CHEMISTRY

BOOKS - CHHAYA CHEMISTRY (BENGALI ENGLISH)

CHEMICAL KINETICS

Numerical Examples

1. In the reaction , $A \rightarrow B$ concentration of A decreases from 0.35 (M) to 0.15 (M) in 30 min. Determine the average rate of reaction in the given interval considering the unit of time to be s .

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2. In the reaction,$A + 2B \rightarrow 3C + 4D,$ the rate of disappearance of B at a given time is $10^{-2}\text{mol}.\ \ L^{-1}.\ s^{-1}$ Calculate

the rate of reaction

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3. In the reaction, $A + 2B \rightarrow 3C + 4D,$ the rate of disappearance of B at a given time is $10^{-2}\text{mol}.\ L^{-1}.\ s^{-1}$ Calculate

the rates of change in concentration of A and C at the same time .

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4. Consider the reaction $2A \rightarrow 4B + C$ taking place in a closed container. If the concentration of B increases to $5 \times 10^{-3}\text{mol}.\ L^{-1}$ in 10s , then find

the rate of formation of B

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5. Consider the reaction $2A \rightarrow 4B + C$ taking place in a closed container. If the concentration of B increases to $5 \times 10^{-3} \text{mol}. L^{-1}$ in 10s , then find

the rate of disappearance of A

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6. Consider the reaction $2A \rightarrow 4B + C$ taking place in a closed container. If the concentration of B increases to $5 \times 10^{-3} \text{mol}. L^{-1}$ in 10s , then find

the reaction -rate in the given interval.

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7. In the reaction : $N_2 + 3H_2 \rightarrow 2HN_3$ the rate of formation of NH_3 is $9.6 \times 10^{-3} \text{mol.L}^{-1}. s^{-1}$. Calculate the rates of disappearance of N_2 and H_2 .

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8. At higher temperature , oxidation of ammonia takes place as follows :

$4NH_3(g) + 50_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

In an experiment , the rate of formation of NO (g) was $6.4 \times 10^{-4} \text{mol.L}^{-1}.s^{-1}$. Determine the rate at which NH_3 get consumed and steam is formed.

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9. In the reaction , $4A + bB \rightarrow cC + dD$, the rate of disappearance of A andB are 0.064 and $0.08 \text{mol L}^{-1}.s^{-1}$, respectively . The rate of formation of C and D are 0.064 and $0.096 \text{mol.L}^{-1}.s^{-1}$, respectively . Find the values of b , c and d.

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10. Consider the reaction $N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ Which was carried out in liquid CCI_4 $\mathrm{at} 48^\circ C$. The concentration of N_2O_5 $\mathrm{in}\ \mathrm{CCl}_4$ solution at the start of the reaction was 2.05(M) and it reduced to 1.80 (M) after 170 min . Determine the average rate and the rate of formation of NO_2 during the given interval.

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11. In a reaction between A and B , the rate of the reaction becomes 1/4 th its initial rate if the concentration of B is doubled . Determine the order of the reaction with respect to B .

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12. For the reaction , $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$, experimentally determined results are as follows :

Determine : the order of reaction with respect to Cl_2 and NO

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13. For the reaction , $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$, experimentally determined results are as follows :

Determine : the rate equation of the reaction

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14. For the reaction , $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$, experimentally determined results are as follows :

Determine : the rate constant of the reaction.

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15. For the reaction $2A + B_2 \rightarrow 2AB$, the experimentally obtained results are as follows:

With arguments , write the probable rate equation.

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16. In the decomposition reaction of a gas, reaction -rates are 7.25 and 5.14 $\mathrm{mol}\ .\mathrm{L}^{-1}.\ s^{-1}$, respectively , for 5% and 20% decomposition of the gas . Determine order of the reaction.

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17. Benzenediazonium chloride dissociates as

$C_6H_5N_2^+Cl^- \rightarrow C_6H_5Cl + N_2$

At $0^\circ C$, if the concentration of diazonium salt is doubled , the rate of evolution of N_2 is also doubled. Find the order of the reaction.

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18. For the reaction $aA + bB + cC \rightarrow$ Product , the experimentally determined results are as follows:

Determine overall order and rate equation for the reaction.

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19. The rate constant of a reaction is $1.5 \times 10^{-3} \mathrm{dm}^3 . \mathrm{mol}^{-1} . s^{-1}$. Determine its order .

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20. The values of rate constants of some reactions are given below . Determine the order in each case.

$k = 2.4 \times 10^{-4} \mathrm{mol}^{-1} . L . s^{-1}$

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21. The values of rate constants of some reactions are given below . Determine the order in each case.

$k = 3.8 \times 10^{-6} \text{atm}^{-2}. s^{-1}$

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22. The values of rate constants of some reactions are given below . Determine the order in each case.

$k = 6.2 \times 10^{-3} s^{-1}$

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23. The values of rate constants of some reactions are given below . Determine the order in each case.

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

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24. The values of rate constants of some reactions are given below . Determine the order in each case.

$k = 7.1 \times 10^{-3} \text{mol}^{-2}. L^2. s^{-1}$

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25. Decomposition of N_2O_5 in liquid CCl_4 is a first order reaction : $2N_2O_5 \rightarrow 4NO_2 + O_2$. The rate constant for this reaction is $3.66 \times 10^{-2} \text{min}^{-1}$.

Determine the reaction -rate when the concentration of $N_2O_5 = 3.15 \text{mol} .\text{L}^{-1}$

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26. Decomposition of N_2O_5 in liquid CCl_4 is a first order reaction : $2N_2O_5 \rightarrow 4NO_2 + O_2$. The rate constant for this reaction is $3.66 \times 10^{-2} \text{min}^{-1}$.

At what concentration of N_2O_5 will the reaction -rate be $3.854 \times 10^{-2} \text{mol.L}^{-1}. \text{min}^{-1}$?

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27. In the reaction $aA \to bB$, when the concentration of A is $2.2 \times 10^{-3} M$ the rate is $2.4 \times 10^{-3} M. s^{-1}$ and when the concentration of A is halved , the rate becomes $0.6 \times 10^{-3} M. s^{-1}$. For what concentration of A will the rate be $1.8 \times 10^{-3} M. s^{-1}$?

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28. For the reaction $2NO(g) + O_2(g) \to 2NO_2(g)$, the rate law is $r = k[NO]^2[O_2]$. The reaction is carried out in a V L closed container . If the container had a volume equal to one-fourth of V L , then what would the reaction - rate be ?

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29. $3A + 2B + C \rightarrow D + E$ is a first order reaction with respect to A , second order with respect to B and zero order with respect to C .

Give the differential rate equation for the reaction .

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30. $3A + 2B + C \rightarrow D + E$ is a first order reaction with respect to A , second order with respect to B and zero order with respect to C .

What will the change in reaction -rate be if the concentration of each of A, B and C is doubled ?

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31. The initial concentration of the reactant in a zero order reaction is $1.386 \mathrm{mol.L}^{-1}$ The half-life of the reaction is 20s. Calculate:

the rate constant

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32. The initial concentration of the reactant in a zero order reaction is $1.386 \mathrm{mol.L}^{-1}$ The half-life of the reaction is 20s. Calculate:

the concentration of the reactant after 30s from the initiation of the reaction.

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33. At constant temperature & high pressure, the given reaction is of the zero order : $2NH_3(g) \xrightarrow{pt} N_2(g) + 3H_2(g)$. If the rate constant of this reaction is $3 \times 10^{-4} \mathrm{mol.L}^{-1}.s^{-1}$, calculate the rate of formation of N_2 and H_2.

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34. Half-life of a first order reaction at a given temperature is a 3 min. Calculate the time required for the completion of 3/4 th of the reaction.

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35. A first order reaction takes 60 minutes for 75% completion. Determine its half- life.

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36. A first order reaction takes 10min to complete 40% of the reaction. Another first order reaction requires 15min to complete 60% of the reaction. Calculate the ratio of the rate constants of the two reactions.

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37. Half-life of a first order reaction at 25° C is 15 min. At 32°, half-life of same reaction is 10 min. Determine the ratio of the rate constants at the given temperatures.

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38. If the constant of a first reaction at a certain temperature is $1.5 \times 10^{-1} s^{-1}$ and t_1 and t_2 are the respective times for 50% and 75% completion of the reaction , determine the ratio of t_2 and t_1

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39. Show that in a first order reaction, time required for completion of $99.9\ \%$ is 10 times of half-life $\left(\frac{t_1}{2}\right)$ of the reaction

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40. $t_{1/2}$ of a first order reaction is 15 min . Calculate the time for 80% completion of the reaction . If the initial concentration of the reactant is doubled , calculate the time taken for 80% completion of the reaction Give reasons.

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41. The rate constant of a first order reaction is $1.5 \times 10^{-6} s^{-1}$ at a specific temperature . What percent of initial concentration of the reactant gets converted into product after 10h?

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42. The rate constant of a first order reaction is 0.0051min^{-1} . If the initial concentration of the reactant is 0.2(M) , find the concentration of the reactant after 2h.

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43. The decomposition of a compound follows the rate law of a first order reaction. For the initial concentration of the compound to drop to $\frac{1}{8}$ and $\frac{1}{10}$ th of this value , times required are $t_{1/8}th$ and $t_{1/10}$ respectively. Find the value of $\left(\frac{t_{1/8}}{t_{1/10}} \times 10\right)$. $[\text{given}: \log 10^2 = 0.3]$

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44. If the concentration of the reactant of a first order reaction is $10^{-1}\text{mol}\,.\text{L}^{-1}$, the reaction -rate is $3 \times 10^{-4}\text{mol.L}^{-1}.\,s^{-1}$. When the concentration is 10^{-2}mol.L^{-1} , what is the rate of reaction ?

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45. The rate constant for an isomerisation reaction, $A \to B$ is $4.5 \times 10^{-3}\text{min}^{-1}$. If the initial concentration of A is 1(M), calculate the rate of the reaction after 1 h.

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46. The Rates of a first order reaction after 10 and 20 min from initiation of the reaction are 0.04 and $0.03\text{mol.}\,\text{L}^{-1}.\,s^{-1}$ respectively . Find the half - life of the reaction.

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47. To calculate the rate of decomposition of H_2O_2 in an aqueous solution , a certain volume of the aqueous solution of H_2O_2 is pipetted out and titrated against $KMnO_4$ solution at different interval of time . In an experiment , the following data were collected.

Show that the reaction is first order . Find the rate constant.

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48. Decomposition of N_2O_5 in CCl_4 solution at $35^\circ C$ occurs according to the equation given below :

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$. Experimental results obtained for the reaction are given below. Show that it is a first order reaction.

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49. For the reaction, $2X(g) \rightarrow 3Y(g) + 2Z(g)$ the following results were obtained experimentally,

If the gases behave like ideal gases, calculate

the order of the reaction .

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50. For the reaction, $2X(g) \rightarrow 3Y(g) + 2Z(g)$ the following results were obtained experimentally,

If the gases behave like ideal gases, calculate

the rate constant of the reaction

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51. For the reaction, $2X(g) \rightarrow 3Y(g) + 2Z(g)$ the following results were obtained experimentally,

If the gases behave like ideal gases, calculate

the time required for 75% completion of the reaction.

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52. For the reaction, $2X(g) \rightarrow 3Y(g) + 2Z(g)$ the following results were obtained experimentally,

If the gases behave like ideal gases, calculate

find the net pressure on the system when $p_x = 700mm.$

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53. The activation energy of the exothermic reaction $A \rightarrow B$ is $40\text{kJ}.mol^{-1}$. The heat of reaction is $15\text{kj}.\text{mol}^{-1}$. What is the activation energy for the backward reaction ?

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54. For a reversible reaction , $X \Leftrightarrow Y$, the activation energies of the forward and reverse reactions are 15 and $9\mathrm{kJ.mol}^{-1}$ respectively . The average energy of X is $10\mathrm{kJ.mol}^{-1}$. Calculate :

the threshold energy

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55. For a reversible , $X \Leftrightarrow Y$, the activation energies of the forward and reverse reactions are 15 and $9\mathrm{kJ.mol}^{-1}$ respectively . The average energy of X is $10\mathrm{kJ.mol}^{-1}$. Calculate :

the heat of reaction

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56. For a reversible , $X \Leftrightarrow Y$, the activation energies of the forward and reverse reactions are 15 and $9\mathrm{kJ.mol}^{-1}$ respectively . The average energy

of X is 10kJ.mol^{-1} . Calculate :

the average energy of Y.

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57. $A + B \rightarrow C - 50kJ,$ in this reaction, the energy of activation of backward reaction is 18 kJ . Calculate the activation energy of forward reaction.

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58. Calculate the frequency factor and activation energy of a reaction , if the rate constants of the reaction at $50^\circ C \text{ and } 100^\circ C \text{ are} 1.5 \times 10^7 s^{-1} \& 4.5 \times 10^7 s^{-1}$ respectively.

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59. Calculate the activation energy of a reaction if the rate of the reaction is doubled while the temperature of the reaction system is increased from $27^{\circ}C \quad \text{to} \quad 37^{\circ}C$

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60. The activation energy of most of the reactions occurring at $25^{\circ}C$ is generally 50kJ.mol^{-1} . Calculate the temperature coefficient of such reactions.

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61. The rate constant of a chemical reaction at 600K is $1.6 \times 10^{-5}s^{-1}$. The activation energy of the reaction is 209kJ.mol^{-1} . Calculate its rate constant at 700K.

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62. The rate constant of a reaction at 200k is 0.1 times its value at TK . If the energy of activation of the reaction is 7.65kJ.mol^{-1} , find the value of 'T'?

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63. The rate constant of a first order reaction can be determined by the equation: $\log k = 12.6 - \frac{4267}{T}K$. Calculate the energy of activation (E_a) and frequency factor (A) of the reaction.

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64. The rate constant of a first order reaction follows the equation $\log k\left(s^{-1}\right) = 22.3 - \frac{12.16 \times 10^3}{T}K$

Find the activation energy of the reaction.

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65. The rate constant of a first order reaction follows the equation

$$\log k\left(s^{-1}\right) = 22.3 - \frac{12.16 \times 10^3}{T} K$$

At what temperature will the half-life of the reaction be 115.5 min ?

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Warm Up Exercise

1. The reaction, $BaCl_2(aq) + K_2SO_4(aq) \rightarrow BaSO_4(s) + 2KCl(aq)$ is a very fast reaction -why?

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2. What do you mean by average rate and instantaneous rate of a reaction ? Give their mathematical expression.

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3. Consider the reaction :

$S_2O_8^{2-}(aq) + 2I^-(aq) \rightarrow I_2(aq) + 2SO_4^{2-}(aq),$

What is the rate of consumption of $I^-(aq)$ if the rate of formation of $I_2(aq)$ is x mol .L $^{-1}$. s^{-1} ?

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4. In the reaction $A \rightarrow B$, if the change in concentration of A in the time interval Δt is $\Delta[A]$, then the rate of reaction is $-\frac{\Delta[A]}{\Delta t}$. What is the significance of the 'negative ' sign in the expression $-\frac{\Delta[A]}{\Delta t}$?

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5. For the reaction $A + 2B \rightarrow 3C$, the rate in terms of change in concentration of A, B and C are x, y and z mol .L $^{-1}$. s^{-1} , respectively, Establish a relation between x , y and z .

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6. In which of the following reactions, reaction-rate is same irrespective of whether the rate is expressed in terms reactant or product ?

(i) $NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$

(ii) $NO_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

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7. In the reaction $aA \rightarrow bB$, the rate of disappearance of A and the rate of formation of B at a given time are x and $1.5 \ \text{xmol.L}^{-1}.s^{-1}$ respectively . Establish the relation between 'a' and 'b'.

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8. In the reaction $3X \rightarrow 2Y + Z$, the rate of disappearance of X at a given time is $0.072\text{mol.L}^{-1}.s^{-1}$. Calculate the rate of formation of Y and that of Z at the same time ?

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9. Determine the order of the reaction involving decomposition of ammonia on the surface of platinum at a high pressure. Given: the value of rate constant for the reaction is, $k = 2.5 \times 10^{-4} \text{mol.L}^{-1}.\ s^{-1}$.

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10. Zinc reacts with HCl to form $ZnCl_2$ and H_2 why is it found that the reaction occurs at higher. rate when Zn-dust instead of a Zn -wire is used ?

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11. $aA \rightarrow bB$ is a first order reaction with respect to A. The rate of this reaction can be determined from any of the following equations : $-\frac{d[A]}{dt} = k_1[A]$ and $\frac{d[B]}{dt} = k_2[A]$. Deduce the relation between k_1 and k_2.

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12. Mention any two factors affecting the rate constant of a reaction.

