CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (HINGLISH)

CHEMICAL KINETICS

Illustration

1. The decompoistion of N_2O_5 in CCI_4 solution at $318K$ has been studied by monitoring the concentration of N_2O_5 in the solution. Initially, the concentration of N_2O_5 is $2.33M$ and after 184 min , it is reduced to $2.08M$. The reaction takes place according to the equation:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

Calculate the average rate of this reaction in terms of hours, minutes, and seconds. What is the rate of Production of NO_2 during this periof?

2. Express the rate of the following reactions:

(a) $PCl_5 \rightarrow PCl_3 + Cl_2$

(b) $2NO_2 \rightarrow 2NO + O_2$

in terms of the concentrations of reactants and Products.

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3. For each of the following reactions, express the given rate of change of concentration of the reactants or Products in that reaction:

a.$H_2O_2 + 2H^{\oplus} + 3l^{\ominus} \rightarrow I_3^{\ominus} + 2H_2O, \frac{-d\left[I^{\ominus}\right]}{dt} = ?, \frac{-d\left[H^{\oplus}\right]}{dt}?$

(b) $16H^{\oplus} + 2Mn_4^{\ominus} + 101^{\ominus} \rightarrow 2Mn^{2+} + 8H_2O + 5I_2, \frac{-d\left[MNO_4^{\ominus}\right]}{dt} = ?$

(c) $4NH_3 + 5O_2 \rightarrow 4NO_2 + 6H_2O, \frac{-d\left[NH_3\right]}{dt} = ?$

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4. Ammonia and oxygen react at high temperature as:

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

In an experiment, the rate of formation of NO is $3.6 \times 10^{-3} Ms^{-1}$. Calculate (a) the rate of disappearance of ammonia and (b) the rate of formation of water.

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5. The following reaction was carried out in water :

$Cl_2 + 2I^{\ominus} \rightarrow I_2 + 2Cl^{\ominus}$

The initial concentration of $I^{\ominus}$ was $0.25 mol L^{-1}$ and the concentration after 10 min was $0.23 mol L^{-1}$. Calculate the rate of disappearance of $I^{\ominus}$ and rate of appearance of I_2.

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6. For a reaction $R \rightarrow P$, the concentration of a reactant changes from 0.03 M to 0.02M in 25 minutes. Calculate the average rate of the reaction using the units of seconds.

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7. In the following reaction, how is the rate of appearance of the underlined Product related to the rate of disappearance of the underlined reactant ?

$BrO_3^{\ominus}(aq) + 5B\underline{r}^{\ominus}(aq) + 6H^{\oplus}(aq) \rightarrow 3Br_{\underline{2}}(l) + 3H_2O(l)$

A. $\frac{d[Br]}{dt} = \frac{5}{3}\frac{-d\left[Br^{\ominus}\right]}{dt}$

B. $\frac{d\left[Br_2\right]}{dt} = \frac{-d\left[Br^{\ominus}\right]}{dt}$

C. $\frac{d\left[Br_2\right]}{dt} = -\frac{d\left[Br^{\ominus}\right]}{dt}$

D. $\frac{d\left[Br_2\right]}{dt} = \frac{3}{5}\frac{-d\left[Br^{\ominus}\right]}{dt}$

Answer: D

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8. For the reaction

$H_2(g) + I_2(g) \rightarrow 2HI(g)$, the rate of disappearance of HI will be $1.0 \times 10^{-4} molL^{-1}s^{-1}$. The rate of appearance of HI will be

A. $1.0 \times 10^{-4} molL^{-1}s^{-1}$

B. $2.0 \times 10^{-4} molL^{-1}s^{-1}$

C. $0.50 \times 10^{-4} molL^{-1}s^{-1}$

D. $4.0 \times 10^{-4} molL^{-1}s^{-1}$

Answer: B

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9. The rate of reaction is expressed as :

$$\frac{1}{2}\frac{+d}{dt}[C] = \frac{1}{3}\frac{-d}{dt}[D] = \frac{1}{4}\frac{+d}{dt}[A] = -\frac{d}{dt}[B]$$

The reaction is:

A. $\frac{1}{4}A + \frac{1}{2}(C) \rightarrow B + \frac{1}{3}D$

B. $4A + 2C \rightarrow B + 3D$

C. $B + 3D \rightarrow 4A + 2C$

D. (d) $B + \frac{1}{3}D \rightarrow \frac{1}{4}A + \frac{1}{2}C$

Answer: C

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10. The term -dx/dt in the rate expresison refers to the

A. Concentration of the reactants

B. Increase in concentration of the reactants

C. Instantaneous rate of reaction

D. (d) Average rate of reaction

Answer: C

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11. In a catalyst experiment involving the Haber process $N_2 + 3H_2 \rightarrow 2NH_3$, the rate of reaction was measured as

$$\text{Rate} = \frac{\Delta\left[NH_3\right]}{\Delta t} = 2.0 \times 10^{-4} molL^{-1}s^{-1}$$

What is the rate of reaction expressed in terms of (a) N_2 (b) H_2 ?

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12. The approach to the following equilibrium was observed kinetically form both directions:

$$\left[PtCl_4\right]^{2-} + H_2O \Leftrightarrow \left[Pt\left(H_2O\right)Cl_3\right]^{\Theta} + Cl^{\Theta}$$

At $25^{\circ}C$ it was found that at 0.3 inoic strength

$$-\frac{\Delta\left[PtCl_4\right]^{2-}}{\Delta t} = \left(3.9 \times 10^{-5}s^{-1}\right)\left[PtCl_4\right]^{2-}$$

$$-\left(2.1 \times 10^{-3}Lmol^{-1}s^{-1}\right)\left[Pt\left(H_2O\right)Cl_3\right]^{\Theta}\left[Cl_3^{\Theta}\right]$$

What is the value of k for the complexation of the fourth Cl^{Θ} by $Pt(II)$ at 0.3 ionic strenght.

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13. Which of the following expression can be used to describe the instantaneous rate of the reaction ?

$2A + B \rightarrow A_2B$

A. $\frac{1}{2}\frac{-d[A]}{dt}$

B. $\frac{-d[A]}{dt}$

C. $\frac{1}{2}\frac{d\left[A_2B\right]}{dt}$

D. $\frac{1}{2}\frac{-d[A]}{dt}.\frac{d[B]}{dt}$

Answer: A

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14. Which of the following will react at the highest rate ?

A. $1mol$ of A and $1molB$ in a $1 - L$ vessel

B. $2mol$ of A and $2molB$ in a $2 - L$ vessel

C. $3mol$ of A and $3molB$ in a $3 - L$ vessel

D. All would react at the same rate

Answer: D

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15. The reaction between $Cr_2O_7^{2-}$ and HNO_2 in an acidic medium is

$Cr_2O_7^{2-} + 5H^{\oplus} + 3HNO_2 \rightarrow 2Cr^{3+} + 3NO_3^{\ominus} + 4H_2O.$

The rate of disappearance of $Cr_2O_7^{2-}$ is found to be $2.4 \times 10^{-4} molL^{-1}s^{-1}$ during measured time interval. What will be the rate of disappearance of HNO_2 during the same time interval?

A. 2.4×10^{-4}

B. 7.2×10^{-4}

C. 4.8×10^{-4}

D. 0.8×10^{-4}

Answer: B

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16. The complexation of Fe^{2+} with the chelating agent dipyridyl has been studied Kinetically in both the forward and reverse direction, For the complexation reaction $Fe^{2+} + 3$ dipy $\rightarrow \left[Fe(dipy)_3\right]^{2+}$, the rate of formation of the complex at $25\,^{\circ}C$ is given by

Rate $= \left(1.45 \times 10^{13} L^3 mol^{-3} s^{-1}\right)\left[Fe^{2+}\right][dipy]^3$ and for the reverse of the above eqaution, the rate of disappearance of the complex is

$\left(1.22 \times 10^{-4} s^{-1}\right)\left[Fe(dipy)_3\right]^{2+}$

What is K_s, the stability constant for the complex ?

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17. For the reaction at $273K$

$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$

It is observed that the pressure of $NO(g)$ falls form $700mmHg$ to $500mmHg$ in $250s$. Calculate the average rate of reaction in (a) $atms^{-1}$, (b) $molL^{-1}s^{-1}$.

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18. The hydrogenation of vegetable ghee at $25 ^{\circ} C$ reduces the pressure of H_2 form $2atm$ to $1.2atm$ in 50 min . Calculate the rate of reaction in terms of change of

(a) Pressure per minute

(b) Molarity per second

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19. For gaseous reactions, the rate is expressed in terms of dP/dt instead of dc/dt or dn/dt (where c is the concentration and n the number of mol). What is the relation among these expresisons ?

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20. In the reaction, $2H_2O_2 \rightarrow 2H_2O + O_2$ The rate of decompoistion of H_2O_2 is $0.68kghr^{-1}$. What is the rate of formation of O_2 and H_2O in

$kghr^{-1}$?

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21. Calculate the overall order of a reaction which has the rate expresison.

(a) Rate $= k[A]^{\frac{1}{2}}[B]^{\frac{3}{2}}$, (b) Rate $= k[A]^{\frac{3}{2}}[B]^{-1}$

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22. From the rate laws for the reactions given below, determine order with order to each species and the overall order:

(a) $2HCrO_4^{\ominus} + 6l^{\ominus} + 14H^{\oplus} \rightarrow 2Cr^{3+} + 3I_2 + 8H_2O$

Rate $= k\left[HCrO_4^{\ominus}\right]\left[I^{\ominus}\right]^2\left[H^{\oplus}\right]^2$

(b) $H_2O_2 + 2I^{\ominus} + 2H^{\oplus} \rightarrow I_2 + 2H_2O$

Rate $= k\left[H_2O_2\right]\left[I^{\ominus}\right]$

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23. The rate constant for the reaction, $2N_2O_5 \rightarrow 4NO_2 + O_2$ is $3.0 \times 10^{-5} s^{-1}$. If the rate is $2.40 \times 10^{-5} molL^{-1} s^{-1}$, then the initial concentration of N_2O_5 (in $molL^{-1}$) is

A. 1.4

B. 1.2

C. 0.04

D. 0.8

Answer: D

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24. The decompoistion of ammonia on platinum surface follows the change

$2NH_3 \rightarrow N_2 + 3H_2$

(a) What does $\frac{-d\left[NH_3\right]}{dt}$ denote?

(b) What does $\frac{d[N_2]}{dt}$ and $\frac{d[H_2]}{dt}$ denote?

(c) If the decompoistion is zero order then what are the rates of Production of N_2 and H_2 if $k = 2.5 \times 10^{-4} Ms^{-1}$?

If the rates obeys $-\frac{d[NH_3]}{dt} = \frac{k_1[NH_3]}{1 + k_2[NH_3]}$, what will be the order for decompoistion of NH_3, if (i) $[NH_3]$ is every less and (ii) $[NH_3]$ is very high? (k_1 and k_2 are constants)

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25. The rate constant for the reaction:

$$CO_2 + \overset{\ominus}{OH} \rightarrow HCO_3^{\ominus}$$

in the aqueous solution is $4 \times 10^{-3} Lmol^{-1}s^{-1}$. Calculate the number of mole of CO_2 and $\overset{\ominus}{OH}$ are 10^{-6} and $10^{-1} molL^{-1}$. Also predict the mole of $HCO_3^{\ominus}$ formed per second.

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26. For a reaction $3A \rightarrow$ Products, it is found that the rate of reaction doubles. If the concentration of A is increased four times, calculated the order of reaction.

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27. The rate of a reaction starting with initial concentration of 2×10^{-3} and $1 \times 10^{-3}M$ are equal to 2.40×10^{-40} and $0.60 \times 10^{-4}Ms^{-1}$, respectively. Calculate the order or reaction w.r.t. reactant and also the rate constant.

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28. The reaction $2A + B + C \rightarrow D + 2E$ is found to be first order in A, second order in B and zero order in C.

(a) Write the rate expresison.

(b) What is the effect on rate on increaisng the concentration of A, B, and C two times ?

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29. For $2A + B + C(excess) \rightarrow$ Products, calculate:

(a) Rate expresison, uisng rate law.

(b) Units of rate and rate constant.

(c) Effect on rate, if the concentration of A is doubled and that of B is tripled.

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30. The rate of reaction: $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$, becomes doubled when the concentration of Cl_2 is doubled. However, when the concentration of both the reactants are doubled, the rate becomes eight times. What is the order w.r.t. NO and w.r.t. chlorine ? What is the total order?

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31. Show by uisng rate laws how much the rate of reaction $2NO(g) + O_2(g) \rightarrow 2NO(g)$ will change if the volume of the reaction vessel is diminished to $1/3$ of its initial volume.

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32. What would be the effect on the rate of reaction due to the four-fold increase in a reactant concentration, if the order of reaction were the following:

(a) Zero order , (b) First order

(c) $1/2$ order , (d) Fourth order

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33. The experiment rate law for the reaction $S_2O_8^{2-}(aq) + 2I^{\ominus}(aq) \rightarrow 2SO_4^{2-}(aq) + I_2(aq)$ is $k\left[S_2O_8^{2-}\right]\left[I^{\ominus}\right]$. How would the rate change if

(a) Concentration of $S_2O_8^{2-}$ is halved.

(b) Concentration of $S_2O_8^{2-}$ and $I^{\ominus}$ are halved.

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34. For the reaction $A + B \rightarrow C + D$, doubling the concentration of both the reactants increases the reaction rate by 8 times and doubling the initial concentration of only B ismply doubles the reaction rate. What is the rate law for the reaction ?

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35. For the non-equilibrium process, $A + B \rightarrow$ Product, 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 were inrofuced into $1.0L$ vessel and the initial rate was $1.0 \times 10^{-2} mol L^{-1} s^{-1}$, calculate the rate when half the reactants have been turned into Products.

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36. The rate constant in numerically the same for the theee reaction of first, second, and third order. Which reaction should be the fastest and it this true for all ranges of concentrations?

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37. The rate law for the following reactions:

$Ester + H^{\oplus} \rightarrow \text{ Acid + Alcohol}$, is

$dx/dt = k(ester)\left[H_3O^{\oplus}\right]^0$

What would be the effect on the rate if

(a) concentration of ester is doubled.

(b) concentration of $H^{\oplus}$ ion is doubled.

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38. Mechanism of the reaction is:

$A_2 \overset{k_1}{\Leftrightarrow} 2A$

$$A + B \xrightarrow{k_2} C$$

$$A_2 + C \xrightarrow{k} D + A$$

What is (a) $\frac{-d[A_2]}{dt}$, (b) $\frac{-d[A]}{dt}$, (c) $\frac{d[C]}{dt}$, (d) $\frac{d[D]}{dt}$?

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39. Mechanism of the reaction is:

$$A \xrightarrow{k_1} B, 2A \xrightarrow{k_2} C + D$$

What is $\frac{-d[A]}{dt}$?

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40. Mechanism of the reaction is:

What is $\frac{-d[A]}{dt}$?

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41. Mechanism of the reaction is:

k_2

$A \Leftrightarrow k_1 B$ ...(i)

k_3

$B + A \Leftrightarrow C$ ...(ii)

$-$

$2A \rightarrow \underline{C}$ ...(iii)

What is (a) $\frac{-d[A]}{dt}$, (b) $\frac{d[B]}{dt}$, (c) $\frac{d[C]}{dt}$

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42. Mechanism of the reaction is:

k_2

$A_2 \Leftrightarrow 2A$

k_2

$A + B \rightarrow C$

k

$A_2 + C \rightarrow D + A$

What is (a) $\frac{-d\left[A_2\right]}{dt}$, (b) $\frac{-d[A]}{dt}$, (c) $\frac{d[C]}{dt}$, (d) $\frac{d[D]}{dt}$?

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43. $2N_2O_5 \rightarrow 4NO_2 + O_2$

If $\frac{-d\left[N_2O_5\right]}{dt} = k_1\left[N_2O_5\right]$

$$\frac{d\left[NO_2\right]}{dt} = k_2\left[N_2O_5\right]$$

$$\frac{d\left[O_2\right]}{dt} = k_3\left[N_2O_5\right]$$

What is the relation between k_1, k_2, and k_3?

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44. $2SO_2 + O_2 \overset{k_1}{\Leftrightarrow} k_2 2SO_3$

What are the expresison for the rate law of the forward and backward reactions?

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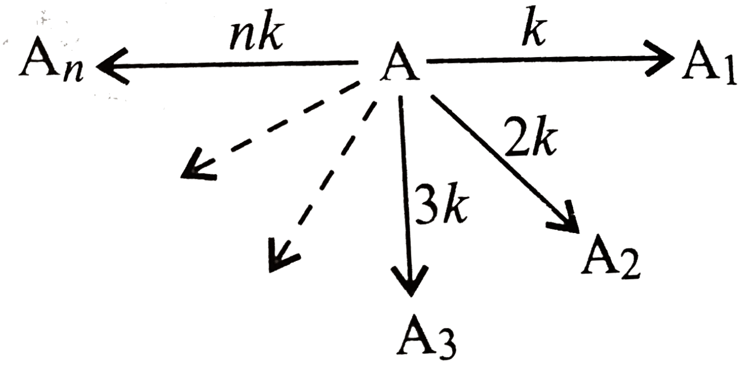
45. Mechanism of the reaction is:



What is (a) $\frac{-d[A]}{dt}$, (b) $\frac{d\left[A_1\right]}{dt}$, (c) $\frac{d\left[A_n\right]}{dt}$, (d) $\frac{d\left[A_1\right]}{-d[A]}$ for same time?

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46. The rate law for the decompoistion of gaseous N_2O_5,

$N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ is observed to be:

$$r = \frac{-d\left[N_2O_5\right]}{dt} = k\left[N_2O_5\right]$$

A reaction machanism which has been suggested to be conisstent with this rate law is

$$N_2O_5(g) \overset{k_{eq}}{\Leftrightarrow} NO_2(g) + NO_3(g)(\text{fast equilibrium})$$

$NO_2(g) + NO_3(g) \xrightarrow{k_1} NO_2(g) + NO(g) + O_2(g)$ (slow)

$NO(g) + NO_3(g) \xrightarrow{k_2} 2NO_2(g)$ (fast)

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47. The termolecular reaction

$2NO(g) + H_2(g) \rightarrow 2NOH(g)$ is found to be third order obeying the rate law $r = k[NO]^2\left[H_2\right]$. Show that it is conisstent with either of the following mechanisms:

(a) $2NO(g) \overset{k_{eq}}{\Leftrightarrow} N_2O_2(g)(\text{fast equilibrium})$

$N_2O_2(g) + H_2(g) \xrightarrow{k'} 2NOH(g)$ (slow)

(b) $2NO(g) + H_2(g) \overset{k'_{eq}}{\Leftrightarrow} NOH_2(g)(\text{fast equilibrium})$

$NOH_2(g) + NO(g) \xrightarrow{k''} 2NOH(g)$ (slow)

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48. For and elementary reaction

k_1

$2A \Leftrightarrow k_2B$, the rate of disappearance of A iss equal to

(a) $\dfrac{2k_1}{k_2}[A]^2$

(b) $-2k_1[A]^2 + 2k_2[B]$

(c) $2k_1[A]^2 - 2k_2[B]$

(d) $\left(2k_1 - k_2\right)[A]$

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49. Conisder the following reactions:

k_1

I. $A + B \Leftrightarrow k_{-1}C$

k_2

II. $C + B \rightarrow D$

Then $k_1[A][B] - k_{-1}[C] - k_2[C][B]$ is equal to

A. $\dfrac{-d[A]}{dt}$

B. $\dfrac{-d[B]}{dt}$

C. $\dfrac{d[C]}{dt}$

D. $\frac{d[D]}{dt}$

Answer: c

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50. The rate expresison of some reactions are given below. Propose a probable mechanism of each of the following reactions:

(a) $2N_2O_5 \rightarrow 4NO_2 + O_2$, Rate $= k\left[N_2O_5\right]$

(b) $2NO_2 + F_2 \rightarrow 2NO_2F$, Rate $= k\left[NO_2\right]\left[F_2\right]$

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51. In the following reaction:

$$2NO(g) + O_2(g) \xrightarrow{k'} 2NO_2(g)$$

What is the predicted rate law, if the mechanism is

$NO + O_2(g) \overset{k_{eq}}{\Leftrightarrow} NO_3(\text{fast})$ (fast)

$NO_3 + NO \xrightarrow{k_1} NO_2 + NO_2$ (slow)

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52. A reaction is found to proceed in two steps as $A + B \rightarrow E$ (slow),, $A + E \rightarrow C + D$ (fast). Write the law expresison and overall balanced equation.

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53. A chemical reaction proceeds as follows:

$A + C \rightarrow D + F$ (Slow)

$F + B \rightarrow G$ (Fast)

$G + C \rightarrow E$ (Fast)

Suggest rate law, overall under,units for rate constant, and overall reaction.

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54. For the chemical reaction:

$$5Br^{\ominus} + BrO_3^{\ominus} + 6H^{\oplus} \rightarrow 3Br_2 + 3H_2O$$

Rate $= k\left[Br^{\ominus}\right]\left[BrO_3^{\ominus}\right]\left[H^{\oplus}\right]$

What is the molecularity and order of reaction with respect to $\left[Br^{\ominus}\right]$?

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55. For the chemical reaction

$$I^{\ominus} + OCl^{\ominus} \rightarrow Cl^{\ominus} + OI^{\ominus}$$

Rate $= \dfrac{k\left[OCl^{\ominus}\right]\left[I^{\ominus}\right]}{\left[\overset{\ominus}{OH}\right]}$

a. What is the order and moleculartiy of the reaction ?

b. In the above reaction, what are the molecularity and order with respect

to

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56. The chemical reaction $2O_3 \xrightarrow{k_1} 3O_2$ proceeds as follows:

$O_3 \overset{k_{eq}}{\Leftrightarrow} O_2 + O$ (fast)

$O + O_3 \xrightarrow{k} 2O_2$ (slow)

What should be the rate law expresison ?

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57. Mechanism of a reaction is given below:

$X_2 \rightarrow 2X, k_1 = 10^5 s^{-1}$ (forward)

$k_2 = 10^5 s^{-1}$ (backward)

$X + Z \rightarrow XZ, k_3 = 10^{-4} M^{-1} s^{-1}$

Write the rate law and calculate the order of overall reaction.

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58. For the reaction

$2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2\overset{\ominus}{OH}$, the rate of formation of Fe^{3+} is given by

Rate $= k\left[Fe^{2+}\right]\left[H_2O_2\right]$. Suggest a mechanism for the reaction and and indicate a probable rate-determining step.

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59. Deduce the rate law for the converison of H_2 and I_2 to HI at $440\,^{\circ}C$ corresponding to the following proposed mechanism:

step I: $I_2 \Leftrightarrow 2I(\text{fast})\left(k_1\right)$

Step II: $I + H_2 \Leftrightarrow IH_2(\text{fast})\left(k_2\right)$

Step III: $IH_2 + I \rightarrow 2HI$ (slow) (k)

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60. For the overall reaction between A and B to yield C and D, two mechanism are proposed:

$\left(I, A + B \rightarrow AB^{*} \rightarrow C + D, , k'_1 = 1 \times 10^{-5} M^{-1} s^{-1}, \right), \left(II, A \rightarrow A^{*} \rightarrow E, , , k_1\right.$

a. Write the rate law expresison fr each mechanism when initial concentration of each is $0.1M$.

b. At that concentration of A and/or B, will the inherent rates be equal?

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61. The initial concentratin of N_2O_5 in the following first order reaction $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2O_2}(g) was 1.24 \times 10^{-2} molL^{-1}$ at 318K. The concentration of N_2O_5 after 60 minutes was $0.20 \times 10^{-2} molL^{-1}$. Calculate the rate constant of the reaction at 138 K.

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62. A first order reaction has a rate constant, $k = 5.5 \times 10^{-14} s^{-1}$, calculate the half life of reaction.

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63. Show that in case of a first order reaction, the time required for 99.9% of the reaction to take place is about 10 times that the required for half the reaction.

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64. For a first order reaction, calculate the ratio between the time taken to complete $3/4th$ of the reaction and time to complete half of the reaction.

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65. Identify the reaction order form each of the following rate constants:

a. $k = 7.06 \times 10^{-3} molL^{-1}s^{-1}$

b. $k = 5.6 \times 10^{-5}s^{-1}$

c. $k = 1.25 \times 10^{-2} mol^{-1}ls^{-1}$

d. $k = 1.25 \times 10^{-2} molL^{2}s^{-1}$

e. $k = 5.0 \times 10^{-6} atm^{-1}s^{-1}$

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66. For the following reaction:

$2A + B + C \rightarrow A_2B + C$

The rate law has been determined to be

Rate $= k[A][B]^2$ with $k = 2.0 \times 10^{-6} mol^{-2} L^2 s^{-1}$

For this reaction, determine the initial rate of the reaction with $[A] = 0.1 molL^{-1}, [B] = 0.2 molL^{-1}, C = 0.8 mo, L^{-1}$. Determine the rate after $0.04 molL^{-1}$ of A has reacted.

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67. A drug becomes ineffective after 30% decompoistion. The original concentration of a sample was $5 mgmL^{-1}$ which becomes $4.2 mgmL^{-1}$ during 20 months. Assuming the decompoistion of first order, calculate the expiry time of the drug in month. What is the half life of the Product?

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68. The half life of a first order reaction is 60 min . How long will is take to consume 90% of the reactant?

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69. A first order reaction has a rate constant of $15 \times 10^{-3}s^{-1}$. How long will $5.0g$ of this reaction take to reduce to $3.0g$?

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70. If in a reaction $A \rightarrow$ Products, the concentrations of reactant A are $c_0, ac_0, a^2c_0a^3c_0$, ...after time interval $0, t, 2t, 3t$.... Where a is constant, given, $0 < a < 1$, show that the reaction is of first order. Also calculate the relation in k, a, and t.

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71. Reaction A follows first order kinetics and reaction B follows second order kinetics. If their half lives are equal, compare their rates (i) at the start of the reaction and (ii) after lapse of one half life.

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72. For the reaction of I, II and III orders, $k_1 = k_2 = k_3$ when concentrations are expressed in mole L^{-1}. What will be the relation in k_1, k_2, k_3, if the concentration are expressed in $molmL^{-1}$?

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73. Starting with one mole of a compound A, it is found that the reaction is $3/4$ completed in $1hr$. Calculate the rate constant if the reaction is of

a. First order , b. Second order

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74. In the decompoistion of N_2O_5, the plot between the reciprocal of concentration of the reactant and the time was found to be linear as shown in figure below. Determine the order of reaction.

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75. A drop of solution (volume $0.05mL$) contains $3 \times 10^{-6}\text{mole}H^{\oplus}$ ions. If the rate constant of disappearance of $H^{\oplus}$ ions is $1 \times 10^{7} molL^{-1}s^{-1}$, how long would it take for $H^{\oplus}$ ions in the drop of disappear?

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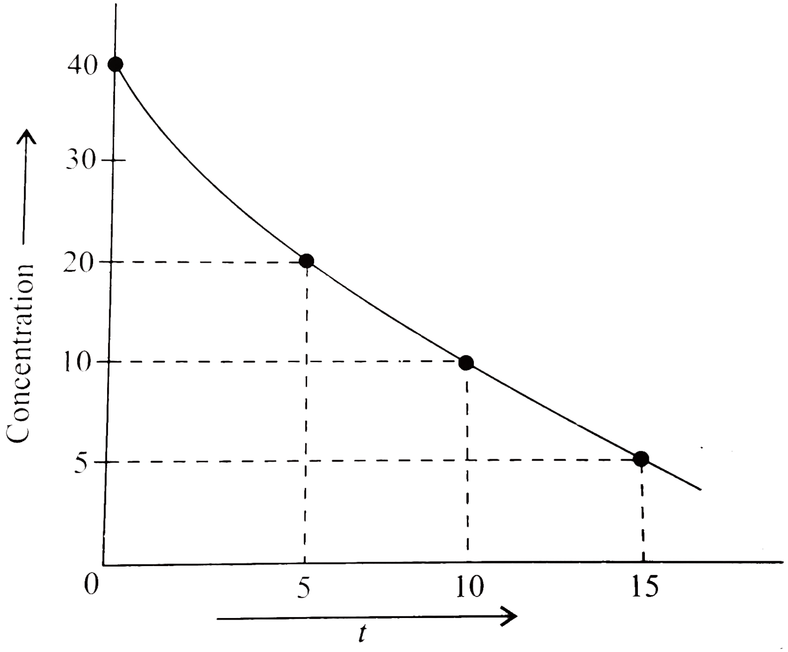
76. For a reaction , a graph was plotted between reactant concentration c and time as shown in the figure below.



Identify the order of the reaction with respect to the reactant. Can the concentration of the reactant be theoretically zero after infinite time?

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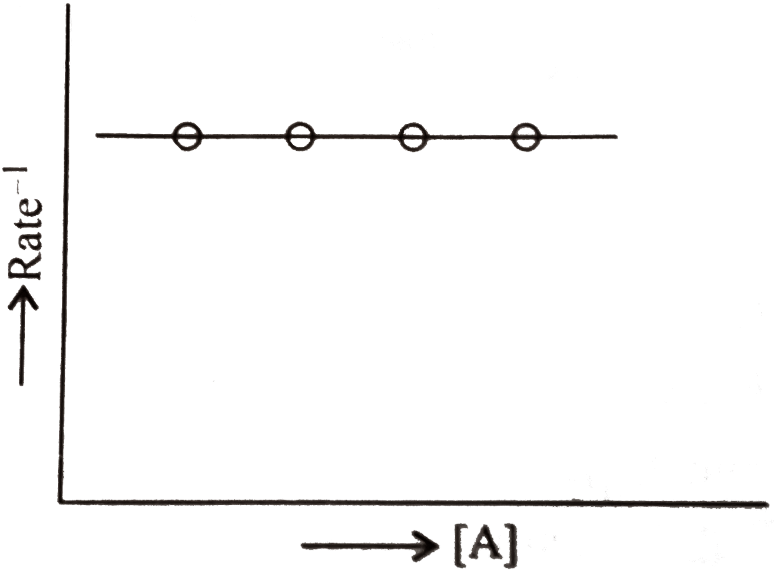
77. $2A + 3B \rightarrow$ Product

a. What is the molecularity of the reaction?

b. What is order w.r.t. A and B in the following cases:



i. When $\left(\frac{dx}{dt}\right) = k[A]$ and B is in excess.

ii. When $\left(\frac{dx}{dt}\right) = k[B]^2$ and graph is true.

iii. When the rate is doubled, then the concentration of A is doubled, and

the rate is eight when the concentration of A and B is doubled.

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78. For the hypothetical reaction

$2A + B \rightarrow$ Products

following data obtained:

Experiment number	Initial conc of (A) $\left(molL^{-1}\right)$	Initial conc of (B) $\left(molL^{-1}\right)$
1	0.10	0.20
2	0.30	0.40
3	0.30	0.80
4	0.10	0.40
5	0.20	0.60
6	0.30	1.20

Find out how the rate of the reaction depends upon the concentration of A and B and fill in the blanks given in the table.

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79. The data for the reaction: $A + B \overset{k}{\rightarrow} C$.

Experiment	$[A]_0$	$[B]_0$	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 corresponding to the above data is

(a) Rate $= k[B]^3$, (b) Rate $= k[B]^4$

(c) Rate $= k[A][B]^3$, (d) Rate $= k[A]^2[B]^2$

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80. Rate of a reaction $A + B \rightarrow$ Product, is given as a function of different initial concentration of A and B.

$[A]\left(molL^{-1}\right)$	$(B)\left(molL^{-1}\right)$	Initial rate $\left(molL^{-1}\min^{-1}\right)$
0.01	0.01	0.005
0.02	0.01	0.010
0.01	0.02	0.005

Determine the order of the reaction with respect to A and with respect to B. What is the half life of A in the reaction ?

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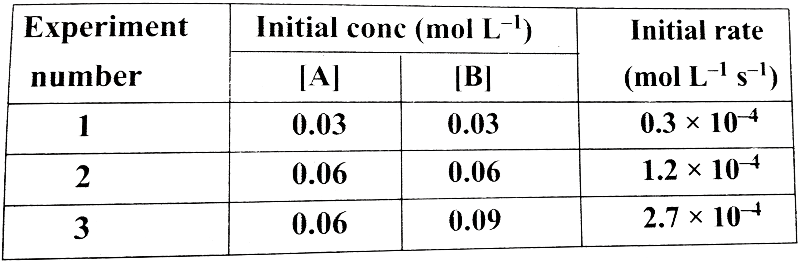
81. For a reaction in which A and B form C, the following data were obtained form theee experiments:



Experiment number	Initial conc (mol L^{-1}) [A]	Initial conc (mol L^{-1}) [B]	Initial rate (mol L^{-1} s^{-1})
1	0.03	0.03	0.3×10^{-4}
2	0.06	0.06	1.2×10^{-4}
3	0.06	0.09	2.7×10^{-4}

What is the rate equation of the equation and what is the value of rate constant ?

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82. The chemical reaction between mercuric chloride and potasisum oxalate proceeds as under:

$$2HgCl_2 + K_2C_2O_4 \rightarrow KCl + 2CO_2 + Hg_2Cl_2$$

The mass of Hg_2Cl_2 precipitated form different solutions in a given time at 100 $^\circ C$ was as follows:

Experiment number	$HgCl_2\left(molL^{-1}\right)$	$K_2C_2O_4\left(molL^{-1}\right)$	Time (min)	Hg_2Cl
1	0.0836	0.404	65	0.0068
2	0.0836	0.202	120	0.0031
3	0.0418	0.404	60	0.0032

form the data calculate order of the reaction.

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83. A certain radio isotope $._{Z}X^{A}$ (half life $= 10$ days) decays to give $._{Z-2}Y^{A-4}$. If $1.0g$ atom of X is kept in a sealed vessel, find the volume of helium accumulated at STP in 20 days ?

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84. The population of India in 1998 was 800 million. What will be the population in 2000 and 2100 if there is no change in the present growth rate which is 25 per 1000 per year?

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85. The experiment data for the reaction $2A + B_2 \rightarrow 2AB$ is

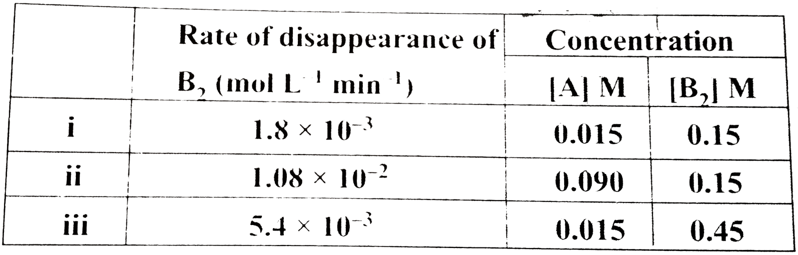
Experiment	$[A]M$	$[B_2]M$	Initial rate $\left(molL^{-1}s^{-1}\right)$
I	0.50	0.5	1.6×10^{-4}
II	0.50	1.0	3.2×10^{-4}
III	1.00	1.0	3.2×10^{-4}

Write the most probable rate equation for the reacting giving reason for you answer.

Watch Video Solution

86. form the gaseous reaction

$2A + B_2 \rightarrow 2AB$, the following rate data were obtained at $300K$.



	Rate of disappearance of B_2 ($mol\ L^{-1}\ min^{-1}$)	Concentration	
		[A] M	$[B_2]$ M
i	1.8×10^{-3}	0.015	0.15
ii	1.08×10^{-2}	0.090	0.15
iii	5.4×10^{-3}	0.015	0.45

Calculate the rate constant for the reaction and the rate of formation of AB when $[A]$ is 0.02 and $\left[B_2\right]$ is $0.04molL^{-1}$ at $300K$.

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87. For a chemical reaction $A \rightarrow B$, it is found that the rate of reaction doubles when the concentration of A is increased 4 times. What is the order of reaction ? Suggest the rate law also.

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88. For a hypothetical reaction $A + B \rightarrow C$, suggest the rate law and order form the following data:

Experiment	$[A]\left(molL^{-1}\right)$	$[B]\left(molL^{-1}\right)$	Refer of reaction $\left(molL^{-1}s^{-1}\right)$
I	0.25	0.25	3.0×10^{-3}
II	0.50	0.25	6.0×10^{-3}
III	0.50	0.50	1.20×10^{-2}

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89. For the chemical reaction

$A + B + C \rightarrow E$,

The rate of reaction is doubled when the concentration of B was doubled, and when the concentration of both A and B were doubled the rate becomes doubled and when the concentration of both B and C were doubled the rate becomes quardrupled. What is order with respect A, B, and C and total order?

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90. For the chemical reaction $A + 2B \rightarrow C$, the rate of reaction is increased by 2.82 times when the concentration of A is doubled and increased by 9 times when the concentration of B was tripled. What is the order with respect to B and A and total order ?

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91. The rate of a gaseous reaction is given by the expresison $k[A]^2[B]^3$. The volume of the reaction vessel is suddenly reduced to one-half of the initial volume. The reaction rate relative to the original rate will be

A. (a) $1/24$

B. (b) $1/32$

C. (c) 32

D. (d) 24

Answer: C

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92. For a chemical reaction $A \rightarrow B$, the rate of reaction increases by a factor of 1.837 when the concentration of A is increased by 1.5 time. The order of reaction with respect to A is:

A. 1

B. 1.5

C. 2

D. -1

Answer: B

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93. The rate of the reaction

$3A + 2B \rightarrow$ Products

is given by the rate expresison: Rate $= k[A][B]^2$

If A is taken in excess, the order of the reaction would be

A. 3

B. 2

C. 1

D. 5

Answer: B

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94. For the decompoistion of HI at $1000K\left(2HI \rightarrow H_2 + I_2\right)$, following data were obtained:

$[HI](M)$	Rate of decomposition of HI $\left(molL^{-1}s^{-1}\right)$
0.1	2.75×10^{-8}
0.2	11×10^{-8}
0.3	24.75×10^{-8}

The order of reaction is

A. 1

B. 2

C. 0

D. 1.5

Answer: B

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95. What will be the initial rate of a reaction if its rate constant is $10^{-3}\ \min^{-1}$ and the concentration of reactant is $0.2 mol dm^{-3}$? How much of reactant will be converted into Products in $200 \min$?

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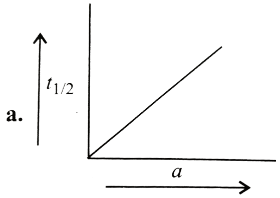
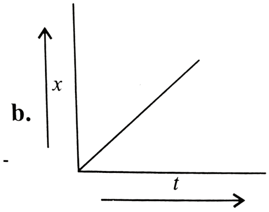
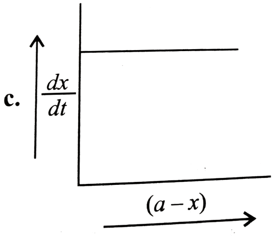
96. Which of the following graphs is not for zero order reaction?



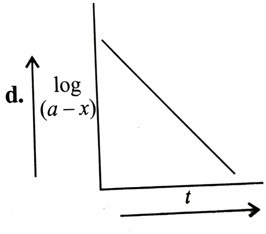
A.



B.



C.



D.

