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## CHEMISTRY

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## Chemical Kinetics

Example

1. Total number of atoms, lons or molecules of
the reactants involved in the reaction is
termed as its $\qquad$
2. The rate at which a substance reacts depends on its
A. Molecular weight
B. Atomic weight
C. Active mass
D. Atomic number

Answer:
3. In __order reaction the rate of a reaction does not change with the concentration of the reactants.

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4. Increasing the temperature of an aqueous
solution will cause
A. Decrease in molarity

## B. Decrease In molality

C. Decrease in mole fraction
D. None of these

## Answer:

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5. The reaction which is blomolecular but order is one is called

## 6. The time required for $100 \%$ completion of a

## zero order reaction Is

A. 2 a
B. $a / k$
C. $k / 2$
D. $2 a / k$

Answer:

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7. Which of these does not Influence the rate of reaction
A. Nature of the reactant

## B. Temperature of the reactant

C. Concentration of the reactant
D. Molecularity of the reactant

## Answer:

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8. The fastest step in the reaction mechanism is called rate determining step". Check whether this statement is true or false?

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9. For the reaction $A+B \rightarrow C$, itls found that doubling the concentration of A Increases
the rate by 4 times, and doubling the concentration of $B$ doubles the reaction rate.

What is the overall order of the reaction?
A. 1
B. 3
C. 4
D. 0

Answer:

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10. In the Arrheniusequation,E represents
A. the energy below which colliding molecules will not react
B. the energy above which colliding molecules will react.
C. the total energy of the colliding molecules.
D. none of thes

## Answer:

11. Following graph is a plot of the rate of reaction concentration of the reactant. What is the order of the reaction.


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12. Following graph is a plot. of the rate of reaction VS concentration of the reactant What is the order of the reaction?


## Concentration

13. Order of the photochemical reaction occurlng between Hydrogen and Chlorine is
A. first order
B. zero order
C. second order

D. third second

## Answer:

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14. Observe the relationship between the first two terms and fill in the blanks. First order reaction : $s^{-1}$ Zero order reaction :

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15. Choose the correctly matched pair.
A. Unimolecular reaction

$$
\mathrm{NH}_{4} \mathrm{NO}_{2} \rightarrow \mathrm{~N}_{2}+2 \mathrm{H}_{2} \mathrm{O}
$$

B. Bimoiecular

$$
2 \mathrm{NO}(g)+\mathrm{O}_{2} \rightarrow 2 \mathrm{NO}_{2}(g)
$$

C. TrImolecular
reaction:
$2 \mathrm{HI}(g) \rightarrow \mathrm{H}_{2}(g)+I_{2}(g)$
D.

Answer:
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16. Identify the order of a reaction if the units of its rate constant is $\mathrm{L} \mathrm{mol}^{-1} \mathrm{~s}^{-1}$

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17. What Is the rate of disappearance of hydrogen in the reaction ? $3 \mathrm{H}_{2}+\mathrm{N}_{2} \rightarrow 2 \mathrm{NH}_{3}$

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18. The temperature dependence of is expressed by Arrhenius equation.

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19. The energy needed to form the intermediate called activated complex is known as

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20. The number of collisions per second per unit volume of the reaction mixture is called ____.

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21. Can we have reactions which proceed with constant rate?

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22. Instantaneous rate of reaction is preferred to average rate. Why?

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23. Identity the graph (A or B), represents the change in concentration of reactant with time.

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24. In a class room discussion a student argues that average rate and instantaneous
rate are same.Do you agree with this arguement? justify your answer.

## D Watch Video Solution

25. In a class room discussion a student argues that average rate and instantaneous rate are same.Justify your answer

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26. From the rate expression for the following reaction determine the order of reaction and dimensions of the rate constant. $3 \mathrm{NO}(g) \rightarrow \mathrm{N}_{2} \mathrm{O}(g)+\mathrm{NO}_{2}(g)$,Rate $=K[\mathrm{NO}]^{2}$.

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27. If half-life of a reaction is directly proportional to Initial concentration of the reactant, what Is the order of the reaction?
28. Give a relation which connects rate constant with temperature.

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29. For first order reaction half-life period Is

Independent of initial concentration and
Inversely proportional to the rate
constant.Give relation for the above In the
case of zero order reaction.
30. For first order reaction half-life period Is Independent of initial concentration and Inversely proportional to the rate constant.