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13. The time taken for the combustion of one piece of coal in air is much greater than for the combustion of powdered coal with the same mass . Explain with reasons.

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14. For the reaction $A + B \rightarrow$ Product, the order of reaction with respect to A is $\frac{1}{2}$ If the overall order of the reaction is zero , find the order of the reaction with respect to B.

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15. For the reaction $P \rightarrow R$, the rate of the reaction = r. On doubling the concentration of P, the reaction-rate reduces to $\frac{1}{4}$ th of it initial value. Find the unit of the rate constant for the reaction.

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16. Consider the reaction $A \rightarrow B$, which is carried out at a given temperature seperately with the initial reactant concentration of 0.1(M) and 0.015(M). Will the rate constants obtained from these experiments be the same ?

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17. For the reaction $A + B \rightarrow C$, the initial rate was $x \text{mol.L}^{-1}.s^{-1}$. After times t_1 and t_2, the rates were found to be y and z $\text{mol.L}^{-1}.s^{-1}$ respectively. Arrange x, y and z in order of their increasing values.

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18. The units of rate constant and reaction -rate of a chemical reaction are the same. Determine the order of the reaction.

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19. Many reaction do not have a definite overall order explain.

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20. Give an example of a reaction for each of the following type.

(i) Zero order (ii) First order (iii) Second order (iv) Third order (v) Fractional order.

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21. (a) What do you mean by rate law of a reaction ? Highlight two important points about rate law.

(b) Mention three quantities that can be known from the rate law of a chemical reaction.

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22. What are the terms that are associated with the rate equation ?

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23. Which one of them can be determined from the balanced chemical equation of an elementary reaction ?

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24. The unit of rate constant of a reaction is $(\text{mol})^{-x}.(dm)^{3x}.s^{-1}$ Find the value of x if the order of the reaction is $\frac{3}{2}$.

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25. At a specific temperature , why does the rate of a reaction increase with increase in concentration of the reactant ?

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26. For the reaction : $2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$ the rate law is , rate $= k[NO_2][F_2]$. Write the differential rate equation for the reaction.

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27. Mention the significance of rate constant of a reaction.

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28. For the reaction : $aA + bB \rightarrow cC$, the rate law is , $r = k[A]^m[B]^n$. If the initial concentration of A and B are doubled, then find the ratio of the new initial rate to the original initial rate.

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29. In the reaction: $A \rightarrow B + C$, the rate of formation of C becomes twice if the concentration of A is made double. What is the order of the reaction ?

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30. For the reaction $CH_3CHO(g) \rightarrow CH_4(g) + CO(g)$ the experimentally deduced rate equation is given by , rate $= k[CH_3CHO]^{3/2}$. Can this reaction be an elementary ? If not, explain.

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31. Write the rate equations and molecularity for the following elementary reactions:

(a) $NO_2(g) + NO_2(g) \rightarrow NO_3(g) + NO(g)$

(b) $Cl(g) + O_3(g) \rightarrow ClO(g) + O_2(g)$

(c)$O_3(g) \rightarrow O_2(g) + O(g)$

(d) $2NO(g) \rightarrow N_2O_2(g)$

(e) $(CH_3)_3CBr \rightarrow (CH_3)_3C^+ + Br^-$

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32. The suggested mechanism of a reaction is :

(a) $A + B \Leftrightarrow D(\text{fast}) \quad (b) A + D \rightarrow 2C(\text{slow})$

Write the balanced equation of the reaction if its experimentally deduced rate equation is , rate $k = [A]^2[B]$ Find the intermediate formed during the course of the reaction . Does the predicted rate law from the mechanism match the experimental rate law ?

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33. Decomposition of hydrogen peroxide in alkaline medium in presence of iodide $\left(I^-\right)$ catalyst occurs according to the equation: $2H_2O_2 \xrightarrow[\text{alkali}]{I^-} 2H_2O(l) + O_2(g)$

A proposed mechanism for this reaction involves the following steps :

Step-I : $H_2O_2(l) + I^-(aq) \rightarrow H_2O(l) + IO^-(aq)(\text{slow})$

Step-II : $H_2O_2(l) + IO^-(aq) \rightarrow H_2O(l) + IO^-(aq) + O_2(g)(\text{fast})$

Write rate law for the reaction .

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34. Decomposition of hydrogen peroxide in alkaline medium in presence of iodide $\left(I^-\right)$ catalyst occurs according to the equation: $2H_2O_2 \xrightarrow[\text{alkali}]{I^-} 2H_2O(l) + O_2(g)$

A proposed mechanism for this reaction involves the following steps :

Step-I : $H_2O_2(l) + I^-(aq) \rightarrow H_2O(l) + IO^-(aq)(\text{slow})$

Step-II : $H_2O_2(l) + IO^-(aq) \rightarrow H_2O(l) + IO^-(aq) + O_2(g)(\text{fast})$

Calculate the order of the reaction.

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35. RCI , an organic chloride, undergoes hydrolysis in presence of a large excess of water $(RCl + H_2O \rightarrow ROH + HCl)$

Find the molecularity and order of the reaction.

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36. Why does a first order reaction never reach completion ?

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37. How long will it take for a zero order reaction to reach completion if the initial concentration of the reactant is 'a' and its rate constant is 'k' ? What is the half-life of this reaction?

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38. What will be the nature of the graph showing the concentration of the reactant and time of a first order reaction ?

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39. The rate constants of two first order reactions at a specific temperature are k_1 and k_2 , respectively . If $k_1 > k_2$, then which reaction has a longer half-life ?

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40. The $t_{1/2}$ of a first order reaction is 20 min . How long will it take for reactant concentration to drop from a to a/8?

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41. The initial concentration of the reactant is a first order reaction is a. What will be its concentration after 4^{th} half-life ?

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42. The rate constant for a zero order reaction $aA \rightarrow bB$ is k. What is the rate of formation of B?

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43. The initial concentration of the reactant in a first order reaction is a . It takes time t for the completion of noth fraction of the reaction. Will it take time 2t for the completion of the same fraction if the initial concentration of the reactant is made twice ?

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44. Determine the order of the following reactions :

A reaction for which half-life becomes double on doubling the concentration of reactant .

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45. Determine the order of the following reactions :

A reaction whose rate doubles on doubling the concentration of reactant .

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46. Determine the order of the following reactions :

A reaction whose half-life becomes half, when the concentration of reactant is doubled ?

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47. Why does the rate of a reaction increase with rise in temperature ? Explain it with the help of Arrhenius equation.

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48. What will the activation energy of a reaction be if rate constant equals the frequency factor ?

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49. How many times is the value of the rate constant compared to the value of the frequency factor if the activation energy (E_a) for a reaction is 2.303RT?

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50. The value of temperature coefficient of a reaction is 2 .By how many factors would the rate of the reaction increase if the temperature is

raised from 298K to 338K ?

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51. At a given temperature , for a reaction , the activation energy in absence of catalyst is greater than that in presence of catalyst be an amount of RT. If the value of the rate constant in presence of catalyst is x times that in absence of catalyst, then find the value of x.

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52. The activation energy of an uncatalysed reaction is $E_a \text{kJ.mol}^{-1}$ and that of the catalysed reaction is $(E_a - 2)\text{kJ.mol}^{-1}$. If the change in enthalpy in absence of the catalyst is - xkJ , then what would be the change in enthalpy in presence of the catalyst ?

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53. Which one of the following reactions has a smaller energy of activation for the backward reaction ? (i) Exothermic reaction (ii) Endothermic reaction.

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54. In some chemical reactions, it is found that a large number of colliding molecules have energy more than threshold energy value, yet the reactions are quite slow. Explain.

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55. The activation energy of a reaction is 80kj.mol^{-1} . The activation energy reduces by 75% in presence of a catalyst. If the other parameters are kept constant , compare the rates of the reaction in presence and absence of the catalyst at $25^{\circ}C$.

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Question Answer Zone For Board Examination Very Short Answer Type

1. For the reaction $\frac{1}{2}A_2 + \frac{3}{2}B_2 \rightarrow AB_3$, express the rate in terms of decrease in concentration of the reactants and increase in concentration of the product.

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2. For the reaction $A + 2B \rightarrow 3C$, express the rate in terms of change in concentration of reactants and product.

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3. The rate of the reaction, $A \rightarrow B$, is expressed by $-\frac{d[A]}{dt}$. What does the (-) sign imply ?

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4. For the reaction $\frac{1}{2}A \rightarrow 2B$, what is the relation between the rate of appearance of B and the rate of disappearance of A ?

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5. For the reaction

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

write the instantaneous reaction -rate in terms of decrease in concentration of the reactants and increase in the concentration of the products.

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6. The reaction $aA \rightarrow bB$ is a zero order in A , with a rate constant of k. show that the rate formation of B is $b \times k$.

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7. The units of reaction -rate and constant of a given reaction are the same. Find the order of the reaction.

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8. A reaction has an overall order of $\frac{3}{2}$. What will be unit of its rate constant be if the concentration of the reactant is expressed in $'\mathrm{mol.dm}^{-3}'$ and time in 'seconds' ?

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9. When the initial concentration of the reactant in a reaction id doubled, the half -life of the reaction becomes double . Determine the order of the reaction.

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10. For the reaction $2O_3(g) \rightarrow 3O_2(g)$, the experimentally obtained rate equation , rate $= k = \frac{[O_3]^2}{[O_2]}$. What is the overall order of this reaction? What is the order of the reaction with respect to O_3 and O_2 ?

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11. The rate equation for a reaction is given by rate, $= k[A][B]^{3/2}$. Determine if the given reaction is an elementary reaction.

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12. Mention any tow factors that affect the value of the rate constant of a reaction.

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13. The reaction $aA + B \rightarrow C$ is zero order with respect to each of the reactant . Write the rate law for the reaction.

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14. For the first order reaction $A \rightarrow 2B$, rate can be expressed any one of the following rate equations.

$(1) -\frac{d[A]}{dt} = k_1[A] (2) \frac{d[B]}{dt} = k_2[A]$

Find the relation between k_1 and k_2.

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15. Thermodynamic predicts that the reaction of H_2 with O_2 at normal temperature and pressure is spontaneous . However , if a mixture of H_2 and O_2 is kept for years in a closed container at normal conditions , no perceptible amount of water is found to be produced . Why does it so happen ?

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16. Why does not a fuel burn on its own air at normal condition of temperature and pressure, even though air contains a sufficient amount of oxygen ?

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17. For which kind of reaction is the rate law predicted by the law of mass action the same as that obtained from experiment ?

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18. For a reaction $A + B \rightarrow C$, the rate doubles if the concentration of A is doubled by holding the concentration of B constant. But the rate remains the same if the concentration of B is made twice by keeping the concentration of A fixed. Write the rate law for the reaction.

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19. For the reaction $A + B \rightarrow C$, the experimentally obtained rate law is ,rate $k[A]^2[B]$. What effect will produce on the rate reaction if the concentration of A is halved and that of B is doubled ?

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20. At a given temperature , the rate constant for the reaction $A \rightarrow B$ is$2.8 \times 10^{-3} \mathrm{L.mol}^{-1}.\, s^{-1}$. If the concentration of A is halved, what would the rate of be the reaction be ?

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21. According to the Arrhenius equation , what would the value of rate constant be for a reaction when $T \rightarrow \infty$?

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22. What would the effect of temperature be on the rate constant of a reaction with zero activation energy ?

Watch Video Solution

23. For the reaction , $A \rightarrow B$ products , rate $k[A][B]$. How can this reaction be transformed into a pseudo first order reaction ?

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24. The reaction , $A + 2B \rightarrow 3C + 4D$, is first order with respect to both A and B. Write the differential rate law for the reaction.

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25. Will the molecularity of a zero order reaction be zero ?

Watch Video Solution

26. For the reaction $A \rightarrow B$, the initial reaction -rate gets halved when the initial concentration of A is doubled . Determine the order of the reaction.

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27. Which of the following reactions have the least probability of occurance ? (1) $A + B \rightarrow$ Product (2) $2A + B \rightarrow$ Product (3) $2A + B + C \rightarrow$ Product.

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28. How do the following factors affect the rate constant of a reaction? (1) concentration of the reactant, (2) temperature and (3) catalyst.

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29. Mention a similarity and a difference between the rate of reaction and its rate constant.

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30. Explain why the reaction -rate does not proceed at a uniform rate during the course of a reaction.

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31. Give the rate equation , overall order and molecularity of the following elementary reactions.

(1) $A + B \rightarrow C$ (2) $2A \rightarrow D$

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32. How does the initial concentration of the reactant in a first order reaction very with time ?

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33. Show that the time of a first order reaction takes for 'the nth' fraction of the initial concentration of its reactant to converted into product does not depend on the initial concentration of the reactant.

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34. If the half-life of a first order reaction is T s , then show that after nTs $\left[1-\left(\frac{1}{2}\right)^{n}\right]$ parts of the initial concentration of the reactant will take part in the reaction.

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35. In presence of excess water, hydrolysis of methyl acetate in basic or alkaline medium, is second order reaction. Explain.

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Solved Wbchse Scanner 2014

1. 50% of a first order reaction gets completed in 10 min. What fraction of reactant of the above reaction would remain after 20min ?

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2. What is rate constant of a reaction? Establish the relation between the rate constant of a first order reaction with its half-life period. If half-life period of a first order reaction is T sec, show that after nT sec $\left[1-\left(\frac{1}{2}\right)^{n}\right]$ fraction of initial concentration of reactant has completely reactad.

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3. What is activation energy of a reaction? On heating the rate of a reaction because faster—explain.

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Solved Wbchse Scanner 2015

1. What is meant by pseudo-unimolecular reaction? Explain with an example.

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2. 0.0625g remains from 1g of a radioactive element after 20 years of radioactive decay. Determine the rate constant and half-life $\left(t_{1/2}\right)$ of the reaction. How much of the element did remain after 10 years from the start?

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3. On the basis of rate equation show that a first order reaction does never go to completion.

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4. For an elementary reaction $A + B \rightarrow C$, the rate constant increase 10 times on increasing the temperature form 27° By 10 degrees. Find out the activation energy of the reaction.

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5. What is the order of the reaction for which the rate constant has a unit of $mol.\ L^{1}.\ s^{-1}$?

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6. The rate constant of a first order reaction is $2.31 \times 10^{-3} s^{-1}$ Calculate the half-life period of the activation energy of the reaction.

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7. Discuss the differences between the order and molecularity of a chemical reaction.

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8. What is a pseudo first order reaction? Explain with the help of an example.

Watch Video Solution

9. Establish the integrated rate equation for a first order reaction and reaction and with its help prove that for 99.9% completion of the reaction, the time required is 10 times of the half-life of the reaction.

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Solved Wbchse Scanner 2016

1. What is meant by a zero order reaction? Give an example of such a reaction. Establish the integrated rate equation for a zero order reaction involving a single reactant. How can the rate constant be determined using this equation?

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2. Write down the Arrhenius equation relating the rate constant of reaction with temperature , mentioning what the terms indicate.

If k_1 and k_2 be the rate constant of a reaction at temperature $t_1^\circ C$ and $t_2^\circ C$, respectively, find out the relation between k_1, k_2 and t_1 and t_2 . Given that the activation energy (E_a) of the reaction remains unchanged within the temperature range mentioned.

The rate constant of a reaction at 400K and 500K are

$0.02s^{-1}$ and $0.08s^{-1}$ respectively . Determine the activation energy (E_a) of the reaction.

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Solved Wbchse Scanner 2017

1. Starting from the rate law of a first order reaction, show that the half-life of the reaction is independent of the initial reactant concentration.

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2. The rate equation for the chemical reaction:

$aA + bB + cC \rightarrow eE + fF$ is expressed as -

rate $= k[A]^{\alpha}[B]^{\beta}[C]^{0}$

Determine overall order and molecularity of the reaction.

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3. In a multistep chemical reaction, which elementary step is considered as the "rate determining step"?

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4. How does a catalyst enhance the rate of a chemical reaction? At a constant temperature, does the enthalpy of chemical reaction remain same or change in presence of a catalyst?

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5. According to collision theory of reactions, why all molecular collisions do not result in "effective collection"?

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Solved Wbchse Scanner 2018

1. What is meant by instantaneous reaction-rate?

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2. Show the time required for 90% completion of a first order reaction is twice for 90% completion of that reaction.

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3. Establish the integrated rate equation for a first order reaction.

Watch Video Solution

4. The half-life of a zero order reaction is x second. If the reaction takes t_1 second to complete, calculate t_1 in terms of x.

