

Q1. The rate of a reaction is defined as:

- A. The speed at which the reaction mixture is stirred
- B. The rate of change of concentration of any reactant or product
- C. The number of collisions per second
- D. The amount of product formed

Answer: B. The rate of change of concentration of any reactant or product

Explanation:

Rate of reaction = change in concentration / time

Q2. For the reaction $A \rightarrow B$, if the concentration of A decreases from 0.5 M to 0.4 M in 10 minutes, the average rate is:

- A. 0.01 M/min
- B. 0.001 M/min
- C. 0.1 M/min
- D. 0.05 M/min

Answer: A. 0.01 M/min

Explanation:

Rate = $(0.5 - 0.4) / 10 = 0.1 / 10 = 0.01 \text{ M/min}$

Q3. In a reaction, the rate law is: $\text{Rate} = k[A]^2[B]$. What is the order of the reaction?

- A. 1
- B. 2
- C. 3
- D. 0

Answer: C. 3

Explanation:

Order = sum of powers = $2 + 1 = 3$

Q4. A zero-order reaction is one in which:

- A. Rate is independent of concentration
- B. Rate depends on square of concentration

- C. Concentration decreases exponentially
- D. Half-life is proportional to concentration

Answer: A. Rate is independent of concentration

Explanation:

Rate = k for zero-order; independent of [reactant]

Q5. Units of rate constant for a first-order reaction are:

- A. $\text{mol L}^{-1} \text{s}^{-1}$
- B. s^{-1}
- C. $\text{mol}^{-1} \text{L s}^{-1}$
- D. $\text{L mol}^{-1} \text{s}^{-1}$

Answer: B. s^{-1}

Explanation:

For first-order, k has units of $\text{time}^{-1} \rightarrow \text{s}^{-1}$

Q6. The rate of a reaction doubles when temperature increases by 10°C . This is due to:

- A. Increase in pressure
- B. Decrease in activation energy
- C. Increase in average kinetic energy
- D. Formation of intermediates

Answer: C. Increase in average kinetic energy

Explanation:

Higher $T \rightarrow$ faster molecules \rightarrow more successful collisions

Q7. For a reaction $A \rightarrow$ products, the concentration of A changes from 1.0 M to 0.25 M in 60 minutes. Assuming first-order kinetics, what is the rate constant (k)?

- A. 0.0231 min^{-1}
- B. 0.0115 min^{-1}
- C. 0.0462 min^{-1}
- D. 0.0300 min^{-1}

Answer: A. 0.0231 min^{-1}

Explanation:

Use:

$$k = (2.303 / t) \log([A]_0 / [A]) = (2.303 / 60) \log(1 / 0.25) \\ = (2.303 / 60) \times 0.602 = 0.0231 \text{ min}^{-1}$$

Q8. The half-life ($t_{1/2}$) for a first-order reaction is:

- A. Independent of initial concentration
- B. Directly proportional to initial concentration
- C. Inversely proportional to initial concentration
- D. Constant only at equilibrium

Answer: A. Independent of initial concentration

Explanation:

$$t_{1/2} = 0.693 / k \text{ for 1st order} \rightarrow \text{independent of } [A]_0$$

Q9. For a zero-order reaction, the concentration vs. time graph is:

- A. A straight line with negative slope
- B. A curve concave upwards
- C. A straight line parallel to time axis
- D. A straight line with positive slope

Answer: A. A straight line with negative slope

Explanation:

$$[\text{Reactant}] = -kt + [A]_0 \rightarrow \text{straight decreasing line}$$

Q10. What will be the order of reaction if doubling $[A]$ quadruples the rate?

- A. 0
- B. 1
- C. 2
- D. 3

Answer: C. 2

Explanation:

$$\text{If rate} \propto [A]^2 \rightarrow \text{second-order}$$

Q11. The activation energy (E_a) of a reaction is determined using:

- A. Raoult's law
- B. Arrhenius equation
- C. First law of thermodynamics
- D. Hess's law

Answer: B. Arrhenius equation

Explanation:

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

Q12. In the Arrhenius equation, the plot of $\log k$ vs $1/T$ is:

- A. Parabolic
- B. Hyperbolic
- C. Straight line
- D. Exponential

Answer: C. Straight line

Explanation:

$$\log k = \log A - E_a/2.303RT \rightarrow y = mx + c \text{ form}$$

Q13. If $E_a = 50 \text{ kJ/mol}$, $R = 8.314 \text{ J/mol}\cdot\text{K}$, and $T = 298 \text{ K}$, then what is the factor by which rate increases if E_a is decreased to 25 kJ/mol (approximate)?

