CHEMISTRY

BOOKS - R G PUBLICATION

CHEMICAL KINETICS

Exercise

1. The rate constant of a reaction is $3 \times 10^2 \ \text{min}^{-1}$. What is the order of the reaction?

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2. The concentration of a solution having concentration 0.24M is reduced to 0.12M in 10 hours and 0.06M in 20 hours. What is the rate of the reaction?

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3. Define order of a reaction.

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4. For the reaction $R \rightarrow P$ write the differential rate law.

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5. Define activation energy of a reaction.

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6. The rate of a reaction is equal to rate constant of the reaction. Mention the order of the reaction.

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7. Give the defination of collision frequency.

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8. Give an example of pseudo first order reaction.

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9. Find out half-life time of first order reaction with rate constant $k = 2.31 \times 10^{-14} s^{-1}$.

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10. The rate constant for a chemical reaction at a given temperature is $2.3 \times 10^{-5} L mol^{-1} s^{-1}$. What is the order of the reaction

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11. A reaction, $SO_2Cl_2 \rightarrow SO_2 + Cl_2$ is first order reaction with half life period $3.15 \times 10^4 s$ at $320^\circ C$. What percentage of

SO_2Cl_2 would be decomposed on heating at $320^\circ C$ for 90 minutes?

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12. For the reaction $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$, the rate of formation of NO is $3.6 \times 10^{-3} molL^{-1}s^{-1}$. Calculate the rate of disappearance of NH_3 and the rate of formation of H_2O.

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13. A certain reaction is 50% complete in 20 minutes at 300K and the same reaction is again 50% complete in 5 minutes at 350K. Calculate the activation energy if the reaction is of first order.

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14. The rate constant of a reaction at 500K and 700K are $0.01s^{-1}$ and $0.07s^{-1}$ respectively. Calculate the value of activation energy for the reaction `(R = 8.314 JK^-1mol^-1).

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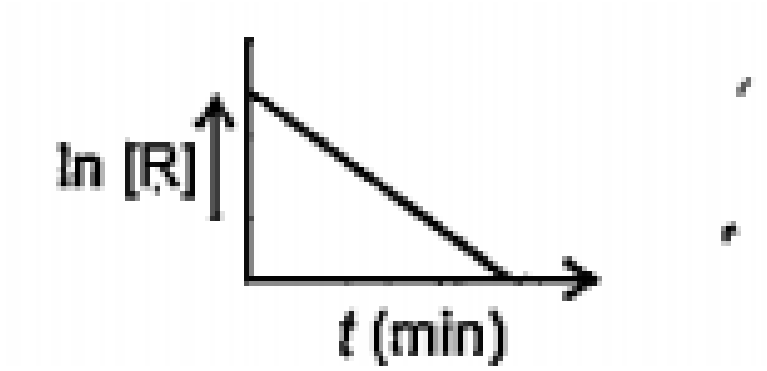
15. For a chemical reaction variation in concentraction, ln[R] vs. time (min) plot is shown below :



What is the order of the reaction?

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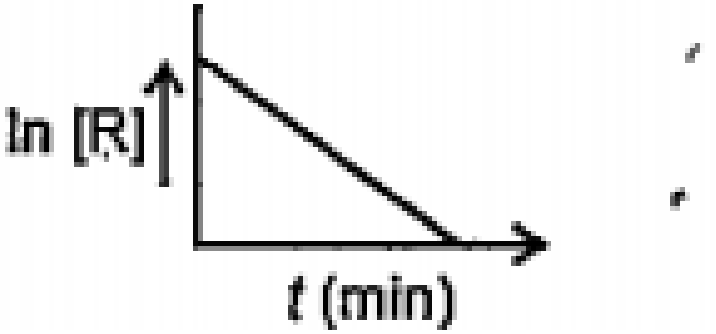
16. For a chemical reaction variation in concentraction, ln[R] vs. time (min) plot is shown below :



What is the unit of rate constant K, for the reaction?

