CHEMISTRY

BOOKS - S DINESH & CO CHEMISTRY (HINGLISH)

CHEMICAL KINETICS

Examples

1. Nitrogen dioxide (NO_2) reacts with fluroine (F_2) to form nitryl fluroide (NO_2F) according to the reaction.

$2NO_2(g) + F_2 \rightarrow 2NO_2F(g)$

Write the instaneous rate of reaction in terms of

i) rate of formation of NO_2F,

ii) Rate of disappearance of NO_2,

iii) rate of disappearance of F_2

2. The reaction $3A \to 2B + C$ is carried in a closed vessel. The rate of disappearance of $A\left[\frac{-d[A]}{dt}\right]$ is 0.01 $molL^{-1}s^{-1}$. Calculate $\frac{d[B]}{dt}$ and $\frac{d[C]}{dt}$.

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3. A chemical reaction $2A \to 4B + C$ in gas phase occurs in a closed vessel. The concentration of B is found to increase by 5×10^{-3} mol L^{-1} in 10 seconds. Calculate

i) the rate of appearance of B

ii) the rate of disappearance of A.

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4. Express the relationship between the rate of formation of water and rate of disappearance of oxygen in the following reaction.

$2H_2 + O_2 \to 2H_2O$

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5. In the reaction $A + 2B \rightarrow 3C + 2D$, the rate of disappearance of B is $1 \times 10^{-2} mol L^{-1} s^{-1}$. What will be the rate of the reaction and rate of change in concentration of A and C?

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6. For the elementary reaction $2A + B \rightarrow 3C$, if the rate of appearance of C at time 't' is $1.3 \times 10^{-4} mol L^{-1} s^{-1}$, calculate at this time (i) rate of the reaction (ii) rate of disappearance of A.

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7. In the reaction

$BrO^{-3}(aq) + 5Br^{-}(aq) + 6H^{+} \rightarrow 3Br_2(1) + 3H_2O(1)$

The rate of appearance of bromine (Br_2) is related to rate of disapperance of bromide ions as folllwoing :

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8. For the reaction $N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$, the rate of disappearance of N_2O_5 is $6.25 \times 10^{-3} \text{mol L}^{-1} s^{-1}$. The rate of formation of NO_2 and O_2 will be respectively.

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9. For the reaction

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

If $\Delta[NH_3]/\Delta t = 4 \times 10^{-8} molL^{-1}s^{-1}$, what is the value of $\Delta[H_2]/\Delta t$ =?

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10. The concentration of C_4H_9Cl (n-butyl chloride) at different times are given. Calculate the average rate for the hydrolysis of n-butyl chloride.

$C_4H_9Cl + H_2O \rightarrow C_4H_9OH + HCl$

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11. The decompoistion of N_2O_5 in CCI_4 solution at $318K$ has been studied by monitoring the concentration of N_2O_5 in the solution. Initially, the concentration of N_2O is $2.33M$ and after 184 min , it is reduced to $2.08M$. The reaction takes place according to the equation:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

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

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12. For the reaction $NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$, the experimentally determined rate expression at 40 K is:

rate $= k[NO_2]^2$

What is the proposed mechanism for the reaction?

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13. For the reaction A + B $\rightarrow$ products, rate low expression for rate = $k[A][B]^2$. If the volume of the vessel is reduced to $\frac{1}{3}$ of its original volume then what will be the effect on the rate of reaction?

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14. The form of rate law for a reaction is expressed as, rate $= k[Cl_2][NO]^2$

Find out the order of the reaction with respect to Cl_2, with respect to NO and also the overall order of the reaction.

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15. For a reaction carried at 400 K,

$NO_2(g) + CO_2(g) \rightarrow CO_2(g) + NO_2(g)$, the proposed mechanism is as follows:

$NO_2 + NO_2 \xrightarrow{\text{Slow}} NO + NO_3 NO_3 + CO \xrightarrow{\text{Fast}} CO_2 + NO_2$

What is the rate law for the reaction?

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16. The reaction $N_2O_5 \rightarrow 2NO_2 + I/2O_2$ is of first order in N_2O_5. Its rate constant is $6.2 \times 10^{-6} s^{-1}$. If the beginning N_2O_5 is 15 $molL^{-1}$, calculate the rate of reaction in the beginning.

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17. State the order with respect to each reactant and overall order for the reaction

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

Rate = $k[H_2][NO]^2$

Calculate the units for the rate constant.

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18. For a reaction : $A+B \to$ Products.

The rate law expression is: rate = $k[A]^{1/3}.\ [B]^2$.

a) What is the order of the reaction?

b) What are the units of rate constant if concentration is measured in mol dm^{-3} and time in seconds?

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

Rate = $k[A]^{1/2}[B]^{3/2}$, (b) Rate = $k[A]^{3/2}[B]^{-1}$.

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20. Identify the order of a reaction for each of the following rate constants:

i) $k = 2.3 \times 10^{-5} Lmol^{-1}s^{-1}$

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

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21. The rate of reaction, 2NO + $Cl_2 \rightarrow 2NOCl$ is doubled when concentration of Cl_2 is doubled and becomes eight times when concentration of both NO and Cl_2 are doubled. Determine the order of the reaction.

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22. The decomposition of N_2O_5 in a carbon tetrachloride solution has been investigated.

$N_2O_5(\text{solution}) \rightarrow 2NO_3$ (solution) +$1/2O_2(g)$. The reaction has been found to be of the first order in N_2O_5 with a first order rate-constant = $6.2 \times 10^{-4} s^{-1}$. Calculate the rate of the reaction when (a) $[N_2O_5]$ = 1.25 mol L^{-1} and b) $[N_2O_5]$ = 0.25 mol L^{-1}. b) What concentration of N_2O_5 would give a rate of $2.4 \times 10^{-3} molL^{-1}s^{-1}$?

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23. For a reaction $A \rightarrow B$ the rate of reaction becomes twenty seven times when the concentration of A is increased three times. What is the order of reaction?

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24. The rate of formation of a dimer in a second order dimerisation reaction is $9.1 \times 10^{-6} mol L^{-1} s^{1}$ at 0.01 mol L^{-1} monomer concentration. Calculate the rate consant for the reaction.

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25. The reaction : $2N_2O_5(g) \rightarrow 2NO_2(g) + (O_2)_g$

was studied and the following data were collected.

Determine: (i) the order, (ii) the rate law and (iii) rate constant for the reaction.

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26. Consider the following data for the reaction:

$A + B \rightarrow$ Products

Determine the order of reaction with respect to A and with respect to B and the overall order of the reaction.

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27. For the chemical reaction $A + 2B \rightarrow 2C + D$.

The experimentally determined information has been tabulated below:

for the reaction,

a)Calculate the order of reaction w.r.t. both the reactants A and B

b) Write the expression for rate law.

c) Calculate the value of the rate constant

d) Write the expression for the rate of reaction in terms A and C.

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28. For the reaction $A + B \rightarrow$ Products, the following initial rates were obtained at various given initial concentrations.

ltrbgt Write rate law and find the rate constant for the above reaction.

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29. For the reaction

$2NO(g) + Cl_2 \rightarrow 2NOCl(g)$

the following data were collected. All the measurnments were taken at 263 K.

a) Write the expression for rate law,

b) Calculate the value of rate constant and specify its untis.

c) What is the initial rate of disappearance of Cl_2 in exp. 4?

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30. For a chemical reaction, variation in concentration [A] vs time (s) plot in given below:

i) Predict the order of the reaction.

ii) What does the slope of the line and intercept indicate ?

iii) What is the unit of rate constant(k)?

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31. Optical rotation of sucrose in 1 N HCl at various times was found as shown below :

Time (sec)	0	7.18	18.0	27.05	∞
Rotation (deg)	$+24.09$	$+21.7$	$+17.7$	$+15.0$	-10.74

Show that the inversion of sucrose is a first order reaction

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32. 1.0 mL of ethyl was added to 25 mL of $\frac{N}{2}$ HCl, 2.0mL of the mixture was withdrawn from time to time during the progress of easter hydrolysis and titrated against standard NaOH solutions. The amount of

NaOH required for titration at various intervals is given below:

The value of at infinite time was obtained by completing the hydrolysis on boiling. Show that the reaction is of first order. Also find the average value of rate constant.

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33. From the following data show that the decomposition of H_2O_2 is a reaction of first order. Also calculate the value of the rate constant.

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

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

b) Calcualte the average rate of reaction between the time interval 30 to 60 seconds.

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

(i) How long will it takes for 15% of a sample of H_2O_2 to decompose?

(ii) How long will it take for 875% of the sample to decompose?

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36. The rate constant of a reaction with respect to the reactant A is 6 $\min^{-1}$. If we start with [A] = $0.8 mol L^{-1}$, when would [A] reach the value of $0.08 mol^{-1}$?

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37. The initial concentration of N_2O_5 in the following first order reaction:

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

was $1.24 \times 10^{-2} molL^{-1}$ at $318K$. The concentration of N_2O_5 after 60 min was $0.20 \times 10^{-2} molL^{-1}$. Calculate the rate constant of the reaction at $318K$.

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

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39. The half life period of the first order reaction is 10 seconds. Calculate its rate constant.

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40. If half life period for a first order reaction in A is 2 minutes, how long will it take [A] to reach (i) 25% of its initial concentration ii) 10% of its initial concentration?

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41. The three fourth of a first order reaction is completed in 32 minutes. What is the half life period of the reaction?

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42. A first order reaction is 20% complete in 10 minutes. Calculate the time for the completion of 75% of the reaction.

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43. Find out two-third $(2/3)$ life of a first order reaction in which $k = 5.48 \times 10^{-14} s^{-1}$

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

$2N_2O_5(g) \rightarrow 2N_2O_2(g) + O_2(g)$

Calculate the rate constant for the gaseous reaction.

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45. The half life period of a substance is 50 minutes at a certain initial concentration. When the concentration is reduced to one half of the initial value, the half-life period is 25 minutes. Calculate the order of the reaction.

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46. At a certain temperature, the half life period for the catalytic decomposition of ammonia was found as follows:

Calculate order of the reaction.

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47. Show that for a first order reaction, time required for 99.99% of the reaction to take place is 10 times the time required for the completion of half of the reaction.

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48. If half life period for a first order reaction in A is 2 minutes, how long will it take [A] to reach (i) 25% of its initial concentration ii) 10% of its initial concentration?

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49. The rate constant for an isomerisation reaction $A \rightarrow B$ is $4.5 \times 10^{-3} \overset{-1}{\min}$. If the initial concentration of A is 1 M, Calculate the rate of the reaction after 1 hour.

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50. The rate of a first order reaction is 0.04 mol $\text{litre}^{-1} s^{-1}$ after 10 minutes and 0.03 mol $\text{litre}^{-1} s^{-1}$ after 20 minutes. Find the half life period of the reaction.

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51. The decomposition of a compound is found to follow the first order rate law. If it takes 15 minutes for 20 per cent of the original material to react, calculate

i) the specific rate constant

ii) the time in which 10 percent of the original material remains unreacted.

iii) The time it takes for the next 20 percent of the reactant left to react.

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52. A reaction $SO_2Cl_2 \rightarrow SO_2 + Cl_2$ is first order reaction with half life period 3.15×10^4s at 320°C. What percentage of SO_2Cl_2 would be decomposed on heating at 320°C for 90 minutes?

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53. A first order reaction has a rate constant of 0.0051 $\min^{-1}$. If we begin with 0.10 M concentration of the reactant, What concentration of reactant will remain in solution after 3 hours?

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54. A first order reaction takes 10 minutes for 25% decomposition. Calculate half life period of the reaction.

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55. Decomposition of phosphine (PH_3) at 120° C proceeds according to the equation

$4PH_3(g) \rightarrow P_4(g) + 6H_2(g)$

It was found that the reaction follows the rate equation, Rate = $k[PH_3]$

The half life period of PH_3 is 37.9 s at 120°C.

i) How much time will be required for $3/4$ of PH_3 to decompose?

ii) What function of the original amount of PH_3 will remain undecomposed after 1 minute?

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56. With rate constant of $5 \times 10^{-4} \sec^{-1}$ at 45°C, If initial concentration of N_2O_5 is 0.25 M, Calcualte the concentration after 2 minutes. Also calculate half life for the decomposition of N_2O_5 ?

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

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57. Under the same reaction condition, initial concentration of 1.386 mol dm^{-3} of a substance becomes half in 40s and 20s through first order and zero order kinetics respectively. Find out the $\frac{k_1}{k_0}$ ratio for first order (k_1) and zero order (k_0) of the reaction.

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58. The rate constant for a reaction of zero order in A is $0.0030 mol L^{-1} s^{-1}$. How long will take for the initial concentration to fall from 0.10 M to 0.075 M?

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59. In a hydrolysis reaction, 5 g of ethyl acetate is hydroloysed in the presence of dilute HCl in 300 minutes. If the reaction is of first order and the initial concentration of ethyl acetate is 22g/L, calculate the rate constant for the reaction.

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60. The thermal decomposition of formic acid (HCOOH) is a first order reaction with the rate constant of $2.4 \times 10^{-3} s^{-1}$ at a certain temperature.Calculate how long will it take for three-fourth of initial quantity of HCOOH to decompose.

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61. Following data is obtained for the reaction,

$$N_2O_5 \rightarrow 2NO + \frac{1}{2}O_2$$

a) Show that the reaction is of first order

b) Calculate the half life period.

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62. For the first order thermal decomposition reaction, following data was obtained:

Calculate the rate constant.

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63. 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 140°C and the data below were collected.

a) Calculate rate constant in all the cases.

b) What will be the concentration of N_2O_5 after 100 minutes?

c) Calculate initial rate of reaction.

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64. A first order reaction $A_2B_2(g) \rightarrow 2A(g) + 2B(g)$ at the temperature 400° C has the rate constant $k = 2.0 \times 10^{-4} s^{-1}$. What percentage of A_2B_2 is decomposed on heating for 900 seconds?

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65. In a first reaction, 10% of the reactant is consumed in 25 minutes. Calcualte.

i) Half life period $(t_{1/2})$ ii) Time taken to complete 87.5% of the reaction.

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66. The half-life of radioisotope bromine-82 is 36 hours. Calculate the fraction of a sample of bromine that remains after one day.

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67. The half-life period of a radioactive element is 1.4×10^{10} years. Calculate the time in which the activity of the element is reduced to 90% of its original value.

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68. Assume that two radioactive substances A and B disintegrate as:

$$\frac{-d[A]}{dt} = k_A, t_{1/2}(A) = \frac{0.693}{K_A}$$
$$\frac{-d[B]}{dt} = k_B[B]^2, t_{1/2}(B) = \frac{1}{k_B[B]_0}$$

If both the half life periods and initial concentrations are equal, what will be the ratio of the rates of the two substances at the start of the reaction?

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69. Two reactions of the same order have equal exponential factors but their activation energies differ by $24.9 kJ mol^{-1}$. Calculate the ratio between the rate constants of these reactions at 27°C (Gas constant $R = 8.3 JK^{-1} mol^{-1}$)

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70. The reaction $C_2H_5I \rightarrow C_2H_4 + HI$ is of first order and its rate constants are $3.20 \times 10^{-4} s^{-1}$ at 600 K and $1.60 \times 10^{-2} s^{-1}$ at 1200 K. Calculate the energy of activation for the reaction. (Given $R = 8.314 JK^{-1} mol^{-1}$)

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71. A first order reaction is 50% complete in 30 minutes at 27°C and in 10 minutes at 47°C. Calculate the reaction rate constants at these

temperatures and the energy of activation of the reaction in kJ/mol

(R=8.314 J$mol^{-1}K^{-1}$)

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

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73. The rate constant for a first order reaction becomes six times when the temperature is raised from 350 to 400 K. Calculate the energy of activation for the reactions.

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74. The rate constant for a first order reaction increases from 4×10^{-2} to 8×10^{-2} when the temperature changes from 27°C to 37°C. Calculate energy of activation for the reaction.

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75. For a reaction, the activation energy is zero. What is the value of rate constant at $300K$ if $k = 1.6 \times 10^{6} s^{-1}$ at 280 K $(R = 8.31 JK^{-1} mol^{-1})$?