Answer: D

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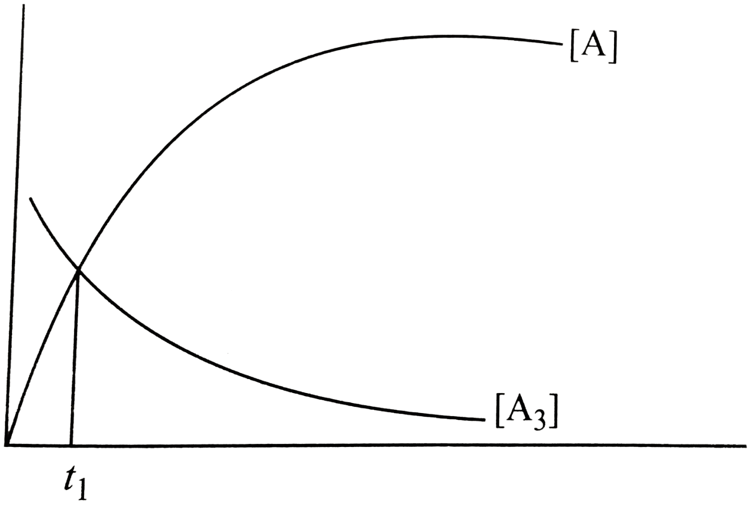
97. Using the given graph showing concentration of reactants and Products as a function of times for the reaction:

$A_3 \rightarrow 3A$

The time t_1 corresponds to



A. $t_{1/2}$

B. $t_{1/3}$

C. $t_{1/4}$

D. $t_{1/5}$

Answer: C

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98. The plot of In $\frac{c_0}{c_0 - x}$ against t is a straight line, showing the reaction to be a

A. Zero order reaction

B. First order reaction

C. Second order reaction

D. Half order reaction

Answer: B

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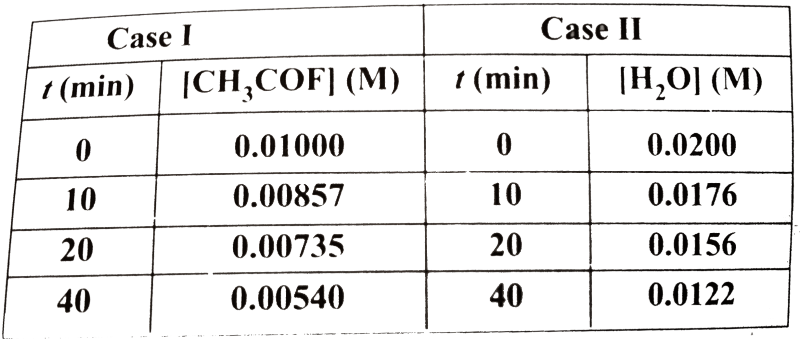
99. The reaction

$$CH_3COF + H_2O \rightarrow CH_3COOH + HF$$

has been studied under the following initial conditions

$CaseI$	$CaseII$
$\left[H_2O\right]_0 = 1.00M$	$\left[H_2O\right]_0 = 0.02M$
$\left[CH_3COF\right]_0 = 0.01M$	$\left[CH_3COF\right]_0 = 0.80M$

Concentration were monitored as a function of time and are given below:



Case I		Case II	
t (min)	$[CH_3COF]$ (M)	t (min)	$[H_2O]$ (M)
0	0.01000	0	0.0200
10	0.00857	10	0.0176
20	0.00735	20	0.0156
40	0.00540	40	0.0122

Determine the order of reaction and rate constant for the reaction.

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100. The half-life periof and initial concentration for a reaction are as follows. What is order of reaction ?

Initial concentration (M)	350	540	158
$t_{1/2}(hr)$	425	275	941

A. 0

B. 1

C. 2

D. 1/2

Answer: C

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101. At a certain temperature the half change periof for the catalystic decompoistion of ammonia was found as follows:

Pressure (Pa)	6667	13333	26666
Half life periof in hours	3.52	1.92	1.0

Calculate the order of reaction.

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102. Calculate the order of reaction form the following data:

$2NH_3 \rightarrow N_2 + 3H_2$ (reaction)

Pressure (mm Hg)	50	100	200
Half lives (min)	3.52	1.82	0.93

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103. Conisder a reaction $A \rightarrow B + C$. The initial concentration of A was reduced form $2M$to $1M$ in $1h$ and form $1M$ to $0.25M$ in $2h$, the order of the reaction is

A. 1

B. 0

C. 2

D. 3

Answer: A

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104. For the reaction:

$2NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$, the mixture containing equilmolar mixture of NO and Cl_2 gases at $0.15atm$ was half changed in $175s$. In an another experiment, with an initial at $0.35atm$, the mixture was half changed in $75s$. Find the order of reaction.

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105. The half-life periofs of a reaction at initial concentration $0.1 mol L^{-1}$ and $0.5 mol L^{-1}$ are $200 s$ and $40 s$, respectively. The order of the reaction is

A. 1

B. $1/2$

C. 2

D. 0

Answer: C

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106. The half-life periof of a substance is $50 \min$ at a certain initial concentration. When the concentration is reduced to one-half of its initial concentration, the half-life periof is found to be $25 \min$. Calculate the order of reaction.

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107. The hydrolyiss of methyl acetate in aqueous solution is has been studied by titrating the liberated acetic acid against $NaOH$. The concentration of ester at different times is given below:

t (min)	0	30	60	90
$C\left(MolL^{-1}\right)$	0.8500	0.8004	0.7538	0.7096

Show that it follows a pseudo first order reaction, as the concentration of water remains nearly constant $\left(55molL^{-1}\right)$ during the course of the reaction . What is the value of k' in the equation ?

Rate $= k'\left[CH_3COOCH_3\right]\left[H_2O\right]$

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108. Pseudo first order rate for the reaction

$A + B \rightarrow P$

when studied in $0.1M$ of B is given by

$$-\frac{d[A]}{dt} = -k[A]$$

where $k = 1.85 \times 10^4 s^{-1}$. Calculate the value of second order rate constant.

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109. The following data were obtained during the first thermal decompoistion of $N_2O_5(g)$ at constant volume.

$2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$

S.No.	Time (s)	Total pressure (atm)
$i.$	0	0.5
$ii.$	100	0.512

Calculate the rate constant.

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110. A gaseous reaction $A_2(g) \rightarrow B(g) + \frac{1}{2}C(g)$ shows increase in pressure form $100mm$ to $120mm$ in 5 min . What is the rate of disappearance of A_2 ?

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111. Azoisopropane decomposes acording to the reaction:

$$\left(CH_3\right)_2CHN = NCH\left(CH_3\right)_2(g) \xrightarrow{250 - 290\,^{\circ}C} N_2(g) + C_6H_{14}(g)$$

It is found to be a first order reaction. If the initial pressure is P_0 and pressure of the mixture at time t is $\left(P_t\right)$, then the rate constant (k) would be

A. $k = \frac{2.303}{t}\log.\frac{P_0}{2P_0 - P_t}$

B. $k = \frac{2.303}{t}\log.\frac{P_0 - P_t}{P_0}$

C. $k = \frac{2.303}{t}\log.\frac{P_0}{P_0 - P - (t)}$

D. $k = \frac{2.303}{t}\log.\frac{2P_0}{2P_0 - P_t}$

Answer: A

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112. For a reaction

$CH_3OCH_3(g) \rightarrow CH_4(g) + H_2(g) + CO(g)$ at $750K$,

the rate constant is $6.72 \times 10^{-3}\ \text{min}^{-1}$. Starting with a pressure of $400mm$ of Hg at this temperature in a closed container, how many minutes would it take for the pressure in the container to become $760mmHg$?

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113. Following data were obtained during the thermal decompoistion of sulphuryl chloride at constant volume and $285^\circ C$.

$SO_2Cl_2(g) \rightarrow SO_2 + Cl_2(g)$

Time (s)	0	240	600
Pressure (torr)	180	244	302

Show that it is first order reaction.

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114. Some PH_3 is introfuced into a flask at $600^\circ C$ containing inert gas. PH_3 decomposed to give $P_4(g)$ and $H_2(g)$. The total pressure as a function of time is given below.

Time (s)	0	60	120	∞
Pressure (mm) (total)	262.4	272.9	275.53	276.4

Find the order and half life.

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115. Arsine decomposes on heating according to the equation $2AsH_3(g) \rightarrow 2As(s) + 3H_2(g)$. The decompoistion was studied at constant temperature and constant volume by measuring the total pressure at various intervals of time.

Time (min)	0	5	7.5	10
Total Pressure (atm)	1	1.09	1.13	1.16

Assume it to be a first order reaction, calculate the specific rate constant and half life of the reaction.

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116. The following first order reaction takes places at $410K$:

$2CO(g) \rightarrow CO_2(g) + C(s)$

The total pressure at the end of $401s$ after starting with pure $CO(g)$ is found to be $0.313atm$. At the time the reaction is 100% complete, the total pressure is found to be $0.1645atm$. Find

(a) The rate constant of the reaction.

(b) The pressure of CO after $401s$.

Note: Here C is the solid form.

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117. The following data were reported for the decompoistion of N_2O_5 in CCl_4 at $303K$:

Time (min)	120	160	200	240	∞
Vol of$O_2(mL)$	37.70	45.85	52.67	58.34	84.35

Show that the reaction is the first order and calculate the rate constant.

Note: This is an example of direct-estimation of Product, i.e., O_2.

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118. In an experiment on the decompoistion of an aqueous NH_4NO_2 at a certain temperature, the volume of nitrogen gas collected at different intervals of time was as follows:

Time (s)	1190	2300	∞
Vol of $N_2(mL)$	5.00	7.30	9.50

Show how the above data illustrate that the reaction is of first order.

Note: This is an example of direct-estimation of Product, i.e., N_2.

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119. In the dehydration of oxalic acid by conc H_2SO_4

$(COOH)_2 \rightarrow CO + CO_2 + H_2O$

$2mL$ of the solution was withdraw at different times and titrated against $0.1NKMnO_4$ solution. Show that the reaction is of first order.

Time (mins)	0	300	450	600
Vol of $KMnO_4$ used (mL)	22.0	17.0	15.0	13.4

Note: This is an example of indirect estimation of reactant, i.e., titrating of oxalic acid by $KMnO_4$.

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120. Methyl acetate was subjected to hydrolyiss in N - HCl at $298K$. $5mL$ of the mixture is withdraw at different intervals and titrated with constant with about $N/8NaOH$. The following results were obtained:

Time (min)	0	25	40	61	∞
Vol of alkali used (mL)	19.24	24.20	26.60	29.50	42.1

Show that the reaction is of first order.

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121. A 20% solution of cane sugar having dextrorotation of 34.50 inverted by $0.5N$ lactic acid to at $298K$. The rotations determined are as follows:

Time (min)	0	14.55	111.36	∞
Rotation	34.50	31.10	13.98	-10.77

Show that the inverison of sugar is a unimolecular reaction.

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122. Methyl acetate is hydrolyzed with $0.1 NHCl$ at $25^\circ C$. $5mL$ of the reacting mixture is withdrawn at various time intervals and is quickly titrated is withdrawn $NaOH$. The volume of $NaOH$ consumed are as follows:

Time (s)	339	1242	2745	4546	∞
vol of NaOH (mL)	26.34	27.80	29.70	31.81	39.81

Show that the hydrolyiss is a first order reaction. Also find the rate constant (k).

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123. The first order reaction:

Sucrose → Glucose + Fructose takes place at $308K$ in $0.5 NHCl$. At time zero the initial total rotation of the mixture is 32.4°. After 10 min, the total rotation is 28.8°. If the rotation of sucrose per mole is 85°, that of glucose is 7.4°, and of fructose is -86.04°, calculate the half life of the reaction.

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124. In the acid hydrolyiss reaction $A + H_2O + H^{\oplus} \rightarrow$ Product, where $\left[H^{\oplus}\right] = 0.1 moldm^{-3}$ and H_2O is present in large excess, the apparent rate constant is $1.5 \times 10^{-5} s^{-1}$. Calculate the true rate constant.

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125. Inverison of sucrose is studied by measuring the angle of rotation at any time t.

$$C_{12}H_{22}O_{11}(\text{Sucrose}) + H_2O(\text{Glucose}) \xrightarrow{H^{\oplus}} C_6H_{12}(\text{Fructose})O_6 + C_6H_{12}O_6$$

It is found that

$\left(r_{\infty} - r_0\right) \propto a$ and $\left(r_{\infty} - r_t\right) \propto, (a - x)$, where r_0, r_t, and r_{∞} are the angle of rotation at the start, at the time t, and at the end of the reaction, respectively. Form the following values calculate the rate constant and the time at which the solution is optically inactive.

Time (min)	0.0	46.0	∞
Rotation of polarized light (degree)	24.1	10.0	-10.7

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126. The rate constant of a reaction at $500K$ and $700K$ are $0.02s^{-1}$, respectively. Calculate the values of E_a and A at $500K$.

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127. The first order rate constant for the decompoistion of C_2H_5I by the reaction.

$C_2H_5I(g) \rightarrow C_2H_4(g) + HI(g)$

at $600Kis1.60 \times 10^{-5}s^{-1}$. Its energy of activation is $209kJmol^{-1}$. Calculate the rate constant at $700K$

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128. The number of flashes of firely change with temperature is as follows:

$T^\circ C$	Number of flashes/min	$T^\circ C$	Number of flashes/min
25	7	38	47
28	10	42	82
32	20	44	108
35	31	-	-

Determine the energy of activation for the chemical reaction that leads to the flsah. $\left(R = 8.314 Jmol^{-1}K^{-1}\right)$

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129. If a catalyst drops the activation energy of a reaction at $25^{\circ} C$ form $80 kJ to 40 kJ$, what is the magnitude of the affect on the forward reaction rate and reverse rate?

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130. What is the value of the rate constant, predicated by the Arrhenius's equation if $T \rightarrow \infty$? It this value phyiscally resonable?

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131. The pre-exponential factor for the free radical addition of chloring is $2 \times 10^{13} s^{-1}$. Find the rate constant of this reaction at STP.

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132. The rate constant of a certain reaction is given by:

$$\log k = 5.4 - \frac{212}{T} + 2.17\log T$$

Calculate $E_a at 127^\circ C$.

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133. Two first order reactions proceed at $25^\circ C$ at the same rate. The temperature coefficient of the rate of the first reaction is 2 and that of second reaction is 3. Find the ratio of the rates of these reactions at $75^\circ C$.

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134. For a reaction $A \rightarrow B, E_a$ for the forward reaction $E_{a(f)}$ and backward reaction $E_{a(b)}$ is $9kJmol^{-1}$ and $9kJmol^{-1}$, respectively. Potential energy of A is $12kJmol^{-1}$. Calculate

(a) The heat of the reaction

(b) The threshold energy of reaction (THE)

(c) The potential energy of Products (PE)

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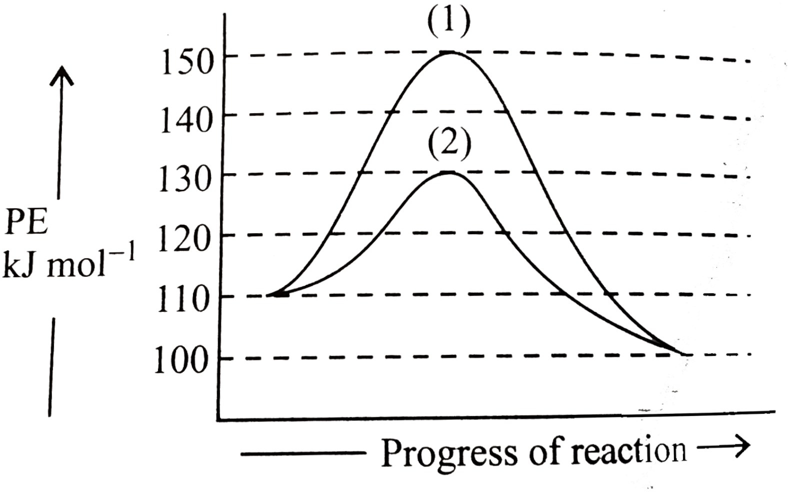
135. Given the following graph.

(a) Calculate ΔH for the reaction and energy of activation for the forward and backward reaction.



(b) Curve (2) is the energy profile in the presence of a catalyst. What is the energy of activation for the two reaction in the presence of a catalyst?

(c) Will the catalyst change the extent of the reaction?

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136. At $407K$, the rate constant of a chemical reaction is $9.5 \times 10^{-5}s^{-1}$ and at $420K$, the rate constant is $1.9 \times 10^{-4}s^{-1}$. Calculate the Arrhenius parameter of the reaction.

A. $5.4 \times 10^{-5}s^{-1}$

B. $5.04 \times 10^{-5}s^{-1}$

C. $5.04 \times 10^{5}s^{-1}$

D. $5.4 \times 10^{5}s^{-1}$

Answer: C

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137. The rate of reaction triples when temperature changes form $20^{\circ} C$ to $50^{\circ} C$. Calculate the energy of activation for the reaction $\left(R = 8.314 JK^{-1} mol^{-1}\right)$.

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138. The energy of activation of a first order reaction is $187.06 kJmol^{-1}$ at $750K$ and the value of pre-exponential factor A is $1.97 \times 10^{12} s^{-1}$. Calculate the rate constant and half life. $\left(e^{-30} = 9.35 \times 10^{-14}\right)$

A. k=0.184s^{-1} and $t_{1/2}$=3.76s

B. k=0.154s^{-1} and $t_{1/2}$=3.76s

C. k=0.184s^{-1} and $t_{1/2}$=2.76s

D. none of the above

Answer: A

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139. A reaction takes place in theee steps: the rate constant are $k_1, k_2,$ and k_3. The overall rate constant $k = k_1 k_3 / k_2$. If the energies of activation are $40, 30,$ and $20 KJmol^{-1}$, the overall energy of activation is (assuming A to be constant for all)

A. 10

B. 15

C. 30

D. 60

Answer: c

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140. Can a reaction have negative activation energy?

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141. In some cases, it is found that a large number of colliding molecules have energy more than thereshold value, yet the reaction is slow. Why?

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142. Why are reactions of higher order less in number?

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143. In chemical kinetics, only a small fraction of colliisons lead to reactions. This is because

A. The colliding molecuels may not be appropriately oriented to one another and the colliisons are not energetic.

B. The colliding molecuels are properly oriented to one another and the colliison are highly energetic.

C. The colliding molecules are properly oriented to one another and the colliisons are not highly enrgetic.

D. The colliding molecules may not be appropriately oriented to one another and the colliison are very enrgetic.

Answer: A

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144. Can activation energy for reactions be zero?

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145. The reaction

$2NO_2 \rightarrow 2NO + O_2$

has an activation energy of $110KJmol^{-}$. At $400\,^{\circ}C$, the rate constant is $7.8mol^{-1}Ls^{-1}$. What is the value of rate constant at $430\,^{\circ}C$?

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146. The activation energy of a first order reaction at $300K$ is $kJmol^{-1}$. In the presence of a catalyst, the activation energy gets lowered to $50kJmol^{-1}$ at $300K$. How many times the reaction rate change in the presence of a catalyst at the same temperature ?

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147. Given that the temperature coefficient for the saponification of ethylacetate by $NaOH$ is 1.75. Calculate the activation energy.

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148. The energy of activation for a reaction is $100KJmol^{-1}$. The peresence of a catalyst lowers the energy of activation by 75%. What will be the effect on the rate of reaction at $20^{\circ}C$, other things being equal?

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149. In a Arrhenius equation for a certain reaction, the values of A and E_a (energy of activation)are $4 \times 10^{13} s^{-1}$ and $98.6 KJmol^{-1}$, respectively. If the reaction of first order at, what temperature will its life periof be 10 min .

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150. How can the activation enrgy for a reaction be determined graphically?

A. Plot k versue T, the slope of the line will be equal to E_a

B. Plot $1[A]_t$, versus t, the slope of the line will be equal to E_a

C. Plot In $[A]_t$ versus t, the slope of the line be equal to $-E_a$.

D. Plot Ink versus $1/T$, the slope of the line will be equal to $-E_a/R$.

Answer: D

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151. The rate constant, activation energy, and Arrphenius parameter of a chemical reaction are $3.0 \times 10^{-4} s^{-1}, 104.4 KJmol^{-1}$, and $6.0 \times 10^{14} s^{-1}$, respectively. The value of rate constant as $T \rightarrow \infty$ is

A. $2.0 \times 10^{18} s^{-1}$

B. $6.0 \times 10^{14} s^{-1}$

C. $3.6 \times 10^{30} s^{-1}$

D. None of these

Answer: B

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152. The rate constants k_1 and k_2 of two reactions are in the ratio $2:1$. The corresponding energies of acativation of the two reaction will be related by

A. $E_1 > E_2$

B. $E_1 < E_2$

C. $E_1 = E_2$

D. $E_1 = 2E_2$

Answer: B

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153. On introfucing a catalyst at $500K$, the rate of a first order reaction increases by 1.718 times. The activation energy in the presence of a catalyst is $4.15KJmol^{-1}$. The slope of the polt of $k\left(s^{-1}\right)$ against $1/T$ in the absence of catalyst is

A. $+1$

B. -1

C. $+1000$

D. -1000

Answer: D

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154. For which of the following reactions k_{310}/k_{300} would be maximum?

A. $A + B \rightarrow , E_a = 500kJ$

B. $X + Y \rightarrow Z, E_a = 40kJ$

C. $P + Q \rightarrow R, E_a = 600kJ$

D. $E + F \rightarrow G, E_a = 100kJ$

Answer: D

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155. For a reaction, $E_a = 0$ and $k = 3.2 \times 10^4 s^{-1}$ at $300K$. The value of k at $310K$ would be

A. $6.4 \times 10^4 s^{-1}$

B. $3.2 \times 10^8 s^{-1}$

C. $3.2 \times 10^4 s^{-1}$

D. $3.2 \times 10^5 s^{-1}$

Answer: C

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156. For a gaseous reaction, following data is given:

$A \rightarrow B, k_1 = 10^{15} e -^{2000/T}$

$C \rightarrow D, k_2 = 10^{14} e^{-1000/T}$

The temperature at which $k_1 = k_2$ is

A. $1000K$

B. $2000K$

C. $868.82K$

D. $434.2K$

Answer: D

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157. For $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + 22kcal$, E_a for the reaction is $70kcal$. Hence, the activation energy for $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ is :

A. $92kcal$

B. $70kcal$

C. $48kcal$

D. $22kcal$

Answer: A

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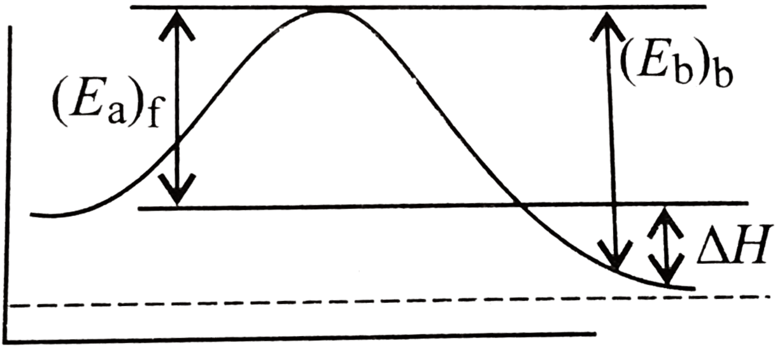
158. In an exothermic reaction $X \rightarrow Y$, the activation energy is $100kJmol^{-1}$ of X. The enthalpy of the reaction is $-140kJmol^{-1}$. The activation energy of the reverse reaction $Y \rightarrow X$ is



A. $40kJmol^{-1}$

B. $340kJmol^{-1}$

C. $240kJmol^{-1}$

D. $100kJmol^{-1}$

Answer: C

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159. The rate constant of a reaction will be equal to the pre-exponential factor when

A. Temperature in centigrade is zero.

B. The absolute temperature is zero.

C. The absolute temperature is infinity.

D. No suitable answer.

Answer: C

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160. The activation energy for the reaction:

$2AB \rightarrow A_2 + B_2(g)$

is $159.7kJmol^{-1}$ at $500K$. Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy.

(Given: $2.3 \times 8.314JK^{-1}mol^{-1} \times 500K = 9561.1Jmol^{-1}$)

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161. From the concetration of C_4H_9Cl (butyl chloride) at different times given below, calculate the average rate of reaction:

$C_4H_9Cl + H_2O \rightarrow C_4H_9OH + HCl$

during different intervals of time.

$[C_4H_9Cl](molL^{-1})$	$t(s)$
0.100	0
0.0905	50
0.0820	100
0.0741	150
0.0671	200
0.0549	300
0.0439	400
0.0210	700
0.017	800

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162. For a reaction

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

The following data were obtained :

	$[NO]\left(molL^{-1}\right)$	$\left[H_2\right]\left(molL^{-1}\right)$	Rate$\left(molL^{-1}s^{-1}\right)$
1.	5×10^{-3}	2.5×10^{-3}	3×10^{-5}
2.	15×10^{-3}	2.5×10^{-3}	9×10^{-5}
3.	15×10^{-3}	10×10^{-3}	3.6×10^{-4}

(a) Calculating the order of reactions.

(b) Find the rate constant.

(c) Find the initial rate if $[NO] = \left[H_2\right] = 8.0 \times 10^{-3}M$

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163. For a reaction at $800\ ^\circ C$

$2NO + 2H_2 \rightarrow N_2 + 2H_2O$, the following data were obtained:

	$[NO] \times 10^{-4}(M)$	$\left[H_2\right] \times 10^{-3}(M)$	$-\frac{1}{2}\frac{d[NO]}{dt} \times 10^{-4}\left(molL^{-1}\min^{-1}\right)$
i.	1.5	4.0	4.4
ii.	1.5	2.0	2.2
iii.	0.5	2.0	0.24

What is the order of this reaction with respect to NO and H_2 ? Also calculate the rate constant.

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Solved Example

1. Which of the following will react fastest (i.e., profuce most of the Product in a given time) and which will react at the highest rate?

(a) $1mol$ of A and $1mol$ of B in a $1 - L$ vessel.

(b) $2mol$ of A and $2mol$ of B in a $2 - L$ vessel.

(c) $0.2mol$ of A and $0.2mol$ of B in a $0.1 - L$ vessel.

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2. For the reaction,

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$, the rate of formation of O_2 is $0.032gh^{-1}$.

(a) Calculate the rate of converison of N_2O_5 in gh^{-1}.

(b) Calculate the rate of formation of NO_2 in gh^{-1}.

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3. The rate of formation of a dimer in a second order dimerization reaction is $9.5 \times 10^{-5} molL^{-1}s^{-1}$ at $0.01 molL^{-1}$ monomer concentration. Calculate the rate constant.

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4. For the decompoistion of phosphorus pentachloride at $200^{\circ} C$, it is observed that its pressure falls form 0.15 to $0.10 atm$ in $25 \min$. Calculate the average rate of reaction in

(a) $atm \min^{-1}$, (b) $molL^{-1}s^{-1}$

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5. Raiisng the concentration of a particular reactant by a factor of 5 increases the reaction rate 25 times. What is the kinetic order of this reactant?

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6. The rate of reaction:

$H_2O + 2S_2O_4^{2-}(aq) \rightarrow 2HSO_3^{\ominus}(aq) + S_2O_3^{2-}(aq)$

was studied as follows. In an experiment, the concentration of $S_2O_4^{2-}(0.4M)$ half changed in $3.73 \times 10^6 s$. In another experiment, $0.25MS_2O_4^{2-}$ half changed in $6.0 \times 10^6 s$. Find the order of the reaction.

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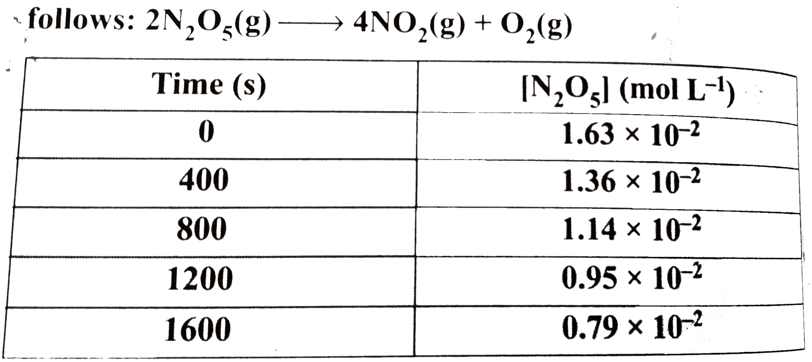
7. The experiment data for the decompoistion of nitrogen pentoxide in the gaseous phase at $218K$ are as follows: $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$



follows: $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$

Time (s)	$[N_2O_5]$ (mol L^{-1})
0	1.63×10^{-2}
400	1.36×10^{-2}
800	1.14×10^{-2}
1200	0.95×10^{-2}
1600	0.79×10^{-2}

Calculating the rates of reaction at the time given above (assuming that the rate remains constant during the intervals given). Also find the out the following:

(a) Rate law expresison

(b) Rate constant

(c) Order of reaction

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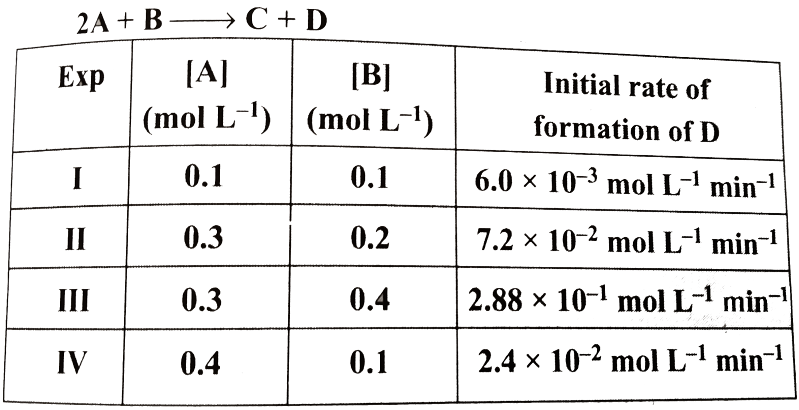
8. The following rate data were obtained at $303K$ for the following reaction:

$2A + B \rightarrow C + D$



$2A + B \longrightarrow C + D$

Exp	[A] (mol L^{-1})	[B] (mol L^{-1})	Initial rate of formation of D
I	0.1	0.1	6.0×10^{-3} mol L^{-1} min^{-1}
II	0.3	0.2	7.2×10^{-2} mol L^{-1} min^{-1}
III	0.3	0.4	2.88×10^{-1} mol L^{-1} min^{-1}
IV	0.4	0.1	2.4×10^{-2} mol L^{-1} min^{-1}

What is the rate law? What is the order with respect to each reactant and the overall order? Also calculate the rate constant and wriye its units.

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9. What is the ratio of $t_{1/2}$ to $t_{1/3}$ (for the amount of substance left) for first order reaction ?

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10. The half life for a given reaction was doubled as the initial concentration of a reactant was doubled. What is the order of reaction.

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11. Why the term half life is not used for second order reaction?

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12. The reaction $SO_2Cl_2 \xrightarrow{k_1} SO_2 + Cl_2$ is a first order reaction with $k_1 = 2.2 \times 10^{-5} s^{-1}$ at $575K$. What percentage of SO_2Cl_2 will get decomposed in $90 \min$ when the reaction is carried out at $575K$.

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13. A first order reaction has a specific reaction rate of $10^{-3}s^{-1}$. How much time will it take for $10g$ of the reactant to reduce to $2.5g$. (Given $\log 4 = 0.6021$).

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14. The esterification of acetic anhydride by ethyl alcohol can be represented by the following balanced equation:

$$\left(CH_3CO\right)_2O A + C_2H_5OH B \rightarrow CH_3COOC_2H_5 + CH_3COOH$$

When the reaction is carried out in dilute hexane solution, the rate may be represented by $k[a][b]$. When ethyl alcohol (B) is the solvent, the rate may be represented by $k[A]$ the values of k are not the same in the two cases). Explain the difference in the apparent order of the reaction.

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15. An optically active drug has one chiral centre and only dextro rotatory isomer is effective. Moreover, it becomes ineffective when its optical activity is reduced to 35% of original. It was found that mutarotation of this drug was first order reaction with a rate constant of $1 \times 10^{-8}s^{-1}$. Find the expiration time of the drug in years.

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16. A radioactive element $\left(t_{1/2} = 50 days\right)$ is spread over a room. Its activity is 30 times the permisible value for safe working. Calculate the number of days after which the room will be available for safe working.

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17. $._{84}Po^{218}\left(t_{1/2} = 3.05 \text{ min }\right)$ decays to $._{82}Pb^{214}\left(t_{1/2} = 2.68 \text{ min }\right)$ by α emisison while Pb^{214} is β-emitter. In an experiment starting with $1g$ atom of pure Po^{218}, how much time would be required for the concentration of Pb^{214} to reach maximum?

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18. The complex $\left[Co\left(NH_3\right)_5F\right]^{2+}$ reacts with water according to the equation

$\left[Co\left(NH_3\right)_5F\right]^{2+}+H_2O\rightarrow\left[Co\left(NH_3\right)_5\left(H_2O\right)\right]^{3+}+F^{\ominus}$ and Rate $=k[\text{Complex}]^a\left[H^{\oplus}\right]^b$

The reaction is acid catalyzed, i.e., $\left[H^{\oplus}\right]$ does not change during the reaction.

Thus, rate $=k'[\text{Complex}]^3$, where $k'=k\left[H^{\oplus}\right]^b$

Calculate a and b form the following data $\left(t=25^{\circ}C\right)$

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19. For the reaction

$k_1=1.78\times10^{-3}s^{-1}$ and $k_2=5.8\times10^{-5}s^{-1}$ for the initial concentration of

$\left[Cr\left(H_2O\right)_4Cl_2\right]^{\oplus}$ is $0.0174molL^{-}$ at $0\,^{\circ}C$. Calculate the value of time at which the concentration of $\left[Cr\left(H_2O\right)_5Cl\right]^{2+}$ is maximum.

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20. Substance A isomerizes according to a first order rate law with $k = 5.0 \times 10^{-5}s^{-1}$.

(a) If the initial concentration of A is $1.00M$, what is the initial rate?

(b) What is the rate after $1.00hr$?

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21. A certain reaction $A + B \rightarrow$ Products is first order w.r.t. each reactant with $k = 5.0 \times 10^{-3}M^{-1}s^{-1}$. Calculate the concentration of A remaining after $100s$ if the initial concentration of A was $0.1M$ and that of B was $6.0M$ State any approximation made in obtaining your result.

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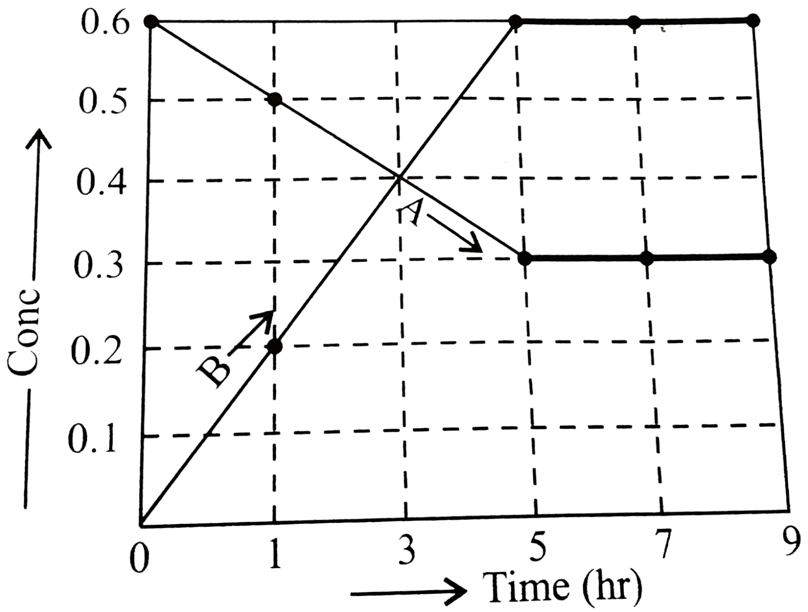
22. The progress of the reaction $A \Leftrightarrow nB$, with times is presented in the figure below.



Determine:

(a) The value of n , (b) K_{eq}

(c) Initial rate of converison of A

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23. At constant temperature and constant pH of 4, the inverison of sucrose proceeds with a constant half life of 300 min . At the same temperature but at pH of 3 the half life is constant at 30 min . Calculate the order of reaction w.r.t. sucrose and w.r.t. $\left[H^{\oplus}\right]$.

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24. In a certain polluted atmosphere containing O_3 at a steady-state concentration of $2.0 \times 10^{-8} molL^{-1}$, the hourly Production of O_3 by all sources was estimated as $7.2 \times 10^{-15} molL^{-1}$. If only mechanism for the destruction of O_3 is the second order reaction,

$2O_3 \rightarrow 3O_2$

Calculate the rate constant for the destruction reaction defined by the rate law for $-\Delta\left[O_3\right]/\Delta t$.

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25. Write a rate expresison for each speices. Assuming $[B]$ is constant, write a rate expresison for $[A]$ and $[C]$ so that they do not contain $[B]$ term. Under what conditions will the reaction be pseudo first order to second conditions will the reaction be pseudo first order to second order ?

Mechanism of reaction is

$$A \overset{k_1}{\Leftrightarrow} k_2 B$$

$$\underline{B + A \overset{k_3}{\rightarrow} C}$$

$$\underline{2A \rightarrow C}$$

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26. Conisder the following proposed mechanism

$$A \overset{k_2}{\Leftrightarrow} k_1 B \, , B + C \overset{k_3}{\rightarrow} D$$

For the overall reaction $A + C \rightarrow D$, assuming B to be an intermediate described by the steady state approximation, write the rate expresison for $[A]$.

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27. Conisder the following proposed mehanism

$A_2 \Leftrightarrow 2A\left(k_1\right)$

$A + B \Leftrightarrow C\left(k_2\right)$

$A_2 + C \rightarrow D + A(k)$

For the overall chemical equation $A_2 + B \rightarrow D$, assuming that the equlibria are rapidly established in the first two steps, write the rated expresison for $[D]$.

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28. Conisder the following mechanism:

$A_2 \Leftrightarrow 2A(k)$

$A + B_2 \xrightarrow{k_1} C + B, B + A_2 \xrightarrow{A_2} C + A$

For the overall chemical equation $A_2 + B_2 \rightarrow 2C$.

Assumming that the equilibrium is rapidly established and the steady approximation is valid for $[B]$, write the rate expresison for $[C]$.

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29. The rate equation for the overall equation is:

$$H_3AsO_4(aq) + 2H^{\oplus} + 3I^{\Theta}(aq) \overset{k_f}{\Leftrightarrow} k_rH_3AsO_3(aq) + I_3^{\Theta}(eq) + H_2O(l)$$

$$\frac{d\left[I_3^{\ominus}\right]}{dt} = k_f\left[H_3AsO_4\right]\left[I^{\ominus}\right]\left[H^{\oplus}\right] - k_f\frac{\left[H_3AsO_3\right]\left[I^{\ominus}3\right]}{\left[I^{\ominus}\right]^2\left[H^{\oplus}\right]}$$

where $k_f = 4.7 \times 10^{-4}L^2mol^{-2}min^{-1}$ and

$k_r = 3 \times 10^{-3}mol^2L^{-2}\overset{-1}{\text{min}}$

Determine the euilibrium constant for this reaction form the rate constants.

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30. $H_2(g) + Ar(g) \overset{k_f}{\Leftrightarrow} k_r2H(g) + Ar(g)$

$k_f = 2.2 \times 10^4Lmol^{-1}s^{-1}$ and $k_c = 1.02 \times 10^{-4}$ at $3000K$. What is the value of k_r?

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31. Conisder parallel reaction:

$A \xrightarrow{k_1} B, 2A \xrightarrow{k_2} C + D$

What would be the rate expresison for $[A]$?