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Solved Cbse Scanner Delhi 2014

1. What do you understand by the 'order of a reaction' ? Identify reaction order from each of the given units of rate constant :

(i) $L^{-1}.\,\text{mol}.\,s^{-1}$ (ii) $L^{-1}.\,\text{mol}.\,s^{-1}$

View Text Solution

2. For the reaction $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$ the following data were collected . All the measurements were taken at 263K:

Write the expression for rate law .

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3. For the reaction $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$ the following data were collected . All the measurements were taken at 263K:

Calculate the value of rate constant and specify its units.

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4. For the reaction $2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$ the following data were collected . All the measurements were taken at 263K:

What is the initial rate disappearance of Cl_2 in experiment 4 ?

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Solved Cbse Scanner Outside Delhi 2014

1. For a chemical reaction $R \rightarrow P$, the variation in concentration (R) vs . Time (t) plot is given as -

predict the order of the reaction.

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2. For a chemical reaction $R \rightarrow P$, the variation in concentration (R) vs . Time (t) plot is given as -

What is the slope of the curve ?

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3. Following data were obtained during first order thermal decomposition of -

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

Experiment	time$\left(s^{-1}\right)$	Total pressure(atm)
1	0	0.4
2	100	0.7

Calculate the rate constant . (Given : log4 = 0.6021, log2 = 0.3010)

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Solved Cbse Scanner Delhi 2015

1. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained :

t/s	0	30	60
$[CH_3COOH]/mol.\ L^{-1}$	0.60	0.30	0.15

Show that it follows pseudo first order reaction, as the concentration of water remains constant.

Watch Video Solution

2. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained :

t/s	0	30	60
$[CH_3COOH]/mol.\ L^{-1}$	0.60	0.30	0.15

Calculate the average rate of reaction between the time interval 30 to 60 seconds [Given: $\log_2 = 0.3010$ and $\log 4 = 0.6021$]

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3. For a reaction $A + B \rightarrow P$, the rate is given by Rate $= k[A][B]^2$

How is the rate of reaction affected if the concentration of B is doubled ?

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4. A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction . (log2=0.3010)

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Solved Cbse Scanner Outside Delhi 2015

1. The rate constant for a first order reaction is $60s^{-1}$ How much time will it take to reduce the initial concentration of the reactant to its $\frac{1}{10}$ th value?

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2. Write units of rate constant for zero order and for the second order reactions if the concentration is expressed in $\mathrm{mol.L^{-1}}$ and time in second.

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Solved Cbse Scanner Delhi 2016

1. For a reaction : $2NH_3(g) \xrightarrow{\text{pt}} N_2(g) + 3H_2(g), rate = K$

Write the order and molecularity of this reaction.

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2. For a reaction : $2NH_3(g) \xrightarrow{\text{pt}} N_2(g) + 3H_2(g), rate = K$

Write the unit of K.

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3. The rate constant for the first order decomposition of H_2O_2 is given by the following equation:

$$\log k = 14.2 - \frac{1.0 \times 10^4}{T} K$$

Calculate E_a for this reaction and rate constant k if its half-life period is 200 minutes.

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Solved Cbse Scanner East Zone 2016

1. For a reaction: $H_2 + Cl_2 \xrightarrow{\text{hv}} 2HCl, \quad \text{rate} = K$

Write the order and molecularity of this reaction.

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2. For a reaction: $H_2 + Cl_2 \xrightarrow{\text{hv}} 2HCl, \quad \text{rate} = K$

Write the unit of K.

Watch Video Solution

3. For the order thermal decomposition reaction, the following data were obtained :

$C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$

Time/sec	$\text{Total pressure /atm}$
0	0.30
300	0.50

Calculate the rate constant.

(Given: log2 = 0.301, log3 = 0.4771 and log4 = 0.6021)

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Solved Cbse Scanner Delhi 2017

1. For a reaction $R \rightarrow P$, half-life $\left(t_{1/2}\right)$ is observed to be independent of the initial concentration of reactants.

What is the order of the reaction ?

Watch Video Solution

2. Following data are obtained for the reaction :

$$N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$$

$t(s)$	0	300	600
$\left[N_2O_5\left(\text{mol.L}^{-1}\right)\right]$	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

Show that it follows first order reaction.

Watch Video Solution

3. Following data are obtained for the reaction :

$$N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$$

$t(s)$	0	300	600
$\left[N_2O_5\left(\text{mol.L}^{-1}\right)\right]$	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

Calculate the half-life.

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4. What is the effect of catalyst on:

(i) Gibbs energy (ΔG) and (ii) activation energy of a reaction ?

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Solved Cbse Scanner All India 2017

1. A first order reaction takes 20 minutes for 25% decomposition . Calculate the time when 75% of the reaction will be completed.

(Given : log 2 = 0.3010, log3 = 0.4771 log4 = 0.6021)

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Solved Cbse Scanner All India 2018

1. For the reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ the rate of formation of $NO_2(g)$ is $2.8 \times 10^3(M).\, s^{-1}$. Calculate the rate of disappearance of $N_2O_5(g)$.

Watch Video Solution

2. A first order reaction is 50% completed in 40 minutes at 300K and in 20 minutes at 320K. Calculate the activation energy of the reaction.

(Given:

$\log 2 = 0.3010, \quad \log 4 = 0.6021, \quad R = 8.314 J.\ K^{-1}.\ \text{mol}^{-1}\Big)$

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Solved Ncert Textbook Problems Ncert Intext Questions

1. The decomposition of N_2O_5 in CCl_4 at 318K has been studied by monitoring the concentration of N_2O_5 in the solution . Initially , concentration of N_2O_5 is 2.33mol.L^{-1} & after 184 minutes , it is reduced to 2.08mol.L^{-1} . The reaction takes place according to the equation $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$. Calculate the average rate of this reaction in terms of hours, minutes & seconds . What is the rate of production of NO_2 during this period ?

Watch Video Solution

2. For the reaction $R \rightarrow P$, the concentration of a reactant changes from 0.03(M) to 0.02(M) in 25 min. Calculate the average rate of reaction using units of time both in minutes and seconds.

Watch Video Solution

3. In a reaction , $2A \rightarrow$ Products , the concentration of A decreases from 0.5mol.L^{-1} to 0.4mol.^{-1} in 10min . Calculate the rate during this interval.

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4. Calculate the overall order of a reaction which has the rate expression :

Rate $= k[A]^{1/2} \times [B]^{3/2}$

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5. Calculate the overall order of a reaction which has the rate expression :

Rate = $k[A]^{3/2} \times [B]^{-1}$

Watch Video Solution

6. Identify the reaction order from each of the given rate constants:

$k = 2.3 \times 10^{-5} \text{L.mol}^{-1}. s^{-1}$

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7. Identify the reaction order from each of the given rate constants:

$k = 3 \times 10^{-4} s^{-1}$

Watch Video Solution

8. For a reaction , $A + B \rightarrow$ product, rate law is given by, $r = k[A]^{1/2} \times [B]^{2}$. What is the order of the reaction?

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9. The conversion of molecules X to Y follows second order kinetics . If concentration of X is increased to three times how will it affect the rate of formation of Y ?

Watch Video Solution

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

Watch Video Solution

11. The following data were obtained during the first order thermal decomposition of $N_2O_5(g)$ at constant volume:

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

SI.No	Time(s)	Pressure (atm)
1.	0	0.5
2.	100	0.512

Calculate the rate constant.

Watch Video Solution

12. A first order reaction is found to have a rate constant, $k = 5.5 \times 10^{-14} s^{-1}$. Find the half-life of the reaction.

Watch Video Solution

13. Show that in a first order reaction , time required for 99.9% completion is 10 times of half-life of the reaction.

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14. Hydrolysis of methyl acetate in aqueous solution has been studied by titrating the liberated acetic acid against sodium hydroxide. The

concentration of the ester at different times is given below.

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

Show that it follows a pseudo first order reaction as, the concentration of water remain nearly constant $\left(55\text{mol.L}^{-1}\right)$, during the course of the reaction what is the value of k' in this equation ? Rate $= k'[CH_3COOCH_3][H_2O]$

Watch Video Solution

15. A first order reaction has a rate constant $1.15 \times 10^{-3} s^{-1}$. How long will 5g of this reactant take to reduce to 3g?

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16. Time required to decompose SO_2Cl_2 to half of its initial amount is 60minutes . If decomposition is a first order reaction, calculate rate constant of the reaction.

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17. The rate constants of reaction at 500K and 700K are $0.02s^{-1}$ and $0.07s^{-1}$ respectively. Calculate the values of E_a and A.

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18. First order rate constant for the decomposition of ethyl iodide, $C_2H_5I(g) \rightarrow C_2H_4(g) + HI(g)$ at 600K is $1.60 \times 10^{-5}s^{-1}$. Its activation energy is $209kJ.\,\mathrm{mol}^{-1}$. Calculate rate constant of the reaction at 700K.

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19. What will be the effect of temperature on the constant?

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20. Rate of the chemical reaction doubles for an increase of 10K from 298K . Calculate E_a.

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21. The activation energy for the reaction $2HI(g) \rightarrow H_2 + I_2(g)$ is 209.5kJ.mol^{-1} at 581K. Calculate the fraction of molecules of reactants having energy equal to or greater than activation. energy ?

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Solved Ncert Textbook Problems Ncert Exercise Questions

1. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.

$3NO(g) \rightarrow N_2O(g), \text{Rate} = k[NO]^2$

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2. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.

$H_2O_2(aq) + 3I^-(aq) + 2H^+ \rightarrow 2H_2O(l) + I^-, \text{Rate} = k[H_2O_2]\left[I^-\right]$

Watch Video Solution

3. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.

$CH_3CHO(g) \rightarrow CH_4(g) + CO(g), \text{Rate} = k[CH_3CHO]^{3/2}$

Watch Video Solution

4. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.

$C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g), \quad \text{Rate} = k[C_2H_5Cl]$

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5. For the reaction: $2A + B \rightarrow A_2B$ the rate $k[A][B]^2$ with $k = 2.0 \times 10^{-6}\text{mol}^{-2}.\ L^2.\ s^{-1}$. Calculate the initial rate of the reaction when $[A] = 0.1\text{mol.L}^{-1}, [B] = 0.02\text{mol.}\ L^{-1}$. Calculate the rate of reaction after [A] is reduced to 0.06mol.L^{-1} .

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6. The decomposition of NH_3 on platinum surface is zero order reaction. What are the rates of production of N_2 and H_2 if $k = 2.5 \times 10^{-4}\text{mol}^{-1}.\ L.\ s^{-1}$?

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7. The decomposition of dimethyl ether leads to the formation of CH_4, H_2 and CO and the reaction -rate is given by Rate $k[CH_3OCH_3]^{3/2}$. The rate of reaction is followed by increase in pressure in a closed vessel , so the rate can also be expressed in terms of

the partial pressure of dimethyl ether , i.e., Rate $= k[P_{CH_3OCH_3}]^{3/2}$. If the pressure is measured in bar and time in minutes , then what are the units of rate and rate constants ?

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8. Mention the factors that affect the rate of a chemical reaction.

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9. A reaction is second order with respect to a reactant . How is the rate of reaction affected if the concentration of the reactant is doubled

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10. A reaction is second order with respect to a reactant . How is the rate of reaction affected if the concentration of the reactant is

reduced to half ?

Watch Video Solution

11. What is the effect of temperature on the constant of reaction ? How can this temperature effect on the constant be represented quantitatively ?

Watch Video Solution

12. In a pseudo first order hydrolysis of ester in water, the following results were obtained :

$t(s)$	0	30	60	90
$[\text{Ester}]\left(\text{mol.L}^{-1}\right)$	0.55	0.31	0.17	0.085

Calculate the average rate of reaction between the time interval 30 to 60s.

Watch Video Solution

13. In a pseudo first order hydrolysis of ester in water, the following results were obtained :

$t(s)$	0	30	60	90
$[\text{Ester}]\left(\text{mol.L}^{-1}\right)$	0.55	0.31	0.17	0.085

Calculate the pseudo first order rate constant for the hydrolysis of ester.

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14. A reaction is first order in A and second order in B.

Write the differential rate equation.

Watch Video Solution

15. A reaction is first order in A and second order in B.

How is the rate affected on increasing the concentration of B three times ?

Watch Video Solution

16. A reaction is first order in A and second order in B.

How is the rate affected when the concentrations of both A and B are doubled ?

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17. In a reaction between A and B , the initial rate of reaction (r_0) was measured for different initial concentrations of A and B as given below:

What is the order of the reaction with respect to A & B ?

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18. The following results have been obtained during the kinetic studies of the reaction : $2A + B \rightarrow C + D$

Determine rate law & rate constant for the reaction.

View Text Solution

19. The reaction between A and B is first order with respect to A and zero order with respect to B . Fill in the blanks in the following table.

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20. Calculate the half-life of a first order reaction from their rate constants:

$200 s^{-1}$

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21. Calculate the half-life of a first order reaction from their rate constants:

$2 \min^{-1}$

Watch Video Solution

22. Calculate the half-life of a first order reaction from their rate constants:

$4y^{-1}$

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23. The half-life for radioactive decay of $.^{14}C$ is 5730 years . An archaeological artifact containing wood had only 80% of the $.^{14}C$ found in a living tree. Estimate the age of the sample.

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24. The experimental data for decomposition of $N_2O_2[2N_2O_5 \rightarrow 4NO_2 + O_2]$ in gas phase at 318K are given below :

Plot $[N_2O_5]$ against t.

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25. The experimental data for decomposition of $N_2O_2[2N_2O_5 \rightarrow 4NO_2 + O_2]$ in gas phase at 318K are given below :

Find the half-life period for the reaction.

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26. The experimental data for decomposition of $N_2O_2[2N_2O_5 \rightarrow 4NO_2 + O_2]$ in gas phase at 318K are given below :

Draw a graph between log $[N_2O_5]$ and t .

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27. The experimental data for decomposition of $N_2O_2[2N_2O_5 \rightarrow 4NO_2 + O_2]$ in gas phase at 318K are given below :

What is the rate law ?

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28. The experimental data for decomposition of $N_2O_2[2N_2O_5 \rightarrow 4NO_2 + O_2]$ in gas phase at 318K are given below :

Calculate the rate constant.

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29. The experimental data for decomposition of $N_2O_2[2N_2O_5 \rightarrow 4NO_2 + O_2]$ in gas phase at 318K are given below :

Calculate the half-life period from k and compare it with 2.

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30. The rate constant for a first order reaction is $60s^{-1}$ How much time will it take to reduce the initial concentration of the reactant to its 1/6th value ?

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31. During nuclear explosion, one of the products is $.^{90}\mathrm{Sr}$ with half-life of 28.1 y. If $1\mu g$ of $^{90}\mathrm{Sr}$ was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10y and 60y if it is not lost metabolically.

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32. For a first order reaction , show that time required for 99% completion is twice the time required for the completion of 90% of reaction.

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33. A first order reaction takes 40 min for 30% decomposition . Calculate $t_{1/2}$.

Watch Video Solution

34. For the decomposition of azoisopropane to hexane and nitrogen at 543 K , the following data are obtained.

$t(s)$	$P(\text{mm Hg})$
0	35.0
360	54.0
720	63.0

Calculate the rate constant.

Watch Video Solution

35. The following data were obtained during the first thermal decomposition of SO_2Cl_2 at a constant volume, $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$ Experiment Time/s Total pressure/ atm 1

0 0.5 2 100 0.6 Calculate the rate of the reaction when total pressure is 0.65 atm.

Watch Video Solution

36. The rate constant for the decomposition of N_2O_5 at various temperature is given below :

$T/^\circ C$	0	20	40	60	80
$10^5 \times k/s^{-1}$	0.0787	1.70	25.7	178	2140

Draw a graph between In k & $1/T$, calculate the values of A and E_a . Predict the rate constant at 30° &$50^\circ C$.

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37. The rate constant for the decomposition of hydrocarbons is $2.418 \times 10^{-5}s^{-1}$ as 546 K . If the energy of activation is 179.9 kJ.mol , what will be the value of pre-exponential factor ?

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38. Consider a certain reaction $A \rightarrow$ products with $k = 2.0 \times 10^{-2} s^{-1}$ .Calculate the concentration of a A remaining after 100s if the initial concentration of A is $1.0 \mathrm{mol} \ . \mathrm{L}^{-1}$.

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39. Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law , with $t_{1/2} = 3.00h$. What fraction of sample of sucrose remains after 8 hours ?

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40. The decomposition of hydrocarbon follows the equation k $= \left(4.5 \times 10^{11} s^{-1}\right) e^{-28000K/T}$. Calculate E_a.

