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CHEMISTRY

BOOKS - P BAHADUR CHEMISTRY (HINGLISH)

CHEMICAL KINETICS

Exercise

1. Derive the relationship between rate of reaction, rate of disappearence of X, Y and rate of formation of X_2Y_3 for the reaction:

$2X + 3Y \rightarrow X_2Y_3$

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

If $\dfrac{-d[N_2O_5]}{dt} = k_1[N_2O_5]$

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

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

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

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3. Which of the following will react fastest (in terms of amount of product formed in a give time) and which will react at the highest rate?

(a) 1 mole of A and 1 mole of B in 1 litre vessel.

(b) 2 mole of A and 2 mole of B in 2 litre vessel.

(c) 0.2 mole of A and 0.2 mole of B in 0.1 liter vessel.

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4. N_2O_5 decomposes according to equation,

$2N_2O_5 \rightarrow 4NO_2 + O_2$

(a) What does $-\frac{d[N_2O_5]}{dt}$ denote?

(b) What does $\frac{d[O_2]}{dt}$ denote?

(c) What is the unit of rate of this reaction?

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5. The reaction, $2N_2O_5 \rightarrow 4NO_2 + O_2$, shows an increase in concentration of NO_2 by 20×10^{-3} mol $litre^{-1}$ in 5 second. Calculate:

(a) rate of appearance of NO_2,

(b) rate of reaction and

(c) rate dissappearance of N_2O_5.

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6. For the decomposition reaction:

$N_2O_{4(g)} \rightarrow 2NO_{2(g)}$, the initial pressure of N_2O_4 falls from 0.46 atm to 0.28 atm in 30 minute. What is the rate of appearance of NO_2?

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7. The rate of change in concentration of C in the reaction, $2A + B \rightarrow 2C + 3D$, was reported as 1.0 mol $litre^{-1}\sec^{-1}$. Calculate the reaction rate as well as rate of change of concentration of A, B and D.

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8. 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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9. A chemical reaction $2A \rightarrow 4B + C$, in gaseous phase shows an increase in concentration of B by $5 \times 10^{-3}M$ in 10 second. Calculate:

(a) rate of appearance of B,

(b) rate of the reaction,

(c) rate of disappearance of A.

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10. The reaction, $2NO + Br_2 \rightarrow 2NOBr$, is supposed to follow the following mechanism,

(i) $NO + Br_2 \overset{\text{fast}}{\Longleftrightarrow} NOBr_2$

(ii) $NOBr_2 + NO \xrightarrow{slow} 2NOBr$

suggest the rate law expression.

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11. The thermal decomposition of N_2O_5 occurs in the following steps:

Step I: $N_2O_5 \xrightarrow{\text{slow}} NO_2 + NO_3$

Step II: $N_2O_5 + NO_3 \xrightarrow{\text{fast}} 3NO_2 + O_2$

Overall reaction, $2N_2O_5 \rightarrow 4NO_2 + O_2$

Suggest the rate expression.

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12. For the reaction,

$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$, the rate of reaction in terms of disappearance of NH_3 is $-\frac{d[NH_3]}{dt}$, then write the rate expression in terms of concentration of O_2, NO and H_2O.

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13. The rate law expression for the reaction,

$2NO + O_2 \rightarrow 2NO_2$ is: rate $= K[NO][O_2]$

Suggest the possible mechanism.

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14. It has been proposed that the conversion of ozone into O_2 proceeds in two steps:

$O_{3(g)} \Leftrightarrow O_{2(g)} + O_{(g)}$

$O_{3(g)} + O_{(g)} \rightarrow 2O_{2(g)}$

(a) Write the equation for overall reaction.

(b) Identify the intermediate, if any.

(c) Derive molecularity for each step of mechanism.

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

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16. In a reaction, $n_1A + n_2B \rightarrow m_1C + m_2D, 5mol litre^{-1}$ of A are followed to react with $3mol litre^{-1}$ of B. After 5 second, the concentration of A was found to be B. After 5 second, the concentration of A was found to be $4M$. Calculate rate of reaction in terms of A and D.

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17. For the reaction, $2A + B + C \rightarrow A_2B + C$

The rate $= k[A][B]^2$ with $K = 2.0 \times 10^{-6} M^{-2} s^{-1}$. Calculate the initial rate of the reaction when $[A] = 0.1M$, $[B] = 0.2M$ and $[C] = 0.8M$. IF the rate of reverse reaction is negligible then calculate the rate of reaction after $[A]$ is reduced to $0.06M$.

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

(a) Write the rate expresison.

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

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19. For, $\underset{(\text{ excess })}{2A} + B + C \rightarrow$ Products, calculate the:

(a) rate expression.

(b) units of rate and rate constant.

(c) effect on rate if concentration of A is doubled and of B is tripled.

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20. Find the order of reaction for the rate expression rate $= K[A][B]^{2/3}$

. Also suugest the units of rate and rate constant for this expression.

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21. 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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22. At $25^\circ C$, the rate constant for the reaction $I^- + ClO^- \rightarrow IO^- + Cl^-$ is $0.0606 \text{litre mol}^{-1} \sec^{-1}$. If a solution is intially $1.0M$ in I^- and $5.0 \times 10^{-4}M$ in ClO^-. Can you calculate the $[CO^-]$ after $300 \sec$? If yes, then how much ? If no, then why ?

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23. 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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24. A reaction is first order in A secod order in B:

(i) write differential rate equation.

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

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

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25. The decomposition of N_2O_5 takes place according to I order as:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

Calculate:

(a) The rate constant, if instantaneous rate is $1.4 \times 10^{-6} mollitre^{-1} \sec^{-1}$ when concentration of N_2O_5 is $0.04M$.

(b) The rate of reaction when concentration of N_2O_5 is $1.20M$.

(c) The concentration of N_2O_5 when the rate of reaction will be $2.45 \times 10^{-5} mollitre^{-1} \sec^{-1}$

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26. For the decomposition,

$N_2O_5(g) \rightarrow N_2O_4(g) + 1/2O_2(g)$, the initial pressure of N_2O_5 is $114mm$ and after $20\sec$, the pressure of reaction mixture becomes $133mm$.

Calculate the rate of reaction in terms of :

(a) change in pressure $\sec^{-1}$ and

(b) change in molarity $\sec^{-1}$. Given that reaction is carried out at $127^{\circ} C$.

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27. The decomposition of N_2O_5 at an initial pressure of $380 mm$ and $50^{\circ} C$ is 50% complete in 56 minutes and 71% complete in 100 minutes. What is the order of reaction? How much of N_2O_5 will decomposes in 100 minutes at $50^{\circ} C$ but at an initial pressure of $500 mm$?

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28. In a pseudo first order hydrolysis of ester in water the following result6s were obtained:

t/s	0	30	60	90
$[\text{Ester}]$	0.55	0.31	0.17	0.085

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

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

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29. 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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30. 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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31. During nuclear explosion, one of the products is $.^{99}Sr$ with half $-$ life of 28.1years. If $1\mu g$ of $.^{90}Sr$ was absorbed in the bones of a newly born baby instead of calcium, how much of its will remain after 10 years and 60 years if it is not lost metabolically.

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32. A substance reacts according to I order kinetics and rate constant for the reaction is $1 \times 10^{-2}\sec^{-1}$. If its initial concentration is $1M$.

(a) What is initial rate?

(b) What is rate after I minute ?

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

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34. Show that time required to complete 99.9% completion of a first order reaction is 1.5 times to 99% completion.

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35. The thermal decomposition of compound is of first order. If 50% of a sample of the compound is decomposition in $120\min$ how long will it take for 90% of the compound to decompose?

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36. A first order gas reaction has $k = 1.5 \times 10^{-6} s^{-1}$ at $200^{\circ} C$. If the reaction is allowed to run for $10h$, what have changed in the Product? What is the half-life of this reaction?

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37. The rate constant for a first order reaction was found to be 0.082 min^{-1}. If initial concentration of reactant is $0.15M$, how long would it take:

(a) to reduce the concentration of A to $0.03M$?

(b) to reduce the concentration of A by $0.03M$?

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

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

$b.\ H_2O_2(aq) + 3I^{c-}(aq) + 2H^{\oplus} \rightarrow 2H_2O(l) + I_3^{c-}$, Rate $= k[H_2O_2]\left[I^{c-}\right]$

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

$d.\ C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$, Rate $k[C_2H_5Cl]$

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39. For a reaction, $3A \rightarrow$ Products, it is found that the rate of reaction becomes nine times if concentration of A is increased three times, calculate order of reaction.

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

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

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

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

A/M	0.20	0.20	0.40
B/M	0.30	0.10	0.05
r_0/Ms^{-1}	5.07×10^{-5}	5.07×10^{-5}	7.6×10^{-5}

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

Experiment	$[A]/M$	$[B]/M$	Initial rate/M min
$I.$	0.1	0.1	2.0×10^{-2}
$II.$	....	0.2	4.0×10^{-2}
$II.$	0.4	0.4	....
$IV.$	....	0.2	2.0×10^{-2}

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43. The data given below are for the reaction of NO and Cl_2 to from $NOCl$ at $295K$.

$[Cl_2]$	$[NO]$	Initial rate$\left(mollitre^{-1}\,\text{sec}^{-1}\right)$
0.05	0.05	1×10^{-3}
0.15	0.05	3×10^{-3}
0.05	0.15	9×10^{-3}

(a) What is the order with respect to NO and Cl_2 in the reaction?

(b) Write the rate expression.

(c) Calculate the rate constant.

(d) Determine the reaction rate when conc. of Cl_2 and NO are $0.2M$ and $0.4M$ respectively.

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44. Calculate the rate of reaction for the change, $2A \rightarrow$ Products, when rate constant of the reaction is $2.1 \times 10^{-5} time^{-1}$ and $[A]_0 = 0.2M$.

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45. Derive order of reaction for the decomposition of H_2O_2 from the following data.

Time (in minutes)	0	10	20	30
Volume of $KMnO_4$	25	16	10.5	7.09

needed for H_2O_2

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46. For reaction $RX + OH^{-} \rightarrow ROH + X^{-}$, rate expression is $R = 4.7 \times 10^{-5}[RX]\left[OH^{-}\right] + 2.4 \times 10^{-5}[RX]$.

What $\%$ of reactant react by S_N2 mechanism when $\left[OH^{-}\right] = 0.001$ molar?

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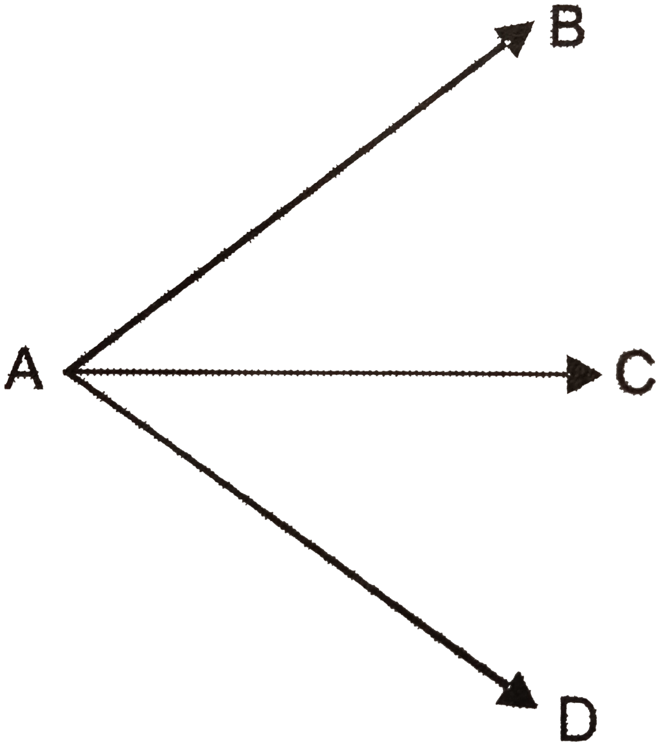
47. For the following first order parallel chain reaction. If the half-life of A is 25 seconds, then find out the half-life of B, C and D. Given that the rate of formation of B and C is $15\,\%$ and $30\,\%$ of the rate of decomposition of A respectively.



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

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49. The rates of most reaction double when their temperature is raised from $298K$ to $308K$. Calculate their activation energy.

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

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51. The specific rate constant for the decomposition of formic acid is $5.5 \times 10^{-4} \sec^{-1}$ at $413K$. Calculate the specific rate constant at $458K$ if the energy of activation is 2.37×10^{4} cal mol^{-1}

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52. Calculate the rate constant and half-life period for first order reaction gaving activation energy $39.3kcalmol^{-1}$ at $300^{\circ}C$ and the frequency constant $1.11 \times 10^{11}\sec^{-1}$

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

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

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

Calculate $E_aat127^{\circ}C$.

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

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

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

The temperature at which $k_1 = k_2$ is

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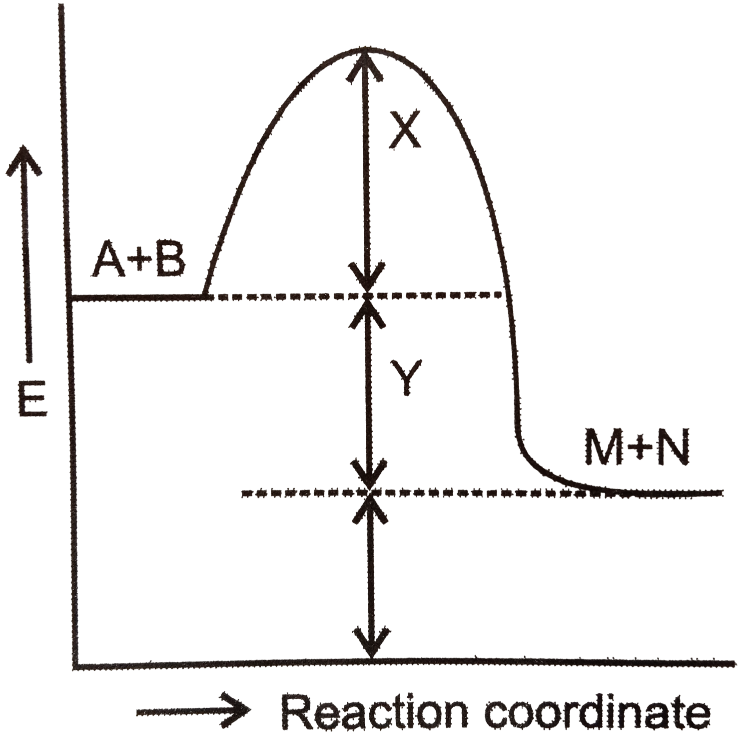
56. Consider the following figure for the reaction:

$A + B \rightarrow M + N$



Answer the following:

(a) Energy level of $(A+B)$

(b) Energy level of $(M+N)$

(c) Threshold energy level for the reaction.

(d) Energy of activation for the forward reaction.

(e) Energy of activation for the backward reaction.

(f) ΔH or heat of reaction.

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57. The decomposition of N_2O in N_2 and O_2 in presence of gaseous argon follows II order kinetics having $K = 5 \times 10^{11} e^{-29000/T}$. Find out energy of activation and rate constant at $27^\circ C$. Also evalute Arrhenius parameter.

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58. H_2O and O atom react in upper atmosphere bimolecularly to form two OH radicals. ΔH for the reaction is $72kJ$ at $500K$ and energy of activation is $77kJmol^{-1}$. Estimate E_a for bimolecular recombination of two OH radicals to form H_2O and O atom.

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59. For the given reaction:

$H_2 + I_2 \rightarrow 2HI$

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

The activation energy will be

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60. The rate constant of decomposition of methyl nitrite (K_1) and ethyl nitrite (K_2) follow the equations.

$$K_1\left(s^{-1}\right) = 10^{13} e^{\left[\frac{-152.3 \times 10^3}{RT} Jmol^{-1}\right]}$$

and $K_2\left(s^{-1}\right) = 10^{14} e^{\left[\frac{-152.3 \times 10^3}{RT} Jmol^{-1}\right]}$

Calculate the temperature at which both have same rate of decomposition if $0.1M$ of each is taken and both show I order kinetics.

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61. The time required for 10% completion of a first order reaction at $298K$ is equal to that required for its 25% completion at $308K$. If the pre-exponential factor for the reaction is $3.56 \times 10^9 s^{-1}$, calculate its rate constant at $318K$ and also the energy of activation.

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

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

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64. A 1st order reaction is 50% complete in 30 minute at $27^\circ C$ and in 10 minute at $47^\circ C$. Calculate the:

(a) Rate constant for reaction at $27^\circ C$ and $47^\circ C$.

(b) Energy of activation for the reaction.

(c) Energy of activation for the reverse reaction if heat of reaction is $-50kJmol^{-1}$.

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65. At $380^\circ C$, the half-life periof for the first order decompoistion of H_2O_2 is 360 min . The energy of activation of the reaction is $200kJmol^{-1}$. Calculate the time required for 75% decompoistion at $450^\circ C$.