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76. The rate constant of a reaction is $1.5 \times 10^{7} s^{-1}$ at 50°C and $4.5 \times 10^{7} s^{-1}$ at 100°C. Calculate the value of activation energy for the reaction $(R = 8.314 JK^{-1} mol^{-1})$

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77. The slope of a line in the graph of log k versus $\frac{1}{T}$ for a reaction is -5841K. Calculate energy of activation for the reaction.

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78. The activation energy of a reaction is 75.2 kJ mol^{-1} in the absence of a catalyst and 50.14 kJ mol^{-1} in the presence of a catalyst. How many times will the reaction grow in the presence of catalyst if the reaction proceeds at 25°C ?

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79. The decomposition of phosphine,

$4PH_3(g) \rightarrow P_4(g) + 6H_2(g)$ has rate law , Rate = $k[PH_3]$. The rate constant is $6.0 \times 10^{-4}s^{-1}$ at 300 K and activation energy is 3.05×10^5 J mol^{-1}. Calculate the value of the rate constant at 310 K ($R = 8.314JK^{-1}mol^{-1}$)

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80. For a decomposition, the values of rate constants at two different temperature are given below:

$k_1 = 2.15 \times 10^{-8} Lmol^{-1}s^{-1}$ at 650 K

$k_2 = 2.39 \times 10^{-7} Lmol^{-1}s^{-1}$ at 700 K

Calculate the value of activation energy for the reaction (R= $8.314 JK^{-1}mol^{-1}$)

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81. The rate of a reaction increases four times when the temperature changes from 300K to 320 K. Calculate the energy of activation of the reaction. $\left(R = 8.314 JK^{-1}mol^{-1}\right)$

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

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83. The first order rate constant for the decomposition of ethyl iodide by the reaction.

$C_2H_5(g) \rightarrow C_2H_4(g) + HI(g)$ at 600 K is $160 \times 10^{-5}s^{-1}$, $T_1 = 600K$, $T_2 = 700K, E_a = 209kJmol^{-1}$.

$$\log k_2 = \log\left(1.60 \times 10^{-5}s^{-1}\right) + \frac{209000Jmol^{-1}}{2.303 \times 8.314Jmol^{-1}K^{-1}}\left[\frac{1}{600K} - \frac{1}{70$$

$$\log k_2 = (- 5 + 0.2041) + 2.5989 = - 2.197 = \overline{3}.8080$$

$$k_2 = \text{Antilog}\overline{3}.8030 = 6.36 \times 10^{-3}s^{-1}$$

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NCERT in text questions

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

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

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

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

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5. 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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6. Time required to decompose SO_2Cl_2 to half of its intial amount is $60min$. If the decomposition is a first order reaction, calculate the rate constant of the reaction.

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7. What will be effect of temperature on rate constant ?

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8. In general, it is observed that the rate of a chemical reaction doubles with every 10° rise in temperature. If the generalisation holds for a

reaction in the temperature range 295 K to 305 K, what would be the value of activation energy for the reaction?

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

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10. For the reaction, $2A + B \to A_2B$, the reaction rate = $k[A][B]^2$ with k $=2.0 \times 10^{-6} mol^{-2} L^2 s^{-1}$. Calculate the initial rate of the reaction when [A] = 0.1 mol L^{-1}, [B]= 0.2 molL^{-1}. Also calculate the reaction rate when [a] is reduced to 0.06 mol L^{-1}.

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11. The rate of decomposition of NH_3 on platinum surface is zero order. What are rate of production of N_2 and H_2 if $k = 2.5 \times 10^{-4} Ms^{-}$?

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12. The decomposition of dimethyl ether leads to the formation of CH_4, H_2 and CO and the reaction rate is given by the expression:

rate =$k[CH_3COOH_3]l^{3/2}$

The rate of reaction is followed by increase in pressure in a close vessel and the rate can also be expressed in terms of partial pressure of dimethyl ether:

rate =$k[CH_3OCH_3]^{3/2}$

The rate of reaction is followed by increase in a close vessel and the rate can also be expressed in terms of partial pressure of dimethyl ether:

rate = $k[pCH_3OCH_3]^{3/2}$

If the pressure is measured in bar and time in minutes, then what are the units of rate and rate constant?

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

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

(a) doubled, (b) reduced to $1/2$?

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

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

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

ii) Calcualte the pseudo first order rate constant for the hydrolysis of ester.

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

i) Write differential rate equation.

ii) How is rate affected when the concentration of B is tripled?

iii) How is rate affected when the concentration of both A and B are doubled?

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18. In a reaction between A and B, the initial rate of reaction was measured for different initial concentration of A and B as given ahead:

what is the order of reaction with respect to A and B?

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19. The following data were obtained at 300K for the reaction $2A + B \rightarrow C + D$

Calculate the rate of formation of D when [A] = $0.5 mol L^{-1}$ and $[B] = 0.2 mol L^{-1}$

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20. 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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21. Calculate the half life of the first order reaction from their rate constant given as

a) $200 s^{-}$

b) $2 \overset{-1}{\min}$

c) 4 year^{-1}.

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22. 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. Estimat the age of the sample.

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

a) Plot $[N_2O_5]$ against t

b) Find the half life period for the reaction.

c) Draw a graph between log $[N_2O_5]$ and t

d) What is rate law?

e) Calculate the rate constant

f) Calculate the half life period from k and compare it with (b)

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24. The rate constant for a first order reaction is $60s^{-1}$. How much time will it take to reduce the initial concentrationof the reactant to its $1/16th$ value ?

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25. During nuclear explosion, one of the products is ^{90}Sr with half $-$ life of 28.1 years. If $1\mu g$ of ^{90}Sr 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 not lost metabolically.

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

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27. A first order reaction takes 40 minutes for 30% decomposition. Calculate its half life period.

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

Calculate the rate constant.

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29. The following data were obtained during first order thermal decomposition of $SO_2(Cl_2)$ at a constant volume.

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

Calculate the rate of the reaction when the total pressure is 0.65 atm.

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30. The rate constant for the decomposition of N_2O_5 at various temperatures is given below:

Draw a graph beetween In k and $1/T$ and calculate the values of A and E_a. Predict the rate constant at 30° and 50°C

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

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

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

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34. The decomposition of hydrocarbon follows the equation

$k = (4.5 \times 10^{11} s^{-1}) e^{-28000 K / T}$

Calculate E_a.

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35. The rate constant for the first order decomposition of a certain reaction is described by the equation

$$\log k(s^{-1}) = 14.34 - \frac{1.25 \times 10^4 K}{T}$$

(a) What is the energy of activation for the reaction?

(b) At what temperature will its half-life period be 256 min ?

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36. 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 of $60 kJ mol^{-1}$. At what temperature would k be $1.5 \times 10^4 s^{-1}$?

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37. 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 $318K$ and E_a.

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38. 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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NCERT Exercise

1. From the rate expression for the following reactions determines the order of reaction and the dimensions of the rate constant.

a) $3NO(g) \rightarrow N_2O(g) + NO_2(g)$, Rate $= k[NO]^2$

b) $H_2O_2(aq) + 3I^-(aq) + 2H^+(aq) \rightarrow 2H_2O(l) + I_3^-$, Rate = $[H_2O_2][I^-]$

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

d) $CHCl_3(g) \rightarrow Cl_4(g) + HCl(g)$: Rate = $k[CHCl_3][Cl_2]^{1/2}$

e) $C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$, Rate =$k[C_2H_5Cl]$

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Short Answer type questions

1. State one condition under which a bimolecular reaction may be kinetically of first order reactions.

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2. Write the rate rate equatioin for the reaction $2A + B \rightarrow C$ if the order of the reaction is zero.

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3. How can you determine the rate law of the following reactions?

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

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4. For which type of reactions, order and molecularity have the same value?

A. Order and molecularity have the same value for elementary reactions that are taking place in single step.

B.

C.

D.

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5. In a reaction if the concentration of reactant A is tripled, the rate of reaction becomes twenty seven times. What is the order of reaction?

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6. Derive an expression to calculate time required for completion of zero order reaction.

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7. For a reaction A+B $\rightarrow$ Products, the rate law is -Rate = $k[A][B]^{3/2}$

Can the reaction be an elementary reaction? Explain.

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8. for a certain reactions, large fractions of molecules has energy more than the threshold energy, yet the rate of reaction is very slow. Why?

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9. For a zero order reaction, will the molecularity be equal to zero? Explain.

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10. For a general reaction A $\rightarrow$ B. plot of concentrating of A vs time is given in fig.

Answer the following questions on the basis of this graph.

a) What is the order of the reaction?

b) What is the slope of the curve?

c) What are the units of rate constant?

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11. The reaction between $H_2(g)$ and O_2 (g) is highly feasible, yet allowing the gases to stand at room temperature in the same vessel does not lead to the formation of water. Explain.

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

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13. Oxygen is available in plenty in air yet fuels do not burn by themselves at room temperature. Explain.

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14. Why is the probablity of reaction with molecularity higher than three very rare?

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15. Why does the rate of any reaction generally decrease during the course of the reaction?

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16. Thermodynamic feasibility of the reaction alone cannot decide the rate of the reaction. Explain with the help of one example.

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17. Why in the redox titration of $KMnO_4$ vs oxalic acid, we heat oxalic acid solution before starting the titration?

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18. Why can't molecularity of any reaction be equal to zero?

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19. Why molecularity is applicable only for elementary reactions and order is applicable for elementary as well as complex reactions?

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20. Why can we not determine the order of a rection by taking into consideration the balanced chemical equation ?

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Long Answer type question

1. All energetically effective collisions do not result in a chemical change. Explain with the help of an example.

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2. What happens to most probable kinetic energy and the energy of activation with increases in temperature?

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3. Describe why the enthalpy of a reaction remains unchanged when a catalyst is used in a reaction.

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4. Explain the difference between instantaneous rate of a reaction and average rate of a reaction .

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5. With the help of an example explain what is meant by pseudo first order reaction .

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6. In a first order reaction, the units of the rate constant donot depend upon the concentration of the reactants. Justify?

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7. State one condition under which a bimolecular reaction may be kinetically of first order reactions.

Watch Video Solution

8. Why equilibrium constant of a reaction does not change in the presence of a catalyst ?

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9. In the following reaction:

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

What is the predicted rate law, if the mechanism is

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

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

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10. If half life of a reaction is inersely proportional to initial concentration of the reactant, what is the order of reaction?

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11. E_1 and E_2 are the reaction is inversely proportional to initial concentration of the reactant, what is the order of reaction?

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

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

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14. Can activation energy for reactions be zero?

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Additional important questions:

1. What is reaction rate?

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2. Identify the reaction order from each of the following rate.

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

ii) $k = 2.3 \times 10^5 Lmol^{-1}s^{-1}$

ii) $k = 3.1 \times 10^{-4}s^{-1}$

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3. Which of the following act as photosensitizer during photosynthesis?

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4. For a reaction $A + H_2O \rightarrow B$, Rate $k \propto [A]$. What is its i) Molecularity

ii) Order ?

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5. Average rate of reaction does not give the true picture of the reaction

rate. Explain.

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6. Powedered sugar dissolves in water faster than crystalline sugar. Why?

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7. Why does it take more time to boil an egg or cook rice at higher altitudes?

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8. Why does the use of pressure cooker reduce cooking time ?

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9. A person living in shimla observd that cooking without using pressure cooker takes more time. The reason for this observation is that at high altitude

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10. Show reactions requires less activation energy as compared to fast reactions. Do you agree with the statement?

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11. A lump of coal burns at moderate rate in air while coal dust burns explosively. Explain.

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12. Why does liquid bromine reacts slowly as compared to vapours of bromine?

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13. A reaction proceeds with a uniform rate throughout. What do you conclude?

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14. What is the order of reaction whose rate constant has the same units as rate of reaction ?

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15. Why coal or petrol does not burn by itself in air but once initiated by flame, it continues to burn?

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16. Why are reactions of high molecularity less in number?

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Qestions from board examinations

1. Give the exmaple of a reaction in which order and molecularity are equal.

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2. The specific rate of a reaction is $6.2 \times 10^{-3}\ molL^{-1}s^{-1}$. What is the order of the reactions?

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3. Does a zero order reaction have molecularity equal to zero?

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4. For which order of the reactions, the units of the rate constant are independent of the concentration?

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5. The reaction $A + B \rightarrow$ C has zero order. Write its rate equatons.

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6. For the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3$, how are the rate of reaction expressin inter- related?

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7. Give one example of a fractional order reactions:

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8. Rate of reaction is given by the eqution : Rate = $k[A]^2[B]$. What are the units for the rate and rate constant for the reaction?

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9. In a multi-step reaction, the rate is determined by conisdering the............step.

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10. For the hypothetical reaction,

$A \rightarrow$ Products, rate $= -k[A]$

The negative sign used in the rate expression indicate that

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11. Why in general a reaction does not proceed with a uniform rate throughout?

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12. State one condition in which a bimolecular reaction may be kinetically of the first order?

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13. The rate law for the decomposition of N_2O_5 is given as: Rate = $k[N_2O_5]$. What is the significance of k in the equation?

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14. What is the source of activation energy in a photochemical reaction?

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15. What is the order of photochemical reactions?

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16. How is activation energy of a reaction affected i) by using a catalyst ii) by increasing the temperature?

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17. With the help of an example explain what is meant by pseudo first order reaction .

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18. What is the elementary reactions?

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

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20. Express the relation between the half-life period of a reaction and initial concentration of the reaction of second order.

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21. Express the relatin between the half-life period of a reaction and initial concentration for the reaction of the nth order.

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22. For a reaction A + 2B $\rightarrow C$, rate =$k[A]^x[B]^y$. What is the order of the reaction?

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23. What are the units of rate constant for zero order reactions?

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24. For the reaction : Ester + $H^{+} \rightarrow$ Acid + Alcohol, rate = $k[A]^{1/2}[B]^{2}$.

What is the order of reaction?

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

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

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27. A substance with initial concentration 'a' follows zero order kinetics. In how much time, will the reactions go to completion ?

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28. How does the value of rate constant vary with reactant concentrations?

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29. The reaction A+B $\rightarrow$ C. has zero order. What is the rate equation?

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30. For a reaction A $\rightarrow$ B, the rate of reaction becomes twenty seven times when the concentration of A is increased three times. What is the order of the reaction?

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31. A reaction is 50 % complete in 2 hours and 75 % complete in 4 hours the order of reaction is

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32. What is meant by elementary step in a reaction?

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33. What is the order of reaction whose rate constant has the same units as rate of reaction ?

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34. A first order reaction is 50% complete in 20 minutes. What is its rate constant?

Watch Video Solution

35. Why in general a reaction does not proceed with a uniform rate throughout?

Watch Video Solution

36. Define activation energy for a reaction.

Watch Video Solution

37. For a reaction, $Cl_2(g) + 2NO(g) \rightarrow 2NOCl(g)$,the rate law is expressed as rate = $k[Cl_2][NO]^2$. What is the order of the reaction?

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38. The kinetics for the reaction, $2NO + 2H_2 \rightarrow N_2 + 2H_2O$ is explained by the following two steps,

i) $2NO + H_2 \rightarrow N_2 + H_2O_2(slow)$

ii) $H_2O_2 + H_2 \rightarrow 2H_2O$ (fast),

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39. Writte the rate law and order for the following reaction:

$AB_2 + C_2 \rightarrow AB_2C + C$ (slow)

$AB_2 + C \rightarrow AB_2C$ (fast)

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40. Write any reaction with fractional order. What is its rate equation?

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41. If the concentration is expressed in mol L^{-1} units and time in seconds, what would be the units of k

i) for a zero order reaction ii) for a first order reaction?

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42. A reaction is first order in A and of second order in B. Write the differential rate equation for the reaction.

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43. Rate of chlorination of methane is accelerated by light. Explain.

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44. Why does the rate of a reaction not remain constant throughtout the reaction?

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45. Give one example of first and second order reactions.

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46. Find the values of the rate constant of a first order reaction having half life of 50 minutes.

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

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48. Calculate the half life of a first order reaction from their rate constants given below :

a.) $200s^{-1}$ b.) $2min^{-1}$ c.) $4years^{-1}$

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49. What is the relation between rate constant and activation energy of a reaction?

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50. What is the relation between half-life period and initial concentration of zero order reaction?

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51. Explain the terms

i) Order of a reaction

ii) Molecularity of a reaction.

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52. Give one example each of zero order and first order reactions:

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53. What is the meant by rate constant k of a reaction?