Watch Video Solution

41. The rate constant for the first order decomposition of H_2O_2 is given by the following equation:

$\log k = 14.34 - 1.25 \times 10^4 K/T$

Calculate E_a for this reaction and rate constant k if its half-life period is 256 minutes.

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42. The decomposition of A into product has value of k as $4.5 \times 10^3 s^{-1}$ at $10^\circ C$ and energy of activation 60kJ.mol^{-1}. At what temperature would k be $1.5 \times 10^4 s^{-1}$?

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43. 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 value of A is $4 \times 10^{10} s^{-1}$ Calculate k at 318 and E_a

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44. The rate of a reaction quadruples when the temperature changes from 293K to 313K. Calculate the energy of activation of the reaction assuming that it does not change with temperature.

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Higher Order Thinking Skill Hots Questions

1. Will the molecularity of a reaction be '2' if its overall order is 2?

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2. At a given temperature, the rates of two first order reactions, $A \to B$ and $C \to D$ are k_1 and k_2 respectively. If $k_1 < k_2$, then which of these reactions will have a shorter half-life?

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3. At 25° a certain reaction with a temperature coefficient of 2 takes four hours for its completion. What is the likely temperature at which the reaction would take half an hour for its completion?

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4. With the help of a graphical representation explain how the rate of a first order reaction varies with the initial concentration of reactant.

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5. For the elementary reaction $aA + bB \rightarrow$ product, the initial reaction-rate is r_0 if the initial concentration of A is doubled and that of B is held constant, the reaction-rate becomes $4r_0$ On doubling the initial concentration of both A and B, the reaction-rate become $8r_0$ Which one of A and B , the disappears to a larger extent at a given time?

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6. For the reaction, $aA + bB \rightarrow$ products, rate =k[A][B] For which of the following mixtures of A and B will the initial rate be maximum? (1) a mixture consisting of 2mol of A and 2mol of B in a 2L vessel (2) a mixture consisting of 0.2 mol of A and 0.2mol of B in a 0.1 L vessel.

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7. For the reaction $A + 2B \rightarrow C + D$, the rate of the reaction= $k[A][B]^2$ where k = rate rate constant. How can the reaction be converted to a pseudo first order and

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8. For the reaction $A + 2B \rightarrow C + D$, the rate of the reaction= $k[A][B]^2$ where k = rate rate constant. How can the reaction be converted to a pseudo second order reactions?

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9. Consider the reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ whose rate can be expressed any one of the following expressions $(1)\frac{-d[N_2O_5]}{dt} = k_1[N_2O_5]$ or $(2)\frac{d[NO_2]}{dt} = k_2[N_2O_5]$ or $(3)\frac{d[O_2]}{dt} =$ Find the relation between k_1, k_2 and k_3 .

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10. The value of ΔG for a reaction is negative at $25^\circ C$ and I atm. Explain whether the reaction is fast or slow.

Watch Video Solution

11. The rate constant of two reactions at $30^\circ C$ are equal. The temperature coefficient of one the reaction is 2 and that other is 2.5. compare the rate constant of the reactions at $50^\circ C$

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12. For a first order reaction , the initial concentration of the reactant is $[A]_0$. How much time is required for the concentration of the reactant to decrease to decrease to $\frac{[A]_0}{e}$? (Where e = base of natural log).

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13. The proposed mechanism for a reaction is - (1) $A + B \Leftrightarrow D(\text{fast})$ $(2) A + D \rightarrow 2C(\text{slow})$. The observed rate for reaction is, rate = $k[A]^2[B]$. Write the balanced equation of the reaction. Identify the reaction intermediate, if any forms during the reaction. Does the observed reaction-rate support the above mechanism ?

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14. The reactant concentrations of a first order reaction at various times, 0 , t , 2t and 3t are $c_0 . a^x c_0 . a^y c_0$ and $a^z c_0$, respectively, where 'a' is a

constant and $0 \leq a < 1$. Establish a relation between x , y and z.

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15. At what temperature (T) will the rate constant (k) and the frequency factor (A) of a reaction be the same?

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16. For a chemical reaction, if the concentration of the reactant a doubled, its half-life is halved. Determine the order of the reaction.

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17. The rate constant and half-life of a first order reaction at temperature T_1 are $k_1 \min^{-1}$ and x_1 min , respectively and those at temperature T_2 are $k_2 \min^{-1}$ and x_2 min , respectively. If $T_2 > T_1$, which is greater , x_1 or, x_2 ?

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18. The reaction $2O_3(g) \rightarrow 3O_2(g)$ is believed to occur according to the mechanism given below.

Step -I : $O_3(g) \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} O_2(g) + O(g)$ (fast)

Step- II : $O_3(g) + O(g) \xrightarrow{k_2} 2O_2(g)$ (slow)

Write the rate law for the reaction . Determine the order of the reaction with respect to $O_3(g)$ and $O_2(g)$.

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Advanced Level Numerical Bank

1. A first order reaction $A \rightarrow B$ requires activation energy of 70kJ.mol^{-1} When a 20% solutions 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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2. At $380^\circ C$ half-life period for the first order decomposition of H_2O_2 is 360 min. The energy of activation of the reaction is 200kJ.mol^{-1} .Calculate the time required for 75% decomposition at $450^\circ C$.

Watch Video Solution

3. From the given data for the reaction between A and B.

(1) Calculate the order of the reaction with respect to A and with respect to B. (2) calculate the rate constant at 300k. (3) Calculate the pre-exponential factor.

View Text Solution

4. 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 it's rate constant at 318k and also the energy of activation.

Watch Video Solution

5. The ionisation constant of $\overset{\oplus}{N}H_4$ ion in water 5.6×10^{-10} at $25^{\circ}C$ The rate constant for the reaction of $\overset{\oplus}{N}H_4$ and $\overset{\ominus}{O}H$ ion to form NH_3 and H_2O at $25^{\circ}C$ is $3.4 \times 10^{10} \text{L.mol}^{-1}. s^{-1}$ Calculate the rate constant for proton transfer from water to NH_3

View Text Solution

6. For the reaction: $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ Calculate the mole fraction of $N_2O_5(g)$ decomposed at constant volume and temperature, if the initial pressure is 600 mm Hg and the pressure at any time is 960 mm Hg. Assume ideal behaviour

Watch Video Solution

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

Watch Video Solution

8. The rate constant for an isomerisation reaction, $A \rightarrow B$ is $4.5 \times 10^{-3} \text{min}^{-1}$. If the initial concentration of A is 1(M), calculate the rate of the reaction after 1 h.

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9. A hydrogenation reaction is carried out at 500K.If the same reaction is carried out in the presence of a catalyst at the same rate temperature required is 400K. Calculate the activation energy of the reaction if the catalyst lowers the activation barrier by 20kJ.mol^{-1}

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10. Vapour pressures of two miscible liquids A and B are 300 and 500mm Hg respectively. In a flask, 10mol of A is mixed with 12mol of B . However, as soon as B is added, A starts polymerisation follows first order kinetics. After 100min, 0.525mol of a solute dissolved, which arrests the polymerisation completely. Final vapour pressure of the solution is 400mm 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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11. For the given reaction $A + B \rightarrow$ Products , the following data are given :

(1) Write the rate equation

(2) Calculate the rate constant

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12. In a certain reaction B^{n+} is getting converted to $B^{(n+4)+}$ in solution. The rate constant for the reaction is measured by titrating a volume of the solution with a reducing agent which reacts only with B^{n+} and $B^{(n+4)+}$. In this process it converts. B^{n+} to $B^{(n-2)+}$ and $B^{(n+4)+}$ to $B^{(n-1)+}$. At t = 0 ,the volume of reagent consumed is 25mL and at t = 10min , the volume used is 32mL. Calculate the rate constant for conversion of $B^{(n)+}$ to $B^{(n+4)+}$ assuming it to be first order reaction.

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13. At 400K, the decomposition of gaseous Cl_2O_7 to Cl_2 and $O_2(g)$ follows first order kinetics. (1) After 55s at 400k, the pressure of $Cl_2O_7(g)$ falls from 0.062 to 0.044atm. Calculate k. (2) Calculate the pressure of Cl_2O_7 at 100s after the beginning of decomposition.

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14. The inversion of cane sugar was studied in HCl at 298K. The following polarimetric readings were obtained at different intervals of time:

Show that inversion of cane sugar is a first order reaction.

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15. Two reactions, (I) $A \rightarrow$ Product & (II) $B \rightarrow$ Products follow first order kinetics. The rate reaction-(I) is doubled when the temperature is raised from 300K to 310K. The half-life for this reaction at 310K is 30min. At the same temperature B decompose twice as fast as A. If the energy of activation for reaction- (I) is twice that of reaction-(II) calculate the rate constant of reaction - (II) at 300K.

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16. 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 30min,

from the start of the decomposition in a closed vessel, total pressure developed is 284.5 mm Hg. On complete decomposition, total pressure is 584.5mm Hg. Calculate the rate constant of reaction .

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Entrance Question Bank Wbjee

1. Which one of the following is wrong about molecularity of a reaction—

A. it may be whole number of fractional

B. it is calculated from reaction mechanism

C. it is the number of molecules of the reactants taking part in a single step chemical reaction.

D. it is always equal to the order of elementary reaction.

Answer: A

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2. Consider the following reaction for $2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$

The expression for the rate of reaction in terms of the rate of change of partial pressure of partial pressure of reactant and product is/ are —

A. $r = -\frac{1}{2}[dp(NO_2)/dt]$

B. $r = \frac{1}{2}[dp(NO_2)/dt]$

C. $r = -\frac{1}{2}[dp(NO_2F)/dt]$

D. $r = \frac{1}{2}[dp(NO_2F)/dt]$

Answer: A::D

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3. For a chemical reaction at $27^\circ C$ the activation energy is 600 R. The ratio of the rate constant at $327^\circ C$ to that of at $27^\circ C$ will be—

A. 2

B. 40

C. e

D. e^2

Answer: C

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4. Acid catalysed hydrolysis of ethyl acetate follows a pseudo first order kinetics with respect to ester, If the reaction is carried out with large excess of ester, the order with respect to ester will be—

A. 1.5

B. 0

C. 2

D. 1

Answer: B

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5. The correct statement regarding the following energy diagram is— 

A. reaction M is faster and less exothermic than reaction N

B. reaction M is slower and less exothermic than reaction N

C. reaction M is faster and more exothermic than reaction N

D. reaction M is slower and more exothermic than reaction N

Answer: C

View Text Solution

6. The rate of a certain reaction is given by, rate $= k\left[H^{+}\right]^{n}$ The rate increase 100times when the pH change from 3 to 1. The order (n) of the reaction is—

A. 2

B. 0

C. 1

D. 1.5

Answer: C

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7. The increase in rate constant of a chemical reaction with increasing temperature is (are) due to the fact (s) that —

A. the number of collision among the reactant molecules increases with increasing temperature.

B. the activation energy of the reaction decreases with increasing temperature.

C. the concentration of the reactant molecules increases with increasing temperature.

D. the number of reactant molecules acquiring the activation energy increases with increasing temperature.

Answer: A::D

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8. For the reaction $A + 2B \rightarrow C$, the reaction -rate is doubled if the concentration of A is doubled. The rate is increased by four times when concentrations of both A and B are increased by four times . The order of the reaction is -

A. 3

B. 0

C. 1

D. 2

Answer: C

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9. The half-life of C^{14} is 5760 years . For a 200 mg sample of C^{14} , the time taken to change to 25 mg is -

A. 11520 y

B. 23040 y

C. 5760 y

D. 17280 y

Answer: D

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Entrance Question Bank Jee Main

1. The rate of a chemical reaction doubles for every $10^{\circ}C$ rise of temperature . If temperature is raised by $50^{\circ}C$ rate to the reaction

increases by about-

A. 24 times

B. 32 times

C. 64 times

D. 10 times

Answer: B

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2. For a first order reaction , $A \rightarrow$ Products , the concentration of A changes from 0.1 (M) to 0.025(M) in 40 minutes . The rate of reaction when the concentration of A is 0.01 (M) , is -

A. $3.47 \times 10^{-4}(M).\min^{-1}$

B. $3.47 \times 10^{-5}(M).\min^{-1}$

C. $1.73 \times 10^{-4}(M).\min^{-1}$

D. $1.73 \times 10^{-5}(M).\ \min^{-1}$

Answer: A

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3. The rate of a reaction doubles when its temperature changes from 300K to 310K . Activation energy of such a reaction will be - $\left(R = 8.314 \text{J.K}^{-1}\text{mol}^{-1} \text{ and } \log 2 = 0.310\right)$

A. 53.6kJ.mol^{-1}

B. 48.6kJ.mol^{-1}

C. 58.5kJ.mol^{-1}

D. 60.5kJ.mol^{-1}

Answer: A

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4. For the non -stoichiometric reaction $2A + B \rightarrow C + D,$ the following kinetic data were obtained in three separate experiments , all at 298K.

The rate law for the formation of C is -

A. $\frac{dC}{dt} = k[A]$

B. $\frac{dC}{dt} = k[A][B]$

C. $\frac{dC}{dt} = k[A]^2[B]$

D. $\frac{dC}{dt} = k[A][B]^2$

Answer: A

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5. Higher order (> 3) reaction are rare due to -

A. low probability of simultaneous collisions of all the reacting species.

B. increase in entropy and activation energy as more molecules are involved

C. shifting of equilibrium towards reactants due to elastic collisions

D. loss of active species on collision

Answer: A

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6. Decomposition of H_2O_5 follows a first order reaction . In fifty minutes , the concentration of H_2O_2 decreases from 0.5 to 0.125 (M) in one such decomposition when the concentration of H_2O_2 reaches 0.05 (M) , the rate of formation of O_2 will be -

A. $6.93 \times 10^{-2} \text{mol.min}^{-1}$

B. $6.93 \times 10^{-4} \text{mol.L}^{-1} \text{min}^{-1}$

C. 2.66L.min^{-1} at STP

D. $1.34 \times 10^{-2} \text{mol.min}^{-1}$

Answer: B

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7. Two reactions , R_1 and R_2 have identical pre-exponential factors . Activation energy of R_1 exceeds that of R_2 by 10kJ.mol^{-1}. If k_1 and k_2 are rate constants for reaction R_1 and R_2 respectively at 300K, then In (K_2/k_1) is equal to $\left(R = 8.314\text{J.mol}^{-1}.\, k^{-1}\right)$-

A. 6

B. 4

C. 8

D. 12

Answer: B

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8. At $518^{\circ}C$ the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 torr, was 1.00torr.^{-1} when 5% had reacted and 0.5torr.s^{-1} when 33% had reacted. The order of the reaction is -

A. 1

B. 0

C. 2

D. 3

Answer: C

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Entrance Question Bank Neet

1. The unit of rate constant for a zero order reaction is -

A. $\mathrm{mol.L}^{-1}.\ s^{-1}$

B. $\mathrm{L.mol}^{-1}.\ s^{-1}$

C. $L^2.\ \mathrm{mol}^{-1}.\ s^{-1}$

D. s^{-1}

Answer: A

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2. The rate of the reaction: $2N_2O_5 \rightarrow 4NO_2 + O_2$ can be written in three ways

$-\frac{d[N_2O_5]}{dt} = k[N_2O_5], \frac{d[NO_2]}{dt} = k'[N_2O_5], \frac{d[O_2]}{dt} = k''[N_2O_5]$ The relationship between k and k' and between k and k'' are-

A. $k' = 2k, k'' = k$

B. $k' = 2k, k'' = k/2$

C. $k' = 2k, k'' = 2k$

D. $k' = k, k'' = k$

Answer: B

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3. In a reaction , $A + B \rightarrow$ Product , rate is doubled, and rate increases by a factor of 8 when the concentrations of both the reactants (A and B) are doubled , rate law for the reaction can be written as -

A. rate = k [A] [B]

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

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

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

Answer: B

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4. Activation energy (E_a) and rate constant $(k_1 \text{ and } k_2)$ of a chemical reaction at two different temperatures $(T_1 \text{ and } T_2)$ are related by -

A. $\ln \frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

B. $\ln \frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} + \frac{1}{T_1}\right)$

C. $\ln \frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

D. $\ln \frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

Answer: A::C

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5. In a zero order reaction for every $10^\circ C$ rise of temperature , the rate is double . If the temperature is increased from $10^\circ C \text{ to } 100^\circ C$, the rate of the reaction will become -

A. 64 times

B. 128 times

C. 256 times

D. 512 times

Answer: D

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6. What is the activation energy for a reaction if its rate doubles when the temperature is raised from $20^{\circ}C$ to $35^{\circ}C - \left(R = 8.314 \text{ J.mol}^{-1}.K^{-1}\right)$

