CHEMICAL KINETICS

Rates of reaction

Change in concentration of any of the reactants or products in unit time.

$$\text{Rate of reaction} = \frac{\text{Change in conc. of any reactant or product}}{\text{Time interval}}$$

Expression of average rate of reaction

For a reaction A + B $\longrightarrow$ C + D

$$\text{The rate of reaction} = -\frac{A}{t} \quad -\frac{B}{t} \quad \frac{C}{t} \quad \frac{D}{t}$$

For the reaction xA + yB $\longrightarrow$ mC + nD

To rationalize the rate of reaction each expression is divided by number of molecules of that substance in equation.

$$\text{So rate of reaction} = -\frac{A}{x \cdot t} \quad -\frac{B}{y \cdot t} \quad \frac{C}{m \cdot t} \quad \frac{D}{n \cdot t}$$

Unit of rate of reaction moles $L^{-1} S^{-1}$ or moles $L^{-1} min^{-1}$ or atm S^{-1} or atm min^{-1}.

Rate of reaction at a given time or instantaneous rate of reaction

For a reaction xA + yB $\longrightarrow$ mC + nD

$$\text{Rate of reaction at a given time 't'} = -\frac{dA}{xdt} \quad -\frac{dB}{ydt} \quad \frac{dC}{mdt} \quad \frac{dD}{ndt}$$

Factors effecting the rate of reaction

(1) Nature of reactants
(2) Temperature — With increase in temperature rate of reaction increases, for every 10° rise in temperature, the rate of reaction is almost doubled.
(3) Concentration — Higher is the conc. of reactants higher will be rate of reaction.
(4) Catalyst — In presence of a catalyst rate of reaction increases.
(5) Surface area of reactants — Larger is the surface area of reactants higher will be the rate of reaction.

Rate law expressions

This expression shows the dependence of rate of reaction on concentration terms of reactants as determined experimentally. The concentration terms may or may not agree with terms given in the reaction. For a reaction

xA + yB $\longrightarrow$ mC + nD

According to rate law expression

Rate of reaction $\propto [C]^a \times [B]^b$
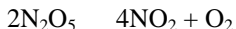
Or Rate of reaction = $K \times [C]^a \times [B]^b$

K = specific rate constant or velocity constant

Velocity constant is the rate of reaction when conc. of all the reactants are taken in unity.

Simple reaction & Complex reaction

Rate law expression for some complex reactions

(1) Thermal decomposition dinitrogen pentoxide:

$2N_2O_5 \longrightarrow 4NO_2 + O_2$

The mechanism of the reaction is :

Step-I $N_2O_5 \longrightarrow NO_2 + NO_3$ (slow)

Step-II $N_2O_5 + NO_3 \longrightarrow 3NO_2 + O_2$ (fast)

Applying law of mass action to the slow step.

Rate of reaction $\propto [N_2O_5]$

So rate law is

Rate of reaction = $K \times [N_2O_5]$

(2) Decomposition of ozone

$2O_3 \longrightarrow 3O_2$

The mechanism of the reaction is

$\rightleftharpoons$

Step-I O_3 $O_2 + O$ (fast)
Step-II $O + O_3$ $2O_2$ (slow)
Applying law of mass action to slow step
Rate of reaction $[O] \times [O_3]$.......(i)

But O is not the actual reactant, so its concentration is taken in terms of O_2 from step – I.
Applying law of chemical equilibrium to step-I

$$K = \frac{O_2 \quad O}{O_3}$$

So $[O] = K \times \dfrac{O_3}{O_2}$

Substituting the value of [O] in eq. (i)

Rate of reaction $\dfrac{O_3 \quad O_3}{O_2}$

Rate of reaction = $K [O_3]^2 \times [O_2]^{-1}$

(3) For the reaction $A_2 + B_2$ $2AB$
Step – I $A_2 \rightleftharpoons 2A$ (fast)

Step – II $A + B_2$ $AB + B$ (slow)
Applying law of mass action to slow step
Rate of reaction $[A] \times [B_2]$......(i)
As A is not the reactant, so its concentration is taken in terms of A2 from step-I.
Applying law of chemical equilibrium to step-I

$$K = \frac{A^2}{A_2}$$

Or $[A] = \sqrt{K \; [A_2]}$ ....(ii)
Applying the value of [A] from eq (ii) in eq (i)