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54. If the concentration is mentioned in mol L^{-1} units and time in seconds, what are the units of k for zero order reaction and first order reaction?

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55. What do you understand by rate law and rate constant of a reaction?

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56. Identify the order of a reaction if the units of rate constant are : i) $L^{-1}mols^{-1}$ ii) $Lmol^{-1}s^{-1}$

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57. A reactions is of 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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58. For a chemical reaction, variation in concentration , in [R] vs time (min) plot is shown:

i) What is the order of the reaction?

ii) What are units of rate constant, k for reaction?

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59. Catalyst have no effect on the equilibrium constant. Why?

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60. Consider the decomposition of hydrogen peroxide in the alkaline medium which is catalysed by iodide ions.

This reaction takes place in two steps as given below

step-1 $H_2O_2 + I^{-1} \rightarrow H_2O + IO^- (Slow)$

Step II $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

a) Write the rate law expression and determine the order of reactan w.r.t

H_2O_2

b) What is the molecularity of each individual step?

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61. What is half life period ? Calculate the half life period for zero order reaction.

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62. Explain the following:

a) Effect of catalyst on reaction rate.

b Molecularity of chemical reaction.

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63. Identify the reaction order from each of the following units of reactions rate constants.

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64. On increasing temperature, activation energy for a reaction decrease. Why?

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65. Prove that the half-life period for a first order reaction is quite independent of the initial concentration of reactants.

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66. For a reaction $A + B \rightarrow$ P, the rate law is given by:

$r = k[A]^{1/2}[B]^2$

What is the order of the reaction?

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

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68. what is the activation energy? How is rate constant related to activation energy?

Watch Video Solution

69. If the rate constant for a reaction is expressed as: rate = $k[A]^2[B]$, what is the order of the reacton?

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70. Give an example of second order reaction.

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71. Write note on activation energy.

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72. Write two differences between 'order of reaction' and 'molecularity of reaction'.

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73. Explain : Pseudo First Order Reaction

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74. For the first order reaction with rate contant k, which expression gives the half life period ? (Initail conc. = a)

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75. What is activated complex?

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76. What is half life period ? Calculate the half life period for zero order reaction.

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77. i) Write the mathematics expressions relating the variation of the rate constant of a reaction with temperatures.

ii) How can you graphically find the activation energy of the reaction from the above expression?

iii) The slope of the line in the graph of log k(k=rate constant) versus $1/T$ is -5841. Calculate the activation energy of the reaction.

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78. Define rate constant, Write units of rate constant for fist and second order reactions.

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79. Write two differences between 'order of reaction' and 'molecularity of reaction'.

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80. Define the term collision frequency.

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81. Define rate of reaction, Write two factors that affects the rate of reactions.

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82. Derive the formula for the calculation of half-life period of first order of reaction.

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83. For a reaction, the unit of rate constants is s^{-1}. What is the order of reaction?

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84. If in a chemical reaction, $A + B \rightarrow$ Products, the rate law is given the expression : rate = $k[A]\left(\frac{1}{2}\right)[B]^{\frac{3}{2}}$. What is the order of the reaction?

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85. Derive an expression for the rate constant in the first order reaction.

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86. For a reaction, $2NH_3(g) \xrightarrow{\text{Pt}} N_2(g) + 3H_2(g)$ (Rate =k)

i) Write the order and molecularity of reaction is two. II) Unit of k =

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

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87. What is the effect of temperature on reaction rate?

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88. Calculate half life period for a first order reaction having k=$4 \min^{-1}$

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89. a) Derive expression for the half period of first order reaction.

b) Given an exmaple of zero order reaction.

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90. What do you mean by order of a reaction? Given example. Derive the expression for the determination of the constant for first order reaction.

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91. 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 reaction ?

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92. In Arrhenius equation, what does the factor e^{Ea}/RT correspond to?

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93. State the Arrhenius equation for the rate constant of a reaction.

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94. Stte the Arrhenius equation for the rate constant of a reaction.

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95. What is an activated complex?

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96. Distinguish between 'rate expression' and 'rate constant' of a reaction.

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97. a) Describe the kinetics of a first order reaction.

b) Why is first order reaction never completed?

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Higher order thinking skills (hots) question

1. In the graphical representation for the reaction:

$A \rightarrow B$ there are two types of regions. What do these regions specify?

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2. the rate law of the reaction $A \rightarrow$ Product is : rate = k[A]. It has been graphically represented. What is the rate constant for the reaction?

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3. Consider the reaction $A \rightarrow P$. The change in concentration of A with time has been shown graphically.

i) Predict the order of the reaction.

ii) Derive an expression for the time required for the completion of the reaction.

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4. For a chemical reactio , variation in the concentration [R] Vs time (s) plot is given:

For this chemical reaction, write/draw:

i) What is the order of the reaction?

ii) What are the units of the rate constant (k)?

iii) Give the relationship between k and $t_{1/2}$ (half life period)

iv) What does the slope of the above line indicate?

v) Draw the plot log $\frac{[R]_0}{R}$ Vs time (s).

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5. A curve has been plotted for the first order reaction $A \to B$, Answer the following questions on the basis of the curve?

i) What is the relation between the slope of this line and rate constant?

ii) Calculate the rate constant for the reaction if the slope is $2 \times 10^{-4} s^{-1}$

iii) Derive the relationship between the half life of a first order reaction and its rate constant.

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6. The reaction $NO_2Cl(g) + NO(g) < \Rightarrow NO_2(g) + NOCl(g)$ is a single step reversible reaction. The energy of activation for the forward reaction is 28.9 kJ and that for the backward reaction is 41.8 kJ. Draw energy level diagram for the reaction. Indicate E_af and E_ab and ΔH in the diagram.

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7. From the given figure:

i) Calculate ΔE for the reaction and energy of activation for the forward reaction and energy of activation for the backward reaction.

ii) The dotted curve is in the presence of a catalyst, what is the energy of activation for the two reactions in the presence of the catalyst?

iii) will the catalyst change the extent of the reaction?

8. consider a reaction that occurs by the following mechanism

$A + BC \rightarrow AC + B$

$AC + D \rightarrow A + CD$

the potential energy profile for the reaction is shown:

a) Write the equation for the overall reaction.

b) What are the different species present at reactions stagest 1 to 5?

c) What is the rate determinig step?

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9. For a reaction $A \to B$, $E_a = 10 kJ mol^{-1}$ and $\Delta H = 5 kJ mol^{-1}$. Which is correct potential energy profile for the reaction?

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10. The expermine data for a reaction $2A + B_2 \to 2AB$ is:

Write the most probable rate equation for the reaction giving a suitable explanation.

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11. At a concentration of 0.1 and 0.2 mol L_{-1}, the rates of decomposition of a compound were found to be 0.18 and 0.72 mol $L^{-1} \overset{-1}{\min}$. What is the order of the reaction?

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12. If one percent of the reactant decomposes in first minute in a first order reaction, calculate how much reactant would remain undecomposed after one hour.

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13. The following reaction was carried out in water :

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

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

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14. The rate constant is given by the Arrhenius equation as :

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

Calcualte the ratio of the catalysed and uncatalysed rate constants at 25° C If the energy of activation of a analysed reaction is 162 kJ mol^{-1} and for uncatalysed reaction, the value is 350 kJ mol^{-1}.

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15. The half time of first order decomposition of nitramide is 2.1 hour at $15^\circ C$.

$NH_2NO_{2(aq.)} \rightarrow N_2O_{(g)} + H_2O_{(l)}$

If $6.2g$ of NH_2NO_2 is allowed to decompose, calculate:

(i) Time taken for NH_2NO_2 to decompose 99%.

(ii) Volume of dry N_2O produced at this point measured at STP.

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

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17. The decomposition of N_2O_5 according to the equation: $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ is a first order reaction. After 30 min. from the start of the decomposition in a closed vessel, the total pressure developed is found to be 284.5 min of Hg and on complete decomposition, the total pressure is 584.5 min of Hg. Calculate the rate constant for the reaction.

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18. A first order reaction $A \rightarrow B$ requires activation energy of $70 kJmol^{-1}$. When a 20% solution of A was kept at $25^\circ C$ for 20 min, 25% decomposition took place. What will be the percentage decomposition in the same time in a 30% solution maintained at $40^\circ C$? (Assume that activation energy remains constant in this range of temperature)

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Multiple Choice Questions

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. decreases

C. remains unchanged

D. may increase or decrease

Answer: C

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

A. determining the rate constant at standard temperature

B. determining the rate constant at two temperatures.

C. determining probability of collision.

D. using catalyst.

Answer: B

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4. Consider the given figure and mark the correct option.

A. Activation energy of forward reaction is $E_1 + E_2$ and product is less stable than reactant.

B. Activation energy of forward reaction is $E_1 + E_2$ and product is more stable than reactant.

C. Activation energy of both forward and backward reaction is $E_1 + E_2$ and reactant is more stable than product.

D. Activation energy of backward reactioni is E_1 and product is more stable than reactant.

Answer: A

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5. Consider a first order gas phase decompostion reaction gives below

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

The initial pressure of the system before decomposition of A p_i. After lapse of time 't' total pressure of the system increased by x units and became p_t. The rate constant K for the reaction is given as....... .

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

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

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

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

Answer: B

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6. According to Arrheneius equation rate constant k is equal to $Ae^{-E_a/RT}$. Which of the following options represents the graph of ln k vs $\frac{1}{T}$?

A.

B.

C.

D.

Answer: A

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7. Consider the Arrhenius equation given below and mark the correct option.

$$k = Ae^{-\frac{Ea}{RT}}$$

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

B. Rate constant decreases 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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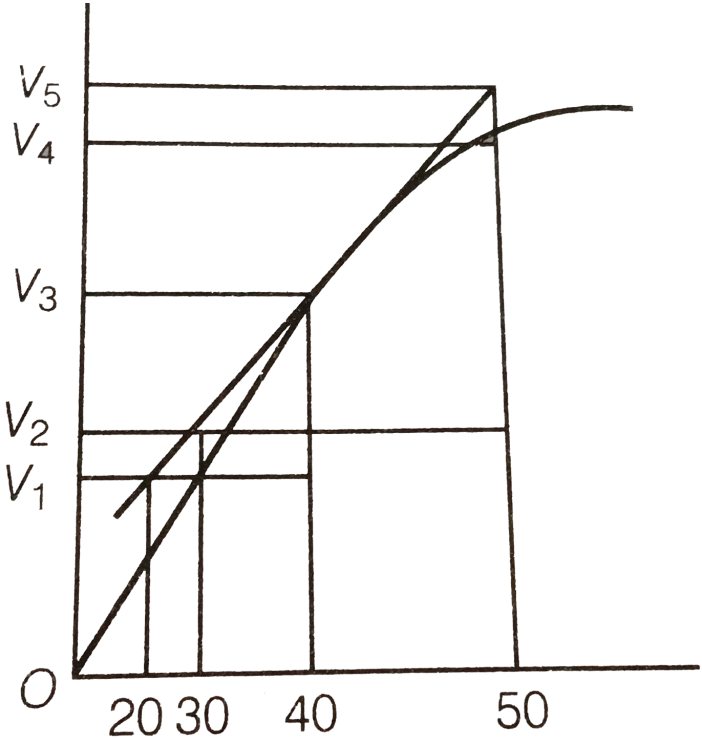
8. A graph of volume of hydrogen released vs time for the reaction between zinc and dil. HCl is given in figure . On the basis of this markt the correct options.



A. Average rate upto 40 seconds is $\frac{V_3 - V_2}{40}$

B. Average rate upto 40 seconds is $\frac{V_3 - V_2}{40 - 30}$

C. Average rate upto 40 seconds is $\frac{V_3}{40}$

D. Average rate upto 40 seconds is $\frac{V_3 - V_1}{40 - 20}$

Answer: C

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9. Which of the following statement is not correct about order of a reaction ?

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

B. Order of a reaction is experimentally determined quantity

C. The order of a reaction is always equal to the sumof 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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10. Consider the graph under question 8. Which of the following options does not show instaneous rate of reactiono at 40^{th} 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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11. Which of the following statements is correct?

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

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

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

D. The rate of a reaction decreases with increases in concentration of reactants(s).

Answer: A

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12. Which of the following expression is correct for the rate of reaction given below ?

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

A. $\dfrac{\Delta\left[Br^{-1}\right]}{\Delta t}=5\dfrac{\Delta[H^{+}]}{\Delta t}$

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

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

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

Answer: C

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13. Which of the following graphs represents exothermic reaction?

A. i) only

B. ii) only

C. iii) only

D. i) and ii)

Answer: A

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

A. the same

B. doubled

C. quadrupled

D. halved

Answer: A

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15. Which of the following statements is incorrect about the collision theory of chemicacl reaction ?

A. It considers reacting molecules or atoms to be hard spheres and ignores their structrual features.

B. Number of effective collisions determines the rate of reaction.

C. Collision of atoms or molecules processig sufficient thereshold energy results into the product formation.

D. Molecules should collide with sufficient threshold energy andproper orientatin for the collision to be effective.

Answer: C

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16. A first order reaction is 50% completed in 1.26×10^{14}s. How much time would it take for 100% completion?

A. 1.26×10^{15}s

B. 2.52×10^{14}s

C. 2.52×10^{28} s

D. infinite

Answer: D

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17. Compounds 'A' and 'B' react according to the following chemical equation

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

Concentration of either 'A' or 'B' were changed keeping the concentrations of one of the reactants constant and rates were measured as a function of initial concentration. Following results were obtained. Choose the correct option for the rate of equations for this reaction.

A. Rate of = $k[A]^2[B]$

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

C. Rate = $k[A][B]$

D. Rate = $k[A]^2[B]^-$

Answer: B

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18. Which of the following statements is not correct for the catalyst?

A. It catalyses the forward and backward reactions to the same extent

B. It alters ΔG for the reaction

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

D. It provides an alternate mechanism by redusing activation energy between reactants and products.

Answer: B

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19. The 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: A

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20. 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 time?

A.

B.

C.

D.

Answer: B

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21. Rate law cannot be determined form balanced chemical equation if â€¦â€¦.. .

A. reverse reaction is involved

B. it is an elementary reaction

C. It is sequence of elementary reactions

D. any of the reactants is in excess.

Answer: A::C::D

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22. Which of the following statements are applicable to a balanced chemical equation of an elementary reaction ?

A. Order is same as the 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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23. 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. the 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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24. For a complex reaction

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

B. order of overall reaction is same as 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-integer.

Answer: A::D

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25. 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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26. 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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27. According to Maxwell Boltzmann distribution of energy

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

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

C. most probable kinetic energy decreases at higher temperatures

D. most probable kinetic energy decreases at higher temperatures.

Answer: A::C

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28. In the graph showing Maxwell Boltzmann distribution of energy ....

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

B. area under the curve increases with increase in temperature

C. area under the curve decreases with increases in temperature

D. with increases in temperature curve broadens and shifts to the righ hand side.

Answer: A::D

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29. Which of the following statements are in accordance with the Arrhenius equation?

A. Rate of a reaction increases with increases in temperatures

B. Rate of a reaction increases with decrease in activation energy

C. Rate constant decreases exponentially with increase in temperature

D. Rate of reaction decreases with decreases in activation energy.

Answer: A::B

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30. 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 enthapy change of the reaction.

Answer: B::D

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31. Which of the following graphs is correct for a zero order of reaction?

A.

B.

C.

D.

Answer: A::D

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32. Which of the following graphs is correct for a first order reaction?

A.

B.

C.

D.

Answer: A::D

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Multiple type questions

1. Match the graph given in Column I with the order of reaction given in Column II. More than one item in column I may link to the same item of Column II.

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2. Match the statements given in Column I and Column II

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3. Match the items of Column I and Column II

View Text Solution

4. Match the items of Column I and Column II

View Text Solution

Assertion Reason type questions

1. Assertion: Order of the reaction can be zero or fractional.

Reason: We cannot determine order from balanced chemical equation.

A. Both assertion and reason are correct and the reason is correct explanation of assertion.

B. Both assertion and reason are correct but reason does not explain assertion.

C. Assertion is correct but reason is incorrect

D. Both assertion and reason are incorrect.

Answer: B

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2. Assertion: Order and molecularity are same.

Reason: Order is determined experimentally and molecularity is the sun of the stoichiometric coefficient of determining elementary step.