The slope of the line in a graph of logK Vs $\frac{1}{T}$ for a reaction is -5841 . Calculate energy of activation for this reaction.
$\left[R=8.314 J K^{-1} \mathrm{~mol}^{-1}\right]$.

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31. A first order reaction is $20 \%$ complete in 10 min . Calculate the specific rate constant of the reaction.

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32. A first order reaction is $20 \%$ complete in ten minutes. Calculate time taken for the reaction to go upto $75 \%$ completion.
33. Mention the factors that affect the rate of a chemical reaction.

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34. The rate constant for a first order reaction
is $60(s)^{\wedge}(-1)$.How much time will it take to
reduce the initial concentration of the reactant to its ${ }^{`} 1 / 16$ th value?
35. From the rate expression for the following reactions determine the order of reaction and the dimensions of the rate constant.
$\mathrm{H}_{2} \mathrm{O}_{2(a q)}+3 \mathrm{I}_{a q}+2 \mathrm{H}^{+}{ }_{-}(a q) \rightarrow 2 \mathrm{H}_{2} \mathrm{O}_{R}+I_{3}$
Rate $=\mathrm{K}\left[\mathrm{H}_{-} 2 \mathrm{O} \_2\right]\left[I^{-}\right]$

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36. From the rate expression for the following
reactions determine the order of reaction and
the dimensions of the rate constant.
$C_{2} H_{5} C I_{(g)} \rightarrow C_{2} H_{2(g)}+H C I(g)$ Rate $=\mathrm{K}$ $\left[C_{2} H_{5} C I\right]$

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37. For a reaction, $A+H_{2} O \rightarrow B$, the rate law is rated [A]. What Is its molecularity and the order of reaction?

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38. $75 \%$ of a reaction of first order was completed in 64 minutes. When was its half completed?

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39. Rate of a reaction is the change in concentration of reactant or product per unit
time.what does the slope of the graph represent, variation In the concentration vs time for a zero order reaction?
40. For a reaction $A+B \rightarrow C+D$. The order with respect to $A$ is 1 and that of $B$ is 2 . Write the rate law expression for the reaction.

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41. For a reaction $A+B \rightarrow C+D$. The order with respect to $A$ is 1 and that of $B$ is 2 . How is the rate affected when the concentration of $B$ Is trippled?

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42. For a reaction $A+B \rightarrow C+D$. The order with respect to A is 1 and that of B is 2 .

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

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43. Study the following reaction.
$2 \mathrm{SO}_{2}(g)+O_{2(g) \rightarrow 2 S O_{3(g) \Delta H}}=-196.6 \mathrm{KJ}$ Here to get
more yield of $\mathrm{SO}_{3}$, a catalyst L Is used. Draw a graph which conveys the fact that activation energy of a catalysed reaction Is different from that of an uncatalysed reaction.

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44. An archaeological substance contained wood had only $66.66 \%$ of $C^{14}$ found in a tree.

Calculate the age of the sample if the half life of $C^{14}$ Is 5730 years.
45. Identify theorder of each of the following reaction.For a reaction $A \rightarrow B$, the rate constant has the same unit as the rate of the reaction.

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46. Identify theorder of each of the following reaction.For a reaction $X \rightarrow Y$, half-life of the reaction is independent of Initial concentration of X .
47. Identify the order of each of the following reaction. For a reaction $P \rightarrow Q$, the rate increases four times when the concentration of $P$ is doubled.

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48. Some statements related to kinetic are given below.The number of reactant molecules
whose concentration changes can determine the rate.

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49. Some statements related to kinetic are given below. The order of a reaction may be a fraction.

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50. Some statements related to kinetic are given below. In certain cases, the rate is independent of the concentration of the reactants illustrate and substantiate the above statements.

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51. The rate equation of the reaction , $x A+y B+2 C \rightarrow$ Products in given as Rate $=$
$\mathrm{K}[A]^{n}[B]^{m}$.Calculate the order of the reaction with respect to $\mathrm{A}, \mathrm{B}$ and C .

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52. The rate equation of the reaction , $x A+y B+2 C \rightarrow$ Products in given as Rate $=$ $\mathrm{K}[A]^{n}[B]^{m}$.Calculate the molecularity of the reaction.