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

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67. The rate constant for the first order decompoistion 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 periof be 256 min ?

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

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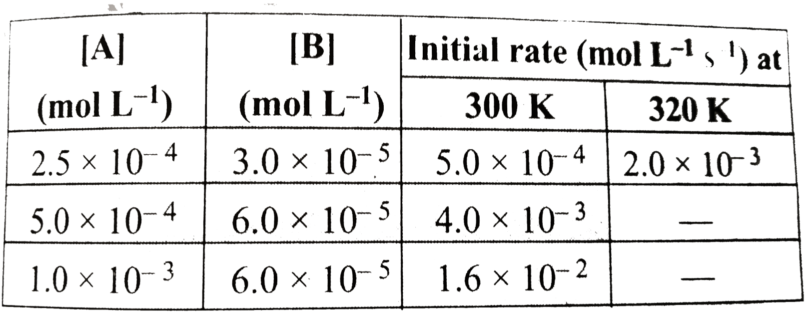
69. form the following data for the reaction between A and B,



[A] (mol L^{-1})	[B] (mol L^{-1})	Initial rate (mol L^{-1} s^{-1}) at	
		300 K	320 K
2.5×10^{-4}	3.0×10^{-5}	5.0×10^{-4}	2.0×10^{-3}
5.0×10^{-4}	6.0×10^{-5}	4.0×10^{-3}	—
1.0×10^{-3}	6.0×10^{-5}	1.6×10^{-2}	—

(a) Calculate the order of the reaction with respect to A and with respect to B.

(b) Calculate the rate constant at $300K$.

(c) Calculate the pre-expontential factor.

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70. 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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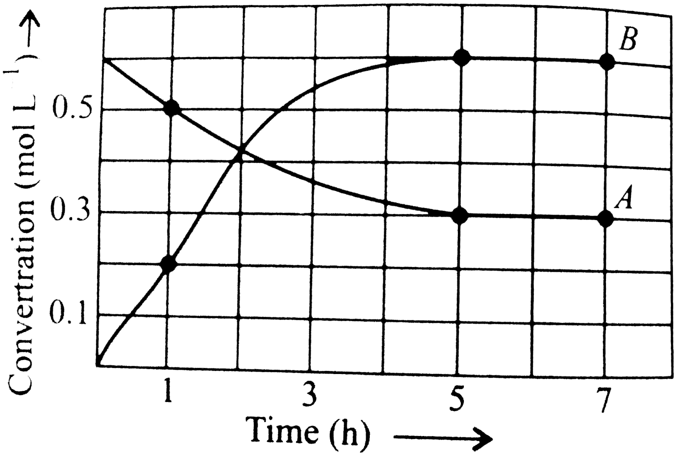
71. The progress of the reaction $A \Leftrightarrow nB$ with time is presented in the figure given below:



Determine

a. The value of n.

b. The equilibrium constant K.

c. The initial rate of concentration of A.

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72. In a reaction with initially $0.12M$, the concentration of reactant is reduced to $0.06M$ in 10 hour and to $0.03M$ in 20 hour.

(i) What is order of reaction?

(ii) What is rate constant?

(b) The rate of a first order reaction is $0.04 mollitre^{-1}s^{-1}$ at 10 minute and $0.30 mollitre^{-1}$ at 20 minute after initiation. Find the half-life of the reaction.

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73. The rate law for the following reactions:

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

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

What would be the effect on the rate if

(a) concentration of ester is doubled.

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

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74. For the reaction $A+B \rightarrow C$. The following data were obtained. In the first experiment, when the initial concentrations of both A and B are $0.1M$, the observed initial rate of formation of C is $1 \times 10^{-4} mollitre^{-1} \min ute^{-1}$. In the second experiment when the initial concentrations of A and B are $0.1M$ and $0.3M$, the initial rate is $9.0 \times 10^{-4} molliter^{-1} \text{minute}^{-1}$. In the third experiment when the initial concentrations of both A and B are $0.3M$ the initial rate is $2.7 \times 10^{-3} mollitre^{-1} \text{minute}^{-1}$.

(a) Write rate law for this reaction.

(b) Calculate the value of specific rate constant for this reaction.

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75. The data given below are for the reaction of NO and Cl_2 to from $NOCl$ at $295K$.

$[Cl_2]$	$[NO]$	Initial rate$\left(mollitre^{-1}\sec^{-1}\right)$
0.05	0.05	1×10^{-3}
0.15	0.05	3×10^{-3}
0.05	0.15	9×10^{-3}

(a) What is the order with respect to NO and Cl_2 in the reaction ?

(b) Write the rate expression.

(c) Calculate the rate constant.

(d) Determine the reaction rate when conc. of Cl_2 and NO are 0.2 M and 0.4 M respectively.

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76. (a) Write the rate expression. (b) Find the rate constant for

$([A]_0, [B]_0, , ,$ R_(0)

Rate$\left(mollitre^{-1}s^{-1}\right))$, $(0.1, 0.2, , , 0.05)$, $(0.2, 0.2, , , 0.10)$, $(0.1, 0.1, , , 0.$

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77. The following data are for the reaction $A + B \rightarrow$ Products:

$Conc. \, of A(M)$	$Conc. \, of B(M)$	$Initial rate$ $\left(mol L^{-1} s^{-1}\right)$
0.1	0.1	4.0×10^{-4}
0.2	0.2	1.6×10^{-3}
0.5	0.1	1.0×10^{-2}
0.5	0.5	5.0×10^{-2}

(a) What is the order with respect to A and B for the reaction?

(b) Calculate the rate constant

Determine the reaction rate when the concentrations of A and B are $0.2M$ and $0.35M$ respectvely.

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

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

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80. A substance reacts according to I order kinetics and rate constant for the reaction is $1 \times 10^{-2} \sec^{-1}$. If its initial concentration is $1M$.

(a) What is initial rate?

(b) What is rate after I minute ?

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81. 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 is decompose 99% .

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

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82. Catalytic decomposition of nitrous oxide by gold at $900^{\circ}C$ at an initial pressure of $200mm$ was 50% in 53 minute and 73% in 100 minute.

(a) What is the order of reaction?

(b) Calculate velocity constant.

(c) How much will it decompose in 100 minute at the same temperature but at an initial pressure of $600mm$?

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83. The decompoistion 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, form the start of the decompoistion in a closed vessel, the total pressure developed is found t be $284.5mmHg$. On complete decompoistion, the total pressure is $584.5mmHg$. Calculate the rate constant of the reaction.

Watch Video Solution

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

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

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

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85. While studying the decompoistion of gaseous N_2O_5, it is observed that a plot of logarithm of its partial pressure versus time is linear. What kinetic parameters can be obtained form this observation?

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86. The gas phase decomposition of dimethyl ether follows first order kinetics.

$CH_3 - O - CH_3(g) \to CH_4(g) + H_2(g) + CO(g)$

The reaction is carried out in a constant volume container at $500^\circ C$ and has a half life of 14.5 min. Initially, only dimethyl ether is present at a pressure $0.40 atm$. What is the total pressure of the system after 12 min ? (Assume ideal gas behaviour)

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

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

Find the order and half life.

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88. The acid catalysed ionisation of γ-hydroxy butyric acid proceeds as a reversible reaction. Which is I order in both the forward and backward steps:

$$\underset{(\text{Acid})}{A} \underset{K_1}{\overset{K_2}{\Longleftrightarrow}} \underset{(\text{Lactose})}{B}$$

The rate $-\dfrac{d[A]}{dt}$ is given by:

A. $K_1[A]$

B. $-K_2[B]$

C. $K_1[A]-K_2[B]$

D. $\dfrac{K_1[A]}{K_2[B]}$

Answer: c

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89. For a certain reaction, a plot of $\dfrac{[C_0-C]}{C}$ against time t, yields a straight line. C_0 and C are concentrations of reaction at $t=0$ and $t=t$ respectively. The order of reaction is:

A. 3

B. Zero

C. 1

D. 2

Answer: d

Watch Video Solution

90. The high temperature decomposition of dimethyl ether obeys the first order kinetics.

	$(CH_3)_2O \longrightarrow$	$CH_4 \quad +$	$H_2 \quad +$	CO
Time (sec)	0	400	x	∞
Total pressure (mm)	312	468	585	y

The values of (x, y) missing above are:

A. $x = 800, y = 936$

B. $x = 620, y = 624$

C. $x = 620, y = 936$

D. $x = 800, y = 624$

Answer: a

Watch Video Solution

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91. For the reaction, $N_2 + 3H_2 \to 2NH_3$ the rate $\frac{d[NH_3]}{dt} = 2 \times 10^{-4} Ms^{-1}$. Therefore the rate $-\frac{d[N_2]}{dt}$ is given as:

A. $10^{-4} M \sec^{-1}$

B. $10^4 M \sec^{-1}$

C. $10^{-2} M \sec^{-1}$

D. $10^{-4} \sec^{-1} M^{-1}$

Answer: a

Watch Video Solution

92. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, under certain conditions of temperature and partial pressure of the reactants, the rate of formation of NH_3 is $0.001kgh^{-1}$. The same rate of converison of hydrogen under the same condition is................kgh^{-1}.

A. $0.0015kgh^{-1}$

B. $1.76 \times 10^{-4}kgh^{-1}$

C. $0.002kgh^{-1}$

D. $0.003kgh^{-1}$

Answer: b

Watch Video Solution

93. The rate constant of a second order reaction is $10^{-2}\text{mol}^{-1}litre\ \text{sec}^{-1}$. The rate constant when expressed in $cm^3\text{molecule}^{-1}\ \overset{-1}{\text{min}}$ is:

A. 9.96×10^{-22}

B. 9.96×10^{-23}

C. 9.96×10^{21}

D. 1.004×10^{-24}

Answer: a

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94. The rate of a reaction gets doubled when the temperature changes from $7^\circ C$ to $17^\circ C$. By what factor will it change for the temperature change from $17^\circ C$ to $27^\circ C$?

A. 1.81

B. 1.71

C. 1.91

D. 1.76

Answer: c

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95. The rate of a heterogeneous reaction (as iron (solid) any oxygen gas) does not depend on:

A. Concentration of reactants

B. Surface area of reactants

C. pressure of reactant gases

D. potential energy of reactant

Answer: d

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96. Which of the following statement is wrong?

A. Law of mass action and rate law expression are same for single step reactions

B. Both order of reaction and molecularity have normally a miximum value of 3

C. Order of reaction and molecularity for elementary reaction are same

D. Molecularity of a complex reaction

$A + 2B \rightarrow C$ is 3

Answer: d

Watch Video Solution

97. The activation energy of a reaction is zero. The rate constant of this reaction

A. Increases with increase of temperature

B. Decreases with decrease of temperature

C. Decreases with increase of temperature

D. Independent of temperature

Answer: d

Watch Video Solution

98. For the reaction, for which the activation energies for forward and backward reactions are same, then:

A. $\Delta H = 0$

B. $\Delta S = 0$

C. The order is zero

D. None of these

Answer: a

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99. The rate constant for a zero order reaction is $2 \times 10^{-2} molL^{-1} \sec^{-1}$. If the concentration of the reactant after $25 \sec$ is $0.5M$, the initial concentration must have been:

A. $0.5M$

B. $1.25M$

C. $12.5M$

D. $1.0M$

Answer: d

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100. A consecutive reaction, $A \xrightarrow{K_1} B \xrightarrow{K_2} C$ is characterised by:

A. Maximum in the concentration of A

B. Maximum in the concentration of B

C. Maximum in the concentration of C

D. Highly exothermicity

Answer: b

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101. Given that for a reaction of nth order, the integrated rate equation is: $K = \frac{1}{t(n-1)}\left[\frac{1}{C^{n-1}} - \frac{1}{C_0^{n-1}}\right]$, where C and C_0 are the concentration of reactant at time t and initially respectively. The $t_{3/4}$ and $t_{1/2}$ are related as $t_{3/4}$ is time required for C to become $C_{1/4}$) :

A. $t_{3/4} = t_{1/2}\left[2^{n-1} + 1\right]$

B. $t_{3/4} = t_{1/2}\left[2^{n-1} - 1\right]$

C. $t_{3/4} = t_{1/2}\left[2^{n+1} + 1\right]$

D. $t_{3/4} = t_{1/2}\left[2^{n+1} - 1\right]$

Answer: a

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102. For a chemical reaction $A \rightarrow$ Products, the rate of disappearance of A is given by:

$-\frac{dC_A}{dt} = \frac{K_1 C_A}{1 + K_2 C_A}$ At low C_A, the reaction is of the .... Order with rate constant .....: $(\text{Assume} K_1, K_2 \text{are lesser than} 1)$

A. $I, K_1 / K_2$

B. I, K_1

C. $II, K_1 / K_2$

D. $II, K_1 / K_1 + K_2$

Answer: b

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103. The rate of an exothermic reaction increases with increasing temperature.True or False?

A. Exponential increase with increase of temperature

B. Exponential decrease with increase of temperature

C. Linear increase with increase of temperature

D. Linear decrease with increase of temperature

Answer: a

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104. The rate equation for an autocatalytic reaction,

$A+B \xrightarrow{K} R+R$ is $\dfrac{-dC_A}{dt}=KC_A.\,C_R$

The rate of disappearance of reaction A is maximum when:

A. $C_A=2C_R$

B. $C_A=C_R$

C. $2C_A=C_R$

D. $C_A=(C_R)^{1/2}$

Answer: c

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105. For a certain reaction of order 'n' the time for half change $t_{1/2}$ is given by : $t_{1/2} = \frac{2-\sqrt{2}}{K} \times C_0^{1/2}$ where K is rate constant and C_0 is the initial concentration. The value of n is:

A. 1

B. 2

C. 0

D. 0.5

Answer: d

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106. For a certain reaction involving a single reaction, it is found that $C_0\sqrt{t_{1/2}}$ is constant where C_0 is the initial concentration of reactant and $t_{1/2}$ is the half-life. The order of reaction is:

A. 1

B. 0

C. 2

D. 3

Answer: d

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107. Two first order reaction have half-life in the ratio $3:2$. Calculate the ratio of time intervals $t_1:t_2$. The time t_1 and t_2 are the time period for 25% and 75% completion for the first and second reaction respectively:

A. $0.311:1$

B. $0.420:1$

C. $0.273:1$

D. $0.119:1$

Answer: a

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108. In which of the following ways does an activated complex differ from an ordinary complex?