A. Both assertion and reason are correct and the reason is correct explanation of assertion.

B. Both assertion and reason are correct but reason does not explain assertion.

C. Assertion is correct but reason is incorrect

D. Assertion is incorrect but reason is correct.

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3. Assertion: The enthalapy of reaction remains constant in the presence of a catalyst.

Reason: A catalyst participating in the reaction, forms different activated complex and lowers down the activation energy but the difference in energy of reactants lead to product formation.

A. Both assertion and reason are correct and the reason is correct explanation of assertion.

B. Both assertion and reason are correct but reason does not explain assertion.

C. Assertion is correct but reason is incorrect

D. Both assertion and reason are incorrect.

Answer: A

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4. Assertion: All collisions of reactant molecules lead to product formation.

Reason: Only those collisions in which molecules have correct orientation and sufficient kinetic energy lead to compound formations.

A. Both assertion and reason are correct and the reason is correct explanation of assertion.

B. Both assertion and reason are correct but reason does not explain assertion.

C. Assertion is correct but reason is incorrect

D. Assertion is incorrect but reason is correct.

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5. Assertion (A) Rate constant determined form Arrhenius equations are fairly accurate for simple as well as complex molecules.

Reason (R) Reatant molecules undergo chemical irrespective of their orientation during collison.

A. Both assertion and reason are correct and the reason is correct explanation of assertion.

B. Both assertion and reason are correct but reason does not explain assertion.

C. Assertion is correct but reason is incorrect

D. Both assertion and reason are incorrect.

Answer: C

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Effect of concentration on rate of reaction

1. Derive an expression for the intergated rate equation for the first order reaction.

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2. Define order of reaction, what are the units for the rate constant of first order reaction?

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3. Show that in first order reaction:

i) Half-life period is independent of the initial molar concentration of the reaction.

ii) Units of rate constant donot depend upon the units of concentration.

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4. For a reaction $A + H_2O \rightarrow B$, Rate $k \propto [A]$. What is its i) Molecularity ii) Order ?

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5. Give one example of first order reaction.

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6. Consider the reaction:

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$.

The equally relationship between $-\frac{d[NH_3]}{dt}$ and $-\frac{d[H_2]}{dt}$ is:

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7. Define rate of reaction and rate constant.

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8. Define molecularity of a reaction.

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9. Draw a schematic graph showing how the rate of first order reaction changes with change in concentration of reactants.

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10. Rate of reaction is given by the equation

Rate = $k[A]^2[B]$

What are the units for the rate and rate constant for the section?

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11. State one condition under which a bimolecular reaction may be kinetically of first order reactions.

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12. The rate law for decomposition N_2O_5 is rate $=k[N_2O_5]$

What is the significance of k in the equation?

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13. Nitric oxide (NO) reacts with oxygen to produce nitrogen dioxide (NO_2) :

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

The rate law for the reaction is:

$rate = k[NO]^2[O_2]$

Propose a mechanism for the above reaction.

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14. The possible mechanism for the reaction

$2NO + 2H_2 \rightarrow N_2 + 2H_2O$ is

i) $2NO < \ \Rightarrow N_2O_2$

ii) $N_2O_2 + H_2 \xrightarrow{\text{slow}} N_2O + H_2O$

iii) $N_2O + H_2 \xrightarrow{\text{fast}} N_2 + H_2O$

a) What is rate law for the reaction?

b) What is the order of the reaction?

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15. The rate law for the reaction:

Ester $+ H^+ \xrightarrow{\text{Fast}}$ Acid + alcohol is:

$$-\frac{dx}{dt} = k[\text{Ester}]\left[H^+\right]^\circ$$

What would be the effect on the rate if the concentration of acid is doubled?

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16. Identify the reaction order from the rate constant value $=3.2 \times 10^{-5}$ litre $mol^{-1}\,\text{sec}^{-1}$

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17. Show that the rate constant in a zero order reaction is inversely proportional of its half life period.

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18. State the units of rate constant in zero order reaction.

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19. a) write dimensions of first order reaction.

b) Give reason for no change in concentration of H_2 and Cl_2 with respect to time in the reactions.

$$H_2(g) + Cl_2 \xrightarrow{hv} 2HCl(g)$$

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20. a) Define order and molecularity of a reaction.

b)Find order and molecularity of the following reactions.

i) $H_2(g) + Cl_2(g) \xrightarrow{\text{sunlight}} 2HCl(g)$

$$CH_3COOC_2H_5 + H_2O(\text{excess}) \rightarrow CH_3COOH + C_2H_5OH$$

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21. Derive an expression for the rate constant in the first order reaction.

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22. Why does the rate of a reaction not remain constant throughtout the reaction?

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23. Write the units of the rate constant for zero order reaction.

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24. For the reaction $A + 3B \rightarrow 2C$

$rate = k[A]^{1/2}[B]^{1/2}$. Find the order of reaction.

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25. Give the units of the rate constant for second order reaction.

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26. Derive the integrated rate law equation for the first order reaction and give its one use.

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27. Express the relation between the half-life period of a reaction and initial concentration of the reaction of second order.

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28. A first order reaction takes 69.3 minutes for 50% completion. How much time will be needed for 80% completion?

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29. What is the order of reaction whose rate constant has the same units as rate of reaction ?

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30. Give one example of pseudo first order reaction.

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31. Why does the rate of a reaction not remain constant throughtout the reaction?

Watch Video Solution

32. For the reaction: $Cl_2(g) + 2NO(g) \rightarrow 2NO_2F(g)$

The following mechanism is suggested.

i) $NO_2 + F_2 \rightarrow NO_2 + F$ (slow)

ii) $NO_2 + F \rightarrow NO_2F + F$ (fast)

What is the predicted rate law?

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33. For the reaction:

$2NO_2(g) + F_2(g) \rightarrow NO_2F + F$ (slow)

ii) $NO_2 + F \rightarrow NO_2F + F$ (fast)

What is the predicted rate law?

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34. Derive the general form of expression for the half-life of a first order reacton.

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35. List the factors on which the rate of a reaction depends.

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36. Define the following terms giving one example of each.

i) Order of a reaction

ii) Molecularity of a reaction.

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37. What is meant by pseudo first order reaction? Given an example of pseudo first order reaction. Write rate equation for the same.

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38. A reaction is second order with respect to reactant A. Given an exmaple of pseudo altered if the concentration of A is:

i) doubled ii) reduced to half?

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39. (i) Distinguish between order and molecularity of a reaction.

(ii) when would order and molecularity of a reaction be the same?

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40. a) Derive and expression for the integrated rate equation for 1 first order reaction.

b) Give an exmaple of pseudo first order reaction.

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41. Define 'order of a reaction'.

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42. Prove that the half-life period for a first order reaction is quite independent of the initial concentration of reactants.

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43. What is meant by rate constant (k) of a reaction?

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44. Give one example each of zero and first order reaction.

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45. Identify the order of a reaction if the units of rate constant are : i) $L^{-1} mol s^{-1}$ ii) $L mol^{-1} s^{-1}$

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46. Explain the following:

a) Half life period $(t_{1/2})$ of a chemical reaction.

b) Effect of catalyst on reaction rate.

c) Molecularity of a chemical reaction.

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47. Prove that the half-life period for a first order reaction is quite independent of the initial concentration of reactants.

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48. Give an example of second order reaction.

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49. Calculate the half life period for zero order reaction..

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50. Write untis of rate constant for first and second order reactions.

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51. Write two differences between 'order of reaction' and 'molecularity of reaction'.

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52. For a reaction : $H_2 + CI_2 \xrightarrow{hv} 2HCI$

Rate = k

(i) Write the order and molecularity of this reaction.

(ii) Write the unit of k.

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53. What is the instantaneous rate of a reaction.

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54. List the factors on which the rate of a reaction depends.

Watch Video Solution

55. What is half life period of a reaction? Calculate half life period of a first order reaction.

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56. What are the units of rate constant for third order reaction?

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57. Rate constant for a chemical reaction is at a given temperature is $2.3 \times 10^{-5} Lmol^{-1}s^{-1}$ What is the order of the reaction?

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Effect of temperature and catalyst on rate of reaction.

1. There is no bar on the collisions among the reacting species. Why most of the reactions donot take place under normal conditions?

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

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3. An increase of 10 K in temperature rarely doubles the kinetic energy of the particles but this increase in temperature may be enough to double the reaction rate. Explain.

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4. What is the effect of temperature on the rate of a chemical reaction? Explain giving reasons.

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5. H_2(g) and O_2 (g) combine to form H_2O (l) by an exothermic reaction. Then why they donot combine when kept together for any period of

time?

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6. Show reactions requires less activation energy as compared to fast reactions. Do you agree with the statement?

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7. What is meant by activation energy? How is activation energy affected by i) Use of catalyst ii) rise in temperature.

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8. What is the effect of temperature on the rate of a reaction.

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9. TEMPERATURE DEPENDENCE OF THE RATE OF A REACTION

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10. Explain graphically the effect of catalyst on reaction rate.

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11. Catalyst have no effect on equilibrium constant. Explain.

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12. On increasing temperature, activation energy for a reaction decrease. Why?

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13. What is collision theory of reactant rates?

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14. What is activated complex?

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15. Define the term collision frequency.

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Select the correct answer.

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

A. 1.4

B. 1.2

C. 0.04

D. 0.8

Answer: D

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2. For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$ if $\frac{\Delta[NH_3]}{\Delta t} = 2 \times 10^{-4} molL^{-1}s^{-1}$, the value of $\frac{-\Delta[H_2]}{\Delta t}$ would be

A. $1 \times 10^{-3} molL^{-1}s^{-1}$

B. $3 \times 10^{-4} molL^{-1}s^{-1}$

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

D. $6 \times 10^{-4} molL^{-1}s^{-1}$

Answer: B

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3. For the reaction $2N_2O_5 \to 4NO_2 + O_2$ rate of reaction and rate constant are 1.02×10^{-4} and $3.4 \times 10^{-5} \sec^{-1}$ respectively. The concentration of N_2O_5 at that time will be

A. 1.732

B. 3

C. 1.02×10^{-4}

D. 3.4×10^{5}

Answer: B

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

A. $r = k[A]^{1/2}[B]^{1/2}$

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

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

D. $r = k[A][B]$

Answer: C

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5. If 60 % of a first order reaction was completed in 60 minutes, 50 % of the same reaction would be completed in approximately

[log = 4 = 0.60, log 5 = 0.69].

A. 45 minutes

B. 60 minutes

C. 40 minutes

D. 50 minutes.

Answer: A

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6. In the first order reaction, half of the reaction is completed in 100 seconds. The time for 99% of the reaction to occur will be

A. 664.64s

B. 646.6s

C. 660.9s

D. 654.5 s

Answer: A

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7. For a first-order reaction $A \rightarrow B$ the reaction rate at reactant concentration of $0.10M$ is found to be $2.0 \times 10^{-5} \text{mol} L^{-1} s^{-1}$. The half-life period of the reaction is

A. 30 s

B. 220s

C. 300s

D. 347 s

Answer: D

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8. A substance reacts with initial concentration of a mol dm^{-3} accroding to zero order kinetics. The time it takes for the completion of the reaction is : (k = rate constant)

A. k / a

B. $a / 2k$

C. a / k

D. ka

Answer: C

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9. for the reaction, $2A + B \to 3C + D$, which of the following does not express the reaction rate

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

B. $-\frac{d[C]}{3dt}$

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

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

Answer: D

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10. Consider the reaction:

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$.

The equally relationship between $-\frac{d[NH_3]}{dt}$ and $-\frac{d[H_2]}{dt}$ is:

A. $\frac{d[NH_3]}{dt} = \frac{-d[H_2]}{dt}$

B. $\frac{d[NH_3]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt}$

C. $\frac{d[NH_3]}{dt} = -\frac{2}{3}\frac{d[H_2]}{dt}$

D. $\frac{d[NH_3]}{dt} = -\frac{3}{2}\frac{d[H_2]}{dt}$

Answer: C

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11. For a reaction, $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ rate of reaction is:

A. $\frac{1}{2}\frac{d}{dt}[N_2O_5]$

B. $2\frac{d}{dt}[N_2O_5]$

C. $\frac{1}{4}\frac{d}{dt}[NO_2]$

D. $4\frac{d}{dt}[NO_2]$

Answer: C

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12. A chemical reaction is said to take place through the various stages with ΔG° values as indicated by the graph.

stages I and II respectively:

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13. Predit the rate law of the following reactions based on the data given below: $2A + B \rightarrow C + D$

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

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

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

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

Answer: A

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14. The reaction of hydrogen and iodine monochlride is given as L

$H_2(g) + 2ICI(g) \rightarrow 2HCl(g) + I_2(g)$

This reaction is of first order with respect to $H_2(g)$ and ICI(g). The following mechanism was proposed for the reaction:

Mechanism A:

$H_2(g) + 2ICl(g) \rightarrow HCl(g) + HI(g)$, slow

$HI(g) + ICI(g) \rightarrow HCI(g) + I_2(g)$, fast

Which of the above mechanism (s) can be consistent with the given information about the reaction?

A. A and B both

B. neither A nor B

C. A only

D. B only

Answer: D

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15. In a first-order reaction $A \rightarrow B$, if K is the rate constant and initial concentration of the reactant is $0.5M$, then half-life is

A. $\frac{\log 2}{k}$

B. $\frac{\log 2}{k\sqrt{0.5}}$

C. $\frac{In2}{k}$

D. $\frac{0.693}{0.5k}$

Answer: B

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16. If 60 % of a first order reaction was completed in 60 minutes, 50 % of the same reaction would be completed in approximately

[log = 4 = 0.60, log 5 = 0.69].

A. 45 minutes

B. 60 minutes

C. 40 minutes

D. 50 minutes.

Answer: A

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17. The bromination of acetone which occurs in acid solution is represented by the equation:

$$CH_3COCH_3(aq) + Br_2(aq) \rightarrow CH_3COCH_2Br(aq) + H^+(aq) + Br^{-1}(a$$

The following kinetic data was obtained for the given reaction concentration:

Initial rates of disappearance of of $Br_2 (Ms^{-1}$

$5.7 \times 10^{-5}, 5.7 \times 10^{-5}$

$1.2 \times 10^{-4}, 3.1 \times 10^{-4}$

Based on these data, the rate equation is:

A. Rate = $k[CH_3COCH_3][Br_2][H^+]^2$

B. Rate = $k[CH_3COCH_3][Br_2][H^+]$

C. Rate = $k[CH_3COH_3][H^+]$

D. Rate = $k[CH_3COCH_3][Br_2]$

Answer: C

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18. For the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, if $\frac{d[NH_3]}{dt} = 2 \times 10^{-4} \text{mol L}^{-1} s^{-1}$, the value of $\frac{-d[H_2]}{dt}$ would be:

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

B. $6 \times 10^{-4} mol L^{-1} s^{-1}$

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

D. $3 \times 10^{-4} mol L^{-1} s^{-1}$

Answer: D

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19. For reaction $A + 2B \rightarrow C$. The amount of C formed by starting the reaction with 5 mole of A and 8 mole of B is :

A. 5 moles

B. 8 moles

C. 16 moles

D. 4 moles

Answer: D

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

A. 0.012

B. 0.024

C. 2×10^{-3}

D. 2×10^{-4}

Answer: D

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21. For an endothermic reaction energy of activation is E_a and enthlpy of reaction is ΔH (both in $kJ\text{mol}^{-1}$). Minimum value of E_a will be

A. less than ΔH

B. equal to ΔH

C. more than ΔH

D. Equal to zero

Answer: C

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22. During the kinetic study of the reaction, $2A + B \rightarrow C + D$. Following results were obtained.

Based on the above data which one of the following is correct?

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

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

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

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

Answer: D

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23. The rate of reaction:

$2NO + Cl_2 \rightarrow 2NOCl$ is given by the rate, equation rate $= k[NO]_2[Cl_2]$. The value of the rate constant can be increased by

A. increasing the temperature

B. increasing the concentration of NO

C. increasing the concentration of Cl_2

D. Doing all these.

Answer: A

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24. The reaction :

$N_2O_5(\text{in}(C)Cl_4\text{solution}) \to 2NO_2(\text{same solution}) + 1/2O_2(g)$ is of first order in N_2O_5 with rate constant = $6.2 \times 10^{-4}s^{-1}$. What is the value of the rate of reaction when $[N_2O_5]$ with rate constant = $6.2 \times 10^{-4}s^{-1}$. What is the rate of reaction when $N_2O_5 = 12.5molL^{-1}$?