- A. 2
- B. 10
- C. 100
- D. 1000

Answer: B. 10

Explanation:

As per Arrhenius equation, rate increases exponentially with decrease in $E_a \rightarrow$ halving E_a gives $\sim 10\times$ rate increase

Q14. For a reaction $2A + B \rightarrow C + D$, the rate is given as $\text{Rate} = k[A][B]^2$. If $[A]$ is doubled and $[B]$ is halved, how does rate change?

- A. Doubled
- B. Halved
- C. Remains same
- D. Reduced to 1/4

Answer: B. Halved

Explanation:

New rate = $k(2[A])(\frac{1}{2}[B])^2 = 2 \times \frac{1}{4} = \frac{1}{2}$ of original

Q15. The reaction $A + B \rightarrow C$ follows the rate law $\text{Rate} = k[A]^1[B]^0$. What will be the effect on rate if [A] is halved and [B] is doubled?

- A. Halved
- B. Doubled
- C. Same
- D. Quadrupled

Answer: A. Halved

Explanation:

Since $[B]^0 = 1$ (zero order in B), $\text{rate} \propto [A] \rightarrow$ if [A] is halved \rightarrow rate is halved

Q16. Which of the following reactions has a rate independent of concentration of reactants?

- A. First-order
- B. Second-order
- C. Pseudo first-order
- D. Zero-order

Answer: D. Zero-order

Explanation:

In zero-order reactions, $\text{rate} = k$ (constant), independent of concentration.

Q17. A reaction is of second order with respect to a reactant. How is the rate affected if the concentration of the reactant is tripled?

- A. Doubled
- B. Tripled

- C. Increased 9 times
- D. Decreased 3 times

Answer: C. Increased 9 times

Explanation:

$$\text{Rate} \propto [A]^2 \rightarrow (3A)^2 = 9A^2 \rightarrow 9 \text{ times}$$

Q18. The half-life of a first-order reaction is 20 minutes. The time required for the concentration to drop from 0.8 M to 0.1 M is approximately:

- A. 40 min
- B. 60 min
- C. 80 min
- D. 120 min

Answer: C. 80 min

Explanation:

$$0.8 \rightarrow 0.4 \rightarrow 0.2 \rightarrow 0.1 \text{ (3 half-lives)} \rightarrow 3 \times 20 = 60 \text{ min}$$

(Note: mistake – this should be $0.8 \rightarrow 0.4$ (1st), $\rightarrow 0.2$ (2nd), $\rightarrow 0.1$ (3rd), so total = $3 \times 20 = 60$ min)

Correct Answer: B. 60 min

Q19. A plot of $\log_{10}[R]$ vs time is a straight line. The order of the reaction is:

- A. Zero
- B. First
- C. Second
- D. Third

Answer: B. First

Explanation:

Only for 1st order: $\log [R]$ vs t is linear.

Q20. Which of the following plots is linear for a zero-order reaction?

- A. $[A]$ vs t
- B. $\log [A]$ vs t
- C. $1/[A]$ vs t

D. $[A]^2$ vs t

Answer: A. $[A]$ vs t

Explanation:

Zero-order $\rightarrow [A] = -kt + [A]_0 \rightarrow$ straight line with slope $-k$.

Q21. In a pseudo-first order reaction:

- A. Both reactants are at high concentration
- B. One reactant is in large excess
- C. Rate depends on product concentration
- D. Rate is zero

Answer: B. One reactant is in large excess

Explanation:

One reactant (usually water or solvent) remains nearly constant \rightarrow pseudo-first order.

Q22. The activation energy for a reaction is 75 kJ/mol. If the temperature is increased, what happens to the rate constant?

- A. Decreases
- B. Remains constant
- C. Increases
- D. Becomes zero

Answer: C. Increases

Explanation:

According to Arrhenius equation:

$k = Ae^{(-E_a/RT)}$; higher T \rightarrow higher k

Q23. The rate constant of a reaction increases from 0.01 to 0.03 when temperature is raised from 300K to 310K. What is the approximate activation energy?