A. 15.1kJ.mol^{-1}

B. 342kJ.mol^{-1}

C. 269kJ.mol^{-1}

D. 34.7kJ.mol^{-1}

Answer: D

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7. A reaction having equal energies of activation for forward and reverse reactions has-

A. $\Delta H = \Delta G = \Delta S = 0$

B. $\Delta S = 0$

C. $\Delta G = 0$

D. $\Delta H = 0$

Answer: D

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8. The rate constant of the reaction $A \rightarrow B$ is $0.6 \times 10^{-3} \text{mol.L}^{-1}.s^{-1}$. If the concentration of A is 5(M), then concentration of B after 20 min is -

A. 3.60 (M)

B. 0.36 (M)

C. 0.72 (M)

D. 1.08(M)

Answer: C

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9. The addition of a catalyst during a chemical reaction alters which of the following quantities-

A. activation energy

B. entropy

C. internal energy

D. enthalpy

Answer: A

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10. The rate of first order reaction is $0.04\text{mol.L}^{-1}.\ s^{-1}$ at 10 seconds and 0.03mol.L^{-1} at 20 seconds after initiation of the reaction . The half-life period of the reaction is -

A. 44.1s

B. 54.1s

C. 24.1s

D. 34.1s

Answer: C

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11. A first order reaction has a specific reaction-rate of $10^{-2}s^{-1}$. How much time will it take for 20 g of the reactant to reduce to 5g-

A. 138.6 s

B. 346.5 s

C. 693.0 s

D. 238.6 s

Answer: A

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12. Mechanism of hypothetical reaction $X_2 + Y_2 \rightarrow 2XY$ is given below:

(i) $X_2 \rightarrow X + X$ (fast)

(ii) $X + Y_2 \Leftrightarrow XY + Y$ (slow)

(iii) $X + Y \rightarrow XY$ (fast)

The overall order of the reaction will be -

A. 2

B. 0

C. 1.5

D. 1

Answer: C

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13. When initial concentration of the reactant is doubled, the half-life period of a zero order reaction -

A. remains unchanged

B. is halved

C. is tripled

D. is doubled

Answer: D

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14. The correct difference between first and second order reactions is that-

A. the rate of a first order reaction does depend on reactant concentrations , the rate of a second order reaction does not depend on reactant concentrations

B. the rate of a first order reaction does not depend on reactant concentrations , the rate of a second order reaction does depend on reactant concentrations

C. a first order reaction can be catalysed, a second order reaction cannot be catalysed

D. the half-life of a first order reaction does not depend on $[A_0]$, the half-life of a second order reaction does depend on $[A]_0$

Answer: D

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Entrance Question Bank Aiims

1. For a first order gas phase reaction :

$$A(g) \rightarrow 2B(g) + C(g)$$

P_0 be initial pressure of A and P_t the total pressure at time 't' . Integrated rate equation is -

A. $\frac{2.303}{t}\log\left(\frac{P_0}{P_0 - P_t}\right)$

B. $\frac{2.303}{t}\log\left(\frac{2P_0}{3P_0 - P_t}\right)$

C. $\frac{2.303}{t}\log\left(\frac{P_0}{2P_0 - P_t}\right)$

D. $\frac{2.303}{t}\log\left(\frac{2P_0}{3P_0 - P_t}\right)$

Answer: B

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2. If $t_{1/2}\text{vs}\frac{1}{a^2}$ is a straight line graph then determine the order of reaction -

A. zero order

B. first order

C. second order

D. third order

Answer: D

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3. For a reaction , $r = k(CH_3COCH_3)^{3/2}$, then unit of rate of reaction and rate constant respectively is -

A. $\text{mol.L}^{-1}.\ s^{-1}, \text{mol}^{-1/2}.\ L^{1/2}.\ s^{-1}$

B. $\text{mol}^{-1}.\ L^{-1}.\ s^{-1}, \text{mol}^{-1/2}.\ L^{-1/2}.\ s^{-1}$

C. $\text{mol}^{1}.\ L^{-1}.\ s^{-1}, \text{mol}^{1/2}.\ L^{1/2}.\ s^{-1}$

D. $mol.\ L.\ s, \text{mol}^{1/2}.\ L^{1/2}.\ s$

Answer: A

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4. Energy of activation of forward reaction for an endothermic process is 50kJ. If enthalpy change for forward reaction is 20kJ then enthalpy change for backward reaction will be-

A. 30 kJ

B. 20 kJ

C. 70 kJ

D. 50 kJ

Answer: A

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5. The plot of a concentration of the reactant vs time for a reaction is a straight line with a negative slope. The reaction follows a -

A. first order rate equation

B. zero order rate equation

C. second order rate equation

D. third order rate equation

Answer: B

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6. For the reaction $A(g) \rightarrow B(g) + C(g)$, the rate constant is given as (P_t is initial pressure and P_t is pressure at time t)-

A. $k = \frac{2.303}{t} \log. \frac{P_i}{P_t}$

B. $k = \frac{2.303}{t} \log. \frac{P_i}{(2P_i - P_t)}$

C. $k = \frac{2.303}{t} \log. \frac{2P_i - P_t}{P_i}$

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

Answer: B

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7. 75% of a first order reaction complete in 4h . 87.5% of the same reaction completes in-

A. 6 h

B. 12 h

C. 8 h

D. 2 h

Answer: A

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8. For reaction $aA \rightarrow xP$, when [A] 2.2 mM , the rate was found to be $2.4mM.\ s^{-1}$. On reducing concentration of A to half, the rate changes to $0.6mM.\ s^{-1}$. The order of reaction with respect to A is -

A. 1.5

B. 2.0

C. 2.5

D. 3.0

Answer:

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9. A first order reaction, which is 30% complete in 30 min has a half-life period of -

A. 102.2 min

B. 58.2 min

C. 24.2 min

D. 120.2 min

Answer:

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10. During the decomposition of H_2O_2 to gives oxygen , 48g O_2 is formed per minute at a certain point of time .The rate of formation of water at this point is -

A. 0.75mol.min^{-1}

B. 1.5mol.min^{-1}

C. 2.25mol.min^{-1}

D. 3.0mol.min^{-1}

Answer:

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11. The temperature dependence of a reaction is represented by the Arrhenius equation :

$\text{In } k = \frac{E_a}{RT} + \text{In}A$

Which among the following is which conclusion about the given plot-

A. intercept of the line = InA

B. slope = $-\frac{E_a}{RT}$

C. reaction with high activation energy is more temperature sensitive than that of low activation energy (E_a).

D. slope = $-\frac{E_a}{R}$

Answer:

View Text Solution

12. The chemical reaction , $2O_3 \rightarrow 3O_2$ proceeds as follows :

Step I : $O_3 \Leftrightarrow O_2 + O$ (fast)

Step II : $O + O_3 \rightarrow 2O_2$ (slow)

The rate law expression should be-

A. $r = k'[O_3][O_2]$

B. $r = k'[O_3]^2[O_2]^{-1}$

C. $r = k'[O_3]^2$

D. unpredicatable

Answer:

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13. Which option is valid for a zero order reaction -

A. $t_{3/4} = \frac{3}{2} t_{1/2}$

B. $t_{1/2} = \frac{4}{3} t_{3/4}$

C. $t_{1/2} = 2t_{3/4}$

D. $t_{3/4} = t_{1/2}^2$

Answer:

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14. If energy of activation of the reaction is 53.6kJ.mol^{-1} and the temperature changes from $27^\circ C$ to $37^\circ C$, then the value of $\left(\frac{k_{37^\circ C}}{k_{27^\circ C}}\right)$ is -

A. 2.5

B. 1.0

C. 2.0

D. 1.5

Answer:

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Solved Ncert Exemplar Problems Multiple Choice Question Single Correct Type

1. The role of a catalyst is to change -

A. gibbs energy of reaction

B. enthalpy of reaction

C. activation energy of reaction

D. equilibrium constant

Answer: C

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2. In the presence of a catalyst , the heat evolved or absorbed during the reaction-

A. increases

B. decrease

C. remains unchanged

D. may increase of decrease

Answer: C

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3. Activation energy of a chemical reaction can be determined by-

A. determining the rate constants at standard temperatures

B. determining the rate constant at two temperature

C. determining probability of collision

D. using catalyst

Answer: B

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4. Consider a first order gas phase decomposition reaction given below :

$A(g) \rightarrow B(g) + C(g)$

The initial pressure of the system before decomposition of A was P_i After lapse of time 't' , total pressure of the system increased by x units and becomes $'P_t'$. The rate constant k for the reaction is given as -

A. $k = \frac{2.303}{t} \log. \frac{P_i}{P_i - x}$

B. $k = \frac{2.303}{t} \log. \frac{P_i}{2P_i - P_t}$

C. $k = \frac{2.303}{t} \log. \frac{P_i}{2P_i + P_t}$

D. $k = \frac{2.303}{t} \log. \frac{P_i}{P_i + x}$

Answer: B

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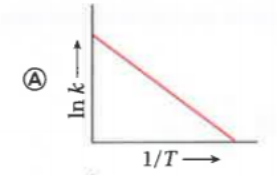
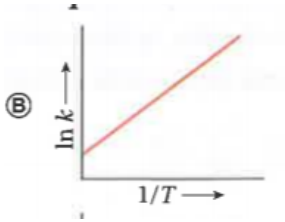
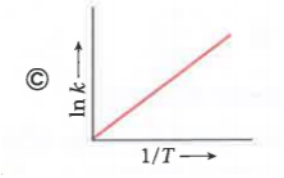
5. According to Arrhenius equations rate constant (k) is equal to $Ae^{-E_a/RT}$. Which of the following options represents the graph of lnk vs. $\frac{1}{T}$ -

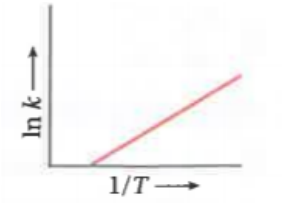
A.



B.



C. 

D. 

Answer: A

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6. Consider the Arrhenius equation given below and mark the correct option -

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

A. rate constant increases exponentially with increasing activation energy and decreasing temperature

B. rate constant increases exponentially with increasing activation energy and decreasing temperature

C. rate constant increases exponentially with decreasing activation energy and decreasing temperature

D. rate constant increases exponentially with decreasing activation energy and increasing temperature

Answer: D

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7. A graph of volume of hydrogen released vs time for the reaction between zinc and dil. HCl is given in the figure. On the basis of this mark the correct option-

A. average rate unto 40 s is $\frac{V_3 - V_2}{40}$

B. average rate unto 40 s is $\frac{V_3 - V_2}{40 - 30}$

C. average rate unto 40 s is $\frac{V_3}{40}$

D. average rate unto 40 s is $\frac{V_3 - V_1}{40 - 20}$

Answer: C

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8. Which of the following statements is not correct about order of a reaction-

A. the order of a reaction can be a fractional number.

B. order of a reaction is experimentally determined quantity

C. the order of a reaction is always equal to the sum of the stoichiometric coefficients of reactants in the balanced chemical equation for a reaction

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

Answer: C

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9. Consider the graph given in question no. 8 . Which of the following options does not show instantaneous rate of reaction at 40th second.

A. $\frac{V_5 - V_2}{50 - 30}$

B. $\frac{V_4 - V_2}{50 - 30}$

C. $\frac{V_3 - V_2}{40 - 30}$

D. $\frac{V_3 - V_1}{40 - 20}$

Answer: B

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10. Which of the following statements is not correct -

A. the rate of a first order reaction decreases with passage of time as the concentration of reactants decreases

B. the rate of a reaction is same at any time during the reaction

C. the rate of a reaction is independent of temperature change

D. the rate of a reaction decreases with increase in concentration of reactant (s)

Answer: A

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11. Which of the following expressions is correct for the rate of reaction given below-

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

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

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

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

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

Answer: C

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12. Rate law for the reaction $A + 2B \rightarrow C$, is found to be Rate =k [A][B] . Concentration of reactant 'B' is doubled keeping the concentration of 'A' constant , the value of rate constant will be-

A. the same

B. doubled

C. 4 times

D. halved

Answer: B

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13. Which of following statements is incorrect about the collision theory of chemical reaction-

A. it considers reacting molecules or atoms to be hard spheres and ignores their structural features

B. no. of effective collisions determines rate of reaction

C. collision of atoms or molecules possessing sufficient threshold energy results into the product formation

D. molecules should collide with sufficient threshold energy & proper orientation for the effective collision.

Answer: C

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14. A first order reaction is 50% completed in $1.26 \times 10^{14} s$. How much time would it take for 100% completion-

A. $1.26 \times 10^{15} s$

B. 2.52×10^{14}

C. $2.52 \times 10^{28} s$

D. infinite

Answer: D

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15. Which of the given statement is incorrect for catalyst-

A. it catalyses the forward and backward reaction to the same extent

B. it alters ΔG of the reaction

C. it is a substance that does not change the equilibrium constant of a reaction.

D. it provides an alternate mechanism by reducing activation energy between reactants and products.

Answer: B

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16. Value of rate constant of a pseudo first order reaction-

A. depends on the concentration of reactants present in small amount

B. depends on the concentration of reactants present in excess

C. is independent of the concentration of reactants

D. depends only on temperature

Answer: B

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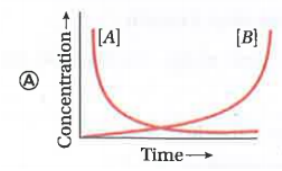
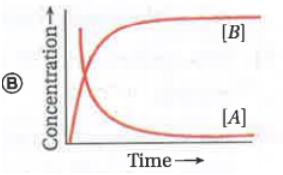
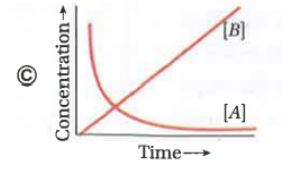
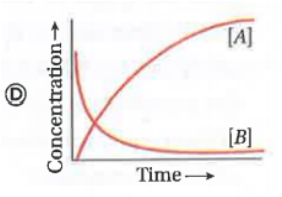
17. Consider the reaction $A \rightarrow B$. The concentration of both the reactants and the products varies exponentially with time . Which of the following figures correctly describes the change in concentration of reactants and products with the -

A. 

B. 

C. 

D. 

Answer: B

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Solved Ncert Exemplar Problems Multiple Choice Question More Than One Correct Type

1. Rate law cannot be determined from balanced chemical equation if-

A. reverse reaction is involved

B. it is an elementary reaction

C. it is a sequence of elementary reactions

D. any of the reactants is in excess

Answer: A::C::D

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2. Which of the given statements are applicable to a balanced chemical equation of an elementary reaction-

A. order is same as molecularity

B. order is less than the molecularity

C. order is greater than the molecularity

D. molecularity can never be zero

Answer: A::D

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3. In any unimolecular reaction-

A. only one reacting species is involved in the rate determining step

B. the order and the molecularity of slowest step are equal to one

C. molecularity of the reaction is one and order is zero

D. both molecularity and order of the reaction are one

Answer: A::B

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4. For a complex reaction -

A. order of overall reaction is same as molecularity of the slowest step

B. order of overall reaction is less than the molecularity of the slowest step

C. order of overall reaction is less than the molecularity of the slowest step

D. molecularity of the slowest step is never zero or non interger

Answer: A::D

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5. At high pressure the following reaction is zero order. $2NH_3(g) \xrightarrow[\text{platinum catalyst}]{1130K} N_2(g) + 3H_2(g)$. Which of the following options are correct for this reaction -

A. rate of reaction= rate constant

B. rate of the reaction depends on concentration of ammonia

C. rate of decomposition of ammonia will remain constant until ammonia disappears completely

D. further increase in pressure will change the rate of reaction.

Answer: A::C::D

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6. During decomposition of an activated complex-

A. energy is always released

B. energy is always absorbed

C. energy does not change

D. reactants may be formed

Answer: A::D

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7. According to Maxwell - Boltzmann distribution of energy-

A. the fraction of molecules with most probable kinetic energy decreases at higher temperatures

B. the fraction of molecules with most probable kinetic energy increases at higher temperatures

C. most probable kinetic energy increases at higher temperatures

D. most probable kinetic energy decreases at higher temperatures

Answer: A::C

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8. In the graph of Maxwell - Boltzmann distribution of energy-

A. area under the curve must not change with increase in temperature.

B. area under the curve increases with increase in temperature.

C. area under the curve decreases with increase in temperature.

D. with increase in temperature curve broadens and shifts to the right hand side.

Answer: A::D

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9. Which of the following statements are in accordance with the Arrhenius equation-

A. rate of reaction increases with increase in temperature

B. rate of reaction increases with decrease in activation energy

C. rate constant decreases exponentially with increase in temperature

D. rate of reaction decreases with decrease in activation energy

Answer: A::B

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10. Mark the incorrect statements-

A. catalyst provides an alternative pathway to reaction mechanism

B. catalyst raises the activation energy

C. catalyst lowers the activation energy

D. catalyst alters enthalpy change of the reaction.

Answer: B::D

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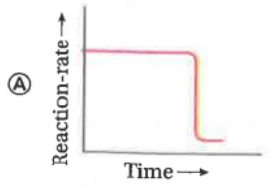
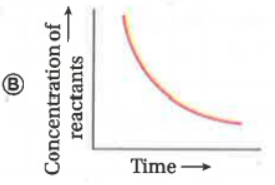
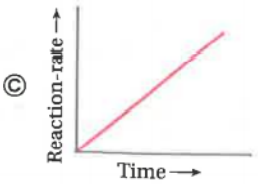
11. Which of the following graphs is correct for a zero order reaction -

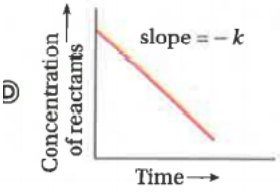
A.



