CHEMISTRY

BOOKS - OMEGA PUBLICATION

CHEMICAL KINETICS

Questions

1. What will be the wavelength of a particle of mass 0.5 kg moving with a velocity of 10ms-1

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2. What are extermaely slow reactions ? Give an example.

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3. What are extremely fast reactions ? Give an example:

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4. What are instantaneous reactions ? Give an example.

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5. Define average rate of a reaction.

6. What is the unit of rate of reaction ?

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

8. A chemical reaction $2A \rightarrow 4B + C$ in gas phase takes place in closed vessel. The concentration of B is found to

increase by $5 \times 10^{-3} molL^{-1}$ in 10 seconds. Calculate:

A. a) the rate of appearance of B

B. b) the rate of disappearance of A

C.

D.

Answer:

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9. The reaction $2N_2O_5(g) \rightarrow NO_2(g) + O_2(g)$ takes place in a closed contaner. It is found that the concentration of NO_2 increases by $1.6 \times 10^{-2} molL^{-1}$

in four seconds . Calculate the rate of change of concentration of N_2O_5.

10. The following results have been obtained during the kinetic studies of the reaction: 2A + B rarr C + D

Experiment	[A]/mol L^{-1}	[B]/mol L^{-1}	Initial rate of formation of D/mol L^{-1} min^{-1}
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

Determine the rate law and the rate constant for the reaction.

11. The reaction $2N_2O_5(g) \rightarrow NO_2(g) + O_2(g)$ takes place in a closed contaner. It is found that the concentration of NO_2 increases by $1.6 \times 10^{-2} molL^{-1}$ in four seconds . Calculate the rate of change of concentration of N_2O_5.

12. For the reaction $:N_2 + 3H_2 \rightarrow 2NH_3$ The rate of reaction measured as $\dfrac{\Delta[NH_3]}{\Delta t}$ we found to be $2 \times 10^{-4} molL^{-1} sec^{-1}$. Calculate the rate of reaction expressed in terms of N_2.

13. The decomposition of NH3 on platinum surface is zero order reaction. What are the rates of production of N_2 and H_2 if $k = 2.5 \times 10^{-4} mol L^{-1} s^{-1}$?

14. For the reaction: $2A + B \rightarrow A2B$ the $rate = k[A][B]^2$ with $k = 2.0 \times 10^{-6} mol^{-2} L^2 s^{-1}$. Calculate the initial rate of the reaction when $[A] = 0.1 mol L^{-1}$, $[B] = 0.2 mol L^{-1}$. Calculate the rate of reaction after [A] is reduced to $0.06 mol L^{-1}$.

15. The rate of a reaction $2A + B \rightarrow A_2B$.

has rate law : rate = k $[A]^2$ with the rate constant equal to

0.50 mol^{-1} $L\sec^{-1}$. Calculate the rate of reaction when

(i) [A] = 0.60 mol L^{-1}, [B] =-0.05 mol L^{-1} and

(ii) When concentration of A and B have been reduced to

1/4 th

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16. Write two three difference between average rate of

reaction and instantaneous rate of reaction

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17. Discuss the various factors affecting the rates of chemical reactions.

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

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19. What is rate law ? Explain with an example.

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20. Discuss briefly the effect of concentration on the rate of a reaction.

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21. Why rate of reaction does not remain constant throughout ?

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22. Define decay constant.

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23. Give four characteristics of rate constant.

24. What is the difference between instantaneous rate of a reaction and rate constant?

25. What is order of reaction ? Explain.

26. For a reaction, $A + B \rightarrow$ Product, the rate law is given by, r = k [A]^(1/2) [B]^2. What is the order of the reaction?

27. What are zero order reactions ? Give example.

28. What are the first order reactions ? Give example.

29. Write an example of second order reaction.

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30. Given the unit of firt order rate constant.

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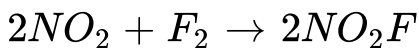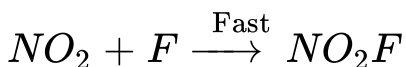**31.** Given the unit of second order rate constant
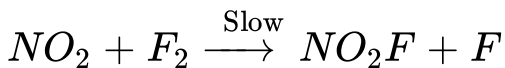
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32. The unit of 1st order rate constant are

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33. The unit of 1st order rate constant are