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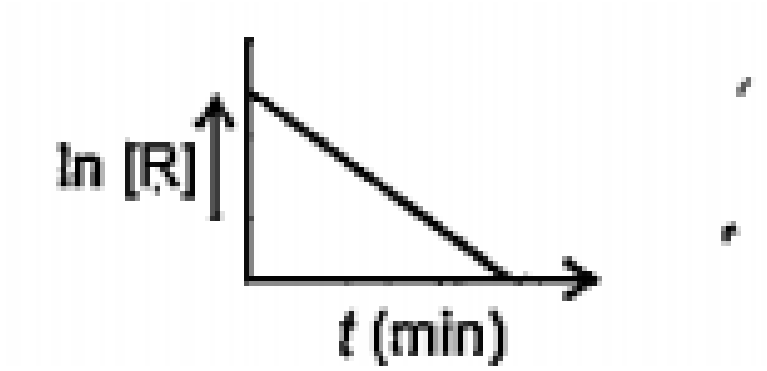
17. For a chemical reaction variation in concentraction, ln[R] vs. time (min) plot is shown below :



If initial concentration of the reactant is half of the original concentration, how will $t_{1/2}$ change?

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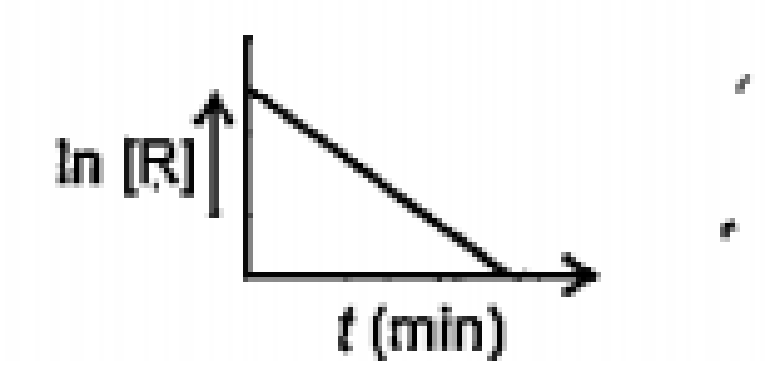
18. For a chemical reaction variation in concentraction, ln[R] vs. time (min) plot is shown below :



Draw the plot of $\frac{\log[R]^{\circ}}{R}$ vs. time(s).

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19. For the reaction

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

results have been obtained.

SI.NO.	$[N_2O_5]$ mol L^{-1}	Rate of disappearance of N_2O_5, mol L^{-1} min^{-1}
1	1.13×10^{-2}	34×10^{-5}
2	0.84×10^{-2}	25×10^{-5}
3	0.62×10^{-2}	18×10^{-5}

Calculate order of the reaction

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

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SI.NO.	$[N_2O_5]$ mol L^{-1}	Rate of disappearance of N_2O_5, mol L^{-1} min^{-1}
1	1.13×10^{-2}	34×10^{-5}
2	0.84×10^{-2}	25×10^{-5}
3	0.62×10^{-2}	18×10^{-5}

Write rate law

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

results have been obtained.

SI.NO.	$[N_2O_5]$ mol L^{-1}	Rate of disappearance of N_2O_5, mol L^{-1} min^{-1}
1	1.13×10^{-2}	34×10^{-5}
2	0.84×10^{-2}	25×10^{-5}
3	0.62×10^{-2}	18×10^{-5}

Calculate rate constant of the reaction.

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

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22. Show that for a first order reaction, the half life is independed of the initial concentration of reactant.

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23. Identify the reaction order from each of the following rate constants.

$k = 1.4 \times 10^{-5} mol^{-1} Ls^{-1}$

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24. Identify the reaction order from each of the following rate constants.

$k = 2.3 \times 10^{-4} s^{-1}$

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25. The conversion of molecule A to B follows second order kinetics. If concentration of A is increased four times how will the rate of formation of B be affected?

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26. Give the defination of collision frequency.

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27. For the reaction $R \rightarrow P$ the rate becomes 4 times faster when the concentration of the reaction R is doubled at a given temperature. What is the order of the reaction?

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28. Show that integrated rate law for the first order reaction $R \rightarrow P$ is -

$$k = \frac{2.303}{t} \frac{\log[R]_0}{R}$$

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29. A first order reaction takes 40minutes for 20% decomposition. Calculate its half life period,

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30. 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?

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31. Show that time required for completion $\frac{3}{4}$ th of a first order reaction is twice the time required for completion of $\frac{1}{2}$ of the reaction.

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32. For a reaction $2A \rightarrow 4B + C$, the concentration of B is increased by 5.0×10^{-3} molL^(-1)` in 10 seconds. Calculate the rate of disappearance of A.