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32. Conisder a mechanism in which a single reactant profuces several Products by the following parallel first order reactions :

$A \xrightarrow{k_1} B, A \xrightarrow{k_2} CA \xrightarrow{k_3} D$

Write the rate expresison for $[A]$.

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33. A proposed mechanism for a reaction $A \rightarrow B$ is

$A \overset{k_1}{\Leftrightarrow} k_2C \quad C \overset{k_3}{\Leftrightarrow} k_4B$

Determine the expresison for the equilibrium constant for the overall reaction in terms of the rate constants.

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34. Bicyclohexane was found to undergo two parallel first order rearrangements. At $730K$, the first order rate constant for the formation of cyclohexene was measured as $1.26 \times 10^{-4}s^{-1}$ and for the formation of methyl cyclopentene the rate constant was $3.8 \times 10^{-5}s^{-1}$. What is the percentage distribution of the rearrangement Products ?

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35. Trans $1, 2$-dideuterocyclopropane (A) undergoes a first order decompoistion. The observed rate constant at a certain temperature, measured in terms of disapperance of A was $1.52 \times 10^{-4}s^{-1}$. The analyiss of Products shwoed that the reaction followed two parallel paths, one leading to dideuteropropane (B) and the other to cis-$1, 2$-dideuterocyclopropane (c). (B) was found to constitute 11.2% of the reaction Product, independently of the extent of reaction. What is the order of reaction for each path and what is the value of the rate constant for the formation of each of the Products ?

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36. The decompoistion of Cl_2O_7 at $400K$ in gas phase to Cl_2 and O_2 is a first order reaction.

a. After $55s$ at $400K$, the pressure of Cl_2O_7 falls form 0.062 to $0.044atm$. Calculate k.

b. Calculate the pressure of Cl_2O_7 after $100s$ of decompoistion.

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37. Ethylene is profuced by

$$C_4H_8(\text{cyclobutane}) \overset{\Delta}{\rightarrow} 2C_2H_4$$

The rate constant is $2.48 \times 10^{-4}s^{-1}$. In what time will the molar ratio of the ethylene to cyclobutane in reaction mixture attain the value (a) 1 (b) 100?

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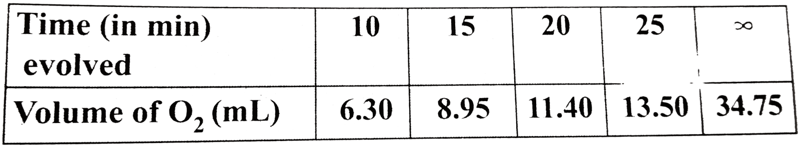
38. form the following data for the decompoistion of N_2O_5 in carbon tertrachloride solution at $321K$, show that the reaction is of the first order and calculate the rate constant.



Time (in min) evolved	10	15	20	25	∞
Volume of O_2 (mL)	6.30	8.95	11.40	13.50	34.75

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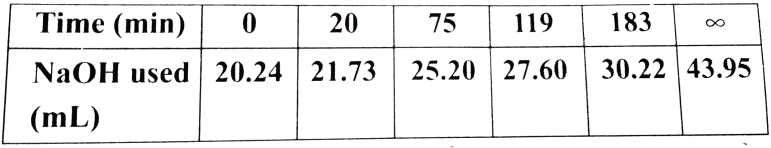
39. $1.0mL$ of ethyl acetate was added to $25mL$ of $N/2HCl, 2mL$ of the mixture were withdraw form time to time during the progress of the hydrolyiss of the ester and titrated against standard $NaOH$ solution. The amount of $NaOH$ required for titration at various intervals is given below:



Time (min)	0	20	75	119	183	∞
NaOH used (mL)	20.24	21.73	25.20	27.60	30.22	43.95

The value at ∞ time was obtained by completing the hydrolyiss on boiling. Show that it is a reaction of the first order and find the average value of the velocity constant.

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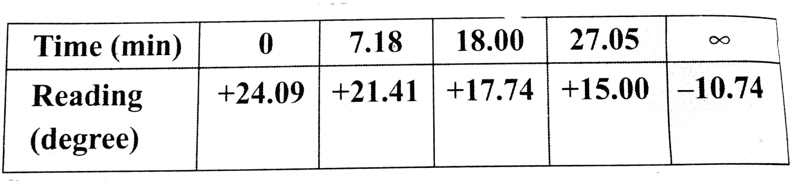
40. The inverison of cane sugar was studied is HCl at $298K$. The following polarimetric readings were obtained at different intervals of time:



Time (min)	0	7.18	18.00	27.05	∞
Reading (degree)	+24.09	+21.41	+17.74	+15.00	–10.74

Show that the inverison of cane sugar is a unimolecular reaction.

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41. An exothermic reaction $X \rightarrow Y$ has an activation energy of $90kJmol^{-1}$ of X and the heat of reaction is $250kJ$. Find the activation energy of the reaction $Y \rightarrow X$.

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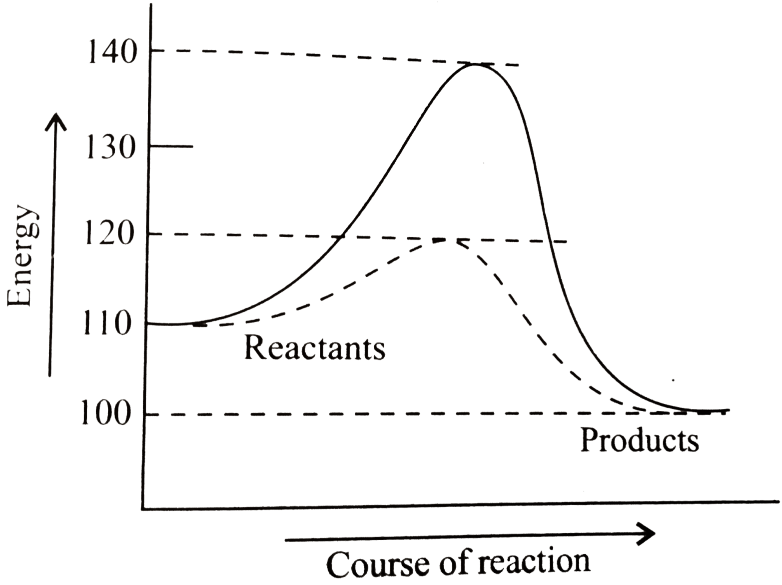
42. Refer picture given below.

(a) Calculate ΔH for the reaction and the energy of activation for the forward reaction as well as backward reaction.

(b) The dotted curve is in the presence of a catalyst. What is the energy of activation for the two reactions in the presence of catalyst?

(c) Will the catalyst change the extent of reaction?



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43. Calculate the activation energy of a reaction whose reaction rate at $300K$ double for $10K$ rise in temperature.

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44. The activation energy of a reaction is $94.14kJmol^{-1}$ and the value of rate constant at $313K$ is $18 \times 10^{-5}s^{-1}$. Calculate the frequency factor or pre-exponential factor, A.

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45. The rate constant of a reaction is $1.5 \times 10^{7}s^{-1}$ at $50^{\circ}C$ and $4.5 \times 10^{7}s^{-1}$ at $100^{\circ}C$. Evaluate the Arrhenius parameters A and E_a.

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46. For two reactions (i) $P \rightarrow$ Product and (ii) $Q \rightarrow$ Product, the order of reaction (i) is 1 while that of reaction (ii) is 2. At $347K$, the energy of activation of reaction (i) is $55kJmol^{-1}$ but whenever this reaction is carried out in the presence of catalyst at the same temperature, the energy of activation is $53kJmol^{-1}$. Moreover, for reaction (ii), when the temperature is increased form $298K$ to $308K$, the rate of reaction increases as many times as for reaction (i) in the presnece of catalyst. Calculate the rate constant of reaction (ii) at $318K$, if the pre-exponential factor for reaction (ii) is $3.56 \times 10^9 mol^{-1}Ls^{-1}$.

Note: Arrhenius equation does not depend on the order of reaction.

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47. For two firstorder reactions having same concentration of A and B at $t = 0$, use the given data to calculate the tempretature at which both occur with same rate.

Reaction I: $A \rightarrow Z, k_1 = 10^{16} e^{\left(-\frac{3000}{T}\right)}$

Reaction II: $B \rightarrow Y, k_2 = 10^{15} e^{\left(-\frac{2000}{T}\right)}$

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48. The Arrehenius equation for the rate constant of decompoistion of methyl nitrite and ethyl nitrite are

$$k_1\left(s^{-1}\right) = 10^{13}\exp\left(\frac{-152300Jmol^{-1}}{RT}\right)$$

and $k_2\left(s^{-1}\right) = 10^{14}\exp\left(\frac{-157700Jmol^{-1}}{RT}\right)$ respectively. Find the temperature at which the rate constant are equal.

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49. The activation energy of the reaction: $A + B \rightarrow$ Products is $105.73kJmol^{-1}$. At $40\,^{\circ}C$, the Products are found at the rate of

$0.133 molL^{-1} \min^{-1}$. What will be the rate of formation of Products at $80^{\circ} C$

?

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50. For a reverisble reaction $A \Leftrightarrow B$, if pre-exponential factor is same for both forward and backward reactions, show that $k_{eq} = e^{-\Delta H / RT}$, where ΔH is the heat of reaction.

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51. Two reaction : $X \rightarrow$ Products and $Y \rightarrow$ Products have rate constants k_1 and k_2 at temperature T and activation energies E_1 and E_2, respectively. If $k_1 > k_2$ and $E_1 < E_2$ (assuming that the Arrhenius factor is same for both the Products), then

(I) On increaisng the temperature, increase in k_2 will be greater than increaisng in k_1.

(II) On increaisng the temperature, increase in k_1 will be greater than increase in k_2.

(III) At higher temperature, k_1 will be closer to k_2.

(IV) At lower temperature, $k_1 < k_2$

A. I

B. II

C. I, III

D. I, III, IV

Answer: B

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52. The decompoistion of compound A in solution is a first order process with an activation energy of $52.3 kJmol^{-1}$. A 10% solution of A is 10% decomposed in 10 min at $10^{\circ} C$. How much decompoistion would be observed with a 20% solution after 20 min at $20^{\circ} C$.

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Ex 4.1 (Objective)

1. In a reaction $2X + Y \rightarrow X_2, Y$ the reactant X will disappear at

A. Half the rats as that of disappearance of Y

B. The same rate as that of disappearance of Y

C. Twice the rate as that of appearance of X_2Y

D. Twice the rate as that of disappearance of Y

Answer: C::D

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2. The units of rate constant and rate of a reaction are idential for:

A. zero-order reaction

B. first-order reaction

C. second-order reaction

D. third-order reaction

Answer: A

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3. The rate law for a reaction between A and B is given by rate $= k[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction becomes

A. $2^{1/(m+n)}$

B. $m + n$

C. $m - n$

D. 2^{n-m}

Answer: D

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4. For the chemical reaction $X \rightarrow Y$, it is found that the rate of reaction increases by 2.25 times when the concentration of X is increased by 1.5 times, what is the order w.r.t. X ?

A. 0

B. 1

C. 2

D. 3

Answer: C

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5. Conisder a reaction $aG + bH \rightarrow$ Products. When concentration of both the reactants G and H is doubled, the rate increases eight times. However, when the concentration of G is doubled, keeping the concentration of H fixed, the rate is doubled. The overall order of reaction is

A. 0

B. 1

C. 2

D. 3

Answer: D

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6. For a hypothetical reaction $A \rightarrow B$, it is found that the rate constant $= xs^{-1}$. By what factor the rate is increased if the initial concentration of A is tripled?

A. 1

B. 2

C. 3

D. 4

Answer: C

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7. For a reaction: $nA \rightarrow$ Product, if the rate constant and the rate of reactant are equal what is the order of the reaction?

A. 0

B. 1

C. 2

D. 3

Answer: A

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8. Analyze the generalized rate data:

$RX + M^{\ominus} \rightarrow$ Product

Experiment	$[RX]$Substrate	$\left[M^{\ominus}\right]$Attaking species	Rate
I	$0.10M$	$0.10M$	1.2×10^{-4}
II	$0.20M$	$0.10M$	2.4×10^{-4}
III	$0.10M$	$0.20M$	2.4×10^{-4}
IV	$0.20M$	$0.20M$	4.8×10^{-4}

The value of rate constant for the give experiment data is

A. 1.2×10^{-2}

B. 1.2×10^{-4}

C. 1.2×10^{-3}

D. 2.4×10^{-3}

Answer: A

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9. Analyze the generalized rate data:

$RX + M^{\ominus} \rightarrow$ Product

Experiment	$[RX]$Substrate	$\left[M^{\ominus}\right]$Attaking species	Rate
I	$0.10M$	$0.10M$	1.2×10^{-4}
II	$0.20M$	$0.10M$	2.4×10^{-4}
III	$0.10M$	$0.20M$	2.4×10^{-4}
IV	$0.20M$	$0.20M$	4.8×10^{-4}

For the reaction under conisderation, 3° alkyl has been found to be the most favourable alkyl group. Which of the following attacking species $\left(M^{\ominus}\right)$ will give the best yield in the reaction ?

A. $\left(CH_3\right)_2CH-O^{\ominus}$

B. $\left(CH_3\right)_3C-O^{\ominus}$

C. $\overset{\ominus}{OH}$

D. $CH_3CH_2O^{\ominus}$

Answer: B

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Ex 4.2 (Objective)

1. The reaction $A(g) + 2B(g) \rightarrow C(g) + D(g)$ is an elementary process. In an experiment involvig this reaction, the initial partial pressure of A and B are $p_A = 0.60 atm$ and $p_B = 0.80 atm$, respectively. When $p_C = 0.20 atm$, the rate of reaction relative to the initial rate is

A. $1/6$

B. $1/12$

C. $1/36$

D. $1/18$

Answer: A

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2. In the decompoistion of $N_2O_5(g)$,

$$2N_2O_5(g) \xrightarrow{k_{obs}} 4NO_2(g) + O_2(g),$$

the observed rate law is given by

$$\frac{d[O_2]}{dt} = k_{obs}[N_2O_5].$$

Which of the following proposed mechanics is conisstent with the rate law?

A. $N_2O_5(g) \overset{k}{\rightarrow} N_2O_3(g) + O_2(g)$

B. $N_2O_5(g) \overset{k_2}{\rightarrow} NO_2(g) + NO_3(g)$

C. $N_2(g) + NO_3(g) \overset{k_1}{\rightarrow} NO(g) + NO_2(g) + O_2(g)$

D. $NO_3(g) + NO(g) \overset{k_2}{\rightarrow} 2NO_2(g)$

Answer: A

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3. Conisder the reaction mechanism:

$A_2 \overset{k_{eq}}{\Leftrightarrow} 2A$(fast) (where A is the intermediate.)

$A + B \rightarrow k_1P(slow)$

The rate law for the reaction is

A. $k_1[A][B]$

B. $k_1k^{1/2}\left[A_2\right]^{1/2}[B]$

C. $k_1k^{1/2}[A][B]$

D. $k_1k^{1/2}[A]^2[B]$

Answer: B

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4. In the formation of HBr form H_2 and Br_2, following mechanism is observed:

I. $Br_2 \Leftrightarrow 2Br^{\cdot}$ (Equilibrium step)

(II) $H_2 + Br^{\cdot} \rightarrow HBr + H^{\cdot}$ (Slow step)

(III) $H^{\cdot} + Br_2 \rightarrow HBr + H^{\cdot}$ (Fast step)

The rate law for the above reaction is

A. $r = k\left[H_2\right]\left[Br_2\right]$

B. $r = k\left[H_2\right]\left[Br_2\right]^{1/2}$

C. $r = k\left[H_2\right]^{1/2}\left[Br_2\right]$

D. $r = k\left[H_2\right]^{1/2}[Br]^{1/2}$

Answer: B

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5. The forward reaction rate for the nitric oxide-oxygen reaction

$2NO + O_2 \rightarrow 2NO_2$ has the rate law as:

$Rate = k[NO]^2\left[O_2\right]$.

If the mechanism is assumed to be:

$2NO + O \overset{k_{eq}}{\Leftrightarrow}$, (rapid equilibration)

$N_2O_2 + O_2 \xrightarrow{k_2} 2NO_2$ (slow step),

then which of the following is (are) correct?

(I) Rate constant $= k_{eq}k_2$, (II) $\left[N_2O_2\right] = k_{eq}[NO]^2$

(III) $\left[N_2O_2\right] = k_{eq}[NO]$, (IV) Rate constant $= k_2$

The correct option is

A. I, II

B. III, IV

C. I, III

D. None of these

Answer: D

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6. Conisder a reaction $X + Y \rightarrow$ Products. If the initial concentration of X increased to four times of its original value, keeping the concentration of Y constant, the rate of reaction increases four-fold. When the concentration of both X and Y becomes four times their original values the rate of reaction becomes 16 times its original values. The observed rate law is

A. $k[X]^2[Y]^2$

B. $k[X]^1[Y]^2$

C. $k[X]^{1}[Y]^{1}$

D. $k[X]^{2}[Y]^{1}$

Answer: C

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7. The rate law for the reaction $O_3 + O \rightarrow 2O_2$ is rate $= k\left[O_3\right][NO]$. Then which is/are correct? (more than one correct)

A. NO is catalyst.

B. O atom is not involved in slow step

C. The slow step is bimolecular.

D. None of these

Answer: A::B::C

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8. The rate of reaction can be increased by (more than one correct)

A. Decreaisng threshold energy

B. Uisng a poistive catalyst

C. Increaisng activation energy

D. Increaisng temperature

Answer: A::B::D

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9. The reaction:

$$OCl^{\ominus} + I^{\ominus} \xrightarrow{\overset{\ominus}{OH}} OI^{\ominus} + Cl^{\ominus}$$

takes place in the following steps:

(i) $OCl^{\ominus} + H_2O \overset{k_1}{\Leftrightarrow} k_2HOCl + \overset{\ominus}{OH}$(fast)

(ii) $I^{\ominus} + HOCl \xrightarrow{k_3} HOI + Cl^{\ominus}$ (slow)

(iii) $\overset{\ominus}{OH} + HOI \overset{k_2'}{\Leftrightarrow} k_1' H_2O + OI^{\ominus}$ (fast)

The rate of consumption of $I^{\ominus}$ in the following equation is

A. $\frac{k_3k_1}{k_2}\frac{\left[OCl^{\ominus}\right]\left[I^{\ominus}\right]}{\left[\overset{\ominus}{OH}\right]^2}$

B. $\frac{k_1k_2}{k_3}\frac{\left[OCl^{\ominus}\right]\left[I^{\ominus}\right]}{\left[\overset{\ominus}{OH}\right]}$

C. $\frac{k_1k_3}{k_2}\frac{\left[OCl^{\ominus}\right]\left[I^{\ominus}\right]}{\left[\overset{\ominus}{OH}\right]}$

D. $\frac{k_2k_3}{k_1}\frac{\left[OCl^{\ominus}\right]\left[I^{\ominus}\right]}{\left[\overset{\ominus}{OH}\right]}$

Answer: C

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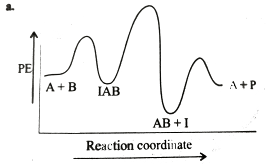
10. The following mechanism has been proposed for the exothermic catalyzed cmplex reaction:

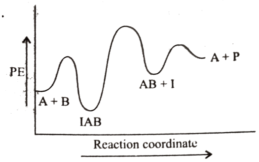
$$A + B \xrightarrow{\text{Fast}} IAB \xrightarrow{k_1} AB + I \xrightarrow{k_2} P + A$$

If k_1 is much smaller than k_2, the most suitable qualitative plot of potential energy (PE) versus reaction coordinates for the above reaction is

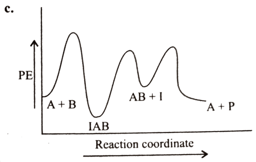
A.



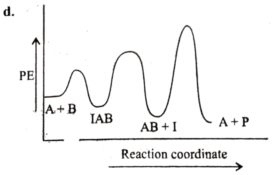
B.



C.



D.



Answer: D

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Ex 4.3 (Objective)

1. Aqueous AB_2 decomposes according to the first order reaction:

$AB_2(aq) \rightarrow A(g) + 2B(l)$

After 20 min the volume of $A(g)$ colledcted during such a reaction is $20mL$, and that collected after a very long time is $40mL$. The rate constant is :

A. $A.\ 3.45 \times 10^{-3} \text{ min}^{-1}$

B. $B.\ 3.45 \times 10^{-2} \text{ min}^{-1}$

C. $C.\ 1.435 \times 10^{-2} \text{ min}^{-1}$

D. $D.\ 6.93 \text{ min}^{-1}$

Answer: B

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2. A plot of logarithm of rate vs logarithm of concentration of the reactant in a first order reaction is straight line whose slope is $\tan\theta$, where θ is

A. $A.\ 45^\circ$

B. $B.\ 135^\circ$

C. $C.\ 90^\circ$

D. $D.\ \log k$

Answer: A

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3. The rate of radioactive decay of a sample are $3 \times 10^8 dps$ and $3 \times 10^7 dps$ after time 20 min and 43.03 min respectively. The fraction of radio atom decaying per second is equal to

A. $A. \frac{1}{600}$

B. $B. 1$

C. $C. 0.5$

D. $D. 0.001$

Answer: A

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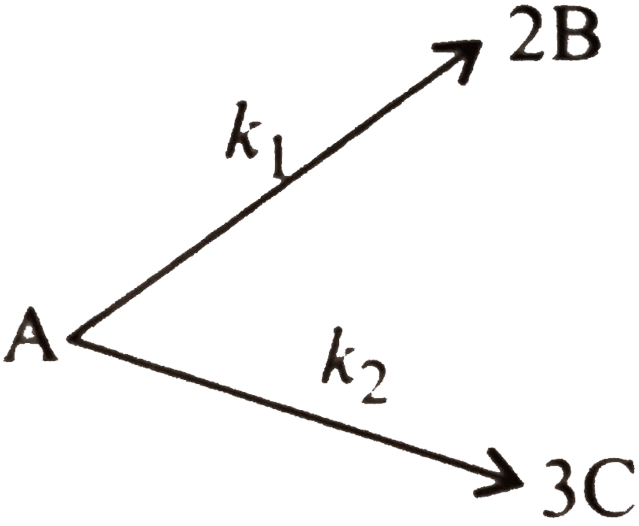
4. Consider the following parallel reactions being given by $A\left(t_{1/2} = 1.386 \times 10^2 hours\right)$, each path being first order.



If the distribution of B in the Product mixture is 50%, the partical half life of A for converison into B is

A. $A.\ 346.5h$

B. $B.\ 131h$

C. $C.\ 115.5h$

D. $D.\ 31h$

Answer: A

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5. The rate constant for forward reaction $A(g) \Leftrightarrow 2B(g)$ is $1.5 \times 10^{-3} s^{-1}$ at $100K$. If 10^{-5} moles of A and 100moles of B are present in a $10 - L$ vessel at equilibrium, then the rate constant for the backward reaction at this temperature is

A. $A.\ 1.50 \times 10^{-4} Lmols^{-1}$

B. $B.\ 1.50 \times 10^{-11} Lmol^{-1}s^{-1}$

C. $C. 1.50 \times 10^{-10} Lmol^{-1}s^{-1}$

D. D. None of these

Answer: B

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6. The rate law for a reaction between A and B is given by rate $= k[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction becomes

A. $\frac{1}{(2)^{m+n}}$

B. $(m+n)$

C. $(n-m)$

D. 2^{n-m}

Answer: D

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7. During the study of kinetics of chemical or nuclear reaction, $t_{1/3}$ can be defined as

A. A. One-third of the reaction molecules are left.

B. B. Two-third of the reaction molecules are left.

C. C. One-third of half of the reaction molecules are left.

D. D. One-third of two-thirds of the reaction molecules are left.

Answer: B

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8. Gadolinium-153, which is used to detect osteoporoiss, has a life of 242 days. After how many days, on an average, a nuclide can be conisdered absent form patient's system?

A. A. Infinity

B. B. 350 days

C. C. 242 days

D. D. 4×10^{-3} days

Answer: B

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9. The rate constant for the hydrolyiss of ethyl acetate in the presence of $0.1N$ acid (A) was found to be $5.4 \times 10^{5} s^{-1}$ and for the hydrolyiss of ethyl acetate in the presence of $0.1N$ acid (B) , it was $6.2 \times 10^{-5} s^{-1}$. form these observations, one may conclude that

A. A. Acids (A) and (B) are both of same strength.

B. B. Acid (B) is weaker than acid (A).

C. C. Acid (B) is stronger than acid (A).

D. D. Data in insufficient.

Answer: C

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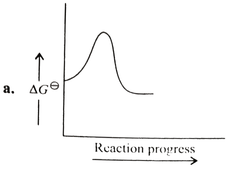
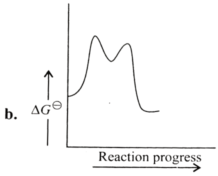
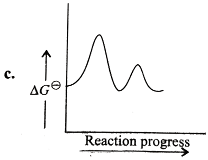
10. For the reaction, $R - X \xrightarrow{Slow} R^{\oplus} + X^{\oplus}$,

$R^{\oplus} + \overset{\ominus}{OH} \xrightarrow{Fast} ROH$

Which type of reaction coordinate diagram represents the above reaction mechanism?

A. 

B. 

C. 

D. d. This is $S_N l$ reaction where no tranistion state will be present

Answer: B

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11. The rate constant for zero order reaction is

A. $A.\ k = \frac{c_0}{2t}$

B. $B.\ .\ k = \frac{\left(c_0 - c_t\right)}{t}$

C. $C.\ k = \ln\left(\frac{c_0 - c_t}{2t}\right)$

D. $D.\ k = \frac{c_0}{c_t}$

Answer: B

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12. Gaseous cyclobutane isomerizes to butadiene in a first order process which has k value at $153\ ^{\circ}C$ of $3.3 \times 10^{-4}s^{-1}$. How many minutes would it take for the isomerization to proceeds 40% to completion at this temperature ?

A. A. 26 min

B. B. 52 min

C. C. 13 min

D. D. None of these

Answer: A

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13. The isomerization of cyclopropane to form propane is a first order reaction. At $760K$, 85% of a sample of cyclopropane change to propane in 79 min . Calculate the value of the rate constant.

A. A. $3.66 \times 10^{-2}\ \text{min}^{-1}$

B. B. $1.04 \times 10^{-2}\ \text{min}^{-1}$

C. C. $2.42\ \text{min}^{-1}$

D. $D. 2.40 \times 10^{-2} \text{ min}^{-1}$

Answer: D

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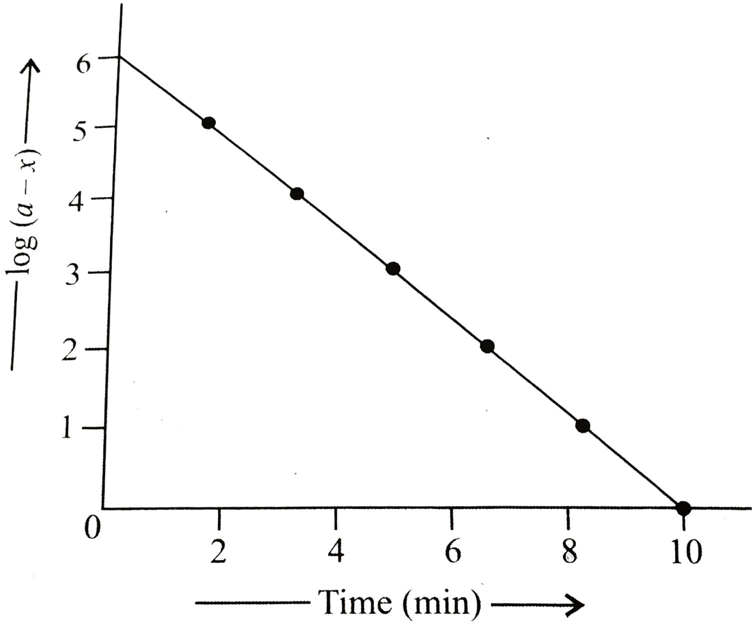
14. The converison of vinyl allyl ether to pent-4-enol follows first order kinetics. The following plot is obtained for such a reaction:



The rate constant for the reaction is

A. $4.6 \times 10^{-2} s^{-1}$

B. $1.2 \times 10^{-2}s^{-1}$

C. $2.3 \times 10^{-2}s^{-1}$

D. $8.4 \times 10^{-2}s^{-1}$

Answer: C

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15. Calculate the half life of the first-order reaction:

$C_2H_4O(g) \rightarrow CH_4(g) + CO(g)$

The initial pressure of $C_2H_4O(g)$ is $80mm$ and the total pressure at the end of 20 min is $120mm$.

A. 40 min

B. 120 min

C. 20 min

D. 80 min

Answer: C

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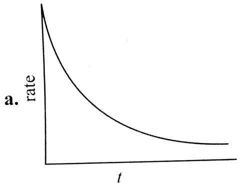
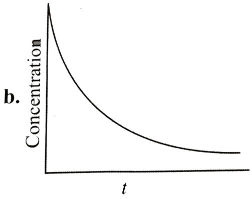
Ex 4.3 More Than One Correct

1. Which of the following is/are correct about the first order reaction ?

A. 

B. 

C. Half life depends on temperature.

D. Rate constant is directly proportional to temperature.

Answer: A::B::C

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2. A reaction is 10% complete in 5 min and 50% complete in 25 min. Which of the following is/are correct?

A. a. Order of reaction is one.

B. b. Order of reaction is zero.

C. c. Reaction will be complete in finite time.

D. d. Reaction will be complete in infinite time.

Answer: B::C

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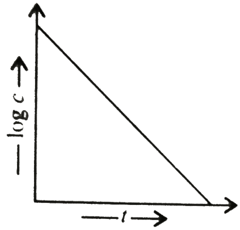
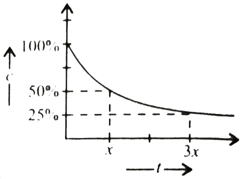
3. The correct nature of plot for first order reaction is (are):

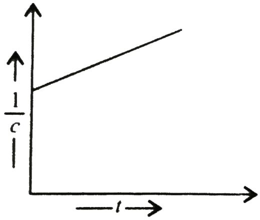
A.



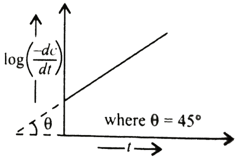
B. **b.**



C.



D. **d.**



Answer: A::D

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4. The correct statement (s) are

A. Order a reaction is an experimental property.

B. Order may change with change in experimental conditions.

C. Molecularity concerns with mechanism while order concerns with kinetics.

D. A reaction taking place by bimolecular colliison must always be of second order.

Answer: A::B::C

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5. For zero order reaction which is (are) true?

A. The rate constant is dimenisonless.

B. Amount of the reactant remains the same theoughout.

C. $t_{1/2} \propto$ initial concentration of the reactant.

D. A plot of concentration of reactant vs time is a straight. line with slope equal to $-k$.

Answer: C::D

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Ex4.4 Objective

1. The half time of a first order reaction is 6.93×10^{-3} min at $27^{\circ} C$. At this temeprature, $10^{-8}\%$ of the reactant molecules are able to cross-over the energy barrier. The pre-exponential factor A in the Arrhenius equation is equal to

A. 10^{4} min^{-1}

B. 10^{8} min^{-1}

C. 10^{10} min^{-1}

D. 10^{12} min^{-1}

Answer: D

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2. Conisder the following reaction at $300K$:

$A \rightarrow B$ (uncatalyzed reaction)

$A \rightarrow B$ (catalyzed reaction)

The activation energy is lowered by $8.314kJmol^{-1}$ for the catalyzed reaction. The rate of this reaction is

A. 15 times

B. 38 times

C. 22 times

D. 28 times

Answer: D

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3. For the given reaction:

$H_2 + I_2 \rightarrow 2HI$

Given:

$T(K)$	$1/T\left(K^{-1}\right)$	$\log k$
769	1.3×10^{-3}	2.9
67	1.5×10^{-3}	1.1

The activation energy will be

A. $41.4 kcal mol^{-1}$

B. $40 kcal mol^{-1}$

C. $-41.4 kcal mol^{-1}$

D. $-40 kcal mol^{-1}$

Answer: B

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4. In the Arrhenius equation: $k = A\exp\left(-E_a/RT\right)$, the rate constant

A. Decreases with increaisng activation energy and increases with temperature.

B. Increases with activation energy and temperature.

C. Decreases with activation energy and temperature.

D. Increases with activation energy and decreaisng temperature.

Answer: D

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5. According to the Arrhenius equation a straight line is to be obtained by plotting the logarithm of the rate constant of a chemical reaction $(\log k)$ against

A. T

B. $\log T$

C. $1/T$

D. $\log 1/T$

Answer: C

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6. Find out the percentage of the reactant molecules crosisng over the energy barrier at $325K$.

Given: $\Delta H_{325K} = 0.12 kcal$,

$E_{a(b)} = 0.02 kcal$

A. 80.65%

B. 70.65%

C. 60.65%

D. 50.65%

Answer: A

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7. In the presence of a catalyst, the rate of a reaction grows to the extent of 10^5 times at $298K$. Hence, the catalyst must have lowered E_a by

A. $25kJmol^{-1}$

B. $20kJmol^{-1}$

C. $10kJmol^{-1}$

D. $28.5kJmol^{-1}$

Answer: D

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8. Which of the following change (s) in the presence of catalyst ? (More than one correct answer)

A. Velocity coefficient of the reaction

B. $\Delta G^{\ominus}$ of the reaction

C. Energy of activation

D. ΔH of the reaction

Answer: A::C

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9. 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 nearly independent of temperature

Answer: D

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10. The rate of a chemical reaction generally increases rapidly even for small temperature rise because of rapid increases in the

A. Colliison frequency

B. Activation energy

C. Fraction of molecules with energies in exess of the activation energy

D. Avergae kinetic energy of the molecules

Answer: C

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Exercises Linked Comprehension

1. The rate of reaction increases isgnificantly with increase in temperature. Generally, rate of reactions are doubled for every $10^{\circ}C$ rise in temperature. Temperature coefficient gives us an idea about the change in the rate of a reaction for every $10\ ^\circ C$ change in temperature.

$$\text{Temperature coefficient}(\mu) = \frac{\text{Rate constant of}(T+10)\ ^\circ C}{\text{Rate constant at} T\ ^\circ C}$$

Arrhenius gave an equation which describes aret constant k as a function of temperature

$k = Ae^{-E_a/RT}$

where k is the rate constant, A is the frequency factor or pre-exponential factor, E_a is the activation energy, T is the temperature in kelvin, R is the universal gas constant.

Equation when expressed in logarithmic form becomes

$$\log k = \log A - \frac{E_a}{2.303RT}$$

For a reaction $E_a = 0$ and $k = 3.2 \times 10^8 s^{-1}$ at $325K$. The value of k at $335K$ would be

A. $3.2 \times 10^8 s^{-1}$

B. $6.4 \times 10^8 s^{-1}$

C. $12.8 \times 10^8 s^{-1}$

D. $25.6 \times 10^8 s^{-1}$

Answer: A

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2. The rate of reaction increases isgnificantly with increase in temperature. Generally, rate of reactions are doubled for every $10\ ^{\circ}C$ rise in temperature. Temperature coefficient gives us an idea about the change in the rate of a reaction for every $10\ ^{\circ}C$ change in temperature.

$$\text{Temperature coefficient}(\mu) = \frac{\text{Rate constant of}(T+10)\ ^{\circ}C}{\text{Rate constant at} T\ ^{\circ}C}$$

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where k is the rate constant, A is the frequency factor or pre-exponential factor, E_a is the activation energy, T is the temperature in kelvin, R is the universal gas constant.

Equation when expressed in logarithmic form becomes

$$\log k = \log A - \frac{E_a}{2.303RT}$$

For which of the following reactions k_{310}/k_{300} would be maximum?

A. $P + Q \rightarrow R, E_a = 10kJ$

B. $E + F \rightarrow D, E_a = 21kJ$

C. $A + B \rightarrow C, E_a = 10.5kJ$

D. $L + M \rightarrow N, E_a = 5kJ$

Answer: B

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3. The rate of reaction increases isgnificantly with increase in temperature. Generally, rate of reactions are doubled for every $10\,^{\circ}C$ rise in temperature. Temperature coefficient gives us an idea about the change in the rate of a reaction for every $10\,^{\circ}C$ change in temperature.

$$\text{Temperature coefficient}(\mu) = \frac{\text{Rate constant of}(T+10)\,^{\circ}C}{\text{Rate constant at}T\,^{\circ}C}$$

Arrhenius gave an equation which describes aret constant k as a function of temperature

$$k = Ae^{-E_a/RT}$$

where k is the rate constant, A is the frequency factor or pre-exponential factor, E_a is the activation energy, T is the temperature in kelvin, R is the universal gas constant.

Equation when expressed in logarithmic form becomes

$$\log k = \log A - \frac{E_a}{2.303RT}$$

Activation energies of two reaction are E_a and E_a' with $E_a > E'_a$. If the temperature of the reacting systems is increased form T_1 to T_2 (k' is rate constant at higher temperature).

A. $\frac{k_1'}{k_1} = \frac{k_2'}{k_2}$

B. $\frac{k_1'}{k_1} < \frac{k_2'}{k_2}$

C. $\frac{k_1'}{k_1} > \frac{k_2'}{k_2}$

D. $\frac{k_1'}{k_1} > \frac{2k_2'}{k_2}$

Answer: C

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4. The rate of reaction increases isgnificantly with increase in temperature. Generally, rate of reactions are doubled for every $10^\circ C$ rise in temperature. Temperature coefficient gives us an idea about the change in the rate of a reaction for every $10\,^\circ C$ change in temperature.

$$\text{Temperature coefficient}(\mu) = \frac{\text{Rate constant of}(T+10)\,^\circ C}{\text{Rate constant at}T\,^\circ C}$$

Arrhenius gave an equation which describes aret constant k as a function of temperature

$$k = Ae^{-E_a/RT}$$

where k is the rate constant, A is the frequency factor or pre-exponential factor, E_a is the activation energy, T is the temperature in kelvin, R is the universal gas constant.

Equation when expressed in logarithmic form becomes

$$\log k = \log A - \frac{E_a}{2.303RT}$$

For the given reactions, following data is given

$$P \rightarrow Q \qquad k_1 = 10^{15}\exp\left(\frac{-2000}{T}\right)$$

$$C \rightarrow D \qquad k_2 = 10^{14}\exp\left(\frac{-1000}{T}\right)$$

Temperature at which $k_1 = k_2$ is

A. $434.22K$

B. $1000K$

C. $2000K$

D. $868.44K$

Answer: A

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5. The rate constant for the decompoistion of a certain reaction is described by the equation:

$$\log k\left(s^{-1}\right) = 14 - \frac{1.25 \times 10^{4}K}{T}$$

Pre-exponential factor for this reaction is

A. $14s^{-1}$

B. $10^{14}s^{-1}$

C. $10^{-14}s^{-1}$

D. $1.25 \times 10^{4}s^{-1}$

Answer: B

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6. The rate constant for the decompoistion of a certain reaction is described by the equation:

$$\log k\left(s^{-1}\right) = 14 - \frac{1.25 \times 10^4 K}{T}$$

Energy of activation (in $kcal$) is

A. $57.6kcal$

B. $1.25 \times 10^4 kcal$

C. $14.0kcal$

D. $14 \times 10^4 kcal$

Answer: A

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7. The rate constant for the decompoistion of a certain reaction is described by the equation:

$$\log k\left(s^{-1}\right) = 14 - \frac{1.25 \times 10^4 K}{T}$$

At what temperature, rate constant is equal to pre-exponential factor?