34. Reaction between NO_2 and F_2 to give NO_2F takes place by the following mechanism

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

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

$$2NO_2 + F_2 \rightarrow 2NO_2F$$
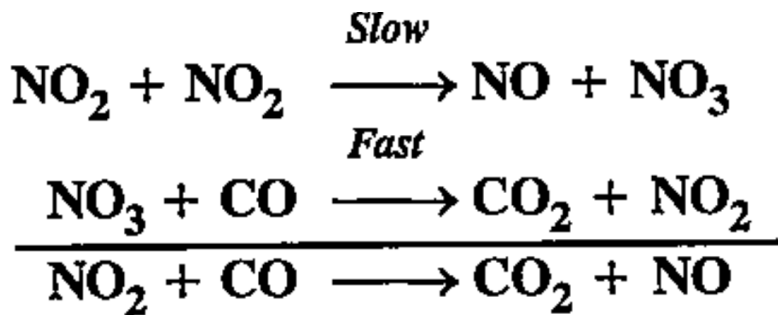
write order of reaction.

35. Reaction between NO_2 and CO to give CO_2 and NO takes place by the following mechanism:

Write the rate expression and order of the reaction. What is the unit of rate constant ?

$$NO_2 + NO_2 \xrightarrow{\text{Slow}} NO + NO_3$$

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

36. 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

37. 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 ?

38. A reaction is first order in A and second order in B. Write the differential rate equation.

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

How is the rate affected on increasing the concentration

of B three times ?

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

How is the rate affected when the concentrations of both

A and B are doubled?

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41. Can overall energy of a body be negative?

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42. Define molecularity of a reaction.

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43. Distinguish between order and the molecularity of a reaction.

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44. What are elementary reactions ? Give an example.

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45. What is meant by an elementry reaction ?

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46. What are Kolbe's Reaction ? Give one example.
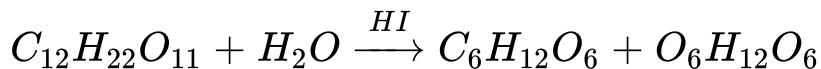
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47. Which is the rate determining step of a reaction ?

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48. Define order of a reaction

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49. For the reaction :

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{HI} C_6H_{12}O_6 + O_6H_{12}O_6$$

Write : (a) Rate of reaction expression.

(b) Molecularity of reaction

(c) Order of reaction

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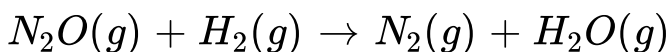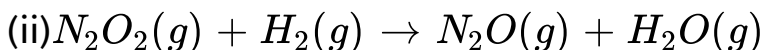**50.** Unit of rate constant for zero order reaction is

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51. for the reaction
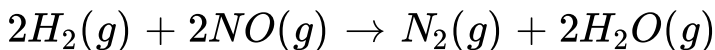
$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$

the proposed mechanism is as followed < br> (i) `2NO(g)

(ii) $N_2O_2(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$
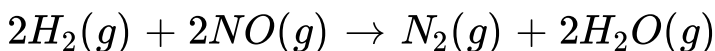
$N_2O(g) + H_2(g) \rightarrow N_2(g) + H_2O(g)$

If the second step is the rate determining step then What is the rate law for the reaction?

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52. for the reaction
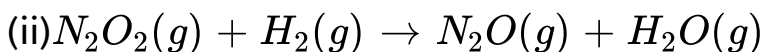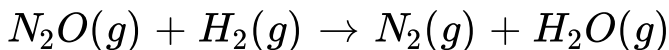
$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$

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$$N_2O(g) + H_2(g) \rightarrow N_2(g) + H_2O(g)$$

If the second step is the rate determining step then What is the rate law for the reaction?

53. for the reaction

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

the proposed mechanism is as followed < br> (i) `2NO(g)

(ii) $N_2O_2(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$

$$N_2O(g) + H_2(g) \rightarrow N_2(g) + H_2O(g)$$
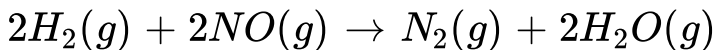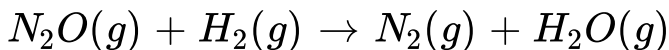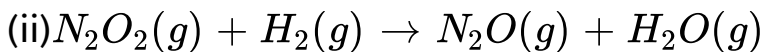
If the second step is the rate determining step then What is the rate law for the reaction?

54. For the reaction

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

the proposed mechanism is as followed

(i) `2NO(g) (ii)$N_2O_2(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$

$$N_2O(g) + H_2(g) \rightarrow N_2(g) + H_2O(g)$$
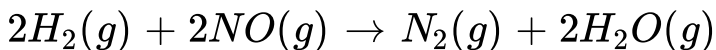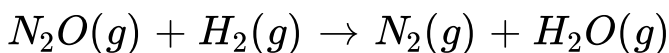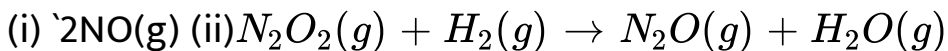
If the second step is the rate determining step then what

Is the molecularity of the reaction

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55. Name two hypnotic drugs?