B.



C. 

D. 

Answer: A::D

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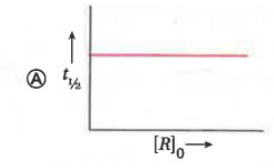
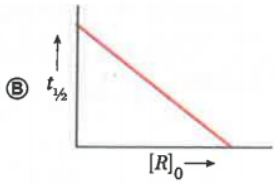
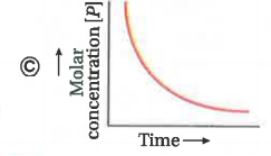
12. Which of the following graphs is correct for a first order reaction -

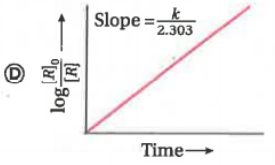
A. 

B. 

C.



D.



Answer: A::D

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Solved Ncert Exemplar Problems Short Answer Type

1. Under what conditions will a bimolecular reaction be of the first order?

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2. For a zero order reaction, $2A + B \rightarrow C$ write its rate equation.

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3. How will you determine the rate-equation of the following reaction: $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

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4. Order and molecularity are the same for what type of reactions?

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5. If the concentration of a reactant A of a reaction is tripled, the rate of the reaction increases by 27 times. Determine the order of the reaction.

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6. Write the equation for the time required for a zero order reaction to reach completion.

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7. For a reaction, $A + B \rightarrow C$ Product, the rate equation is $= k[A][B]^{3/2}$ Explain whether the reaction is an elementary reaction.

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8. For a certain reaction, though most of the molecules possess energy greater than the threshold energy. the rate of the reaction is very slow. Explain.

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9. For a general reaction $A \rightarrow B$ form the graph of concentration of A vs time, answer the following questions:

What is the order of the reaction?

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10. For a general reaction $A \rightarrow a$ form the graph of concentration of A vs time, answer the following questions:

What is the slope of the graph?

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11. For a general reaction $\rightarrow B$ form the graph of concentration of A vs time, answer the following questions:

What is the unit of the rate constant ?

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12. $H_2(g)$ and $O_2(g)$ have a very strong tendency to react with each other. However, keeping them in the same container at room temperature, do not produce water. Explain.

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13. Why does the rate of a reaction increase with rise in temperature?

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14. Why aren't the fuels ignited on their own though there is a large amount of oxygen in the air?

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15. Trimolecular reactions are very rare. Explain.

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16. Why does the rate of a reaction keep decreasing as the reaction advances?

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17. Explain with the help of an example, 'the rate of a chemical reaction cannot be determined only from its thermodynamic feasibility.

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18. In the redox titration, why is it important to warm the oxalic acid before titrating it with $KMnO_4$?

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19. Can the molecularity of a reaction be zero? Explain with example.

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20. 'Molecularity' applies only to elementary reactions However 'order' applies to both elementary as well as complex reactions. Explain.

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Solved Ncert Exemplar Problems Assertion Reason Type

1. Assertion (A) : The order of a reaction can be zero or a fraction .

Reason (R) : Order cannot be determined from the balanced equation.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements and (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) is wrong statement but (R) is correct statement .

Answer: B

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2. Assertion (A) : The order and molecularity of the reaction is the same.

Reason (R) : Order is determined experimentally. Molecularity is the sum of all the stoichiometric coefficients of the rate- determining elementary step.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements and (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) is wrong statement but (R) is correct statement .

Answer: D

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3. Assertion (A) : The enthalpy of a reaction does not change in the presence of a catalyst.

Reason (R) : A catalyst takes part in the reaction, forms an activated complex and reduces the activation energy. However, the energy difference between the reactants and the products remain the same.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements and (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) is wrong statement but (R) is correct statement .

Answer: A

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4. Assertion (A) : All collisions between the reactant molecules result in product formation .

Reason (R) : The collision between molecules having sufficient amount of energy and proper orientations, results in the formation of compounds.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements and (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) is wrong statement but (R) is correct statement .

Answer: D

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5. Assertion (A) : The values of the rate-constants of simple and complex molecules, determined with the help of Arrhenius equation, are all

correct.

Reason (R) : A chemical change does not depend on the orientation of the molecules at the moment of a collision.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements and (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) is wrong statement but (R) is correct statement .

Answer: C

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Solved Ncert Exemplar Problems Long Answer Type

1. All effective collisions (having the threshold energy) do not necessarily bring in a chemical change. Explain with an example.

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2. How does enthalpy of a reaction remain unaltered in the presence of a catalyst, explain.

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3. Explain the difference between the average and instantaneous rates of a reaction.

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4. What is a pseudo first order reaction? Explain with the help of an example.

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Mcq Hotspot Single Correct Type

1. At a particular time , in the reaction $3A + 2B \rightarrow 4C$ -

A. the rate of disappearance of B is 1.5 times that of A

B. the rate of disappearance of A is 1.5 times that of B

C. the rate of formation of C is half of the rate of disappearance of B

D. the rate of formation of C is 1.5 times greater than the rate of disappearance of A

Answer: B

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2. At a particular time , in the reaction $aA + bB \rightarrow cD$, if the rate of disappearance of B is thrice that of A and the rate of formation of D is

twice the rate of disappearance of A , then the ratio between a, b and c will be -

A. $1:2:1$

B. $1:2:3$

C. $1:3:2$

D. $2:3:1$

Answer: C

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3. After 200s of the initiation of the reaction, $2A \rightarrow 4B + \frac{1}{2}D$, the concentration of B is $4 \times 10^{-2} \text{mol.L}^{-1}$. At the particular time , the rate of the reaction is -

A. $10^{-4} \text{mol.L}^{-1}.\ s^{-1}$

B. $2 \times 10^{-4} \text{mol.L}^{-1}$

C. $5 \times 10^{-5} \text{mol.L}^{-1}.\ s^{-1}$

D. $2.5 \times 10^{-4} \text{mol.L}^{-1}. s^{-1}$

Answer: C

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4. The rate of formation of $NO_2(g)$ at a particular instance is $4 \times 10^{-2} \text{mol.L}^{-1}. s^{-1}$ in case of the following reaction : $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ The rate of disappearance of $N_2O_5(g)$ at that particular time will be -

A. $10^{-2} \text{mol. L}^{-1}. s^{-1}$

B. $2 \times 10^{-2} \text{mol. L}^{-1}. s^{-1}$

C. $4 \times 10^{-2} \text{mol. L}^{-1}. s^{-1}$

D. $8 \times 10^{-2} \text{mol. L}^{-1}. s^{-1}$

Answer: B

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5. $2A(g) + B(g) \rightarrow C(g)$ is a gaseous elementary reaction , the rate of which is found to be $r \ \text{mol.L}^{-1}.s^{-1}$. If the volume of the reaction system is suddenly reduced to 1/4th of its original volume , then the rate of the reaction will be -

A. $8r\text{mol.L}^{-1}.s^{-1}$

B. $\frac{r}{16}\text{mol.L}^{-1}.s^{-1}$

C. $16r\text{mol.L}^{-1}.s^{-1}$

D. $64r\text{mol.L}^{-1}.s^{-1}$

Answer: D

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6. At a particular temperature , a certain reaction is separately carried out in the presence as well as in the absence of a catalyst . Which one of the following quantities will have different values under these two conditions -

A. reaction enthalpy

B. equilibrium constant

C. rate constant

D. gibbs free energy

Answer: C

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7. The rate of the reaction , $A_3B \rightarrow \frac{3}{2}A_2 + \frac{1}{2}B_2$, is $x\text{mol.L}^{-1}.s^{-1}$. If the rates of formation of A_2 and B_2 are x_1 and $x_2\text{mol.L}^{-1}.s^{-1}$, respectively , then -

A. $x_1 : x_2 = 1:2$

B. $x_1 : x_2 = 3:2$

C. $x_1 : x_2 = 3:1$

D. $x_1 : x_2 = 2:1$

Answer: C

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8. The reaction -rate of the reaction $AB_3 \rightarrow \frac{1}{2}A_2 + \frac{3}{2}B2$ can be expressed by any one of the following equations : $\frac{-d[AB_3]}{dt} = k_1[AB_3], \frac{d[A_2]}{dt} = k_2[AB_3]$ or, $\frac{d[B_2]}{dt} = k_3[AB_3]$ The ratio between k_1, k_2 and k_3 is -

A. $1:2:3$

B. $2:1:3$

C. $3:2:1$

D. $2:3:1$

Answer: B

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9. $2A(g) + B(g) \rightarrow$ Product. At a particular temperature, the reaction - rate is r and partial pressures of A and B are p_A and p_B, respectively . At the same temperature if partial pressures of A and B are $p_A/2$ and p_B respectively , then reaction - rate becomes $r/4$, and when they are $p_A/2$ and $p_B/2$, respectively , reaction - rate becomes $r/2$. Rate equation of the reaction is -

A. $r = k \times p_A \times p_B$

B. $r = k \times p_A^{1/2} \times p_B$

C. $r = k \times p_A \times p_B^2$

D. $r = k \times p_A^2 \times p_B^{-1}$

Answer: D

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10. The initial concentration of A in the reaction $A \rightarrow B$ is 0.01 (M) . If the initial concentration of A is changed to 0.02(M) , then -

A. the values of both reaction -rate and rate constant will increase

B. the value of reaction -rate will increase but that of rate constant will decrease

C. the value of reaction -rate will decrease but that of rate constant will increase

D. the value of reaction -rate will increase but that of rate constant will remain unchanged

Answer: D

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11. For a given reaction $A \rightarrow B$, then time required for 75% disappearance of A is twice that required for 50% disappearance of A . The order of the reaction with respect to A is -

A. 0

B. 1

C. 2

D. 3

Answer: B

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12. In a zero -order reaction , initial concentration of the reactant is a and value of the constant is k . If the time required for the completion of the reaction is t and the value of its half-life $t_{1/2}$ then-

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

B. $t_{1/2} = \frac{a}{k}$

C. $\frac{t}{t_{1/2}} = 2$

D. $\frac{t}{t_{1/2}} = \frac{1}{2}$

Answer: C

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13. The experimentally determined rate law for the following reaction is , rate $= k[H_2][ICl]H_2(g) + 2ICl(g) \rightarrow 2HCl(g) + I_2(g)$. Two probable reaction mechanisms for this reaction are -

Mechanism -I : $H_2(g) + 2ICI(g) \rightarrow 2HCl(g) + I_2(g)$

Mechanism - II : $H_2(g) + ICl(g) \rightarrow HCl(g) + HI(g)$ (slow)

$$HI(g) + ICl(g) \rightarrow HCl(g) + I_2(g) \text{ (fast)`}$$

Which one of the following statements is correct with regard to these mechanisms -

A. both the mechanisms I and II support the experimental rate equation

B. neither of the mechanisms I and II support the experimental rate equation

C. only the mechanism I supports the experimental rate equation

D. only the mechanism II supports the experimental rate equation

Answer: D

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14. At a particular temperature , the rate constant of the reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ is $6 \times 10^{-5} s^{-1}$. If the reaction -rate of the reaction is $4.2 \times 10^{-5} \text{mol.L}^{-1}. s^{-1}$, then concentration of $N_2O_5\left(\text{mol.L}^{-1}\right)$ will be -

A. 0.83

B. 0.70

C. 0.64

D. 0.58

Answer: B

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15. If the unit of the rate constant of a reaction is $dm^{3/2}. mol^{-1/2}. s^{-1}$, then the overall order of the reaction will be -

A. $\frac{1}{2}$

B. 2

C. $\frac{3}{2}$

D. $\frac{2}{3}$

Answer: C

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16. In the reaction $aA \rightarrow bB$, if the concentration of A is doubled , then rate of formation of B also becomes double. The order of the reaction is -

A. 0

B. 1

C. 2

D. 0.5

Answer: B

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17. The rate constant of the reaction $A \rightarrow B$ is $6.932 \times 10^{-3} \text{min}^{-1}$. If initial concentration of A is 1(M) , then , the rate of the reaction (in $mol.\ L^{-1}.\ \text{min}^{-1}$) after 100 min will be -

A. 3.192×10^{-2}

B. 2.764×10^{-3}

C. 6.932×10^{-2}

D. 3.466×10^{-3}

Answer: D

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18. A first order reaction takes t_1 and $t_2 s$ for its 20% and 60% completions , respectively . If its half-life is $t_3 s$, then -

A. $t_2 - t_1 > t_3$

B. $t_2 - t_1 < t_3$

C. $t_2 - t_1 = t_3$

D. cannot be predicted

Answer: C

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19. In acidic medium hydrolysis of dilute aqueous solution of sucrose is -

A. unimolecular and first order

B. bimolecular and second order

C. bimolecular & first order

D. none of the above

Answer: C

Watch Video Solution

20. Which one of the following statement is correct -

A. bimolecular reactions are always of second order type

B. zero order reaction cannot occur in a single step

C. for the reaction $A + B \rightarrow C$, rate = k [A] [B] and the rate constant of the reaction depends on the initial concentrations of A and B

D. for the reaction $P + Q \rightarrow D$, rate $= k[P][Q]^{1/2}$ so it is an elementary reaction

Answer: B

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21. The reaction $A \rightarrow B$ is a first order reaction . If 1 h time is required for the production of 0.6 mol of B from 0.8 mol of A , then the time required for the production of 0.675 mol of B from 0.9 mol of A will be -

A. 30 min

B. 50 min

C. 55 min

D. 60 min

Answer: D

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22. Probable reaction mechanism of the reaction $2O_3(g) \rightarrow 3O_2(g)$ is $O_3(g) \Leftrightarrow O_2(g) + O(g)(\text{fast})O_3(g) + O(g) \rightarrow 2O_2($

. Rate law for the reaction -

A. reaction -rate $= k\frac{[O_3]}{[O_2]}$

B. reaction -rate $= k\frac{[O_2]}{[O_3]}$

C. reaction -rate $= k\frac{[O_3]^2}{[O_2]}$

D. reaction -rate $= k\frac{[O_3]}{[O_2]^2}$

Answer: C

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23. $2A(g) \rightarrow 2B(g) + 3C(g)$ is a first order reaction . When the reaction started , the pressure of the system was P_0 , and it was found to be P_t after time t . The rate constant of the reaction can be expressed by the equation -

A. $k = \frac{2.303}{k} \log. \frac{3P^0}{P_t}$

B. $k = \frac{2.303}{k} \log. \frac{3P^0}{3P^0 - 2P_t}$

C. $k = \frac{2.303}{k} \log. \frac{3P^0}{5P^0 - 2P_t}$

D. $k = \frac{2.303}{k} \log. \frac{P^0}{5P^0 - P_t}$

Answer: C

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24. In a zero order reaction , concentration of the reactant reduces to 0.35mol.L^{-1} after 30s . If the rate constant of the reaction is $0.035\text{mol.L}^{-1}.s^{-1}$, then its half-life is -

A. 10s

B. 12s

C. 15s

D. 20s

Answer: D

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25. If temperature is increased , then -

A. the value of the rate constant for an endothermic reaction increases

B. the value of the constant for an endothermic reaction decreases

C. the values of the constant for both exothermic and endothermic reaction increases

D. the activation energy of a reaction decreases

Answer: C

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26. The activation energy of a reaction depends on -

A. temperature

B. initial concentration of the reactant

C. effective collisions among the reactant molecules

D. nature of the reactants

Answer: D

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27. For a reaction, $A \rightarrow B$, $\Delta H = +xkJ.mol^{-1}$ and activation energy is $\mathrm{ykj.mol}^{-1}$. If activation energy of the reaction , $B \rightarrow A$ is $\mathrm{z\ kJ.mol}^{-1}$, then -