A. $T = \frac{1.25 \times 10^4 K}{14}$

B. $T = \infty$

C. $T = 0$

D. $\left(14 - 1.25 \times 10^4\right)K$

Answer: B

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8. The rate constant for the decompoistion of a certain reaction is described by the equation:

$$\log k\left(s^{-1}\right) = 14 - \frac{1.25 \times 10^4 K}{T}$$

What is the effect on the rate of reaction at $127^\circ C$, if in the presence of catalyst, energy of activation is lowered by $10 kJmol^{-1}$?

A. 5 times

B. 10 times

C. 7 times

D. 20 times

Answer: D

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9. The rate constant for the decompoistion of a certain reaction is described by the equation:

$$\log k\left(s^{-1}\right) = 14 - \frac{1.25 \times 10^4 K}{T}$$

A two-step mechanism has been suggested for the reaction of nitric oxide and bromine:

$$NO(g) + Br_2(g) \overset{k_1}{\rightarrow} NOBr_2(g)$$

$$NOBr_2(g) + NO(g) \overset{k_2}{\rightarrow} 2NOBr(g)$$

The observed rate law is, rate $= k[NO]^2\left[Br_2\right]$. Hence, the rate-determining step is

A. $NO(g) + Br_2(g) \rightarrow NOBr_2(g)$

B. $NOBr_2(g) + NO(g) \rightarrow 2NOBr(g)$

C. $2NO(g) + Br_2(g) \rightarrow 2NOBr(g)$

D. None of these

Answer: B

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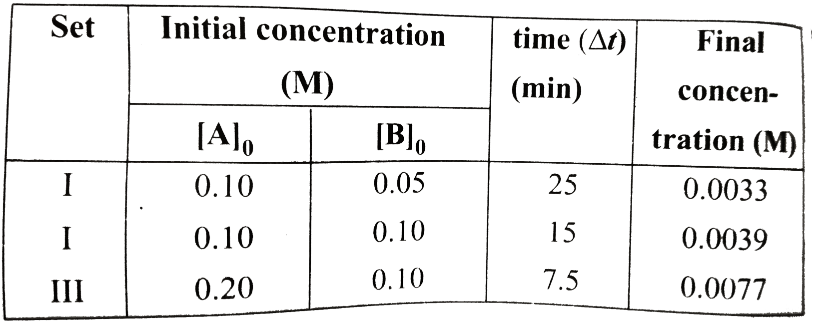
10. The following data were observed for the following reaction at $25\,^{\circ}C$, $CH_3OH + \left(C_6H_5\right)_3CCl \rightarrow \left(C_6H_5\right)_3C.OCH_3 + HCl$



Set	Initial concentration (M)		time (Δt) (min)	Final concentration (M)
	$[A]_0$	$[B]_0$		
I	0.10	0.05	25	0.0033
I	0.10	0.10	15	0.0039
III	0.20	0.10	7.5	0.0077

Rates $\frac{d[C]}{dt}$ in sets I, II, and III are, respectively, (in $M\ \text{min}^{-1}$):

A.

I	II	III
1.30×10^{-4}	2.6×10^{-4}	1.02×10^{-3}

B.

I	II	III
0.033	0.0039	0.0077

C.

I	II	III
0.02×10^{-4}	0.04×10^{-4}	0.017

D. None of these

Answer: A

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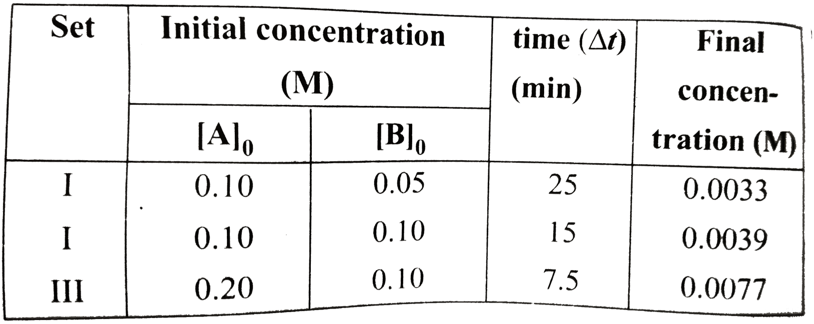
11. The following data were observed for the following reaction at $25\,^{\circ}C$, $CH_3OH + \left(C_6H_5\right)_3CCl \rightarrow \left(C_6H_5\right)_3C.OCH_3 + HCl$



Set	Initial concentration (M)		time (Δt) (min)	Final concentration (M)
	$[A]_0$	$[B]_0$		
I	0.10	0.05	25	0.0033
I	0.10	0.10	15	0.0039
III	0.20	0.10	7.5	0.0077

Rate constant of the above experiment is (in $L^2M^{-2}\min^{-1}$) :

A. 2.6×10^{-2}

B. 2.6×10^{-1}

C. 2.6×10^{-4}

D. 1.3×10^{-2}

Answer: B

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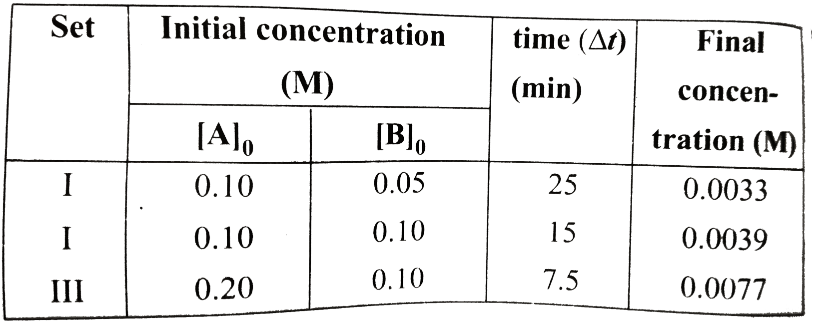
12. The following data were observed for the following reaction at $25^{\circ} C, CH_3OH + \left(C_6H_5\right)_3CCl \rightarrow \left(C_6H_5\right)_3C.OCH_3 + HCl$



Set	Initial concentration (M)		time (Δt) (min)	Final concentration (M)
	$[A]_0$	$[B]_0$		
I	0.10	0.05	25	0.0033
I	0.10	0.10	15	0.0039
III	0.20	0.10	7.5	0.0077

Rate law of the above experiment is

A. $k[A]^2[B]$

B. $k[A][B]$

C. $k[A][B]^2$

D. $k[A]^2[B]^2$

Answer: A

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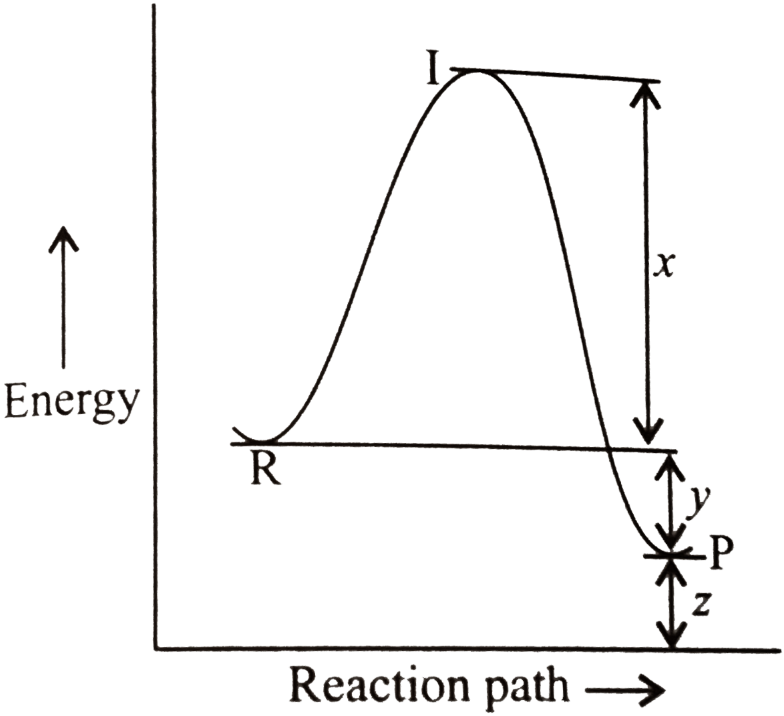
13. The energy profile diagram for the reaction:

$CO(g) + NO_2(g) \Leftrightarrow CO_2(g) + NO(g)$ is given below:



The activation energy of the forward reaction is

A. x

B. y

C. $x + y$

D. $x - y$

Answer: A

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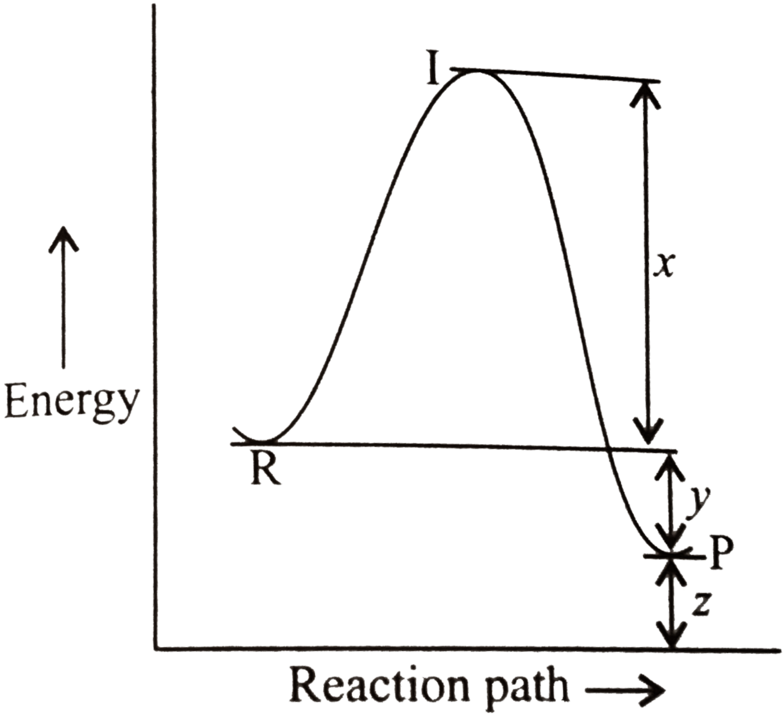
14. The energy profile diagram for the reaction:

$CO(g) + NO_2(g) \Leftrightarrow CO_2(g) + NO(g)$ is given below:



The activation energy of the backward reaction is

A. x

B. y

C. $x + y$

D. $x - y$

Answer: C

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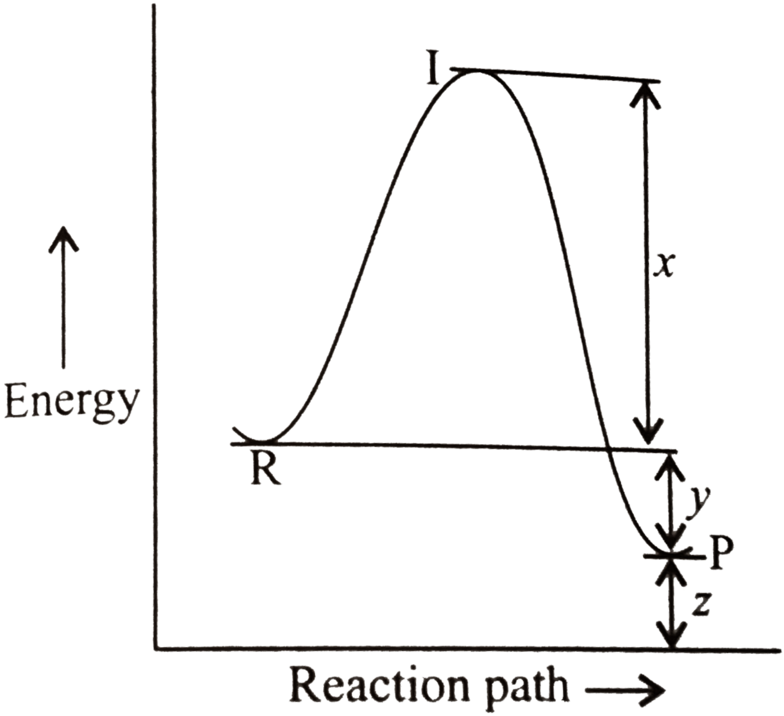
15. The energy profile diagram for the reaction:

$CO(g) + NO_2(g) \Leftrightarrow CO_2(g) + NO(g)$ is given below:



the heat of the reaction is

A. x

B. y

C. $x + y$

D. $x - y$

Answer: B

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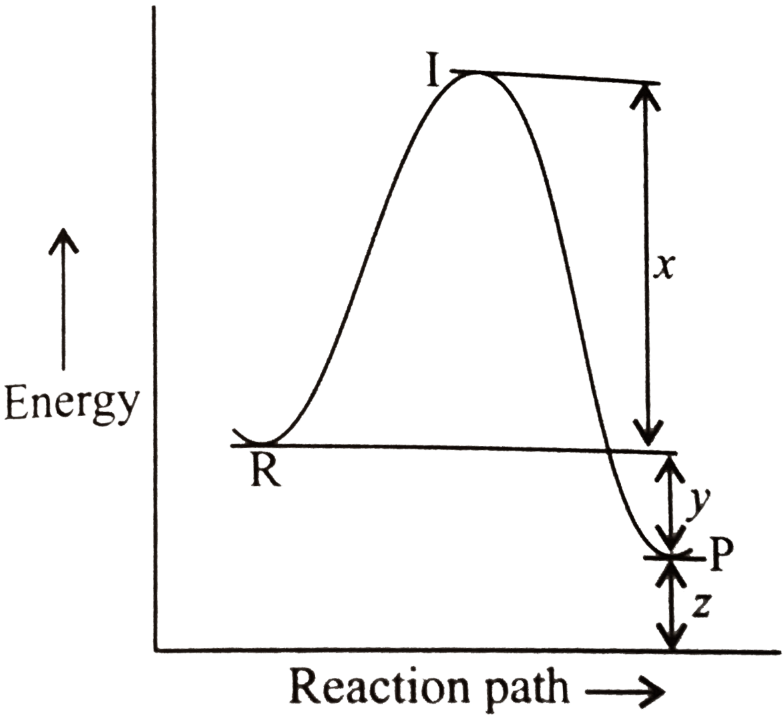
16. The energy profile diagram for the reaction:

$CO(g) + NO_2(g) \Leftrightarrow CO_2(g) + NO(g)$ is given below:



The threshold energy of the reaction is

A. $x + y - z$

B. $x - y + z$

C. $x + y + z$

D. $x - y - z$

Answer: C

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17. The reaction $S_2O_8^{2-} + 3I^{\ominus} \rightarrow 2SO_4^{2-} + I_3^{\ominus}$ is of first order both with respect to persulphate and iofide ions. Taking the initial concentration as a and b, respectively, and taking x as the concentration of the triofide at time t, a differential rate equation can be written.

Two suggested mechanism for the reaction are:

I. $S_2O_8^{2-} + I^{\ominus} \Leftrightarrow SO_4I^{\ominus} + SO_4^{2-}\text{(fast)}$

$I^{\ominus} + SO_4I^{\ominus} \overset{k_1}{\rightarrow} I_2 + SO_4^{2-}$ (show)

$I^{\ominus} + I_2 \overset{k_2}{\rightarrow} I_3^{\ominus}\text{(fast)}$

II. $S_2O_8^{2-} + I^{\ominus} \overset{k_1}{\rightarrow} S_2O_8I^{2-}(slow)$

$S_2O_8I^{3-} \overset{k_2}{\rightarrow} 2SO_4^{2-} + I^{\oplus}\text{(fast)}$

$I^{\oplus} + I^{\ominus} \overset{k_3}{\rightarrow} I_2\text{(fast)}$

$I_2 + I^{\oplus} \overset{k_4}{\rightarrow} I_3^{\ominus}\text{(fast)}$

The general difference equation for the above reaction is

A. $\frac{dx}{dt} = k[a - x][b - 3x](k > 0)$

B. $\frac{dx}{dt} = -k[a - x][b - 3x](k > 0)$

C. $\frac{dx}{dt} = k[a - x][b - x](k > 0)$

D. $\frac{dx}{dt} = - k[a - x][b - x](k > 0)$

Answer: A

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18. The reaction $S_2O_8^{2-} + 3I^{\ominus} \rightarrow 2SO_4^{2-} + I_3^{\ominus}$ is of first order both with respect to persulphate and iofide ions. Taking the initial concentration as a and b, respectively, and taking x as the concentration of the triofide at time t, a differential rate equation can be written.

Two suggested mechanism for the reaction are:

I. $S_2O_8^{2-} + I^{\ominus} \Leftrightarrow SO_4I^{\ominus} + SO_4^{2-}(\text{fast})$

$I^{\ominus} + SO_4I^{\ominus} \xrightarrow{k_1} I_2 + SO_4^{2-}$ (show)

$I^{\ominus} + I_2 \xrightarrow{k_2} I_3^{\ominus}(\text{fast})$

II. $S_2O_8^{2-} + I^{\ominus} \xrightarrow{k_1} S_2O_8I^{2-}(slow)$

$S_2O_8I^{3-} \xrightarrow{k_2} 2SO_4^{2-} + I^{\oplus}(\text{fast})$

$I^{\oplus} + I^{\ominus} \xrightarrow{k_3} I_2(\text{fast})$

$I_2 + I^{\oplus} \xrightarrow{k_4} I_3^{\ominus}$ (fast)

For the reaction $I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^{\ominus}$

I. $\frac{-d[I_2]}{dt} = -\frac{1}{2}\frac{d[S_2O_3^{2-}]}{dt}$

II. $\frac{-d[I_2]}{dt} = -2\frac{d[S_2O_3^{2-}]}{dt}$

III. $\frac{-d[I_2]}{dt} = -2\frac{d[I^{\ominus}]}{dt} \times \frac{d[S_2O_3^{2-}]}{dt}$

IV. $\frac{d[S_4O_6^{2-}]}{dt} = \frac{1}{2}\frac{d[I^{\ominus}]}{dt}$

The correct option is

A. Only I

B. I and IV

C. II and IV

D. Only III

Answer: B

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19. Conisder the reaction represented by the equation:

$$CH_3Cl(g) + H_2O(g) \rightarrow CH_3OH(g) + HCl(g)$$

These kinetics data were obtained for the given reaction concentrations:

Initial conc (M)		Initial rate of disappearance
$[CH_3Cl]$	$[H_2O]$	of $CH_3Cl\left(Ms^{-1}\right)$
0.2	0.2	1
0.4	0.2	2
0.4	0.4	8

The rate law for the reaction will be

A. $r = k[CH_3Cl][H_2O]$

B. $r = k[CH_3Cl]^2[H_2O]$

C. $r = k[CH_3Cl][H_2O]^2$

D. $r = k[CH_3Cl]^2[H_2O]^4$

Answer: C

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20. Conisder the reaction represented by the equation:

$CH_3Cl(g) + H_2O(g) \rightarrow CH_3OH(g) + HCl(g)$

These kinetics data were obtained for the given reaction concentrations:

Initial conc (M)		Initial rate of disappearance
$\left[CH_3Cl\right]$	$\left[H_2O\right]$	of $CH_3Cl\left(Ms^{-1}\right)$
0.2	0.2	1
0.4	0.2	2
0.4	0.4	8

Order with respect to $\left[CH_3Cl\right]$ will be

A. 0

B. 1

C. 2

D. 3

Answer: B

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21. Conisder the reaction represented by the equation:

$CH_3Cl(g) + H_2O(g) \rightarrow CH_3OH(g) + HCl(g)$

These kinetics data were obtained for the given reaction concentrations:

Initial conc (M)		Initial rate of disappearance
$[CH_3Cl]$	$[H_2O]$	of $CH_3Cl(Ms^{-1})$
0.2	0.2	1
0.4	0.2	2
0.4	0.4	8

Overall order of the reaction will be

A. 0

B. 1

C. 2

D. 3

Answer: D

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22. Conisder the reaction represented by the equation:

$$CH_3Cl(g) + H_2O(g) \rightarrow CH_3OH(g) + HCl(g)$$

These kinetics data were obtained for the given reaction concentrations:

Initial conc (M)		Initial rate of disappearance
$\left[CH_3Cl\right]$	$\left[H_2O\right]$	of $CH_3Cl\left(Ms^{-1}\right)$
0.2	0.2	1
0.4	0.2	2
0.4	0.4	8

Unit of rate constant will be

A. s^{-1}

B. $L^2mol^{-2}s^{-1}$

C. $Lmol^{-1}s^{-1}$

D. $molL^{-1}s^{-1}$

Answer: B

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23. Conisder the reaction represented by the equation:

$$CH_3Cl(g) + H_2O(g) \rightarrow CH_3OH(g) + HCl(g)$$

These kinetics data were obtained for the given reaction concentrations:

Initial conc (M)		Initial rate of disappearance
$[CH_3Cl]$	$[H_2O]$	of $CH_3Cl\left(Ms^{-1}\right)$
0.2	0.2	1
0.4	0.2	2
0.4	0.4	8

If H_2O is taken in large excess, the order of the reaction will be

A. 1

B. 0

C. 3

D. 2

Answer: A

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24. For the reaction: $aA + bB \rightarrow cC + dD$

$$\text{Rate} = \frac{dx}{dt} = \frac{-1}{a}\frac{d[A]}{dt} = \frac{-1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$$

For reaction $3BrO^{\ominus} \rightarrow BrO_3^{\ominus} + 2Br^{\ominus}$, the value of rate constant at $80\,^{\circ}C$ in the rate law for $-\frac{d\left[BrO^{\ominus}\right]}{dt}$ was found to be $0.054 L mol^{-1} s^{-1}$. The rate constant (k) for the reaction in terms of $\frac{d\left[BrO_3^{\ominus}\right]}{dt}$ is

A. $0.018 L mol^{-1} s^{-1}$

B. $0.162 L mol^{-1} s^{-1}$

C. $0.036 L mol^{-1} s^{-1}$

D. None of these

Answer: A

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25. For the reaction: $aA + bB \rightarrow cC + dD$

$$\text{Rate} = \frac{dx}{dt} = \frac{-1}{a}\frac{d[A]}{dt} = \frac{-1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$$

The rate of formation of SO_3 in the following reaction $2SO_2 + O_2 \rightarrow 2SO_3$ is $100g\ \min^{-1}$. Hence the rate of disappearance of O_2 is

A. $2g\ \min^{-1}$

B. $20g\ \min^{-1}$

C. $200g\ \min^{-1}$

D. $50g\ \min^{-1}$

Answer: B

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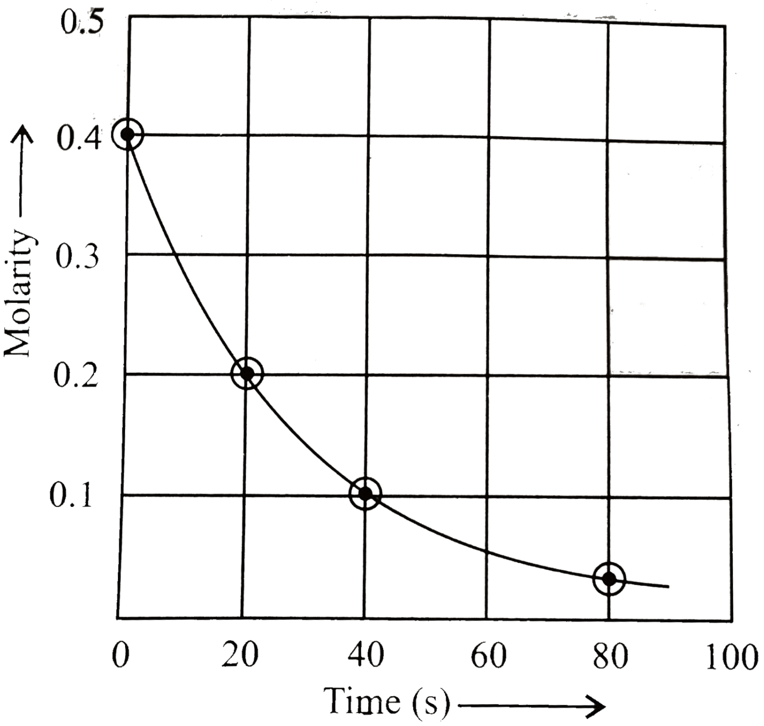
26. For the reaction: $aA + bB \rightarrow cC + dD$

$$\text{Rate} = \frac{dx}{dt} = \frac{-1}{a}\frac{d[A]}{dt} = \frac{-1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$$

A reaction follows the given concentration-time graph. The rate for this reaction at $20s$ will be



A. $4 \times 10^{-3} Ms^{-1}$

B. $1 \times 10^{-2} Ms^{-1}$

C. $2 \times 10^{-2} Ms^{-1}$

D. $7 \times 10^{-3} Ms^{-1}$

Answer: D

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27. For the reaction: $aA + bB \rightarrow cC + dD$

Rate $= \frac{dx}{dt} = \frac{-1}{a}\frac{d[A]}{dt} = \frac{-1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$

In the following reaction,

$xA \rightarrow yB$

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

where negative isgn indicates rate of disappearance of the reactant. Thus,

$x : y$ is:

A. $1:2$

B. $2:1$

C. $3:1$

D. $3:10$

Answer: B

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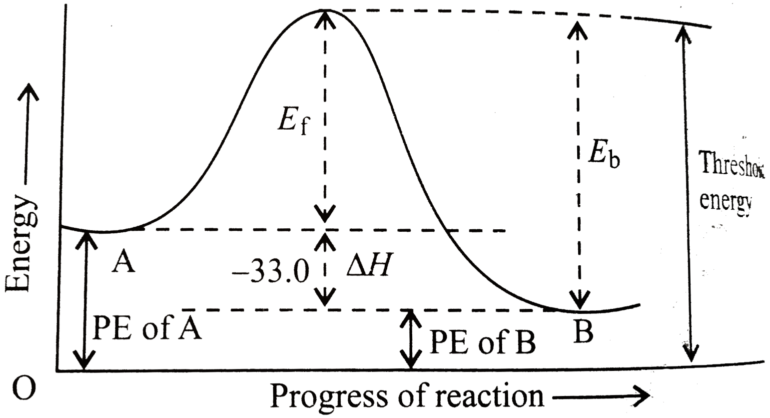
28. The energy change accompanying the equilibrium reaction $A \Leftrightarrow B$ is $-33.0 kJmol^{-1}$.



Assuming that pre-exponential factor is same for forward and backward reaction answer the following:

The equilibrium constant k for the reaction at $300K$

A. 5.55×10^5

B. 5.67×10^3

C. 5.55×10^6

D. 5.67×10^2

Answer: A

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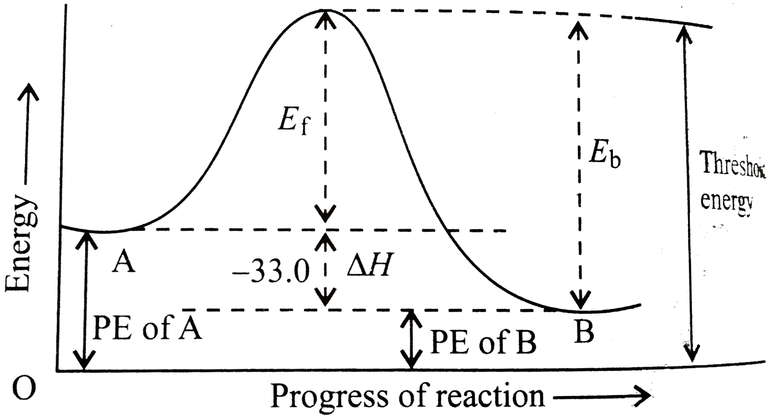
29. The energy change accompanying the equilibrium reaction $A \Leftrightarrow B$ is $-33.0kJmol^{-1}$.



Assuming that pre-exponential factor is same for forward and backward reaction answer the following:

The energy of activation for forward and backward reactions (E_f and E_b) at $300K$. Given that E_f and E_b are in the ratio $20:31$,

A. $69, 93$

B. $60, 93$

C. $93, 60$

D. 90, 60

Answer: B

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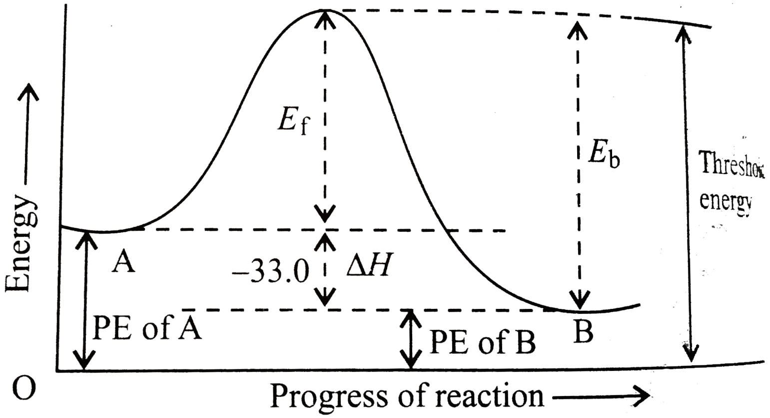
30. The energy change accompanying the equilibrium reaction $A \Leftrightarrow B$ is $-33.0kJmol^{-1}$.



Assuming that pre-exponential factor is same for forward and backward reaction answer the following:

The threshold energy of the reaction is when PE of B is $30kJmol^{-1}$.

A. 30

B. 140

C. 123

D. 125

Answer: C

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31. In the start of summer, a given sample of milk turns sour at room temperature $\left(27^{\circ}C\right)$ in 48 hours. In a refrigerator at $2^{\circ}C$, milk can be stored there times longer before it sours.

The activation energy of the souring of milk is $\left(kJmol^{-1}\right)$

A. 30.210

B. 30.146

C. 30.0

D. 35.126

Answer: B

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32. In the start of summer, a given sample of milk turns sour at room temperature $\left(27^{\circ} C\right)$ in 48 hours. In a refrigerator at $2^{\circ} C$, milk can be stored there times longer before it sours.

The time taken by the milk to sour at $37^{\circ} C$

A. $35.2 hr$

B. $32.5 hr$

C. $35.3 hr$

D. $32.3 hr$

Answer: B

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33. In the start of summer, a given sample of milk turns sour at room temperature $\left(27^{\circ}C\right)$ in 48 hours. In a refrigerator at $2^{\circ}C$, milk can be stored there times longer before it sours.

Calculate the rate constant at $310K$, when rate constant at $300K$ is 1.6×10^5

A. 2.363×10^5

B. 2.4×10^5

C. 2.450×10^5

D. 3.123×10^5

Answer: A

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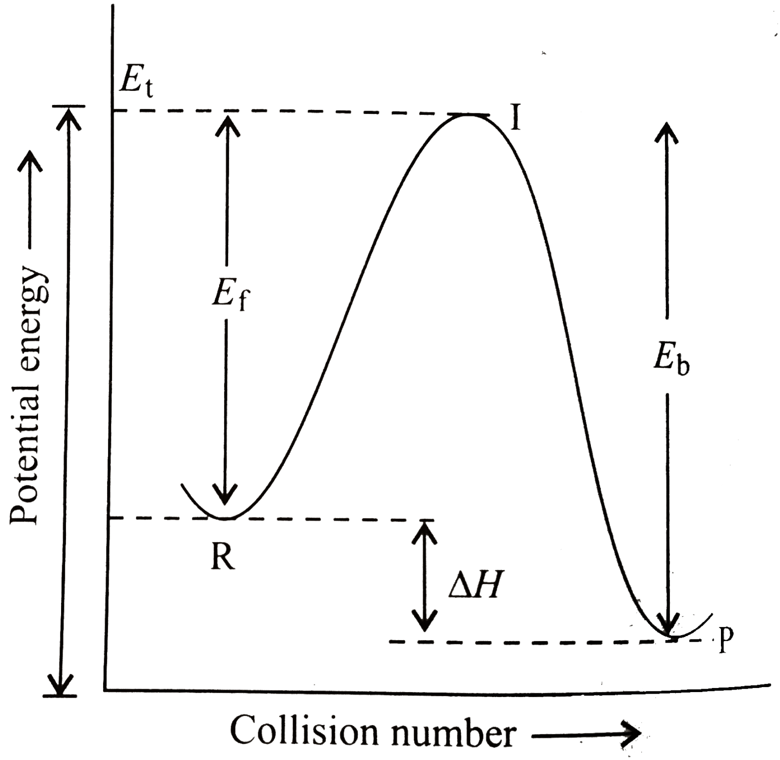
34. A colliison between reactant molecules must occur with a certain minimum energy before it is effective in yielding Product molecules. This minimum energy is called activation energy E_a Large the value of activation energy, smaller the value of rate constant k. Larger is the value of activation energy, greater is the effect of temperature rise on rate constant k.



E_f = Activation energy of forward reaction

E_b = Activation energy of backward reaction

$\Delta H = E_f - E_b$

E_f = threshold energy

If a reaction $A + B \rightarrow C$ is exothermic to the extent $30 kJmol^{-1}$ and the forward reaction has an activation energy of $249kJmol^{-1}$ the activation energy for reverse reaction in $kJmol^{-1}$ is

A. 324

B. 279

C. 40

D. 100

Answer: B

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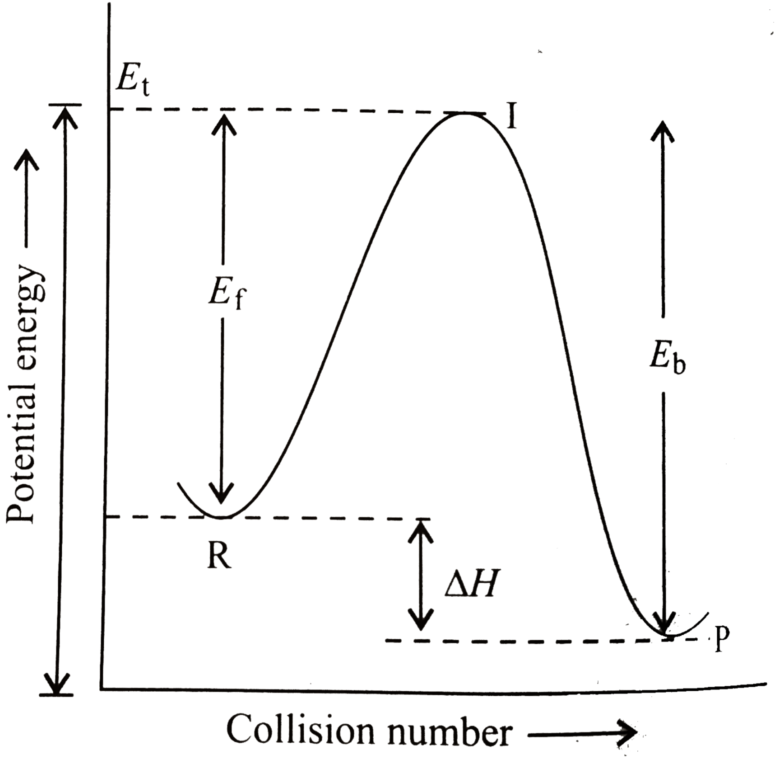
35. A colliison between reactant molecules must occur with a certain minimum energy before it is effective in yielding Product molecules. This minimum energy is called activation energy E_a Large the value of activation energy, smaller the value of rate constant k. Larger is the value of activation energy, greater is the effect of temperature rise on rate constant k.



E_f = Activation energy of forward reaction

E_b = Activation energy of backward reaction

$\Delta H = E_f - E_b$

E_f = threshold energy

For the following reaction at a particular temperature, according to the equations

$$2N_2O_5 \rightarrow 4NO_2 + O_2$$

$$2NO_2 + \frac{1}{2}O_2 \rightarrow N_2O_5$$

The activation energies are E_1 and E_2, respectively. Then

A. $E_1 > E_2$

B. $E_1 < E_2$

C. $E_1 = 2E_2$

D. $\sqrt{E_1E_2^2} = 1$

Answer: A

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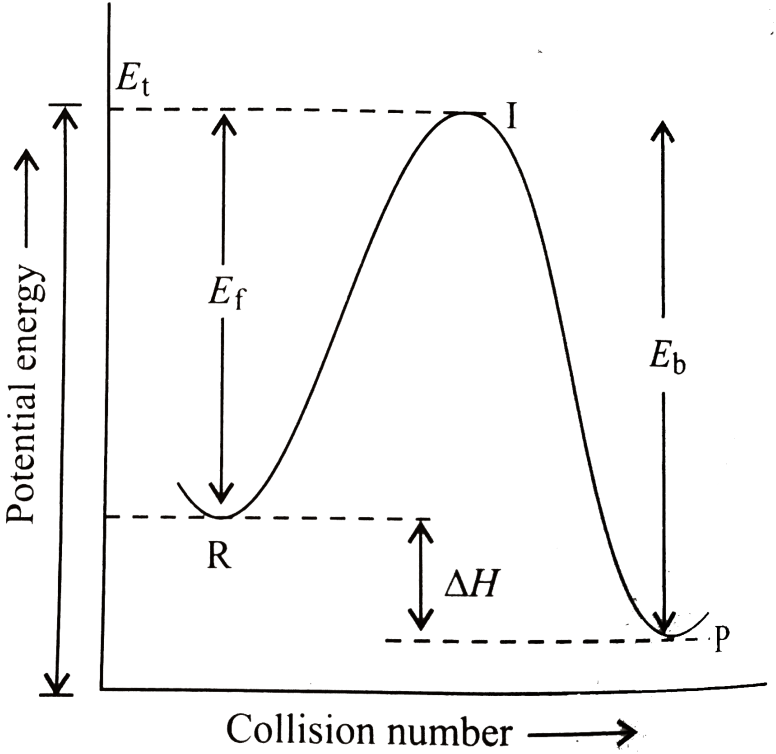
36. A colliison between reactant molecules must occur with a certain minimum energy before it is effective in yielding Product molecules. This minimum energy is called activation energy E_a Large the value of activation energy, smaller the value of rate constant k. Larger is the value of activation energy, greater is the effect of temperature rise on rate constant k.



E_f = Activation energy of forward reaction

E_b = Activation energy of backward reaction

$\Delta H = E_f - E_b$

E_f = threshold energy

In a hypothetical reaction $A \rightarrow B$, the activation energies for the forward and backward reactions are 15 and $9 kJmol^{-1}$, respectively. The potential energy of A is $10 kJmol^{-1}$. Which of the following is wrong?

