

CLASS 12

CHEMISTRY

EXTRA QUESTIONS

Class 12 Chemistry Chapter 3 Chemical Kinetics – Extra Questions with Answers

These extra practice questions for Class 12 Chemistry Chapter 3 – Chemical Kinetics go beyond the NCERT textbook exercises to reinforce rate laws and order of reaction, integrated rate equations, half-life, and the Arrhenius equation. Useful for board exam revision and quick concept checks.

Contents

Very Short Answer Type Questions (1 Mark)

Short Answer Type Questions (2–3 Marks)

Higher Order Thinking Skills (HOTS)

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Very Short Answer Type Questions (1 Mark)

Q1. Define the rate of a chemical reaction.

Ans: The rate of a reaction is the change in concentration of any one reactant or product per unit time, at a given instant — it is always expressed as a positive quantity, with reactant concentration terms carrying a negative sign since they decrease over time.

Q2. What is meant by the order of a reaction?

Ans: The order of a reaction is the sum of the powers to which the concentration terms are raised in the experimentally determined rate law. It can be zero, a whole number, or a fraction, and must be determined experimentally — it cannot be deduced from the balanced chemical equation alone.

Q3. What is the half-life of a first-order reaction?

Ans: For a first-order reaction, the half-life ($t_{1/2}=0.693/k$) is **independent of the initial concentration** — it takes the same amount of time to reduce the concentration from any starting value to half that value.

Q4. What is activation energy?

Ans: Activation energy (E_a) is the minimum extra energy that reactant molecules must possess, over their average energy, for a collision between them to result in a successful reaction (i.e. to form the activated complex/transition state).

Short Answer Type Questions (2–3 Marks)

Q5. Distinguish between the order of a reaction and the molecularity of a reaction.

Ans: **Order** is an experimentally determined quantity obtained from the rate law — it can be zero, fractional, or a whole number, and applies to the overall reaction (or to individual steps of a complex mechanism).

Molecularity is a theoretical concept — the number of reacting species (atoms, ions or molecules) that must collide simultaneously to bring about a single elementary reaction step; it is always a whole number (1, 2, or rarely 3) and is meaningful only for a single elementary step, not for a complex multi-step reaction as a whole.

Q6. Explain why a reaction with a small activation energy is generally fast, while one with a large activation energy is generally slow.

Ans: According to the Boltzmann distribution of molecular energies, only a fraction of molecules possess energy equal to or greater than the activation energy E_a at any given temperature. If E_a is small, a large fraction of the colliding molecules already have enough energy to react, so the reaction proceeds quickly. If E_a is large, only a very small fraction of collisions have enough energy to be effective, so the reaction is slow — this fraction is captured mathematically by the exponential term $e^{-E_a/RT}$ in the Arrhenius equation.

Q7. For a zero-order reaction, show that the rate constant has the same units as the rate of reaction, and describe how concentration varies with time.

Ans: For a zero-order reaction, $\text{rate}=k[A]^0=k$, so k itself has units of **concentration/time (e.g. $\text{mol L}^{-1}\text{s}^{-1}$)**, identical to the units of rate, since the concentration term carries no power. Integrating $-d[A]/dt=k$ gives $[A]_t=[A]_0-kt$ — concentration decreases **linearly** with time for a zero-order reaction.

Higher Order Thinking Skills (HOTS)

Q8. A first-order reaction has a rate constant of $1.15 \times 10^{-3} \text{ s}^{-1}$. How long will it take for 5g of this reactant to reduce to 3g?

Ans: Since $t = (1/k) \ln([A]_0/[A]_t)$ and the ratio $[A]_0/[A]_t$ can be taken directly as a mass ratio for a first-order reaction (concentration is proportional to mass at constant volume):

$$t = (1/1.15 \times 10^{-3}) \times \ln(5/3) \approx (1/1.15 \times 10^{-3}) \times 0.5108 \approx 444 \text{ s } (\approx 7.4 \text{ minutes}).$$

Q9. Two students run the same reaction at the same temperature but disagree about its activation energy after fitting their own rate-constant-vs-temperature data to the Arrhenius equation. Explain what feature of their data (plotted as $\ln k$ vs $1/T$) would let them resolve the disagreement without repeating the experiment, and what a steeper slope would mean physically.

Ans: Since $\ln k = \ln A - (E_a/R)(1/T)$, plotting **$\ln k$ against $1/T$** should give a straight line whose slope equals $-E_a/R$; both students can plot their own (k, T) data pairs this way and read off E_a directly from the slope ($E_a = -\text{slope} \times R$), rather than relying on a single two-point calculation that is more sensitive to experimental error in any one measurement. A **steeper (more negative) slope** corresponds to a **larger activation energy** — physically, it means the reaction's rate constant is more sensitive to temperature change, since a higher energy barrier means a proportionally larger fraction of molecules gain (or lose) the ability to react for a given change in T .

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