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56. Name two non-addictive neurological active analgesics?

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57. Define zero order reaction. Derive integrated rate equation for rate constant of a zero order reaction.

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58. Define zero order reaction. Derive integrated rate equation for rate constant of a zero order reaction.

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59. Derive the integrated rate law equation for 1st order reaction and write its one use.

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

Write the differential rate equation.

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

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

62. A reaction is first order in A and second order in B. How is the rate affected when the concentrations of both A and B are doubled?

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63. First order reacton ha specific rate of $10^{-3}s^{-1}$. How much time will it take for 10 g of the reactant to reduce to 5 g ?

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

65. Show that the time required for 99% completion of a first order reaction In twice the time required for the completion of 90%.

66. Show that for a first order reaction, the time taken to complete half of the change is Independent of the initial concentration of the reactant.

67. Define half life period. Derive expression for half life period for 1st oder reaction.

68. A first order reaction takes 40 min for 30% completion. Calculate $t_{\frac{1}{2}}$.

69. The half-life for radioactive decay of $.^{14}C$ is 5730 years. An archaeological artifact contented wood that has

only 80% of the $.^{14}C$ found in living tree. Estimate the age of the sample.

70. The reaction $A(g) \rightarrow B(g) + 2C(g)$ is a first order reaction with rate constant $2.772 \times 10^{-3}s^{-1}$, Starting with 0.1 mole of A in 2 litre vessel, find the concentration of A after 250 sec when the reaction is allowed to take place at constant pressure and at 300 K?

a) $0.0125M$

b) $0.025M$

c) $0.05M$

d) none of these

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

72. A first order reaction has a rate constant vlaue $10^{-3} s^{-1}$. How much time will it take for 10 g of the reactant of reduce to $2.5g$.

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

the reaction.

74. Give relationship between half life period and concentration for different order of reactions.

75. A first order reaction is 40% complete in 50 minutes. In what time will the reaction be 80% compelete ?

76. Rate constant for a first order reaction is $60s^{-1}$. How much time will it take to reduce the concentration of the reaction on $\dfrac{1}{10}$ th of its initial value.

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77. The rate constant for a first order reaction is 60 s^(-1). How much time will it take to reduce the initial concentration of the reactant to its l/16^(th) value?

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78. Calculate the half-life of a first order reaction from its rate constant which is

$200\ S^{-1}$

79. Calculate the half-life of a first order reaction from their rate constants given below: $2\ \text{min}^{-1}$

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

81. Calculate rate constant for the first order reaction, whose half-life period is 4.6 s.

82. 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

83. For a reaction, $A + B \rightarrow$ Product, the rate law is given by, r = k [A]^(1/2) [B]^2. What is the order of the reaction?

84. A first order reaction takes 23.1 minutes for 50% conmpletion. Calculate the time required for 75% completion of this reaction $(\log 2 = 0.301), (\log 3 = 0.4771)(\log 4 = 0.6021)$

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

86. One fourth of a first order reaction is completed in 32 minutes. What is the half life period of the reaction ?

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87. A first order reaction is 50% complete in 69.3 minutes. Calculate the time for 80% completion of the reaction.

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88. A first order reaction is 15% complete in 20 minutes. How long will it take to complete 60%?

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89. What are pseudochemical reactions ? Give an example.

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90. What is temperature coefficient of resistance of the material of conductor ?

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91. Why paracetamol is preferred over aspirin?

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92. Name two Addictive neurological active analgesics?

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93. What Is activated complex ?

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94. What are haloalkanes? Give examples

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95. Derive the following relation

$$: \log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[\frac{T_2 - T_1}{T_1 T_2} \right]$$

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96. What are Alkenyl Halides? give examples?

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97. what is activated complex ?

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98. The rate of reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reacton assuming that it does not change with temperature. $\left[R = 8.314 JK^{-1}mol^{-1}, \log 4 = 0.6021\right]$

99. The rate constant of a first order reaction increases from $4 \times 10^{-2} \rightarrow 8 \times 10^{-2}$ when the temperatur changes from $27°C$ to $37°C$. Calculate the energy of activation

$(Ea). \log 2 = 0.301), \log 3 = 0.4771, \log 4 = 0.6021$

100. The rate constant of a reaction increases four times when the temperature changes from 300 K to 320 K, Calculate the activation energy for the reaction.

$$\left(R = 8.314 Jmol^{-1}K^{-1}\right)$$

101. Define activation energy of a reaction.

102. The rate of particular reaction doubles when temperature changes from $27°C$ to $37°C$. Calculate the

energy of activation of such a reaction.