A. $5.15 \times 10^{-5}molL^{-1}s^{-1}$

B. $6.35 \times 10^{-3}molL^{-1}s^{-1}$

C. $7.75 \times 10^{-4}molL^{-1}s^{-1}$

D. $3.85 \times 10^{-4}molL^{-1}s^{-1}$

Answer: C

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25. Which of the following statements for the order of a reaction is incorrect?

A. order can be determined only experimentaly

B. Order is not influenced by stoichiometric coefficient of the reactants.

C. Order of a reaction is sum of power to the concentration termsof reaction to express rate of reactions.

D. Order of reaction is always a whole numbers.

Answer: D

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26. The half life period of a subtance in a certain enzyme-catalysed reaction is 138s. The time required for the concentration of the substance to fall from 1.28 mgL^{-1} is:

A. 414s

B. 552 s

C. 690 s

D. 276 s

Answer: C

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27. The rate of reaction.

$2N_2O_5 \rightarrow 4NO_2 + O_2$

can be written in three ways.

$$\frac{-d[N_2O_5]}{dt} = k[N_2O_5]$$
$$\frac{d[N_2O_5]}{dt} = (k'[N_2O_5])$$
$$\frac{d[O_2]}{dt} = (k'[N_2O_5])$$

The relation between k and k' are:

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

B. $k' = 2k,\ k^{''} = \frac{k}{2}$

C. $k' = 2k,\ k^{''}$

D. $k' = k,\ k^{''} = k$

Answer: B

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28. The initial rates of reaction

$3A + 2B + C \rightarrow$ Products, at different initial concentrations are given below

The order with the respect to the reactants A, B and C are respectively.

A. 3,2,0

B. 3,2,1

C. 2,2,0

D. 2,2,1

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29. In a zero order reaction, for every 10° rise of temperaure, reaction rate is doubled. If the temperature 10°C to 100°C, the reaction rate will become:

A. 256 times

B. 512 times

C. 64 times

D. 128 times

Answer: B

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30. Activation energy (E_a) and rate constant $(K_1$ and (K_2) for a chemical reaction at two different temperatures T_1 and T_2 are related by:

A. In $\frac{K_2}{K_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

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

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

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

Answer: B::D

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31. What is the activation energy for a reaction if the rate is doubled when the temperature is raised from 20° C to 35°C (R= $8.314 J mol^{-1} K^{-1}$)

A. 15.1 kJ mol^{-1}

B. $342 kJ mol^{-1}$

C. $269 kJ mol^{-1}$

D. $34.7 kj mol^{-1}$

Answer: D

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32. The activation energy of a reaction can be determined from the slope of which of the following graphs?

A. In $k \quad \text{vs} \quad \frac{1}{T}$

B. $\frac{T}{I}nk \quad \text{vs} \quad \frac{1}{T}$

C. In $k \quad \text{vs} \quad T$

D. In $\frac{k}{T} \quad \text{vs} \quad T$

Answer: A

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33. The decomposition of N_2O_5 in $(C)Cl_4$ at 318 K is studied by monitoring the concentration of N_2O_5 in the solution. Initially the concentration of N_2O_5 is 2.4 $molL^{-1}$. What is the rate of production of NO_2 during this period in $molL^{-1}\overset{-1}{\min}$?

A. 4×10^{-3}

B. 2×10^{-3}

C. 1×10^{-3}

D. 2×10^{-4}

Answer: A

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34. In a first order reaction, the concentration of the reactant decreases from 0.6 M to 0.3 M in 30 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is

A. 50 min

B. 30 min

C. 15 min

D. 60 min

Answer: D

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35. The rate constant of the reaction $A \rightarrow B$ is 0.6×10^{-3} mole per second. If the concentration of A is $5M$, then concentration of B after 20 minutes is:

A. 3.60 M

B. 0.36 M

C. 0.72 M

D. 1.08 M

Answer: C

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

A. 44.1 s

B. 54.1 s

C. 24.1 s

D. 34.1 s

Answer: C

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37. consider the reaction:

$$CH_3CH_2CH_2Br + NaCN \rightarrow CH_3CH_2CH_2CN + NaBr$$

This reaction will be fastest in:

A. ethanol

B. methanol

C. N, N'-dimethyl formamide (DMF)

D. water

Answer: C

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38. The slope of Arrhenius plot $(l_n k \text{ vs } 1/J)$ of a first order reaction is -5×10^3. The value of E_a of the reaction is $(R = 8.314 JK^{-1} mol^{-1})$

A. $41.5 kJmol^{-1}$

B. $83 kJmol^{-1}$

C. $-41.5 kJmol^{-1}$

D. $-83 kJmol^{-1}$

Answer: A

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39. Mechanism of a 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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40. A first order reaction has specific rate of $10^{-2}s^{-1}$. How much time will it take for 20 g of the reactant to reduce to 5 g?

A. 238.6 s

B. 138.6s

C. 346.5 s

D. 693.0s

Answer: B

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41. the correct difference between first and second order reactions is that

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

B. 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 $[A]_0$, the half-life of a second-order reaction does depend on $[A]_0$

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

D. The rate of a first-order reaction does not depend on reactant concentration, the rate of a second-order reaction does not depend on reactant concentration.

Answer: B

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

A. is halved

B. is doubled

C. is tripled

D. remains unchanged.

Answer: B

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43. Which of the following represents the expression for $3/4$th life of first order reaction?

A. $\frac{k}{2.303}\log 4/3$

B. $\frac{2.303}{k}(\log 3/4)$

C. $\frac{2.303}{k}\log 4$

D. $\frac{2.303}{k}\log 3$

Answer: C

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44. If energy of activation of the rection is 53.6kJmol^{-1} and the temperature changes from $27\%^{\circ}$ to 37° C, then the value of $\frac{k_{37^{\circ}C}}{k_{27^{\circ}C}}$ is

A. 2.5

B. 1

C. 2

D. 1.5

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45. A substance undergoes first order decomposition. It follows two first order reaction as follow:

A. 75% B and 25% C

B. 80% B and 20% C

C. 90% B and 10% C

D. 76.83% B and 23.17% C.

Answer: D

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46. Consider the following statements.

i) Increase in concentration of rectant increases the rate of a zero order reaction.

ii) rate constant k is equal to collision frequency a if $E_a = 0$

iii) rate constant k is equal to collision frequency A if $E_a = \infty$.

iv) In k vs T is a straight line.

v) In k vs $1/T$ is a straight line.

Correct statements are:

A. i) and iv)

B. ii) and v)

C. iii) and iv)

D. ii) and iii)

Answer: B

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47. For a reaction taking place in three steps, the rate constant are k_1, k_2 and k_3 and overall rate constant is $k = \frac{k_1 k_3}{k_2}$. If the energies of activation E_1, E_2 and E_3 are 60, 30 and 10 kJ mol^{-1} respectively, then the overall energy of activation is:

A. 30 kJ mol^{-1}

B. 40 kJ mol^{-1}

C. $60 kJ mol^{-1}$

D. $100 kJ mol^{-1}$

Answer: B

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48. Graph between log k and $1/T$ [where K is rate constant in s^{-1} and T is the temperature (in K) is a straight line with Hence, E_a will be

A. 2.303×2 cal

B. $\frac{2}{2.303} cal$

C. 2 cal

D. None of these

Answer: C

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49. The correct statement regarding the following energy diagrams is:

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

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

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

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

Answer: C

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50. For the reaction X-Y, the concentration of X are 1.2 M, 0.6M, order of reaction is:

A. Zero

B. Half

C. one

D. two

Answer: C

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51. 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 became P_t. the rate constant k for the reaction is given as

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

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

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

D. $k = \frac{2.303}{t} \frac{\log P_i}{2P_i + x}$

Answer: B

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52. In a second order reaction, when the concentration of both the reactants are equal, the reaction is completed 20% in 500 s. How long would it take for the reaction to go to 60% completion?

A. 3000s

B. 5000s

C. 1000 s

D. 2000s

Answer: A

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53. A graph plotted between $\log t_{50\%}$ vs log concentration in a straight line. What conclusion can you draw from this graph?

A. n= 1, $t_{1/2} = \frac{t}{x \times a}$

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

C. $n = 1, t_{1/2} = \frac{0.693}{k}$

D. none of these

Answer: C

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54. The difference rate law for the reaction

$H_2 + I_2 \rightarrow 2HI$ is

A. $-\frac{d[H_2]}{dt} = \frac{-d[I_2]}{dt} = \frac{-d[HI]}{dt}$

B. $\frac{-d[H_2]}{dt} = \frac{d[I_2]}{dt} = \frac{1}{2}\frac{d[HI]}{dt}$

C. $\frac{1}{2}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[I_2]}{dt} = -\frac{d[HI]}{dt}$

D. $-2\frac{dH_2}{dt}$

Answer: D

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55. The integrated rate equation is:

$Rt = \log C_0 - \log C_r$

The straight line graph is obtained by plotting.

A. time vs log C_1

B. $\frac{1}{\text{time}}$ vs C_t

C. time vs C_t

D. $\frac{1}{\text{time}}$ vs $\frac{1}{C_t}$

Answer: A

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56. In respect of the equation $k = Ae^{-Ea/RT}$ in chemical kinetics, which one of the following statements is correct?

A. A is adsorption factor

B. E_a is energy of activation

C. R is Rydberg's constant

D. k is equilibrium constant.

Answer: B

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57. The rate law for a reaction between the substances A and B is given by

Rate = $k[A]^n[B]^m$

On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as:

A. (m+n)

B. (n-m)

C. 2^{n-m}

D. $\frac{1}{2^{m+n}}$

Answer: C

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58. For the reaction system $2NO(g)+O_2(g)\to 2NO(g)$ volume is suddenly produced to half its value by increasing the pressure on it. If the reaction is of first order with respect to O_2 and second order with respect to NO. The rate of reaction will

A. diminish to one-eighth of its reaction wil

B. Increase to eight times of its initial value.

C. Increase to four times of its initial value.

D. diminish to one-fourth of its initial value.

Answer: B

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59. The rate equation for the reactions $2A + B \rightarrow C$ is found to be: rate = $k[A][B]$. The correct statement in relation to this reaction is that the

A. rate of formation of C is twice the rate of dissappearing of A

B. $t_{1/2}$ is a constant.

C. unit of k must be s^{-1}

D. value of k is independent of the initial concentration of A and B.

Answer: D

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60. $t_{1/4}$ can be taken as the time taken for concentration of reactant to drop to $.^3/_4$ of its initial value. If the rate constant for a first order reaction is K, then $t_{1/4}$ can be written as:

A. $0.10/k$

B. $0.29/k$

C. $0.69/k$

D. $0.75/k$

Answer: B

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61. A reaction was found to be of second order with respect to concentration of carbon monoxide. If the concentration of carbon

monoxide is doubled with everything else keep the same, the rate of reaction will

A. remain unchanged

B. become triple

C. increase by a factor 4

D. become double

Answer: C

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62. The rate of reaction can be expressed by Arrhenius equation $R = Ae^{-K/RT}$. In this equation. E represents

A. the energy below which all the colliding molecules will react

B. the energy below which colliding molecules will not react

C. The total energy of the reacting molecules at a temperature T.

D. The fraction of the molecules with energy energy greater than the activation energy of the reactants.

Answer: B

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63. A radioactive element gets spilled over the floor of a room. Its half life period is 30 days. If its initial activity is ten times the permissible value, after how many days will it be safe to enter the room?

A. 100 days

B. 1000 days

C. 300 days

D. 10 days.

Answer: A

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64. Consider a reaction $2A + B \rightarrow$ Products. When the concentration of B alone was doubled, the half life did not change. When concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for the reaction is:

A. s^{-1}

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

C. no unit

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

Answer: B

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65. The energies of activation for forward and reverse reaction for $A_2 + B_2 \Leftrightarrow 2AB$ are $180kJ\text{mol}^{-1}$ and $200kJ\text{mol}^{-1}$ respectively. The presence of catalyst lowers the activation energy of both (forward and reverse) reactions by $100 kJ \mathrm{mol}^{-1}$. The enthalpy change of the reaction $(A_2 + B_2 \rightarrow 2AB)$ in the presence of catalyst will be (in $kJ \mathrm{mol}^{-1}$):

A. 20

B. 300

C. 120

D. 280

Answer: A

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66. For a reaction $1/2A \rightarrow 2B$, rate of disappearance of A is related to the rate of appearance of B by the expression:

A. $\frac{-d[A]}{dt} = 4\frac{d[B]}{dt}$

B. $\frac{-d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$

C. $\frac{-d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$

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

Answer: C

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67. The half life period of a first order chemical reaction is 6.93 minutes. The time required for the completion of 99% of the reaction will be $(\log 2=0.301)$

A. 230.3 minutes

B. 23.03 minutes

C. 46.06 minutes

D. 460.6 minutes.

Answer: C

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68. The time for half life period of a certain reaction $A \rightarrow$ Products A is $2.0 mol L^{-1}$, how much time does it take for its concentration to come from 0.50 to 0.25 mol L^{-1} if it is a zero order reaction?

A. 1 h

B. 4 h

C. 0.5h

D. 0.25h

Answer: D

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69. Consider the reaction,

$Cl_2(aq) + H_2S(aq) \rightarrow S(s) + 2H^+(aq) + 2Cl^-(aq)$

The rate equation for this reaction is,

Rate $= k[Cl_2][H_2S]$

Which of these mechanisms is / are consistent with this rate equation ?

(I) $Cl_2 + H_2S \rightarrow H^+ + Cl^- + Cl^+ + HS^-$ (slow)

$Cl^{+} + HS^{-} \rightarrow H^{+} + Cl^{-} + S$ (fast)

(II) $H_2S \Leftrightarrow H^{+} + HS^{-}$ (fast equilibrium)

$Cl^{+} + HS^{-} \rightarrow 2Cl^{-} + H^{+} + S$ (slow)

A. A only

B. B only

C. Both A and B

D. Neither A nor B

Answer: A

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70. The activation energy for a reaction at the temperature T K was found to be $2.303RT J mol^{-1}$. The ratio of the rate constant to Arrhenius factor is

A. 10^{-1}

B. 10^{-2}

C. 2×10^{-3}

D. 2×10^{-2}

Answer: A

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71. The time required for 100 percent completion of a zero order reaction is:

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

B. $\frac{a}{2k}$

C. $\frac{a}{k}$

D. ak

Answer: C

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72. The half life period of a reaction is halved as the initial concentration of the reactants is doubled. The order of reaction is:

A. 0.5

B. 2

C. 1

D. zero

Answer: B

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73. Half lives for first order and zero reactions are the same. The ratio of initial first order reaction is:

A. $\frac{1}{0.693}$

B. 2×0.693

C. 0.693

D. 6.93

Answer: B

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74. the rate of a chemical reaction becomes double for every 10° rise in temperature. If the tempeature is raised by 50°C, the rate of reaction increases by about:

A. 10 times

B. 24 times

C. 32 times

D. 64 times

Answer: C

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75. For a first order reaction , $A \to$ Products, the concentrations 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. 1.73×10^{-5} M/min

B. $3.47 \times 10^{-4} M / \min$

C. $3.47 \times 10^{-5} M / \min$

D. $1.73 \times 10^{-4} M / \min$

Answer: B

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76. The rate of a reaction doubles when the tempeature changes from 300 K to 310 K. Activation energy for the reaction is: $\left(R = 8.314 JK^{-1} mol^{-1}, \log 2 = 0.3010\right)$

A. $60.5 kJmol^{-1}$

B. $53.6 kJmol^{-1}$

C. $48.6 kJmol^{-1}$

D. $58.5 kJmol^{-1}$

Answer: B

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77. The half life of radioactive sodium is 15 hours. How many hours would it take for 64 g of sodium to decay to one-eight of its original value?

A. 3 hours

B. 15 hours

C. 30 hours

D. 45 hours

Answer: D

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78. Half life period is independent of initial concentration of reactant for

A. First order reaction

B. second order reaction

C. Zero order reaction

D. Third order reaction.

Answer: A

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79. If 50% of the rectant is converted into a product in a first order reaction in 25 minutes, how much of it would react in 100 minutes?

