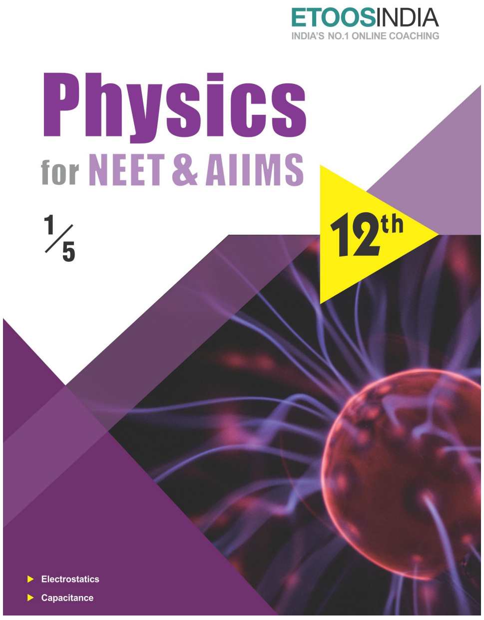
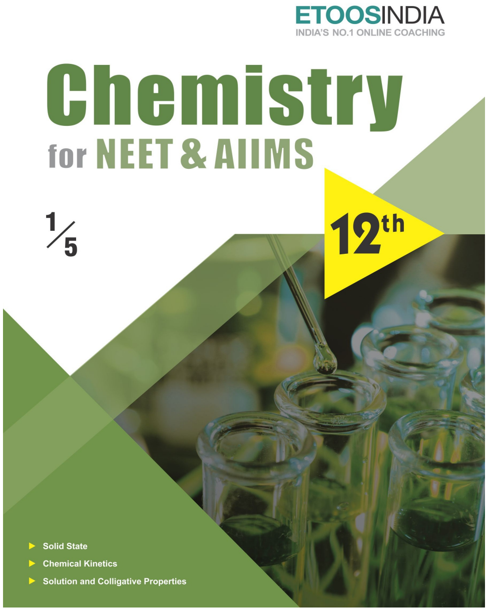
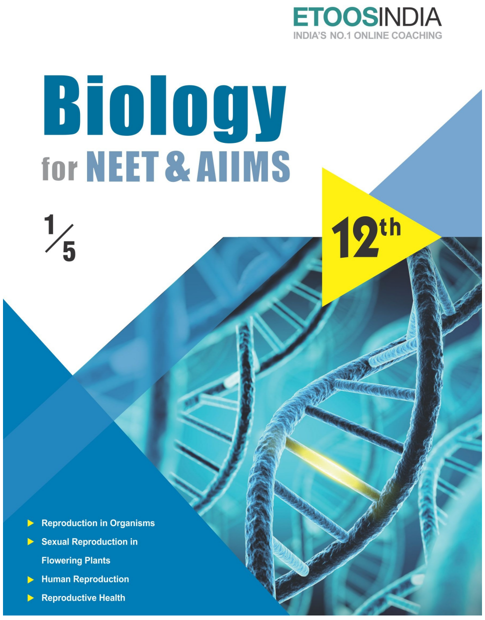












ETOOS Comprehensive Study Material
For NEET & AIIMS

CHAPTER 02

CHEMICAL KINETICS

Your life is a reflection of how effectively you balance potential and kinetic energy

"STEVE MARABOLI"

INTRODUCTION

Thermodynamics tells only about the feasibility of a reaction whereas chemical kinetics tells about the rate of reaction.

IN a spontaneous chemical reaction following questions arises.

How fast do the chemical reaction go?

How can the speed of a reaction change?

What is the mechanism of a reaction?

To answer the above question we study chemical kinetics.

So, chemical kinetics is the branch of physical chemistry which deals with study of rates of reactions, the mechanism by which the reactions proceed and factors affecting rate of reaction.