A. ΔH_f° is probably positive

B. The formation of activated complex need the presence of catalyst

C. The activated complex has lower energy level than the ordinary complex

D. All of these

Answer: d

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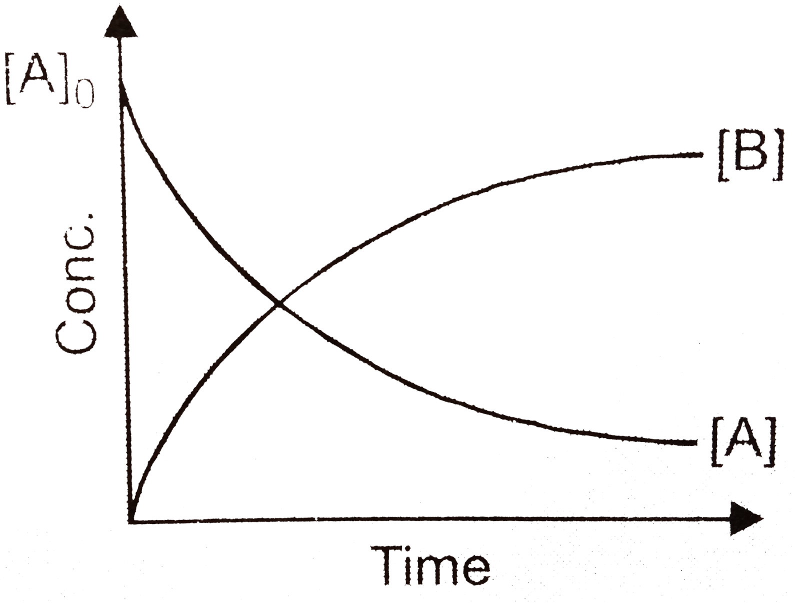
109. At the point of intersection of the two curves shown, the conc. of B is given by .... for, $A \to nB$:



A. $\frac{nA_0}{2}$

B. $\frac{A_0}{n-1}$

C. $\frac{nA_0}{n+1}$

D. $\left(\frac{n-1}{n+1}\right)A_0$

Answer: c

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110. The maximum value of activation energy is equal to:

A. Zero

B. Heat of the reaction

C. Threshold energy

D. None of these

Answer: d

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111. A molecule of gas is struck by another molecule of the same gas, the first molecule shows:

A. An exchange of potential energy

B. An exchange of kinetic energy

C. An exchange of chemical energy

D. No exchange of energy

Answer: b

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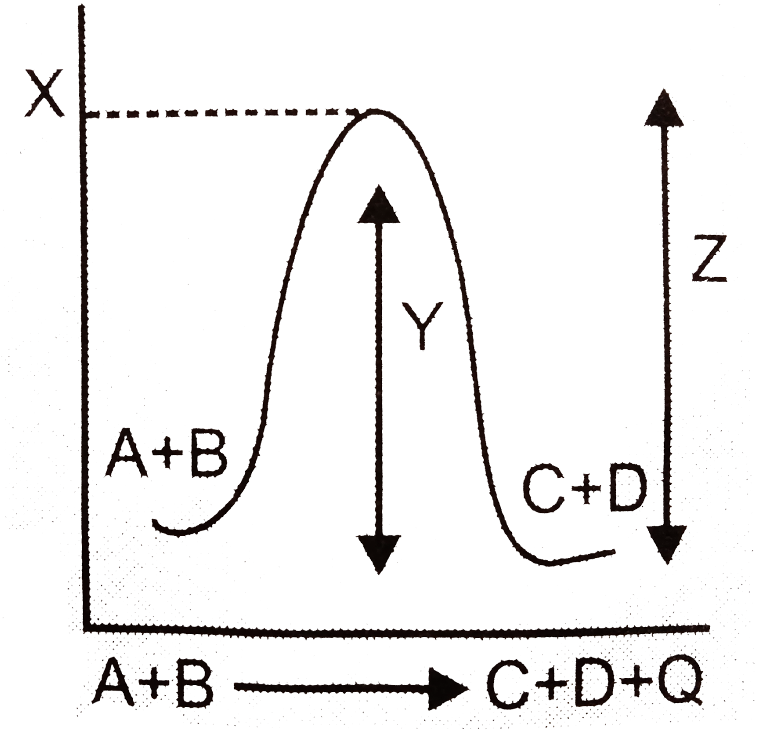
112. Mark the correct statement about given graph:



A. X is threshold energy level

B. Y and Z are energy of activation for forward and backward reaction respectively

C. Q is heat of reaction and reaction is exothermic

D. All of these

Answer: d

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113. For the reaction:

$$\left[Cu(NH_3)_4\right]^{2+} + H_2O \Leftrightarrow \left[Cu(NH_3)_3H_2O\right]^{2+} + NH_3$$

The net rate of reaction at any time is given net by: rate

$$= 2.0 \times 10^{-4}\left[\left[Cu(NH_3)_4\right]^{2+}\right][H_2O] - 3.0 \times 10^5 \Big[\left[Cu(NH_3)_3H_2O\right]^{2+}[N$$

Then correct statement is (are) :

A. Rate constant for forward reaction $= 2 \times 10^{-4}$

B. Rate constant for backward reaction= 3×10^5

C. Equilibrium constant for the reaction= 6.6×10^{-10}

D. All of these

Answer: d

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

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

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

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

Answer: d

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115. The decomposition of N_2O_5 occurs as, $2N_2O_5 \rightarrow 4NO_2 + O_2$ and follows I order kinetics, hence:

A. The reaction is bimolecular

B. The reaction is unimolecular

C. $t_{1/2} \propto a^0$

D. None of these

Answer: c

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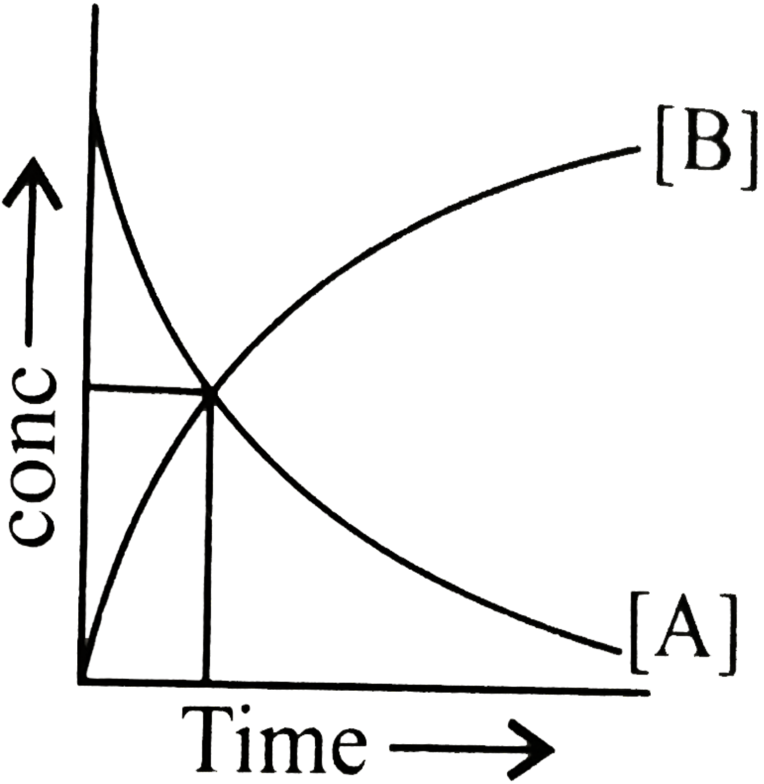
116. The accompanying figure depicts a change in concentration of species A and B for the reaction $A \rightarrow B$, as a function of time. The point of inter section of the two curves represents



A. $t_{1/2}$

B. $t_{3/4}$

C. $t_{2/3}$

D. $t_{1/4}$

Answer: a

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117. For an endothermic reaction, where ΔH represents the enthalpy of reaction in $kJmol^{-1}$, the minimum value for the energy of activation will be

A. Less than ΔH

B. Zero

C. More than ΔH

D. Equal to ΔH

Answer: c

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118. The half-life for a reaction is .... of temperature:

A. Independent

B. Increased with increase

C. Decreased with increase

D. Dependent

Answer: c

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

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

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

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

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

A. At higher temperature K_A will be greater than K_B

B. At lower temperature K_A and K_B will differ more and $K_A > K_B$

C. As temperature rises K_A and K_B will be close to each other in magnitude

D. All of these

Answer: d

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120. Combustion of carbon is exothermic, but coal stored in coal depots does not durn automatically because of:

A. High threshold energy barrier

B. Kinetic stability of coal

C. Higher energy of ectivation needed for burning

D. All of these

Answer: d

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121. If a is the initial concentration then time required to decompose half of the substance for nth order is inversely proportional to:

A. a^{n}

B. a^{n-1}

C. a^{1-n}

D. a^{n-2}

Answer: b

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122. It has been proposed that the conversion of ozone into O_2 proceeds in two steps:

$O_{3(g)} \Leftrightarrow O_{2(g)} + O_{(g)}$

$O_{3(g)} + O_{(g)} \rightarrow 2O_{2(g)}$

(a) Write the equation for overall reaction.

(b) Identify the intermediate, if any.

(c) Derive molecularity for each step of mechanism.

A. $O_3(g)$

B. $O(g)$

C. $O_2(g)$

D. None of these

Answer: b

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123. The rate constant is given by the equation $K = Ae^{-E_a/RT}$ which factor should register a decrease for the reaction to proceed more rapidly:

A. T

B. A

C. A and T

D. E_a

Answer: d

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124. The rate constant K_1 of a reaction is found to be double that of rate constant K_2 of another reaction. The relationship between corresponding activation energies of the two reaction at same temperature $(E_1 \text{and} E_2)$ can be represented as:

A. $E_1 > E_2$

B. $E_1 < E_2$

C. $E_1 = E_2$

D. None of these

Answer: d

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125. The rate of the elementary reaction,

$2NO + O_2 \rightarrow 2NO_2$, when the volume of the reaction vessel is doubled:

A. Will grow eight times of its initial rate

B. Reduce to one-eight of its initial rate

C. Will grow four times of its initial rate

D. Reduce to one-fourth of its initial rate

Answer: b

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126. Rate of which reactions increases with temperature:

A. of any reaction

B. of exotherminc reaction

C. of endothermic reaction

D. none

Answer: a

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127. At room temperature, the reaction between NO and O_2 to give NO_2 is fast, while that between CO and O_2 is slow. It is due to:

A. CO is smaller in size than that of NO

B. CO is poisonous

C. The activation energy for the reaction,

$2NO + O_2 \rightarrow 2NO_2$ is less than

$2CO + O_2 \rightarrow 2CO_2$

D. None of these

Answer: c

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128. For producing effective collisions, the colliding molecules must have

A. Have energy aqual to or greater than the threshold energy

B. Have proper orientation

C. Acquire the energy of activation

D. All of these

Answer: d

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129. A reaction $A_2 + B_2 \rightarrow 2AB$ occurs by the following mechanism:

$A_2 \rightarrow A + A$... (slow)

$A + B_2 \rightarrow AB + B$... (fast)

$A + B \rightarrow AB$ ... (fast)

Its order would be

A. $3/2$

B. 1

C. Zero

D. 2

Answer: b

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130. A following mechanism has been proposed for a reaction:

$2A + B \rightarrow D + E$

$A + B \rightarrow C + D$ (slow)

$A + C \rightarrow E$ (fast)

The rate law expresison for the reaction is

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

B. $r = K[A][B]$

C. $r = K[A]^2$

D. $r = K[A][C]$

Answer: b

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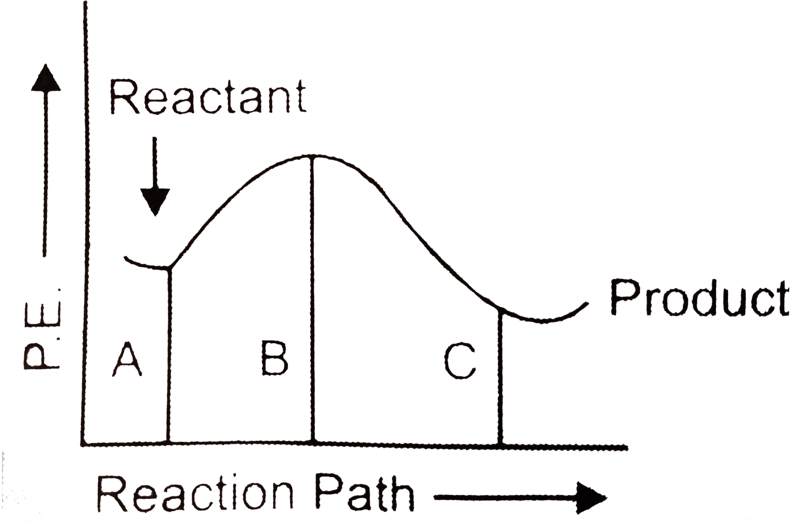
131. With respect to the figure given below which of the following statement is correct?



A. E_a for the forward reaction is $C - B$

B. E_a for the forward reaction is $B - A$

C. $E_{a(\text{forward})} > E_{a(\text{backward})}$

D. E_a (for reverse reaction)= $C - A$

Answer: b

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

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

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

What should be the rate law expression ?

A. $r = K[O_3]^2$

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

C. $r = K[O_3][O_2]$

D. Unpredictable

Answer: b

Watch Video Solution

133. A hypothetical reaction $A_2 + B_2 \rightarrow 2AB$ follows the mechanism as given below:

$A_2 \Leftrightarrow A + A(\text{fast})$

$A + B_2 \rightarrow AB + B$ (slow)

$A + B \rightarrow AB$ (fast)

The order of the overall reaction is

A. 2

B. 1

C. $3/2$

D. Zero

Answer: c

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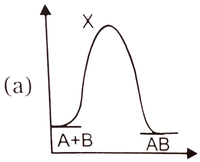
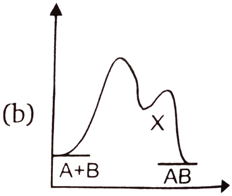
134. For an exothermic chemical process occurring in two as

(i) $A+B \rightarrow X$ (slow)

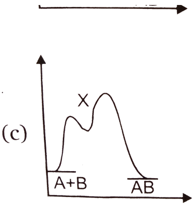
(ii) $X \rightarrow AB$ (fast)

The process of the reaction can be best described by

A. 



B.



C.

D. All are correct

Answer: a

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135. The rate constant (K) for the reaction, $2A + B \rightarrow$ Product was found to be $2.5 \times 10^{-5} litremol^{-1} \sec^{-1}$ after $15 \sec$, $2.60 \times 10^{-5} litremol^{-1} \sec^{-1}$ after 30 sec and $2.55 \times 10^{-5} litremol^{-1} \sec^{-1}$ after $50 \sec$. The order of reaction is:

A. 2

B. 3

C. Zero

D. 1

Answer: a

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136. When ethyl acetate was hydrolyzed in the presence of $0.1MHCl$, the constant was found to be $5.40 \times 10^{-5}s^{-1}$. But when $0.1MH_2SO_4$ was used for hydrolyiss, the rate constant found to be $6.20 \times 10^{-5}s^{-1}$. form these we can say that

A. H_2SO_4 is stronger than HCl

B. H_2SO_4 is weaker than HCl

C. H_2SO_4 and HCl both have the same strength

D. The data are not sufficient to compare the strength of H_2SO_4 and HCl

Answer: a

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137. The activation energy of a reaction is $9.0 kcal / mol$.

The increase in the rate consatnt when its temperature is increased from

$298K$ to $308K$ is

A. 10%

B. 100%

C. 50%

D. 63%

Answer: d

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138. An endothermic reaction, $A \rightarrow B$ have an activation energy $15kcal/mol$ and the heat of the reaction is $5kcal/mol$. The activation energy of the reaction, $B \rightarrow A$ is:

A. $20kcal/mol$

B. $15kcal/mol$

C. $10kcal/mol$

D. Zero

Answer: c

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139. How much faster would a reaction proceed at $25^{\circ}C$ than at $0^{\circ}C$ if the activation energy is $65kJ$?

A. 2times

B. 16times

C. 11times

D. 6times

Answer: c

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140. A first order reaction is carried out with an initial concentration of 10 mol litre and 80% of the reactant changes into product in $10\,\text{sec}$. Now if the same reaction is carried out with an intial concentration of 5 mol per litre the percentage of the reactant changing to the product in 10 sec is:

A. 40

B. 80

C. 60

D. 50

Answer: b

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141. For $A + B \rightarrow C + D, \Delta H = -20 kJ mol^{-1}$, the activation energy of the forward reaction is $85 kJ mol^{-1}$. The activation energy for backward reaction is ...... $kJ mol^{-1}$.

A. 65

B. 105

C. 85

D. 40

Answer: b

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142. For the reaction,

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

$$-\frac{d[N_2O_5]}{dt} = K_1[NO_2O_5]$$

$\frac{d[NO_2]}{dt} = K_2[N_2O_5]$ and $\frac{d[O_2]}{dt} = K_3[N_2O_5]$

The relation in 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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143. The rate constant in numerically the same for the theee reaction of first, second, and third order. Which reaction should be the fastest and it this true for all ranges of concentrations?

A. $r_1 = r_2 = r_3$

B. $r_1 > r_2 > r_3$

C. $r_1 < r_2 < r_3$

D. All of these

Answer: c

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144. 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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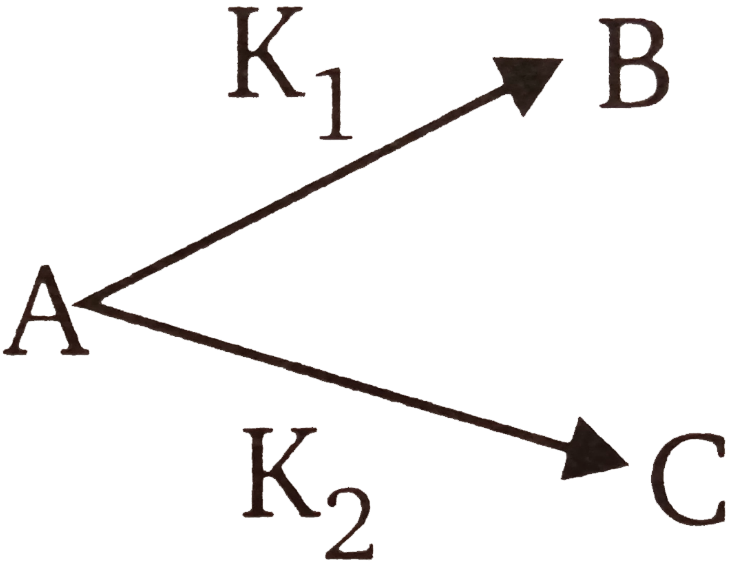
145. A substance undergoes first order decomposition. The decomposition follows two parallel first order reaction as:



and

$KP_1 = 1.26 \times 10^{-4} \sec^{-1}$

$K_2 = 3.80 \times 10^{-5} \sec^{-1}$

The percentage distribution of B and C are:

A. $80\% B$ and $20\% C$

B. $76.83\% B$ and $231.7\% C$

C. $90\% B$ and $10\% C$

D. $60\%B$ and $40\%C$

Answer: b

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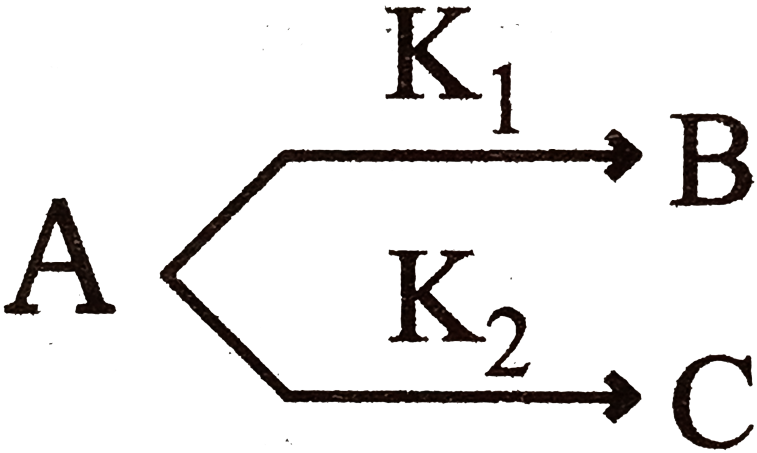
146. For a first order reaction,



which of the following relation is not correct?