Rate of reaction $\sqrt{A_2} \quad B_2$

Order of reaction
Rate of reaction = $K \times [C]^a \times [B]^b$
So order of reaction = a + b

Molicularity of a reaction:

Modification of Rate law expression
 If for a reaction xA + yB   products
If rate law expression is
Rate of reaction = $K [A]^m \times [B]^n$
Order of reaction = m + n
If one of the reactants i.e. B is taken in large excess then its conc. is eliminated from the rate law, which may be written as
Rate of reaction = $K \times [A]^m$ [modified rate law expression].
So order of reaction = m

Pseudo unimolecular reactions
Some reactions which have molecularity greater than one but follow the kinetics of 1st order reaction are known as pseudo unimolecular reaction.

Units of rate constant or Specific reaction rate for different order reactions.
For a reaction of nth order

Rate, $\dfrac{dx}{dt}$ = K [conc.]^n.

Or K = $\dfrac{dx}{dt} \times \dfrac{1}{conc.^n}$ $\dfrac{1}{conc.^n}\dfrac{conc.}{time}$ = $\dfrac{1}{time \quad conc.^{n\ 1}}$

Integrated rate equations

Zero order reaction:

K = $\dfrac{[R]_0 \quad [R]}{t}$

Taking this equation as equation of straight line if we plot [R] against time, we get a straight line with slope = -K and intercept = $[R]_0$

1st order reaction

K = $\dfrac{1}{t} 2.303 \log \dfrac{R \quad 0}{R}$

If we consider the conc. of reactants $[R]_1$ and $[R]_2$ at time t_1 and t_2.

Half life of a reaction

Half life of a zero order reaction

[K] = $\dfrac{1[R]_0}{2}$

Half life of a 1st order reaction

$t_{1/2}$ = $\dfrac{0.693}{K}$

Relation between half life period & initial conc. of reactants for nth order reaction.
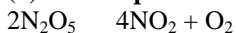
$t_{1/2}$ $\dfrac{1}{[R]_0^{n\ 1}}$

where $[R]_0$ = initial conc. of reactant and n = order of reaction.

Amount of a substance left after nth half life periods for a 1st order reaction.

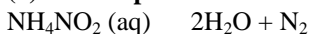Amount of reactant left = $\dfrac{initial\ \text{amount}}{2^n}$, where n = number of half-lives.

Examples of 1st order reactions
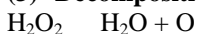
(1) Decomposition of nitrogen pentoxide

$2N_2O_5$ $4NO_2 + O_2$

K = $\dfrac{2.303}{t} \log \dfrac{V}{V \quad Vt}$

(2) Decomposition of Ammonium nitrite

NH_4NO_2 (aq) $2H_2O + N_2$

K = $\dfrac{2.303}{t} \log \dfrac{V}{V \quad Vt}$

(3) Decomposition of H_2O_2

H_2O_2 $H_2O + O$

K = $\dfrac{2.303}{t} \log \dfrac{V_0}{Vt}$

(4) Hydrolysis of ester in acidic medium

$$CH_3COOC_2H_5 + H_2O \xrightarrow{H} CH_3COOH + C_2H_5OH$$
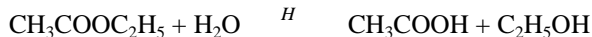
$$K = \frac{2.303}{t}\log\frac{V_\infty - V_0}{V_\infty - V_t}$$

(5) Inversion of canesugar

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H} C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose	Glucose	Fructose
$+66.5^o$	$+52.5^o$	-92°
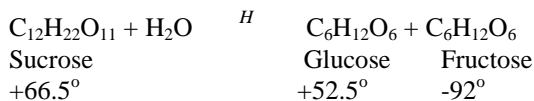
$$K = \frac{2.303}{t}\log\frac{r_0 - r_\infty}{r_t - r_\infty}$$

Determination of order of reaction

(1) On the basis of units of K.
(2) On the basis of relation between $t_{1/2}$ and initial conc. of reactants.
(3) Graphical method:
(4) Initial rate method:

Collision theory of chemical reactions

All the molecular collisions are not effective, only those molecular collisions are effective in which colliding molecules have

(i) Proper orientation
(ii) Energy = certain minimum energy which is known as *threshold energy or critical energy*.