- A. 38 kJ/mol
- B. 57 kJ/mol
- C. 69 kJ/mol
- D. 92 kJ/mol

Answer: B. 57 kJ/mol

Explanation:

Using Arrhenius equation:

$\ln(k_2/k_1) = E_a/R(1/T_1 - 1/T_2) \rightarrow$ approximate value comes ~ 57 kJ/mol

Q24. For a first-order reaction, the time taken for 75% completion is:

- A. $t_{1/2}$
- B. $2t_{1/2}$
- C. $3t_{1/2}$
- D. $4t_{1/2}$

Answer: C. $3t_{1/2}$

Explanation:

50% $\rightarrow 1 t_{1/2}$

75% $\rightarrow 2 t_{1/2}$ (to reach 25%), then 1 more for 12.5%

\rightarrow Total = $1 + 1 + 1 = 3t_{1/2}$

Q25. Which of the following statements is true about the rate constant (k)?

- A. Depends only on concentration
- B. Changes with temperature
- C. Independent of catalyst
- D. Unit is always the same

Answer: B. Changes with temperature

Explanation:

k depends on T and E_a (via Arrhenius equation), but not on concentration.

Q26. The rate law for a reaction is: Rate = $k[A][B]$. If the initial concentration of A is doubled and B is kept constant, rate will:

- A. Double
- B. Halve
- C. Remain same
- D. Become four times

Answer: A. Double

Explanation:

$\text{Rate} \propto [\text{A}] \rightarrow 2[\text{A}] \rightarrow 2 \times \text{Rate}$

Q27. A reaction has rate constant $k = 1.5 \times 10^{-3} \text{ s}^{-1}$. What is the half-life ($t_{1/2}$) for the reaction if it is first-order?

- A. 462 s
- B. 231 s
- C. 693 s
- D. 346 s

Answer: A. 462 s

Explanation:

$$t_{1/2} = 0.693 / k = 0.693 / 1.5 \times 10^{-3} \approx 462 \text{ s}$$

Q28. In a reaction, the half-life increases with decrease in initial concentration. The order of the reaction is:

- A. Zero
- B. First
- C. Second
- D. Third

Answer: C. Second

Explanation:

For second-order:

$$t_{1/2} \propto 1 / [\text{A}]_0 \rightarrow \text{lower } [\text{A}]_0 \rightarrow \text{longer half-life}$$

Q29. For a chemical reaction, doubling the temperature increases the rate constant 8 times. This implies the activation energy is:

- A. High
- B. Low
- C. Zero
- D. Infinite

Answer: A. High

Explanation:

Large rate change \rightarrow indicates high E_a (more sensitive to T)

Q30. The order of reaction with respect to a reactant can be determined by:

- A. Measuring product amount at end
- B. Measuring change in pressure
- C. Studying variation of rate with concentration
- D. Observing color change

Answer: C. Studying variation of rate with concentration

Explanation:

Order is experimentally found by checking how rate changes with concentration.

Q31. If a reaction follows the rate law $\text{Rate} = k[A]^2[B]$, the overall order of the reaction is:

- A. 1
- B. 2
- C. 3
- D. 0

Answer: C. 3

Explanation:

Order = exponent sum = 2 (A) + 1 (B) = 3

Q32. A reaction is first order. What will be the ratio of time required for 90% completion to that for 50% completion?

- A. 1.5
- B. 2
- C. 3.32
- D. 0.693

Answer: C. 3.32

Explanation:

$$t = (2.303/k) \times \log(100/10) = (2.303/k) \times 1 = t_{90}$$

$$t_{50} = 0.693/k$$

$$\text{So, } t_{90} / t_{50} = 2.303 / 0.693 \approx 3.32$$

Q33. What is the unit of rate constant for a second-order reaction?

- A. $\text{mol}^{-1} \text{L s}^{-1}$
- B. s^{-1}
- C. $\text{mol L}^{-1} \text{s}^{-1}$
- D. $\text{L mol}^{-1} \text{s}^{-1}$

Answer: D. $\text{L mol}^{-1} \text{s}^{-1}$

Explanation:

For second-order: unit = $1/(\text{mol} \cdot \text{L}^{-1} \cdot \text{s}) = \text{L mol}^{-1} \text{s}^{-1}$

Q34. In which of the following reactions is the rate affected by catalyst but not the equilibrium constant?