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33. Show that slope of the plot of Ink against $\frac{1}{T}$ is $-\frac{Ea}{R}$. Give the graphical representation of the plot.

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34. Starting from the intergrated rate law of a zeroth order reaction $R \rightarrow P$ show that half life time of the reaction is directly

proportional to the initial molar concentration of the reactant.

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36. Show that in a 1st reaction, time required for completion of 99.9% is 10 times of half life time of the reaction.

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37. The rate of a chemical reaction.

A. Increases as the reaction proceeds.

B. Decreases as the reaction proceeds.

C. May increase or decrease during the reaction

D. Remains constant as the reaction proceeds.

Answer:

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38. The correct order indicated against the rate of raction $A + B \xrightarrow{K}$ is

A. $\left(d[A]\frac{B}{t} = K[A]\right.$

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

C. $\left(- d\frac{A}{dt} = K[A][B]\right.$

D. $\frac{+d[A]}{dt} = K[A]$

Answer:

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39. For a gaseous reaction the unit of rate for a first order reaction is given by

A. $molL^{-1}$

B. $Lmol^{-1}S$

C. $atmS^{-1}$

D. $molL^{-1}\ \min^{-1}$

Answer:

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40. In a reaction $2X + Y \rightarrow X_2Y$. The reactant X will disappear at

A. half the rate at that Y will decrease.

B. The same rate at that Y will decrease.

C. The same rate at that X_2Y will form.

D. Twice the rate at that Y wil decrease.

Answer:

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41. Which of the following is false?

A. Rate law is the expression in which the rate is given in terms oif molar concentration of reactants raised to some power equal to the stiochiometric coefficients of the reactants.

B. A zero order reaction is one whose rate is independent of the concentration of the reactant.

C. Reaction rates generally decrease when the concentration or reactants decrease

D. None of the above.

Answer:

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42. For a zero order reaction.

A. The reaction rate is doubled when the initial concentration is doubled.

B. The time for half change is half the time taken for completion of the reaction.

C. The time for half change is dependent of the initial concentration.

D. The time for completion of the reaction is independent of the initial concentration.

Answer:

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43. Order of a complex reaction is determined from.

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44. The rate constat (k) for a particular reaction is $2.3 \times 10^{-5} Lmol^{-1} S^{-1}$. The order of the reaction is

A. 1st

B. 2nd

C. zero

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

Answer:

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45. The one which is unimolecular reaction is

A. $2HI \rightarrow H_2 + I_2$

B. $N_2O_5 \rightarrow N_2O_4 + \frac{1}{2}O_2$

C. $H_2 + Cl_2 \rightarrow 2HCl$

D. $PCl_2 + Cl_2 \rightarrow PCl_5$

Answer:

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46. The hydrolusis of ethylacetate

$$CH_3COOEt + H_2O \xrightarrow{H^+} CH_3COOH + EtOH$$

A. 1st order

B. 2nd order

C. 3rd order

D. zero order

Answer:

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47. Give one exampe of first order reaction.

A. $2NH_3(g) \xrightarrow[Pt]{\Delta} N_2(g) + 3H_2(g)$

B. $\_ 88^{226}Ra \rightarrow {}_2^4He + {}_{86}^{222}Rn$

C. $CHCl_3 + Cl_2 \rightarrow \mathbb{C}l_4 + HCl$

D. None of the above.

Answer:

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48. What will be the order of the reaction if doubling of the concentration of the reactant increases of the rate by a factor of 4 and tripling the concentration of the reactant by a factor of 9.

A. 1st order

B. zero order

C. 2nd order

D. 3rd order

Answer:

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49. The half life of a first order reaction is 10min. If initial amount is 0.80mol/lit and concentration at some instant is 0.01 mol/lit then then t-

A. 10 min

B. 30 min

C. 20 min

D. 40 min

Answer:

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50. The minimum energy necessary to permit a reaction is

A. internal energy

B. threshold energy

C. activation energy

D. enthalpy

Answer:

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51. For an endothermic reaction, where ΔH represents the enthalpy of the electro in

kJ/mol the minimum value for the energy of activation will be-

A. less then ΔH

B. zero

C. more than ΔH

D. equla to ΔH

Answer:

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52. The rate constant, the activation energy and the Arrhenius parameter of a chemical reaction at $25^{\circ}C$ are $3 \times 10^{-4}s^{-1}, 104.4kJmol^{-1}$ and $6 \times 10^{-14}s^{-1}$ respectively. The value of the rate constant at $T \rightarrow \propto$ is

A. $2 \times 10^{18}s^{-1}$

B. $6 \times 10^{14}s^{-1}$

C. infinity

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

Answer:

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53. A catalyst

A. Increases the average kinetic energy of reaction moelcules

B. Decreases the activation energy

C. Alters the reaction mechanism

D. Decreases the frequency of collisions of reacting species.

Answer:

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54. Which one of the following is true in case of catalyst?