Ex. The rate of change in concentration of R in the reaction, $2P + Q \longrightarrow 2R + 3S$, was reported as 1.0 mol L^{-1} sec^{-1}. Calculate the reaction rate as well as rate of change of concentration of P, Q and S.

Sol. $$\frac{-1}{2}\frac{d[P]}{dt} = -\frac{d[Q]}{dt} = \frac{1}{2}\frac{d[R]}{dt} = \frac{1}{3}\frac{d[S]}{dt} = \text{Rate of reaction}$$

$$\because \quad \frac{d[R]}{dt} = 1.0\ \text{molL}^{-1}\ \text{s}^{-1}$$

$$\therefore \quad -\frac{d[P]}{dt} = \frac{d[R]}{dt} = 1.0\ \text{mol L}^{-1}\ \text{s}^{-1}$$

$$\frac{-d[Q]}{dt} = \frac{1}{2}\frac{d[R]}{dt} = \frac{1}{2} = 0.5\ \text{molL}^{-1}\text{s}^{-1}$$

$$\frac{-d[S]}{dt} = \frac{3}{2}\frac{d[R]}{dt} = \frac{3}{2} \times 1 = 1.5\ \text{molL}^{-1}\ \text{s}^{-1}$$

$$\text{Rate of reaction} = \frac{1}{2}\frac{d[C]}{dt} = \frac{1}{2} \times 1 = 0.5\ \text{mol L}^{-1}\text{s}^{-1}$$

ETOOS KEY POINTS

Rate law for reversible reaction :

$$2NO_2 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} N_2O_4$$

$$\text{Rate} = \frac{1}{2}\frac{d[NO_2]}{dt} = K_1[NO_2]^2 - K_2[N_2O_4]$$

Rate Law

The experimental expression of rate of reaction in terms of concentration of reactions is known as rate law. In this expression the rate of a reaction is proportional to the product of molar concentration of reactants with each term raised to a power or exponent that has to be found experimentaly.

In a chemical reaction :- $aA + bB \longrightarrow$ Product

The rate law is :- Rate $\propto [A]^x[B]^y$

The values of exponents x and y are found experimentaly which may or may not be same as stoichiometric coefficients.

Above relationship can be written as :-

$$\text{Rate} = k[A]^x[B]^y$$

Where k is a proportionality constant known as rate constant.

Order of Reaction

The sum of powers of concentration of of reactants in rate law expression is known as order of reaction.

For the reaction $aA + bB \rightarrow$ Product

Rate law is rate $= k[A]^x[B]^y$

Here x = order of reaction with respect to A

y = order of reaction with respect to B

$x + y = n$ (overall order of reaction)

Order of reaction may be zero, positive, negative or fractional.