Progress of a chemical reaction

(a) Exothermic reaction:

Ea = Activation energy which is the *additional energy required by the molecules of reactants, so that their energy becomes equal to threshold energy and they undergo effective molecular collision to give activated complex and then products.*

Ea = Threshold energy or energy of activated complex or energy barrier – average energy of reactants.

Higher is the value of Ea, smaller number of molecules will cross the energy barrier and rate of reaction will be slower. If Ea has small value then larger number of molecules will cross the energy barrier and rate of reaction will be higher.

For an exothermic reaction Ea has small value and

Ea (forward reaction) + ΔH = Ea (reverse reaction)

(b) Endothermic reaction:

In endothermic reaction Ea (forward) has a large value, larger than ΔH

Ea (forward) = ΔH + Ea (reverse)

Effect of catalyst on the rate of reaction

In presence of a catalyst a new reaction path is developed with low Ea so larger number of molecules will cross the energy barrier and rate of reaction will increase.

Effect of temperature on the rate of a reaction (Arrhenius Equation)

The rate of reaction increases with increase in temperature. The rate of reaction is almost doubled for every 10° rise in temperature.

$$\text{Temperature co-efficient} = \frac{Rate \text{ of reaction at } T + 10\,K}{Rate \text{ of reaction at } T\,K}$$

The value of temperature co-efficient is 2 -3.

The effect of change in temperature on the rate of reaction is given by Arrehenius equation.

$K = A\,e^{-Ea/RT}$. Where A = frequency factor,   K = velocity constant

Ea = Activation energy   R = molar gas constant
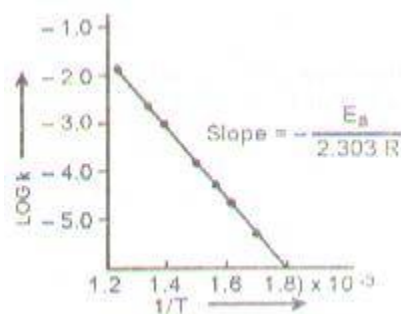
T = temperature in Kelvin

Taking log on both sides

$$2.303 \log K = 2.303 \log A - \frac{Ea}{RT} \qquad \text{or} \quad \log K = \log A - \frac{Ea}{2.303RT}$$

If the values of rate constants at temp T_1 and T_2 are K_1 and K_2.

$$\log \frac{K_2}{K_1} = \frac{Ea}{2.303R} \left[\frac{T_2 - T_1}{T_1 T_2} \right]$$

This equation is equation of straight line so if we plot log verses 1/T we get a straight line.

The slope of line = $\dfrac{Ea}{2.303R}$

MCQ with only one answers

1. Rate constant of a reaction with a virus is 3.3×10^{-4} s^{-1}. Time required for the virus to become 75% inactivated is:
   (a) 35 min   (b) 70min
   (c) 105mm   (d) 17.5 min.

2. If in the fermentation of sugar in an enzymatic solution that is 0.12 M, the concentration of the sugar is reduced to 0.06 M in 10 h and to 0.03 M in 20 h. What is the order of the reaction?
   (a) 1   (b) 2   (c) 3   (d) 0

3. For the reaction
   $$2NO + Br_2 \longrightarrow 2NOBr,$$
   the following mechanism has been given
   $$NO + Br_2 \xrightarrow{fast} NOBr_2$$
   $$NO + NOBr_2 \xrightarrow{slow} 2NOBr$$
   Hence, rate law is:
   (a) $k[NO]^2[Br_2]$ (b) $k[NO][Br_2]$
   (c) $k[NOBr][NO]$ (d) $k[NO][Br_2]^2$

4. At a certain temperature, the first-order rate constant k_1 is found to be smaller than the second-order rate constant k_2. If the Ea (l) of the first order reaction is greater than Ea (2) of the second-order reaction, then as temperature is raised:
   (a) k_2 will increase faster than k_1
   (b) k_1 will increase faster than k_2 but will always remain less than k_2
   (c) k_1 will increase faster than k_2 and become equal to k_2|
   (d) k_1 will increase faster than k_2 and become greater than k_2