A. It catalyses non-spontaneous reaction

B. It disturbs equilibrium by changing equilibrium constant.

C. It does not alter Gibbs free energy

D. A small amount of the catalyst can not catalyse a large amount of reactants.

Answer:

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55. Which of the following factors is helpful for effective collision between reactant molecules?

A. Activation energy and an average energy.

B. Threshold energy and proper orientation of the molecules for collision.

C. Heat energy and sufficient collision frequency.

D. Catalyst and proper orientation of the reacting molecules

Answer:

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56. What is the rate of a reaction?

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57. Differentiat between instantaneous rate and average rate of a reaction .

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58. For a reaction the rate of given by $-\frac{1}{2}\frac{\Delta[HI]}{\Delta t} = \frac{\Delta[H_2]}{\Delta t} = \frac{I_2}{\Delta t}$. Write the reaction.

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59. Describe the rate law.

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60. Give an example of Bimolecular reaction.

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61. Show the rate of the following reaction in terms of partial pressure of the reactants and

the products.

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

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62. In a reaction $2A \rightarrow P$ the Conc of A decreases from $0.5 molL^{-1}$ to $0.4 molL^{-1}$ in 10 sec. Calculate the rate of the reaction.

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63. What is zero order reaction?

Watch Video Solution

64. Give an example each from first order and zero order reaction.

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65. For the following radioactive reaction $_88^{226}Ra \rightarrow {}_2^4He + {}_{86}^{222}Rn$ write the rate of the reaction.

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66. Write the integrated rate law and half life for a zero order reaction.

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67. Give an example of pseudo first order reaction.

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68. A plot of $\frac{\log[R_0]}{R}$ vs time is a straight line passing through origin point. What is order of the reaction?

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69. Write the Arrhenius equation regarding the dependence of rate constant with temperature of a reaction.

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70. The graph of logK vs X is linear with a slop = $-\frac{E}{2.303R}$. What is X?

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71. What is activated complex?

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72. A catalyst provides____of a reaction of lower _____.

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73. What is threshold energy.

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74. Rate of a reaction is given by $Z_{AB}e^{Ea/RT}$.

What does $e^{-Ea/RT}$ represent?

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75. What will be the effect of temperature on rate constant?

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76. If half life period of a first order reaction is x and $3/4$th life period of the same reaction is y. How are x and y related to each other?

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77. What is the meaning of an elementary reaction?

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78. Show that the amount of the substance left after n-half lives in equal to $\frac{A_0}{2^n}$ where $A_0 \rightarrow$ initial concentration of the reactant.

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79. For the reaction $A \rightarrow B$, the concentration of a reactant changes from 0.03M to 0.02 M in 20 mins. Calculate the average rate of reaction. What is the rate of production of 'B' during this period?

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80. Write the difference between order and molecularity.

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81. What is compex reaction? Give one example What is the rate determining step of this type of reaction?

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82. Show that for a zero order reaction

$Kt = a_0 - a_1$ where $K \rightarrow$ rate constant

$a_0 \rightarrow$ initial concentration of reactant

$a_1 \rightarrow$ Concentration of the reactant at time 't'

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83. From first order kinetics. We can write $[R] = [R]_0 e^{-kt}$. Draw the graph the [R] against 't'. Why [R] can not be zero? How instantaneous rate is determined form the plot?

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84. The following data were obtained for thermal decomposition of $N_2O_5(g)$ at constant volume.

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

Sl. No. ক্র.নং.	Time/Sec (সময়)	Total pressure/atm (মুঠ চাপ)/এটম'চ
1	0	0.5
2	50	0.256

Calculate the rate constant.

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85. Show that for a first order reaction, the half life is independed of the initial concentration of reactant.

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86. 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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87. Mention two factors that effect the rate of a chemical reaction.