A. $z > y$

B. z = y - x

C. $z = y + x$

D. $z = -y + x$

Answer: B

Watch Video Solution

28. The activation energy of a reaction is zero . If the rate constant of the reaction at 300K is $3.2 \times 10^{6} s^{-1}$, then at 316K the rate constant of the reaction will be -

A. $3.2 \times 10^{12} s^{-1}$

B. $6.4 \times 10^6 s^{-1}$

C. $3.2 \times 10^6 s^{-1}$

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

Answer: C

Watch Video Solution

29. The rate of a reaction at $37^\circ C$ is twice the rate of the reaction at $27^\circ C$. The activation energy $\left(kJ.\, mol^{-1}\right)$ of the reaction is -

A. 48.2

B. 37.9

C. 62.4

D. 53.6

Answer: D

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30. Arrhenius equation: $k = Ae^{-E_a/RT}$. Which one of the following statements related to E_a is correct -

A. all collisions among reactant molecules having energy greater than E_a leads product formation

B. collisions among reactant molecules having energy less than E_a do not cause reaction

C. raising temperature decreases the value of E_a and thereby increases the rate of the reaction.

D. E_a is the total energy of the reacting molecules

Answer: B

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31. For every 10 K rise in temperature , the rate of a reaction becomes double. If temperature is increased from 303K to 353K , then the rate of the reaction at 353K compared to 303K will be -

A. 8 times

B. 16 times

C. 32 times

D. 64 times

Answer: C

Watch Video Solution

32. At 300K , frequency factor (A) of a first order reaction is 1000 times its rate constant . The activation energy of the reaction $\left(\text{in kJ. Mol}^{-1}\right)$ is -

A. 12.56

B. 7.48

C. 15.69

D. 17.22

Answer: D

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33. A reaction occurs in three steps . The rate constants of the first , second and third steps of the reaction are k_1, k_2 and k_3 respectively and the overall rate constant of the reaction is $k = k_1 k_2 / k_3$. If the activation energies of the first , second and third step of the reaction are 30, 44 and $56 \mathrm{kJ.mol}^{-1}$ respectively , then the overall activation energy of the reaction (in kJ.mol) is -

A. 23

B. 37

C. 18

D. 42

Answer: C

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34. At a given initial concentration of reactant , the half-life of a reaction is found to be 50min . If the initial concentration is quadrupled , then half-life of the reaction becomes 25min . The order of the reaction is -

A. $\frac{1}{2}$

B. $\frac{3}{2}$

C. 2

D. $\frac{2}{3}$

Answer: B

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35. For a reaction , the graph obtained by plotting $t_{1/2}$ of the reaction against initial concentrations $[A]_0$ of the reactant is a straight line passing through the origin . The order of the reaction is -

A. 0

B. 1

C. 2

D. 3

Answer: A

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36. The slope and intercept of a logk vs 1/T graph of a first order reaction is $-1.25 \times 10^4 k$ and 14.34 respectively . If at a fixed temperature , the value of k is $4.51 \times 10^{-5} s^{-1}$, then the value of the temperature is -

A. $550.8K$

B. $669.1K$

C. $710.5K$

D. $612.4K$

Answer: B

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37. A reaction , $2A \rightarrow$ product , follows a zero order kinetics. If the rate constant of the reaction is $4.0 \times 10^{-4} \text{mol.L}^{-1}.s^{-1}$, then the rate of disappearance of A is -

A. $4.0 \times 10^{-4} \text{mol.L}^{-1}.s^{-1}$

B. $2.0 \times 10^{-4} \text{mol.L}^{-1}.s^{-1}$

C. $8.0 \times 10^{-4} \text{mol.L}^{-1}.s^{-1}$

D. $1.2 \times 10^{-3} \text{mol.L}^{-1}.s^{-1}$

Answer: C

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38. Initial concentration of the reactant of a first order reaction with a rate constant of 0.01min^{-1} is $[A]_0$ Concentration of the reactant changes tao $[A]_1$ after time t_1 and to $[A]_2$ after time t_2. If $t_2 - t_1$ is 100 min, then -

A. $[A]_1 = 2.303 \times [A]_2$

B. $[A]_2 = 2.303 \times [A]_1$

C. $[A]_2 = 4 \times [A]_1$

D. $[A]_1 = 2.717 \times [A]_2$

Answer: D

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39. Half -life of a zero order reaction is 60 min . In an experiment , the initial concentration of the reactant is 2(M) . Time required for the

change in concentration from 0.5 to 0.25 (M) if -

A. 240 min

B. 60 min

C. 30 min

D. 15 min

Answer: D

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40. A first order reaction takes 46 min for its 99% completion . How much time did it take for its 75% completion -

A. 15.33 min

B. 13.86 min

C. 23.00 min

D. 16.21 min

Answer: B

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41. If reversible reaction is exothermic in the forward direction , then -

A. activation energy is larger in the reverse reaction compared to the forward reaction

B. both the forward and reverse reactions have the same activation energy

C. activation energy for the reverse reaction is small

D. reaction does not require activation energy , as it is exothermic.

Answer: A

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42. An endothermic reaction have an activation energy of $E_a kJ.\, mol^{-1}$, and the enthalpy change in the reaction is $\Delta H kJ.\, mol^{-1}$.The minimum value of E_a is -

A. zero

B. $< \Delta H$

C. $= \Delta H$

D. $> \Delta H$

Answer: D

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43. In the reaction , $A(g) \rightarrow 2B(g) + \frac{1}{2}C(g)$, rate of formation of C is $10^{-3} \text{mol.L}^{-1}.\, s^{-1}$. Therefore , rate of disappearance $\left(\text{in mol.L}^{-1}.\, s^{-1}\right)$ of A and rate of formation $\left(\text{in mol.L}^{-1}.\, s^{-1}\right)$ of B , respectively , are -

A. $2.5 \times 10^{-3}, 5.0 \times 10^{-3}$

B. $2.0 \times 10^{-3}, 4.0 \times 10^{-3}$

C. $3.1 \times 10^{-2}, 6.2 \times 10^{-2}$

D. $1.0 \times 10^{-3}, 0.5 \times 10^{-3}$

Answer: B

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44. In the reaction,

$A + 3B \rightarrow 2C, \frac{d[C]}{dt} = 2 \times 10^{-4} \text{mol.L}^{-1}. s^{-1}$

So , $\frac{-d[B]}{dt}\left(\text{in mol.L}^{-1}. s^{-1}\right)$ is -

A. 1.74×10^{-4}

B. 6.60×10^{-5}

C. 3.19×10^{-4}

D. 3.00×10^{-4}

Answer: D

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45. A reaction , $X \rightarrow$ products , is first order. If takes 40min for its concentration to drop from 0.1 (M) to $5 \times 10^{-3}(M)$ .What would the concentration of X be , when the rate of the reaction is $7.5 \times 10^{-4}(M)\min^{-1}$ -

A. 0.05 (M)

B. 0.04 (M)

C. 0.01(M)

D. 0.025 (M)

Answer: C

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Mcq Hotspot More Than One Correct Type

1. Factors which affect rate constant of a reaction are -

A. concentration of reactants

B. temperature

C. concentration of products

D. catalyst

Answer: B::D

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2. The rate constants of some reactions are given below :

(i) $k = 1.2 \times 10^{-3} \mathrm{dm}^3 . \mathrm{mol}^{-1} . s^{-1}$

(ii) $k = 5.2 \times 10^{-2} \mathrm{atm}^3 . s^{-1}$

(iii) $k = 3.2 \times 10^{-3} \mathrm{dm}^{3/2} . \mathrm{mol}^{-1/2} . s^{-1}$

(iv) $k = 4.5 \times 10^{-3} \mathrm{dm}^6 . \mathrm{mol}^{-2} . s^{-1}$

Reactions with the same overall order are -

A. (i)

B. (ii)

C. (iii)

D. (iv)

Answer: B::D

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3. The experimental rate equation for the reaction, $CO(g) + Cl_2(g) \rightarrow COCl_2(g)$ is , rate $= k[CO][Cl_2]^{3/2}$. Which of the following comments are correct regarding this reaction -

A. overall order of the reaction $= \frac{5}{2}$

B. this is an elementary reaction

C. the reaction occurs in several elementary steps

D. molecularity of the reaction is 2

Answer: A::C

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4. $aA + bB \rightarrow$ Products . In the reaction , initial concentrations of the reactants A and B are x and y $mol.\, L^{-1}$ respectively and the initial reaction -rate is r_0 . If x is doubled while y is held constant , then reaction -rate becomes $2r_0$ .If y is made four times its initial value while x is held constant. then reaction -rate becomes $2r_0$. Which of the comments about this reaction -are correct-

A. overall order of the reaction $= \frac{3}{2}$

B. this is an elementary reaction

C. order of the reaction with respect to A = $\frac{1}{2}$

D. order of the reaction with respect to B $= \frac{1}{2}$

Answer: A::D

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5. Which of the following comments are incorrect-

A. in a zero order reaction , concentration of reactant decrease exponentially.

B. time required for completion of a zero order reaction is twice the value of the half-life of the reaction

C. at a fixed temperature , in a first order reaction , time required for conversion of 3/4 th of the reactant

D. at a temperature of TK , the activation energy of a reaction is $RT\ J.mol^{-1}$. The rate constant and frequency factor of the reaction have the same value.

Answer: A::C::D

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6. At $25^{\circ}C$, the activation energies for a reaction in absence and presence of a catalyst are E_a and $(E_a - 2)\text{kcal.mol}^{-1}$, respectively . For the reaction , the reaction -rate and enthalpy change in absence of catalyst are $r\text{mol.L}^{-1}.\ s^{-1}$ and $\Delta H k\text{cal.mol}^{-1}$, respectively . which of the following would be true regarding the reaction when it is carried out in presence of a catalyst -

A. reaction -rate $= 14 \times r\text{mol}^{-1}.\ L.\ s^{-1}$

B. reaction -rate $= 28 \times r\text{mol}^{-1}.\ L.\ s^{-1}$

C. change in enthalpy $= \Delta H\text{kcal.mol}^{-1}$

D. change in enthalpy $= \dfrac{\Delta H}{2}\text{kcal.mol}^{-1}$

Answer: B::C

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7. In acidic medium , hydrolysis of $CH_3COOC_2H_5$ occurs according to the reaction given below :

$CH_3COOC_2H_5(aq) + H_2O(l) \xrightarrow{H+} CH_3COOH(aq) + C_2H_5OH(aq)$

In the reaction mixture, if $[H_2O] > > [CH_3COOC_2H_5]$, then which of the following quantities would be true for the reaction -

A. molecularity = 2

B. overall order = 2

C. molecularity = 1

D. overall order = 1

Answer: A::D

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8. For the reaction , $A \rightarrow P$, the value of the rate constant (k) is found to vary with temperature according to the equation given below :

$$\log k = \frac{2000}{T} + 0.6$$

If the pre-exponential factor and activation energy for the reaction are A and E_a , respectively, then -

A. $A = 1.0 \times 10^6 s^{-1}$

B. $A = 6.0 s^{-1}$

C. $E_a = 38.3 \text{kJ.mol}^{-1}$

D. $E_a = 9.2 \text{kJ.mol}^{-1}$

Answer: C

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9. Which of the following relations are not true -

A. $t_{1/2} = \frac{[A]_0}{2K}$, for a zero order reaction

B. $t_{1/2} = \frac{0.693}{k}$, for a first order reaction

C. $t_{1/2} = \frac{1}{2k[A]_0}$, for a second order reaction

D. $t_{1/2} = \frac{2.303}{k[A]_0}$,for a first order reaction

Answer: C::D

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10. In case of first order reaction -

A. extent of reaction of the reactant is given by $\left(1 - e^{-kt}\right)$

B. Graph obtained by plotting reciprocal of the concentration of reactant against time is a straight line.

C. time required for 75% completion of the reaction is thrice the value of $t_{1/2}$

D. Pre-exponential factor in Arrhenius equation has an unit of $(time)^{-1}$

Answer: A::D

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11. Which of the following comments are true -

A. for a complex reaction , the fastest step is the rate- determining step

B. for most reactions , a rise in temperature by $10^{\circ}C$ leads to almost a 2 fold increase in the rate of reaction

C. in a reaction , collisions among reactant molecules with energy greater than threshold energy lead to product formation

D. for a zero order reaction , half-life is directly proportional to the initial concentration of reactant

Answer: B::D

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12. For the reaction , $RCl + NaOH \rightarrow ROH + NaCl$ the rate law is : Rate = k [RCl] . In the reaction -

A. rate becomes twice , when [NaOH] is made twice

B. rate becomes half, when [RCl] is halved

C. rate increases with rise in temperature

D. rate does not depend on temperature

Answer: B::C

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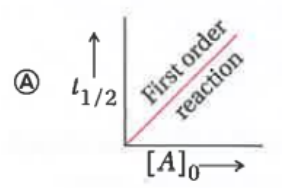
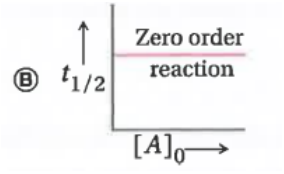
13. Which of the following graphs are the correct representations for the concerned reactions -

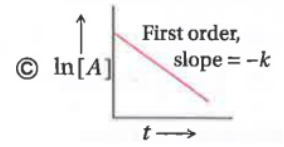
A.

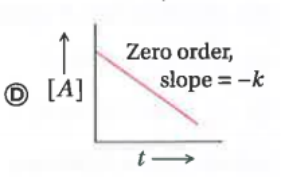


B.



C.





D.

Answer: C::D

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14. The rate law for the reaction involving BrO_3^- and Br^- in acid medium is :

$$-\frac{d[BrO_3^-]}{dt} = k[BrO_3^-][Br^-][H^+]^2$$

Which of the following comments regarding the reaction are ture -

A. rate does not depend on the concentration of acid

B. rate change with the variation of pH of the solution

C. doubling $[H^+]$ makes quadruples the rate

D. it is a pseudo first order reaction

Answer: A::B::C

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15. Which of the following statements with regard to the role of a catalyst in a reaction are not true -

A. it changes the value of ΔH

B. it decreases the activation energy for both forward and reverse reactions to the same extent

C. it causes the reaction to follow a reaction path involving high activation energy

D. average kinetic energy of the reactant molecules increases in its presence

Answer: A::C::D

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16. The correct relations for a first order reaction are -

A. $k = \frac{1}{t} In\left(\frac{C_0}{C_t}\right)$

B. $t = \frac{2.303}{t} \log\left(\frac{a}{a-x}\right)$

C. $[A]_0 = [A]_e^{-kt}$

D. $t_{1/2} = \frac{In2}{k}$

Answer: A::B::D

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17. The correct forms of Arrhenius equation are -

A. $In\left(\frac{A}{k}\right) = \frac{E_a}{RT}$

B. $\frac{dInk}{dt} = \frac{E_a}{RT^2}$

C. $InA = Ink + \frac{E_a}{2.303RT}$

D. $\log\left(-\frac{E_a}{RT}\right) = \frac{k}{A}$

Answer: A::B

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18. Which of the following correct comments about a zero order reaction are -

A. unit of rate constant : $\mathrm{mol.L}^{-1}.\ s^{-1}$

B. rate of the reaction does not depend on the concentration of reactant

C. half-life of the reaction depends on the concentration of reactant

D. rate of the reaction does not depend on temperature

Answer: A::B::C

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Exercise Very Short Answer Type Questions

1. Give two examples each of very fast and very slow reactions.

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2. For a general reaction , $2A \rightarrow 3C$ Write the relation between the rate of disappearance of A and the of formation of C.

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3. Write the units of reaction-rate for reactions occurring in solutions and in gaseous medium.

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4. What do you mean by rate law?

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5. Are the rate equations obtained from law of mass action always equal to those obtained experimentally? If not, then for what type of reactions are they equal?

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6. What will be the unit of rate constant of 'n th' order reaction if the concentration of reactant is expressed as $\mathrm{mol.dm}^{-3}$ and time is expressed as second.

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7. For the reaction $A + B \rightarrow C$ the order with respect to A is 2 and with respect to B is $\frac{1}{2}$ Write the rate equation of the reaction. Determine its overall order.

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8. $A + B \rightarrow C$, on doubling the concentration of 'A , the rate of the reaction doubles. However on doubling the concentration of B , the rate of the reaction remains unaltered. Write the rate law of the reaction.

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9. For the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ express the rate of the reaction with respect to the reactants and the product formed.

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10. $aA + bB \rightarrow$ Product, The experimental rate law of the give reaction is: rate $= k[A]^2[B]$ If concentration of A is halved and B is doubled, then what will be the effect on rate constant ?

