

Class 12 Chemistry – Alcohols, Phenols & Ethers | Study Guide

1. Theory in Simple Words with Visuals

1.1 What are Alcohols, Phenols, and Ethers?

Compound	General Formula	Structure	Example	Analogy
Alcohols	R-OH	OH attached to saturated carbon	CH ₃ CH ₂ OH	"OH = water tap on a carbon road"
Phenols	Ar-OH	OH attached to aromatic ring	C ₆ H ₅ OH	"OH = flag on a benzene roundabout"
Ethers	R-O-R	Oxygen between 2 carbons	CH ₃ -O-CH ₃	"Oxygen bridge connecting two carbons"

1.2 Classification

Alcohols:

- **Primary (1°):** -OH on 1° carbon (CH₃CH₂OH)
- **Secondary (2°):** -OH on 2° carbon (CH₃CHOHCH₃)
- **Tertiary (3°):** -OH on 3° carbon ((CH₃)₃COH)

Phenols:

- **Monohydroxy:** C₆H₅OH
- **Dihydroxy:** Catechol, Resorcinol, Hydroquinone

Ethers:

- **Symmetrical:** CH₃-O-CH₃
 - **Unsymmetrical:** CH₃-O-C₂H₅
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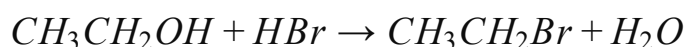
1.3 Physical Properties

Property	Alcohols	Phenols	Ethers
Boiling Point	Higher (H-bonding)	High (H-bonding)	Lower (no H-bond)
Solubility	Soluble in water	Soluble in water	Less soluble
Odor	Sweetish	Sweet, medicinal	Ether-like, pungent

1.4 Chemical Reactions

1.4.1 Reactions of Alcohols

1. **Acidic Reaction:** Alcohol + HX → Alkyl halide



2. **Oxidation:**

- 1° Alcohol → Aldehyde → Carboxylic acid
- 2° Alcohol → Ketone
- 3° Alcohol → No oxidation

3. **Dehydration:** Alcohol → Alkene (alc. H₂SO₄, 170°C)

Example: CH₃CH₂OH → CH₂=CH₂ + H₂O

1.4.2 Reactions of Phenols

1. **Acid-Base Reaction:** Phenol + NaOH → Sodium phenoxide + H₂O

2. **Electrophilic Substitution:**

- Halogenation (Br₂) → Tribromophenol
- Nitration (HNO₃) → Ortho/Para nitrophenol

Mnemonic: Phenol is **more reactive than benzene** → due to –OH activating effect.

1.4.3 Reactions of Ethers

1. **Cleavage by HX:**

- CH₃–O–CH₃ + HI → CH₃I + CH₃OH

2. **Generally stable** → no oxidation like alcohols
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2. Key Concepts & Formulas

Concept	Formula / Key Points	Tips / Mnemonics
Alcohol Oxidation	1° → Aldehyde → Acid, 2° → Ketone	"1 step = aldehyde, 2 steps = acid"
Dehydration	ROH → Alkene + H ₂ O	Alc. H ₂ SO ₄ , heat
SN1 / SN2 in Alcohol → RX	Alcohol + HX → Alkyl halide	3° → SN1, 1° → SN2
Phenol Reactivity	Ortho/Para activator	OH group = electron donating
Ether Cleavage	R–O–R + HX → RX + ROH	Strong acid, heat needed

Mnemonic for Alcohol Oxidation:

"Primary → Aldehyde → Acid, Secondary → Ketone, Tertiary → None"

3. Solved Numerical / Mechanism Problems

Example 1: Oxidation Product Prediction

Problem: Predict product of $\text{CH}_3\text{CH}_2\text{OH}$ with $[\text{O}]$

Solution:

1° Alcohol → Aldehyde: CH_3CHO → Carboxylic acid: CH_3COOH

Example 2: Dehydration Mechanism

Problem: $\text{CH}_3\text{CH}_2\text{OH} \rightarrow ?$ (alc. H_2SO_4 , 170°C)

Solution:

- Elimination → $\text{CH}_2=\text{CH}_2 + \text{H}_2\text{O}$

Tip: Mark β -Hydrogen → double bond forms there.

4. Previous Years' Board Questions

- **Preparation reactions:** From alcohols to ethers, phenols from benzene
- **Reactivity & mechanism:** Oxidation, halogenation, nitration
- **Identification reactions:** iodoform, bromination, phenol tests

High-weightage areas: Oxidation products, substitution reactions, and phenol reactions.

5. Quick Revision Notes / Important Points

- **Alcohol** = ROH , **Phenol** = Ar-OH , **Ether** = R-O-R
- **Oxidation:** $1^\circ \rightarrow$ Aldehyde → Acid, $2^\circ \rightarrow$ Ketone, $3^\circ \rightarrow$ None
- **Dehydration:** Alcohol → Alkene (alc. H_2SO_4)
- **Phenol reactions:** Halogenation, Nitration, Acid-base
- **Ethers:** Generally stable, cleaved by HX

Visual Table:

Compound	Reaction Type	Key Notes
Alcohol	Oxidation, Dehydration, Substitution	Check primary/secondary/tertiary
Phenol	Electrophilic substitution, Acid-base	Ortho/para activation

Compound	Reaction Type	Key Notes
Ether	Cleavage by HX	Stable otherwise

6. Predicted / Likely Questions

1. Identify products of oxidation, dehydration
 2. Distinguish alcohol, phenol, ether reactions
 3. Electrophilic substitution reactions of phenols
 4. Preparation of alcohols and ethers
 5. Mechanism-based questions
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7. Exam Tips & Tricks

- Always **check degree of carbon** for alcohol reactions
 - Use **color coding** for OH (blue), alkyl (green), aromatic (orange)
 - For **electrophilic substitution**, remember **–OH activates ortho/para**
 - **Mechanism arrows** fetch marks → practice flowchart style
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8. Visual & Kid-Friendly Learning Style

- Imagine **OH as a tap** → water or acid reactions
- Think **ether as a bridge** → connects two carbon islands
- Color-code reactions → H-bonding = blue, cleavage = red
- Draw **flowcharts for oxidation & substitution** → easy recall