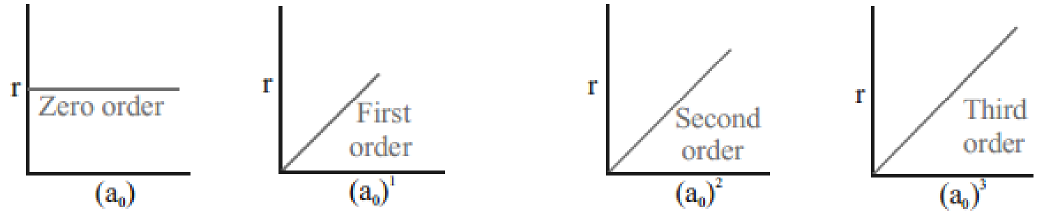
Etoos Tips & Formulas

1. Expression for rate constants for reaction of different orders

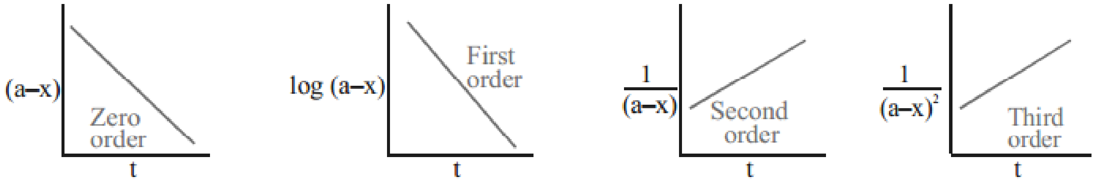
Type of reaction	Integrated rate equation	Unit of rate constant	Half-life period	$t^{3/4}$ life period
Zero order reaction	$-\frac{d[A]}{dt} = k_0[A]^0$ Differentiation form $\frac{dx}{dt} = k$	Concentration/time–1	$t_{\frac{1}{2}} = \frac{a}{2k_0}$	--
First order reaction	$k_1 \frac{2.303}{t} \log_{10} \frac{a}{(a-x)}$	$time^{-1}$	$t_{\frac{1}{2}} = \frac{0.693}{K_1}$	$t_{\frac{3}{4}} = 2 \times \frac{0.693}{k_1} = \frac{1.382}{k_1}$
Second order reaction	$k_2 = \frac{2.303}{t(a-b)} \log \frac{b(a-x)}{a(b-x)}$ Differential form $\frac{dx}{dt} = k(a-x)^2$	$Mole^{-1} litre\ time^{-1}$	$t_{\frac{1}{2}} = \frac{1}{k_2 a}$	$t_{\frac{3}{4}} = \frac{3}{k_2 a}$
Third order reaction	$k_3 = \frac{x \times (2a-x)}{t2a^2(a-x)^2}$ Differential form $\frac{dx}{dt} = k(a-x)^3$	$Litre^2 mole^{-2} time^{-1}$	$t_{\frac{1}{2}} = \frac{3}{2k_3 a^2}$	--

2. Some typical linear plots for reactions of different orders :

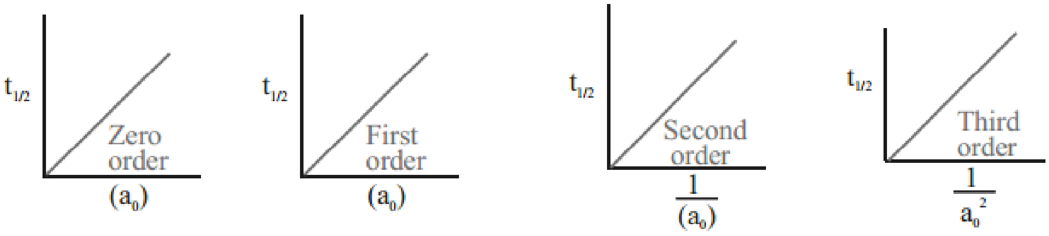
(i)



(ii)



(iii)



SOLVED EXAMPLE

Ex.1 Which of the following statement is not correct about order of a reaction

(A) The order of a reaction can be a fractional number

(B) Order of a reaction is experimentally determined quantity

(C) The order of a reaction is alaway equalt to the sum of the stoichiometric coefficients of reactants in the balanced chemical equation for a reaction

(D) The order of a reaction is the sum of the powers of molar concentration of the reactants in the rate law expression

Sol. (C) Order of reaction is equal to the sum of power of concentration of the reactants in rate law expression. For any chmical reaction

$xA + yB \rightarrow \text{Product}$

$\text{Rate} = k[A]^x[B]^v$

Order of reactino can be a fraction also, Order of reaction is not always equal to sum of the stoichiometric coefficients of reactants in the balanced chmical equation. For a reaction it may or may hnot be equal to sum of stoichiometiric coeffients of reactants.