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11. The unit of rate constant of a reaction is $(\mathrm{mol})^{-1/2}.(\mathrm{dm})^{3/2}.s^{-1}$. Determine the order of the reaction.

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12. $A \rightarrow B$ at a specific temperature, the rate constant of the reaction is $2.8 \times 10^{-3}\mathrm{mol}^{-1}.L.s^{-1}$ If the concentration of A is halved, what will be the rate of the reaction?

Watch Video Solution

13. For a zero order reaction, the initial concentration of the reactant $= [A]_0$ and after time 't' from the initiation of the reaction, the concentration =[A] . What will be the nature of the graph of '[A]' vs 't,

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14. What is slope of the graph of log[A] vs t for a first order reaction, where [A] is the concentration of reactant at any time t during the reaction.

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15. Plot of rate of a reaction against concentration of reactant gives a straight line parallel to the axis of concentration . What is the order of the reaction >

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16. What do you mean by temperature coefficient?

Watch Video Solution

17. Two first order reactions have same frequency factor but different activation energies. At a certain temperature, the rate constant of which reaction is more?

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18. If the change in enthalpy of a reaction in absence of a catalyst is $\mathrm{xkJ.mol}^{-1}$ what will be the change in enthalpy of the reaction in the presence of a catalyst?

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19. The ΔH of a reversible reaction in negative. Among the forward and the backward reactions, which will have a higher activation energy?

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Exercise Fill In The Blanks

1. The rate of a reaction is directly proportional to the .....

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2. Hydrolysis of ethyl acetate in ..... medium is a ..... order reaction.

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3. $SO_3 \rightarrow SO_2 + \frac{1}{2}O_2$, The rate of this reaction with respect to O_2 .....

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4. $\frac{1}{2}A \rightarrow 2B$ The relation between the rate of disappearance of A and the of production of B is .....

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5. Plot of rate of reaction against the concentration of the reactant gives a straight line passing through the origin. The order of the reaction is .....

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6. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, For this reaction ..... $\times$ rate of disappearance of H_2 = ... $\times$ rate of production of NH_3

A. $\frac{1}{3}, \frac{1}{2}$

B. $\frac{1}{3}, \frac{1}{4}$

C. $\frac{1}{6}, \frac{1}{2}$

D. $\frac{1}{3}, \frac{1}{3}$

Answer: A

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7. The rate constant a reaction at a given temperature is the rate of reaction when the molar concentration of each reactant is .....

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8. Arrhenius equation is, $k = A.\, e^{-E_a/RT}$ .k = A if the value of T is .....

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9. The coefficient of temperature of a reaction is 2. If the temperature is raised by 20° , the rate of reaction increase by ..... times.

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10. The activation energy of the forward reaction of a reversible exothermic reaction is $50 \text{kcal} \text{mol}^{-1}$ and the activation energy of the backward reaction is $80 \text{kcal}.\text{mol}^{-1}$ The heat of this reaction is .....

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11. The half-life $\left(t_{1/2}\right)$ was determined for a reaction at various initial concentrations of the reaction (a). It was observed that, the value of $\left(a \times t_{1/2}\right)$ remained constant all through the reaction. The order of the reaction is.....

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12. The half-life $\left(t_{1/2}\right)$ of a first order reaction= 25min. After 50min, ... Part of the reaction will be left.

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13. The order of a reaction is $\frac{3}{2}$. If concentration is expressed in mol... and time in $\mathrm{mol.L}^{-1}$ and in 's' , then the unit of rate constant of the reaction would be .....

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14. $2A + B \rightarrow 3C + D$, This reaction is an elementary reaction. The order and molecularity of this reaction are ..... and ..... respectively.

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15. $2A + 3D \rightarrow$ Product. If the order of the reaction with respect to A is 1 and with respect to D is 2, then the rate law of the reaction is.....

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16. The minimum energy that the reactant molecules acquire to get activated and form products is known as.....

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17. If activation energy of a reaction is higher than its reaction- rate would be ..... and if activation energy of a reaction is lower its reaction-rate would be .....

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18. According to Arrhenius equation, the slope of the plot of logk against 1/T is .....

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19. To make effective collisions the barriers that the reacting species should overcome are.....and.....

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20. If the units of reaction-rate and rate constant of a reaction are equal. the order of the reaction is .....

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21. The reaction with molecularity greater than.....do not exist.

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22. Plot of $t_{1/2}$ against different initial concentration given a straight line parallel to the concentration axis. The order of the reaction is.....

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Exercise Short Answer Type Questions

1. What do you mean by average rate and instantaneous rate of a reaction ? Give their mathematical expression.

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2. "Average rate of reaction does not give the true picture of the reaction - rate." Explain.

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3. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$, In this reaction, if the rate of formation of $2H_2O(g)$ is $\text{xmol.L}^{-1}.s^{-1}$, what will be the of disappearance of $H_2(g)$ and $O_2(g)$?

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4. For the reaction , $A + 2B \rightarrow 3C + 4D$, the order with respect to each of A and B is 1 . Write the differential rate equation for the reaction.

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5. The rate at which a piece of coal burns is much slower than the rate of burning of powdered coal of equal weight. Explain.

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6. $xA + yB + zC \rightarrow$ Product , For this reaction : (a) rate of reaction becomes half when concentration of A is doubled. (b) rate of reaction remains the same when concentration of B is doubled. (c) the rate of reaction becomes eight times when concentration of C is doubled. Determine the overall order of the reaction .

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7. $A + B \rightarrow$ Product . The rate of this reaction is , rate =k[A][B] . How will you convert it into a pseudo unimolecular reaction ?

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8. There are almost no elementary reactions with molecularity greater than three . Explain.

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9. The overall rate of the reaction does not remain the same throughout , the course of a chemical reaction . Explain.

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10. Give an example of a reaction whose rate does not depend on the concentration of reactant during the course of the reaction.

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11. $A \rightarrow B$, Rate of this reaction is expressed by $-\frac{d[A]}{dt}$ or $+\frac{d[B]}{dt}$. What is the significance of (-) sign and (+) sign in this case ?

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12. The rate law of reaction is given by: rate $= k[A][B]^2$. In which of the following cases will the rate of the reaction be the highest ? (a) Volume of the reaction mixture = 1L, number of moles A = 2 and B = 1 (b) Volume of the reaction mixture = 500mL, number of moles of A = 2 and B = 1.

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13. "The instantaneous reaction -rate indicates actual rate"- Explain.

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14. Among 'order' and 'molecularity' which one is obtained experimentally ? For what type of reactions , the order can be determined from the stoichiometric coefficients of the reactants and products of a balanced chemical reaction ?

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15. The order and molecularity of an elementary reaction are the same - explain.

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16. The term 'order' is not applicable for all kinds of reactions -explain with example.

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17. Will the molecularity of a zero order reaction be zero? Explain.

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18. Why is the term 'molecularity ' not applicable for complex reactions ?

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19. Show that the unit of a rate constant depends on the unit of time and the overall of the reaction.

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20. Why is rate constant of a reaction called specific reaction-rate ?

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21. Define activation energy . What is threshold energy ?

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22. "Lower the activation energy , higher is the rate of a chemical reaction and vice-versa" -explain.

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23. If $T \to \infty$, determine the value of rate constant according to the Arrhenius equation ?

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24. What will be the effect on the rate constant of a reaction having zero activation energy ?

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25. The order of a reaction is '1' and hence its molecularity is 1. Justify the statement .

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26. $NO + O_3 \rightarrow NO_2 + O_2,$ This is an elementary reaction. Write the rate law of the reaction.

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27. Plot a graph of concentration of a reactant at time t, [(a-x)] against time for a first order reaction .Here a = initial concentration of the reactant an x = change in concentration of the reactant at any time 1 during the reaction.

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28. plot a graph of reaction -rate vs concentration of the reactant for a fist order reaction.

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29. Show that the time required to complete a part of first order reaction does not depend on the initial concentration of the reactants.

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30. What do you mean by the statement 'the rate constant of the first order reaction is $0.02s^{-1}$

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31. Show that , $t_{3/4}$ of a first order reaction is twice the value of $t_{1/2}$ of that reaction.

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32. Hydrolysis of cane sugar in acidic medium is a pseudo first order reaction - explain.

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33. Hydrolysis of ethyl acetate in acidic solution is a pseudo first order reaction -explain.

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34. All the collisions among reactant molecules are not effective to bring in a change " - Justify the statement .

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35. How is the rate of a reaction affected by the presence of catalyst ?

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36. What do you mean by effective collisions ? What barriers should the reacting species overcome to make such collisions.

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Exercise Numerical Problems

1. $2A \rightarrow 4B + D$, in this reaction, concentration of B increases to $2 \times 10^{-3} \text{mol.L}^{-1}$ after 10s from the start of the reaction . Calculate : rate of formation of B

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2. $2A \rightarrow 4B + D$, in this reaction, concentration of B increases to $2 \times 10^{-3} \text{mol.L}^{-1}$ after 10s from the start of the reaction . Calculate : rate of disappearance of A.

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3. $2N_2O_5 \rightarrow 4NO_2(g) + O_2(g)$, The above reaction is completed in a closed vessel . It is observed that the concentration of NO_2 is increased by $4 \times 10^{-2} \text{mol.L}^{-1}$ in 5 second . Calculate

the rate of reaction

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4. $2N_2O_5 \rightarrow 4NO_2(g) + O_2(g)$, The above reaction is completed in a closed vessel . It is observed that the concentration of NO_2 is increased by $4 \times 10^{-2} \text{mol.L}^{-1}$ in 5 second . Calculate

the rate of disappearance of N_2O_5

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5. $2N_2O_5 \rightarrow 4NO_2(g) + O_2(g)$, The above reaction is completed in a closed vessel . It is observed that the concentration of NO_2 is increased

by $4 \times 10^{-2} \mathrm{mol.L}^{-1}$ in 5 second . Calculate

the rate of formation of O_2

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6. $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$, the concentration of I^- falls from $0.35 \mathrm{mol.L}^{-1}$ to $0.25 \mathrm{mol.L}^{-1}$ in 5min . What is the average rate of reaction ? Calculate the rate of formation of I_2 .

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7. $A + B \rightarrow C + D$, Calculate the rate law and rate constant of the reaction by using the following experimentally obtained data :

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8. For the reaction ,

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, $\frac{1}{2}\frac{d[NH_3]}{dt} = 2 \times 10^{-4}\text{mol.L}^{-1}.\, s^{-1}$

Find rate of disappearance of $N_2 \& H_2$

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9. For the reaction , $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$ the concentration of NO increases to 0.18mol.L^{-1} in 5s. Calculate the rate of the reaction during that period of time

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10. For the reaction , $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$ the concentration of NO increases to 0.18mol.L^{-1} in 5s. Calculate rate of formation of water

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11. For the reaction , $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$ the concentration of NO increases to 0.18mol.L^{-1} in 5s. Calculate rate of disappearance of NH_3

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12. $A_2 + B_2 \rightarrow 2AB$, Fill up the blanks writing the order of reaction with respect to A_2 to B_2 , in the following table.

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13. For the reaction $A + B \rightarrow$ product , (a) the rate of reaction doubles on doubling the concentration of A. (b) the rate of reaction increases by four times on doubling the concentration of B. Determine the overall order of the reaction ?

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14. For the reaction $A + B \rightarrow C + D$, it is found that rate of reaction doubles when the concentration of B is doubled and increases by 8 times on doubling the concentration of both A and B . Write the rate equation of the reaction.

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15. Half - life of a first order reaction is 15 min . Calculate rate constant of the reaction and the time required to complete 80% of the reaction. If the initial concentration of the reactant is doubled , how long will it take to reach 50% completion ? Give reason.

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16. 25% of a first order reaction is completed in 30 min . Find the time required for completion of 50% of the reaction.

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17. A first order reaction takes one hour for 50% completion How long will it take to reach 90% completion ?

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18. The half -life of a first order reaction $A \rightarrow B$ is 10 min . What fraction of the reactant will be left behind after 1 h ?

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19. In a first order reaction , the amount of reactant decomposed in the first 1 min is 1 % of its initial amount. What percent of the reactant will remain undecomposed after 1 hour from the start of the reaction ?

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20. The half -life of a first order reaction is 40min . Calculate the time taken by the reaction to reach 78% of completion . If the initial concentration of the reactant is doubled , how long will it take to reach 50% completion . Justify your answer.

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21. The following data are obtained for the decomposition of H_2O_2 at $25^\circ C$:

Time (min)	0	10	20	30
%decomposed	0	37	60	75

Calculate the order , rate constant and half -life of the reaction.

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22. If decomposition of H_2O_2 is a first order reaction , how long would it take to complete one- third of the decomposition ? The rate constant of this decomposition reaction is $3 \times 10^{-2} \text{min}^{-1}$.

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23. Show that for a first order reaction , the time taken to reach 75% of completion is about double that required for 50% of completion.

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24. $A \rightarrow B + C$, the following records are obtained :

$t(s)$	0	900	1800
$[A](mol.\ L^{-1})$	50.8	19.7	7.62

Show that the reaction follows the rate law of first order reaction .

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25. To calculate the rate of decomposition of H_2O_2 in an aqueous solution , a certain volume of the aqueous solution of H_2O_2 is pipetted out and titrated against $KMnO_4$ solution at different interval of time .

Intervals The observations are given below :

$Time(\text{in min})$	0	5	10	20
Volume of $KMnO_4(\text{inML})$	46.2	37.1	29.8	19.6

Show that the decomposition of H_2O_2 in aqueous solution is a first order reaction and calculate its rate constant .

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26. The decomposition of ammonium nitrite was studied by placing the apparatus in a thermostat maintained at a particular temperature .The volume of N_2 gas collected at different intervals are as follows :

$Time(\text{in min})$	10	15	20	25	∞
Volume of $N_2(\text{inML})$	6.25	9.00	11.40	13.65	35.05

From the above data, prove that the reaction is of the first order.

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27. The following data were obtained during the first order thermal decomposition of $N_2O_5(g)$ at constant volume.

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

$Time(\text{in s})$	0	52	103	205	309
Total pressure (in mm)	117.04	163.40	197.6	239.4	258.4

Calculate the rate constant of the reaction.

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28. The following data are obtained of the decomposition of N_2O_4 in CCl_4 at $44^\circ C$

Time (min)	20	30	40	∞
Volume of $O_2(ml)$	11.40	15.53	18.50	34.75

Show that the reaction follows the rate law of first order reaction.

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29. The decomposition of gaseous Cl_2O_7 to gaseous Cl_2 and O_2 at 400K is a first order reaction . After 55 s , the pressure of Cl_2O_7 falls from 0.062 to 0.044 atm . Calculate

the rate constant

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30. The decomposition of gaseous Cl_2O_7 to gaseous Cl_2 and O_2 at 400K is a first order reaction . After 55 s , the pressure of Cl_2O_7 falls from

0.062 to 0.044 atm . Calculate

the pressure of Cl_2O_7 after 100s.

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31. Calculate the Activation Energy (E_a) of a reaction that follows the equation , $k = \left(4.5 \times 10^{11} s^{-1}\right)$ e.

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32. The decomposition of H_2O_2 is a first order reaction . The rate constant of the reaction can be expressed as $\log k = 14.34 - \frac{1.25 \times 10^4}{T}$. Calculate the activation energy of the reaction . At what temperature does the half-life of the reaction become 265min?

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33. The rate constant of decomposition of B is $4.8 \times 10^3 s^{-1}$ at $15^\circ C$. If the activation energy of the reaction is 80 kJ.mol , at what temperature will the rate constant of the reaction be $1.5 \times 10^4 s^{-1}$?

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34. The time taken by a first order reaction to reach 10% completion at 298K is the same as the time taken to reach 30% completion at 308K . If value of $A = 4 \times 10^{11} s^{-1}$, calculate the rate constant at 308K.

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35. Calculate the activation energy of the reaction whose rate constant for decomposition of N_2O_5 at $25^\circ C$ and $65^\circ C$ are 3.46×10^{-5} and $4.87 \times 10^{-3} \text{min}^{-1}$ respectively.

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36. The rate constants of a reaction at $35^{\circ}C$ and $65^{\circ}C$ are $6.65 \times 10^{-5}s^{-1}$ and $2.24 \times 10^{-3}s^{-1}$ respectively. Calculate the frequency factor of the reaction.

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37. At $25^{\circ}C$ and $45^{\circ}C$, a first order reaction takes 30min and 10min respectively to reach 50% completion. Calculate the activation energy . If $\Delta H = -40\text{kJ.mol}^{-1}$, calculate the activation energy of backward reaction.

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