- A. Reversible reactions only
- B. Irreversible reactions only
- C. All reactions
- D. Catalyst affects both rate and equilibrium

Answer: C. All reactions

Explanation:

Catalyst changes activation energy \rightarrow affects rate but not equilibrium constant.

Q35. The slope of the plot of $\log [A]$ vs time gives:

- A. Rate constant for zero order
- B. Rate constant for first order
- C. Half-life
- D. Activation energy

Answer: B. Rate constant for first order

Explanation:

For first-order, slope = $-k / 2.303$

Q36. In a reaction $A \rightarrow B$, rate of reaction becomes four times when concentration of A is doubled. The order of reaction is:

- A. 1
- B. 2
- C. 3

D. 0

Answer: B. 2

Explanation:

$$\text{Rate} \propto [A]^n \rightarrow 2^n = 4 \rightarrow n = 2$$

Q37. The plot of $[A]$ vs time is a straight line. The reaction is:

A. Zero order

B. First order

C. Second order

D. Fractional order

Answer: A. Zero order

Explanation:

Only zero-order reaction shows linear decrease of $[A]$ with time.

Q38. Which of the following is not true about a catalyst?

A. Increases rate

B. Changes ΔG of reaction

C. Lowers activation energy

D. Provides alternative pathway

Answer: B. Changes ΔG of reaction

Explanation:

Catalyst affects kinetics, not thermodynamics $\rightarrow \Delta G$ remains unchanged.

Q39. The integrated rate law for a first-order reaction is:

A. $[A] = [A]_0 - kt$

B. $\log [A] = \log [A]_0 - kt$

C. $\ln [A] = \ln [A]_0 - kt$

D. $1/[A] = 1/[A]_0 + kt$

Answer: C. $\ln [A] = \ln [A]_0 - kt$

Explanation:

This is the standard integrated rate equation for first-order reactions.

Q40. The rate law for a reaction is $\text{Rate} = k[A]^0$. Which of the following is true?

- A. $\text{Rate} \propto [A]$
- B. Rate remains constant
- C. $\text{Rate} = 0$
- D. Rate decreases with time

Answer: B. Rate remains constant

Explanation:

Zero-order \rightarrow rate independent of $[A] \rightarrow$ constant rate.

Q41. The activation energy of a reaction can be calculated using:

- A. Raoult's law
- B. Van't Hoff equation
- C. Arrhenius equation
- D. Nernst equation

Answer: C. Arrhenius equation

Explanation:

$k = Ae^{(-E_a/RT)} \rightarrow$ used to calculate E_a

Q42. For a second-order reaction, the half-life is:

- A. Directly proportional to $[A]_0$
- B. Inversely proportional to $[A]_0$
- C. Independent of $[A]_0$
- D. Zero

Answer: B. Inversely proportional to $[A]_0$

Explanation:

$t_{1/2} = 1 / (k[A]_0)$ for second-order

Q43. The temperature dependence of rate constant is described by:

- A. Boyle's law

- B. Charles' law
- C. Arrhenius equation
- D. Dalton's law

Answer: C. Arrhenius equation

Explanation:

Arrhenius equation relates temperature and rate constant.

Q44. What is the value of rate constant if rate = $0.1 \text{ mol L}^{-1} \text{ s}^{-1}$ and $[A] = 0.2 \text{ mol L}^{-1}$ for a zero-order reaction?

- A. 0.5 s^{-1}
- B. $0.02 \text{ mol L}^{-1} \text{ s}^{-1}$
- C. $0.1 \text{ mol L}^{-1} \text{ s}^{-1}$
- D. $0.05 \text{ mol L}^{-1} \text{ s}^{-1}$

Answer: C. $0.1 \text{ mol L}^{-1} \text{ s}^{-1}$

Explanation:

For zero-order: Rate = $k \rightarrow k = 0.1$

Q45. For the reaction $2A + B \rightarrow \text{Products}$, the rate law is Rate = $k[A]^2[B]$. If $[A]$ is halved and $[B]$ is doubled, what happens to the rate?

- A. Doubled
- B. Reduced to half
- C. Unchanged
- D. Reduced to $\frac{1}{4}$

Answer: B. Reduced to half

Explanation:

New rate = $k(\frac{1}{2}A)^2(2B) = k \times \frac{1}{4} \times 2 = \frac{1}{2}$ of original rate