Ex.2 Which of the following statements is correct

(A) The rate of a reaction decreases with passage of time as the concentration of reactants decreases

(B) The rate of a reaction is same at any time during the reaction

(C) The rate of a reaction is independent of temperature change

(D) The rate of a reaction decreses with increses in concentration of reactants (s)

Sol. (A) Rate of reaction defined as rate of decrease of concentration of any one of reactant with passage of time

$$\text{Rate of reaction} = \frac{\text{Rate of disappearance of rac tan t}}{\text{Time taken}}$$

$$r = \frac{-dx}{dt}$$

Thus, as the concentration of reactant decreases with passage of time, rate of reaction decreases.

Ex.3 Which of the following expressions is correct for the rate of reaction given below

$$5Br^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$$

(A) $\frac{\Delta[Br^-]}{\Delta t} = 5\frac{\Delta[H^+]}{\Delta t}$ **(B)** $\frac{\Delta[Br^-]}{\Delta t} = \frac{6}{5}\frac{\Delta[H^+]}{\Delta t}$

(C) $\frac{\Delta[Br^-]}{\Delta t} = \frac{5}{6}\frac{\Delta[H^+]}{\Delta t}$ **(D)** $\frac{\Delta[Br^-]}{\Delta t} = 6\frac{\Delta[H^+]}{\Delta t}$

Sol. **(C)** Given, chimcal reaction is

$$5Br^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$$

Rate law expression for the above equation can be written as

$$-\frac{1}{5}\frac{\Delta[Br^-]}{\Delta t} = -\frac{\Delta[BrO_3{}^-]}{\Delta t} = \frac{-1}{6}\frac{\Delta[H^+]}{\Delta r} = \frac{+1}{3}\frac{\Delta[Br_2]}{\Delta t}$$

$$\Rightarrow \frac{\Delta[Br^-]}{\Delta t} = -\frac{\Delta[BrO_3^-]}{\Delta t} = \frac{-5}{6}\frac{\Delta[H^+]}{\Delta t}$$

$$\Rightarrow \frac{\Delta[Br^-]}{\Delta t} = \frac{5}{6}\frac{\Delta[H^+]}{\Delta t}.$$

Ex.4 Rate law for reaction $A + 2B \rightarrow C$ is found to be

$\text{Rate} = k[A][B]$

Concentration of reactant 'B' is doubled, keeping the concentration of 'A' constant, the value of rate constant will be ....

(A) The same **(B)** Doubled

(C) Quadrupled **(D)** Halved

Sol. (B) Rate law can be written as

$\text{Rate} = k[A][B]$

Rate of reaction w.r.t. B is of first order.

$R_1 = k[A][B]$

when concentration of reactant 'B' is doubled then rate (R_2)

$R_2 = k[A][2B]$

$R_2 = 2k[A][B]$

$R_2 = 2R_1$

Therefore; as concentration of B is doubled keeping the concentration of A constant rate of reaction doubles.

Exercise # 1

SINGLE OBJECTIVE NEET LEVEL

1. The rate of a chemical reaction
(A) Increases as the reaction proceeds
(B) Decreases as the reaction proceeds
(C) May increase or decrease during the reaction
(D) Remains constant as the reaction proceeds

2. The rate of a reaction that not involve gases is not dependent on
(A) Pressure **(B)** Temperature
(C) Concentration **(D)** Catalyst

3. The rate at which a substance reacts depends on its
(A) Atomic weight **(B)** Equivalent weight
(C) Molecular weight **(D)** Active mass

4. The rate law for the reaction
$RCl + NaOH(aq)$ ® $ROH + NaCl$ is given by Rate . The rate of the reaction will be
(A) Doubled on doubling the concentration of sodium hydroxide
(B) Halved on reducing the concentration of alkyl halide to one half
(C) Decreased on increasing the temperature of the reaction
(D) Unaffected by increasing the temperature of the reaction

5. If doubling the concentration of a reactant `A' increases the rate 4 times and tripling the concentration of `A' increases the rate 9 times, the rate is proportional to
(A) Concentration of `A'
(B) Square of concentration of `A'
(C) Under root of the concentration of `A'
(D) Cube of concentration of `A'