A. The threshold energy of the reaction is $25 kJ$.

B. The potential energy of B is $16kJ$.

C. The heat of reaction is $6kJ$.

D. The reaction is exothermic.

Answer: D

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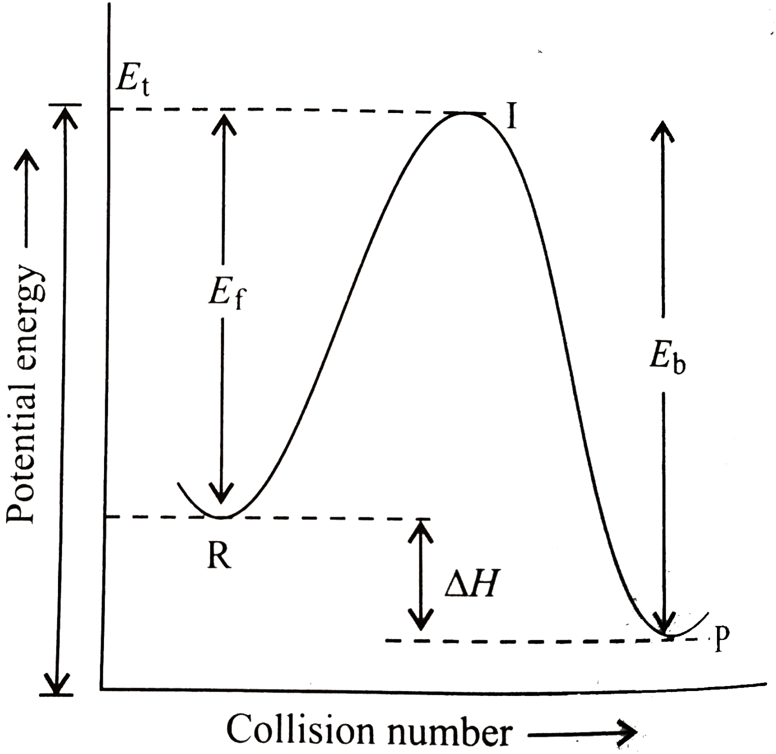
37. A colliison between reactant molecules must occur with a certain minimum energy before it is effective in yielding Product molecules. This minimum energy is called activation energy E_a Large the value of activation energy, smaller the value of rate constant k. Larger is the value of activation energy, greater is the effect of temperature rise on rate constant k.



E_f = Activation energy of forward reaction

E_b = Activation energy of backward reaction

$\Delta H = E_f - E_b$

E_f = threshold energy

For two reactions, activation energies are E_{a1} and E_{a2}, rate constant are k_1 and k_2 at the same temperature. If $k_1 > k_2$, then

A. $E_{a1} > E_{a2}$

B. $E_{a1} = E_{a2}$

C. $E_{a1} < E_{a2}$

D. $E_{a1} \geq E_{a2}$

Answer: C

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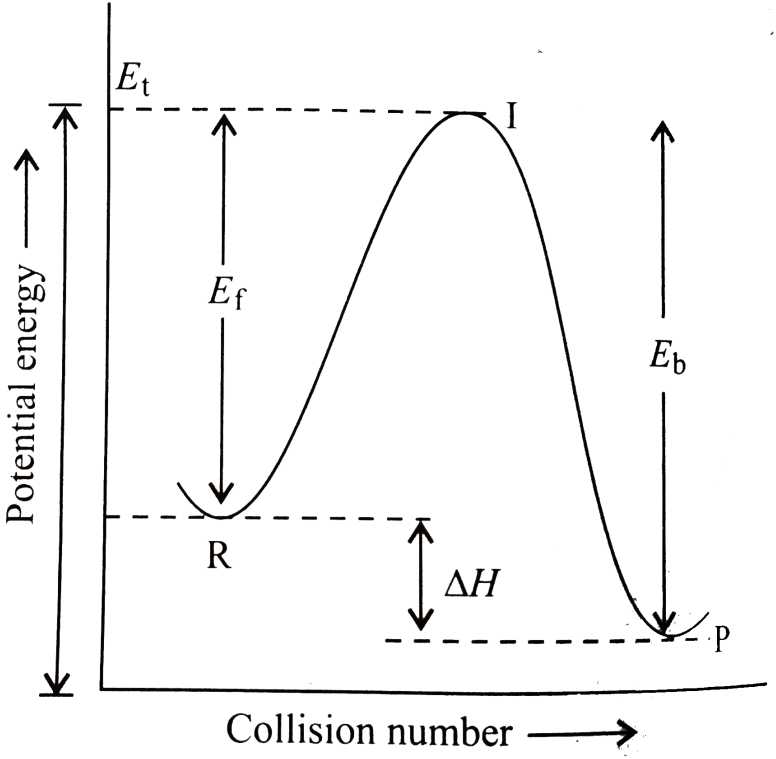
38. A colliison between reactant molecules must occur with a certain minimum energy before it is effective in yielding Product molecules. This minimum energy is called activation energy E_a Large the value of activation energy, smaller the value of rate constant k. Larger is the value of activation energy, greater is the effect of temperature rise on rate constant k.



$E_f =$ Activation energy of forward reaction

$E_b =$ Activation energy of backward reaction

$\Delta H = E_f - E_b$

$E_f =$ threshold energy

The rate constant of a certain reaction is given by $k = Ae^{-E_a/RT}$ (where $A =$ Arrhenius constant). Which factor should be lowered so that the rate of reaction may increase?

A. T

B. Z

C. A

D. E_a

Answer: D

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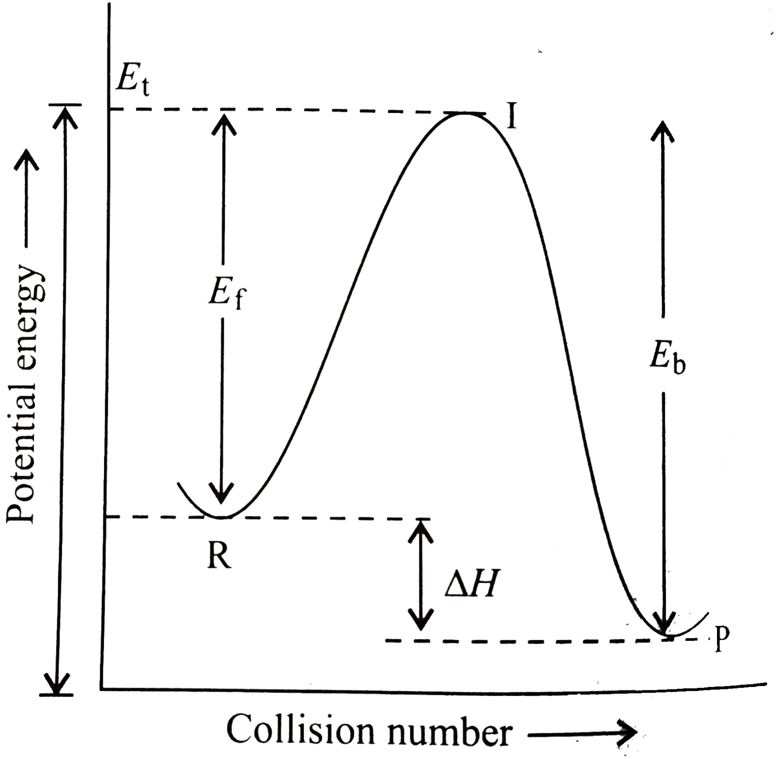
39. A colliison between reactant molecules must occur with a certain minimum energy before it is effective in yielding Product molecules. This minimum energy is called activation energy E_a Large the value of activation energy, smaller the value of rate constant k. Larger is the value of activation energy, greater is the effect of temperature rise on rate constant k.



$E_f =$ Activation energy of forward reaction

$E_b =$ Activation energy of backward reaction

$\Delta H = E_f - E_b$

$E_f =$ threshold energy

The activation eneries for forward and backward reactions in a chemical reaction are 30.5 and $45.4 kJmol^{-1}$ respectively. The reaction is

A. Exothermic

B. Endothermic

C. Neither exothermic nor endothermic

D. Independent of temperature

Answer: A

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40. The order of reaction is an experimentally determined quanity. It may be zero, poistive, negative, or fractional. The kinetic equation of *nth* order reaction is

$$k \times t = \frac{1}{(n-1)}\left[\frac{1}{(a-x)^{n-1}} - \frac{1}{a^{n-1}}\right] \text{...(i)}$$

Half life of *nth* order reaction depends on the initial concentration according to the following relation:

$$t_{1/2} \propto \frac{1}{a^{n-1}} \text{...(ii)}$$

The unit of the rate constant varies with the order but general relation for the unit of *nth* order reaction is

$$\text{Units of } k = \left[\frac{1}{Conc}\right]^{n-1} \times \text{Time}^{-1} \text{...(iii)}$$

The differential rate law for *nth* order reaction may be given as:

$$\frac{dX}{dt} = k[A]^n \text{ ...(iv)}$$

where A denotes the reactant.

The unit of rate and rate constant are same for

A. Zero order reaction

B. First order reaction

C. Second order reaction

D. Half order reaction

Answer: A

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41. The order of reaction is an experimentally determined quanity. It may be zero, poistive, negative, or fractional. The kinetic equation of *nth* order reaction is

$$k \times t = \frac{1}{(n-1)}\left[\frac{1}{(a-x)^{n-1}} - \frac{1}{a^{n-1}}\right] \text{...(i)}$$

Half life of *nth* order reaction depends on the initial concentration according to the following relation:

$t_{1/2} \propto \frac{1}{a^{n-1}}$ ...(ii)

The unit of the rate constant varies with the order but general relation for the unit of *nth* order reaction is

Units of $k = \left[\frac{1}{Conc}\right]^{n-1} \times \text{Time}^{-1}$ ...(iii)

The differential rate law for *nth* order reaction may be given as:

$\frac{dX}{dt} = k[A]^n$ ...(iv)

where A denotes the reactant.

The rate constant for zero order reaction is

where c_0 and c_t are concentration of reactants at respective times.

A. $k = \frac{c_0}{2t}$

B. $k = \frac{c_0 - c_t}{t}$

C. $k = \ln. \frac{c_0 - c_t}{2t}$

D. $k = \frac{c_0}{c_t}$

Answer: B

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42. The order of reaction is an experimentally determined quanity. It may be zero, poistive, negative, or fractional. The kinetic equation of *nth* order reaction is

$$k \times t = \frac{1}{(n-1)}\left[\frac{1}{(a-x)^{n-1}} - \frac{1}{a^{n-1}}\right] \text{...(i)}$$

Half life of *nth* order reaction depends on the initial concentration according to the following relation:

$$t_{1/2} \propto \frac{1}{a^{n-1}} \text{...(ii)}$$

The unit of the rate constant varies with the order but general relation for the unit of *nth* order reaction is

$$\text{Units of } k = \left[\frac{1}{Conc}\right]^{n-1} \times \text{Time}^{-1} \text{...(iii)}$$

The differential rate law for *nth* order reaction may be given as:

$$\frac{dX}{dt} = k[A]^n \text{...(iv)}$$

where A denotes the reactant.

The half life for a zero order reaction equals

A. $\frac{1}{2}\frac{k}{a^2}$

B. $\frac{a^2}{2k}$

C. $\frac{2k}{a}$

D. $\frac{a}{2k}$

Answer: D

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43. The order of reaction is an experimentally determined quanity. It may be zero, poistive, negative, or fractional. The kinetic equation of nth order reaction is

$$k \times t = \frac{1}{(n-1)}\left[\frac{1}{(a-x)^{n-1}} - \frac{1}{a^{n-1}}\right] \text{...(i)}$$

Half life of nth order reaction depends on the initial concentration according to the following relation:

$$t_{1/2} \propto \frac{1}{a^{n-1}} \text{...(ii)}$$

The unit of the rate constant varies with the order but general relation for the unit of *nth* order reaction is

Units of $k = \left[\frac{1}{Conc}\right]^{n-1} \times \text{Time}^{-1}$ ...(iii)

The differential rate law for *nth* order reaction may be given as:

$\frac{dx}{dt} = k[A]^n$ ...(iv)

where A denotes the reactant.

For a reaction:

$$I^{\ominus} + OCl^{\ominus} \rightarrow IO^{\ominus} + Cl^{\ominus}$$

in an aqueous medium, the rate of the reaction is given by

$$\frac{d\left[IO^{\ominus}\right]}{dt} = k\frac{\left[I^{\ominus}\right]\left[OCl^{\ominus}\right]}{\left[\overset{\ominus}{OH}\right]}$$

The overall order of the reaction is

A. -1

B. 1

C. Zero

D. 2

Answer: B

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44. The order of reaction is an experimentally determined quanity. It may be zero, poistive, negative, or fractional. The kinetic equation of *nth* order reaction is

$$k \times t = \frac{1}{(n-1)}\left[\frac{1}{(a-x)^{n-1}} - \frac{1}{a^{n-1}}\right] \text{...(i)}$$

Half life of *nth* order reaction depends on the initial concentration according to the following relation:

$$t_{1/2} \propto \frac{1}{a^{n-1}} \text{...(ii)}$$

The unit of the rate constant varies with the order but general relation for the unit of *nth* order reaction is

$$\text{Units of } k = \left[\frac{1}{Conc}\right]^{n-1} \times \text{Time}^{-1} \text{...(iii)}$$

The differential rate law for *nth* order reaction may be given as:

$$\frac{dx}{dt} = k[A]^n \text{...(iv)}$$

where A denotes the reactant.

In a chemical reaction $A \rightarrow B$, it is found that the rate of the reaction doubles when the concentration of A is increased four times. The order of the reaction with respect to A is:

A. 0

B. $\frac{1}{2}$

C. 1

D. 2

Answer: B

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45. Conisder the following elementary reaction,

$2A+B+C \rightarrow$ Products. All reactants are present in the gaseous state and reactant C is taken in excess.

What is the rate expresison of the reaction?

A. Rate $=k[A]^2[B][C]$

B. Rate $=k[A]^2[B]$

C. Rate $= k\frac{[A]^2[B]}{[C]}$

D. Rate $= k[C]^0$

Answer: B

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46. Conisder the following elementary reaction,

$2A + B + C \rightarrow$ Products. All reactants are present in the gaseous state and reactant C is taken in excess.

What is the unit of rate constant of the reaction?

A. $mol^{-1}time^{-1}$

B. $time^{-1}$

C. $mol^{-1}L^2time^{-1}$

D. $mol^{-2}L^2time^{-1}$

Answer: D

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47. Conisder the following elementary reaction,

$2A + B + C \rightarrow$ Products. All reactants are present in the gaseous state and reactant C is taken in excess.

How will the rate change if the concentration of A is doubled and that of B is tripled ?

A. The rate increases 12 times of original value.

B. The rate increases 8 times of original value.

C. The rate reduces 12 times of original value.

D. The rate reduces 8 times of original value.

Answer: A

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48. For the reaction: $X(g) \rightarrow Y(g) + Z(g)$, the following data were obtained at $30\,^{\circ}C$:

Experiment	$[X]\left(molL^{-1}\right)$	$\text{Rate}\left(molL^{-1}hr^{-1}\right)$
I	0.17	0.05
II	0.34	0.10
III	0.68	0.20

The rate constant of the above reaction is

A. $0.588hr^{-1}$

B. $0.294hr^{-1}$

C. $0.123hr^{-1}$

D. $0.210hr^{-1}$

Answer: B

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49. For the reaction: $X(g) \rightarrow Y(g) + Z(g)$, the following data were obtained at $30\,^{\circ}C$:

Experiment	$[X]\left(molL^{-1}\right)$	$\text{Rate}\left(molL^{-1}hr^{-1}\right)$
I	0.17	0.05
II	0.34	0.10
III	0.68	0.20

The equilibrium constant for the reaction is 0.50. Assuming that the reaction proceeds by one-step mechanism. Find the rate constant of reverse reaction?

A. $0.294hr^{-1}$

B. $0.588hr^{-1}$

C. $0.123hr^{-1}$

D. $0.117hr^{-1}$

Answer: B

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50. For the reaction: $X(g) \rightarrow Y(g) + Z(g)$, the following data were obtained at $30^{\circ}C$:

Experiment	$[X]\left(molL^{-1}\right)$	$\text{Rate}\left(molL^{-1}hr^{-1}\right)$
I	0.17	0.05
II	0.34	0.10
III	0.68	0.20

In experiment (I), what time will reactant (X) take to be reduced into $0.0425M$?

A. $2.4hr$

B. $0.48hr$

C. $3.1hr$

D. $4.7hr$

Answer: D

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51. The reaction $2AX(g) + 2B_2(g) \rightarrow A_2(g) + 2B_2X(g)$ has been studied kinetically and on the baiss of the rate law following mechanism has been proposed.

I. $2AX \Leftrightarrow A_2X_2 \quad \text{(fast and reverse)}$

II. $A_2X_2 + B_2 \rightarrow A_2X + B_2X$

III. $A_2X + B_2 \rightarrow A_2 + B_2X$

where all the reaction intermediates are gases under ordinary condition.

form the above mechanism in which the steps (elementary) differ conisderably in their rates, the rate law is derived uisng the principle that the slowest step is the rate-determining step (RDS) and the rate of any step varies as the Product of the molar concentrations of each reacting speacting species raised to the power equal to their respective stoichiometric coefficients (law of mass action). If a reacting species is solid or pure liquid, its active mass, i.e., molar concentration is taken to be unity, the standard state. In qrder to find out the final rate law of the reaction, the concentration of any intermediate appearing in the rate law of the RDS is substituted in terms of the concentration of the reactant(s) by means of the law of mass action applied on equilibrium step.

Let the equilibrium constant of Step I be $2 \times 10^{-3} mol^{-1} L$ and the rate constants for the formation of A_2X and A_2 in Step II and III are $3.0 \times 10^{-2} mol^{-1} L \min^{-1}$ and $1 \times 10^{3} mol^{-1} L \min^{-1}$ (all data at $25^{\circ} C$), then what is the overall rate constant $\left(mol^{-2}L^{2}\min^{-1}\right)$ of the consumption of B_2?

A. 6×10^{-5}

B. 1.2×10^{-4}

C. 3×10^{-5}

D. 1.5×10^{-5}

Answer: B

Watch Video Solution

52. The reaction $2AX(g) + 2B_2(g) \rightarrow A_2(g) + 2B_2X(g)$ has been studied kinetically and on the baiss of the rate law following mechanism has been proposed.

I. $2AX \Leftrightarrow A_2X_2 \quad (\text{fast and reverse})$

II. $A_2X_2 + B_2 \rightarrow A_2X + B_2X$

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How many times the rate of formation of A_2 will increase if concentrations of AX is doubled and that of B_2 is increased theee fold?

A. 36

B. 12

C. 6

D. 8

Answer: B

Watch Video Solution

53. The reaction $2AX(g) + 2B_2(g) \rightarrow A_2(g) + 2B_2X(g)$ has been studied kinetically and on the baiss of the rate law following mechanism has been proposed.

I. $2AX \Leftrightarrow A_2X_2 \quad \text{(fast and reverse)}$

II. $A_2X_2 + B_2 \rightarrow A_2X + B_2X$

III. $A_2X + B_2 \rightarrow A_2 + B_2X$

where all the reaction intermediates are gases under ordinary condition.

form the above mechanism in which the steps (elementary) differ conisderably in their rates, the rate law is derived uisng the principle that the slowest step is the rate-determining step (RDS) and the rate of any step varies as the Product of the molar concentrations of each reacting speacting species raised to the power equal to their respective stoichiometric coefficients (law of mass action). If a reacting species is solid or pure liquid, its active mass, i.e., molar concentration is taken to be unity, the standard state. In qrder to find out the final rate law of the reaction, the concentration of any intermediate appearing in the rate law of the RDS is substituted in terms of the concentration of the reactant(s) by means of the law of mass action applied on equilibrium step.

What is the initial rate of formation of A_2 when $[AX] = 0.1M$ and $\left[B_2\right] = 1.0M$

A. $1.2 \times 10^{-5} molL^{-1} \min^{-1}$

B. $4.5 \times 10^{-6} molL^{-1} \min^{-1}$

C. $3 \times 10^{-7} molL^{-1} \min^{-1}$

D. $6 \times 10^{-7} molL^{-1} \min^{-1}$

Answer: D

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54. The rate law expresison is given for a typical reaction, $n_1A + n_2B \rightarrow P$ as $r = k[A]^n[B]^{n2}$. The reaction completes only in one step and A and B are present in the solution. If the reaction occurs in more than one step, then the rate law is expressed by consdering the slowest step, i.e., for S_Nl

reaction $r = k[RX]$. If the eraction occurs in more than one step and the rates of the steps involved are comparable, then steady state approximation is conisdered, i.e., the rate of formation of intermediate is always equal to the rate of decompoistion of the intermediate. Conisder the reaction:

$$\begin{bmatrix} I_2 \overset{k_2}{\Leftrightarrow} k_1 2I(\text{rapid equilibrium}) \\ H_2 + 2I \overset{k_3}{\rightarrow} 2HI(\text{slow}) \end{bmatrix}$$

If we increase the concentration of I_2 two times, then the rate of formation of HI will

A. Increase four times

B. Increase two times

C. Remain same

D. Cannot predict

Answer: B

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55. The rate law expresison is given for a typical reaction, $n_1A + n_2B \rightarrow P$ as $r = k[A]^n[B]^{n2}$. The reaction completes only in one step and A and B are present in the solution. If the reaction occurs in more than one step, then the rate law is expressed by consdering the slowest step, i.e., for $S_N l$ reaction $r = k[RX]$. If the eraction occurs in more than one step and the rates of the steps involved are comparable, then steady state approximation is conisdered, i.e., the rate of formation of intermediate is always equal to the rate of decompoistion of the intermediate. Conisder the reaction:

$$\left[\begin{array}{c} \overset{k_2}{I_2 \Leftrightarrow k_1 2I}\text{(rapid equilibrium)} \\ H_2 + 2I \xrightarrow{k_3} 2HI\text{(slow)} \end{array}\right]$$

Which of the following expresison is correct?

A. $\frac{d[HI]}{dt} = \frac{k_3k_1}{k_2}[H_2][I_2]$

B. $\frac{d[HI]}{dt} = \frac{k_1k_3}{k_2}2[H_2][I_2]$

C. $\frac{d[HI]}{dt} = k_2[H_2][I_2]^2$

D. None of these

Answer: A

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56. A secondary alkyl halide (A) hydrolyzes with alkali (B) in aqueous medium ismultaneously via S_N1 and S_N2 pathways with rate constants k_1 and k_2, respectively. form kinetic data, it was found that a plot of $= \frac{-1}{[A]}\frac{d[A]}{dt}$ vs $[B]$ is straight line with a slope equal to $2.7 \times 10^{-4} Lmol^{-1} \min^{-1}$ and intercept equal to 1.02×10^{-3}. Minimum initial concentration of $[A] = 0.2M$ and $[B]$, i.e., $\left[\overset{\ominus}{OH}\right] = 0.5M$.

The value of overall rate constant of the hydrolyiss of A (in $Lmol^{-1} \min^{-1}$) is

A. $a.\ 2.7 \times 10^{-4}$

B. $b.\ 1.02 \times 10^{-3}$

C. $c.\ 1.29 \times 10^{-3}$

D. d. None of these

Answer: C

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57. A secondary alkyl halide (A) hydrolyzes with alkali (B) in aqueous medium ismultaneously via S_N1 and S_N2 pathways with rate constants k_1 and k_2, respectively. form kinetic data, it was found that a plot of $= \frac{-1}{[A]}\frac{d[A]}{dt}$ vs $[B]$ is straight line with a slope equal to $2.7 \times 10^{-4} Lmol^{-1}\min^{-1}$ and intercept equal to 1.02×10^{-3}. Minimum initial concentration of $[A] = 0.2M$ and $[B]$, i.e., $\left[\overset{\ominus}{OH}\right] = 0.5M$.

The initial rate of consumption is isopropyl chloride (in $M\min^{-1}\Big)$ is

A. $a.\ 0.2 \times 10^{-3}$

B. $b.\ 3 \times 10^{-5}$

C. $c2.31 \times 10^{-4}$

D. $d. \ 2.31 \times 10^{-3}$

Answer: C

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58. If a unimolecular reaction, $A(g) \rightarrow$ Products, takes place according to the mechanism

I. $A + A \overset{k_1}{\Leftrightarrow} k_{-1}A^* + A$

II. $A^* \rightarrow k_2 P$

where k_1, k_{-1}, and k_2 are the rate constant and P, A, and A^* stand for Product molecule, normal molecules of reactants and activated molecules of reactants respectively.

Which of the following expresison are correct?

A. $\dfrac{d\left[A^*\right]}{dt} = k_1[A]^2 - k_1\left[A^*\right][A] - k_2\left[A^*\right]$

B. $\frac{d\left[A*\right]}{dt}=0$

C. $\left[A*\right]=\frac{k_1[A]^2}{k_{-1}[A]+k_2}$

D. All of the above

Answer: D

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59. If a unimolecular reaction, $A(g) \rightarrow$ Products, takes place according to the mechanism

I. $A+A \overset{k_1}{\Leftrightarrow} k_{-1}A^* + A$

II. $A^* \rightarrow k_2P$

where k_1, k_{-1}, and k_2 are the rate constant and P, A, and A^* stand for Product molecule, normal molecules of reactants and activated molecules of reactants respectively.

Which of the following statements are correct ?

A. At high pressure of A, i.e., high concentration of A reaction obeys first order kinetics.

B. At low pressure of A, reaction reaction obeys first order kinetics

C. The rate of reaction depends on both steps at all pressures.

D. All of the above statements are correct.

Answer: A::C

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Exercises Multiple Correct

1. Which of the following is (are) not correct for a first order reaction?

A. $t_{1/2} \propto a$

B. $t_{1/2} \propto 1/a$

C. $t_{1/2} \propto a^0$

D. $t_{1/2} \propto a^2$

Answer: A::B::D

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2. Which of the following statement is (are) correct ?

A. Rate of reaction $\propto 1/E_a$

B. At lower temperature increase in temperature causes more change in the value of k.

C. $k = Ae^{-\left(E_a/RT\right)}$

D. None f these

Answer: A::B::C

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3. Taking the reaction, $A + 2B \rightarrow$ Products to be of second order, which of the following is/are the correct rate law expresisons (s)?

A. $\frac{dx}{dt} = k[A]^2$

B. $\frac{dx}{st} = k[A][B]^2$

C. $\frac{dx}{dt} = k[A][B]$

D. $\frac{dx}{dt} = k_1[A] + k_2[B]^2$

Answer: A::C

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4. Which of the following statements (s) are not correct?

A. A plot of $\log k$ versus $1/T$ is linear

B. A plot of $\log k_p$ versus $1/T$ is nonlinear.

C. A plot of $\log P$ versus $1/T$ is linear at constant volume.

D. A plot of P versus $1/V$ is linear at constant temperature.

Answer: B::C

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5. In a hypothetical reaction $X \rightarrow Y$, the activation energy for the forward and backward reactions is 15 and $9kJmol^{-1}$, respectively. The potential energy of X is $10kJmol^{-1}$. Then

Plot $t_{1/2}$ vs. concentration

A. The heat of reaction is $6kJ$

B. The potential energy of Y is $16kJ$.

C. The threshold energy of the reaction is $25kJ$.

D. The reaction is endothermic.

Answer: A::B::C::D

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6. The rate constant of a reaction is given by $k = 2.1 \times 10^{10} \exp(-2700/RT)$. It means that

A. $\log k$ versus $1/T$ will be a straight line with slope $= \dfrac{-2700}{2.303R}$

B. $\log k$ versus $1/T$ will be straight line with intercept on $\log k$ axis $= \log\left(2.1 \times 10^{10}\right)$.

C. The number of effective colliisons are $2.1 \times 10^{10} cm^{-3} s^{-1}$.

D. Half-life of the reaction increase with increase of temperature.

Answer: A::B

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7. In acidic medium, the rate of reaction between $BrO_3^{\ominus}$ and $Br^{\ominus}$ is given by the expresion

$$\frac{-d\left[BrO_3^{\ominus}\right]}{dt} = k\left[BrO_3^{\ominus}\right]\left[Br^{\ominus}\right]\left[H^{\oplus}\right]^2$$

A. The rate constant of the reaction depends upon the concentration of $H^{\oplus}$ ions.

B. The rate of reaction is independent of the concentration of the acid added.

C. Doubling the concentration of $H^{\oplus}$ ions will increase the reaction rate by 4 times

D. The change in pH of the solution will affect the rate of reaction.

Answer: C::D

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8. Which of the following relations are correct if ΔH represents only magnitude ?

A. a. Exothermic reactions: $E_{a(f)} + \Delta H = E_{a(b)}$

B. b. Endothermic reactions: $E_{a(f)} = E_{a(b)} + \Delta H$

C. c. Exothermic reactions: $\Delta H > E_a$

D. d. Exothermic reactions: $\Delta H < E_a$

Answer: A::B::D

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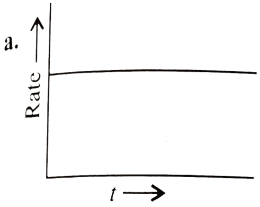
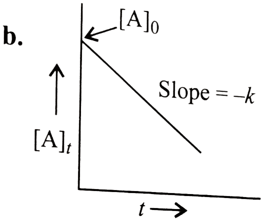
9. Which of the following graphs represents zero order if

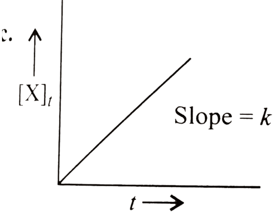
$A \rightarrow P$

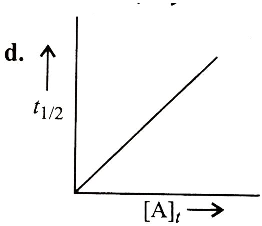
At $t = 0 \Rightarrow [A]_0$

At $t = t \Rightarrow [A]_t$

A. 

B. 

C. 

D. 

Answer: A::B::C::D

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10. Which one is correct according to the colliison theory of the rate of reaction?

A. The threshold energy level is a characteristic of reaction.

B. The energy of activation decreases with rise in temperature.

C. The energy of absorbed activated complex is lower than ismple activated complex.

D. The energy of activated complex (both activated or adsorbed) is higher than reactant or Product.

Answer: A::C::D

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11. The rate expresison for the reaction:

$NH_4CNO \Leftrightarrow NH_2CONH_2$ can be derived form the mechanism:

(i) $NH_4CNO \overset{k_1}{\Leftrightarrow} \mathrm{k_2} NH_4NCO(\text{Fast})$

(ii) $NH_4CNO \xrightarrow{k_3} NH_3 + HNCO$ ("fast")

(iii) $NH_3 + HNCo \xrightarrow{k_4} NH_2CONH_2$ (Slow)

Which of the following statement (s) is/are correct about the rate expresison?

A. $\dfrac{d[urea]}{dt} = \dfrac{k_1k_3}{k_2}\left[NH_4NCO\right]$

B. $\dfrac{d[urea]}{dt} = \dfrac{k_1k_3}{k_2k_4}\left[NH_4NCO\right]$

C. $\frac{d[urea]}{dt} = k\left[NH_4NCO\right]$

D. $\frac{d[urea]}{dt} = \frac{k_1 \times k_2}{k_3 \times k_4}\left[NH_4NCO\right]$

Answer: A::C

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12. According to the colliison theory, most molecular colliisons do not lead to reaction. Which of the following is/*are* necessary for colliisons to successfully lead to reaction ?

A. The total kinetics energy of the collision must be greater than some minimum value.

B. A catalyst must be present at the collision.

C. The colliding particles must be properly oriented in space when they collide.

D. None of these

Answer: A::C

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13. Identify the true statement (s).

A. A catalyst is chemically unchanged at the end of a reaction.

B. A catalyst may appear in the kinetic rate equation of the reaction.

C. A catalyst will not affect the compoistion of an equilibrium mixture.

D. A catalyst cannot cause a non- spontaneous $(\Delta G > 0)$ reaction to proceed.

Answer: A::B::C::D

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14. Which of the following statement (s) is/are correct?

A. Zero order reactions are complex reactions.

B. A reaction having first order may be either elementary or complex reaction.

C. A reaction having second order reaction must have molecularity $= 2$.

D. A reaction with molecularity $= 2$ must be a second order reaction.

Answer: A::B

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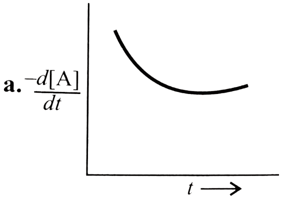
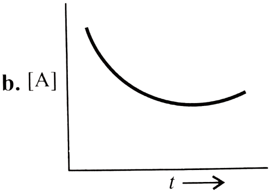
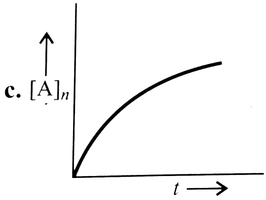
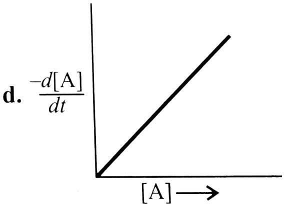
15. Which of the following plots are correctly made for the reaction $nA \Leftrightarrow (A)_n$ if it obeys first order reaction?



A.

B. 

C. 

D. 

Answer: A::B::C::D

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16. Rate constant k varies with temperature by equation $\log k\left(\min^{-1}\right) = \log 5 - \frac{2000 kcal}{RT \times 2.303}$. We can conclude that

A. The pre-exponential factor A is 10^5.

B. E_a is $2000 kcal$

C. E_a is $9.12 kcal$

D. The pre-exponential factor A is 5

Answer: B::D

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17. Which of the following reaction (s) is $/$ are of the first order ?

A. The decompoistion of ammonium nitrate in an aqueous solution.

B. The inverison of cane sugar in the presence of an acid.

C. The acidic hydrolyiss of ethyl acetate.

D. All radioactive decays.

Answer: A::B::C::D

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18. The baiss theory behind Arrhenius' equation is that

A. The number of effective colliisons is proportional to the number of molecules above a certain threshold energy.

B. As the temperature increases, so does the number of molecules with energies exceeding the threshold energy.

C. The rate constant is a function of temeperature.

D. The activation energy and pre-exponential factor are always temperature inedpendent.

Answer: A::B::C::D

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19. In Arrhenius equation $k = A\exp\left(-\frac{E_a}{RT}\right)$. A may be termed as the rate constant at

A. Very low temperature

B. Very high temperature

C. Zero activation energy

D. The boiling temperature of the reaction mixture

Answer: B::C

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20. Select the correct statement (s).

A. The order of a reaction may be changed with change in the experimental conditions.

B. The rate of reaction, either exotherimc or endothermic, both decreases with decrease in the temperature.

C. A reaction mixture thermofyanmically stable should be kinetically unstable.

D. A negative catalyst increases the energy of activation.

Answer: A::B

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21. For a gaseous reaction: $A(g) \rightarrow B(g)$, the rate expresion may be given as

A. $-\frac{d[A]}{dt} = k[A]^n$

B. $-\frac{1}{V}\frac{dn_A}{dt} = k[A]^n$

C. $-\frac{1}{RT}\frac{dP_A}{dt} = k[A]^n$

D. $-\frac{dP}{dt} = k\left[P_A\right]^n$

Answer: A::B::C::D

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22. The rate of formation of $C_6H_6 + 3H_2 \overset{k_f}{\Leftrightarrow} k_bC_6H_{12}$ for the forward reaction is first order with respect to C_6H_{12} and H_{12} each. Which one of the options is/are correct?

A. $k_{eq} = \dfrac{k_f}{k_b}$

B. $k_{eq} = \dfrac{\left[C_6H_{12}\right]}{\left[C_6H_6\right]\left[H_2\right]^3}$

C. $r_f = k_f\left[C_6H_6\right]\left[H_2\right]$

D. $r_b = k_b\left[C_6H_{12}\right]\left[H_2\right]^{-2}$

Answer: A::B::C::D

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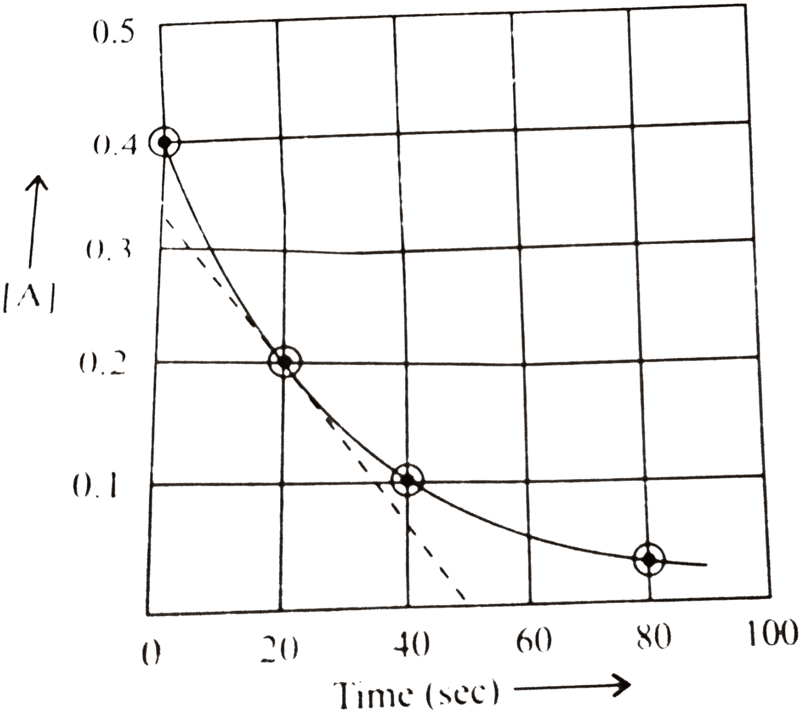
23. A certain reaction $A \rightarrow B$ follows the given concentration (Molarity)-time graph. Which of the following statements is/are true?



A. The reaction is second order with respect to A.

B. The rate for this reaction at $20s$ will be $7 \times 10^{-3} Ms^{-1}$

C. The rate for this reaction at $80s$ will be $1.75 \times 10^{-3} Ms^{-1}$

D. The $[B]$ will be $0.35M$ at $t = 60s$.

Answer: B::D

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24. For a first order reaction,

A. The degree of dissociation is equal to $\left(1-e^{-kt}\right)$.

B. A plot of reciprocal concentration of the reactant *vs* time gives a straight line.

C. The time taken for the completion of 75% reaction is theice the $t_{1/2}$ of reaction.

D. The pre-exponential factor in the Arrhenius equations has the dimenison of time, T^{-1}.

Answer: A::D

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25. Which of the following statement (s) is/are correct

A. The rate constant for the reaction

$2N_2O_5 \rightarrow 4NO_2+O_2$, is $3.0\times10^{-5}s^{-1}$. If the rate is

$2.40 \times 10^{-5} molL^{-1}s^{-1}$, then the concentration of $N_2O_5 = 0.8 molL^{-1}$.

B. In the intensity equation, $k = A\exp(-E/RT)$. A may be termed as the rate constant at very low temperature.

C. If I is the intensity of absorbed light and c is the concentration of AB for the photochemical process $AB + hv \rightarrow AB^*$, the rate of formation of AB^* is diretly proportional to I^2.

D. The rate constant, the activation energy, and the Arrhenius parameter of a chemical reaction at $25^\circ C$ are $3.0 \times 10^{-4} s^{-1}$, $104.4 kJmol^{-1}$, and $6.0 \times 10^{14} s^{-1}$, respectively. The value of the rate constant as $T \rightarrow \infty$ is $6.0 \times 10^{14} s^{-1}$.

Answer: A::D

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26. Which of the following statements is/are correct?

A. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ under certain conditions of temperature and partial pressure of the reactants, the rate of formation of NH_3 is $0.001kgh^{-1}$. The rate of conversions of H_2 under the same conditions is $0.0015kghr^{-1}$.

B. The rate law for the reaction

$RCl + NaOH(aq) \rightarrow ROH + NaCl$

is given by, rate $= k[RCl]$. The rate of the reaction will be halved on reducing the concentration of alkyl halide to one half.