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103. How is rate constant of a reaction related to its activation energy?

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104. Draw a schematic graph showing rate constant changes with change in temperature.

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105. Discuss the effect of catalyst on the activation energy.

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106. What is effective collision ?

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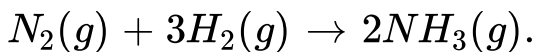**107.** What is collision frequency?

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108. write the relation between rate of reaction and collision frequency.

Multiple Choice Questions Mcq S

1. Consider 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 derivative of concentration of $N_2(g), H_2(g)$ or $NH_3(g)$. Identify the correct relationship amongest the rate expression.

A. Rate

$$= -d[N_2]/dt = -1/3d[H_2]/dt = 1/2d[NH_3]/dt$$

B. Rate

$$= -d[N_2]/dt = -3d[H_2]/dt = 2d[NH_3]/dt$$

C. Rate

$$= d\frac{N_2}{d}/t = 1/3d[H_2]/dt = 1/2d[NH_3]/dt$$

D. Rate

$$= -d[N_2]/dt = -d[H_2]/dt = d[NH_3]/dt$$

Answer:

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2. For a reaction involving solid, decreasing which given below will increase the rate of reaction?

A. Particle size

B. Concentration

C. Temperature

D. Pressure

Answer:

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3. Rate of first order reaction depends upon

A. time

B. concentration of reaction

C. temperature

D. all the three.

Answer:

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4. Under a given set of experimental conditions, with increase of concentration of the reactants, the rate of a chemical reaction

A. decreases

B. increases

C. first decreases

D. none of these.

Answer:

5. Rate at which a substance reacts depends upon its

A. Atomic weight

B. Equivalent weight

C. Molecular weight

D. Active Mass

Answer:

6. $RCOOR' + NaOH \rightarrow RCOONa + R'OH$. What type of reaction is this ?

    A. 2nd order

    B. unimolecular

    C. pesudo unimolecular

    D. 2nd order

Answer:

7. Units of rate constant for the first and zero order reactions in terms of molarity, M units are respectively

A. $\sec^{-1}, M \sec^{-1}$

B. $\sec^{-1}, M$

C. $M \sec^{-1}, \sec^{-1}$

D. $M, \sec^{-1}$

Answer:

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8. Units of specific reaction rate for 2nd order reaction is

A. $\sec^{-1}$

B. $mol L^{-1} \sec^{-1}$

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

D. $Lmol^{-1} \sec^{-1}$

Answer:

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9. The units of rate constant for first order equation.

A. s^{-1}

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

C. $mol s^{-1}$

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

Answer:

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10. The hydrolysis of ester in alkaline medium is a

A. 1st order reaction with molecularity 1

B. 2nd order reaction with molecularity 2

C. 1st order reaction with molecularity 2

D. 2nd order reaction with molecularity 1

Answer:

11. Given the unit of second order rate constant

    A. $mol \, liter \, sec^{-1}$

    B. $mol^{-1} litre^{-1} sec^{-1}$

    C. $mol \, litre^{-1} sec^{-1}$

    D. $mol^{-1} litre \, sec^{-1}$

Answer:

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12. The half life period of a zero order reaction is independent of initial concentration

A. temperature of the reaction

B. the concentration of the reactants

C. the concentration of the products

D. the material of the vessel in which the reaction is

carried out.

Answer:

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

A. Claisen-Clapeyron equation

B. Arrhenius equation

C. Gibbs-Helmholtz equation

D. Kirchoff's equation

Answer:

14. The activation energy of reaction is equal to

A. Threshold energy for the reaction

B. Threshold energy + Energy of the reactants

C. Threshold energy - Energy of the reactants

D. Threshold energy + Energy of the products.

Answer:

15. The activation energy of a reaction can be determined by

    A. changing the concentration of reactants

    B. evaluating rate constant at two standard temperatures

    C. evaluating rate constant at two different temperatures

    D. by doubling concentration of reactants

Answer:

16. The wavelength of first spectral line in the balmer series is 6561 angstrom. Calculate the wavelength of second spectral line in balmer series.