6. The rate of chemical reaction at constant temperature is proportional to
(A) The amount of products formed
(B) The product of masses of the reactants
(C) The product of the molar concentration of the reactants
(D) The mean free path of the reaction

7. The concentration of a reactant decreases from 0.2 M to 0.1 M in 10 minutes. The rate of the reaction is
(A) 0.01 M **(B)** 10^{-2}
(C) 0.01 mol dm^{-3}min^{-1} **(D)** 1 mol dm^{-3}min^{-1}

8. When a reaction is progressing
(A) The rate of the reaction goes on increasing
(B) The concentration of the products goes on decreasing
(C) The concentration of the reactants goes on decreasing
(D) The reaction rate always remains constant

9. In a catalytic conversion of N_2 to NH_3 by Haber's process, the rate of reaction was expressed as change in the concentration of ammonia per time is 40×10^{-3} mol litre^{-1}s^{-1} . If there are no side reaction, the rate of the reaction as expressed in terms of hydrogen is (in mol litre^{-1}s^{-1})
(A) 60×10^{-3} **(B)** 20×10^{-3}
(C) 1.200 **(D)** 10.3×10^{-3}

10. If the concentration of the reactants is increased, the rate of reaction
(A) Remains unaffected
(B) Increases
(C) Decreases
(D) May increase or decrease

11. Time required for completion of ionic reactions in comparison to molecular reactions is
(A) Maximum **(B)** Minimum
(C) Equal **(D)** None

12. For reaction $2A + B \rightarrow$ products, the active mass of B is kept constant and that of A is doubled. The rate of reaction will then
(A) Increase 2 times **(B)** Increase 4 times
(C) Decrease 2 times **(D)** Decrease 4 times

13. In a reaction $2A + B \rightarrow A_2B$, the reactant A will disappear at
(A) Half the rate that B will decrease
(B) The same rate that B will decrease
(C) Twice the rate that B will decrease
(D) The same rate that A_2B will form

14. The rate of a gaseous reaction is given by the expression K[A][B]. If the volume of the reaction vessel is suddenly reduced to 1/4th of the initial volume, the reaction rate relating to original rate will be
(A) 1/10 **(B)** 1/8
(C) 8 **(D)** 16

15. A catalyst increases the rate of reaction because it
(A) Increases the activation energy
(B) Decreases the energy barrier for reaction
(C) Decreases the collision diameter
(D) Increases the temperature coefficient

16. Which of these does not influence the rate of reaction
(A) Nature of the reactants
(B) Concentration of the reactants
(C) Temperature of the reaction
(D) Molecularity of the reaction

Exercise # 2

SINGLE OBJECTIVE

AIIMS LEVEL

1. aA + bB $\longrightarrow$ Product, dx/dt = k $[A]^a$ $[B]^b$. 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

2. For the reaction,

$$2NO(g) + 2H_2(g) \longrightarrow N_2(g) + 2H_2O(g)$$

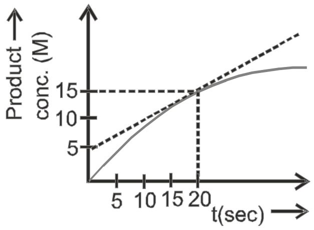
the rate expression can be written in the following ways:

$\{d[N_2]/dt\} = k_1[NO][H_2]$; $\{d[H_2O]/dt\}$
$= k[NO][H_2]$; $\{-d[NO]/dt\}$
$= k'_1[NO][H_2]$; $\{-d[H_2]/dt\} = k''_1[NO][H_2]$

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)** $k = k_1 = k'_1 = 2k''_1$

3. Rate of formation of product at t = 20 seconds is



(A) 0.5 MS^{-1} **(B)** 1 M S^{-1}
(C) 1.5 M S^{-1} **(D)** 2MS^{-1}

4. In the following reaction : xA $\longrightarrow$ yB

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

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

5. Rate of formation of SO_3 in the following reaction $2SO_2 + O_2 \rightarrow 2SO_3$ 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}