A. $K=K_1+K_2$

B. $\frac{1}{\tau}=\frac{1}{\tau_1}+\frac{1}{\tau_2}$

C. $\frac{1}{t_{1/2}}=\left(\frac{1}{t_{1/2}}\right)_1+\left(\frac{1}{t_{1/2}}\right)_2$

D. $\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2}$

Answer: d

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147. Half-life (t_1) of the first order reaction and half-life (t_2) of the second order reaction are equal. Hence ratio of the rate at the start of the start of the reaction:

A. 1

B. 2

C. 0.693

D. 1.44

Answer: c

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148. For the reaction,

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

The rate expression can be written in the following ways:

$$\frac{d[N_2]}{dt} = k_1[NO][H_2], \frac{d[H_2O]}{dt} = k_2[NO][H_2]$$
$$-\frac{d[NO]}{dt} = k_3[NO][H_2], -\frac{d[H_2]}{dt} = k_4[NO][H_2]$$

The relationship between k_1, k_2, k_3, k_4 is

A. $k = k_1 = k'_1 = k_1$

B. $k = 2k_1 = k'_1 = k_1$

C. $k = 2k'_1 = k_1 = k_1$

D. $k = k_1 k'_1 = 2k_1$

Answer: b

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149. In a second order reaction, first order in each reactant A and B, which one of the following reactant mixtures will provide the highest initial rate?

A. 0.1 mole of A of 0.1 mole of B in 0.1litre solution.

B. 0.2 mole of A of 0.2 mole of B in 0.1 litre solution.

C. 0.1 mole of A and 0.1 mole of B in 1 litre solution.

D. 0.1 mole of A and 0.1 mole of B in 0.2litre solution.

Answer: b

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150. For the reaction $A \rightarrow$ Products, it is found that the rate of reaction increases by a factor of 6.25 when concentration of A increases by a factor of 2.5. Calculate the order of reaction with respect to A.

A. 2.5

B. 2

C. 1

D. 0.5

Answer: b

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151. The activation energies of the forward and reverse reaction in the case of a chemical reaction are 30.5 and $45.4kJ/mol$ respectively. The reaction is:

A. Exothermic

B. Endothermic

C. Neither exothermic nor endothermic

D. Independent of temperature

Answer: a

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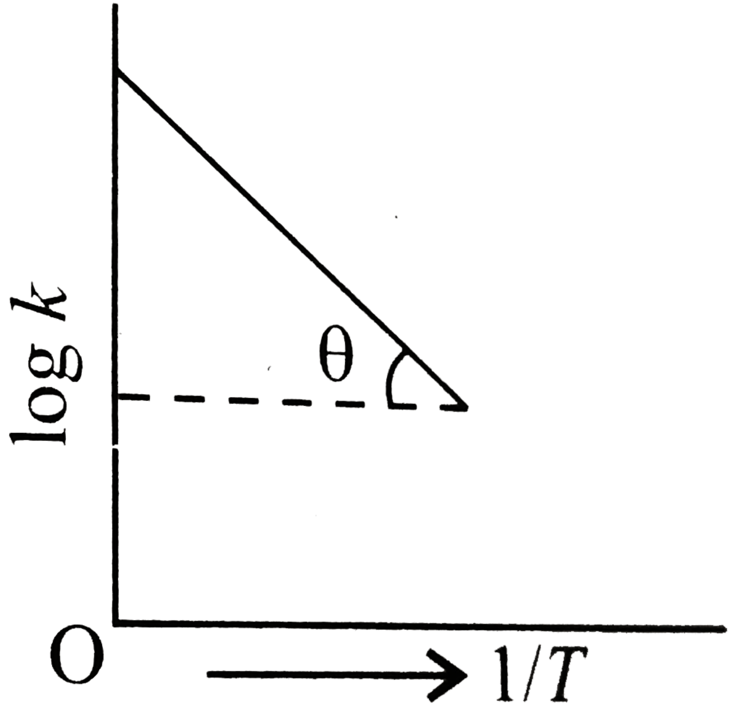
152. Graph between $\log k$ and $1/T$ [k rate constant $\left(s^{-1}\right)$ and T and the temperature (K)] is a straight line with $OX = 5, \theta = \tan^{-1}(1/2.303)$. Hence $-E_a$ will be



A. $2.303 \times 2 cal$

B. $2/2.303 cal$

C. $2 cal$

D. None of these

Answer: c

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153. The half-life of decomposition of gaseous CH_3CHO at initial pressure of $365mm$ and $170mm$ of Hg were $420\sec$ and $880\sec$ respectively. The order of the reaction is:

A. 2

B. 1

C. Zero

D. 1.5

Answer: a

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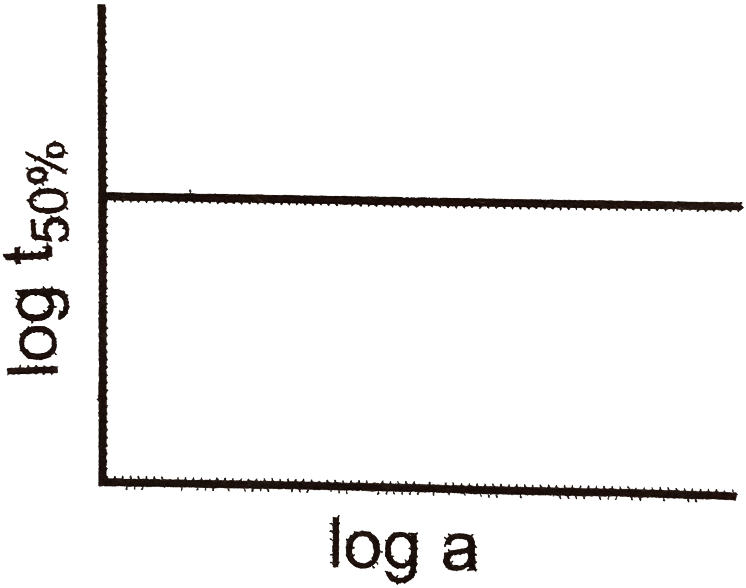
154. A graph plotted between log $t_{50\%}$ vs log concentration is a straight line. What conclusion can you draw from this graph?



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

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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155. What specific name can be given to the following sequence of steps:

$$Hg + hv \rightarrow Hg^*$$

$$Hg^* + H_2 \rightarrow H_2^* + Hg$$

A. Photosensitization

B. Phosphorescence

C. Fluorescence

D. Chemiluminescence

Answer: a

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

A. 4

B. 8

C. 16

D. 2

Answer: b

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157. A large increase in the rate of a reaction for a rise in temperature is due to

A. Increase in collision frequency

B. Lowering of activation energy

C. Increase in number of effective collisions

D. None of these

Answer: c

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158. Mathematical representation for $t_{1/4}$ life i.e., when $1/4th$ reaction is over, is given by:

A. $t_{1/4}=\frac{2.303}{K}\log 4$

B. $t_{1/4}=\frac{2.303}{K}\log 3$

C. $t_{1/4}=\frac{2.303}{K}\log\frac{4}{3}$

D. $t_{1/4}=\frac{2.303}{K}\log\frac{3}{4}$

Answer: c

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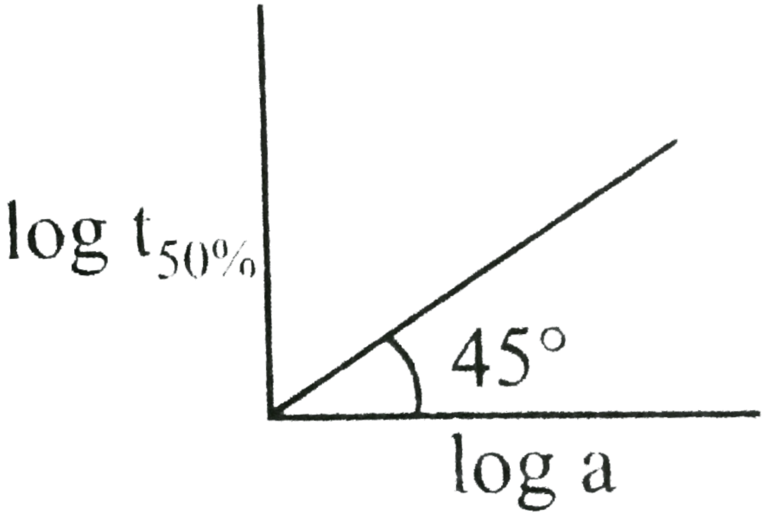
159. What will be the order of reaction and rate constant for a chemical change having $\log t_{50\%}$ versue log concentration of (a) curves as:



A. 0, 1

B. 1, 1

C. 2, 2

D. 3, 1

Answer: a

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

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

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

The temperature at which $k_1 = k_2$ is

A. $1000K$

B. $2000K$

C. $868.4K$

D. $434.22K$

Answer: d

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161. For reaction $RX + OH^{-} \rightarrow ROH + X^{-}$, rate expression is $R = 4.7 \times 10^{-5}[RX][OH^{-}] + 2.4 \times 10^{-5}[RX]$.

What $\%$ of reactant react by S_N2 mechanism when $[OH^{-}] = 0.001$ molar?

A. 1.9

B. 66.2

C. 95.1

D. 16.4

Answer: a

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162. Two substances A and B are present such that $[A_0] = 4[B_0]$ and half life A is 5 min and that of B is 15 min . If they start decaying at the same time following first order kinetics now much time later will take if the concentration of both of them would be same?

A. 15 minute

B. 10 minute

C. 5 minute

D. 12 minute

Answer: a

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163. The activation energies of two reactions are E_{a1} and E_{a2} with $E_{a1} > E_{a2}$. If the temperature of the reacting systems is increased from T to T', which of the following is correct?

A. $\frac{K'_1}{K_1} = \frac{K'_2}{K_2}$

B. $\frac{K'_1}{K_1} > \frac{K'_2}{K_2}$

C. $\frac{K'_1}{K_1} < \frac{K'_2}{K_2}$

D. $\frac{K'_1}{K_1} > 2\frac{K'_2}{K_2}$

Answer: b

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164. For the decomposition of $N_2O_5((g))$, it is given that:

$2N_2O_{5g} \rightarrow 4NO_{2(g)} + O_{2(g)}$,

Activation energy E'_a then ,

E_a, $N_2O_{5(g)} \rightarrow 2NO_{2(g)} + 1/2O_{2(g)}$,

Activation energy E'_a then:

A. $E_a = E'_a$

B. $E_a > E'_a$

C. $E_a < E'_a$

D. $E_a = 2E'_a$

Answer: a

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165. Milk turns sour at $40^\circ C$ three times faster as at $0^\circ C$. The energy of activation for souring of milk is:

A. $4.693kcal$

B. $2.6kcal$

C. $6.6kcal$

D. None of these

Answer: a

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166. The inversion of cane sugar proceeds with half life of 500 min at $pH5$ for any concentration of sugar. However, if $pH = 6$, if the half life changes to 50 min . The rate law expression for the sugar inversion can be written as

A. $r = K[\text{sugar}]^2[H^+]^0$

B. $r = K[\text{sugar}]^1[H^+]^0$

C. $r = K[\text{sugar}]^1[H^+]^1$

D. $r = K[\text{sugar}]^0[H^+]^1$

Answer: b

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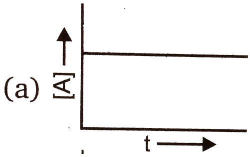
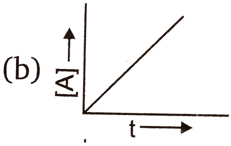
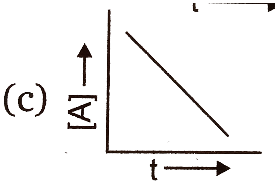
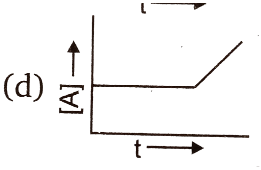
167. Which of the following curve represent zero order reaction of $A \rightarrow$ products ?

A. 

B. 

C. 

D. 

Answer: c

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

A. $\text{if } [A] = 1\text{then}r_1 = r_2 = r_3$

B. $\text{if } [A] < 1\text{then}r_1 > r_2 > r_3$

C. $\text{if } [A] > 1\text{then}r_3 > r_2 > r_1$

D. All of these

Answer: d

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169. For the reaction $2NO_2 + F_2 \rightarrow 2NO_2F$, following mechanism has been provided:

$$NO_2 + F_2 \xrightarrow{\text{slow}} NO_2F + F$$

$NO_2 + F \xrightarrow{\text{fast}} NO_2F$

Thus rate expression of the above reaction can be writtens as:

A. $r = K[NO_2]^2[F_2]$

B. $r = K[NO_2]$

C. $r = K[NO_2][F_2]$

D. $r = K[F_2]$

Answer: c

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

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

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

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

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

Answer: c

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171. The rate of a gaseous phase reaction becomes half if volume of container is doubled. Order of reaction is

A. 1

B. $1/2$

C. 2

D. $1/3$

Answer: a

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172. For the non-equilibrium process, $A + B \rightarrow$ Product, the rate is first-order w.r.t. A and second order w.r.t. B. If $1.0 mol$ each of A and B were inrofuced into $1.0L$ vessel and the initial rate was $1.0 \times 10^{-2} mol L^{-1} s^{-1}$, calculate the rate when half the reactants have been turned into Products.

A. 1.2×10^{-3}

B. 1.2×10^{-2}

C. 2.5×10^{-4}

D. None of these

Answer: a

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

(a) Pressure per minute

(b) Molarity per second

A. 1.09×10^{-6}

B. 1.09×10^{-5}

C. 1.09×10^{-7}

D. 1.09×10^{-9}

Answer: b

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174. Ethylene is produced by,

$$\underset{\text{Cyclobutane}}{C_4H_8} \xrightarrow{\Delta} 2C_2H_4$$

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

A. 27.25 minute

B. 28.25 minute

C. 25 minute

D. 20 minute

Answer: a

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175. 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} sec

B. 6×10^{-7} sec

C. 6×10^{-9} sec

D. 6×10^{-10} sec

Answer: c

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176. If for two reaction $E_{a_1} > E_{a_2}$ and TC_1 and TC_2 are temperature coefficient respectively, then which alternative is correct?

A. $TC_1 > TC_2$

B. $TC_1 < TC_2$

C. $TC_1 = TC_2$

D. None of these

Answer: a

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177. The steady state concentration of the activated molecule $[A*]$ in the following sequence of steps is given by:

$$A + A \xrightarrow{k_1} A + A^* \, A^* + A \xrightarrow{k_2} 2A$$

A. $k_2[A]/k_1$

B. $k_1[A]/k_2$

C. $k_1k_2[A]$

D. $k_1k_2/[A]$

Answer: b

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178. For a second order reaction, half-life concentration of reactants:

A. Independent of initial concentration of reactants

B. Directly proportional to concentration of reactants

C. Inversely proportional to concentration of reactants

D. Inversely proportional to the square of concentration of reactants

Answer: c

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179. Unit of frequency factor A in: $K = Ae^{-E_a/RT}$ is:

A. $time^{-1}$

B. $mollitre^{-1}time^{-1}$

C. $litremol^{-1}time^{-1}$

D. dependent of order of reaction

Answer: d

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180. A reaction takes place in three rate determining steps having rate constants K_1, K_2, K_3 respectively. The overall rate constant $K = \frac{K_1 K_3}{K_2}$. If energy of activations for the three steps are respectively $10, 20, 40 kJ$. The overall energy of activation is:

A. $30kJ$

B. $20kJ$

C. $10kJ$

D. $70kJ$

Answer: a

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181. Which one is not correct for areaction showing a free radical combination?