A. 93.75%

B. 87.5%

C. 75%

D. 100%

Answer: A

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80. A plot of k vs $1/T$ for a reaction gives the slope -1×10^4 K. The energy of activation for the reaction is:

A. 8314 J mol^{-1}

B. $1.202 kJ mol^{-1}$

C. $12.02 J mol^{-1}$

D. $83.14 kJ mol^{-1}$

Answer: D

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81. For the non-stoichiometric reaction:

$2A + B \rightarrow C + D$, the following kinetic data were obtained in three separate experiments, all 298 K

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: C

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82. The half-life period of a first order reaction is 10 minutes. Starting with initial concentration 12 M, the rate after 20 minutes is

A. $0.693 \times 3M \min^{-1}$

B. $0.0693 \times 4M \min^{-1}$

C. $0.0693M \min^{-1}$

D. $0.0693 \times 3M \min^{-1}$

Answer: D

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83. Higher order (> 3) reaction are rare due to :

A. Shifting of equilibrium towards reactants due to elastic collisions

B. Loss of active species on collisions

C. Low probability of simultaneous collisons of all the reaction species.

D. Increase in entropy and activation energy as more molecule are involved.

Answer: C

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84. For the reaction $A + 2B \rightarrow C$, the reaction rate is doubled if the concentration of A is doubled. The rate becomes four times when the concentration of both A and B are made four times. The order of reaction is:

A. 3

B. 0

C. 1

D. 2

Answer: C

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85. Which concentration plot is linear for a first order reaction?

A. [A] versus time

B. In [A] versus time

C. log [A] versus $\frac{1}{\text{time}}$

D. square root of [A] versus time.

Answer: B

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86. In a reversible reaction $2NO_2 \underset{k_2}{\overset{k_1}{\Longleftrightarrow}} N_2O_4$, the rate of disappearance of NO_2 is equal to

A. $\frac{2k_1}{k_2}[NO_2]^2$

B. $2k_1[NO_2] - 2k_2[N_2O_4]$

C. $2k_1[NO_2] - 2k_2[N_2O_4]$

D. $(2k_1 - k_2)[NO_2]$

Answer: C

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87. Total order of the reaction $X + Y \rightarrow XY$ is 3. The order of reaction with respect to X is 2. State differential rate equation for the reaction.

A. $\frac{-d[X]}{dt} = k[X]^3[Y]^0$

B. $\frac{-d[X]}{dt} = k[X]^2[Y]$

C. $\frac{-d[X]}{dt} = k[X]^0[Y']^3$

D. $\frac{-d[X]}{dt} = k[X][Y]^2$

Answer: B

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88. $X \xrightarrow{\text{Step1}} Y \xrightarrow{\text{StepII}} Z$ is a complex reaction.

Total order of reaction is 2 and step II is a slow step. What is the molecularity of step II?

A. 1

B. 3

C. 2

D. 4

Answer: C

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89. For a second order reaction

$k = \frac{1}{t}. \frac{x}{a(a-x)}$ if the concentration of the two reactants A and B are:

A. [A] = [B]

B. [A] gt [B]

C. [A] lt [B]

D. In all the case.

Answer: A

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90. The time required for a first order reaction to complete 90% is 't'. What is the time required to complete 99% of the same reaction?

A. 2t

B. 3t

C. t

D. 4t

Answer: A

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91. The rate constant of the reaction,

$2N_2O_5 \to 4NO_2 + O_2$ at 300 K is $3 \times 10^{-5} s^{-1}$. If the rate of the reaction at the same temperaturre is 2.4×10^{-5} mol $dm^{-3} s^{-1}$, then the molar concentration of N_2O_5 is

A. 0.4 M

B. 0.8 M

C. 0.04 M

D. 0.08 M

Answer: B

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92. The activation energy of a reaction can be determined by

A. evaluating rate constant at two different temperatures.

B. Changing concentration of reactants.

C. evaluating concentration of reactants at two differents temperatures.

D. Evaluating rate constants at standard temperature.

Answer: A

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93. Decompsition of H_2O_2 follows a frist order reactions. In 50 min the concentrations 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 fromation of O_2 will be

A. 6.93×10^{-2} mol $\min^{-1}$

B. $6.93 \times 10^{-4} molL^{-1} \min^{-1}$

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

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

Answer: B

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94. Which of the following plots represents an exothermic reaction?

A.

B.

C.

D.

Answer: A

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95. The activation energy for a reaction when the temperature is raised from 300K to 310K is

A. $50.6kJmol^{-1}$

B. $53.6kJmol^{-1}$

C. $56.6kJmol^{-1}$

D. $59.6kJmol^{-1}$

Answer: B

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96. Which of the following statements is in accordance with the Arrhenius equations?

A. Rate of a reaction increases with increases in temperatures

B. Rate of reaction does not change with increase in activation energy.

C. Rate constant decreases exponentially with increase in temperature.

D. Rate of reaction increases with decreases in activation energy.

Answer: A::D

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97. Two reactions R_2 and R_2 have identical pre - exponential factors. Activations enery of R_1 exceeds that of R_2 by 10 kJ mol_{-1} . If k_1 and k_2 are rate constants for rate constants for reactions R_1 and R_2 respectively at 300k , then In $\left(\frac{k_2}{k_1}\right)$ is equal to $\left(R = 8.314 Jmol^{-1}K^{-1}\right)$

A. 6

B. 4

C. 8

D. 12

Answer: B

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98. At 518°C, the rate of decomposition of a simple of gaseous acetaldehyde initially at a pressure of $363 \rightarrow \mathrm{rr}$ was $1 \rightarrow \mathrm{rr}s^{-1}$ when 5% had reacted and $0.5 \rightarrow \mathrm{rr}s^{-1}$ when 33% had reached. The order of reaction is:

A. 2

B. 3

C. 1

D. 0

Answer: B

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99. For a reaction $2SO_2 + O_2 < \Rightarrow 2SO_3$, rate of disappearance of O_2 is 2×10^{-4} mol L^{-1}. The rate of appearance of SO_3 is:

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

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

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

D. $6 \times 10^{-4} mol L^{-1} s^{-1}$

Answer: B

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

A. 11520 years

B. 23040 years

C. 5760 years

D. 17280 years.

Answer: D

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Comprehension type

1. The mathematical expression which describes the reaction rate in terms of molar concentrations of the reactants as determined experimentally is called rate law. The sum of the coefficients of the reacting species that are involved in the rate equation of a particular reaction is known as the order of the reaction, The reactions may be classified as first, second and third order reactions depending upon the number of of reacting species involved in the rate equation. It can be fractional in complex reations and even zero in certain reactions such as photochemicla reactions. The units of the rate constant(k) can help ini predicting the nature of a particular reaction.

1) A substance decomposes in a solution followig first order kinetics. Flask A contains 1L of 1M solution and flask B has 100 mL of 0.6 M solutions. After 8 hours, the concentrations of substance in flask A becomes 0.25 M. What will be the time taken for the concentration of the same substances in flask B to becomes 0.3 M?

A. 0.4 hr

B. 2.4hr

C. 4.0 hr

D. unpredictable as rate constant is not given.

Answer: C

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2. The mathematical expression which describes the reaction rate in terms of molar concentrations of the reactants as determined experimentally is called rate law. The sum of the coefficients of the reacting species that are involved in the rate equation of a particular reaction is known as the order of the reaction, The reactions may be classified as first, second and third order reactions depending upon the number of of reacting species involved in the rate equation. It can be fractional in complex reations and even zero in certain reactions such as photochemicla reactions. The units of the rate constant(k) can help ini predicting the nature of a particular reaction.

The concentration of a reactant in a solution falls from 0.2 M to 0.1 M in 2 hours and to 0.05 M in horus. The order of the reaction is:

A. zero

B. two

C. one

D. half.

Answer: C

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3. The mathematical expression which describes the reaction rate in terms of molar concentrations of the reactants as determined experimentally is called rate law. The sum of the coefficients of the reacting species that are involved in the rate equation of a particular reaction is known as the order of the reaction, The reactions may be classified as first, second and third order reactions depending upon the number of of reacting species involved in the rate equation. It can be fractional in complex reations and even zero in certain reactions such as photochemicla reactions. The units of the rate constant(k) can help ini predicting the nature of a particular reaction.

For a reaction

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

Given: $\frac{-d[N_2O_5]}{dt} = k_1[N_2O_5]$

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

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

the relation between k_1, k_2 and k_3 is:

A. $2k_1 = k_2 = 4k_3$

B. $k_1 = k_2 = k_3$

C. $2k_1 = 4k_2 = k_3$

D. None of these.

Answer: A

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4. The mathematical expression which describes the reaction rate in terms of molar concentrations of the reactants as determined experimentally is called rate law. The sum of the coefficients of the reacting species that are involved in the rate equation of a particular reaction is known as the order of the reaction, The reactions may be classified as first, second and third order reactions depending upon the number of of reacting species involved in the rate equation. It can be fractional in complex reations and even zero in certain reactions such as photochemicla reactions. The units of the rate constant(k) can help ini predicting the nature of a particular reaction.

The rate constant is numerically the same for three reactions of first, second and third order respectively. Which one is true for rates of three reactions if concentrations of the reactant is 1M?

A. $r_1 = r_2 = r_3$

B. $r_1 > r_2 < r_3$

C. $r_1 < r_2 < r_3$

D. All the above.

Answer: C

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5. The mathematical expression which describes the reaction rate in terms of molar concentrations of the reactants as determined experimentally is called rate law. The sum of the coefficients of the reacting species that are involved in the rate equation of a particular reaction is known as the order of the reaction, The reactions may be classified as first, second and third order reactions depending upon the number of of reacting species involved in the rate equation. It can be fractional in complex reations and even zero in certain reactions such as photochemicla reactions. The units of the rate constant(k) can help ini predicting the nature of a particular reaction.

The rate of a gaseous reaction is given by the expression : $k[A][B]$. If the volume of the reaction mixture is suddenly reduced to $1/4th$ of its initial volume, the reaction rate relating to original rate will be:

A. $1/10$

B. $1/8$

C. 8

D. 16

Answer: D

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6. The mathematical expression which describes the reaction rate in terms of molar concentrations of the reactants as determined experimentally is called rate law. The sum of the coefficients of the reacting species that are involved in the rate equation of a particular reaction is known as the order of the reaction, The reactions may be classified as first, second and third order reactions depending upon the number of of reacting species involved in the rate equation. It can be fractional in complex reations and even zero in certain reactions such as photochemicla reactions. The units of the rate constant(k) can help ini predicting the nature of a particular reaction.

The rate constant of a reaction increases by

A. carrying out the reaction for a longer period.

B. increasing the temperature

C. increasing the concentration of reactants.

D. None of these.

Answer: B

View Text Solution

7. According to the collision theory, only the effective collisions among the reacting species result in the products. In order that the collisions may be effective, the reacting species must have energy equal to or more than a certain minimum energy called threshold energy (E°). Extra energy which has be supplied to the reactants to make collisions effective is known as activation energy (E_a). This is related to reaction rate with the help of Arrhenius equation, $k = Ae^{-Ea/RT}$

The equation also helps in calculating the activation energy for a reaction at a specific temperature. In general, the rate of reaction is inversely proportional to the activation energy required.

The plot of log k Vs $1/T$ helps to calculate

A. Energy of activation

B. Rate constant of the reaction

C. Order of reaction

D. Energy of activation as well as the frequency factor,

Answer: D

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8. According to the collision theory, only the effective collisions among the reacting species result in the products. In order that the collisions may be effective, the reacting species must have energy equal to or more than a certain minimum energy called threshold energy (E°). Extra energy which has be supplied to the reactants to make collisions effective is known as activation energy (E_a). This is related to reaction rate with the help of Arrhenius equation, $k = Ae^{-Ea/RT}$

The equation also helps in calculating the activation energy for a reaction at a specific temperature. In general, the rate of reaction is inversely proportional to the activation energy required.

An increase in reaction rate with rise in temperature is due to

A. an increase in the number of collisons

B. an increase in the number of activated molecules.

C. lowering the activation energy

D. shortening of mean free path.

Answer: B

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9. According to the collision theory, only the effective collisions among the reacting species result in the products. In order that the collisions may be effective, the reacting species must have energy equal to or more than a certain minimum energy called threshold energy (E°). Extra energy which has be supplied to the reactants to make collisions effective is known as activation energy (E_a). This is related to reaction rate with the help of Arrhenius equation, $k = Ae^{-Ea/RT}$

The equation also helps in calculating the activation energy for a reaction at a specific temperature. In general, the rate of reaction is inversely proportional to the activation energy required.

Which of the following expressions gives the effect of temperature on the reaction rate?

A. In k= In A$-E_a/RT$

B. In k= In A$+E_a/RT$

C. In k = $A - E_a/RT)$

D. k= In A$+\text{In}E_a/RT$

Answer: A

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10. According to the collision theory, only the effective collisions among the reacting species result in the products. In order that the collisions may be effective, the reacting species must have energy equal to or more than a certain minimum energy called threshold energy (E°). Extra energy which has be supplied to the reactants to make collisions effective is known as activation energy (E_a). This is related to reaction rate with the help of Arrhenius equation, $k = Ae^{-Ea/RT}$

The equation also helps in calculating the activation energy for a reaction at a specific temperature. In general, the rate of reaction is inversely proportional to the activation energy required.

The chemical reactions in which the reactants require high amount of activation energy are generally.

A. slow

B. fast

C. instaneous

D. spontaneous

Answer: A

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11. According to the collision theory, only the effective collisions among the reacting species result in the products. In order that the collisions may be effective, the reacting species must have energy equal to or more than a certain minimum energy called threshold energy (E°). Extra energy which has be supplied to the reactants to make collisions effective is known as activation energy (E_a). This is related to reaction rate with the help of Arrhenius equation, $k = Ae^{-Ea/RT}$

The equation also helps in calculating the activation energy for a reaction at a specific temperature. In general, the rate of reaction is inversely proportional to the activation energy required.

Consider the reaction $A \rightarrow 2B + C, \Delta H = -15$ kcal. The energy of activation of backward reaction is 20 kcal mol^{-1}. In presence of the catalyst, the energy causes the rate of the reaction to increase by the number of times equal to

A. $e^{3.5}$

B. $e^{2.5}$

C. $e^{-2.5}$

D. $e^{2.303}$

Answer: B

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12. The rate of reaction depends on the concentration of the reacting species, i.e., reactants in rate equations or rate law, consider the gaseous reactions:

$aAbB \rightarrow \text{Products}$

The rate laws is $r = k[AP][Y]^y$

Here (x+y) is the order with respect to that reactant will be taken as zero.

12 $A \rightarrow \text{Products}$. If concentration of A increases four times then its rate increases two times. The order w.r.t A will be:

A. 2

B. 1

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

D. Can't predicted.

Answer: C

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13. The rate of reaction depends on the concentration of the reacting species, i.e., reactants in rate equations or rate law, consider the gaseous reactions:

$aAbB \rightarrow \text{Products}$

The rate laws is $r = k[AP][Y]^y$

Here (x+y) is the order with respect to that reactant will be taken as zero.

In the reaction $A + B \rightarrow \text{Products}$, if the concentration of B is kept fixed and the concentration of A is increased 3 times, the reaction rate increases 27 times. If the concentration of both A and B are doubled, then the increases 8 times. The order w.r.t. A is:

A. 3

B. 2

C. 1

D. zero

Answer: A

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14. In the above question, the order w.r.t. B is:

A. 3

B. 2

C. 1

D. zero

Answer: D

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Stright objective types MCQs

1. For an endothermic reaction, ΔH represents the enthalpy of the reaction in $kJmol^{-1}$. The minimum of activation energy will be:

A. less than ΔH

B. zero

C. more than ΔH

D. equal to ΔH

Answer: C

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2. The rate of reaction $A + B \rightarrow$ Product is given by the equation $r = k[A][B]$. If B is taken in large excess, the order of the reaction would be

A. 2

B. 1

C. 0

D. unpredictable

Answer: B

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3. The rate constant for a reaction is 1.5×10^{-7} at 50°C and $4.5 \times 10^{7} s^{-1}$ at 100°C. What is the value of activation energy?