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88. In a pseudo first order hydrolysis of ester in water the following results are obtained.

t/sec	0	30	60	90
[ester]/molL^{-1}	0.65	0.31	0.17	0.085

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

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89. In a pseudo first order hydrolysis of ester in water the following results are obtained.

t/sec	0	30	60	90
[ester]/molL^{-1}	0.65	0.31	0.17	0.085

Calculate the pseudo first order rate constant for the hydrolysis.

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90. The date below are for the reaction of NO and Cl_2 to form NOCl at 295K.

Sl No.	Conc of Cl_2(M) (গাঢ়তা)	Conc of NO (M) (গাঢ়তা)	Initial rate ($molL^{-1}s^{-1}$) (প্রাৰম্ভিক হাৰ)
(i)	0.05	0.05	1.0×10^{-3}
(ii)	0.15	0.05	3.0×10^{-3}
(iii)	0.05	0.15	9.0×10^{-3}

What is the order w.r.t. NO of Cl_2 in the reaction.

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91. The date below are for the reaction of NO and Cl_2 to form NOCl at 295K.

Sl No.	Conc of Cl_2(M) (গাঢ়তা)	Conc of NO (M) (গাঢ়তা)	Initial rate ($molL^{-1}s^{-1}$) (প্রাবস্তিক হার)
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Write the rate expression?

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Calculate the rate constant.

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(i)	0.05	0.05	1.0×10^{-3}
(ii)	0.15	0.05	3.0×10^{-3}
(iii)	0.05	0.15	9.0×10^{-3}

Determine the reaction rate when the concentrations of Cl_2 and NO are 0.2M and 0.4M respectively?

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94. During nuclear explosion one of the products is $\hat{}\ 90Sr$ with half life of 28.1 years. If $1\mu g$ of $\hat{}\ 90Sr$ was absorbed in the bones of a newly born baby instead of calcium how much of it will remain after 10 years and 60 years if it is lost metabolically?

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95. Show that for a first order reaction the time required for 75% completion is twice the time required for the completion of 50% of reaction.

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96. The experimental data for decomposition of N_2O_5 in a gas phase at 318K are given below

$2N_2O_5 \rightarrow 4NO_2 + O_2$

t/sec	0	400	800	1200	1600
$10^2 \times [N_2O_5]$ molL^{-1}	1.63	1.36	1.14	0.93	0.78
t/sec	2000	2400	2800	3200	
$10^2 \times [N_2O_5]$ molL^{-1}	0.64	0.53	0.43	0.35	

What is the rate law

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$10^2 \times [N_2O_5]$ molL^{-1}	0.64	0.53	0.43	0.35	

Calculate the rate constant (K)

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$10^2 \times [N_2O_5]$ molL^{-1}	1.63	1.36	1.14	0.93	0.78
t/sec	2000	2400	2800	3200	
$10^2 \times [N_2O_5]$ molL^{-1}	0.64	0.53	0.43	0.35	

Calculate the half-life period from K

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99. The decomposition of NH_3 on plantinum surface is a zero order reaction. What are the rates of productions of N_2 and H_2 if $K = 2.5 \times 10^{-4} mol^{-1} Ls^{-1}$?

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100. The half-life for radioactive decay of C-14 is 57830 year. An archaeological artifact containing wood had only 80% of the C-14 found in a living tree. Estimating the age of the sample.

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101. A zero order reaction is 50% complete in 10 mins. What percentage would be completed

at the end of 25 mins? In how many mins would the concentration be reduced to zero?

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102. Discuss the effect of temperature on reaction rate.

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103. An endothermnic reaction $A \rightarrow B$ has an activation energy $15kJ/mol$ and energy of

reaction is $5kJ/mol$. What is the activation energy for backward reaction $B \rightarrow A$. Draw the required graph to describe the above energies.

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

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

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106. What are the functions of catalyst in a reaction?

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107. Discuss the collision theory of reaction rate.

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108. The time required for 10% completion of a first order reaction at 298 K is equal to that required for its 25% completion at 308 K. If the value of A is $4 \times 10^{10} s^{-1}$. Calculate k at 318 K and E_a.

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109. The activation energy of a certain uncatalysed reaction at 300K is $76kJmol^{-1}$. The activation energy is lowered to $57kJmol^{-1}$ by the use of a catalyst. By what factor is the rate of the catalysed reaction increased?