A. Rate constant = Frequency factor

B. Energy of activatio is zero

C. Unit of rate constant and frequency factor depends upon the order of reaction

D. The rate of reaction depends upon temperature

Answer: d

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182. For a first order reaction $-\frac{d[A]}{dt}=K[A]_0$. The reaction is carried out by taking $100 mol/litre$ of A, then concentration of A decayed after time $\frac{1}{K}$ is:

A. $36.79 mollitre^{-1}$

B. $61.21 mollitre^{-1}$

C. $26.79 mollitre^{-1}$

D. $53.21 mollitre^{-1}$

Answer: b

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183. For a reation: $A \rightarrow$ Product,

rate law is $-\frac{d[A]}{dt}=K[A]_0$.

The concentration of A left after time t when $t=\frac{1}{K}$ is:

A. $\frac{[A]_0}{e}$

B. $[A]_0.\ e$

C. $\frac{[A]_0}{e^2}$

D. $\frac{1}{[A]_0}$

Answer: a

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184. For a given reaction, presence of catalyst reduces the energy of activation by 2 kcal at 27^(@)C`. Thus rate of reaction will be increased by:

A. 20 times

B. 14 times

C. 28 times

D. 2 times

Answer: c

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185. At 3 km altitude, water boils at $90^{\circ} C$ and 300 sec are taken to cook a "3 minute egg." The temperature coefficient for the process of cooking is:

A. 1.66

B. 2.66

C. 3.66

D. 0.6

Answer: a

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186. Which conclusion can be drawn if a graph is plotted between log $t_{50\%}$ vs. log [reactant] if it show an intercept 'A' and $\tan\theta = 0$?

A. $n = 1, t_{1/2} = \dfrac{1}{K.a}$

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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187. For an elementry reaction $aA \rightarrow$ product, the graph plotted between reaction $\log\left[\frac{-d[A]}{dt}\right]$ vs. time gives a straight line with intercept equal to 0.6 and showing an angle of 45° with origin, then:

A. rate constant $=3.98\text{mol litre}^{-1}t^{-1}$ and $a=1$

B. rate constant $=3.98\text{time}^{-1}$ and $a=1$

C. rate constant $=1.99\text{mol litre}^{-1}t^{-1}$ and $a=2$

D. rate constant $=1.99\text{time}^{-1}$ and $a=1$

Answer: b

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188. For the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$, if rate formation of $O_2 is 16g/hr$, then rate of decomposition of N_2O_5 and rate of formation of NO_2 respectively is:

A. $54g/hr \text{ and } 46g/hr$

B. $32g/hr \text{ and } 64g/hr$

C. $108g/hr \text{ and } 92g/hr$

D. None of these

Answer: c

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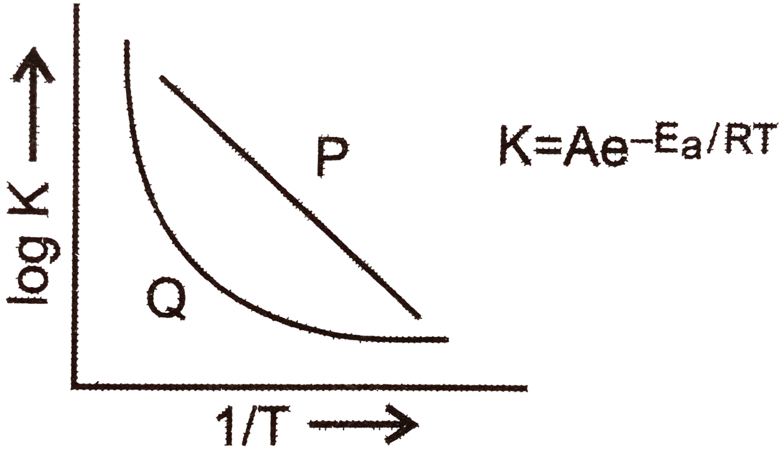
189. Which of the following statement are true regarding the log K vs. $1/T$ plot shown in the given diagram?



A. (a) Plot P shows that the energy of activation is independent of temperature

B. (b) Plot Q describes the behaviour of temperature dependence of energy of activation

C. (c) Arrhenius behaviour is described by P

D. (d) None of these

Answer: a, b, c

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190. Which of the following statement is (are) true?

A. (a) For endothermic reactions, energy of activation is always greather than heat of reaction

B. (b) For endothermic reactions, energy of activation is always smaller than heat of reaction

C. (c) Rate of reaction always increases with in temperature

D. (d) Temperature coefficient of a reaction is given by $\frac{K_{t-10}}{K_t}$

Answer: a, c,

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191. A reaction is catalysed by H^+ ions. The reaction has rate constant $3 \times 10^{-3} \text{ min}^{-1}$ in presence of acid HA and $2 \times 10^{-3} \text{ min}^{-1}$ in presence of acid HB. If both HA and HB are strong acid, which is//are correct?

A. (a) HA is strong acid, than HB

B. (b) Relative strength for $HA : HB = 1.5$

C. (c) The reaction, $NaB + HA \rightarrow NaA + HB$ may possible

D. (d) HB is stromger acid than HA

Answer: a, b, c

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192. Which of the following statement is (are) correct?

A. (a) It is possible to change the specific rate constant by changing the temperature

B. (b) The specific rate constant is independent of the concentrations of the reacting species

C. (c) In step-wise reaction the rate determining step is the slowest one

D. (d) The rate of a catalysed reaction is always independent of the concentration of the catalyst

Answer: a, b, c

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193. In a zero order reaction:

A. (a) The rate is independent of the temperature of the reaction

B. (b) The rate is independent of the concentration of the reactants

C. (c) The half-life depends on the concentration on the reactants

D. (d) The rate constant has the unit mol $litre^{-1}s^{-1}$

Answer: b, c, d

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194. In a reaction $2A + B \to A_2B$, the reactant A will disappear at

A. (a) The same rate at which B will decrease

B. (b) Twice the rate at which B will decrease

C. (c) Half the rate at which B will decrease

D. (d) Twice the rate at which A_2B will form

Answer: b, d

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195. Which of the following statement is (are) true for the given reaction,

$4A \to B \Leftrightarrow 2C + 2D$?

A. (a) The rate of disappearance of B is one-forth the rate of disappearance of A

B. (b) The rate of appearance of C is half the rate of disappearance of B

C. (c) The rates of formation of C and D are equal

D. (d) The rate of formation of D is half the rate of disappearance of A

Answer: a, c, d

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196. Which of the following statement is (are) correct?

A. (a) The order of a reaction can be zero

B. (b) The order of an elementary reaction is equal to its molecularity

C. (c) The order of the inversion of sucrose is 2

D. (d) The oder of a reaction may change if the experimental conditions are changed

Answer: a, b, d

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197. The half-life period of any first order reaction:

A. (a) is independent of the initial concentration of the reactant

B. (b) is inversely proportional to the rate constant

C. (c) is always the same whatever the reaction

D. (d) is half the specific rate constant

Answer: a, b

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198. For a first order reaction,

A. (a) The degree of dissociation isequal to $\left(1 - e^{-Kt}\right)$

B. (b) A plot of reciprocal concentration of the reactant vs. time gives a straight line

C. (c) The time taken for the completion of 75% reaction is thrice the $t_{1/2}$ of the reaction

D. (d) The pre-exponential factor in the Arrhenius equation has the dimension of time, (T^{-1})

Answer: a, d

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199. The rate equation for the decomposition of N_2O_5 in CCl_4 is rate $= K[N_2O_5]$, where $K = 6.3 \times 10^{-4} s^{-1}$ at $320K$. What would be the initial rate of decomposition of N_2O_5 in a $0.10M$ solution of N_2O_5 ?

A. (a) $6.3 \times 10^{-6} mollitre^{-1} s^{-1}$

B. (b) $0.63 \times 10^{-6} mollitre^{-1} s^{-1}$

C. (c) $6.3 \times 10^{-5} mollitre^{-1} s^{-1}$

D. (d) $0.63 \times 10^{-4} mollitre^{-1} s^{-1}$

Answer: c, d

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200. In the reaction,

$3BrO^- \rightarrow BrO_3^- + 2Br^-$ (aqueous alkaline medium at $80^\circ C$) the vlaue of the rate constant in the rate law in terms of $- -\frac{d}{dt}[BrO^-]$ is $0.056L\text{mol}^{-1}s^{-1}$. What will be the rate constant when the law is stated in terms of $\frac{d}{dt}[BrO^-]$?

A. (a) $18.7 \times 10^{-3} litremol^{-1}s^{-1}$

B. (b) $3.74 \times 10^{-3} litremol^{-1}s^{-1}$

C. (c) $0.0187 litremol^{-1}s^{-1}$

D. (d) $18.7 \times 10^{-2} litremol^{-1}s^{-1}$

Answer: a, c

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201. Arrhenius equation may be written as:

A. (a) $(d/dt)\log K = -(\Delta U/RT^2)$

B. (b) $(d/dt)\log K = +(\Delta U/RT^2)$

C. (c) $(d/dt)\log K = -(\Delta U/RT)$

D. (d) $K = Ae^{-\Delta U/RT}$

Answer: a, b

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202. Which of the following statements is (are) true?

A. (a) Law of mass action and rate law expressions are same for single step reactions

B. (b) Order for the slowest elementry reaction of a multi-step reaction gives the oder of the multi-step reaction

C. (c) Both order and molecularity have normally a maximum value of

3

D. (d) Molecularity of a complex reaction,

$A + 2B \rightarrow C$ is 3

Answer: a, b, c

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203. The rate of reaction:

A. Decreases with time

B. Decreases with decrease in conc. Of reactant

C. Both A and B

D. None of these

Answer: B

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204. For the reaction, $A+2B \to C$, the differential from of the rate law is:

A. (a) $\frac{d[C]}{dt} = -\frac{d[A]}{dt}$

B. (b) $\frac{3d[C]}{dt} = \frac{-d[B]}{dt}$

C. (c) $\frac{-3d[B]}{dt} = \frac{-d[C]}{dt}$

D. (d) $\frac{d[A]}{dt} = \frac{d[C]}{dt}$

Answer: a, b

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205. A container of 2 litre contain 4 moles of N_2O_5. On heating to $100^\circ C$, N_2O_5 undergoes complete dissociation to NO_2 and O_2. If rate constant for decomposition of N_2O_5 is $6.2 \times 10^{-4} \sec^{-1}$, select the correct statements:

A. (a) The mole ratio before and after dissociation is $4:2$

B. (b) The time required to complete 40% of reaction is $824\,\mathrm{sec}$

C. (c) $t_{1/2}$ of N_2O_5 is 1117.7 sec and it is independent of temperature

D. (d) If volume of container is doubled, the rate of decomposition becomes half of the initial rate

Answer: b, c, d

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206. Which of the following statement are correct?

A. (a) In an Arrgenius equation,

$K = Ae^{-E_a/RT}$, if $T \to \infty$ then $K = A$

B. (b) Alkaline hyroysis of ester is irreversible reaction

C. (c) Rate of exothermic reaction increase with increase in temperature

D. (d) For $N_2 + 3H_2 \Leftrightarrow 2NH_3$, if rate of formation of NH_3 is $0.001kg/hr$, then rate of consumption of H_2 is $1.76 \times 10^{-4} kg/hr$

Answer: a, b, c, d,

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207. Which of the following statement about the rate of a chemical reaction is (are) not true?

A. (a) The rate remains constant throughout the reaction in all order of reaction

B. (b) The rate increases as the reaction proceeds

C. (c) The rate decreases as the reaction proceeds

D. (d) None of these

Answer: a, b

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208. In which of the following, E_a for backward reaction is greater than E_a for forward reaction?

A. (a) $A \xrightarrow{E_a = 50kcal} B, \Delta H = -10kcal$

B. (b) $A \xrightarrow{E_a = 50kcal} B, \Delta H = +10kcal$

C. (c) $A + 10kcal \rightarrow B, E_a = 50kcal$

D. (d) $A - 10kcal \rightarrow B, E_a = 50kcal$

Answer: a, c

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209. The rate of chemical reaction increases:

A. (a) If the temperature is increased

B. (b) If the concentration of the reactants is decreased

C. (c) If the concentration of the reactants is increased

D. (d) With time

Answer: a, c

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210. Which of the statement is (are) correct?

A. (a) A pot of $\log K_p$ vs. $\frac{1}{T}$ is linear

B. (b) A plot of $\log[X]$ vs. time is linear for a first order reaction, $X \rightarrow P$

C. (c) A plot of $\log P$ vs. $\frac{1}{T}$ is linear at constant volume

D. (d) A plot of $\log P$ vs. $\frac{1}{V}$ is linear at constant temperature

Answer: a, b, d

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211. For the reaction $A+B+C \rightarrow D$, the following observations were made:

(i) When the concentration of A was doubled, the rate of formation of D was doubled

(ii) When the concentration of B was halved, the rate of formation of D becomes one fourth

(iii) Doubling the concentration of C had no effect on rate.

Slect the correct statement(s):

A. (a) Rate equation, $r=k[A][B]^{1/2}$

B. (b) Reactant C must involve after rate determining step

C. (c) Only A and B participate in the rate determining step

D. (d) Order of C is 1

Answer: b, c

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212. The rate constant is numerically the same for I order, II order and III order. Select the correct statements:

A. (a) If $[A] < 1,$ then $r_1 > r_2 > r_3$

B. (b) If $[A] > 1,$ then $r_1 < r_2 < r_3$

C. (c) If $[A] > 1,$ then $r_1 > r_2 > r_3$

D. (d) If $[A] = 1,$ then $r_1 = r_2 = r_3$

Answer: a, b, d

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213. Select the correct statements:

A. (a) A transient state cannot be isolated

B. (b) A transient state is a unstable state

C. (c) The degree of dissociation for a reaction obeying first order kinetics is $1 - e^{-KT}$

D. (d) A large value of half-life implies for a fast reaction

Answer: a, b, c

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214. For a gaseous phase, first order reaction,

$A_{(g)} \to B_{(g)} + 2C_{(g)}$ (rate constant $K = 10^{-2} time^{-1}$)

in a closed vessel of 2 litre containing 5 moles of $A_{(g)}$ at $27^\circ C$. then correct statements:

A. (a) Rate of disappearrance of $A_{(g)}$ is $6.15 \times 10^{-3} atm t^{-1}$

B. (b) Rate of disappearance of $C_{(g)}$ is $5.0 \times 10^{-2} mol litre^{-1} t^{-1}$

C. (c) Rate of disappearance of $B_{(g)}$ is $5.0 \times 10^{-2} mol litre^{-1} t^{-1}$

D. (d) Rate of disappearance of $A_{(g)}$ is $5.0 \times 10^{-2} mol^{-1} t^{-1}$

Answer: a, d

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215. The variation of K and $\frac{k_f}{K_b}$ with temperature shows the following effects:

A. (a) For endothermic reactions K and $\frac{K_f}{K_b}$ both decreases

B. (b) For endothermic reactions K and $\frac{K_f}{K_b}$ both increases

C. (c) For endothermic reactions K and $\frac{K_f}{K_b}$ both decreases

D. (d) For endothermic reactions K and $\frac{K_f}{K_b}$ both increases

Answer: b, c

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216. According to kinetic theory of gases:

A. (a) collisions are always elastic

B. (b) heavier molecules transfer more momentum to the wall of the container

C. (c) only a small number of molecules have very high velocity

D. (d) between collisions, the molecules move in straight lines with constant velocities

Answer: a, b, c, d,

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217. For the first order reaction

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

A. (a) The concentration of the reactant decreases exponentially with time

B. (b) the half-life of the reaction decreases with increasing temperature

C. (c) the half-life of the reaction depends on the initial concentration of the reactant

D. (d) the reaction proceeds to 99.6% completion in eight half-life duration

Answer: a, b, d

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218. Units of rate constant of first and zero order reactions in terms of molarity M are respectively:

A. (a) s^{-1}, Ms^{-1}

B. (b) s^{-1}, M

C. (c) Ms^{-1}, s^{-1}

D. (d) M, s^{-1}

Answer: a

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219. For a reaction $A + 2B \rightarrow C$, rate is given by $R = K[A][B]^2$. The order of reaction is:

A. (a) 3

B. (b) 6

C. (c) 5

D. (d) 7

Answer: a

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220. For the reaction $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$, the rate of reaction is expressed as

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

B. (b) $\frac{d[H_2]}{dt} = \frac{d[I_2]}{dt} = \frac{d[HI]}{dt}$

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

D. (d) $-2\frac{d[H_2]}{dt} = -2\frac{d[I_2]}{dt} = \frac{d[HI]}{dt}$

Answer: d

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221. Which one is correct for $K = Ae^{-E_a/RT}$?