C. The rate of the reaction in part (b) increased on decreasing the temperature of the reaction.

D. The rate of the chemical change is inversely proportional to the concentration at that instant.

Answer: B

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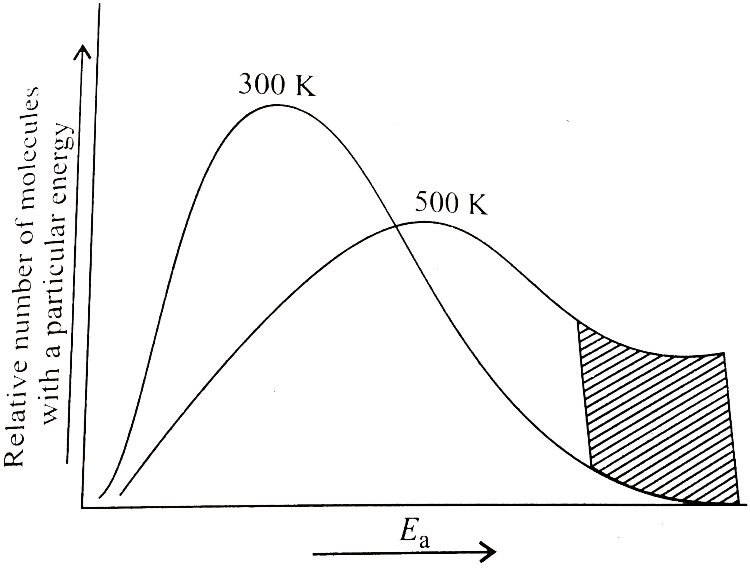
27. The distribution of molecular kinetic energy at two temperature is as shown in the following graph:



Which is the following concluison is/are correct?

A. The number of molecules with energy E_a or greater is proportional to the shaded area for each temperature.

B. The number of molecules with energy E_a or less is proportional to the shaded area for each temperature.

C. The number of molecules with energy E_a is the mean of all temperatures.

D. The graph follows the Maxwell-Boltzmann energy distribution law.

Answer: A::D

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28. Which of the following isomerization reactions is/are of the first order?

A. Cylopropane → Propane

B. cis-But-2-ene → Trans-but-2-ene

C. Vinyl allyl ether → Pent-4-enal

D. $CH_3NC \rightarrow CH_3CN$

Answer: A::B::C::D

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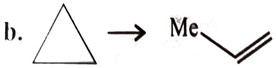
29. Which of the following is/are examples of unimolecular reactions?

A. $O_3 \rightarrow O_2 + O$

B.



C. $NO + O_3 \rightarrow NO_2 + O_2$

D. $O + NO + N_2 \rightarrow NO_2 + N_2$

Answer: A::B

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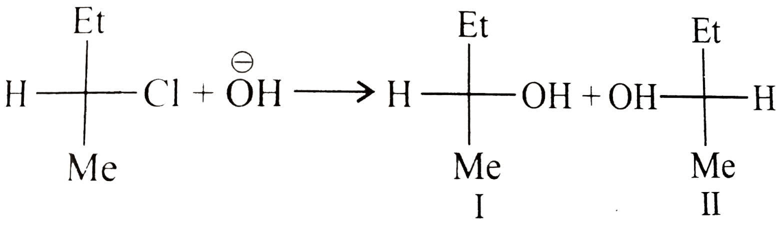
30.



$$H-\overset{Et}{\underset{Me}{|}}-Cl + \overset{\ominus}{O}H \longrightarrow \underset{I}{H-\overset{Et}{\underset{Me}{|}}-OH} + \underset{II}{OH-\overset{Et}{\underset{Me}{|}}-H}$$

Which of the followinf is/are correct?

A. It is unimolecular nucleophilic substitution reaction S_N1 if or II is formed.

B. It is bimolecular nucleophilic substitution reaction S_N2 is I or II is formed.

C. It is S_N1 if I and is enantomer are formed so that the mixture is racemic.

D. It is S_N2 if II is formed.

Answer: C::D

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31. $Zn + 2H^{\oplus} \rightarrow Zn^{2+} + H_2$

The half-life periof is independent of the concentration of zinc at constant pH. For the constant concentration of Zn, the rate becomes 100 times when pH is decreased form 3 to 2. Hence,

A. $\frac{dx}{dt} = k[Zn]^0\left[H^{\oplus}\right]^2$

B. $\frac{dx}{dt} = k[Zn]\left[H^{\oplus}\right]^2$

C. Rate is not affected if the concentration of zinc is made four times and that of $H^{\oplus}$ ion is halved.

D. (d) Rate becomes four times if the concentration of $H^{\oplus}$ ion is doubled at constant Zn concentration.

Answer: B::C::D

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32. Which of the following is/are examples of pseudo unimolecular reactions?

A. $CH_3CO_2C_2H_5 + H_2O \xrightarrow{H^{\oplus}} CH_3CO_2H + C_2H_5OH$

B. $C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^{\oplus}} C_6H_{12}O_6(\text{Glucose}) + C_6H_{12}O_6(\text{Fructose})$

C. $CH_3COCl + H_2O \rightarrow CH_3CO_2H + HCl$

D. $CH_3CO_2C_2H_5 + H_2O \xrightarrow{\overset{\ominus}{OH}} CH_3CO_2H + C_2H_5OH$

Answer: A::B::C

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33. In which of the following ways does an activated complex differ form an ordinary molecule?

A. It is quite unstable and has no independent existence.

B. $\Delta_f H^{\ominus}$ is probably poistive.

C. The system has no vibrational character.

D. The system has no vibrational character.

Answer: A::C

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34. Which of the following statements is/are correct?

A. The rate of the reaction involving the converison of ortho-hydrogen to parahydrogen is $-\frac{d[H_2]}{dt} = k[H_2]^{3/2}$.

B. The rate of the reaction involving the thermal decompoistion of acetaldehyde is $k[CH_3CHO]^{3/2}$.

C. In the formation of phosgene gas form CO and Cl, the rate of the reaction is $k[CO][Cl_2]^{1/2}$.

D. In the decompoistion of H_2O, the rate of the reaction is $k[H_2O_2]$.

Answer: A::B::C::D

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Exercises Single Correct

1. The rate constant of a reaction with a virus is $3.3 \times 10^{-4} S^{-1}$. Time required for the virus to become 75% inactivated is

A. $35 min$

B. $70 min$

C. $105 min$

D. $17.5 min$

Answer: B

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2. $2N_2O_5 \rightarrow 4NO_2 + O_2$

If $\frac{-d[N_2O_5]}{dt} = k_1[N_2O_5]$

$\frac{d[NO_2]}{dt} = k_2[N_2O_5]$

$\frac{d[O_2]}{dt} = k_3[N_2O_5]$

What is the relation between k_1, k_2, and k_3?

A. $k_1 = k_2 = k_3$

B. $2k_1 = k_2 = 4k_3$

C. $2k_1 = 4k_2 = k_3$

D. None

Answer: B

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3. For gaseous reactions, the rate is expressed in terms of dP/dt instead of dc/dt or dn/dt (where c is the concentration and n the number of mol). What is the relation among these expresisons ?

A. $\frac{dc}{dt} = \frac{1}{V}\left(\frac{dn}{dt}\right) = \frac{1}{RT}\left(\frac{dP}{dt}\right)$

B. $\frac{dc}{dt} = \left(\frac{dn}{dt}\right) = \left(\frac{dP}{dt}\right)$

C. $\frac{dc}{dt} = \left(\frac{dn}{dt}\right) = \frac{V}{RT}\left(\frac{dP}{dt}\right)$

D. None of these

Answer: A

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4. A Geiger melter countries is used to study , the radicuacting process in the abserence of radoactive substance A , it couts 2 disingration per second (dps) Al the start in due presence of A, it recoirds 23 dps and after 10 in 3 dps,

(i) What does it count after 20 min?

(ii) What is the half -life A?

A. $8dps, 10min$

B. $5dps, 10min$

C. $5dps, 20min$

D. $5dps, 5min$

Answer: A

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5. 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 $E_a(1)$ of the first order reaction is greater than $E_a(2)$ 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.

Answer: A

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6. $A \rightarrow B, \Delta H = -10KJmol^{-1}, E_{a(f)} = 50KJmol^{-1}$, then E_a of $B \rightarrow A$ will be

A. $40KJmol^{-1}$

B. $50 KJmol^{-1}$

C. $-50 KJmol^{-1}$

D. $60 KJmol^{-1}$

Answer: D

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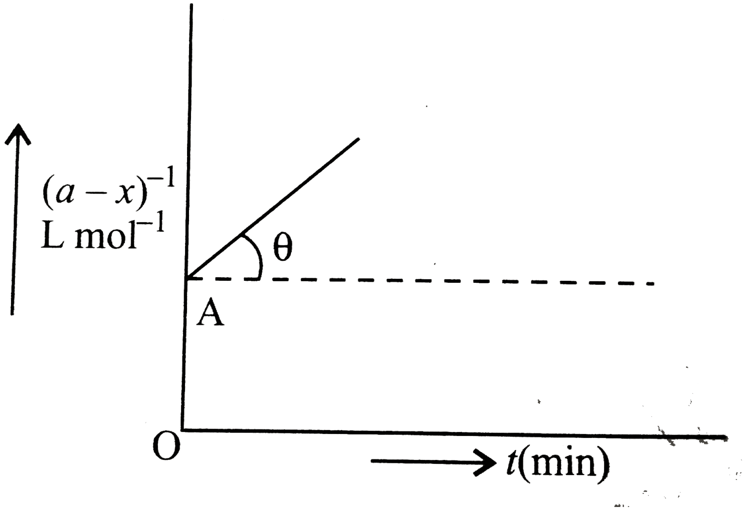
7. Following is the graph between $(a - x)$ and time t for second order reaction $\theta = \tan^{-1}(0.5) OA = 2 Lmol^{-}$



Hence, the rate at the start of the reaction is

A. $1.25molL^{-1}min^{-1}$

B. $0.5molL^{-1}min^{-1}$

C. $0.125molL^{-1}mi^{-1}$

D. $12.5molL^{-1}\min^{-1}$

Answer: C

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8. The half-life periof of the reaction in the above question is

A. $1.386y$ min

B. 4 min

C. 16 min

D. 2 min

Answer: B

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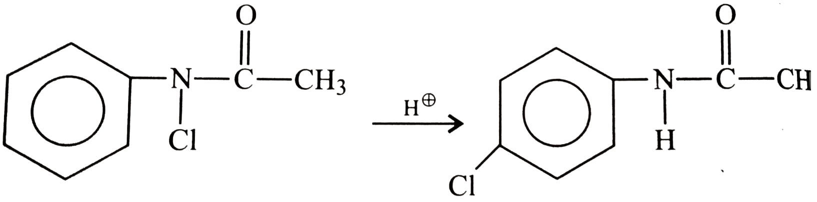
9.



The reaction kinetics can be studied by

A. Measurement of pH

B. Titration with hypo after adding KI

C. Both (a) and (b) are correct

D. None is correct

Answer: B

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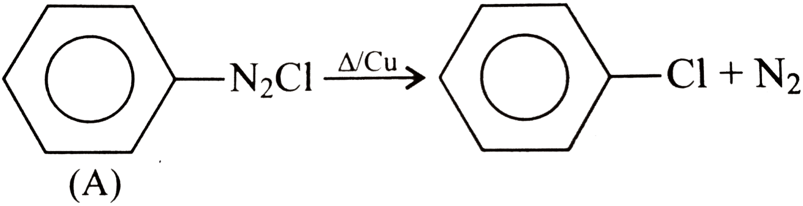

10.

Half life id independent of the concentration of A. After $10 min$ volume of N_2 gas is $10L$ and after complete reaction is $50L$. Hence, the rate constant is

A. $\frac{2.303}{10}\log 5 min^{-1}$

B. $\frac{2.303}{10}\log 1.25 min^{-1}$

C. $\frac{2.303}{10}\log 2 min^{-1}$

D. $\frac{2.303}{10}\log 4 min^{-1}$

Answer: B

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11. $A \rightarrow$ Product, $[A]_0 = 2M$. After 10 min reaction is 10% completed. If $\frac{d[A]}{dt} = k[A]$, then $t_{1/2}$ is approximately

A. 0.693 min

B. 69.3 min

C. 66.0 min

D. 0.0693 min

Answer: C

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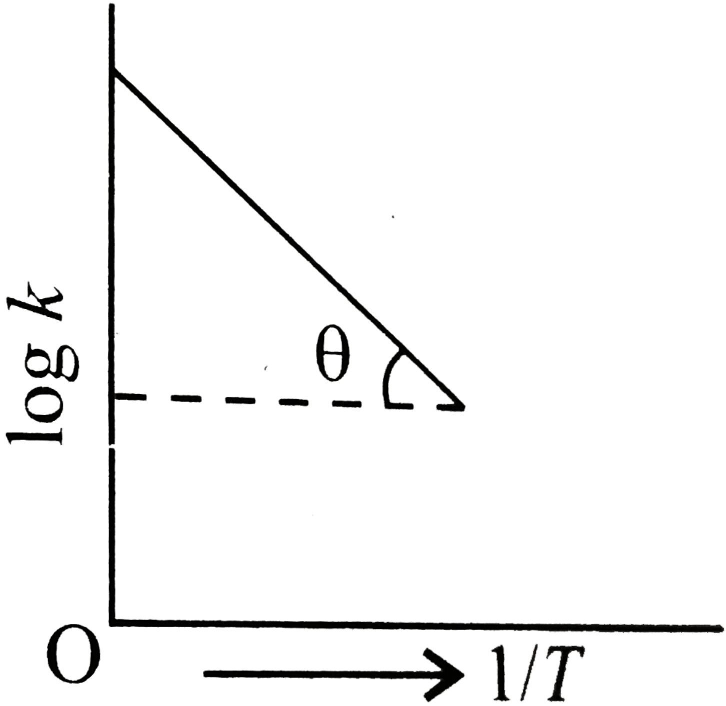
12. Graph between $\log k$ and $1/T$ [k rate constant $\left(s^{-1}\right)$ and T and the temperature (K)] is a straight line with $OX = 5$, $\theta = \tan^{-1}(1/2.303)$. Hence

-E_a will be



A. $2.303 \times 2cal$

B. $2/2.303cal$

C. $2cal$

D. None

Answer: C

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13. The rate of a chemical reaction generally increases rapidly even for small temperature increases because of a rapid increase in

A. Colliison frequency

B. Fraction of molecules with energies in excess of the activation energy

C. Activation energy

D. Average kinetic energy of molecules

Answer: B

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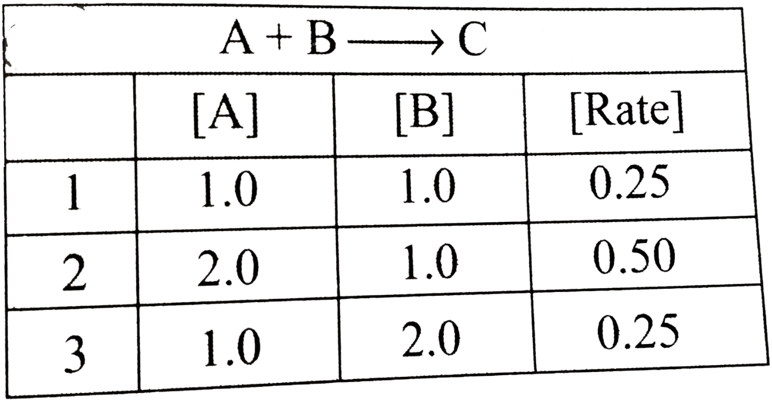
14. 

A + B ⟶ C			
	[A]	[B]	[Rate]
1	1.0	1.0	0.25
2	2.0	1.0	0.50
3	1.0	2.0	0.25

Rate is expressed in $molL^{-1}\min^{-1}$.

In the above reaction, the order is

A. Zero in A and one in B

B. One in A and zero in B

C. One in both A and B

D. Zero in both A and B

Answer: B

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15. Rate constant $k = 1.2 \times 10^3 mol^{-1}Ls^{-1}$ and $E_a = 2.0 \times 10^2 kJmol^{-1}$. When $T \rightarrow \infty$:

A. $A = 2.0 \times 10^2 kJmol^{-1}$

B. $A = 1.2 \times 10^3 mol^{-1}Ls^{-1}$

C. $A = 1.2 \times 10^3 molL^{-1}s^{-1}$

D. $A = 2.4 \times 10^3 kJmol^{-1}s^{-1}$

Answer: B

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16. The rate constant of a reaction is $0.0693 \min^{-1}$. Starting with $10 mol$, the rate of the reaction after $10 \min$ is

A. $0.0693 mol \min^{-1}$

B. $0.0693 \times 2 mol \min^{-1}$

C. $0.0693 \times 5 mol \min^{-1}$

D. $0.0693 \times (5)^2 mol\ min^{-1}$

Answer: C

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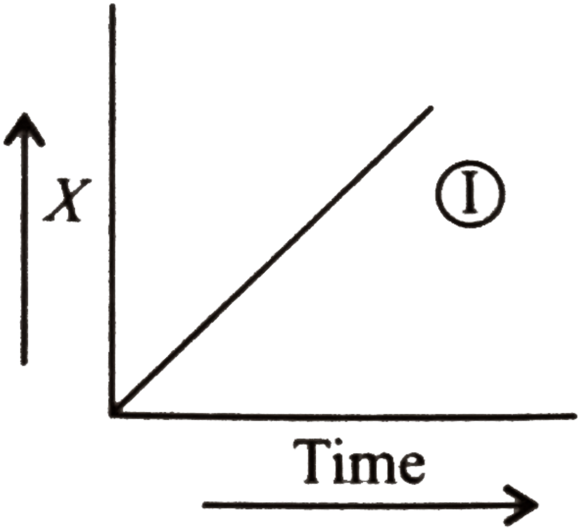
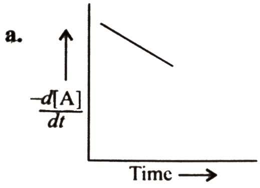
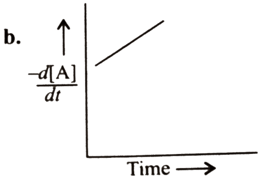
17. The graph between concentration (X) of the Product and time of the reaction $A \rightarrow B$ is of the type 1. Hence, graph between $-\frac{d[A]}{dt}$ and time will be of the type:



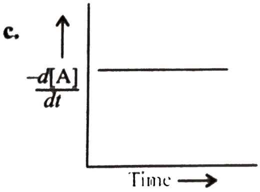
A.



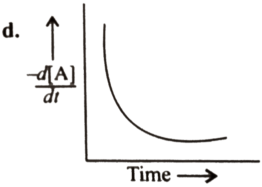
B.



C.



D.



Answer: C

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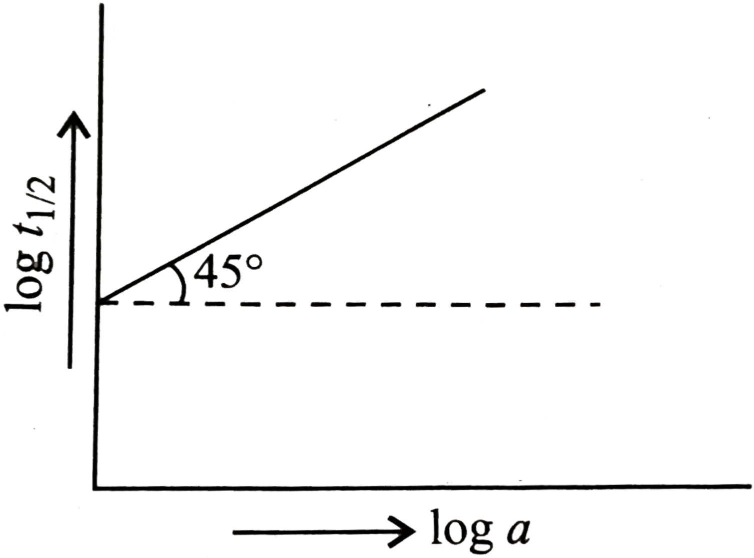
18. Following is the graph between $\log T_{50}$ and $\log a$ $(a =$ initial concentration) for a given reaction at $27^{\circ} C$. Hence order is



A. 0

B. 1

C. 2

D. 3

Answer: A

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19. The half life of radioactive element is 20 min. The time interval between the stages of its 33% and 67% decay is

A. 40 min

B. 20 min

C. 30 min

D. 25 min

Answer: B

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20. Which of the following reaction is not of the first order ?

A. Inverison of sucrose in the presence of acid

B. Acid-catalyzed hydrolyiss of ethyl acetate

C. Hydrolyiss of tertiary butyl halide uisng alkali

D. Oxidation of $I^{\ominus}$ ion by $S_2O_8^{2-}$ ion

Answer: D

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21. For the reaction $X + 3Y \rightarrow Z$, which form of differential rate law is incorrect?

A. $dX / dt = dY / 3dt$

B. $3dZ / dt = - dY / dt$

C. $dZ / dt = - dX / dt$

D. $dX / dt = dZ / dt$

Answer: D

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22. 60% of a first order reaction was completed in 60 min. The time taken for reactants to decompose to half of their original amount will be

A. $\approx 30 \text{ min}$

B. $\approx 45 \text{ min}$

C. $\approx 20 \text{ min}$

D. $\approx 40 \text{ min}$

Answer: B

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23. 70% of a first order reaction was completed in 70 min. What is the half life of the reaction?

A. 4.2 min

B. 42 min

C. $4.2hr$

D. $4.2s$

Answer: B

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24. 80% of a fisrt order reaction was completed in 70 min. How much it will take for 90% completion of a reaction?

A. 114 min

B. 140 min

C. 100 min

D. 200 min

Answer: C

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25. 90% of a first order reaction was completed in 100 min. How much time it will take for 80% completion of a reaction

A. 90 min

B. 80 min

C. 70 min

D. 60 min

Answer: C

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26. 90% of a first order reaction was completed in 100 min .What is the half life of the reaction ?

A. 63.3 min

B. 53.3 min

C. 43.3 min

D. 30 min

Answer: D

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27. The hydrolyiss of ester in alkaline medium is a

A. First order reaction with molecularity 1

B. Second order reaction with molecularity > 2

C. First order reaction with molecularity 2

D. Second order reaction with molecularity 1

Answer: B

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28. A second order reaction requires 70 min to change the concentration of reactants form $0.08M$ to $0.01M$. How much time will require to become $0.04M$?

A. 10 min

B. 20 min

C. 30 min

D. 40 min

Answer: A

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29. Select the law that correponds to data shown for the following reaction $A + B \rightarrow$ Products

Exp	$[A]$	$[B]$	Initial rate
1	0.012	0.035	0.1
2	0.024	0.070	0.8
3	0.024	0.035	0.1
4	0.012	0.070	0.8

A. Rate $= k[B]^3$

B. Rate $= k[B]^4$

C. Rate $= k[A][B]^3$

D. Rate $= k[A]^2[B]^2$

Answer: A

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30. The temperature at which the average speed of perfect gas molecules is double than at $17^{\circ}C$ is

A. $34^{\circ}C$

B. $68^{\circ}C$

C. $162^{\circ}C$

D. $887^{\circ}C$

Answer: D

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31. The temperature at which the average speed of perfect gas molecules is double than at $17^{\circ}C$ is

A. $molL^{-1}\min^{-1}$

B. $L^2mol^{-2}\min^{-1}$

C. $Lmol^{-1}\min^{-1}$

D. $\min^{-1}$

Answer: B

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32. A catalyst lowers the activation energy of a reaction form $20kJmol^{-1}$ to $kJmol^{-1}$. The temperature at which the uncatalyzed reaction will have the same rate as that of the catalyzed at $27^{\circ}C$ is

A. $-123^{\circ}C$

B. $327^{\circ}C$

C. $32.7^{\circ}C$

D. $+23^{\circ}C$

Answer: B

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33. The rate of a reaction increases four-fold when the concentration of reactant is increased 16 times. If the rate of reaction is $4 \times 10^{-6} molL^{-1}s^{-1}$ when the concentration of the reactant is $4 \times 10^{-4} molL^{-1}$. The rate constant of the reaction will be

A. $2 \times 10^{-4} mol^{1/2}L^{1/2}s^{1/2}$

B. $1 \times 10^{-2}s^{-1}$

C. $2 \times 10^{-4} mol^{-1/2}L^{1/2}s^{-1}$

D. $25 mol^{-1}L \overset{-1}{\min}$

Answer: A

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34. Two reacants A and B are present such that $\left[A_0\right] = 4\left[B_0\right]$ and $t_{1/2}$ of A and B are 5 and 15 mintute respectively. If both decay folliwing I order, how much time later will concentrations of both of them would be equal?

A. 15 min

B. 10 min

C. 5 min

D. 12 min

Answer: A

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35. A first order reaction: $A \rightarrow$ Products and a second order reaction: $2R \rightarrow$ Products both have half time of 20 min when they are carried out taking $4molL^{-1}$ of their respective reactants. The number of mole per litre of A and R remaining unreacted after 60 min form the start of the reaction, respectively, will be

A. 1 and $0.5M$

B. $0.5M$ and negligible

C. 0.5 and $1M$

D. 1 and $0.25M$

Answer: C

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36. The inverison of cane sugar proceeds with half life of 500 min at $pH5$ for any concentration of sugar. However, if $pH = 6$, if the half life changes to 50 min . The rate law expresison for the sugar inverison can be written as

A. $r = k[\text{sugar}]^2[H]^6$

B. $r = k[\text{sugar}]^1[H]^0$

C. $r = k[\text{suagr}]^0\left[H^{\oplus}\right]^6$

D. $r = k[\text{sugar}]^0\left[H^{\oplus}\right]^1$

Answer: B

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37. In a reaction carried out at 500 K, 0.001% of the total number of collisions are effective. The energy of activation of the reaction is approximately

A. $15.8 kcalmol^{-1}$

B. $11.5 kcalmol^{-1}$

C. $12.8 kcalmol^{-1}$

D. zero

Answer: B

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38. The thermal decompoistion of compound is of first order. If 50% of a sample of the compound is decompoistion in $120 \min$ how long will it take for 90% of the compound to decompose?

A. 399 min

B. 410 min

C. 250 min

D. 120 min

Answer: A

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39. If a reaction $A + B \rightarrow C$ is exothermic to the extent of $30 KJmol^{-1}$, the the forward reaction has an activation energy , $70 KJmol^{-1}$, the activation energy for the reverse reaction is

A. $30 kJmol^{-1}$

B. $40 kJmol^{-1}$

C. $70 kJmol^{-1}$

D. $100 kJmol^{-1}$

Answer: D

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40. The rate constant, the activation energy, and the Arrhenius parameter of a chemical reaction at $25^{\circ}C$ are $3.0 \times 10^{-4}S^{-1}$, $104.4KJmol^{-1}$, and $6.0 \times 10^{14}S^{-1}$, respectively. The value of the rate constant as $T \rightarrow \infty$ is

A. $2.0 \times 10^{8}s^{-1}$

B. $6.0 \times 10^{14}s^{-1}$

C. ∞

D. $3.6 \times 10^{30}s^{-1}$

Answer: B

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41. The reaction $A(g) + 2B(g) \rightarrow C(g) + D(g)$ is an elementary process. In an experimetn, the initial partial pressure of A and B are $P_A = 0.60$ and $P_B = 0.80 atm$. When $P_C = 0.2 atm$, the rate of reaction relative to the initial rate is

A. $1/48$

B. $1/24$

C. $9/16$

D. $1/6$

Answer: D

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42. A catalyst decreases E_a form $100 KJmol^{-1}$ to $80 KJmol^{-1}$ At what temperature the rate of reaction in the absence of catalyst at $500 K$ will be equal to rate reaction in the presence of catalyst?

A. $400K$

B. $200K$

C. $625K$

D. None of these

Answer: A

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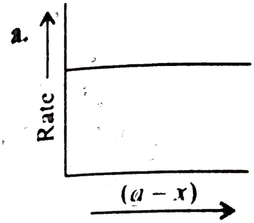
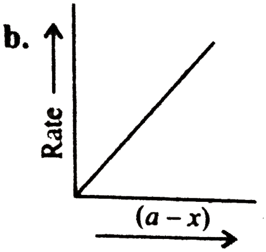
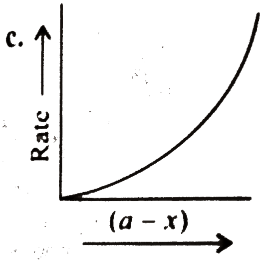
43. Which of the following graphs is for a second order reaction?

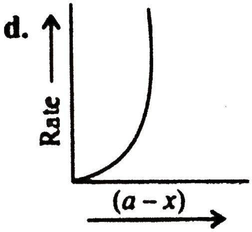


A.



B.

C. 

D. 

Answer: C

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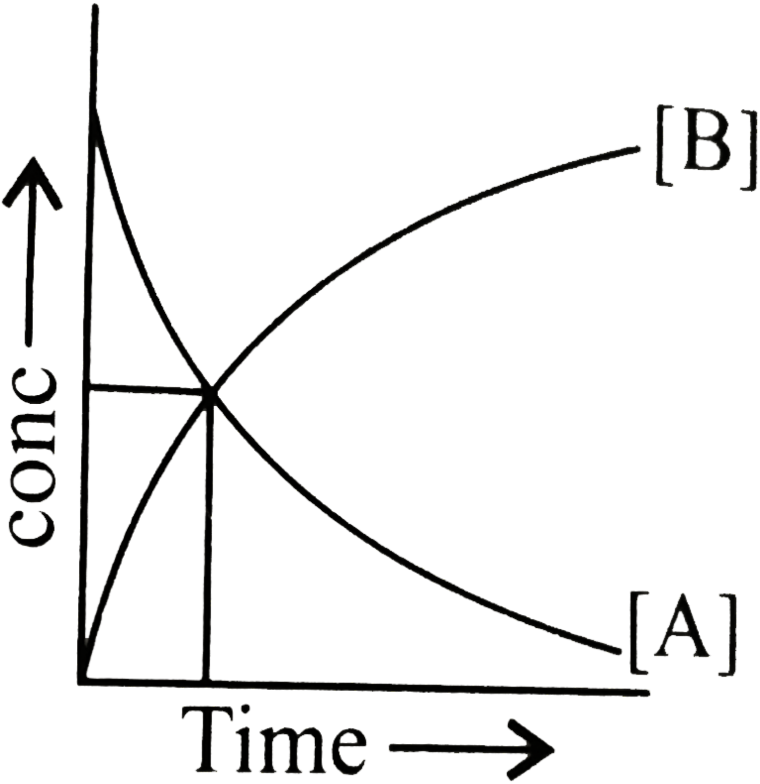
44. The accompanying figure depicts a change in concentration of species A and B for the reaction $A \rightarrow B$, as a function of time. The point of inter section of the two curves represents



A. $t_{1/2}$

B. $t_{3/4}$

C. $t_{2/3}$

D. Data insufficient to predict

Answer: A

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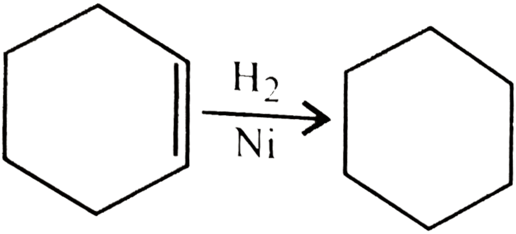
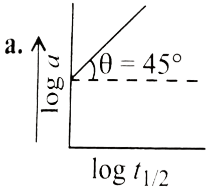
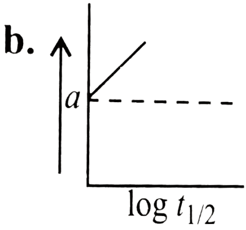
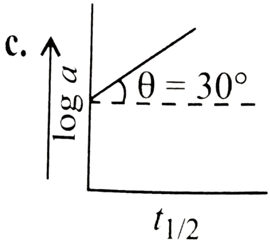
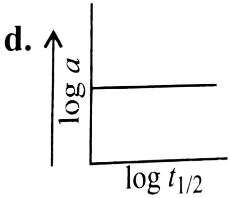
45. Which of the following is correct graph for the reaction?



A. 

B. 

C. 

D. 

Answer: A

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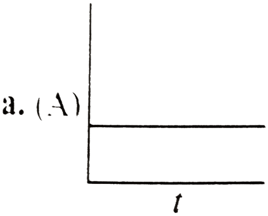
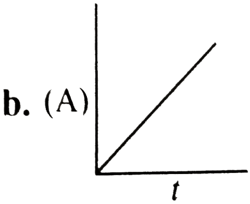
46. Which of the following graphs represents zero order if

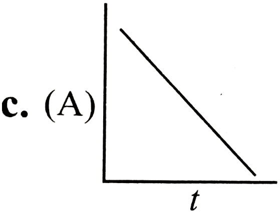
$A \rightarrow P$

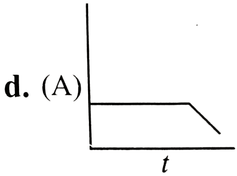
At $t = 0 \Rightarrow [A]_0$

At $t = t \Rightarrow [A]_t$

A. 

B. 

C. 

D. 

Answer: C

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47. Which of the following expresisons give the effect of temperature on the rate constant?

A. $InA = RTInE_a - InK$

B. $\ln k = \ln A - E_a / RT$

C. $k = AE_a / RT$

D. None of these

Answer: B

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48. The plot og $\log k$ vs $1/T$ helps to calculate

A. The energy of activation

B. The rate constant of the reaction

C. The order of the reaction

D. The energy of activations as well as the frequency factor

Answer: D

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49. For a first order reaction $t_{0.75}$ is $1386s$. Therefore, the specific rate constant is

A. $10^{-1}s^{-1}$

B. $10^{-3}s^{-1}$

C. $10^{-2}s^{-1}$

D. $10^{-4}s^{-1}$

Answer: B

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50. In a first order reaction, the concentration of the reactant decreases form $0.8M$ to $0.4M$ in 15 min. The time taken for the concentration to change form $0.1M$ to $0.025M$ is

A. 60 min

B. 15 min

C. 7.5 min

D. 30 min

Answer: D

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51. The rate equation for the reaction $2A+B \to C$ is found to be: $rate = k[A][B]$. The correct statement in relation of this reaction is that

A. The value of k is indepedennt of the initial concentration of A and B

.

B. $t_{1/2}$ is a constant.

C. The rate of formation of C is twice the rate of disappearnce of A.

D. The unit of k must be s^{-1}

Answer: A

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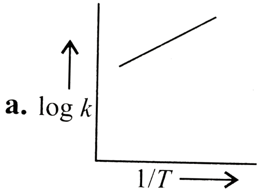
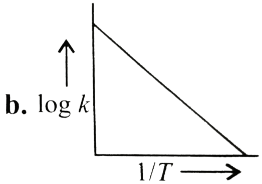
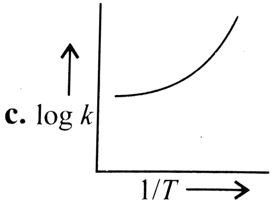
52. A graph plotted between $\log k$ versus $1/T$ for calculating activation energy is shown by



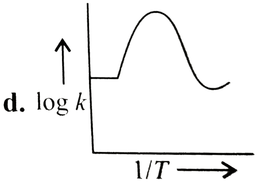
A.



B.



C.



D.

Answer: B

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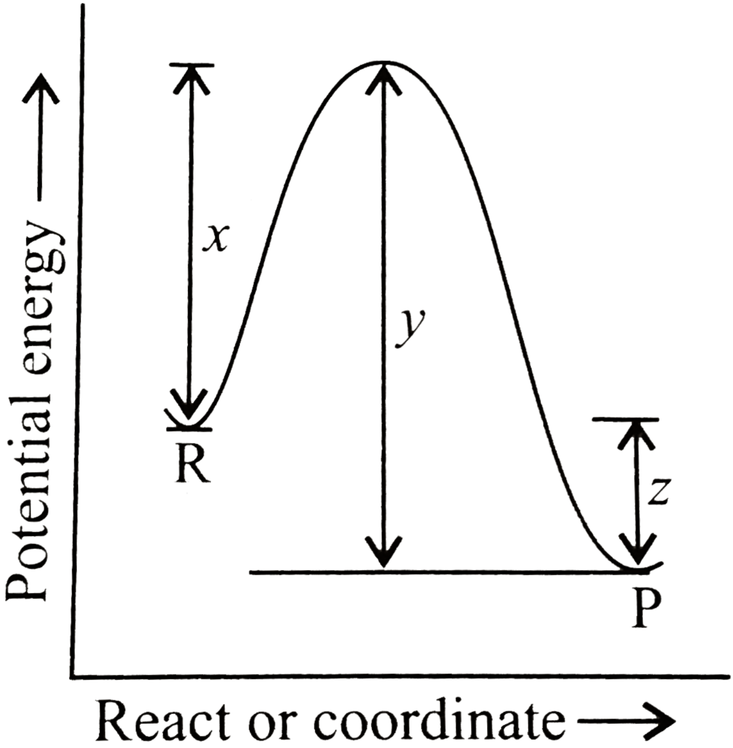
53. The potential energy diagram for a reaction $R \rightarrow P$ is given below. $\Delta H^{\ominus}$ of the reaction corresponds to the energy



A. x

B. y

C. z

D. $(x+y)$

Answer: C

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54. The activation energy for a ismple chemical reaction $A \rightarrow B$ is E_a in the forward reaction: The activation of the reverse reaction

A. Is negative of E_a

B. Is always less than E_a

C. Can be less than or more than E_a

D. Is always double of E_a

Answer: C

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55. The reaction $A \rightarrow B$ follows first order kinetics. The time taken for $0.8 mol$ of A to profuce $0.6 mol$ of B is $1 hr$. What is the time taken for the conversion of $9.0 mol$ of A to Product $0.675 mol$ of B ?

A. $1 hr$

B. $0.5 hr$

C. $0.25 hr$

D. $2 hr$

Answer: A

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56. The quantum yield of photosynthesis of

A. $HCl > HBr$

B. $HCl < HBr$

C. $HCl = HBr$

D. None of these

Answer: A

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57. When the rate determined by the change in concentration of two different reactants, then the kinetic equation may be expressed as

A. $k_2 = \frac{2.303}{(a - b)t}\log.\frac{(a - x)b}{(b - x)a}$

B. $k_2 = \frac{2.303}{(a - b)t}\log.\frac{(a - x)}{(b + x)}$

C. $k_2 = \frac{2.303}{(a - b)t}\log.\frac{(a - x)}{(b - x)}$

D. $k_2 = \frac{1}{t} \times \frac{x}{(a - x)}$

Answer: A

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58. The slope of the line graph of $\log k$ versus $1/T$ for the reaction $N_2O_5 \rightarrow 2NO_2 + 1/2O_2$ is -5000.Calculate the energy of activation of the reaction (in $kJK^{-1}mol^{-1}$).

A. 95.7

B. 9.57

C. 957

D. None

Answer: A

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59. The inverison of a sugar follows first order rate equation which can be followed by noting the change in the rotation of the plane of polarization of light in the polarimeter. If r_{∞}, r_f and r_0 are the rotations at $t = \infty, t = t$, and $t = 0$, then the first order reaction can be written as

A. $k = \frac{1}{t}\log.\frac{r_1 - r_{\infty}}{r_o - r_{\infty}}$

B. $k = \frac{1}{t}\ln.\frac{r_0 - r_{\infty}}{r_t - r_o}$

C. $k = \frac{1}{t}\ln.\frac{r_{\infty} - r_o}{r_{\infty} - r_t}$

D. $k = \frac{1}{t}\ln.\frac{r_{\infty} - r_t}{r_{\infty} - r_0}$

Answer: B

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60. For a certain decompoistion, the rate is $0.30Ms^{-1}$ when the concentration of the reactant is $0.20M$. If the reaction is order, the rate (in Ms^{-1}) when concentration is increased theee times is

A. 0.30

B. 0.90

C. 0.60

D. 2.70

Answer: D

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61. For a second order reaction $dx/dt = k(a - x)^2$. Its half life periof is

A. $\frac{1}{a.k}$

B. $\frac{0.693}{k}$

C. $\frac{a}{k}$

D. $\frac{0.693}{ak}$

Answer: A

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62. The activation energy of reactant molecules in a reaction depends upon

A. Temperature

B. Nature of the reactants

C. Colliison per unit time

D. Concentration of reactants

Answer: B

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63. The dissociation of nitrogen pentaoxide is a first order reaction. In first 24 min , 75% of nitrogen pentaoxide is dissociated. What amount of nitrogen pentaoxide will be left behind after one hour of the start of reaction?