5. A $\longrightarrow$ B, $H = -10$kJmol^{-1}, $Ea = 50$ kJ mol^{-1} then Ea of B $\longrightarrow$ A will be:
   (a) 40 kJ mol^{-1} (b) 50 kJ mol^{-1}
   (c) -50 kJ mol^{-1} (d) 60 kJ mol^{-1}

6. Rate of formation of S03 in the following reaction
   $$2SO_2 + O_2 \dashrightarrow 2SO_3$$
   is 100 kg min^{-1} Hence, rate of disappearance of SO_2 will be:
   (a) l00 kgmin^{-1} (b) 80 kg min^{-1}
   (c) 64 kg min^{-1} (d) 32 kg min^{-1}

7. Rate constant $k = 1.2 \times 10^3$ mol^{-1} Ls^{-1} and $Ea = 2.0 \times 10$- kJmol^{-1}. When T
   (a) $A = 2.0 \times 10^2$ kJmol^{-1}
   (b) $A = 1.2 \times 10^3$ mol^{-1} Ls^{-1}
   (c) $A = 1.2 \times 10^3$ mol^{-1} L^{-1}s^{-1}
   (d) $A = 2.4 \times 10^3$ kJmol^{-1} s^{-1}

8. The rate of a chemical reaction generally increases rapidly even for small temperature increase because of rapid increase in the
   (a) collision frequency
   (b) fraction of molecules with energies in excess of the activation energy'
   (c) activation energy
   (d) average kinetic energy of molecules

9. Rate constant of a reaction is 0.0693 min^{-1}. Starting with 10 mole, rate of the reaction after 10 min is:
   (a) 0.693 mol min^{-1}
   (b) 0.0693×2 mol min^{-1}
   (c) 0.0693×5 mol min^{-1}
   (d) $0.0693 \times (5)^2$ molmin^{-1}

10. The reaction $H_2(g) + 2ICl(g) \longrightarrow I_2(g) + 2HCl(g)$ has a second-order rate law, rate $= k[H_2][ICl]$. Hence, rate-determining step is:
    (a) $H_2(g) + ICl(g) \longrightarrow HCl(g) + HI(g)$
    (b) $HI(g) + ICl(g) \longrightarrow HCl(g) + I_2(g)$
    (c) both (a) and (b)
    (d) none of these

11. For the reaction:
    $$A_2 + 2B \longrightarrow 2AB$$

A_2	B	$\dfrac{d[A_2]}{dt}$
0.1 M	0.2 M	1×10^{-2} Ms^{-1}

0.2 M	0.2 M	2×10^{-2} Ms^{-1}
0.2 M	0.4M	8×10^{-2} Ms^{-1}

Order of reaction w. r. t. A_2 and B are respectively;
(a) 1, 2   (b) 2, 1
(c) 1, 1   (d) 2, 2

12. A $\longrightarrow$ B $k_A = 10^{15} \, e^{-2000/T}$
C $\longrightarrow$ D $k_C = 10^{14} \, e^{-1000/T}$
Temperature T/K at which $(k_A = k_C)$ is;
(a) 1000K   (b) 2000 K
(c) $\dfrac{2000}{2.303}$ K   (d) $\dfrac{1000}{2.303}$ K
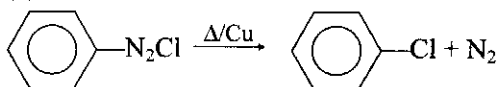
13.

(A)
Half-life is independent of concentration of A. After 10 minutes volume of N_2 gas is 10 L and after complete reaction 50 L. Hence rate constant is :

(a) $\dfrac{2.303}{10} \log 5 \min^{-1}$ (b) $\dfrac{2.303}{10} \log 1.25 \min^{-1}$

(c) $\dfrac{2.303}{10} \log 2 \min^{-1}$ (d) $\dfrac{2.303}{10} \log 4 \min^{-1}$