A. (a) E_a is energy of activation

B. (b) R is Rydberg constant

C. (c) K is equilibrium constant

D. (d) A is adsorption factor

Answer: a

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

A. (a) $n - m$

B. (b) 2^{n-m}

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

D. (d) $m + n$

Answer: b

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223. In a first order reaction, the concentration of the reactant decreases form $0.8M$ to $0.4M$ in 15 min . The time taken for the concentration to change form $0.1M$ to $0.025M$ is

A. (a) 60 minute

B. (b) 15 minute

C. (c) 7.5 minute

D. (d) 30 minute

Answer: d

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224. The rate equation for the reaction

$2A + B \rightarrow C$ is rate $= K[A][B]$.

The correct statement about this is:

A. (a) K is independent of $[A]$ and $[B]$

B. (b) $t_{1/2}$ is constant

C. (c) Unit of K is $\sec^{-1}$

D. (d) Rate of formation of C is twice the rate of disappearance of A

Answer: a

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225. The energy of activations for forward and backward change for an endothermic reaction, $X \rightarrow Y$ are E_f and E_b respectively. Which of the following is correct ?

A. (a) $E_b < E_f$

B. (b) $E_b > E_f$

C. (c) $E_b = E_f$

D. (d) No relation between them

Answer: a

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226. A reaction involiving two different reactants can never be:

A. (a) Unimolecular reaction

B. (b) I order reaction

C. (c) II order reaction

D. (d) Bi-molecular reaction

Answer: a

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227. $t_{1/4}$ 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. (a) $0.10/K$

B. (b) $0.29/K$

C. (c) $0.69/K$

D. (d) $0.75/K$

Answer: b

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228. The following mechanism has been proposed for the reaction of NO with Br_2 to from NOBr.

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

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

If the second step is the rate determining step, the order of the reaction with respect to NO(g) is

A. (a) 1

B. (b) 0

C. (c) 3

D. (d) 2

Answer: d

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229. Rate of a reaction can be expressed by Arrhenius equation as:

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

In this equation, E_a represents:

A. (a) The energy above which all the colliding molecules will react

B. (b) The energy below which colliding molecules will not react

C. (c) The total energy of the reactant molecules at a temperature T

D. (d) the fraction of molecules with enrgy greater than the activation energy of the reaction`

Answer: b

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230. A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, with everything else kept the same, the rate of reaction will:

A. (a) Remain unchanged

B. (b) Tripled

C. (c) Increase by a factor four

D. (d) Doubled

Answer: c

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

A. (a) 300

B. (b) 120

C. (c) 280

D. (d) -20

Answer: d

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232. Consider a reaction, $2A + B \rightarrow$ Products

When concentration of B alone was doubled, the half-life did not change.

When the concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for this reaction is :

A. (a) $Lmol^{-1}s^{-1}$

B. (b) No unit

C. (c) $molL^{-1}s^{-1}$

D. (d) s^{-1}

Answer: a

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233. For a reaction $\frac{1}{2}A \rightarrow 2B$, rate of disappearance of $'A'$ is related to the rate of apperance of $'B'$ by the expression:

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

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

C. (c) $-\frac{d[A]}{dt} = \frac{d[B]}{dt}$

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

Answer: b

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

A. (a) $230.3 \min utes$

B. (b) $23.03 \min utes$

C. (c) $46.06 \min utes$

D. (d) $460.6 \min utes$

Answer: c

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

A. (a) $2.0 \times 10^{18} \sec^{-1}$

B. (b) $6.0 \times 10^{14} \sec^{-1}$

C. (c) Inifinity

D. (d) $3.6 \times 10^{30} \sec^{-1}$

Answer: b

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236. The rate constant for the reaction:

$2N_2O_5 \rightarrow 4NO_2 + O_2$ is $3.0 \times 10^{-5} \sec^{-1}$. If the rate is $2.40 \times 10^{-5} M \sec^{-1}$, then the concentration of N_2O_5 (in M) is:`

A. (a) 1.4

B. (b) 1.2

C. (c) 0.04

D. (d) 0.8

Answer: d

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237. If I is the intenisty of an absorbed light and c is the concentration of AB for the photochemical process. $AB + hv \rightarrow AB^*$, the rate of formation of AB^* is directly proportional to

A. (a) C

B. (b) I

C. (c) I^2

D. (d) $C.\ I$

Answer: b

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238. 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. (a) $Rate = \frac{-d[N_2]}{dt} = \frac{-1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

B. (b) $Rate = \frac{-d[N_2]}{dt} = \frac{3d[H_2]}{dt} = \frac{2d[NH_3]}{dt}$

C. (c) $Rate = \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

D. (d) $Rate = \frac{-d[N_2]}{dt} = \frac{-d[H_2]}{dt} = \frac{d[NH_3]}{dt}$

Answer: a

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239. 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. (a) 2×10^4

B. (b) 3.45×10^{-5}

C. (c) 1.386×10^{-4}

D. (d) 2×10^{-4}

Answer: c

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240. A follows first order reaction.

$(A) \rightarrow Product$

The concentration of A changes form $0.1M$ to $0.025M$ in 40 min . Find the rate of reaction of A when the concentration of A is $0.01M$.

A. (a) $1.73 \times 10^{-4} M / \text{ min}$

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

C. (c) $3.47 \times 10^{-4} M / \text{ min}$

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

Answer: c

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241. Which of the following statements for the order of reaction is not correct ?

A. (a) Order can be determined experimentally

B. (b) Order of reaction is equal to sum of the powers of concentration terms in differential rate law

C. (c) It is not affected with stoichiometric coefficient of the reactants

D. (d) Order cannot be fractional

Answer: d

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

A. (a) 0

B. (b) 1

C. (c) 2

D. (d) 3

Answer: d

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243. Under the same reaction conditions, the intial concentration of $1.386 mol dm^{-3}$ of a substance becomes half in $40s$ and $20s$ theough first order and zero order kinetics, respectively.

The ratio (k_1/k_0) of the rate constants for first order (k_1) and zero order (k_0) of the reaction is

A. (a) $0.5 mol^{-1} dm^3$

B. (b) $1.0 mol dm^{-3}$

C. (c) $1.5 mol dm^{-3}$

D. (d) $2.0 mol^{-1} dm^3$

Answer: a

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244. 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. (a) $1.0 \times 10^6 s^{-1}$ and $9.2 kJ mol^{-1}$

B. (b) $6.0 s^{-1}$ and $16.6 kJ mol^{-1}$

C. (c) $1.0 \times 10^6 s^{-1}$ and $16.6 kJ mol^{-1}$

D. (d) $1.0 \times 10^6 s^{-1}$ and $38.3 kJ mol^{-1}$

Answer: d

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245. The time for half-life period of a certain reaction, $A \rightarrow$ products is $1h$. When the initial concentration of the reactant $'A'$ is $2.0\text{mol}L^{-1}$, how much time does it take for its concentration to come from 0.50 to $0.25\text{mol}L^{-1}$, if it is zero order reaction ?

A. (a) $4hr$

B. (b) $0.5hr$

C. (c) $0.25hr$

D. (d) $1hr$

Answer: c

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246. 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) $2only$

B. (b) $Both 1 \text{ and } 2$

C. (c) $Neither 1n \text{ or } 2$

D. (d) $1only$

Answer: d

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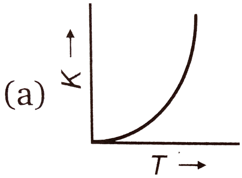
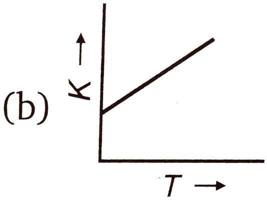
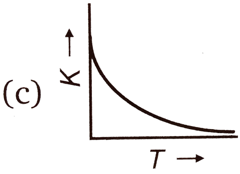
247. Plots showing the variation of the rate constant (k) with temperature (T) are given below. The plot that follows the Arrhenius equation is



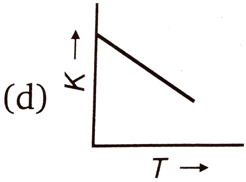
A. (a)



B. (b)



C. (c)



D. (d)

Answer: a

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248. The rate of a chemical reaction doubles for every $10^\circ C$ rise of temperature. If the temperature is raised by $50^\circ C$, the rate of the reaction increases by about

A. (a) 10 times

B. (b) 24 times

C. (c) 32 times

D. (d) 64 times

Answer: c

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249. A follows first order reaction.

$(A) \rightarrow Product$

The concentration of A changes form $0.1M$ to $0.025M$ in 40 min . Find the rate of reaction of A when the concentration of A is $0.01M$.

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

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

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

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

Answer: a

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250. Water and oxygen atoms react in upper atmospheric level bimolecularly to form two OH radicals having heat of reaction $72kJ$ at $400K$ and energy of activation being $77kJmol^{-1}$. Calculate the E_a for bimolecular combination of two OH radicals to form H_2O and O-atom.

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251. What is the order of reaction for which rate becomes half if volume of the container having same amount of reactant is doubled? Assume gaseous phase reaction.

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

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253. The conversion of $A \rightarrow B$ follows second-order kinetics. Doubling the concentration of A will increase the rate of formation of B by a factor

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254. A reaction is first order in A and second order in B. How is rate affected when concentration of B is tripled?

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255. The rate constant for a chemical reaction has unit litre $mol^{-1}\sec^{-1}$. Find the order of the reaction.

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256. A drop of a solution $(0.05mL)$ contains 6.0×10^{-7} mole of H^{+}. If the rate of disappearance of H^{+} is $6.0\times10^{5}mollitre^{-1}\sec^{-1}$, it takes $x\times10^{-8}$ sec for H^{+} in the drop to disappear. Find the value of x.

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257. For a chemical reaction $A\rightarrow B$,the rate of the reaction is $2.0\times10^{-3}\sec^{-1}$, when the initial concentration is $0.05moldm^{-3}$. The rate of the same reaction is $1.6\times10^{-2}moldm^{-3}\sec^{-1}$. When the initial concentration is 0.1 mol dm^{3}, find the order of reaction.

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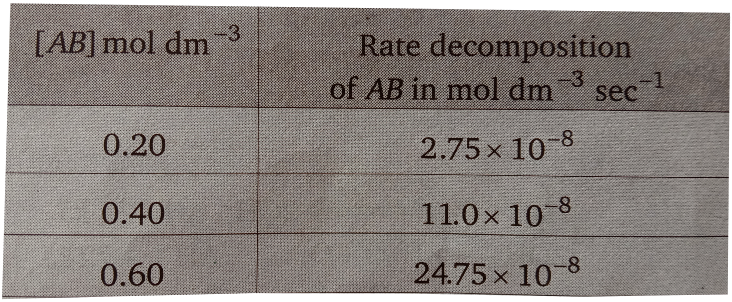
258. For the decomposition of a compount AB at 600 K, the following data were obtained.



$[AB]$ mol dm^{-3}	Rate decomposition of AB in mol dm^{-3} sec^{-1}
0.20	2.75×10^{-8}
0.40	11.0×10^{-8}
0.60	24.75×10^{-8}

Find the order for the decomposition of AB.

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259. For the first order reaction, the rate constant is $7.7 \times 10^{-2}\,\text{sec}^{-1}$. Calculate the time required for the initial concentration 1.5 mole of the reactant to be reduced to 0.75 mole.

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260. A first order of reaction is 75% complete in 18 minute. What is the half-life period for the reaction ?

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261. For a reaction $\frac{dx}{dt} = K\left[H^{+}\right]^{n}$. If pH of reaction medium changes from two to one rate becomes 100 times of value at $pH = 2$, The order of reaction is

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262. The reaction , $2N_2O_5 \rightarrow 4NO_2 + O_2$ is first order and takes 24 minutes for 75% decomposition of N_2O_5 at the end of 1 hour after the start of the reaction find the amount of oxide is left.

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263. For a chemical reaction $aA \to bB$,

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

Then find the approximately ratio of a and b is.

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264. A drop of solution $(\text{volume} = 0.05mL)$ contains 3×10^{-2} mole of H^{+}. If the rate constant of disappearance of H^{+} is $1.0 \times 10^{2} mollitre^{-1} \min ute^{-1}$. How long (in minutes) will it take to disappear all the H^{+} ions?

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265. The concentration of R in the reaction $R \to P$ was measured as a function of time and the following data were obtained. What is the order of the reaction?

$$\begin{vmatrix} [R](mol) & 1.0 & 0.75 & 0.40 & 0.10 \\ T(\min) & 0.0 & 0.05 & 0.12 & 0.18 \end{vmatrix}$$

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266. An organic compound undergoes first decompoistion. The time taken for its decompoistion to $1/8$ and $1/10$ of its initial concentration are $t_{1/8}$ and $t_{1/10}$, respectively. What is the value of $\frac{[t_{1/8}]}{[t_{1/10}]} \times 10$? $(\log_{10} 2 = 0.3)$

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267. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as: $rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$ or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate =0. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

The rate of formation of SO_3 in the following reaction,

$2SO_2 + O_2 \rightarrow 2SO_3$ is $10g\sec^{-1}$

The rate of disappearance of O_2 will be:

A. (a) $5g\sec^{-1}$

B. (b) $100g\sec^{-1}$

C. (c) $20g\sec^{-1}$

D. (d) $2g\sec^{-1}$

Answer: d

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268. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as: $rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$ or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate =0. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

For the reaction, $aA \rightarrow bB$,

$\log\left[\frac{-dA}{dt}\right] = \log\left[\frac{dB}{dt}\right] + 0.6$, then $a : b$ is:

A. (a) 3.98

B. (b) 2.18

C. (c) 1.48

D. (d) 0

Answer: a

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269. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as:

$rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$ or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate =0. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

For a reaction, $2ND_3 \rightarrow N_2 + 3D_2$,

$\frac{-d[ND_3]}{dt} = K_1[ND_3], \frac{d[N_2]}{dt} = K_2[ND_3]$

$\frac{d[D_2]}{dt} = K_3[ND_3]$, then:

A. (a) $K_1 = K_2 = K_3$

B. (b) $3K_1 = 6K_2 = 2K_3$

C. (c) $K_1 = 2K_2 = K_3$

D. (d) $K_1 = K_2 = 2K_3$

Answer: b

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270. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as:

$rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$ or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate =0. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

For the reaction, $A + 2B \Leftrightarrow AB_2$, the rate of forward reaction is $\frac{dx}{dt} = 1 \times 10^5[A][B]^2 - 1 \times 10^4[AB_2]$. The rate constants for forward and backward reactions are:

A. (a) $1 \times 10^5 L^2 m^{-2} s^{-1}, 1 \times 10^4 \sec$

B. (b) $1 \times 10^5 \sec^{-1}, 1 \times 10^4 L^2 m^{-2} s^{-1}$

C. (c) $1 \times 10^5 L^2 m^{-2} s^{-1}, 1 \times 10^4 \sec^{-1}$

D. (d) $1 \times 10^{-5} L m^{-1} s^{-1}, 1 \times 10^4 \sec$

Answer: c

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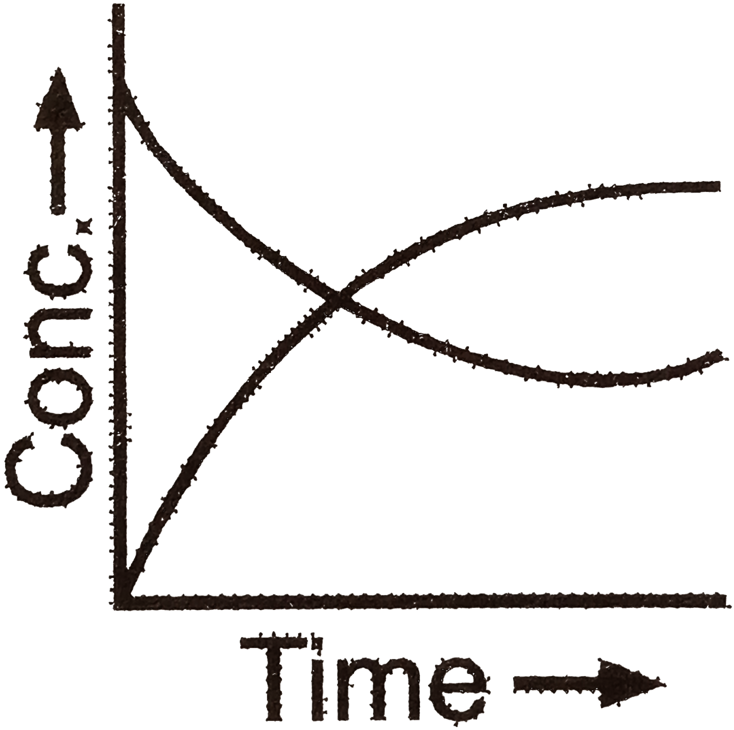
271. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as:

$$rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$$

or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate $=0$. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

At the point of intersection of the two curve shown for the reaction:

$A \rightarrow nB$ the concentration of B is given by:



A. (a) $\frac{nA_0}{2}$

B. (b) $\frac{A_0}{n-1}$

C. (c) $\frac{nA_0}{n+1}$

D. (d) $\frac{(n-1)}{(n+1)}A_0$

Answer: c

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272. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as:

$$rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$$

or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate =0. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

For a hypothetical reaction $aA + bB \rightarrow$ Product, the rate law is: rate $= K[A]^x[B]^y$, then:

A. (a) $(a + b) = (x + y)$

B. (b) $(a + b) < (x + y)$

C. (c) $(a + b) > (x + y)$

D. (d) Any of these

Answer: d

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273. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as:

$$rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$$

or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate =0. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

For the reaction, $2NO + Br_2 \Leftrightarrow 2NOBr$, the mechanism is given in two steps:

$$(1) NO + Br_2 \overset{\text{fast}}{\Longleftrightarrow} NOBr_2$$

$$(2) NOBr_2 + NO \xrightarrow{\text{slow}} 2NOBr$$

The rate expression for the reaction is:

A. (a) $r = K[NO]^2[Br_2]$

B. (b) $r = K[NO][Br_2]$

C. (c) $r = K[NO][Br_2]^2$

D. (d) $r = K[NOBr_2]$

Answer: a

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274. The rate and mechamical reaction are studied in chemical kinetics. The elementary reactions are single step reaction having no mechanism. The order of reaction and molecularity are same for elementary reactions. The rate of forward reaction $aA + bB \rightarrow cC + dD$ is given as: $rate = \left(\frac{dx}{dt}\right) = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = \frac{1}{d}\frac{d[D]}{dt}$ or expression can be written as : rate $= K_1[A]^a[B]^b - K_2[C]^c[D]^d$. At equilibrium, rate =0. The constants K, K_1, K_2 are rate constants of respective reaction. In case of reactions governed by two or more steps reaction mechanism, the rate is given by the slowest step of mechanism.