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53. The rate equation of the reaction, $x A+y B+2 C \rightarrow$ Products in given as Rate $=$ $\mathrm{K}[A]^{n}[B]^{m}$.Calculate the overall order of the reaction.

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54. Decomposition of ammonia on metal
surface is a zero order reaction.Give the rate law of this reaction.
55. Decomposition of ammonia on metal surface is a zero order reaction. Plot rateconcentration graph for this reaction.

## D Watch Video Solution

56. Decomposition of ammonia on metal surface is a zero order reaction.Plot rateconcentration graph for this reaction.
57. The decomposition of $N_{2} O_{5}$ In $C C I_{4}$ solution has been studied by monitoring the concentration of $\mathrm{N}_{2} \mathrm{O}_{5}$ In the solution. Initially the concentration of $\mathrm{N}_{2} \mathrm{O}_{5}$ is 2.33 M and after

184 minutes, it Is reduced to 2.08 M . The reaction takes place according to the equation. $2 \mathrm{~N}_{2} \mathrm{O}_{5} \rightarrow 4 \mathrm{NO}_{2}+\mathrm{O}_{2}$ Calculate the average rate of this reaction.

## D Watch Video Solution

58. The decomposition of $N_{2} O_{5}$ In $C C I_{4}$ solution has been studied by monitoring the concentration of $\mathrm{N}_{2} \mathrm{O}_{5}$ In the solution. Initially the concentration of $\mathrm{N}_{2} \mathrm{O}_{5}$ is 2.33 M and after

184 minutes, it Is reduced to 2.08 M . The reaction takes place according to the equation. $2 \mathrm{~N}_{2} \mathrm{O}_{5} \rightarrow 4 \mathrm{NO}_{2}+\mathrm{O}_{2}$ What Is the rate of production $\mathrm{NO}_{2}$ during this period?

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59. Explain a pseudo order reaction with an example.

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60. Ammonia and Oxygen react at high temperature according to equation.
$4 \mathrm{NH}_{3}(\mathrm{~g})+5 \mathrm{O}_{2(\mathrm{~g})} \rightarrow 4 \mathrm{NO}(\mathrm{g})+6 \mathrm{H}_{2} \mathrm{O}(\mathrm{g})$
The rate of formation of $\mathrm{NO}=$
$4 \times 10^{-4} \mathrm{~mol} / \mathrm{L} / \mathrm{S}$. Calculate rate of
disappearance of $\mathrm{NH}_{3}$.
61. Ammonia and Oxygen react at high temperature according to equation.
$4 \mathrm{NH}_{3}(g)+5 \mathrm{O}_{2}(g) \rightarrow 4 \mathrm{NO}(g)+6 \mathrm{H}_{2} \mathrm{O}(g)$

The rate of formation of $\mathrm{NO}=$
$4 \times 10^{-4} \mathrm{~mol} / \mathrm{L} / \mathrm{S}$. Calculate rate of formation of water.

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62. Assign the order of the following reaction.
$H_{2(g)}+C I_{2(g) \vec{\hbar} 2 H C I G}$.

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63. Derive theintegratedrateequation for the

First order reaction and give the expression
for half-life of reaction.

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64. A reaction is second order with respect to
a reactant. How is the rate of reaction affected
if the concentration of the reactant Is reduced to half?

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65. Identify the reaction order If the rate constant Is $4 \times 10^{-5} \mathrm{Lmol}^{-1} \mathrm{sec}^{-1}$
66. For a reaction suppose the activation energy Is zero. What is the value of rate constant at 300 K ? If K is $1.6 \times 10^{8} S^{-1}$ at 280 $\mathrm{K}\left(R=8.314 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}\right.$.

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67. How will you differentiate between reaction
rate and rate constant?
68. Graphically represent the dependence of half-life, and Initial concentration of reactant for a zero order and first order reaction.

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69. Does molecularity has any meaning for a complex reaction? Explain
70. Can a reaction have zero activation energy?

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71. "Activation energies are low for fast reaction and high for slow reactions" a) Justify
the statement. b) The rate of a reaction quadruples when the temperature changes from 310 K to 330 K . Calculate the activation,

$$
R=8.314 J k^{-1}(\mathrm{~mol})^{-1}
$$

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72. "Activation energies are low for fast reaction and high for slow reactions" a) Justify
the statement. b) The rate of a reaction quadruples when the temperature changes from 310 K to 330 K . Calculate the activation, energy of the reaction
$R=8.314 J k^{-1}(\mathrm{~mol})^{-1}$
73. In a classroom discussion about order and moleculrity of a reaction,Ramu argued that "there are reactions which appear to be of higher order but actually follows first order kinetics"How far is his statement true? Give your opinion in this regard. Justify your answer using suitable example.