14. $2N_2O_5 \longrightarrow 4NO_2 + O_2$

If $-\dfrac{N_2O_5}{t} = k_1[N_2O_5]$, $\dfrac{NO_2}{t} = k_2[N_2O_5]$,

$\dfrac{O_2}{t} = k_3[N_2O_5]$

then:
(a) $k_1 = k_2 = k_3$ (b) $2 k_1 = k_2 = 4k_3$
(c) $2k_1 = 4k_2 = k_3$ (d) none of these

15. The rate law for the dimerisation of NO_2 into N_2O_4 is
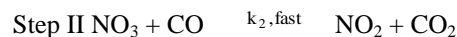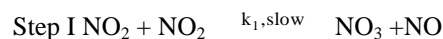
$$-\dfrac{d[NO_2]}{dt} = k[NO_2]^2$$

Which of the following changes will change the value of the specific rate constant k7?
(a) doubling the total pressure
(b) decreasing the pressure
(c) changing the volume of the flask
(d) changing the temperature

16. When temperature of a reaction is changed from T_1 and T_2 half-life is found to decrease. Thus:
(a) $T_1 > T_2$ and reaction is endothermic
(b) $T_2 > T_1$ and reaction is exothermic
(c) $T_1 > T_2$ and reaction is exothermic
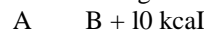(d) $T_2 > T_1$ and reaction can be exothermic or endothermic

17. Following reaction takes place by mechanism

$NO_2 + CO \longrightarrow NO + CO_2$

Step I $NO_2 + NO_2 \xrightarrow{k_1, slow} NO_3 + NO$
Step II $NO_3 + CO \xrightarrow{k_2, fast} NO_2 + CO_2$

Hence, $\dfrac{dx}{dt}$ for the given reaction is:

(a) $k_1[NO_2]^2 - k_2[NO_3][CO]$
(b) $k_1[NO_2]^2 + k_2[NO_3][CO]$
(c) $k_1[NO_2]^2$
(d) $k_1[NO_2] + k_2[CO]$

18. For the following reaction
A $\longrightarrow$ B + l0 kcaI
increase in temperature:
(a) increases rate of the forward as well as backward reaction
(b) increases rate of the forward reaction but decreases that of backward reaction
(c) decreases rate of the forward reaction but increases that of the backward reaction
(d) decreases rate of forward as well as backward reaction.
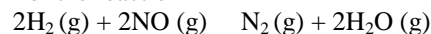
19. for the second order reaction:
$2A \longrightarrow$ Product
the initial concentration of A is 0.1 M and rate constant is 2×10^{-3} dm^3 mol^{-1} s^{-1}. The half-life period of the reaction is:
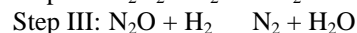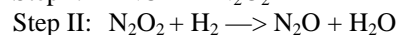(a) 5 sec   (b) 50 sec
(c) 500 sec   (d) 5000 sec

20. The activation energy of a reaction is zero. At 280 K rate constant is 1.6×10^{-6} s^{-1}. The rate constant at 300 K is
(a) zero   (b) 3.2×10^{-6}s^{-1}
(c) 1.6×10^{-5}s^{-1} (d) 1.6×10^{-6}s^{-1}

21. For the reaction
$2H_2(g) + 2NO(g) \longrightarrow N_2(g) + 2H_2O(g)$
rate law is: rate = $k[NO]^2 [H_2O_2]$, Mechanism is given by:
Step I: $2NO \longrightarrow N_2O_2$
Step II: $N_2O_2 + H_2 \longrightarrow N_2O + H_2O$
Step III: $N_2O + H_2 \longrightarrow N_2 + H_2O$
Rate law is true if:
(a) step I is the slow step
(b) step II is the slow step
(c) step III is the slow step
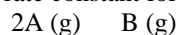(d) steps I and II are slow steps

22. Rate constant k of a reaction is dependent on temperature:
$$K = Ae^{-Ea/RT}$$
k has the least value at:
(a) high T and high Ea
(b) high T and small Ea
(c) low T and low Ea
(d) low T and high Ea

23. Which of the these factors affect the value of the specific rate constant for the reaction?

    2A (g)   B (g)

    (a) temperature only
    (b) temperature and concentration
    (c) pressure only
    (d) pressure and concentration