6. For a reaction pA + qB $\rightarrow$ products, the rate law expression is $r = k[A]^1[B]^m$, then :

(A) (p+1) < (1+m)
(B) (p + q) > (1 + m)
(C) (p + q) may or may not be equal to (1+ m)
(D) (p + q) = (1 + m)

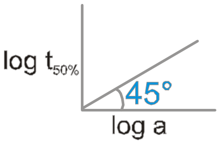
7. If rate constant is numerically the same for the three reactions of first, second and third order respectively. Assume all the reactions of the kind A $\rightarrow$ products. Which of the following is correct :

(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

8. For the irreversible process, A + B $\longrightarrow$ 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 1.0×10^{-2} mol L^{-1} s^{-1}, rate when half reactants have been turned into products is :

(A) 1.25×10^{-3} mol L^{-1} s^{-1}
(B) 1.0×10^{-2} mol L^{-1} s^{-1}
(C) 2.50×10^{-3} mol L^{-1} s^{-1}
(D) 2.0×10^{-2} mol L^{-1} s^{-1}

9. What will be the order of reaction and rate constant for a chemical change having log $t_{50\%}$ vs log concentration of **(A)** curves as :



(A) 0, 1/2 **(B)** 1, 1
(C) 2, 2 **(D)** 3, 1

10. For a reaction 2A + B $\rightarrow$ product, rate law is $-\frac{d[A]}{dt} = k[A]$. At a time when $t = \frac{1}{k}$, concentration of the reactant is

(C_0 = initial concentration)

(A) $\frac{C_0}{e}$ **(B)** C_0e
(C) $\frac{C_0}{e^2}$ **(D)** $\frac{1}{C_0}$

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. Match the following :

Column-I	Column-II
(A) $A + B \longrightarrow C + D$ $r = k_1 [A][B]$	**(p)** Unit of rate constant possess concentration unit
(B) $A + B \longrightarrow C + D$ $r = k_2 [A][B]^o$	**(q)** Rate constant for the reaction of both the reactants are equal
(C) $A + B \longrightarrow C + D$ $r = k_3 [A]^o [B]^o$	**(r)** Rate of consumption of at least one of the reactants is equal to rate of production of at least one of the products
(D) $2A + B \longrightarrow 2C + 3D$ $r = k_3 [A]^o [B]^o$	**(s)** If both reactants are taken in stoichiometric ratio, half life for both reactants are equal.

2. Match the following :

Column-I (Graph)	Column-II (Slope)
(A) C Vs t (abscissa) for zero order	**(p)** unity
(B) log C Vs t (abscissa) for first order	**(q)** zero
(C) $\left(\frac{-dc}{dt}\right)$ Vs c for zero order	**(r)** $-k$
(D) $\ln\left(\frac{-dc}{dt}\right)$ Vs ℓnc for first order	**(s)** $-\frac{k}{2.303}$

3. Match the following :

Column-I	Column-II
(A) If the activation energy is 65 kJ then how much time faster a reaction proceed at 25°C than at 0°C	**(p)** 2
(B) Rate constant of a first - order reaction is 0.0693 min^{-1}. If we start with 20 mol L^{-1}, it is reduced to 2.5 mol L^{-1} in how many minutes	**(q)** Zero
(C) Half - lives of first - order and zero order reactions are same. Ratio of rates at the start of reaction is how many times of 0.693 Assume initial concentration to be same for the both.	**(r)** 11
(D) the half-life periods are given , (see below) order of the reaction is	**(s)** 30

$[A]_0$	(M)	0.0677	0.136	0.272
$t_{1/2}$	(sec)	240	480	960

order of the reaction is

Exercise # 4

PART - 1

PREVIOUS YEAR (NEET/AIPMT)