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74. In a class room discussion about order and molecularity of a chemical reaction, Ramu argued that "there are reactions which appear to be of higher order but actually follow first order kinetics.List out any three Important differences between order and molecularity.

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75. At a certain temperature, $\mathrm{T} K$ the endothermic reaction $A \rightarrow B$ proceeds
completely to the end. Determine sign of
$\Delta G(+$ or -$)$ for the reaction $B \rightarrow A$ at the temperature, T K.

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76. Enthalpy and Entropy changes of two reactions are given below: Find out whether they are spontaneous or not at $27^{\circ} C$. Justify.
a) $\Delta H=26 \mathrm{~kJ} / \mathrm{mole}, \Delta S=8.3 \mathrm{~J} / \mathrm{K} / \mathrm{mole}$
b) $\Delta H=-393.4 \mathrm{~kJ} / \mathrm{mole}, \Delta S=6 \mathrm{~J} / \mathrm{K} / \mathrm{mole}$

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

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78. A reaction is second order with respect to a reactant. How is the rate of reaction affected.
if the concentration of the reactant is doubled
79. A reaction is second order with respect to a
reactant. How is the rate of reaction affected if
the concentration of the reactant Is reduced to half?

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80. A reaction is first order in A and second
order in B.Write the differential rate equation
for the reaction.
81. A reaction is first order in A and second order in B. How isthe rate affected on increasing the concentration of $B$ three times?

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82. A reaction is first order in A and second
order in B.How is the rate affected when the concentration of both $A$ and $B$ is doubled?
83. Calculate the half-life of a first order reaction from their rate constants given below: i) $200(s)^{-1}$

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84. Calculate the half-life of a first order reaction from their rate constants given below. 2 min

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85. Calculate the half-life of a first order reaction from their rate constants given below.4years ${ }^{-1}$.

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86. For a first order reaction, show that time required for $99 \%$ completion is twice the time required for the completion of $90 \%$ of reaction.
87. The rate constant for the decomposition of hydrocarbons is $2.418 x 10^{-5}(s)^{-1}$ at $546(\sim K)$
. if the energy of activation is $179.9 \frac{\mathrm{~kJ}}{\mathrm{~mol}}$, what wilt be the value of pre-exponential factor:

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88. For a reaction $A+B \rightarrow C+D$, the rate equation is, Rate $=K[A]^{3 / 2}[B]^{1 / 2}$. Give the overall order and molecularity of reaction.
89. The temperature dependence of the rate of
a chemical reaction can be explained by Arrhenius equation.Give Arrhenius equation.

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90. The temperature dependence of the rate of a chemical reaction can be explained by

Arrhenius equation. The rate of a chemical reaction doubles for an increase of 10 K in absolute temperature from 300 K . Calculate
the activation energy(Ea)?
$\left.R=8.314 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, \log 2=0.3010\right]$.

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91. For the reaction, $2 N O_{(g)}+O_{2(g)} \rightarrow$
$2 \mathrm{NO}_{2(g)}$ the rate law is given as. Rate $=\mathrm{k}$
$[\mathrm{NO}]^{2}\left[\mathrm{O}_{2}\right]$ The order of the reaction with respect to $O_{2}$ is

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92. The rate constant of.a reaction at 293 K is
$1.7 \times 10^{5} s^{-1}$ When the temperature Is increased by 20.K, the rate constant is increased to $2.57 \times 10^{5} s^{-1}$. Calculate Ea and

A of the reaction.

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93. Identify the order of reaction if the unit of rate constant is $m o l L^{-1} S^{-1}$.
94. Plot a graph showing variation in the concentration of reactants against time for a zero order reaction.

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95. What do you mean by zero order of a reaction?
96. The initial concentration of the first order reaction, $\mathrm{N}_{2} \mathrm{O}_{5(g)} \rightarrow 2 \mathrm{NO}_{2(g)}+\frac{1}{2} \mathrm{O}_{2(g)}$ was $1.24 \times 10^{-2} \mathrm{molL} L^{-1}$. The concentration of N2O5 after ' 1 ' hour was $0.20 \times 10-2 \mathrm{~mol} \mathrm{~L}-1$ Calculate the rate constant of the reaction at 300 K.