24. The radioisotope N-13, which has a half-life of 10 minutes, is used to image organs in the body. If the injected sample has an activity of 40 Ci (microcurie), what is the activity after 30 minutes?
    (a) 10 Ci   (b) 20 Ci
    (c) 5 Ci   (d) 2.5 Ci

25. A particular reaction increases by a factor of 2 when the temperature is increased from 27°C to 37°C. Hence activation energy of the reaction is
    (a) 12.9 kcal   (b) 0.14 kcal
    (c) 1.1 kcal   (d) none is correct

26. What function of $[X]$, plotted against time, will give a
    straight line for a second-order reaction?
    (a) $[X]$ (b) $[X]^2$
    (c) $\log[X]$ (d) $\dfrac{1}{[X]}$

27. Two reaction with different activation energies have the same rate at room temperature. Which statement correctly describes the rates of these two reactions at the same higher temperature?
    (a) the reaction with the greater activation energy will be faster
    (b) the reaction will the smaller activation energy will be faster
    (c) the two reactions will have the same rate
    (d) temperature range is also required

28. The rates of many chemical reactions double for a ten degree rise in temperature. Which of these factors does not contribute to this change in the rate with increaser temperature?
    (a) the average kinetic energy of the reactant species
    (b) the number of collisions in a given time
    (c) the number of very eneretic spector
    (d) the activation energy

29. Given the following diagram for the reaction
    A+B ——> C+D
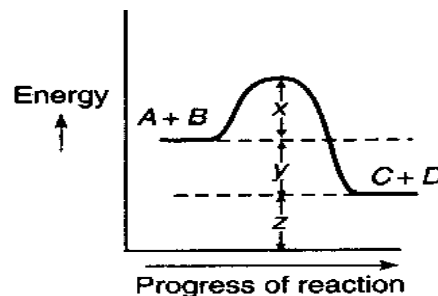
The enthalpy change and activation energy for the reverse) reaction C + D ——> A + B are respectively:
    (a) x, y   (b) x, x + y
    (c) y, x + y   (d) y, y + z

30. The rate of a first order reaction is 1.5×10^{-2} mol l^{-1} min^{-1} at 0.5 M conc. of reactants. the half life of the reaction
    (a) 23.1 min   (b) 8.73 min
    (c) 7.53 min   (d) 0.383 min

31. In a first order reaction conc. of reactants decreases from 0.8 M to 0.4 M in 15 minutes . Time taken for the conc. to change from 0.1 M to 0.025 M is
    (a) 30 min   (b) 60 min
    (c) 7.5 min   (d) 15 min

32. The rate equation for the reaction   2A + B   C is found to be rate = k[A][B]. The correct statement in relation to this reaction is that the
    (a) the unit of k be s^{-1}
    (b) value of k is independent of initial conc of A and B
    (c) rate of formation of C is twice the rate of disappearance of A
    (d) t$^{1/2}$ is constant

33. The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation, k = A. e$^{-Ea/RT}$. Activation energy (Ea) of the reaction can he calculated by ploting :
    (a) $\log k$ vs $\dfrac{1}{\log T}$ (b) k vs T
    (c) k vs $\dfrac{1}{\log T}$ (d) $\log k$ vs $\dfrac{1}{T}$

34. The rate of reaction is equal to the rate constant . the order of reaction is
    (a) 3   (b) 0   (c) 1   (d) 2

35. The activation energy for a simple chemical reaction A   B Ea in forward direction. The activation energy for reverse reaction is
    (a) Always double of Ea
    (b) is negative of Ea
    (c) is always less than Ea
    (d) Can be less that or more than Ea

36. The reaction A → B follows first order kinetics. the time taken for 0.8 mole of A to produce 0.6 moles of B is one hour. What is the time taken for the conversion of 0.9 mole of A to produce 0.675 mole of B ?
    (a) 2 hr   (b) 1 hr
    (c) 0.5 hr   (d) 0.25 hr

37. For the reaction system
    $2NO(g) + O_2(g) → 2NO_2 (g)$,the volume is suddenly reduced to half its value by increasing the pressure . If the reaction is of first order w.r.t. O_2 and 2nd order w.r.t. NO. the rate of reaction will
    (a) diminishes to ¼ of its value
    (b) diminishes to 1/8 of its value
    (c) increases to 8 times of its initial value
    (d) increase to 4 times of its initial value