A. $2.2 \times 10^{3} Jmol^{-1}$

B. $2300 Jmol^{-1}$

C. $2.2 \times 10^{4} Jmol^{-1}$

D. $220 Jmol^{-1}$

Answer: C

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4. Conisder the chemical reaction

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

The rate of this reaction can be expressed in terms of time derivatives of the concentration of $N_2(g), H_2(g)$, or $NH_3(g)$. Identify the correct relationship among the rate expresisons.

A. Rate = $-d[N_2]/dt = -1/3d[H_2]/dt$

$= 1/2d[NH_3]/dt$

B. Rate = $-d[N_2]/dt = -3d[H_2]/dt$

=$2d[NH_3]/dt$

C. Rate $= -d[N_2]/dt = -1/3d[H_2]/dt$

$= 2d[NH_3]/dt$

D. Rate = $-d[N_2]/dt = -d[H_2/dt$

$= d[NH_3]/dt$

Answer: A

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5. In a first order reaction, the concentration of the reactant decreases form 800mol dm^{-3} to 50mol dm^{-3} in $2 \times 10^4 s$. The rate constant of the reaction (in s^{-1}) is

A. 2×10^{-4}

B. 3.45×10^{-5}

C. 1.386×10^{-4}

D. 2×10^{-4}

Answer: C

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6. The reaction X $\rightarrow$ Products

follows first order kinetics. In 40 minutes, the concentration of X changes from 0.1 M to 0.025M. The rate of reaction when concentration of X is 0.01 M is:

A. $1.73 \times 10^{-4} M \min^{-1}$

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

C. $3.47 \times 10^{-4} M \min^{-1}$

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

Answer: C

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7. Which of the following is incorrect about the order of reaction ?

A. It is calculated experimentally

B. It is sum of powers of concentrations in rate law expression.

C. The order of powers of concentrations in rate law expression.

D. There is not necessarily a concentration between order and stoichometry of a reaction.

Answer: C

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8. Under the same reaction condition, initial concentration of 1.386 mol dm^{-3} of a substance becomes half in 40s and 20s through first order and zero order kinetics respectively. Find out the $\frac{k_1}{k_0}$ ratio for first order (k_1) and zero order (k_0) of the reaction.

A. $0.5 mol^{-1} dm^3$

B. $1.0 \text{mol} dm^{-3}$

C. $1.5 \text{mol} dm^{-3}$

D. $2.0 mol^{-1} dm^3$

Answer: A

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9. For a first order reaction $A \to P$, the temperature (T) dependent rate constant (k) was found to follow the equation $\log k = -2000(1/T) + 6.0$. The pre-exponential factor A and the activation energy E_a, respective, are

A. $1.0 \times 10^6 s^{-1}$ and $9.2kJmol^{-1}$

B. $6.0s^{-2}$ and $16.6kJmol^{-1}$

C. $1.0 \times 10^6 s^{-1}$ and $16.6kJmol^{-1}$

D. $1.0 \times 10^6 s^{-1}$ and $38.3kJmol^{-1}$

Answer: D

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10. Plots showing the variation of the rate constant (k) with temperature (T) are given below. The plot that follows the Arrhenius equation is

A.

B.

C.

D.

Answer: A

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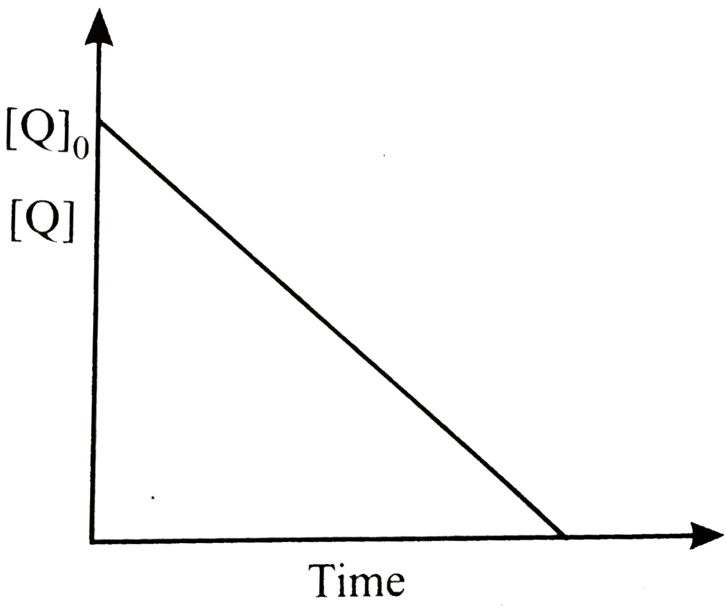
11. In the reaction, $P + Q \rightarrow R + S$

the time taken for 75% reaction of P is twice the time taken for 50% reaction of P. The concentration of Q varies with reaction time as shown in the figure. The overall order of the reaction is



A. 2

B. 3

C. 0

D. 1

Answer: D

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12. The initial rate of hydrolysis of methyl acetate (1M) by a weak acid $(HA, 1M)$ is $1/100th$ of that of a strong acid $(HX, 1M)$, at $25^{\circ}C$. The $K_a(HA)$ is

A. 1×10^{-4}

B. 1×10^{-5}

C. 1×10^{-6}

D. 1×10^{-3}

Answer: A

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13. For the elementary reaction $M \to N$, the rate of disappearance of M increases by a factor of 8 upon doubling the concentration of M. The order of the reaction will respect to M is

A. 4

B. 3

C. 2

D. 1

Answer: B

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

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

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

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

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

Answer: A::D

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15. A catalyst:

A. increases the average kinetic energy of reacting molecules.

B. decreases the activation energy

C. alters the reaction mechanism

D. increases the frequency of collisions of reacting species.

Answer: B::C

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16. For the first order reactions:

A. the degree of dissociation is equal to $(1 - e^{kt})$

B. a plot of reciprocal concentration of the reactant vs tme gives a straight line.

C. the time taken for the completion of $75\,\%$ reaction is thrice the $1/2$ of the reaction.

D. the pre-exponential factor in the Arrhenius equation has the dimension of time (T^{-1})

Answer: A::D

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17. The following statements is are correct,

A. A plot of log k_p vs $\frac{1}{T}$ is linear.

B. A plot of log $[X]$ vs time is linear for a first order reaction, $x \rightarrow p$

C. A plot of log p vs $\frac{1}{T}$ is linear at constant volume.

D. A plot of p vs $\frac{1}{T}$ is linear at constant temperature.

Answer: A::B::C

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18. Which of the following statement is correct about the half life period?

A. It is proportional to initial concentration for zeroth order

B. Average life= 1.44 half life for first order reaction.

C. Time to complete 75% reaction is thrice of half life period in second order reaction.

D. 99.9% of reaction takes place in 100 minutes for the case when rate constant is 0.0693 min^{-1}

Answer: A::B::C::D

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19. The rate law for the reaction

$RCl + NaOH(aq) \rightarrow ROH + NaCl$ is given by

Rate $= k[RCl]$. The rate of the reaction will be

A. Doubled by doubling the concentration of NaOH

B. Halved by reducing the concentration of RCl by one half

C. increased by increasing the temperature of the reaction

D. unaffected by change in temperature.

Answer: B::C

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20. For the reaction

$A + B \rightarrow 2C + D$ which of the following statements is/are correct?

A. Rate of disappearance of B = $1/2$ x rate of appearance of C

B. Rate of disappearance of B =$1/2$ x rate of appearance of C

C. Rate of disappearance of A = rate of appearance of B

D. Rate of disapperance of A = rate of disapperance of B.

Answer: A::C::D

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21. For the first order reaction:

A. The concentration of reactants decreases exponentially with time

B. The half life of the reaction decreases with increasing temperature.

C. The half-life of the reaction depends upon initial concentration of the reactant

D. The reaction proceeds to 99% completion in eight half life periods.

Answer: A::B::D

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22. According to the Arrhenius equation,

A. a high activation energy usually implies a fast reaction.

B. rate constant increases with increases in temperature. This is due to a greater number of collisions whose energy exceeds the activation energy.

C. higher the magnitude of activation energy, strongest is the temperature dependencies of the rate constant.

D. the pre-exponential factor is a measure of the rate at which collisions occur, irrespective of their energy.

Answer: B::C::D

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23. In a bimolecular reaction, the steric factor P was experimentally determined to be 4.5. The correct options among the following is (are):

A. The activation energy of the reaction is unaffected by the value of the steric factor.

B. Experimentally determined value of frequency factor is higher than that predicted by Arrhenius equation.

C. The value of frequency factor predicted by Arrhenius equation is higher than that determined experimentally.

D. Since, P=4.5, the reactions will not proceed unless an effective catalyst is used.

Answer: A::B

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24. For a first order reaction $A(g) \rightarrow 2B(g) + C(g)$ at constant volume and 300 K, the total pressure at the beginning (t=0) and at time t and P_0 and P_t respectively, Initially, only A is present with concentration $[A]_0$ and $t_{1/3}$ is the required for the partial pressure of A to reach $1/3rd$ of its initial value. The correct option(s) is are

(Assume that all these gases behave as ideal gases)

A.

B.

C.

D.

Answer: A::D

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Assertion type question,

1. Assertion: Order and molecularity of a reaction are always equal.

Reason: Complex reactions take place in steps and slowest step determines the reaction order.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: C

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2. Assertion: Order of a reaction can be fractional.

Reason: Order of a reaction cannot be written from the balanced chemical equation.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: C

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3. Assertion: In rate law, unlike in expression for equilibrium constants, the exponents for the concentration donot necessarily match the stoichometric coefficients.

Reason: It is the mechanism and not the balanced chemical equation for the overall change that governs the reaction rate.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: A

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4. Assertion (A): Hydrolyiss of ethyl acetate in the presence of acid is a reaction of first order whereas in the presence of alkali, it is a reaction of second order.

Reason (R): Acid acts as catalyst only whereas alkali act as one of the reactant.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: A

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5. Assertion: The reaction $2NO + O_2 \rightarrow 2NO_2$ and $2CO + O_2 \rightarrow CO_2$ proceed at the same rate because these are similar.

Reason: Both reactions have same activation energy.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: D

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6. Assertion (A) : If the activation energy of a reaction is zero, temperature will have no effect on the rate constant. Reason (R): Lower the activation energy, faster is the reaction.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: B

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7. Assertion: Rate of constant increases with the increase in temperature.

Reason: Number of collisions increase with the increase in temperatures.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: B

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8. Assertion (A) : In the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, the rate of reaction is different in terms of N_2, H_2 and NH_3.

Reason (R): The rate of reaction is equal to the rate of disappearance of a reactant or rate of formation of a Product.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: D

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9. Assertion (A) : The rate constant of a zero order reaction has same units as the rate of reaction.

Reason (R): Rate constant of a zero order reaction does not depend upon the units of concentration.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: C

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10. Assertion (A) : The molecularity of the reaction

$H_2 + Br_2 \rightarrow 2HBr$ is 2.

Reason (R): The order of the reaction is $3/2$.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: B

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11. Assertion: A solution of sucrose in water is dextro-rotatory but upon the hydrolysis in the presence of a little hydrolysis in the presence of a little hydrochloric acid, it becomes laevo rotatory.

Reason: Sucrose upon hydrolysis gives unequal amounts of glucose and fructose. As a result, change in sign of rotation is observed.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: C

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12. Assertion: According to transition state theory for the formation of an activated complex, one of the vibrational degree of freedom is converted into a transitional degree of freedom.

Reason: Energy of the activated complex is higher than the energy of reactant molecules.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: A

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13. Assertion: In rate law, the exponents for concentration donot necessarily match the stoichiometric coefficients.

Reason: It is the mechanism and not the balanced chemical equation for the overall change which governs the reaction rate .

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: A

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14. Assertion: The rate of a reaction is normally accelerated by the presence of a catalyst.

Reason: The presence of a catalyst makes the value of ΔG° more negative.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: C

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15. Assertion (A): The rate of reaction increases generally by 2 to 3 times for every $10^\circ C$ rise in temperature.

Reason (R): An increase intemperature increases the colliison frequency.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: B

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16. Assertion (A) : The order of the reaction,

$$CH_3COOC_2H_5 + H_2O \Leftrightarrow CH_3COOH + C_2H_5OH$$

is 2. Reason (R): The molecularity of this reaction is 2.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: B

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17. Assertion: Alkaline hydrolysis of ester is known as saponification.

Reason: Alkaline hydrolysis of ester is a first order reaction.

Reason: Alkaline hydrolysis of ester is a first order reaction.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: C

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18. Assertion: Rate constant k is equal to Arrhenius parameter if it involves free radical mechanism.

Reason: $E_a = 0$ for the free radical combinations.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: A

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19. Assertion: Rate of reaction doubles when the concentration of the reactant is doubled if it is a first order reaction.

Reason: Rate constant also becomes double.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: C

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20. Assertion: Catalyst changes Gibbs free energy of a system.

Reason: Catalyst changes pre-exponential factor for a reaction.

A. If both assertion and reason are correct explanation for assertion.

B. If both assertion and reason are correct but reason is not correct explanation for assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: D

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INTEGER ANSWER TYPES QUESTIONS

1. The rate equation for a certain reaction is:

$r = k[Cl_2][NO]^2$.

What is the overall order of the reaction?

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2. The rate of reaction $2NO + Cl_2 \rightarrow 2NOCl$ is doubled when the concentration of Cl_2 is doubled and becomes eight times when the concentration of both NO and Cl_2 are doubled. Predict the order of reaction.

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3. For the first order reaction, calculate the ratio of the time taken to complete 99% of the reaction to the time taken to complete 90% of the reaction.

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4. The concentration R in the reaction $R \rightarrow P$ was measured as a function of time and the following data is obtained.

The order of reaction is

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5. The half life period of a reaction is halved when the initial concentration is doubled. Calculate the order of reaction.

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6. A substance decomposes in a solution following first order kinetics. Flask A contains 1L of 1M solution and flask B contains, 100 mL of 0.6 M solution. After 8 hours, the concentration of substance in flask A becomes

0.25 M. What will be time taken for the concentration of the same substance in flask B to become 0.3 M?

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7. An organic compound undergoes first order decomposition. The time taken for the decomposition of $1/8$ and $1/10$ of its initial concentration are $1/8$ and $1/10$ respectively. What is the value of $\frac{t_{1/8}}{[t_{1/10}]} \times 10$ (take $\log_{10} 2 = 0.3$)

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8. For a reaction $A \rightarrow B + C$, the initial concentration of A was reduced from 2M to 1 M in one hour and from 1 M to 0.25 M in two hours. What is the order of reaction?

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9. Calculate the order of reaction for the reaction

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

Given that half life period $(t_{1/2})$ under a pressure of 50mm Hg is 3.52 and under a pressure of 100 mm Hg is 1.82

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10. Energy of activation for a reversible reaction is 6 kcal (E_a forward) and heat of reaction (ΔH) is -3 kcal. What is the energy of activation for the backward reaction?

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11. For a reaction of second order , $t_{75\%} = xt_{50\%}$. The value of X is:

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12. In a dilute aqueous H_2SO_4, the complex disaquadioxalato ferrate (II) is oxidised by MnO_4^-. For this reaction, the ratio of the rate of change of $[H^+]$. For this reaction, the ratio of the rate of change of $[H^+]$ to the rate of change on $[MnO_4^-]$ is:

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Brain storming Multiple choice questions.

1. The activation energies for the two reactions are Ea and Ea' with $E_a > E_a'$. If the temperature of the reaction system is increased from T_1 to T_2. Predict which alternative is correct. (k') are the rate constants at highest temperature.

A. $\dfrac{k_1'}{k+(1)} = \dfrac{k_2'}{k_2}$

B. $k_1 < k_2$ and $k_2' < k_1'$

C. $k_1 < k_2$

D. $\left(\frac{k_1'}{k_1}\right) < \frac{2k_2'}{k_2}$

Answer: B

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2. The reaction $2NO + 2H_2 \rightarrow N_2 + 2H_2O$ follows the mechanism:

I) $NO + NO_2 < \quad \Rightarrow N_2O_2$ (fast)

II) $N_2O_2 + H_2 \rightarrow N_2O + H_2O$ (slow)

III) $N_2O + H_2 \rightarrow N_2 + H_2O$ (fast)

the rate constant for the slow step (II) is $1.2 \times 10^{-4} mol^{-1} L \min^{-1}$ while the equilibrium constant for step (I) is 1.4×10^{-2} what is the rate of reaction when the concentration of NO and H_2 each is 0.5 $mol^{-1} L$?