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97. The molecularity of reaction
$2 \mathrm{NO}+\mathrm{O}_{2} \rightarrow 2 \mathrm{NO}_{2}$ is
A. 5
B. 2
C. 3
D. 0

## Answer:

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## 98. What do you mean by rate of a reaction?

99. What will be the effect of temperature on a rate of a reaction?

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100. A first order reaction is found to have a
rate constant, $k=5.5 \times 10^{-4} s^{-1}$. Find out
the half-life of the reaction.

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101. The term order and molecularity are common in chemical kinetics. What do you mean by order and molecularity?

## D Watch Video Solution

102. The term order and molecularity are common in chemical kinetics. Write two factor influencing rate of a reaction
103. The term order and molecularity are common in chemical kinetics. Write Arrhenius equation.

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104. Consider a general reaction
$a A+b B \rightarrow c C+d D$

The rate expression for the reaction is Rate $=$ $k[A]^{x}[B]^{y}$.Establish the significance of (a+b) and $(x+y)$ term in terms of order and molecularity.

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105. Consider a general reaction
$a A+b B \rightarrow c C+d D$

The rate expression for the reaction is Rate $=$
$k[A]^{x}[B]^{y}$.Write any two differences between order and molecularity.

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106. 'Reaction with zero order is possible but zero molecularity is not".Justify the statement.

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107. For a general reaction $A+B \rightarrow$

Products, rate law Is given as rate $=K[A][B]^{2}$
What is rate law?

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108. For a general reaction $A+B \rightarrow$

Products, rate law Is given as rate $=K[A][B]^{2}$.

What Is the unit of rate constant for the above reaction?

## D Watch Video Solution

109. For a general reaction $A+B \rightarrow$

Products, rate law Is given as rate $=K[A][B]^{2}$
.Give any 2 differencesbetween order and molecularity of a reaction.
110. Zero order reaction means that the rate of a reaction is independent of the concentration of reactants. Write an example for a zero order reaction.
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111. Zero order reaction means that the rate of a reaction is independent of the concentration
of reactants. Write the integral rate expression for the zero order reaction, $R \rightarrow P$

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112. The rate constant of a reaction is
$1.2 \times 10^{-5} s^{-1}$.The order of the reaction is ______-

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113. Radioactive decay is a

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114. Consider the composition reaction given below. $2 \mathrm{HI}(g) \rightarrow \mathrm{H}_{2}(g)+I_{2}(g)$.The rate of appearatance of hydrogen is equal to times the rate of disappearance of HI .

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115. Consider the decomposition reaction given below. $2 \mathrm{HI}(g) \rightarrow \mathrm{H}_{2}(g)+I_{2}(g)$. Write
the differential rate expression of this reaction with respect of the reactant.

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

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117. Rate of a reaction is the change in concentration of any one of the reactants or any one of the products in unit tim.Express the rate of the following reaction in terms of reactants and products
$2 \mathrm{NO}(g)+\mathrm{O}_{2(G)} \rightarrow 2 \mathrm{NO}_{2(G)}$

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118. Rate of a reaction is the change in concentration of any one of the reactant or
any one of the products in unit time.
$\mathrm{N}_{2} \mathrm{O}_{5(g) \rightarrow 2 \mathrm{NO}\left(2(g)+\mathrm{O}_{2(g)}\right.}$ is a first order recation find the unit of $K$.

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119. By deriving the equation for $t_{1 / 2}$ of first order reaction. Prove that $t_{1 / 2}$ is independent of initial concentration of its reacting spectes.

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120. The conversion of molecule $A$ to $B$ follows
second order kinetics its rate equation for the
second order reaction is rate $={ }^{`} K[A]^{\wedge} 2$.If the
concentration of $A$ is increased to 4 times how
will it affect the formation of $B$.

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121. The conversion of molecule $A$ to $B$ follows second order kinetics. Indicate the order and
molecularity of the reaction given below:

$$
\mathrm{C}_{12} \mathrm{H}_{22} \mathrm{O}_{11}+\mathrm{H}_{2} \mathrm{O} \xrightarrow{H} \mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}+\mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}
$$

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