

Class 12 Chemistry – Haloalkanes & Haloarenes | Study Guide

1. Theory in Simple Words with Visuals

1.1 What are Haloalkanes and Haloarenes?

- **Haloalkanes:** Compounds in which a **halogen** (F, Cl, Br, I) is attached to an **alkane** (saturated carbon).
Example: CH₃CH₂Cl (Chloroethane)
- **Haloarenes:** Compounds in which a **halogen** is attached to an **aromatic ring** (like benzene).
Example: C₆H₅Cl (Chlorobenzene)

Analogy:

- Haloalkane = "halogen flag on a simple carbon road"
 - Haloarene = "halogen flag on a fancy benzene roundabout"
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1.2 Nomenclature

1. Haloalkanes:

- Identify the parent chain → number the carbon atoms → attach halogen prefix
Example: 2-Bromo-3-chloropentane

2. Haloarenes:

- Halogen + benzene → use ortho/meta/para for di-substituted
Example: o-Dichlorobenzene

Flowchart for Naming Haloalkanes:

Parent Alkane → Number Chain → Add Halogen Prefix → Combine

1.3 Classification

Type	Example	Notes
Primary (1°)	CH ₃ CH ₂ Cl	Halogen attached to 1° C
Secondary (2°)	CH ₃ CHClCH ₃	Halogen attached to 2° C
Tertiary (3°)	(CH ₃) ₃ CCl	Halogen attached to 3° C

1.4 Physical Properties

- Boiling points ↑ with chain length and polarity

- Solubility: Insoluble in water, soluble in organic solvents
- Colorless liquids, denser than water

Visual Tip: Draw "haloalkane molecules floating in water" to remember insolubility.

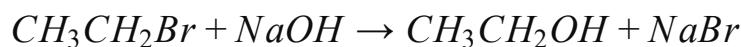
1.5 Chemical Reactions

1.5.1 Nucleophilic Substitution (SN1 & SN2)

- SN1: 2 steps, carbocation formed, $3^\circ > 2^\circ > 1^\circ$
- SN2: 1 step, backside attack, $1^\circ > 2^\circ > 3^\circ$

Mnemonic: "1 Step = SN2, 2 Steps = SN1"

Example Reaction:



1.5.2 Elimination (Dehydrohalogenation)

- Formation of alkenes using alc. KOH
- Example: $CH_3CH_2Br \rightarrow CH_2=CH_2 + HBr$

1.5.3 Reaction of Haloarenes

- Less reactive due to resonance stabilization
 - Requires **catalyst / special conditions**
 - Example: $C_6H_5Cl + NaOH$ (fused) $\rightarrow C_6H_5OH$
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2. Key Concepts & Formulas

Concept	Formula/Definition	Tips / Mnemonics
SN2 Rate	$Rate = k[RX][Nu^-]$	"2 reactants = 1 step"
SN1 Rate	$Rate = k[RX]$	"1 reactant = 2 steps"
Reactivity (Haloalkanes)	$RI > RBr > RCl > RF$	I = most reactive
Wurtz Reaction	$2R-X + 2Na \rightarrow R-R + 2NaX$	Coupling reaction
Hell-Volhard-Zelinsky	$R-CH_3 + Br_2 \rightarrow R-CH_2Br$	For alpha-halogenation

Mnemonic for Reactivity: "I Br Cl F \rightarrow I Bakes Cool Food"

3. Solved Numerical / Mechanism-Based Problems

Example 1: SN2 Reaction Rate

Problem: Explain why CH_3Br reacts faster than $(\text{CH}_3)_3\text{CBr}$ with OH^- .

Solution:

- CH_3Br = primary \rightarrow less steric hindrance \rightarrow faster SN2
 - $(\text{CH}_3)_3\text{CBr}$ = tertiary \rightarrow bulky \rightarrow slow SN2
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Example 2: Product Prediction

Problem: Predict product: $\text{CH}_3\text{CH}_2\text{Cl} + \text{KOH}$ (alc)

Solution:

- Alcohol \rightarrow elimination $\rightarrow \text{CH}_2=\text{CH}_2 + \text{HCl}$
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4. Previous Years' Board Questions (Solved)

- Naming & classification \rightarrow frequently asked (2013–2022)
 - SN1/SN2, reactivity trends
 - Mechanism-based reactions (Wurtz, Finkelstein, Dehydrohalogenation)
 - Haloarene reactions (nitration, phenol formation)
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5. Quick Revision Notes / Important Points

- Haloalkane = R-X , Haloarene = Ar-X
- SN2: 1 step, backside attack, primary > secondary
- SN1: 2 steps, carbocation, tertiary > secondary
- Reactivity Order: $\text{R-I} > \text{R-Br} > \text{R-Cl} > \text{R-F}$
- Haloarene reactions are slow, require catalysts
- Elimination forms alkenes (alc. KOH)

Visual Table:

RX Type	Reaction Type	Rate/Order	Notes
1°	SN2	Fast	Backside attack
2°	SN2 / SN1	Medium	Depends on Nu^- & solvent
3°	SN1	Fast	Carbocation formed

6. Predicted / Likely Questions

1. Naming of haloalkanes & haloarenes
2. SN1 vs SN2 mechanism & factors affecting rate

3. Elimination vs substitution products
 4. Preparation reactions (e.g., from alcohols, halogenation)
 5. Reactivity trends and reasons
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7. Exam Tips & Tricks

- Draw **mechanism arrows** clearly; marks given for steps
 - Remember **steric hindrance affects SN2, carbocation stability affects SN1**
 - Use **color coding for halogens** (F = green, Cl = yellow, Br = red, I = violet)
 - For elimination, check alc. KOH → alkene
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8. Visual & Kid-Friendly Learning Style

- Think **halogen** as a “flag” on the carbon road
- Use **colorful charts** for SN1/SN2 & reactivity order
- Draw **mechanism flowcharts** to memorize steps quickly
- Analogies: “**Primary = open road (fast), Tertiary = crowded street (slow)**”