A. $2.1 \times 10^{-7} mol L^{-1} \min^{-1}$

B. $3.2 \times 10^{-6} mol L^{-1} \min^{-1}$

C. $3.5 \times 10^{-4} mol L^{-1} \min^{-1}$

D. None of the above.

Answer: A

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3. The inversion of sucrose $(C_{12}H_{22}O_{11})$ is a first order reaction and is studied by measuring angle of rotation at different time intervals.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}.$$

if $(r_{\infty} - r_0)$ and $(r_{\infty} - r_t)(a - x)$, then 50% invertion will be completed when:

A. $r_0 = 2r_t - r_{\infty}$

B. $r_0 = r_t - r_{\infty}$

C. $r_0 = r_t - 2r_{\infty}$

D. $r_0 = r_t + r_{\infty}$

Answer: B

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4. For a reaction $A \rightarrow C + D$, initial concentration of A is 0.010 M. After 100s, the concentration of A is 0.01 M. The rate constant has numerical value 9.0. The reaction is of:

A. Zero Order

B. First order

C. Second order

D. Third order.

Answer: C

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5. 2×10^{-3} g of green algae absorbs 7×10^{-4} moles of CO_2 per hour by photosynthesis as per the following equation:

$$6CO_2 + 5nH_2O \xrightarrow[\text{Chlorophyll}]{hr} (C_6H_1O_5)_n + 6nO_2$$

If all the carbon of CO_2 is converted into starch, then how long will it take for algae to increase its mass by $100\,\%$?

A. 6.34 hours

B. 6.34 minutes.

C. 63.4 minutes

D. 3.33 hours.

Answer: B

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

A. 6×10^{-8} s

B. 6×10^{-7} s

C. 6×10^{-9} s

D. 6×10^{-10} s

Answer: C

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7. In the following first order reactions:

$$A + \text{Reagent} \xrightarrow{K_1} Product$$

$$B + \text{Reagent} \xrightarrow{K_2} Product$$

The ratio of K_1 / K_2 when only 50% of B reacts in a given time when 94% of A has been reacted is:

A. 4.06

B. 0.246

C. 2.06

D. 0.06

Answer: A

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8. For a non-equilibrium process $A + B \rightarrow$ Produts the rate is first order with respect to A and second order with respect to B. If 1.0 Mole each of A and B are introduced into a one liter vessel and the intial rate is 1.0×10^{-2}mol $L^{-1}s^{-1}$, the rate when half of the reaction have been eonsumed is:

A. 1.2×10^{-3}

B. 1.2×10^{-2}

C. 1.2×10^{-4}

D. None of these

Answer: A

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9. The rate constant (k_1) of one of the reactions is found to be double than that of the rate constant (k_2) of another reaction. The relationship between the corresponding activation energies of the two reactions $E_{a1} < E_{a2}$

A. $E_{a1} > E_{a2}$

B. $E_{a1} = E_{a2}$

C. $E_{a1} = 2E_{a_2}$

D. None of these

Answer: A

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10. $100cm^3$ of 1M CH_3COOH and $100cm^3$ of 2 M CH_3OH were mixed to form an ester. The change in their intial rate if each solution is mixed with equal volume of water would be:

A. 4 times

B. 0.25 times

C. 2 times

D. 0.5 times.

Answer: B

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Problems for Practice

1. a) Nitrogen dioxide (NO_2) dissociates into nitric oxide (NO) and oxygen (O_2) as follows:

Write the rate of reaction in terms of (i) rate of disappearance of NO_2 ii) rate of formation of NO and iii) rate of formation of O_2. Equate the three rates of reaction.

b) If the rate of decreases of concentration of NO_2 is 6.0×10^{-12} mol $L^{-1}s^{-1}$, calculate the rate of increase of concentration of NO and O_2

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2. For a chemicla reaction A $\rightarrow$ B, the change in concentration of A in 40s is -0.04 mol/litre. What is the rate of chemical reaction?

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3. For the chemical decomposition of SO_2Cl_2, its initial concentration is 0.842 mol L^{-1} and the concentration after two hours is $0.210 mol L^{-1}$. What is the average rate of the reaction?

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4. The following reaction was carried out in water

$Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$

The initial concentration of I^- was $0.50 mol L^{-1}$ and concentration after 10 minutes was 0.46 mol L^{-1}. Calculate the rate of disappearance of I^- and rate of appearance of I_2.

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5. For a chemical reaction $A \rightarrow B$, it was found that concentration of B increases by 0.20 mol L^{-1} in half an hour. What is the average rate of the reaction?

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6. Which of the following will react fastest (produce more products in a given time) and which will react at the highest rate? A) 1 mol of A and 1 mol of B in a 1L vessel b) 2mol of A and mol of B in a 2L vessel c) 0.2 mol of A and 0.2 mol of B in a 0.1 L vessel.

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7. a)Express the relationship between the rate of production of water and the rate of disappearance of oxygen in the following reaction:

$2H_2 + O_2 \rightarrow 2H_2O$

b) For the chemical reaction

$X_2(g) + 2Y_2(g) \rightarrow 2XY_2(g)$

Write the rate equation in terms of disappearance of Y_2.

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8. The following reaction was carreid at 300 K.

$2SO_2(g) + O_2(g) < \ \Rightarrow 2SO_3(g)$

The concentration of SO_3 gas is 5.0×10^{-3} moles after 7.5 minutes of the start of the reaction. Calcualte the average rate of formation of SO_3 during the reaction.

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9. Identify the order of reaction from each of the following rate constants?

a) $k = 2.3 \times 10^{-3} Lmol^{-1}s^{-1}$

b) $k = 1.25 \times 10^{-2} s^{-1}$

c) $k = 2.9440 \times 10^{6} molL^{-1}s^{-1}$

d) $k = 2.8 \times 10^{-8} atm^{-1}s^{-1}$

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10. Find the overall order for the following reactions:

i) A + 3B $\rightarrow$ C, rate = $k[A]^{1/2}[B]^{3/2}$

ii) $2H_2(g) + 2NO(g) \rightarrow 2H_2O(g) + N_2(g)$, rate =$k[H_2][NO]^2$

What are the dimensions of rate constant in each case?

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11. a) The reaction $A + B \rightarrow C$, has zero order. Write its rate equation.

b) A reaction $A \rightarrow B$ has been found to be of second order w.r.t A i) Write the rate expression for the reaction. (ii) What are the units of rate constants?

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12. In the reaction, $A \rightarrow B$, the value of the rate constant was found to be $1.0 \times 10^{-2} mol^{-1} Ls^{-1}$. What is the order of the reaction? How will the catalyst affect of the value of the rate constant?

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

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14. The rate constant for a chemical reaction has unit litre $mol^{-1} \sec^{-1}$. Find the order of the reaction.

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15. The specific reaction rate of a reaction is $6.2 \times 10^{-3} molL^{-1} s^{-1}$. What is the order of the reaction?

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16. The reaction, $A + 2B \rightarrow C + D$ obeys rate equation, Rate =$k[A]^x[B]^y$

What would be the order of the reaction?

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

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18. The form of rate law for a reaction is expressed as, rate = k$[Cl_2][NO]^2$

Find out the order of the reaction with respect to Cl_2, with respect to NO and also the overall order of the reaction.

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19. Consider the following reaction ,

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

The rate law for the reaction is first order with respect to H_2 and second order with respect to NO.Write the rate law for the reaction.

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20. Ther rate of decomposition of a substance A becomes eight times when its concentration is doubled. What is the order of reaction?

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

$2A + B \rightarrow C + D$

What is the rate law? What is the order with respect to each rectant and the overall order? What are the units of the rate constant?

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22. Fill in the blanks in the following table which treats a reaction of a compound A with a compound B, that is the first order with respect to A and zero order with respect to B.

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23. The initial rate of reaction $A + B \rightarrow C$, was measured for several concentration of A and B. The decomposition made are recorded in the following table.

Using the data in the above table, determine a) the rate law for the reason b) the magnitude of the rate constant.

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24. Consider the reaction $2A + B \rightarrow C + D$

Following results was obtained in experiments designed to study the rate of reaction"

a) Write the rate law for the reaction

b) Calculate the value of rate constant for the reactio.

c) Which of the following possible reaction mechanisms is consistent with the rate law found in (a) ?

I. $A + B \rightarrow C + E$ (slow)

$A + E \rightarrow D$ (fast)

IIgt $B \rightarrow C + E$ (slow)

$A + E \rightarrow F$ (fast)

$A + F \rightarrow D$ (fast)

25. If the half life of a first order reaction in A is 2 min, how long will it take A to reach a) 25 percent of its initial concentration b) 10 percent of its initial concentration?

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26. For the first order reaction, the rate constant is $4.62 \times 10^{-2} s^{-1}$. What will be the time required for the initial concentration 1.5 mol of the reactant to be be reduced to 0.75 mol?

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27. A first order reaction is found to have a rate constant, $k = 7.39 \times 10^{-5} s^{-1}$. Find the half life of the reaction.

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28. For a first order reaction, it takes 5 minutes for the initial concentration of 0.6 mol L^{-1} to become 0.4 mol L^{-1}. How long in all will it take for the initial concentration to become 0.3 mol L^{-1}?

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29. A first order reaction is 20% complete in 5 minutes. Calculate the time taken for the reaction to go to 60% complete.

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30. A first order reaction is 20% complete in 10 minutes. Calculate the time taken for the reaction to go to 80% completion.

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31. A first order reaction in 75% complete is 60 minutes. Find the half life of this reaction.

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32. The thermal decomposition of a compound is of first order. If 50% of a sample of the compound is decomposed in 120 minutes, how long it take for 90% of the compounds to decompose.

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33. Time required to decompose SO_2Cl_2 to half of its intial amount is $60 min$. If the decomposition is a first order reaction, calculate the rate constant of the reaction.

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

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35. In a reaction, 5g of ethyl acetate is hydrolysed per litre in presence of dil . HCl in 300 minutes. If the reactant to be reduced to 2.5g?

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36. The decomposition of H_2O_2 is a first order reaction. Calculate the half life time and rate constant for the decomposition from the fact that the fraction decomposed in 50 minutes is 0.75

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37. Calculate the half life period of a reaction of first order whose specific rate constant is $200s^{-1}$

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38. A first order reaction has specific rate constant of $10^{-3}s^{-1}$. How much time will it take for 10g to reduce to half the quantity (i.e. 5g) ?

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39. a) What will be the initial rate of reaction if rate constant is $10^{-3}s^{-1}$ at concentration of 0.2 mol L^{-1}? How much of the reactant will be converted into product in 200 minutes? Assume reaction to be of first order.

b) The half life of 1st order reaction $A \rightarrow B$ is 600s. What percentage of A remains after 30 minutes?

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40. 60 percent of first order reaction was complete in 60 minutes. When was it half completed?

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41. In a particular reduction process, the concentration of a solution that is initially 0.24 M is reduced to 0.12 M in 10 hours and 0.06 M in 20 hours. What is the rate constant for the reaction?

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42. A first order reaction is 15% compelte in 20 minutes. How long it take to be 60% complete?

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43. The rate constant of the first order, decomposition of N_2O_5 at 25° is $3.00 \times 10^{-3} \overset{-1}{\min}$. If the initial concentration of N_2O_2 is 2.00×10^{-3} mol L^{-1}, How long will it take for the concentration to drop to 5.00×10^{-4} mol L^{-1}?

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44. A first order reaction is 20% complete in 10 minutes. Calculate the time taken by the reaction for 75% completion?

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45. A first order reaction is 75% complete in 60 min. Find the half life period of the reaction?

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46. A first order reaction takes 40 minutes for 30% decomposition of rectants. Calculate its half life period.

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47. Rate constant k for a first order reaction has been found to be $2.54 \times 10^{-3} \sec^{-1}$. Calculate three forth half life period.

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48. The following data were obtained during the first order decomposition of SO_2Cl_2 at a constant volume:

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

Calculate the rate constant.

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49. The half period for the decomposition of a compound is 20 minutes. If the initial concentration is made twice, the half life period becomes 10 minutes. Calculate the order of reaction.

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50. Show that the time taken to complete $3/4th$ of the reaction for first order reaction is twice that of the half life period $\left(t_{A/2}\right)$.

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51. The rate constant for a first order reaction is $60s^{-1}$. How much time would it take to reduce 1g of the reactant to 0.0625 g

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52. The following values for the first order rate constant were obtained for a certain reaction.

Calculate the activation energy, $R = 8.31 JK^{-1} mol^{-1}$.

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

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54. The rate of a reaction doubles when its temperature changes form $300K$ to $310K$. Activation energy of such a reaction will be:

$(R = 8.314 JK^{-1} mol^{-1} \text{ and } \log 2 = 0.301)$

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55. If the rate constant of a reaction is 3.0 mol $L^{-1}s^{-1}$ at 700 K and 30 mol $L^{-1}s^{-1}$ at 800 K, what is the energy of activation for this reaction? $R = 8.314 JK^{-1}mol^{-1}$

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56. The rate of a particular reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation for such a reaction.

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57. The activation energy of a reaction is $94.14 kJ mol^{-1}$ and the value of rate constant at 313 K is $1.8 \times 10^{-5} s^{-1}$. Calculate the frequency factor A.

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58. The rate constant 'k'. For a reaction varies with temperature 'T' according to the question. $\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$

Where E_a is the activation energy. When a graph is plotted for $\log k vs 1/T$, a straight line with a slope of -4250 K is obtained. Calcualte E_a for this reaction.

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59. The rate constant for the order reaction increases from 4×10^{-2} to 24×10^{-2} when the temperature changes from 300K to 350 K. Calculate energy of activation for this reaction.

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Additional Numerical Problems For Practice

1. The following initial rate data were obtained at 300K for the reactions:

$2A + B \rightarrow C + D$

Deducethe rate law.

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2. At elevated temperature, HI decomposes according to the chemical equations:

$2HI(g) \rightarrow H_2(g) + I_2(g)$

a)Determine (i) the order of reaction and (iii) Write the rate expression.

b) Calculate the rate constant and give its units.

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3. The rate lalw for the reaction $A + B \rightarrow C$ is

$(\text{rate}) = k[A]^2[B]$

What would bethe reation if concentration of both [A] and [B] are made double?

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4. The following results were obtained in the decomposition of N_2O_5 in carbon tetrachloride at 40° C.

Where x denotes volume of oxygen evolved. Show that the reaction is of first order. How long will it take half of original material to decomposes?

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5. What percentage of the initial concentration will react in 5 hours in a first order reaction whose rate constants is $5.78 \times 10^{-5} s^{-1}$?.

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

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

at $600K is 1.60 \times 10^{-5} s^{-1}$. Its energy of activation is $209 kJ mol^{-1}$. Calculate the rate constant at $700K$

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7. At 300K, a certain reaction is 50% complete in 20 minutes. At 350K, the same reaction is 50% complete in 5 minutes. Calcualte the activation energy for the reaction.

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8. If the half life period of a first order reaction is 2.31×10^3 minutes, how long will it take for $1/5$th of the reactant to be left behind?

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9. A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of reaction?

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10. The half life period of a first order reaction is 60 min. What percentage will be left after 240 min.

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11. A first order reaction has $k = 1.5 \times 10^{-6} s^{-1}$ at 200° C. If the reaction is allowed to run for 10 hours, what percentage of initial concentration would have changed in products?

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12. The thermal decomposition of a compound is of first order. If 50% of a sample of the compound is decomposed in 120 minutes, how long it take for 90% of the compounds to decompose.

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13. A first order reaction is 40% completed in 50 minutes. What is the time required for 90% of the reaction to complete?

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14. Calcualte the time required for the initial concentration of $2.0 mol / dm^3$ to get reduced to $1.2 mol / dm^3$. Given specific rate constant(k) = $0.009 \min^{-1}$

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15. Half life period for a reaction $A \rightarrow$ Products at 298 K is 3.33 hours. Calcualte the rate constant for the reaction. If the reaction is started from one mole of A, what amount of A would remain unreacted at the end of 9 hours?

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16. A substance having a half-life period of 30 min decomposes according to firt order rate law.

a) What fraction of this will be decomposed and what will remian behind after 1.5 hr?

b) How long will it take to be 60% decomposed, If the molar concentration is just doubled?

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