For a gaseous reaction, the rate is expressed in terms of $\frac{dP}{dt}$ in place of $\frac{dC}{dt}$ or $\frac{dn}{dt}$ where C is concentration, n is number of moles and 'P' is pressure of reactant. The three are related as:

A. (a) $\left[\frac{dP}{dt}\right] = \frac{RT}{V}\left[\frac{dn}{dt}\right] = \left[\frac{dC}{dt}\right]$

B. (b) $\frac{1}{RT}\left[\frac{dP}{dt}\right] = \frac{1}{V}\left[\frac{dn}{dt}\right] = \left[\frac{dC}{dt}\right]$

C. (c) $\left[\frac{dP}{dt}\right] = \left[\frac{dn}{dt}\right] = \left[\frac{dC}{dt}\right]$

D. (d) None of these

Answer: b

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275. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

For a reaction, $A \rightarrow B$, if

$\log_{10} K(\sec^{-1}) = 14 - \frac{1.25 \times 10^4}{T} K$, the Arrhenius parameter and energy of activation for the reaction are:

A. (a) $10^{14} \sec^{-1}, 239.34 kJ$

B. (b) $14, 57.6 kcal$

C. (c) $10^{14} \sec^{-1}, 23.93 kJ$

D. (d) $10^{14} \sec, 5.76 kcal$

Answer: a

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276. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

At what conditions exponential factor is zero a reaction?

A. (a) Inifinite remperature

B. (b) Free radical combination

C. (c) Energy of activation = Threshold energy

D. (d) All of these

Answer: d

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277. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

For an endothermic reaction, which one is true if ΔH is heat of reaction and E_a is energy of activation?

A. (a) $E_a > \Delta H$

B. (b) $E_a < \Delta H$

C. (c) $E_a \ _{-} (<)^{>} \Delta H$

D. (d) $E_a = 0$

Answer: a

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278. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

For a chemical reaction: $A \rightarrow$ Product, the rate of disappearance of A is given by: $\frac{-dC_A}{dt} = K_1 \frac{C_A}{1 + K_2 C_A}$. At low C_A, the order of reaction and rate constants are respectively:

A. (a) $I, \frac{K_1}{K_2}$

B. (b) I, K_1

C. (c) $II, \frac{K_1}{K_2}$

D. (d) $II, \frac{K_1}{K_1 + K_2}$

Answer: b

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279. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

For a reversible reaction, $A + B \Leftrightarrow C + D, \Delta H = -Akcal$. If energy is B kcal, the energy of activation for backward reaction in kcal is:

A. (a) $-A + B$

B. (b) $A + B$

C. (c) $A - B$

D. (d) $-A - B$

Answer: b

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280. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

The quantity $-E_a/RT$ in $-Ae^{-E_a/RT}$ is referred as:

A. (a) Boltzmann factor

B. (b) Frequency factor

C. (c) Activation factor

D. (d) None of these

Answer: a

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281. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

How much faster would a reaction proceed at $25^\circ C$ than at $0^\circ C$ if the activation energy is 2 cal?

A. (a) 2 times

B. (b) 16 times

C. (c) 11 times

D. (d) Almost at same speed

Answer: d

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282. The rate of reaction $\left(\frac{dx}{dt}\right)$ varies with nature, physical state and concentration of reactants, temperature, exposure to light and catalyst, whereas rate constant (K) varies with temperature and catalyst only. The rate constant K is given as $K = Ae^{-E_a/RT}$ where A is Arrhenius parameter or pre-exponential factor and E_a is energy of activation. The minimum energy required for a reaction is called threshold energy and the additional energy required by reactant molecules to attain threshold energy level is called energy of activation.

The temperature coefficient of reaction I is 2 and reaction II is 3. Both have same speed at $25^\circ C$ and show I order kinetics. The rati of rates of reaction of these two at $75^\circ C$ is:

A. (a) 7.6

B. (b) 5.6

C. (c) 6.6

D. (d) 8.6

Answer: a

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283. A certain endothermic reaction: $A \rightarrow$ Product, $\Delta H = +ve$ proceeds in a sequence of three elementary steps with the rate constants K_1, K_2 and K_3 and each one having energy of activation E_a, E_2 and E_3 respectively at $25^\circ C$. The observed rate constant for the reaction is equal to $K_3\sqrt{\frac{K_1}{K_2}}$. A_1, A_2 and A_3 are Arrhenius parameters respectively.

The observed energy of activation for the reaction is:

A. (a) $\frac{2E_1 - E_2 + 2E_3}{2}$

B. (b) $\frac{E_2 - E_1 - 2E_3}{2}$

C. (c) $\sqrt{\frac{E_1E_3}{E_2}}$

D. (d) $\frac{E_1 - E_2}{2} + E_3$

Answer: d

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284. A certain endothermic reaction: $A \rightarrow$ Product, $\Delta H = +ve$ proceeds in a sequence of three elementary steps with the rate constants K_1, K_2 and K_3 and each one having energy of activation E_a, E_2 and E_3 respectively at $25^\circ C$. The observed rate constant for the reaction is equal to $K_3\sqrt{\frac{K_1}{K_2}}$. A_1, A_2 and A_3 are Arrhenius parameters respectively.

The observed Arrhenius parameter for the reaction is:

A. (a) $\frac{2A_1 - A_2 + 2A_3}{2}$

B. (b) $\sqrt{\frac{A_1}{A_2}}.\ A_3$

C. (c) $A_1A_2A_3$

D. (d) $\frac{A_1.\ A_3}{A_2}$

Answer: b

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285. A certain endothermic reaction: $A \to$ Product, $\Delta H = +ve$ proceeds in a sequence of three elementary steps with the rate constants K_1, K_2 and K_3 and each one having energy of activation E_a, E_2 and E_3 respectively at $25^\circ C$. The observed rate constant for the reaction is equal to $K_3\sqrt{\frac{K_1}{K_2}}$. A_1, A_2 and A_3 are Arrhenius parameters respectively. Presence of a catalyst decreases the energy of activation of each path by half the value of E_1. Assuming the order actors same, the observed energy of activation would be:

A. (a) $E_3 - \frac{E_2}{2}$

B. (b) $2E_3 - E_2$

C. (c) $E_2 - \frac{E_3}{2}$

D. (d) $\frac{E_1}{2} + \frac{E_2}{2} + E_3$

Answer: a

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286. A certain endothermic reaction: $A \rightarrow$ Product, $\Delta H = +ve$ proceeds in a sequence of three elementary steps with the rate constants K_1, K_2 and K_3 and each one having energy of activation E_a, E_2 and E_3 respectively at $25^\circ C$. The observed rate constant for the reaction is equal to $K_3\sqrt{\frac{K_1}{K_2}}$. A_1, A_2 and A_3 are Arrhenius parameters respectively. Which represents the correct value, if catalyst is not present?

A. (a) ΔH is definitely lower than E_1

B. (b) ΔH is definitely lower than E_3

C. (c) ΔH is definitely lower than $E_1 - E_2$

D. (d) ΔH is definitely lower than $\frac{E_1 - E_2 + 2E_3}{2}$

Answer: d

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287. A certain endothermic reaction: $A \rightarrow$ Product, $\Delta H = +ve$ proceeds in a sequence of three elementary steps with the rate constants

K_1, K_2 and K_3 and each one having energy of activation E_a, E_2 and E_3 respectively at $25^\circ C$. The observed rate constant for the reaction is equal to $K_3\sqrt{\frac{K_1}{K_2}}$. A_1, A_2 and A_3 are Arrhenius parameters respectively.

If temperature coefficient of the observed reaction is 2, the numerical value of $E_1 - E_2 + 2E_3$ is:

A. (a) $12.73 kcal$

B. (b) $25.46 kcal$

C. (c) $38.19 kcal$

D. (d) Cannot be calculated

Answer: b

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288. A certain endothermic reaction: $A \rightarrow$ Product, $\Delta H = +ve$ proceeds in a sequence of three elementary steps with the rate constants K_1, K_2 and K_3 and each one having energy of activation E_a, E_2 and E_3

respectively at $25^{\circ} C$. The observed rate constant for the reaction is equal to $K_3\sqrt{\frac{K_1}{K_2}}$. A_1, A_2 and A_3 are Arrhenius parameters respectively.

For a reversible reaction, $A \underset{K_2}{\overset{K_1}{\Longleftrightarrow}} B, \Delta H = q$, if perexponential factors are same. The correct relation is:

A. (a) $K_{eq} = e^{-q/RT}$

B. (b) Rate of reaction $= \frac{-d[A]}{dt} = K_1[A] - K_2[B]$

C. (c) At equilibrium, $K_1[A] = K_2[B]$

D. (d) Either of these

Answer: d

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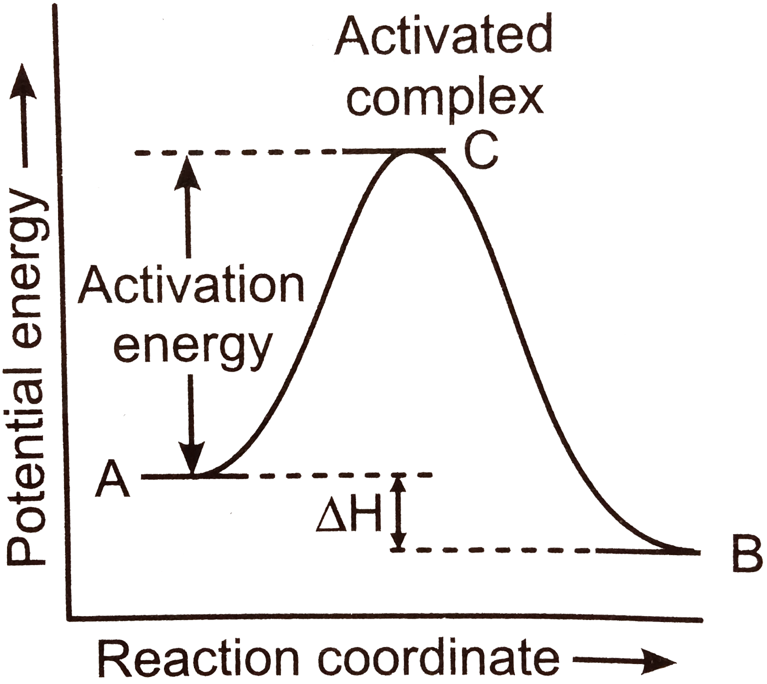
289. The energy required to form the intermediate, called activated complex (C) is known as activation energy (E_a). The diagram is obtained by plotting potential energy vs. reaction coordinate. Reaction coordinate represents the profile of energy change when reactants change into products.

Some energy is released when the complex decomposes to form products. So, the heat of the reaction depends upon the nature of reactants and products.



If a reaction $A + B \rightarrow C$, is exothermic to the extent of $30 kJmol^{-1}$ and the forward reaction has an activation energy of $249 kJmol^{-1}$, the activation energy for reverse reaction in $kJmol^{-1}$ is:

A. (a) 324

B. (b) 279

C. (c) 40

D. (d) 100

Answer: b

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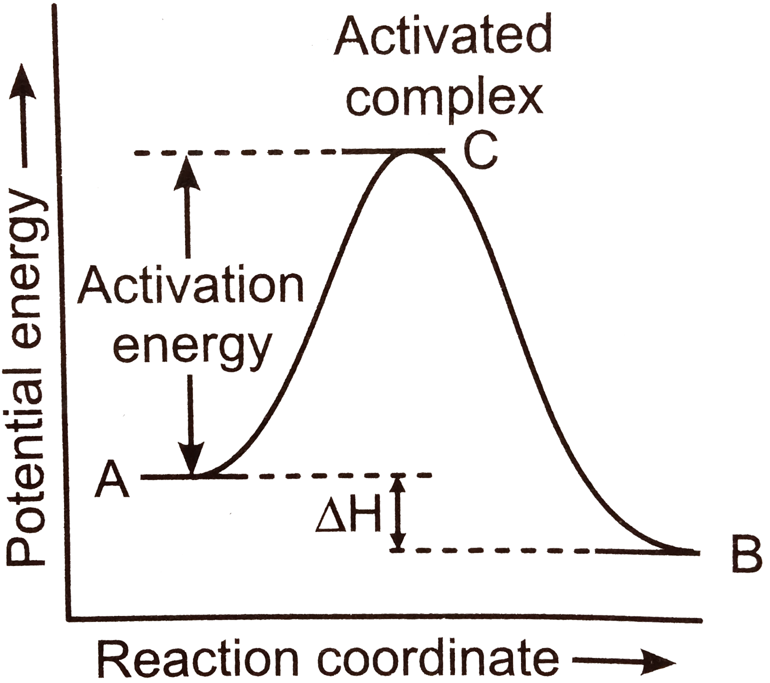
290. The energy required to form the intermediate, called activated complex (C) is known as activation energy (E_a). The diagram is obtained by plotting potential energy vs. reaction coordinate. Reaction coordinate represents the profile of energy change when reactants change into products.

Some energy is released when the complex decomposes to form products. So, the heat of the reaction depends upon the nature of reactants and products.



If a reaction $A + B \rightarrow C$, is exothermic to the extent of $30 kJ mol^{-1}$ and the forward reaction has an activation energy of $249 kJ mol^{-1}$, the activation energy for reverse reaction in $kJ mol^{-1}$ is:

A. (a) $E_1 > E_2$

B. (b) $E_1 < E_2$

C. (c) $E_2 = 2E_1$

D. (d) $\sqrt{E_1 E_2^2} = 1$

Answer: a

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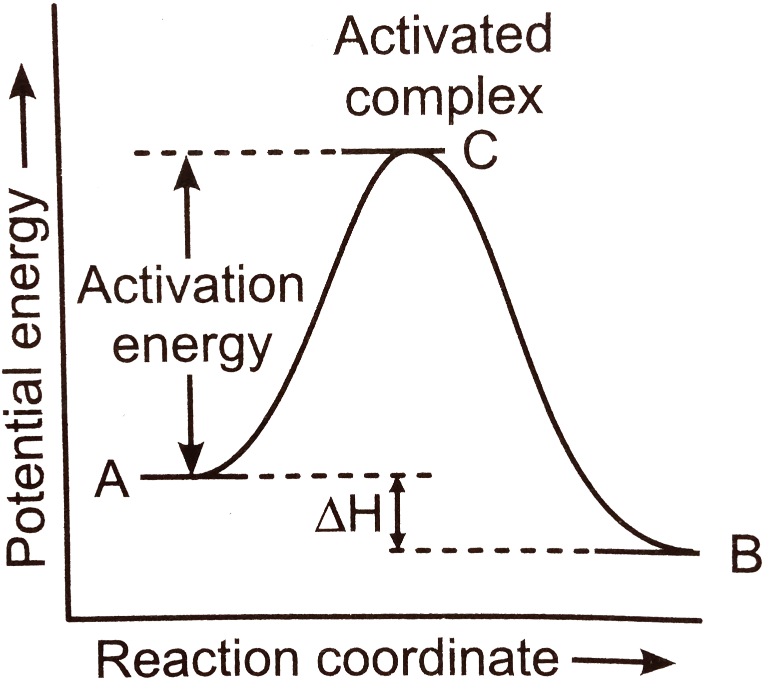
291. The energy required to form the intermediate, called activated complex (C) is known as activation energy (E_a). The diagram is obtained by plotting potential energy vs. reaction coordinate. Reaction coordinate represents the profile of energy change when reactants change into products.