A. Approximately 1%

B. Approximately 2%

C. Approximately 3%

D. None

Answer: C

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64. In a certain reaction, 10% of the reactant decomposes in one hour, 20% in two hours, 30% in theee hours, and so on. The dimenison of the velocity constant (rate constant) are

A. hr^{-1}

B. $MolL^{-1}hr^{-1}$

C. $Lmol^{-1}s^{-1}$

D. $Mols^{-1}$

Answer: B

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65. The decompoistion of H_2O_2 can be followed by titration with $KMnO_4$ and is found to be a first order reaction. The rate constant is 4.5×10^{-2}. In an experiment, the initial titre value as $25mL$. The titre value will be $5mL$ after a lapse of

A. $4.5 \times 10^{-2} \times 5 \text{ min}$

B. $\dfrac{\log_e 5}{4.5 \times 10^{-2}} \text{ min}$

C. $\dfrac{\log_e 5/4}{4.5 \times 10^{-2}} \text{ min}$

D. None of these

Answer: B

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66. The half life of decompoistion of N_2O_5 is a first order reaction represented by $N_2O_5 \rightarrow N_2O_4 + 1/2O_2$

After 15min the volume of O_2 profuced is $9ml$ and at the end of the reaction $35ml$. The rate constant is equal to

A. $\dfrac{1}{15}\log_e . \dfrac{35}{26}$

B. $\dfrac{1}{15}\log_e . \dfrac{44}{26}$

C. $\dfrac{1}{15}\log_e . \dfrac{35}{36}$

D. None of these

Answer: A

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67. The rate constant of a reactant is 1.5×10^{-3} at $25\,^{\circ}C$ and 2.1×10^{-2} at $60\,^{\circ}C$. The activation energy is

A. $\frac{35}{333}R\log_e.\frac{2.1 \times 10^{-2}}{1.5 \times 10^{-2}}$

B. $\frac{298 \times 333}{35}R\log_e.\frac{21}{1.5}$

C. $\frac{298 \times 333}{35}R\log_e 2.1$

D. $\frac{298 \times 333}{35}R\log_e.\frac{2.1}{1.5}$

Answer: B

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68. In the reaction $A + B \rightarrow C + D$, the concentration of A and B are equal and the rate of the reaction is rate $= k[A][B]$. The integrated rate equation for this reaction is

A. $k = \frac{x}{t(a - x)}$

B. $k = \frac{xa}{(a - x)}$

C. $k = \frac{1}{t}.\frac{x}{a(a - x)}$

D. $k = \frac{1}{t}.\frac{x}{a(x - a)}$

Answer: C

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69. If a graph is plotted between $\log(a - x)$ and t, the slope of the straight line is equal to -0.03. The specific reaction rate will be

A. 6.9×10^{-2}

B. 6.9

C. 0.69

D. 6.9×10^{-4}

Answer: A

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70. In the Wilhelmey equation of a first order reaction $c_t = c_0 e^{-kt}$. If the initial concentration c_0 is increased m times, then

A. The value of k will increase m times

B. The value of k will decrease m times

C. The value of k will remain unchanged

D. None of these

Answer: C

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71. The mechanism of the reaction

$2NO + O_2 \rightarrow 2NO_2$ is

$$NO + NO \overset{k_1}{\Leftrightarrow} k_{-1}N_2O_2(\text{fast})$$

$$N_2O_2 + O_2 \overset{k_2}{\rightarrow} 2NO_2(slow)$$

The rate constant of the reaction is

A. k_2

B. $k_2k_1\left(k_{-1}\right)$

C. k_2k_1

D. $k_2\left(\frac{k_1}{k_{-1}}\right)$

Answer: D

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72. True statement is

A. poistive catalyst increases the rate of reaction.

B. During the course of the reaction, specific reaction rate remains constant.

C. Rate constant always increases with rise in temperature whether the reaction is endothermic or exothermic.

D. All are correct.

Answer: D

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73. In a second order reaction, 20% of a substance is dissociated in 40 min. The time taken by 80% of its dissociation is

A. 160 min

B. 640 min

C. 200 min

D. 320 min

Answer: B

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74. $t_{1/2} =$ constant confirms the first order of the reaction as one $a^2 t_{1/2} =$ constant confirms that the reaction is of

A. Zero order

B. First order

C. Second order

D. Third order

Answer: D

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75. Collision theory is applicable to

A. First order reactions

B. Zero order reactions

C. Bimolecular reactions

D. Intermolecular reactions

Answer: C

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76. The wrong statement is

A. All the colliisons between reactant molecules do not lead to a chemical change.

B. A zero order reaction proceeds at a constant rate independent of concentration or time.

C. Fast reactions have low activation energies.

D. In a first order reaction, the reaction ideally takes finite time to be complete.

Answer: D

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77. Which of the following will react at the highest rate ?

A. $1mol$ of A and $1molB$ in a $1 - L$ vessel

B. $2mol$ of A and $2molB$ in a $2 - L$ vessel

C. $3mol$ of A and $3molB$ in a $3 - L$ vessel

D. All would react at the same rate

Answer: D

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78. For a reaction, the rate constant is expressed as $k = Ae^{-40000/T}$. The energy of the activation is

A. $40000cal$

B. $88000cal$

C. $80000cal$

D. $8000cal$

Answer: C

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79. A reaction takes place in theee steps: the rate constant are $k_1, k_2,$ and k_3. The overall rate constant $k = \frac{k_1 k_3}{k_2}$. If $E_1, E_2,$ and E_3 (energy of activation) are $60, 30$ and $10kJ$, respectively, the overall energy of activation is

A. 40

B. 30

C. 400

D. 60

Answer: A

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80. A reaction rate constant is given by

$k = 1.2 \times 10^{14} e^{\frac{-2500}{RT}} s^{-1}$. It means

A. $\log k$ versus $\log T$ will give a straight line with a slope as 25000.

B. $\log k$ versus $\log T$ will give a straight line with a slope as -25000.

C. $\log k$ versus T will give a straight line with a slope as -25000.

D. $\log k$ versus $1/T$ will give a straight line.

Answer: D

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81. For the reaction $2NO(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$, at $900K$ following data are observed.

Initial pressure of NO (atm)	Initial pressure of$H_2o(atm)$	Initial rate of pressure d
0.150	0.40	0.020
0.075	0.40	0.005
0.150	0.20	0.010

Find the order of reaction.

A. 3

B. 2

C. 1

D. 0

Answer: A

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82. An exothermic reaction $A \rightarrow B$ has an activation energy of $17kJ$ per mole of A. The heat of the reaction is $40kJ$. Calculate the activation energy for the reverse reaction $B \rightarrow A$.

A. $60kJ$

B. $57kJ$

C. $75kJ$

D. $90kJ$

Answer: B

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83. $k_{34^{\circ}}, k_{35^{\circ}} < 1$, then

A. Rate increase with the rise in temperature

B. Rate decreases with rise in temperature

C. Rate does not change with rise in temperature

D. None of these

Answer: A

Watch Video Solution

84. The compoistion of N_2O_5 is a first order reaction represented by: $N_2O_5 \rightarrow N_2O_4 + 1/2O_2$.

After 20 min the volume of O_2 profuced is $10mL$ and at the end of the reaction $40mL$. The rate constant is equal to

A. $\frac{1}{20} \ln. \frac{30}{50}$

B. $\frac{1}{20} \ln. \frac{50}{30}$

C. $\frac{1}{20} \ln. \frac{50}{40}$

D. $\frac{1}{20} \ln. \frac{40}{30}$

Answer: D

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85. A catalyst only

A. Decrease activation energy

B. Increases activation energy

C. Both (a) and (b)

D. comes to equilibrium

Answer: C

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86. The free energy change the due to a reaction is zero when

A. The reactants are initially mixed

B. A catalyst is added

C. The system is at equilibrium

D. The reactants are completely consumed

Answer: C

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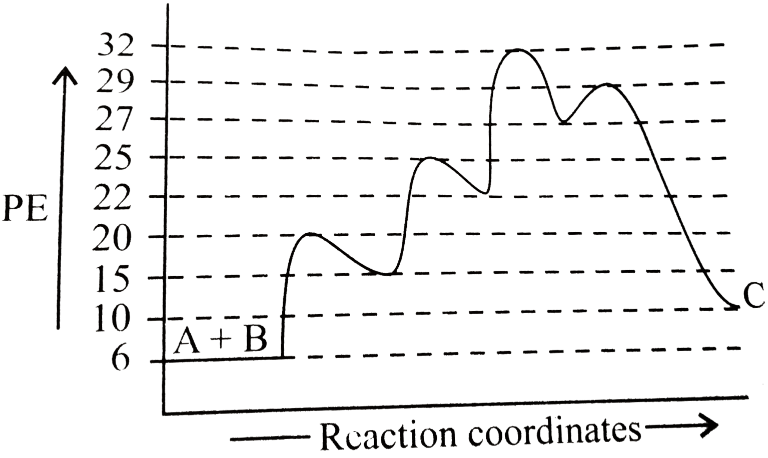
87. What is ΔH for the reaction $A + B \rightarrow C$ where the mechanism involves several kinetics steps.



A. 11kcal mol^{-1}

B. 4kcal mol^{-1}

C. 5kcal mol^{-1}

D. 22kcal mol^{-1}

Answer: B

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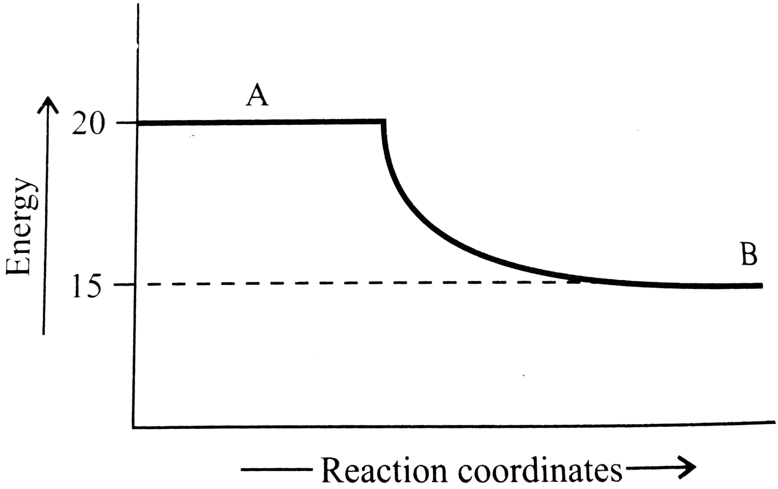
88. What can you say about the existence of A if the potential energy diagram for the reaction

$A \rightarrow B$ looks line



A. A will exist

B. A will not exist

C. B will not exist

D. A and B are in equilibrium

Answer: B

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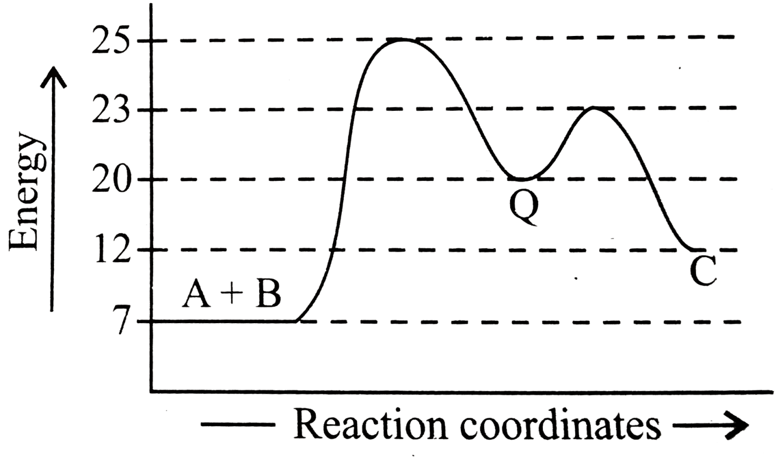
89. In a multistep reaction such as $A + B \rightarrow Q \rightarrow C$. The potential energy diagram is shown below. What is E_a for the reaction $Q \rightarrow C$?



A. $3kcalmol^{-1}$

B. $5kcalmol^{-1}$

C. $8kcalmol^{-1}$

D. $11kcalmol^{-1}$

Answer: A

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90. In which statement is true ?

A. Reaction $A + B \rightarrow Q$ is faster.

B. Reaction $Q \rightarrow C$ is faster.

C. Reaction in (a) and (b) are equal.

D. Unpredictable.

Answer: B

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91. Given the following two mechanisms, one with catalyst and the other without catalyst.

(i) $A + B \rightarrow C$ (slow)

(ii) $C + B \rightarrow F + A$ (fast)

(iii) $B + B \rightarrow F$ (slow)

Which mechanism use the catalyst and what is it ?

A. Step (i), A

B. Step (ii), B

C. Step (iii), F

D. Steps (i) and (ii), C

Answer: A

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92. The mechanism for the overall reaction is

$A_2 + B \rightarrow C$

$A_2 \rightarrow 2A$ (slow)

$2A + B \rightarrow X$ (fast)

If a catalyst D changes the mechanism to

$A_2 + D \rightarrow A_2D$ (slow)

$A_2D \Rightarrow 2A + D$ (fast)

$2A + B \rightarrow C$ (fast)

Which is the rate expresison for the reaction with and without a catalyst ?

A. $r = k' \left[A_2\right][D], r = k\left[A_2\right]$

B. $r = k\left[A_2\right], r = k' \left[A_2\right][D]$

C. $r = k' \left[A_2D\right], r = k\left[A_2\right][B]$

D. $r = k\left[A_2\right][B], r = k' \left[A_2D\right]$

Answer: A

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93. Which of the following statement is correct

A. For reaction $xX \rightarrow yY$

Rate $= \dfrac{1dx}{xdt} = \dfrac{dy}{dt}$

B. The parameter, rate constant, and specific reaction rate have different meaning.

C. For any reaction the value of specific reaction rate is independent of the initial concentration of reactants.

D. $E_a = E_R + E_{\text{threshold}}$

Answer: C

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94. For a chemical reaction $2X + Y \rightarrow Z$, the rate of appearance of Z is $0.05 molL^{-1}\min^{-1}$. The rate of diappearance of X will be

A. $0.05 molL^{-1}hr^{-1}$

B. $0.05 molL^{-1}\min^{-1}$

C. $0.1 molL^{-1}\min^{-1}$

D. $0.25 molL^{-1}\min^{-1}$

Answer: C

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95. A chemical reaction occurs as a result of colliisons between reacting molecules. Therefore, the reaction rate is given by

A. Total number of colliisons occurring in a unit volume per second.

B. Fraction of molecules which posses energy less than the threshold energy.

C. Total number of effective colliisons.

D. None of these

Answer: C

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96. For profucing effective colliisons, the colliding molecules must have

A. A certain minimum amount of energy

B. Energy equal to or greater than threshold

C. Proper orientation

D. threshold energy and proper orientation both

Answer: D

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97. A following mechanism has been proposed for a reaction:

$2A + B \rightarrow D + E$

$A + B \rightarrow C + D$ (slow)

$A + C \rightarrow E$ (fast)

The rate law expresison for the reaction is

A. $r = k[A]^2[B]$

B. $r = k[A][B]$

C. $r = k[A]^2$

D. $r = k[A][C]$

Answer: B

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98. For a chemical reaction $A \rightarrow B$, it is found that the rate of reaction doubles when the concentration of A is increased 4 times. What is the order of reaction ? Suggest the rate law also.

A. 4

B. 0

C. $1/2$

D. 1

Answer: C

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99. For a hypothetical reaction: $A+B \rightarrow$ Products, the rate law is $r=k[A][B]^{0}$. The order of reaction is

A. 0

B. 1

C. 2

D. 3

Answer: B

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100. A hypothetical reaction $A_2 + B_2 \rightarrow 2AB$ follows the mechanism as given below:

$A_2 \Leftrightarrow A + A(\text{fast})$

$A + B_2 \rightarrow AB + B$ (slow)

$A + B \rightarrow AB$ (fast)

The order of the overall reaction is

A. 2

B. 1

C. 1.5

D. 0

Answer: C

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101. The slowest step of a particular reaction is found to be $1/2X_2 + Y_2 \rightarrow XY_2$. The order of the reaction is

A. 2

B. 3

C. 3.5

D. 1.5

Answer: D

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102. For hypothetical chemical reaction $A \rightarrow I$, it is found that the reaction is third order in A. What happens to the rate of reaction when the concentration of A is doubled?

A. Rate increases by a factor of 2.

B. Rate decreases by a factor of 3.

C. Rate increases by a factor of 8

D. Rate remains unaffected.

Answer: C

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103. Calculate the overall order of a reaction which has the rate expresison.

(a) Rate $= k[A]^{\frac{1}{2}}[B]^{\frac{3}{2}}$, (b) Rate $= k[A]^{\frac{3}{2}}[B]^{-1}$

A. $3/2$

B. $1/2$

C. Zero

D. None of these

Answer: B

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104. The rate of reaction increases by the increase of temperature because

A. colliison frequency is increased.

B. Energy Products decreases.

C. Fraction of molecules possesisng energy $\geq E_T$ (threshold energy) increases.

D. Meachanism of a reaction is changed.

Answer: C

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105. Which of the following explains the increase of the reaction rate by catalyst?

A. Catalyst decreases the rate of backward reaction so that the rate of forward reaction increases.

B. Catalyst provides extra energy to reacting molecules so that they may profuce effective colliisons.

C. Catalyst provides an alternatively path of lower activation energy to the reactants

D. Catalyst increases the number of colliisons between the reacting molecules.

Answer: C

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106. Burning of coal is represented as $C(s) + O_2(g) \rightarrow CO_2(g)$. The rate of this reaction is increased by

A. Decrease in the concentration of oxygen

B. Powdering the jump of coal

C. Decreaisng the temperature of coal

D. Providing inert atmosphere

Answer: B

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107. For the reaction: $2HI \rightarrow H_2 + I_2$, the expresison $-d(HI)/2dt$ represents

A. The rate of formation of HI

B. The rate of disappearance of HI

C. The instantaneous rate of the reaction

D. The average rate of reaction

Answer: C

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108. For which of the following reactions, the units of rate constant and rate of reaction are same?

A. First order reaction

B. Second order reaction

C. Third order reaction

D. Zero order reaction

Answer: D

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109. For which of the following represents the expresison for theee/fourth life reaction?

A. $\frac{k}{2.303}\log 4/3$

B. $\frac{2.303}{k}\log 3/4$

C. $\frac{2.303}{k}\log 4$

D. $\frac{2.303}{k}\log 3$

Answer: C

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110. Which of the following expresison is correct for first order reaction (c_0 refers to initial concentration of reactant)

A. $t_{1/2} \propto c_0$

B. $t_{1/2} \propto c_0^{-1}$

C. $t_{1/2} \propto c_0^{-2}$

D. $t_{1/2} \propto c_0^0$

Answer: D

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111. The term -dx/dt in the rate expresison refers to the

A. The concentration of the reactants

B. Increase in the concentration of the reactants

C. The instantaneous rate of the reaction

D. The average rate of the reaction

Answer: C

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112. If a reaction involves gaseous reactants and Products, the units of its rate are

A. atm

B. atm-s

C. atm-s^{-1}

D. atm^2s^2

Answer: C

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113. Which of the following expresison can be used to describe the instantaneous rate of the reaction ?

$2A + B \rightarrow A_2B$

A. $-\frac{dA}{2dt}$

B. $-\frac{dA}{dt}$

C. $\frac{d\left(A_2B\right)}{2dt}$

D. - $\frac{1}{2}\frac{dA}{dt}\frac{dB}{dt}$

Answer: A

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114. For a single step reaction $X + 2Y \rightarrow$ Products, the molecularity is

A. Zero

B. 2

C. 3

D. 1

Answer: C

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115. In a first order reaction, the concentration of the reactants is reduced to 25% in one hour. The half-life periof of the reactions is

A. $2hr$

B. $4hr$

C. $1/2hr$

D. $1/4hr$

Answer: C

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116. The rate of a certain reaction increases by 2.3 times when the temperature is raised form $300K$ to $310K$. If k is the rate constant at $300K$, then the rate constant at $310K$ will be equal to

A. $2k$

B. k

C. $2.3k$

D. $3k^2$

Answer: C

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117. For a hypothetical reaction $A \rightarrow B$, the rate constain is $0.25s^{-1}$. If the concentration of A is reduced to half, then the value of rate constant is

A. $0.25s^{-1}$

B. $0.30s^{-1}$

C. $0.075s^{-1}$

D. $2.25s^{-1}$

Answer: A

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118. A reaction $A_2 + B_2 \rightarrow 2AB$ occurs by the following mechanism:

$A \rightarrow A + A$... (slow)

$A + B_2 \rightarrow AB + B$... (fast)

$A + B \rightarrow AB$ ... (fast)

Its order would be

A. $3/2$

B. 1

C. Zero

D. 2

Answer: B

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119. In acidic medium, the rate of reaction between $BrO_3^{\ominus}$ and $Br^{\ominus}$ is given by the expression

$$\frac{-d\left[BrO_3^{\ominus}\right]}{dt} = k\left[BrO_3^{\ominus}\right]\left[Br^{\ominus}\right]\left[H^{\oplus}\right]^2$$

A. The rate constant of overall reaction is $4s^{-1}$.

B. The rate of reaction is independent of the concentration of acid.

C. The change in pH of the solution will no affect the rate.

D. Doubling the concentration of $H^{\oplus}$ ions will increase the reaction rate by 4 times.

Answer: D

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120. For the reaction:

$$\left[Cr\left(H_2O\right)_6\right]^3 + \left[SCN^{\ominus}\right] \rightarrow \left[Cr\left(H_2O\right)_5NCS\right]^{2+}H_2O$$

The rate law is $r = k\left[Cr\left(H_2O\right)_6\right]^{3+}\left[SCN^{\ominus}\right]$.

The value of k is $2.0 \times 10^{-6}Lmol^{-1}s^{-1}$ at $14\,^{\circ}C$ and $2.2 \times 10^{-5}Lmol^{-1}s^{-1}$ at $30\,^{\circ}C$. What is the value of E_a ?

A. 26kcal mol^{-1}

B. 2.6kcal mol^{-1}

C. 2600kcal mol^{-1}

D. 260kcal mol^{-1}

Answer: A

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121. It is generalized that a $10^{\circ}C$ increases in temperature casues the rate of reaction to double. Applied to a reaction at $295K$, what is the value of E_a?

A. 120kcal mol^{-1}

B. 1200kcal mol^{-1}

C. 1.2kcal mol^{-1}

D. 12kcal mol^{-1}

Answer: D

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122. For the chemical reaction:

$5Br^{\ominus} + BrO_3^{\ominus} + 6H^{\oplus} \rightarrow 3Br_2 + 3H_2O$

Rate $= k\left[Br^{\ominus}\right]\left[BrO_3^{\ominus}\right]\left[H^{\oplus}\right]$

What is the molecularity and order of reaction with respect to $\left[Br^{\ominus}\right]$?

A. 5, 1

B. 1, 5

C. 1, 1

D. 6, 2

Answer: A

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123. For the chemical reaction

$I^{\ominus} + OCl^{\ominus} \rightarrow Cl^{\ominus} + OI^{\ominus}$

Rate $= \frac{k\left[OCl^{\ominus}\right]\left[I^{\ominus}\right]}{\left[\overset{\ominus}{OH}\right]}$

a. What is the order and moleculartiy of the reaction ?

b. In the above reaction, what are the molecularity and order with respect

to

A. $1, 2$

B. $2, 1$

C. $2, 2$

D. $3, 2$

Answer: A

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124. In the molecularity and order with respect to $\left[\overset{\ominus}{OH}\right]$ is

A. $0, 1$

B. $0, \ -1$

C. $1, 0$

D. $-1, 0$

Answer: B

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125. The activation energy for the forward reaction $X \to Y$ is $60kJmol^{-1}$ and ΔH is $-20kJmol^{-1}$. The activation energy for the reverse reaction is

A. $40kJmol^{-1}$

B. $60kJmol^{-1}$

C. $80kJmol^{-1}$

D. $20kJmol^{-1}$

Answer: C

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126. For a reaction $pA + qB \rightarrow$ Product, the rate law expresison is $r = k[A][B]^m$. Then

A. $(p + q) = (1 + m)$

B. $(p + q) > (1 + m)$

C. $(p + q)$ may or may not b equal to $(1 + m)$

D. $(p + q) = (1 + m)$

Answer: C

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127. The chemical reaction $2O_3 \xrightarrow{k_1} 3O_2$ proceeds as follows:

$O_3 \overset{k_{eq}}{\Leftrightarrow} O_2 + O$ (fast)

$O + O_3 \xrightarrow{k} 2O_2$ (slow)

What should be the rate law expresison ?

A. $r = k\left[O_3\right]^2$

B. $r = k\left[O_3\right]^2\left[O_2\right]^{-1}$

C. $r = k\left[O_3\right]\left[O_2\right]$

D. Unpredictable

Answer: B

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128. A gaseous reaction $A_2(g) \rightarrow B(g) + \frac{1}{2}C(g)$ shows increase in pressure form $100mm$ to $120mm$ in 5 min . What is the rate of disappearance of A_2 ?

A. $4mm \text{ min}^{-1}$

B. $8mm \text{ min}^{-1}$

C. $16mm \text{ min}^{-1}$

D. $2mm \text{ min}^{-1}$

Answer: B

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129. What specific name can be given to the following sequence of steps:

$$Hg + hv \rightarrow Hg^*$$

$$Hg^* + H_2 \rightarrow H_2^* + Hg$$

A. Fluorescence

B. Phosphoresecence

C. Photosenistization

D. Chemiluminescence

Answer: C

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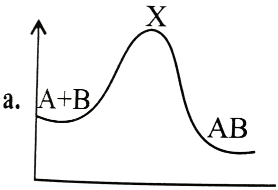
130. For an exothermic chemical process ocuuring in two process occuring in two steps as follows

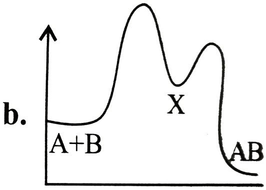
$(i) A + B \rightarrow X(\text{slow}) \quad (ii) X \rightarrow AB(\text{fast})$

The progress of reaction can be best described by :

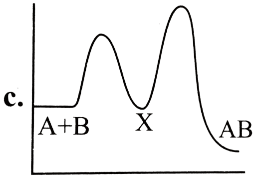
A.



B.



C.



D. All are correct

Answer: A

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131. In a hypothetical reaction $2X + Y \rightarrow M + N$. If the concentration of Y is kept constant but that of X is tripled, the rate of reaction then will be

A. Increased by 3 times

B. Increased by 6 times

C. Increased by 9 times

D. Unpredictable

Answer: D

Watch Video Solution

132. For the reaction $A + B \rightarrow C + D$, doubling the concentration of both the reactants increases the reaction rate by 8 times and doubling the initial concentration of only B ismply doubles the reaction rate. What is the rate law for the reaction ?

A. $r = k[A][B]^2$

B. $r = k[A][B]$

C. $r = k[A]^{1/2}[B]$

D. $r = [A]^2[B]$

Answer: D

Watch Video Solution

133. In fire flies the flashes are profuced due to the slow combustion of a protein luciferin in air and moisture. The phenomenon is known as

A. Photochemical change

B. Photocombustion

C. Chemiluminescence

D. None of these

Answer: C

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134. The rate of certain hypothetical reaction

$A + B + C \rightarrow$ Products, is given by

$$r = -\frac{dA}{dt} = k[A]^{1/2}[B]^{1/3}[C]^{1/4}$$

The order of a reaction is given by

A. 1

B. $1/2$

C. 2

D. $13/12$

Answer: D

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135. In the formation of sulphur trioxide by the contact process,

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

The rate of reaction is expressed as

$$-\frac{d(O_2)}{dt} = 2.5 \times 10^{-4} molL^{-1}s^{-1}$$

The rate of disappearance of (SO_2) will be

A. $5.0 \times 10^{-4} molL^{-1}s^{-1}$

B. $-2.25 \times 10^{-4} molL^{-1}s^{-1}$

C. $3.75 \times 10^{-4} molL^{-1}s^{-1}$

D. $50.0 \times 10^{-4} molL^{-1}s^{-1}$

Answer: A

Watch Video Solution

136. Conisder a gaseous reaction, the rate of which is given by $k[A][B]$. The volume of the reaction vessel containing these gases is suddenly reduced to $1/4th$ of the initial volume. The rate of the reaction as compared with original rate is

A. $1/16$ times

B. 16 times

C. $1/8$ times

D. 8 times

Answer: B

Watch Video Solution

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137. In a catalyst experiment involving the Haber process $N_2 + 3H_2 \rightarrow 2NH_3$, the rate of reaction was measured as

Rate $= \dfrac{\Delta[NH_3]}{\Delta t} = 2.0 \times 10^{-4} molL^{-1}s^{-1}$

What is the rate of reaction expressed in terms of (a) N_2 (b) H_2 ?

A. $2.50 \times 10^{-4} molL^{-1}s^{-1}$

B. $1.25 \times 10^{-4} molL^{-1}s^{-1}$

C. $3.75 \times 10^{-4} molL^{-1}s^{-1}$

D. $5.00 \times 10^{-4} molL^{-1}s^{-1}$

Answer: C

Watch Video Solution

138. When ethyl acetate was hydrolyzed in the presence of $0.1 M HCl$, the constant was found to be $5.40 \times 10^{-5} s^{-1}$. But when $0.1 M H_2SO_4$ was used for hydrolyiss, the rate constant found to be $6.20 \times 10^{-5} s^{-1}$. form these we can say that

A. H_2SO_4 is stronger than HCl

B. H_2SO_4 and HCl are both of the same stength of HCl

C. H_2SO_4 is weaker than HCl.

D. The data is insufficient to compare the strength of HCl and H_2SO_4.

Answer: A

Watch Video Solution

139. The activation energy for a hypothetical reaction $A \rightarrow X$ is $12.49kcalmol^{-1}$. If temperature is raised to 305 form $295K$, the reaction rate increased by $0.002kcalL^{-1}mol^{-1}$ is almost equal to

A. $60\ \%$

B. $50\ \%$

C. $100\ \%$

D. Unpredictable

Answer: C

Watch Video Solution

140. How will the rate of reaction

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ change if the volume of the reaction vessel is halved?

A. (a) It will br $1/16th$ of its initial value.

B. (b) it will be $1/4th$ of its initial value.

C. It will be 8 times of its initial value.

D. It will be 4 times of its initial value.

Answer: C

Watch Video Solution

141. The half life period for catalytic decomposition of AB_3 at 50 mm is found to be 4 hrs and at 100 mm it in 2 hrs. The order of reaction is :

A. 3

B. 1

C. 2

D. 0

Answer: C

Watch Video Solution

142. The hydrolyiss of an ester was carried out with $0.1MH_2SO_4$ and $0.1MHCl$ separately. Which of the following expresison between the rate constants is expected ? The rate expresison being rate $= k\left[H^{\oplus}\right][\text{ester}]$

A. $k_{HCl} = k_{H_2SO_4}$

B. $k_{HCl} > k_{H_2SO_4}$

C. $k_{HCl} < k_{H_2SO_4}$

D. $k_{H_2SO_4} = 2k_{HCl}$

Answer: B

Watch Video Solution

143. For a zero order reaction, the plot of concentration of a reactant vs time is (intercept refers to concentration axis)

A. $+ve$ slope and zero intercept

B. $-ve$ slope and zero intercept

C. $+ve$ slope and non-zero intercept

D. $-ve$ slope and non-zero intercept

Answer: A

Watch Video Solution

144. In a certain gaseous reaction between A and B, $A+3B \rightarrow AB_3$. The initial rate are reported as follows:

$[A]$	$[B]$	$Rate$
$0.1M$	$0.1M$	$0.002Ms^{-1}$
$0.2M$	$0.1M$	$0.002Ms^{-1}$
$0.3M$	$0.2M$	$0.008Ms^{-1}$
$0.4M$	$0.3M$	$0.018Ms^{-1}$

The rate law is

A. $r=k[A][B]^3$

B. $r=k[A]^0[B]^2$

C. $r=k[A][B]$

D. $r = k[A]^0[B]^3$

Answer: B

Watch Video Solution

145. In the presence of acid, the initial concentration of cane sugar was reduced from 0.2 M to 0.1 M in 5 h and to 0.05 M in 10 h. The reaction must be of

A. Zero order

B. First order

C. Second order

D. Fractional order

Answer: B

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146. For an elementary reaction , $X(g) \rightarrow Y(g) + Z(g)$

the half life period is 10 min. In what period of time would the concentration of X be reduced to 10% of original concentration?

A. 20 min

B. 33 min

C. 15 min

D. 25 min

Answer: B

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147. If a is the initial concentration of reaction, then the half-life periof of a certain of nth order is

A. a^n

B. a^{n-1}

C. a^{1-n}

D. a^{n+1}

Answer: C

Watch Video Solution

148. The rate constant of forward and backward reactions for certain hypothetical reaction are 1.1×10^{-2} and 1.5×10^{-3}, respectively. The equilibrium constant of the reaction is

A. 7.33

B. 0.733

C. 73.3

D. 733

Answer: A

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149. The activation energy for most of the reaction is approximately $50kJmol^{-1}$. The rate for temperature coefficient for such reaction will be

A. ≈ 2

B. ≈ 3

C. < 1

D. > 4

Answer: A

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150. Which of the following theory is not related to the chemical kinetics?

A. Colliisons theory

B. Absolutely theory

C. Absolute reaction rate

D. VSEPR theory

Answer: D

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151. When the concentration of a reactant in reaction $A \rightarrow B$ is increased by 8 times but rate increases only 2 times, the order of the reaction would be

A. 2

B. $1/3$

C. 4

D. $1/2$

Answer: B

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152. Phosphrous undergoes slow combustion and glows in dark. The precess is called

A. Photochemical change

B. Chemiluminescence

C. Flourescene

D. Phosphorescene

Answer: D

Watch Video Solution

153. The rate law for the reaction

$RCl + NaOH(aq) \rightarrow ROH + NaCl$ is given by

Rate $= k[RCl]$. The rate of the reaction will be

A. Doubled on doubling the concentration of sofium hydroxide.

B. Halved on reducing the concentration of alkyl halide to one half.

C. Decrease on increaisng the temperature of the reaction.

D. Unaffected by increaisng the temperature of the reaction.

Answer: B

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154. The rate of reaction between A and B increases by a factor of 100, when the concentration with respect to A is increased 10 folds, the order of reaction w.r.t. A is

A. 10

B. 1

C. 4

D. 2

Answer: D

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155. The efficiently of an enzyme in catalyzing a reaction is due to its capacity

A. To form a strong enzyme-substrate complex.

B. To decrease the bond energy of all substrate molecules.

C. To change the shape of the substrate molecule.

D. To lower the activation energy of the reaction.

Answer: D

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156. When $KClO_3$ is heated, it decomposes into KCl and O_2. If some MnO_2 is added, the reaction goes much faster because

A. MnO_2 decomposes to give O_2.

B. MnO_2 provides heat by reacting.

C. Better contact is provided by MnO_2.

D. MnO_2 acts as a catatlyst.

Answer: D

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157. For a chemical reaction $A \rightarrow B$, it is found that the rate of reaction doubles when the concentration of A is increased 4 times. What is the order of reaction ? Suggest the rate law also.

A. 2

B. 1

C. $1/2$

D. Zero

Answer: C

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158. The reaction $2N_2O_5(g) \rightarrow 4NO_2(g)$ is first order w.r.t. N_2O_5. Which of the following graphs would yield a straight line?

A. $\log p_{N_2O_5}$ vs time with $-ve$ slope

B. $\left(p_{N_2O_5}\right)^{-1}$ vs time

C. $p_{N_2O_5}$ vs time

D. $\log p_{N_2O_5}$ vs time with $+ve$ slope

Answer: A

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159. The rate of chemical reaction

A. Increases as the reaction proceeds

B. Decreases with as the reaction proceeds

C. May increase or decrease during the reaction

D. Remains constant as the reaction proceeds

Answer: B

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160. The specific rate constant of a first order reaction depends on the

A. Concentration of the reactant

B. Concentration of the Product

C. Time

D. Temperature

Answer: D

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161. The specific rate constant of a first order reaction depends on the

A. Temperature

B. Mass

C. Weight

D. Time

Answer: A

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162. A catalyst only

A. Increases the free energy change in the reaction

B. Decreases the free energy change in the reaction

C. Does not increase or decrease the free energy change in the reaction

D. Can either increase or decrease the free energy change depending order rate what catalyst we use

Answer: C

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163. The second order rate constant is usually expressed as

A. $MolLs^{-1}$

B. $Mol^{-1}L^{-1}s^{-1}$

C. $MolL^{-1}s^{-1}$

D. $Mol^{-1}Ls^{-1}$

Answer: D

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164. Mark the correct statement in a reverisble reaction.

A. A catalyst catalyzes the forward reaction.

B. A catalyst catalyzes the backward reaction.

C. A catalyst influences a direct and a reverse reaction to the same extent.

D. A catalyst increases the rate of forward reaction and decreases the rate of backward reaction.

Answer: C

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165. Which of the following statement regarding catalyst is not true?

A. A catalyst remains unchanged in compoistion and quantity at the end of the reaction.

B. A catalyst can initiate a reaction.

C. A catalyst does not alter the equilibrium in a reverisble reaction.

D. Catalysts are sometimes very specific in respect of reaction.

Answer: B

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166. An example of autocatalytic reaction is

A. Decompoistion of nitroglycerine

B. Thermal decompoistion of $KClO_3$ and MnO_2 mixture

C. Breakdown of $.^{14}C_6$

D. Hydrogenation of vegetable oil uisng nickel catalysts

Answer: B

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167. A catalysts is used

A. Only for increaisng the velocity of a reaction

B. For altering the velocity of a reaction

C. Only for decreaisng the velocity of a reaction

D. All (a), (b), and (c) are correct

Answer: B

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168. The rate of reaction $A + B \rightarrow$ Product is given by the equation $r = k[A][B]$. If B is taken in large excess, the order of the reaction would be

A. $a. 2$

B. $b. 1$

C. $c. 0$

D. d. Unpredictable

Answer: B

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169. If the initial concentration of reactant in certain reaction is double, the half-life periof of the reaction doubles, the order of a reaction is

A. Zero

B. First

C. Second

D. Third

Answer: A

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170. In a first order reaction, 75% of the reactants disappeared in $1.386hr$. What is the rate constant ?

A. $3.6 \times 10^{-3} s^{-1}$

B. $2.7 \times 10^{-4} s^{-1}$

C. $72 \times 10^{-3} s^{-1}$

D. $1.8 \times 10^{-3} s^{-1}$

Answer: B

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171. A substance $''A''$ decomposes in solution following the first order kinetics. Flask I contains L of $1M$ solution of A and falsk II constains $100mL$ of $0.6M$ solution. After $8hr$, the concentration, of A in flask I becomes $0.25M$. What will be the time for concentration of A in flask II to become $0.3M$?