17. The substance that increases the speed of a chemical reactions is called

    A. inhibitor

    B. promotor

    C. moderator

    D. catalyst.

Answer:

18. The reaction rate is found to depend upon two concentration terms. The order of the reaction is

A. 1

B. 2

C. 3

D. 0

Answer:

19. For which of the following , the units of r constant and rate of the reaction are same

    A. First order reaction

    B. Second order reaction

    C. Third order reaction

    D. Zero order reaction

Answer:

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20. A zero order reaction is one whose rate independent of

A. temperature of the reaction

B. presence of light

C. concentration of the reactants

D. the material of the vessel in which t reaction is carried out.

Answer:

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21. Calculate the wavelength of spectral line in lyman series corresponding to n2 = 3.

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22. For the hypothetical reaction

$A \rightarrow Products$, rate = - k [A]
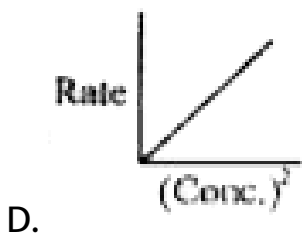
The negative sign used in the rate expression indicate that
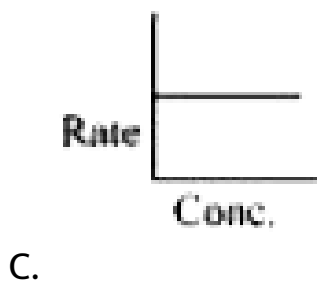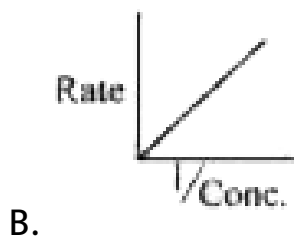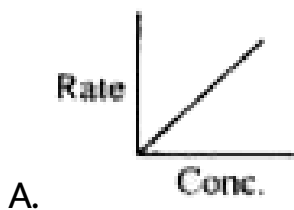
    A. The rate of reaction increases with time

    B. The concentration of reactants decrease wil time

    C. There are repulsive forces between reactants

    D. The reaction is reversible.

Answer:

23. Which of the following graphs corresponds to first order reaction:

A.

Rate

Conc.

B.

Rate

1/Conc.

C.

Rate

Conc.

D.

Rate

(Conc.)²

Answer:

24. Arrhenius equation is

A. $K = -Ae^{-Ea/RT}$

B. $K = Ae^{-Ea/RT}$

C. $K = e^{-Ea/RT}$

D. $K = Ae^{Ea/RT}$

Answer:

25. The chemical reactions in which the reactants require high amount of activation energy are generally

A. Slow

B. Fast

C. Instantaneous

D. None of these

Answer:

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26. Which of the following does not influence the reaction rate?

A. Nature of reactants

B. Conc. of reactants

C. Temperature of the reaction

D. Molecularity of the reaction

Answer:

27. A reaction was found to be of second order with respect to concentration of carbon monoxide . If the concentration of carbon monoxide is doubled, the rate of reaction will :

A. triple

B. increase by a factor of 4

C. double

D. remain unchanged

Answer:

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28. For a reaction involving solid, decreasing which given below will increase the rate of reaction?

A. Particle size

B. Concentration

C. Temperature

D. Pressure

Answer:

29. Rate of first order reaction depends upon

A. time

B. concentration of reactant

C. temperature

D. All the three

Answer:

30. Under a given set of experimental conditions, with increase of concentration of the reactants, the rate of a chemical reaction

    A. decreases

    B. increases

    C. remains unaffected

    D. first decreases

Answer:

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31. Units of specific reaction rate for 2nd order reaction is

A. $\sec^{-1}$

B. $mol L^{-1} \sec^{-1}$

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

D. $L mol^{-1} \sec^{-1}$

Answer:

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32. The hydrolysis of ester in alkaline medium is a

A. 1st order reaction with molecularity 1

B. 2nd order reaction with molecularity 2

C. 1st order reaction with molecularity 2

D. 2nd order reaction with molecularity 1

Answer:

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33. The second order rate constant is usually expressed

A. mol litre $\sec^{-1}$

B. mol^{-1} liter $\sec^{-1}$

C. mol litre^{-1} $\sec^{-1}$

D. mol^{-1} litre $\sec^{-1}$

Answer:

34. A zero order reaction is one whose rate independent of

A. temperature of the reaction

B. the concentration of the reactants

C. the concentration of the products

D. the material of the vessel in which the reaction is

carried out.

Answer:

35. Rate constant of a reaction depends upon:

A. temperature

B. initial concentration of the reactants

C. time of reaction

D. extent of reaction.

Answer:

36. The unit of 1st order rate constant are

A. $conc.time^{-1}$

B. $time\ comc.^{-1}$

C. $time^{-1}$

D. $time^{-1}conc.^{-1}$

Answer:

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