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110. Rate constant K for a first order reaction has been found to be $2.54 \times 10^{-3} \sec^{-1}$

Calculate its $3/4$the life (log 4=0.6020)

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111. A first order gas phase reaction $A_2B_2(g) \rightarrow 2A(g) + 2B(g)$ at the temperature $400^\circ C$ has the rate constant $k = 2.0 \times 10^{-4}\,\text{sec}^{-1}$. What percentage of A_2B_2 is decomposed on heating for 900 secs (antilog 0.0781=1.197)`

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112. In a first order reaction, the concentration of the reactant is reduced from $0.6 mol l^{-1}$ to $0.2 mol l^{-1}$ in 5 minutes. Calculate the rate constant of the reaction.

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113. The half life for the first order reaction is 5×10^4 sec. What percentage of the initial reactant will react in 2 hrs.

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114. In Arrhenius equation

What does the term $e^{-E/RT}$ signify?

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115. In Arrhenius equation

Can activation energy E for a reaction be zero?

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116. The rate of formation of a dimer in a second order dimerisation reaction is $9.1 \times 10^{-6} molL^{-1}S^{-1}$ at $0.01 molL^{-1}$ monomer concentration. Calculate the rate constant for the reaction.

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117. The following reaction takes place in one step.

$2NO(g) + O_2(g) \leftrightarrow 2NO_2(g)$

How will the rate of the above reaction change if the volume of the reaction vessel is diminished to one third of its original volume? Willthere be any change in the order of the reaction with the reduced volume?

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118. A certain reaction is 50% complete in 20 minutes at 300K and the same reaction is again 50% complete in 5 minutes at 350K.

Calculate the activation energy if the reaction is of first order.

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119. A substance with intitial concentration 'a' follows zero order kinetics. In how much time, will the reaction go to completion?

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120. The gas phase decomposition of acetaldehyde,

$CH_3CHO(g) \rightarrow CH_4(g) + CO(g)$ at 680K is observed to followed the rate expression: Rate $-d\frac{CH_3CHO}{dt} = k[CH_3CHO]^{\frac{3}{2}}$ IF the rate of decomposition is followed by monitoring the pantial pressure of actetaldehyde, we can express the rate as.

$dP_{CH_3CH\,\frac{\emptyset}{dt}} = k\left[P_{CH_3CHO}^{\frac{3}{2}}\right.$

If the pressure is measured in atomospheres and the time in minutes than

What are the units of the rate of reaction?

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$$-dP_{CH_3CH\frac{\emptyset}{dt}} = k\left[P_{CH_3CHO}^{\frac{3}{2}}\right.$$

If the pressure is measured in atomospheres

and the time in minutes than

What are the units of the rate constantK?

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122. Higher the activation energy of a reaction slower is the rate of the reaction Explain.

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123. The activation energy of a reaction `2H I_(g) rarrH_2 + I_(2(g)) is 209.5 kJ mol^-1 at 581K.

Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy?

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124. Hydrogen peroxide $H_2O_2(aq)$ decomposes to $H_2O(l)$ and $O_2(g)$ in a reaction that is first order in $H2O_2$ and has a rate constant $k = 1.06 \times 10^{-3}\ \text{min}^{-1}$

How long will it take for 15% of a sample of H_2O_2 to decompose ?

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125. Hydrogen peroxide $H_2O_2(aq)$ decomposes to $H_2O(l)$ and $O_2(g)$ in a reaction that is first order in $H2O_2$ and has a rate constant $k = 1.06 \times 10^{-3}\ \text{min}^{-1}$

How long will it take for 85% of the sample to decompose?

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126. Nitrogen pentoxide decomposes according to equation

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

The first order reaction was allowed to proceed at $40^\circ C$ and the data below were collected .

$[N_2O_5]$ (M)	Time (min)
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

Calculate the rate constant, include units with you answer.

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127. Nitrogen pentoxide decomposes according to equation

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

The first order reaction was allowed to proceed at $40^\circ C$ and the data below were collected .

$[N_2O_5]$ (M)	Time (min)
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

What will be the concentration of N_2O_5 after 100 mins.?

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128. Nitrogen pentoxide decomposes according to equation

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

The first order reaction was allowed to proceed at $40^{\circ}C$ and the data below were collected .

$[N_2O_5]$ (M)	Time (min)
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

Calculate the initial rate of reaction.

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129. 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 at what temperature will its half-period by 256 minutes?

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