38. In respect of equation $k = A. e^{-Ea / RT}$ in chemical kinetics which of the following statement is correct?
    (a) k is equilibrium constant
    (b) A is adsorption factor
    (c) Ea energy of activation
    (d) R is Rydbergs constant

39. Select the law that corresponds to data shown ofr the following reaction
    A + B → C,

Exp.	$[A]_0$	$[B]_0$	Initial rate
1	0.012	0.035	0.10
2	0.024	0.070	0.80
3	0.024	0.035	0.10
4	0.012	0.070	0.80

    The rate law corresponds lo the above data is:
    (a) rate $= k[B]^3$ (b) rate $= k[B]^4$
    (c) rate $= k[A][B]^3$ (d) rate $= [A]^2[B]^2$

40. A reaction was found to be of 2nd order with respect to the conc. of carbon monoxide. If conc. of carnon monoxide is doubled with everything else kept the same , the rate of reaction will
    (a) decrease by a factor of 4
    (b) double

    (c) remains unchanged
    (d) Triple

41. Rate of reaction can be expressed by Arrhenius equation $k = A. e^{-Ea / RT}$. In the reaction e represents
    (a) total energy of reacting molecules at a temp T.
    (b)fraction of molecule with energy greater than activation energy of reactants .
    (c) Energy above which all the colliding molecules will react
    (d) Energy below which colliding molecules will not react

42. The following mechanism has been proposed for the of NO with Br_2 to form NOBr

$NO (g) + Br_2(g) \rightleftharpoons NOBr_2(g)$

$NOBr_2 (g) + NO (g) → 2NOBr(g)$
If second step is rate determining step , the order of reaction with respect to NO (g) is
(a) 3   (b) 2   (c) 1   (d) 0

43. For the reaction $2A + B → 3C + D$ Which of the following doesnot express the reaction rate

    (a) $\dfrac{d(D)}{dt}$ (b) $\dfrac{dA}{2dt}$

    (c) $\dfrac{dC}{3dt}$ (d) $\dfrac{d[B]}{dt}$

44. A reaction involving two different reactants can never be
    (a) 2nd order   (b) Bimolecular
    (c) Unimolecular   (d) first order

45. Consider the reaction
    $N_2 (g) + 3H_2(g) → 2NH_3 (g)$
    the rection between $\dfrac{d[NH_3]}{dt}$ and $\dfrac{d[H_2]}{dt}$

    (a) $+\dfrac{d[NH_3]}{dt} = \dfrac{3}{2}\dfrac{d[H_2]}{dt}$

    (b) $\dfrac{d[NH_3]}{dt} = \dfrac{d[H_2]}{dt}$

    (c) $\dfrac{d[NH_3]}{dt} = \dfrac{1}{3}\dfrac{d[H_2]}{dt}$

    (d) $\dfrac{d[NH_3]}{dt} = \dfrac{2}{3}\dfrac{d[H_2]}{dt}$

46. Rate of reaction between two reactants decreases by a factor of 4 if conc. of B is doubled . the order of reaction with respect to reactant 'B' is :-
    (a) 2   (b) 1   (c) 1   (d) –2

47. For a first order reaction A → B the reaction rate at a conc of 0.01 m is found to be 2.0×10^{-5} $moll^{-1}s^{-1}$. the half life period of reaction is :-
    (a) 300 s   (b) 30 s
    (c) 220 s   (d) 347 s

48. Rate constant of a chemical reaction has unit L $mol^{-1} s^{-1}$ order of reaction is :
    (a) 0   (b) 1   (c) 2   (d) 3

49. For a reaction xA → yP   [A] = 2.2 mM rate was found to be 2.4 mMs^{-1} on reducing the conc of A to half . the rate changes to 0.6 m M s – 1 . Order of reaction is :-
    (a) 1.5   (b) 2.0
    (c) 2.5   (d) 3.0

50. Consider a reaction aG + bH → Products

When concentration of both reactants G and H is doubled, the rate increases by 8 tomes. However when the conc. of G is doubled keeping the conc. of H fixed . the rate is doubled. Over all order of reaction is

(a) 0   (b) 1   (c) 2   (d) 3