A. $0.4hr$

B. $2.4hr$

C. $4.0hr$

D. Unpredictable as rate constant is not given

Answer: C

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172. For a second order reaction $dx/dt = k(a - x)^2$. Its half life periof is

A. Proportional to the initial concentration of reactants

B. Independent of the initial concentration of reactants

C. Inversely proportional to the initial concentration of reactants

D. Inversely proportional to square of initial concentration of reactants

Answer: C

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173. The oxidation of oxalic acid by acidified $KMnO_4$ is an example of autocatalyiss. It is due to which of the following ?

A. SO_4^{2-}

B. MnO_4^{2-}

C. Mn^{2+}

D. $K^{\oplus}$

Answer: C

Watch Video Solution

174. Diazonium salt decomposes as

$C_6H_5N_2^{\oplus}Cl^{\ominus} \rightarrow C_6H_5Cl + N_2$

at $10^{\circ}C$, the evolution of N_2 becomes two first faster when the initial concentration of the salt is doubled. Thus, it is

A. A first order reaction

B. A second order reaction

C. Independent of the initial concentration of reactant

D. A zero order reaction.

Answer: A

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175. At $27^\circ C$ it was observed in the hydrogenation of a reaction, the pressure of $H_2(g)$ decreases form $10atm$ to $2atm$ in $10\min$. Calculate the rate of reaction in $M\min^{-1}$ (Given $R = 0.08LatmK^{-1}mol^{-1}$)

A. 0.02

B. 0.03

C. 0.04

D. 0.05

Answer: B

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176. A sample of $._{53}I^{131}$, as $I^{\ominus}$ ion, was administered to a patient in a carrier conissting $1.0mg$ of stable $I^{\ominus}$ ion. After 4.0 days, 60% of the initial radioactivity was detected in the thyroid gland of the patient. What mass of the stable $I^{\ominus}$ ion had migrated to the thyroid gland? (Given: $t_{1/2}$ of $I^{131} = 8$ days)

A. $0.65mg$

B. $0.75mg$

C. $0.85mg$

D. $0.95mg$

Answer: C

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177. The half-life for the viral inactivation if in the beginning 1.5% of the virus is inactivated per minute is (Given : The reaction is of first order)

A. 76 min

B. 66 min

C. 56 min

D. 46 min

Answer: D

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Exercises Assertion-Reasoning

1. Assertion (A): The rate of reaction sometimes does not depends on concentration.

Reason(R): The order of reaction can be negative.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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2. Assertion (A): The rate of reaction increases generally by 2 to 3 times for every $10^{\circ}C$ rise in temperature.

Reason (R): An increase intemperature increases the colliison frequency.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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3. Assertion (A): Hydrolyiss of ethyl acetate in the presence of acid is a reaction of first order whereas in the presence of alkali, it is a reaction of second order.

Reason (R): Acid acts as catalyst only whereas alkali act as one of the reactant.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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4. Assertion (A): Poistive catalyst lowers the activation energy of the reaction whereas the heat of reaction remains same.

Reason (R): The heat of reaction is equal to the difference between activation energies for forward and backward reactions.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

Watch Video Solution

5. Assertion (A) : The molecularity of the reaction

$H_2 + Br_2 \rightarrow 2HBr$ is 2.

Reason (R): The order of the reaction is $3/2$.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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6. Assertion (A): For the reaction

$RCl + NaOH(g) \rightarrow ROH + NaCl$, the rate of reaction is reduced to half on reducing the cocentration of RCl to half.

Reason (R): The rate of the reaction is represented by $k[RCl]$, i.e., it is a first order reaction.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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7. According to the tranistion state theory, for the formation of on activation complex, one of the vibrational degree of freedom is converted into the tranistion degree of freedom.

Reason (R): The energy of the activated complex is higher than the energy of the reactant molecules.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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8. Assertion (A) : The order of a reaction can be fractional but molecularity is never fractional.

Reason (R): The order of reaction does not depend upon the stoichiometric coefficients of a balanced equation.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

9. Assertion (A) : Both $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ and $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ have the same order of reaction.

Reason (R): Both reaction proceed by the same mechanism.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: D

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10. Assertion (A) : In the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, the rate of reaction is different in terms of N_2, H_2 and NH_3.

Reason (R): The rate of reaction is equal to the rate of disappearance of a reactant or rate of formation of a Product.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: D

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11. Assertion (A) : Poistive catalysts increase the rate of reaction.

Reason (R): Catalysts decrease the value of $\Delta G^{\ominus}$.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

Watch Video Solution

12. Assertion (A) : $k = Ae^{-E_a/RT}$, the Arrhenius equation represents the dependence of rate constant with temperature.

Reason (R): Plot of $\log. k$ against $1/T$ is linear and the activation energy can be calculated with this plot.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

13. Assertion (A) : If the activation energy of a reaction is zero, temperature will have no effect on the rate constant. Reason (R): Lower the activation energy, faster is the reaction.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

Watch Video Solution

14. Assertion (A) : An order with respect to any reactant or Product can be zero, poistive, negative, and fractional. Reason (R): Rate cannot decrease with increase in the concentration of a reactant or Product.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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15. Assertion (A) : Formation of HI is a bimolecular reaction.

Reason (R): Two molecules of reactants are involved in this reaction.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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16. Assertion (A) : The order of the reaction,

$CH_3COOC_2H_5 + H_2O \Leftrightarrow CH_3COOH + C_2H_5OH$

is 2. Reason (R): The molecularity of this reaction is 2.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: D

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17. Assertion (A) : For: $aA + bB \rightarrow$ Product. The order of reaction is equal to $(a + b)$.

Reason (R): Rate of reaction $= k[A]^a[B]^b$.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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18. Assertion (A) : The rate constant of a pseudo unimolecular reaction has the units of a second order reaction. Reason (R): A pseudo unimolecular reaction is a reaction of second order in whiich one of the reactant is present in large excess.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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19. Assertion (A) : The rate constant of a zero order reaction has same units as the rate of reaction.

Reason (R): Rate constant of a zero order reaction does not depend upon the units of concentration.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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20. Assertion (A) : $k = Ae^{-E_a/RT}$, the Arrhenius equation represents the dependence of rate constant with temperature.

Reason (R): Plot of $\log. k$ against $1/T$ is linear and the activation energy can be calculated with this plot.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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21. Assertion (A) : The rate of a chemical reaction whether exothermic or endothermic increases with temperature. Reason (R): The rate reaction $= k[\text{Reactant}]^n$ and k increases with temperature.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

Watch Video Solution

22. Assertion (A) : For a first order, the concentration of a reaction decreases exponentially with time.

Reason (R): The rate of reaction at any time depends upon the concentration of the reactant at that time.

A. If both (A) and (R) are correct, and (R) is the correct explnation of (A).

B. If both (A) and (R) are correct, but (R) is noth the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

Watch Video Solution

Exercises Integer

1. The half-life periof of a radioactive element is 40 days. If $32g$ of this element is stored for $160 days$, calculate the weight of the element that would remain in gram.

Watch Video Solution

2. If one starts with 1 Curie (Ci) of radioactive substance $\left(t_{1/2} = 15hr\right)$ the activity left after a periof of two weeks will be about $0.02x\mu Ci$. Find the value of x.

Watch Video Solution

3. If 80% of a radioactive element undergoing decay is left over after a certain periof of time t form the start, how many such periofs should elapse form the start for just over 50% of the element to be left over?

Watch Video Solution

4. Hydrolyiss of an alkyl halide (RX) by dilute alkali $[OH]^{\ominus}$ takes place ismultaneously by SN^2 and SN^1 pathways. A plot of $-\frac{1}{[RX]}\frac{d[R-X]}{dt}$ vs $[OH]^{\ominus}$ is a straight line of the slope equal to $2 \times 10^3 mol^{-1} Lh^{-1}$ and intercept equal to $1 \times 10^2 h^{-1}$. Calculate the initial rate $\left(\text{mole}L^{-1}\overset{-1}{\min}\right)$ of consumption of RX when the reaction is carried out taking $molL^{-1}$ of RX and $0.1 molL^{-1}$ of $[OH]^{\ominus}$ ions.

Watch Video Solution

5. Following is the graph between $\log t_{1/2}$ and $\log a$ (a initial concentration) for a given reaction at $27^\circ C$.

Find the order of reaction.

Watch Video Solution

6. For the reaction $A \rightarrow$ Products, it is found that the rate of reaction increases by a factor of 6.25 when concentration of A increases by a factor of 2.5. Calculate the order of reaction with respect to A.

Watch Video Solution

7. In the case of a first order reaction, the time required for 93.75% of reaction to take place is x time required for half of the reaction. Find the value of x.

Watch Video Solution

8. For the reaction $NO_2 + CO \rightarrow CO_2 + NO$, the experimental rate expresison is $-dc/dt = k\left[NO_2\right]^2$. Find the number of molecules of CO involved in the slowest step.

Watch Video Solution

9. Following are two first order reaction with their half times given at $25^\circ C$.

$$A \xrightarrow{t_{1/2}=30\min} \text{Products}$$

$$B \xrightarrow{t_{1/2}=40\min} \text{Products}$$

The temperature coefficients of their reactions rates are 3 and 2, respectively, beween $25^\circ C$ and $35^\circ C$. IF the above two resctions are carried out taking $0.4M$ of each reactant but at different temperatures: $25^\circ C$ for the first order reaction and $35^\circ C$ for the second order reaction, find the ratio of the concentrations of A and B after an hour.

Watch Video Solution

10. Conisder the following statement for a second order reaction and score of each statement.

$2A \rightarrow P$

		Score
$a.$	$[A] = \frac{[A_0]}{1+kt}$	3
$b.$	A plot of $1/[A]^2$ vs time will be straight line	2
$c.$	Half life is long when the concentration is low	1

Find the total score of the correct statements.

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11. Two substances $A\left(t_{1/2} = 5 \text{ min}\right)$ and $B\left(t_{1/2} = 15 \text{ min}\right)$ follow first order kinetics and are taken in such a way that initially $[A] = 4[B]$. The time after which the concentration of both the substance will be equal is $5x$ min . Find the value of x.

Watch Video Solution

12. The initial concentration of both the reactants of a second order reaction are equal and 60% of the reaction gets completed in $30s$. How much time will be taken in 20% completion of the reaction?

Watch Video Solution

13. A second order reaction requires 70 min to change the concentration of reactants form $0.08M$ to $0.01M$. The time required to become $0.04M = 2x \text{ min}$. Find the value of x.

Watch Video Solution

14. For the reaction:

$H_2 + Cl_2 \rightarrow \text{Sunlight} 2HCl$

taking place on water. Find the order of reaction.

Watch Video Solution

15. What is the order of reaction for which rate becomes half if volume of the container having same amount of reactant is doubled? Assume gaseous phase reaction.

Watch Video Solution

Exercises Fill In The Blanks

1. Decompoistion of hydrogen peroxide,

$2H_2O_2 \rightarrow 2H_2O + O_2$ is a ....

Watch Video Solution

2. The inverison of cane sugar is a...............reaction though its molecularity is................... .

Watch Video Solution

3. For the first order reaction half-life time is .... on the initial concentration.

Watch Video Solution

4. The half-life periof of a radioactive substance is x years. The fraction remaining after $2x$ years is.............. .

Watch Video Solution

5. A reaction is said to be of............. if its rate is entirely independent of the concentration of the reactants.

Watch Video Solution

6. The time required for the decompoistion of 99.9% fraction of a first order reaction is.............to that of its half-life time.

Watch Video Solution

7. The temperature coefficient of a reaction is determined by comparing velocity constants at two temperatures separated by.......... .

Watch Video Solution

8. The rate of reaction is measured either by an increase in the amount of..........or by a decrease in the amount of...........per unit interval of............... .

Watch Video Solution

9. If doubling the concentration of a reactant X in a reaction $X + Y \rightarrow$ Products, increases the rate times and tripling its concentration increases the rate nine times, this indicates that the rate of reaction is proportional to the ....of the concentration of............and thus rate is given by.......... .

Watch Video Solution

10. When rate $= k[A]^2[B]$, the reaction is said to be of ....order in A and of..........order in B. The order of the overall reaction will be sum of the..........of A and B.

Watch Video Solution

11. N_2O_5 decomposes according to equation,

$2N_2O_5 \rightarrow 4NO_2 + O_2$

(a) What does $-\frac{d[N_2O_5]}{dt}$ denote?

(b) What does $\frac{d[O_2]}{dt}$ denote?

(c) What is the unit of rate of this reaction?

Watch Video Solution

12. For a relatively fast reaction, the rate constant is relatively............and half-change time is relatively............ .

Watch Video Solution

13. A substance which itself is not a catalyst but............. .the reactivity of a catalyst is called a promoter and the one which reduces the activity is called............for the catalyst.

Watch Video Solution

14. A catalyst accelerates the reaction by......... the activation energy of the reaction, or by forming an ....with.................activation energy.

Watch Video Solution

15. According to..............theory of catalyiss, there are some..........centres with..........valencies.

Watch Video Solution

16. In autocatalyiss, one of the................of the itself acts as a........... .

Watch Video Solution

17. Hydrogeneration of oils (manufacture of vegetable ghee) is carried out in the presence of..........(name of catalyst).

Watch Video Solution

18. The half-change time for a first order reaction is 20 min hence the rate constant for the reaction............. .

Watch Video Solution

19. For a first order reaction, $t_{1/2} = \ldots\ldots\ldots\underline{.}k.$

Watch Video Solution

20. For a first order reaction, $A \rightarrow B$, the rate $= k \times \ldots\ldots\ldots\ldots$.

Watch Video Solution

21. The unit of first order rate constant is ....

Watch Video Solution

22. The unit of first order rate constant when concentration is measured in terms of pressure and time in minutes is ....

Watch Video Solution

23. .... reaction obeys the expresison $t_{1/2} = 1/ka$ in chemical kinetics.

Watch Video Solution

24. The half-life periof of a first order reaction is..............of initial concentration.

Watch Video Solution

25. A first order reaction has $t_{1/2} = 6.93 \text{ min}$. The rate constant is........... .

Watch Video Solution

26. The rate first order reaction is $2.4 \times 10^{-3} molL^{-1}s^{-1}$, when the initial concentration is $0.2 molL^{-1}$. The rate constant is............. .

Watch Video Solution

27. The rate of a second order reaction is $6 \times 10^{-5} molL^{-1}s^{-1}$, when the initial concentration is $0.2 molL^{-1}$. The rate constant is..................... .

Watch Video Solution

28. The temperature coefficient of a reaction is determined by comparing velocity constant at two temperatures differing by.................. .

Watch Video Solution

Watch Video Solution

29. The value of temperatuer coefficient is usually.................. .

Watch Video Solution

30. The reactions having low activation energy are...............reactions.

Watch Video Solution

31. Activation energy $=$ threshold energy -................. .

Watch Video Solution

32. Increases in temeprature increases the number of ....colliisons.

Watch Video Solution

33. In a multi-step reaction, the rate is determined by conisdering the............step.

Watch Video Solution

34. Molecularity is always a whole.............. while the order of reaction may be..............., ..., ..., or even zero.

Watch Video Solution

35. All radioactive decompoistion reactions are.............order reactions.

Watch Video Solution

36. The inverison of cane sugar is a..............reaction though its molecularity is.................. .

Watch Video Solution

37. The difference of energy between activated complex and that of the reactants is called ....

Watch Video Solution

Exercises True/False

1. The order of reaction may be a fractional number.

Watch Video Solution

2. The molecularity and order of reaction can be $0, 1, 2$, etc.

Watch Video Solution

3. The hydrolysis of ester in alkaline medium is a

Watch Video Solution

4. All first order reactions are unimolecular.

Watch Video Solution

5. All radioactive decompoistion reactions are..............order reactions.

Watch Video Solution

6. Negative catalyst stop chemical reactions.

Watch Video Solution

7. Catalyiss does not alter state of chemical equilibrium.

Watch Video Solution

8. A first order reaction has very high value of activation energy.

Watch Video Solution

9. The molecularity of a complex reaction is always greater than the order of the reaction.

Watch Video Solution

10. For a zero order reaction, The rate becomes double when the order of the reaction.

Watch Video Solution

11. For a zero order reaction, the half-life periof is independent of the initial concentration.

Watch Video Solution

12. xg of a radioactive substance will be decomposed to $7/8xg$ in $40s$ if the half-life periof is $10s$.

Watch Video Solution

13. For a first order reaction, the half-life periof is $0.263k$.

Watch Video Solution

14. The sum of powers to which of the concentration terms are raised in the rate law is called molecularity of the reaction.

Watch Video Solution

15. The difference between the energy maximum along a reaction path and the energy of the reactant is called activation energy.

Watch Video Solution

16. The graph between $\log k$ versus $1/T$ is a straight line.

Watch Video Solution

17. The slope of the tangent at a point on the curve of concentration of a reactant as a function of time gives the instantaneous rate of reaction.

Watch Video Solution

18. A poistive catalyst increases the activation energy of the reaction.

Watch Video Solution

19. The slope of straight line in a plot of $\log.[A]$ versus time for a first order raction is equal to -$k/2.303$.

Watch Video Solution

Watch Video Solution

20. The rate of reaction increases with increase in activation energy.

Watch Video Solution

21. The average rate and instantaneous rate are the same.

Watch Video Solution

22. Longer the reaction life time, faster is the reaction.

Watch Video Solution

23. A mixture of reactants may be thermodynamically unstable but kinetically stable.

Watch Video Solution

24. The rate constant of a specific reaction is independent of the concentration of the reactants.

Watch Video Solution

25. The order of reaction can never be zero.

Watch Video Solution

26. In a gaseous reaction, an increase in the pressure of the reactant gases increases the rate of reaction.

Watch Video Solution

27. The hydrolyiss of ethyl acetate in the pressure of sofium hydroxide is a first order reaction.

Watch Video Solution

28. The unit of rate constant for a zero order reaction is s^{-1}.

Watch Video Solution

29. In a second order reaction, the plot of $1/(a - x)$ versus t is a straight line.

Watch Video Solution

Archives Multiple Correct

1. A catalyst

A. Increases the average kinetic energy of the reacting molecules.

B. Decreases the activation energy

C. Alters the reaction mechanism

D. Increases the frequency of the colliisons of the reacting species

Answer: B::C

Watch Video Solution

2. The rate law for the reaction

$RCl + NaOH(aq) \rightarrow ROH + NaCl$ is given by

Rate $= k[RCl]$. The rate of the reaction will be

A. Doubled by doubling the concentration of $NaOH$

B. Halved by reducing the concentration of RCl by one half

C. Increased by increaisng the temperature of the reaction.

D. Unaffected by change of temperature

Answer: B::C

Watch Video Solution

3. For a first order reaction,

A. The degree of dissociation is equal to $\left(1 - e^{-kt}\right)$.

B. A plot of reciprocal concentration of the reactant versus time gives a straight line.

C. The time taken for the completion of 75% of the reaction is theice the time taken for $1/2$ of the reaction.

D. The pre-exponential factor in the Arrhenius equation has the dimenison of time T^{-1}.

Answer: A::D

Watch Video Solution

4. Which of the following statements is/are correct?

A. A plot of $\log k_p$ versus $1/T$ is linear.

B. A plot of $\log[X]$ versus time is linear for a first order reaction, $x \rightarrow p$.

C. A plot of $\log p$ versus $1/T$ is linear at constant volume.

D. A plot of p versus $1/V$ is linear at constant temperature.

Answer: A::B::D

Watch Video Solution

5. For the first order reaction

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

A. The concentration of the reactant decreases exponentially with time.

B. The half life of the reaction decreases with increaisng temperature.

C. The half life of the reaction depends on the initial concentration of the reactant.

D. The reaction proceeds to 99.6% completion in 8 half. Life durations.

Answer: A::B::D

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Archives Single Correct

1. The rate constant of a reaction depends on

A. Temperature

B. Initial concentration of the reactions

C. Time of reaction

D. Extent of reaction

Answer: A

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2. A catalyst is a substance which

A. Increases the equilibrium concentration of the Product

B. Changes the equilibrium constant of the reaction

C. Shortens the time to reach equilibrium

D. Supplies energy to the reaction

Answer: C

Watch Video Solution

3. The specific rate constant of a first order reaction depends on the

A. Concentration of the reactant

B. Concentration of the Product

C. Time

D. Temperature

Answer: D

Watch Video Solution

4. The rate constant for the reaction

$2N_2O_5 \rightarrow 4NO_2 + O_2$

is $3.0 \times 10^{-5}s^{-1}$. If the rate is $2.40 \times 10^{-5} molL^{-1}s^{-1}$, then the concentration of N_2O_5 (in $molL^{-1}$) is

A. 1.4

B. 1.2

C. 0.04

D. 0.8

Answer: D

Watch Video Solution

5. For an endothermic reaction, where ΔH represents the enthalpy of reaction in $kJmol^{-1}$, the minimum value for the energy of activation will be

A. Less than ΔH

B. Zero

C. More than ΔH

D. Equal to ΔH

Answer: C

Watch Video Solution

6. The rate constant, the activation energy, and the Arrhenius parameter of a chemical reaction at $25^{\circ}C$ are $3.0 \times 10^{-4}S^{-1}, 104.4KJmol^{-1}$, and $6.0 \times 10^{14}S^{-1}$, respectively. The value of the rate constant as $T \rightarrow \infty$ is

A. $2.0 \times 10^{18}s^{-1}$

B. (b) $6.0 \times 10^{14}s^{-1}$

C. Infinity

D. $3.6 \times 10^{30}s^{-1}$

Answer: B

Watch Video Solution

7. If I is the intenisty of an absorbed light and c is the concentration of AB for the photochemical process. $AB + h\nu \rightarrow AB^*$, the rate of formation of AB^* is directly proportional to

A. c

B. I

C. I^2

D. $c \times I$

Answer: B

Watch Video Solution

8. Conisder the chemical reaction

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

The rate of this reaction can be expressed in terms of time derivatives of the concentration of $N_2(g), H_2(g)$, or $NH_3(g)$. Identify the correct relationship among the rate expresisons.

A. Rate $= -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

B. Rate $= -\frac{d[N_2]}{dt} = -3\frac{d[H_2]}{dt} = 2\frac{d[NH_3]}{dt}$

C. Rate $= \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

D. Rate $= -\frac{d[N_2]}{dt} = -\frac{d[H_2]}{dt} = \frac{d[NH_3]}{dt}$

Answer: A

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9. In a first order reaction, the concentration of the reactant decreases form 800mol dm^{-3} to 50mol dm^{-3} in $2 \times 10^4 s$. The rate constant of the reaction (in s^{-1}) is

A. 2×10^4

B. 3.45×10^{-5}

C. 1.386×10^{-4}

D. 2×10^{-4}

Answer: C

Watch Video Solution

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10. A follows first order reaction.

$(A) \rightarrow Product$

The concentration of A changes form $0.1M$ to $0.025M$ in 40 min . Find the rate of reaction of A when the concentration of A is $0.01M$.

A. $3.47 \times 10^{-4} M \text{ min}^{-1}$

B. $3.47 \times 10^{-5} M \text{ min}^{-1}$

C. $1.73 \times 10^{-4} M \text{ min}^{-1}$

D. $1.73 \times 10^{-5} M \text{ min}^{-1}$

Answer: A

Watch Video Solution

11. Which of the following statements for the order of reaction is not correct ?

A. The order can be determined experimentally.

B. The order of the reaction is equal to the sum of the power of the concentration terms in different rate law.

C. It is not affected by the stoichiometric coefficient of the reactants.

D. The order cannot be fractional.

Answer: D

Watch Video Solution

12. Conisder a reaction $aG + bH \rightarrow$ Products. When concentration of both the reactants G and H is doubled, the rate increases eight times. However, when the concentration of G is doubled, keeping the concentration of H fixed, the rate is doubled. The overall order of reaction is

A. 0

B. 1

C. 2

D. 3

Answer: D

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13. Under the same reaction conditions, the intial concentration of $1.386 mol dm^{-3}$ of a substance becomes half in $40s$ and $20s$ theough first order and zero order kinetics, respectively.

The ratio $\left(k_1/k_0\right)$ of the rate constants for first order $\left(k_1\right)$ and zero order $\left(k_0\right)$ of the reaction is

A. $0.5 mol^{-1} dm^3$

B. $1.0 mol dm^{-3}$

C. $1.5 mol dm^{-3}$

D. $2.0 mol^{-1} dm^3$

Answer: A

Watch Video Solution

14. For a first order reaction $A \rightarrow P$, the temperature (T) dependent rate constant (k) was found to follow the equation $\log k = -2000(1/T) + 6.0$. The pre-exponential factor A and the activation energy E_a, respective, are

A. $1.0 \times 10^{6} s^{-1}$ and $9.2 kJ mol^{-1}$

B. $6.0 s^{-1}$ and $16.6 kJ mol^{-1}$

C. $1.0 \times 10^{6} s^{-1}$ and $16.6 kJ mol^{-1}$

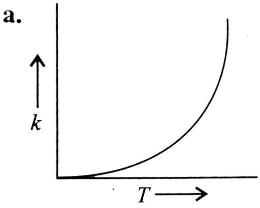
D. $1.0 \times 10^{6} s^{-1}$ and $38.3 kJ mol^{-1}$

Answer: D

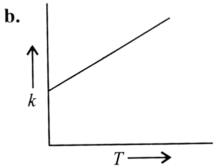
Watch Video Solution

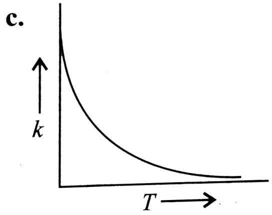
15. Plots showing the variation of the rate constant (k) with temperature (T) are given below. The plot that follows the Arrhenius equation is

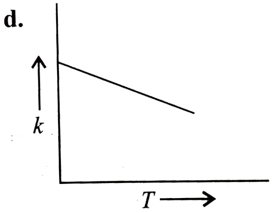
A.



B.



C. 

D. 

Answer: A

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16. The rate of a reaction doubles when its temperature changes form $300K$ to $310K$. Activation energy of such a reaction will be:

$\left(R = 8.314JK^{-1}mol^{-1} \text{ and } \log 2 = 0.301\right)$

A. $48.6kJmol^{-1}$

B. (b) $58.5kJmol^{-1}$

C. $60.5kJmol^{-1}$

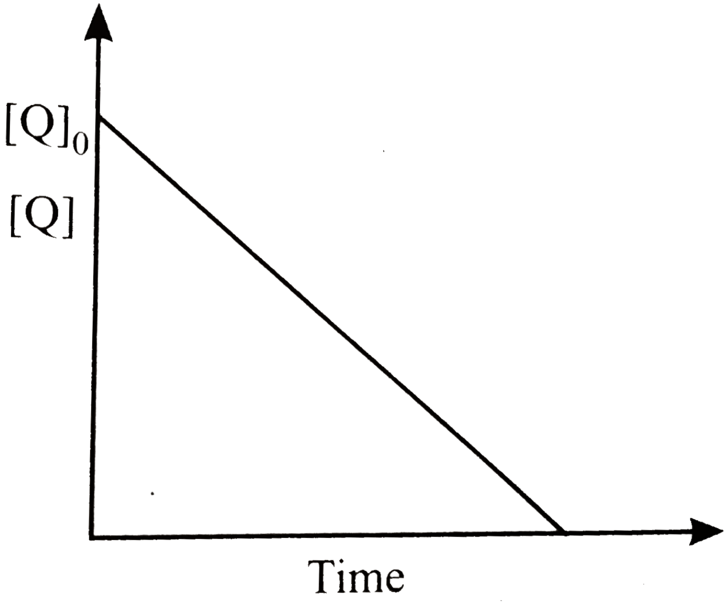
D. $53.6kJmol^{-1}$

Answer: D

Watch Video Solution

17. In the reaction, $P + Q \rightarrow R + S$

the time taken for 75% reaction of P is twice the time taken for 50% reaction of P. The concentration of Q varies with reaction time as shown in the figure. The overall order of the reaction is



A. 2

B. 3

C. 0

D. 1

Answer: D

Watch Video Solution

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18. For the non-stoichiometric reaction $2A + B \rightarrow C + D$

The following kinetic data were obtained in theee separate experiment, all at $98K$

Initial concentration (A)	Initial concentration (B)	Initial rate of formation of C (
$0.01M$	$0.1M$	1.2×10^{-3}
$0.1M$	$0.2M$	1.2×10^{-3}
$0.2M$	$0.1M$	2.4×10^{-3}

The rate law for the formation of C is:

A. $\frac{dc}{dt} = K[A][B]^2$

B. $\frac{dc}{dt} = k[A]$

C. $\frac{dc}{dt} = k[A][B]$

D. $\frac{dc}{dt} = k[A]^2[B]$

Answer: B

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19. 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 will respect to M is

A. 4

B. 3

C. 2

D. 1

Answer: B

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Archives Integer

1. The concentration of R in the reaction $R \rightarrow P$ was measured as a function of time and the following data were obtained. What is the order of the reaction?

$[R](mol)$	1.0	0.75	0.40	0.10
$T(\text{ min })$	0.0	0.05	0.12	0.18

Watch Video Solution

2. An organic compound undergoes first decompoistion. The time taken for its decompoistion to $1/8$ and $1/10$ of its initial concentration are $t_{1/8}$ and $t_{1/10}$, respectively. What is the value of $\frac{\left[t_{1/8}\right]}{\left[t_{1/10}\right]} \times 10? \left(\log_{10}2 = 0.3\right)$

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Archives Fill In The Blanks

1. The rate of chemical change is directly proportional to ....

Watch Video Solution

2. The hydroliss of ethyl acetate in........... medium is a.............order reaction.

Watch Video Solution

3. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, uneder certain conditions of temperature and pressure of the reactants, the rate of formation, of ammonia is $0.001 kg hr^{-1}$. The rate of consumption of hydrogen under the same conditions is ...... kg hr^{-1}

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4. In the Arrhenius equation, $k = A\exp^{-Ea/RT}$, A may be termed as the rate constant at............. .

Watch Video Solution

Archives True/False

1. For a first order reaction, the rate of the reaction doubled as the concentration of the reactant is doubled.

Watch Video Solution

Archives Subjective

1. Rate of a reaction $A + B \rightarrow$ Product, is given as a function of different initial concentration of A and B.

$[A]\left(molL^{-1}\right)$	$(B)\left(molL^{-1}\right)$	Initial rate $\left(molL^{-1}\min^{-1}\right)$
0.01	0.01	0.005
0.02	0.01	0.010
0.01	0.02	0.005

Determine the order of the reaction with respect to A and with respect to B. What is the half life of A in the reaction ?

Watch Video Solution

2. A first order reaction is 20% complete in 10 min . Calculate (a) the specific rate constant of the reaction and (b) the time taken for the reaction to reach 75% completion.

Watch Video Solution

3. While studying the decompoistion of gaseous N_2O_5, it is observed that a plot of logarithm of its partial pressure versus time is linear. What kinetic parameters can be obtained form this observation?

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Watch Video Solution

4. A first order gas reaction has $k = 1.5 \times 10^{-6} s^{-1}$ at $200^{\circ} C$. If the reaction is allowed to run for $10h$, what have changed in the Product? What is the half-life of this reaction?

Watch Video Solution

5. A first order reaction is 50% completed in 30 min at $27^{\circ} C$ and in 10 min at $47^{\circ} C$. Calculate the reaction rate constants at $27^{\circ} C$ and the energy of activation of the reaction in $kJmol^{-1}$.

Watch Video Solution

6. In a Arrhenius equation for a certain reaction, the values of A and E_a (energy of activation)are $4 \times 10^{13} s^{-1}$ and $98.6 KJmol^{-1}$, respectively. If the reaction of first order at, what temperature will its life periof be 10 min .

Watch Video Solution

7. The decomposition of N_2O_5 according to the equation: $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ is a first order reaction. After 30 min. from the start of the decomposition in a closed vessel, the total pressure developed is found to be 284.5 mm of Hg and on complete decomposition, the total pressure is 584.5 mm of Hg. Calculate the rate constant for the reaction.

Watch Video Solution

8. Two reaction, $(I)A \rightarrow$ Products and $(II)B \rightarrow$ Products, follow first order kinetics. The rate of reaction (I) is doubled when the temperature is raised form $300K$ to $310K$. The half life for this reaction at $310K$ is 30 min. At the same temperature B decomposes twice as fast as A. If the energy of activation for reaction (II) is twice that of reaction (I), (a) calculate the rate of constant of reaction (II) at $300K$.

Watch Video Solution

9. The gas phase decomposition of dimethyl ether follows first order kinetics.

$CH_3 - O - CH_3(g) \rightarrow CH_4(g) + CO(g)$

The reaction is carried out in a constant volume container at $500\,^\circ C$ and has a half life of $14.5 \min$. Initially, only dimethyl ether is present at a pressure $0.40 atm$. What is the total pressure of the system after $12 \min$? (Assume ideal gas behaviour)

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10. A first order reaction $A \rightarrow B$ requires activation energy of $70 kJ mol^{-1}$. When a $20\,\%$ solution of A was kept at $25\,^\circ C$ for $20 \min$, $25\,\%$ decomposition took place. What will be the percentage decomposition in the same time in a $30\,\%$ solution maintained at $40\,^\circ C$? (Assume that activation energy remains constant in this range of temperature)

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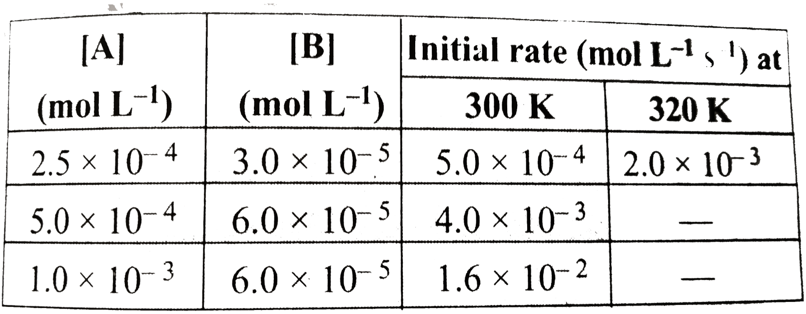
11. form the following data for the reaction between A and B,



[A] (mol L^{-1})	[B] (mol L^{-1})	Initial rate (mol L^{-1} s^{-1}) at	
		300 K	320 K
2.5×10^{-4}	3.0×10^{-5}	5.0×10^{-4}	2.0×10^{-3}
5.0×10^{-4}	6.0×10^{-5}	4.0×10^{-3}	—
1.0×10^{-3}	6.0×10^{-5}	1.6×10^{-2}	—

(a) Calculate the order of the reaction with respect to A and with respect to B.

(b) Calculate the rate constant at $300K$.

(c) Calculate the pre-expontential factor.

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12. At $380^{\circ} C$, the half-life periof for the first order decompoistion of H_2O_2 is 360 min . The energy of activation of the reaction is $200 kJmol^{-1}$. Calculate the time required for 75% decompoistion at $450^{\circ} C$.

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13. The ionization constant of $\overset{\oplus}{NH_4}$ ion in water is 5.6×10^{-10} at $25^{\circ} C$. The rate constant the reaction of $\overset{\oplus}{NH_4}$ and $\overset{\ominus}{OH}$ ion to form NH_3 and H_2O at $25^{\circ} C$ is $3.4 \times 10^{10} L mol^{-1} s^{-1}$. Calculate the rate constant for proton transfer form water to NH_3.

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14. The time required for 10% completion of a first order reaction at $298K$ is equal to that required for its 25% completion at $308K$. If the pre-exponential factor for the reaction is $3.56 \times 10^{9} s^{-1}$, calculate its rate constant at $318K$ and also the energy of activation.

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15. The rate constant for the first order decompoistion of a certain reaction is described by the equation

$$\log k\left(s^{-1}\right) = 14.34 - \frac{1.25 \times 10^{4} K}{T}$$

(a) What is the energy of activation for the reaction?

(b) At what temperature will its half-life periof be 256 min ?

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16. For the equation

$N_2O_5(g) = 2NO_2(g) + (1/2)O_2(g)$, calculate the mole fraction of $N_2O_5(g)$ decomposed at a constant volume and temperature, if the initial pressure is $600mmHg$ and the pressure at any time is $960mmHg$. Assume ideal gas behaviour.

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17. The rate constant of a reaction is $1.5 \times 10^7 s^{-1}$ at $50^\circ C$ and $4.5 \times 10^7 s^{-1}$ at $100^\circ C$. Evaluate the Arrhenius parameters A and E_a.

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18. The rate constant for an isomerization reaction, $A \rightarrow B$ is $4.5 \times 10^{-3} \min^{-1}$. If the initial concentration of A is $1M$, calculate the rate of the reaction after $1h$.

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19. A hydrogenation reaction is carried out at 500 K. If the same reaction is carried out in the presence of a catalyst at the same rate, the temperature required is 400 K. Calculate the activation energy of the reaction if the catalyst lowers the activation barrier by 20 kJ mol^{-1}.

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20. The vapour pressure of two miscible liquids (A) and (B) are 300 and $500mm$ of Hg respectively. In a flask 10 mole of (A) is mixed with 12 mole of (B). However, as soon as (B) is added, (A) starts polymerising into a completely insoluble solid. The polymerisation follows first-order kinetics. After 100 minute, 0.525 mole of a solute is dissolved whivh arrests the polymerisation completely. The final vapour pressure of the solution is $400mm$ of Hg. Estimate the rate constant of the polymerisation reaction. Assume negligible volume change on mixing and polymerisation and ideal behaviour for the final solution.

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21. The rate of first order reaction is $0.04 mol L^{-1} s^{-1}$ at 10 min and $0.03 mol L^{-1} s^{-1}$ at 20 min after initiation. Find the half life of the reaction.

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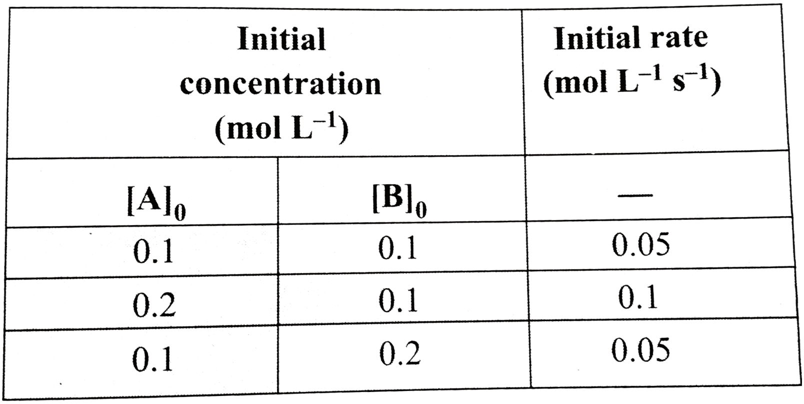
22. For the given reaction

$A + B \rightarrow$ Products,

the following data are given.



Initial concentration (mol L^{-1})		Initial rate (mol L^{-1} s^{-1})
$[A]_0$	$[B]_0$	—
0.1	0.1	0.05
0.2	0.1	0.1
0.1	0.2	0.05

(a) Write the rate equation.

(b) Calculate the rate constant.

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23. $2X(g) \rightarrow 3Y(g) + 2Z(g)$

Time (in min) 0 100 200

| Partial pressure of X (mm Hg) 800 400 200
| Assuming ideal gas condition, calculate

(a) Order of reaction

(b) Rate constant

(c) Time taken for 75% completion of reaction

(d) Total pressure when $p_x = 700mm$

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