1. For the reaction **[CBSE AIPMT 2001]**
$2N_2O_5 \rightarrow 4NO_2 + O_2$, rate and rate constant are 1.02×10^{-4} and 3.4×10^{-5} s^{-1} respectively, then concentration of N_2O_5 at that time will be
(A) 1.732 **(B)** 3
(C) 1.02×10^{-4} **(D)** 3.4×10^{5}

2. When a biochemical reaction is carrid out in laboratory from outside of human body in the absence of enzyme, the rate of reaction obtained is 10^{-6} then activation energy of the reaction in the presence of enzyme is **[CBSE AIPMT 2001]**

(A) $\frac{6}{RT}$
(B) P is required
(C) different from E_a obtained in laboratory
(D) cannot say any hings

3. $3A\rightarrow 2B$, rate of reaction $+\frac{d[B]}{dt}$ is equal to

[CBSE AIPMT 2002]

(A) $-\frac{3}{2}\frac{d[A]}{dt}$ **(B)** $-\frac{2}{3}\frac{d[A]}{dt}$

(C) $-\frac{1}{3}\frac{d[A]}{dt}$ **(D)** $+2\frac{d[A]}{dt}$

4. $3A\rightarrow B+C$ It would ba a zero order reaction, when

[CBSE AIPMT 2002]

(A) the rate of reaction is proportional to square of concentration of A
(B) the rate of reaction remains same at any concentration of A
(C) the rate remains unchanged at any concentration of B and C
(D) the rate of reaction doubles if concentration of B is increased to double

5. The reaction, $A\rightarrow B$ follows first order kinetics. The time taken for 0.8 mole of A to produce 0.6 mole of B is 1h. what is the time taken for the conversion of 0.9 mole of A to 0.675 mole of B? **[CBSE AIPMT 2003]**
(A) 0.25h **(B)** 2h
(C) 1 h **(D)** 0.5 h

6. The temperature dependence of rate constant (k) of a chemical eaction is written in terms of Arrhenius equation, $k=Ae^{-E^*/RT}$, Activation energy (E*) of the reaction can be calculated by plotting

[CBSE AIPMT 2003]

(A) $\log k \text{ vs } \frac{1}{T}$ **(B)** $\log k \text{ vs } \frac{1}{\log T}$

(C) k vs T **(D)** $k \text{ vs } \frac{1}{\log T}$

7. If the rate of a reaction is equal to the rate constant, the order of the reaction is **[CBSE AIPMT 2003]**
(A) 2 **(B)** 3
(C) 0 **(D)** 1

8. The activation energy for a simple chemical reaction, $A\rightarrow B$ is E_α in forward direction. The activation energy for reverse reaction. **[CBSE AIPMT 2003]**
(A) can be less than or more than E_a
(B) is always double of E_a
(C) is negative of E_a
(D) is always less than E_a

9. The rate of first order reaction is 1.5×10^{-2} mol L^{-1} min^{-1} at 0.5 M concentration of the reactant. The half-life on the reaction is.

[CBSE AIPMT 2004]

(A) 0.383 min **(B)** 23.1min
(C) 8.73 min **(D)** 7.53 min

10. For a fistt order reaction, $A\rightarrow B$, the reaction rate at reactant concentration of 0.01 M is found to be 2.0×10^{-5} mol L^{-1} s^{-1}. The half-life period of the reaction is **[CBSE AIPMT 2005]**
(A) 220s **(B)** 30s
(C) 300s **(D)** 347s

11. The rate of reaction between two reactants A and B decreases by a factor of4, if the concentration of reactant B is doubled. The order of this reaction with respect to reactant B is **[CBSE AIPMT 2005]**
(A) -1 **(B)** -2
(C) 1 **(D)** 2

MOCK TEST

STRAIGHT OBJECTIVE TYPE

1. For the reaction $2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$, if concentration of NO_2 in 100 seconds is increased by 5.2×10^{-3}m. Then rate of reaction will be