Some energy is released when the complex decomposes to form products. So, the heat of the reaction depends upon the nature of reactants and products.



If a reaction $A + B \to C$, is exothermic to the extent of $30 kJmol^{-1}$ and the forward reaction has an activation energy of $249 kJmol^{-1}$, the activation energy for reverse reaction in $kJmol^{-1}$ is:

A. (a) $E_{a_1} > E_{a_2}$

B. (b) $E_{a_1} = E_{a_2}$

C. (c) $E_{a_1} < E_{a_2}$

D. (d) $E_{a_1} \geq E_{a_2}$

Answer: c

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292. Statement: The rate of reaction whether exothermic or endothermic usually, increases with temperature.

Explanation: The rate of reaction $= K[\text{reactant}]^n$ and K increases with temperature.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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293. Statement: A catalyst always lower the energy of ectivation.

Explanation: The catalyst-reactant interaction forms activated adsorbed complex and adsorption is always exothermic.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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294. Statement: A catayst does not affect the heat of reaction.

Explanation: It increases the rate of reaction.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: D

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295. Statement: The elementary reaction is single step reaction and does not possess mechanism.

Explanation: An elementry reaction has order of reaction and molecularity same.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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296. Statement: Temperature coefficient is the ratio of two rate constants preferably $35^{\circ}C$ and $25^{\circ}C$.

Explanation: It can also be given as $e^{\frac{-Ea}{R}\left[\frac{T_2-T_1}{T_1T_2}\right]}$

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: D

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297. For the reaction $2NO_2 + F_2 \rightarrow 2NO_2F$, following mechanism has been provided:

$$NO_2 + F_2 \xrightarrow{\text{slow}} NO_2F + F$$

$$NO_2 + F \xrightarrow{\text{fast}} NO_2F$$

Thus rate expression of the above reaction can be writtens as:

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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298. Assertion: For a free radical combination, $K = A$.

Reason: E_a is zero for free radical combination.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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299. Statement: For the reaction $2O_3 \rightarrow 3O_2$,

the rate $= K[O_3]^2[O_2]^{-1}$

Explanation: The reaction has -ve order for O_2

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: D

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300. Statement: Threshold energy of a reaction is independent of temperature.

Explanation: The energy of activation however decreases with increase in temperature.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: D

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301. Assertion: The emission of light during burning of P in O_2 is called chemiluminescence.

Reason: The chemical energy is converted into light energy.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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302. Statement: In order for molecules to interact, they must approach each-other so closely to collide with each other.

Explanation: Rearrangement of chemical bonds occur during collision.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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303. Statement: The Arrhenius equation explains the temperature dependence of rate of a chemical reaction.

Explanation: Plots of $\log K$ versus $1/T$ are linear and the energy of activation is obtained from such plots.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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

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

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

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305. The rate law of a chemical reaction given below:

$2NO + O_2 \rightarrow 2NO_2$

is given as rate $= K[NO]^2[O_2]$. How will the rate of reaction change if the volume of reaction vessel is reduced to $1/4th$ of its original valur?

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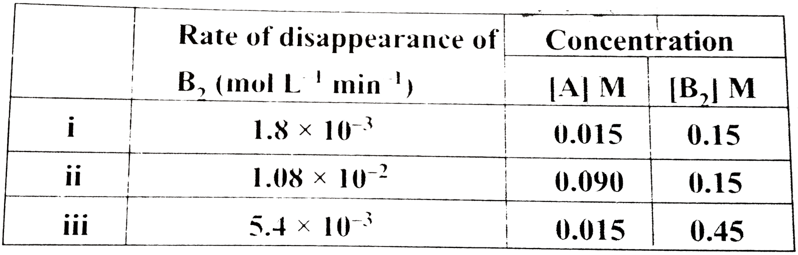
306. form the gaseous reaction

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



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

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

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307. The rate of a certain reaction depends on concentration according to the equation:

$$\frac{-dC}{dt}=\frac{K_1C}{1+K_2C}.$$

What will be the order of reaction, when concentration (C) is:

(a) very-very high?

(b) very-very low?

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308. Surface catalysed reaction that are inhibited by the products obey the rate equation (in same cases)

$$\frac{dx}{dt}=\frac{K(a-x)}{1+bx},$$

where a is the initial concentration of the reactant and K and b are constants. Intergrate this equation. Derive an expression for $t_{1/2}. x$ is the concentration of products at any time t and the reaction is $A \to B$.

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309. Show that the time $t_{1/2}/t_{3/4}$ for n^{th} order reaction is a function of 'n' alone. $t_{3/4}$ is the time required for concentration to become $1/4$ of original concentration.

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310. The inversion of cane sugar proceeds with half life of 500 min at $pH5$ for any concentration of sugar. However, if $pH = 6$, if the half life changes to 50 min . The rate law expression for the sugar inversion can be written as

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311. The oxidation of certain metal is found to obey the equation $A^2 = \alpha t + \beta$, where A is the thickness of the oxide film at time t, α and β are constants. What is the order of this reaction?

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

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313. For a homogeneous gaseous phase reaction $2A \rightarrow 3B + C$, the initial pressure was P° while pressure at time 't' was P. Find the pressure after time $2t$. Assume first-order reaction.

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

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

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

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317. Ethylene is produced by,

$$\underset{\text{Cyclobutane}}{C_4H_8} \xrightarrow{\Delta} 2C_2H_4$$

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

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318. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, under certain conditions of temperature and partial pressure of the reactants, the rate of formation of NH_3 is $0.001 kgh^{-1}$. The same rate of converison of hydrogen under the same condition is................kgh^{-1}.

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319. The rate expression for a reaction is $-\frac{dA}{dt} = \frac{\alpha A}{1 + \beta A}$, where α, β are constants and greather than zero.

Calculate $t_{1/2}$ for this reaction if initial concentration is $[A]_0$.

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Exercise 1

1. The following data represent for the decomposition of NH_4NO_2 in aqueous solution.

Time (in minutes), 10, 15, 20, 25, ∞

Volume of N_2 (in mL), 6.25, 9.0, 11.40, 13.65, 33.05,

(a) Show that reaction is of first order.

(b) Calculate velocity constant.

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2. Derive the order of reaction for decomposition of H_2O_2 from the following data.

Time (in minutes)	10	15	20	25	∞
Volume of O_2 given	6.30	8.95	11.40	13.5	35.75

by H_2O_2

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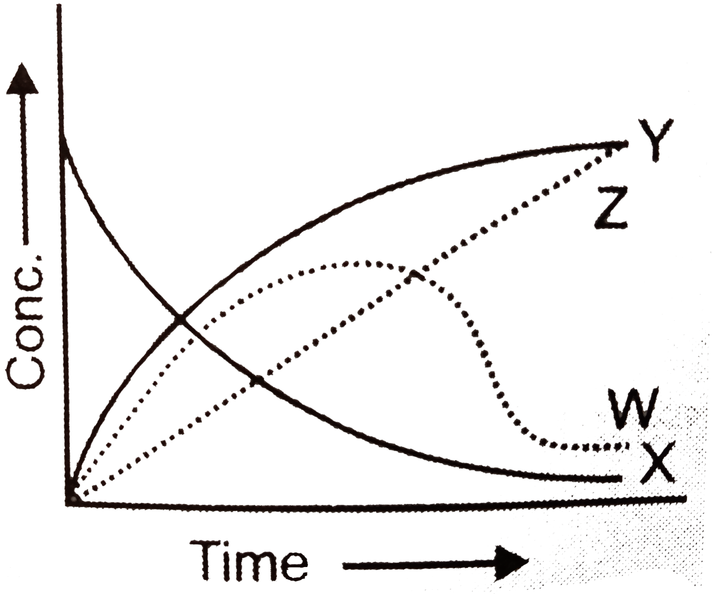
Exercise 3A

1. For the reaction, $A + B \rightarrow C + D$. The variation of the concentration of the products with time is given by the curve:



A. X

B. Y

C. Z

D. W

Answer: b

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2. In the above problem if concentration of reactant is less than $1M$ then:

A. $r_1 = r_2 = r_3$

B. $r_1 > r_2 > r_3$

C. $r_1 < r_2 < r_3$

D. All of these

Answer: b

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Exercise 3B

1. Rate constant for a reaction varies with temperature as, ln

$$K\left(\sec^{-1}\right) = 14.34 - \frac{1.25 \times 10^4}{T}$$

Which statement(s) is (are) correct?

A. (a) The graph plotted $\log_{10} k$ vs. $\frac{1}{T}$ is straight line with

$E_a = 24.83 kcal$

B. (b) Pre-exponential factor $= 13.34$

C. (c) The rate constant at $500K$ is $2.35 \times 10^{-5} \sec^{-1}$

D. (d) $E_a = 30.63 kcal$

Answer: a, b, c

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Exercise 7

1. A certain endothermic reaction: $A \rightarrow$ Product, $\Delta H = +ve$ proceeds in a sequence of three elementary steps with the rate constants K_1, K_2 and K_3 and each one having energy of activation E_a, E_2 and E_3 respectively at $25^\circ C$. The observed rate constant for the reaction is equal to $K_3\sqrt{\frac{K_1}{K_2}}$. A_1, A_2 and A_3 are Arrhenius parameters respectively.

For the reaction,

$H^{\cdot} + {}^{\cdot}CH_2CH_3 \xrightarrow{K} CH_3.CH_3$, a chain termination step of the reaction: $2C_2H_6 \rightarrow CH_2 = CH_2 + H_2$, the activation energy and Arrhenius parameter can be given as:

A. (a) $0, K$

B. (b) $0, E_a$

C. (c) $A, 1$

D. (d) $1, K$

Answer: a

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Exercise 8

1. Statement: Photosynthesis in plants involves reaction of CO_2 and H_2O in presence of light and chlorophyll.

Explanation: It is chlorophyll which absorbs light and possess this energy to reactant molecules.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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2. Statement: Fluresence is the emission of light by sucstances after absorbing light.

Explanation: It may continue for appreciable time after the exciting light is switched off.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: A

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3. Statement: The rate of reaction normally increases by a factor of 2 or 3 for evergy 10° rise in temperature.

Explanation: Increase in temperature increases the number of collisions.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: D

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4. Statement: The rate of a chemical reaction increases as the temperature is increased.

Explanation: The collision frequency between the reactant molecules increases on increasing the temperature.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: D

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5. Statement: In rate laws, unlike in the expression for equilibrium constants, the exponents for concentration do not necessarity match stoichiometric coefficients.

Explanation: It is the mechanism and not the balanced chemical equation for the overall change that governs the reaction rate.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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6. Statement: According 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.

Explanation: Energy of the the activated complex is higher than the energy of reactant molecules.

A. (a) S is correct but E is wrong

B. (b) S is wrong but E is correct

C. (c) Both S and E are correct and E is correct explanation of S

D. (d) Both S and E are correct but E is not correct explanation of S.

Answer: C

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Exercise 9

1. For the reaction $2NO_2 + F_2 \rightarrow 2NO_2F$, the experimental rate law is $r = K[NO_2][F_2]$. Propose the mechanism of reaction.

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2. The rate of decomposition for methyl nitrite and ethyl nitrite can be given in terms of rate constant $(\text{in} \sec^{-1}) K_1$ and K_2 respectively. The energy of activation for the two reaction are $152.30 kJ mol^{-1}$ and $157.7 kJ mol^{-1}$ as well as frequency factor are 10^{13} and 10^{14} respectively for the decomposition of methyl and ethyl nitrite. Calculate the temperature at which rate constant will be same for the two reactions.

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3. A given sample of milk turns sour at room temperature $(20^\circ C)$ in 64 hour. In a refrigerator at $3^\circ C$, milk can be stored three times as long before it sours. Estimate:

(a) The activation energy for souring of milk,

(b) How long it take milk to sour at $40^\circ C$?

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4. The catalytic decomposition of formic acid may take place in two ways:

(I) $HCOOH \rightarrow H_2O + CO$

(II) $HCOOH \rightarrow H_2 + CO_2$

The rate constant and activation energy for reaction

(I) are $2.79 \times 10^{-3} \min^{-1} at237^{\circ}C$ and $12.0kcalmol^{-1}$ respectively.

(II) are $1.52 \times 10^{-4} \min^{-1} at237^{\circ}C$ and $24.5kcalmol^{-1}$ respectively.

Find out the temperature at which equimolar quantities of H_2O, CO, CO_2 and H_2 are formed. $\left(R = 2calK^{-1}mol^{-1}\right)$

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5. A 22.4 litre flask contains $0.76mm$ of ozone at $25^{\circ}C$.

Calculate:

(i) the concentration of oxygen atoms needed so that the reaction $O + O_3 \rightarrow 2O_2$ having rate constant equal to $1.5 \times 10^7 litremol^{-1} \sec^{-1}$ can proceed with a rate of $0.15mollitre^{-1} \sec^{-1}$.

(ii) the rate of formation of oxygen under this condition.

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

$\left[Co(NH_3)_5F\right]^{2+} + H_2O \rightarrow \left[Co(NH_3)_5H_2O\right]^{3+} + F^-$ The rate of reaction

$= \text{rate constant} \times [\text{complex}]^n \times \left[H^+\right]^m = K[\text{complex}]^n\left[H^+\right]^m$. The reaction is acid catalyzed, i.e., $\left[H^+\right]$ does not change during the reaction.

Thus, rate $= K'[\text{complex}]^n$ where $K' = K\left[H^+\right]^m$

Calculate m and n if they are integers from the following data at $25^\circ C$.

$[\text{complete}]$ M	$[H^+]M$	$t_{1/2}(\text{hour})$	$t_{3/4}(\text{hour})$
0.1	0.01	1	2
0.2	0.02	0.5	1

$t_{3/4}$ is time required for three fourth completion of the reaction.

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7. The conversion of trypsinogen (A) into trypsin (B) is an autocatalytic reaction $A \rightarrow B$ where B catalyses the reaction. The rate equation is

$\frac{-dx}{dt} = K.x.y$, where x and y are concentration of tripsinogen at time t. Integrate this equation for initial concentration of x_0 and y_0 for A and B. show that

$$Kt = \frac{2.303}{x_0 + y_0}\log\frac{y.x_0}{x.y_0}$$

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8. Arsine decomposes on heating to give As and H_2. The decomposition studied at constant volume and temperature gives the following data.

T in hr.	0	5.5	6.5	8
P in atm.	0.9654	1.06	1.076	1.1

Calculate velocity constant, assuming first-order reaction.

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9. A vessel contains dimethyl ether at a pressure of $0.4 atm$. Dimethyl ether decomposes as

$$CH_3OCH_{3(g)} \rightarrow CH_{4(g)} + CO_{(g)} + H_{2(g)}$$

The rate constant of decomposition is $4.78 \times 10^{-3} \text{min}^{-1}$. Calculate the ratio of initial rate of diffusion to rate of diffusion after 4.5 hour of initiation of decomposition. Assume the composition of gas present and gas diffused to be same.

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10. Decomposition of H_2O_2 is a first-order reaction. A solution of H_2O_2 labelled as 20 volumes was left open. Due to this some H_2O_2 decomposed. To determine the new volume strength after 6 hours, $10mL$ of this solution was diluted to $100mL$. $10mL$ of this diluted solution was titrated against $25mL$of $0.025mKMnO_4$ acidified solution. Calculate the rate constant for decomposition of H_2O_2.

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11. In a certainreaction B^{n+} is getting converted to $B^{(n+4)+}$ in solution. The rate constant of this reaction is measured by titrating a volume of the solution with a ruducing agent which reacts only with B^{n+} and $B^{(n+4)+}$. In this process, it converts B^{n+} to $B^{(n-2)+}$ and $B^{(n+4)+}$ to

$B_{(n-1)+}$. At $t=0$, the volume of reacgent consumed is $25mL$ and $t=10$ min, the volume used is $32mL$. Calculate the rate constant of the conversion of B^{n+} to $B^{(n+4)+}$ assuming it to be a first-order reaction.

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12. For a reversible first-order reaction,

$$A \underset{K_2}{\overset{K_1}{\Longleftrightarrow}} B, K_f = 10^{-2}s^{-1} \text{ and } \frac{B_{eq.}}{A_{eq.}} = 4,$$

If $A_0 = 0.01ML^{-1}$ and $B_0 = 0$, what will be concentration of B after 30 sec?

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13. For a reversible reaction $C \Leftrightarrow D$, heat of reaction at constant volume is $-33.0kJmol^{-1}$, calculate:

(i) The equilibrium constant at $300K$.

(ii) If E_f and E_b are energy of activation for forward and backward reactions respectively, calculate E_f and E_b at $300K$. Given that

$E_f : E_b = 20 : 31$ Assumw pre exponential factor same for forward and backward reaction.

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