CHAPTER 3

Chemical Kinetics

CBSE · Chemistry · Class 12

WHAT THIS CHAPTER DOES

Boards prep that builds confidence, not anxiety.

TODAY'S MISSION

WHY THIS MATTERS

The Big Picture

TOPIC

Before we begin — quick check

TOPIC

A

Part A — Rate of Reaction

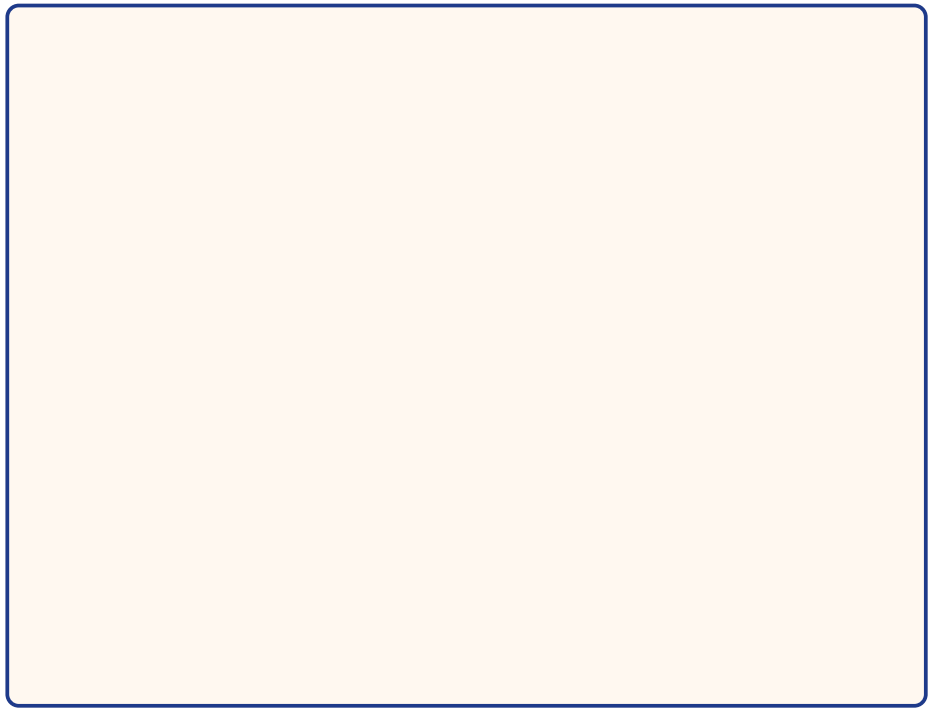
TOPIC

Defining rate

POINT 1	POINT 2

WORKED EXAMPLE

Rate expression for a balanced equation



TOPIC

Factors affecting rate — at a glance

TOPIC

B

Part B — Rate Law and Order

TOPIC

Rate law and rate constant

POINT 1

POINT 2

TRY IT · SOLVE BEFORE YOU PEEK

Quick check — Order

For rate = $k[A]^2[B]^0$, what is the overall order of the reaction?

SOLUTION

TOPIC

Order vs Molecularity — the critical distinction

POINT 1	POINT 2

TOPIC

C

Part C — Integrated Rate Equations

WORKED EXAMPLE

First-order: from differential to integrated form

TRY IT · SOLVE BEFORE YOU PEEK

Pause — rate vs k

Work it out before you flip the answer.

SOLUTION

WORKED EXAMPLE

Numerical — Half-life of first-order

TOPPER TEMPLATE · MARK-BY-MARK

Topper's 3-mark answer — Pseudo-first-order numerical

1. STEP 1
2. STEP 2
3. STEP 3
4. STEP 4

TOPIC

D

Part D — Temperature & Catalysis

TOPIC

Arrhenius equation — what each symbol means

POINT 1	POINT 2	POINT 3

WORKED EXAMPLE

Numerical — Arrhenius two-temperature form

TOPIC

Effect of catalyst — energy profile

PYQ PATTERNS

Top 5 PYQ patterns — boards 2018-2024

MARKS DISTRIBUTION

Sub-topic weight in CBSE boards (2018-2024 average)

TRY IT · SOLVE BEFORE YOU PEEK

Quick check — Catalyst

Which of the following does a catalyst NOT change?

SOLUTION

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Order of a reaction = sum of stoichiometric coefficients (molecularity).

✓ **CORRECT** Order is determined experimentally from the rate law exponents; molecularity is the count of reactant species in an elementary step. They are equal only for elementary reactions.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** A catalyst shifts the equilibrium constant K toward products.

✓ **CORRECT** A catalyst lowers Ea for both forward and reverse equally; it does NOT change ΔH, ΔG, or K. It only reaches the same equilibrium faster.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Activation energy Ea is the same as enthalpy change ΔH.

✓ **CORRECT** Ea is the energy barrier from reactants to the transition state. ΔH = E_a(forward) – E_a(reverse). They are different physical quantities.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Half-life of every reaction is independent of initial concentration.

✓ **CORRECT** Only first-order half-life t½ = 0.693/k is independent of [A]0. Zero-order t½ = [A]0/2k depends linearly on [A]0; second-order depends inversely.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Rate constant k changes with concentration.

✓ **CORRECT** k depends only on temperature (and presence of a catalyst). Rate depends on concentration via the rate law; k itself is concentration-independent.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Molecularity can be zero or fractional, just like order.

✓ **CORRECT** Molecularity is the integer count of reactant molecules colliding in an elementary step — it must be 1, 2, or rarely 3. Order can be 0, fractional, negative, or any real number.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Increasing temperature increases rate because molecules move faster (more collisions).

✓ **CORRECT** The major reason is the exponential rise in the fraction of molecules with energy ⩾ Ea (Boltzmann distribution shifts right). Collision frequency increases only ~2% per 10 K but rate doubles — Ea dominance is the key idea.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** A pseudo-first-order reaction is genuinely first-order overall.

✓ **CORRECT** It is bi-molecular in reality (e.g., ester + water). Water is in large excess so [H2O] is effectively constant and absorbed into k′. Order APPEARS first but molecularity is two.

PYQ PATTERNS

Top PYQ patterns to drill

#1	Pseudo-first-order numerical: given t and [A]/[A]0, find k or vice versa (3 marks)	90%
#2	Arrhenius	find Ea from two rate constants at two temperatures (3 marks) — 70%
#3	Order vs molecularity (2-3 differences + example) (2 marks)	75%
#4	Half-life derivation for zero / first order (2 marks)	60%
#5	Energy profile + effect of catalyst (graph) (2 marks)	55%

RECAP · MEMORISE THESE

What you must walk away with

1 Rate = $-(1/a)\cdot d[A]/dt$ for $aA \rightarrow$ products; coefficients are divisors

2 Order is from experiment; molecularity is from mechanism — they often differ

3 First order: $t_{1/2} = 0.693/k$, INDEPENDENT of $[A]_0$

4 $k = (2.303/t)\cdot\log([A]_0/[A])$ — your numerical workhorse

5 Arrhenius: $\ln(k_2/k_1) = (Ea/R)(1/T_1 - 1/T_2)$; use $R = 8.314\ J\ K^{-1}\ mol^{-1}$

6 Catalyst lowers Ea, does NOT change ΔH or K

WHAT'S NEXT

Next class

Your move

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