(A) $1.3 \times 10^{-5} ms^{-1}$ **(B)** $5 \times 10^{-4} ms^{-1}$ **(C)** $7.6 \times 10^{-4} ms^{-1}$ **(D)** $2 \times 10^{-3} ms^{-1}$

(E) $2.5 \times 10^{-5} ms^{-1}$

2. A first order reaction complete its 10% in 20 minutes then time required to complete its 19% is

(A) 30 minutes **(B)** 40 minutes **(C)** 50 minutes **(D)** 38 minutes

(E) 45 minutes

3. If a substance with half life 3 days is taken at other place in 12 days. What amount of substance is left now

(A) 1/4 **(B)** 1/8 **(C)** 1/16 **(D)** 1/32

4. The half-life of a first order reaction having rate constant $K = 1.7 \times 10^{-5} s^{-1}$ is

(A) 12.1 h **(B)** 9.7 h **(C)** 11.3 h **(D)** 1.8 h

5. For the reaction $A + B \rightarrow C$, it is found that doubling the concentration of A increases the rate by 4 times, and doubling the concentration of B doubles the reaction rate. What is the overal order of the reaction.

(A) 4 **(B)** 3/2 **(C)** 3 **(D)** 1

6. Which of the following reactions end in finite time

(A) 0 order **(B)** 1st order **(C)** 2nd order **(D)** 3rd order

7. The rate constant of a reaction at temperature 200K is 10 times less than the rate constant at 400 K. What is the activation energy (E_a) of the reaction (R = gas constant)

(A) 1842.4 R **(B)** 921.2 R **(C)** 460.6 R **(D)** 230.3 R

8. In respect of the equation $k = Ae^{-E_a/RT}$ in chemical kinetics, which one of the following statement is correct

(A) k is equilibrium constant **(B)** A is adsorption factor

(C) E_a is energy of activation **(D)** R is Rydberg's constant

9. The rate constant is doubled when temperature increases from 27°C to 37°C. Activation energy in kJ is

(A) 34 **(B)** 54 **(C)** 100 **(D)** 50

10. The activation energy of a reaction is zero. The rate constant of this reaction

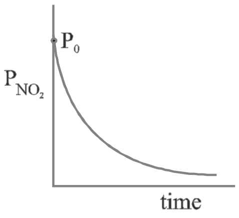
(A) Increases with increase of temperature **(B)** Decreases with an increase of temperature

(C) Decreases with decrease of temperature **(D)** Is independent of temperature

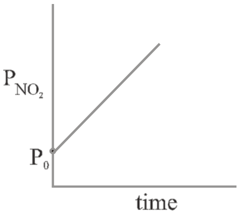
11. $N_2O_5 \longrightarrow 2NO_2 + \frac{1}{2}O_2$

When N_2O_5 decompose, its $t_{1/2}$ does not change with its changing pressure during the reaction. So which one is the correct representation for "pressure of NO_2" vs "time" during the reaction when initial $P_{N_2O_5}$ is equals to P_0.

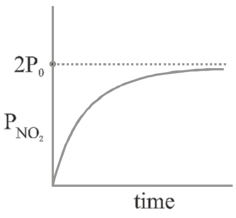
(A)



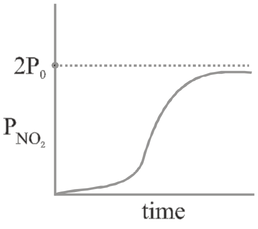
(B)



(C)



(D)



12. Choose the correct option :

(A) Antineutrino can be detected during the emission of :

(i) α-rays **(ii)** β-particles **(iii)** Protons **(iv)** X-rays

(B) Which has magic number of neutrons :

(i) ${}^{27}_{13}Al$ **(ii)** ${}^{209}_{83}Bi$ **(iii)** ${}^{238}_{92}U$ **(iv)** ${}^{56}_{26}Fe$

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