

CLASS 12

CHEMISTRY

EXTRA QUESTIONS

Class 12 Chemistry Chapter 7 Alcohols, Phenols and Ethers – Extra Questions with Answers

These extra practice questions for Class 12 Chemistry Chapter 7 – Alcohols, Phenols and Ethers go beyond the NCERT textbook exercises to reinforce nomenclature, acidity trends, reaction mechanisms, and the preparation of alcohols, phenols and ethers. Useful for board exam revision and quick concept checks.

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Very Short Answer Type Questions (1 Mark)

Q1. Arrange in increasing order of acidic strength: ethanol, phenol, water.

Ans: **Ethanol < water < phenol**. Phenol is the most acidic since its conjugate base (phenoxide) is resonance-stabilised; ethanol is the least acidic since the ethyl group's electron donation destabilises the ethoxide ion relative to even a simple hydroxide ion.

Q2. Name the catalyst used in the cumene process for manufacturing phenol.

Ans: No catalyst is needed for the autoxidation step (air/O₂ alone converts cumene to cumene hydroperoxide); the subsequent cleavage step uses **dilute acid** to convert the hydroperoxide to phenol and acetone.

Q3. Which reagent converts anisole to phenol by cleaving the alkyl–oxygen bond rather than the aryl–oxygen bond?

Ans: **Concentrated HI (hydroiodic acid)** — it cleaves the weaker alkyl–oxygen bond via S_N2 attack of iodide, giving phenol+iodomethane, since the aryl–oxygen bond has partial double-bond character and resists nucleophilic attack.

Q4. What is the product of the Lucas test with a tertiary alcohol, and how quickly does it appear?

Ans: Turbidity (from the insoluble alkyl chloride formed) appears **immediately at room temperature** with a tertiary alcohol, since it ionises fastest via the most stable (tertiary) carbocation in this S_N1 test.

Short Answer Type Questions (2–3 Marks)

Q5. Why does the boiling point of alcohols decrease with increasing branching of the carbon chain for a given number of carbon atoms?

Ans: Branching makes the molecule more **compact and spherical**, reducing its surface area available for intermolecular contact; this weakens the van der Waals forces between molecules (though hydrogen bonding via –OH is largely unaffected), so more highly branched isomers boil at a lower temperature than their straight-chain counterparts.

Q6. Explain why the dehydration of alcohols to alkenes follows the order 3° > 2° > 1° in ease of reaction, which is the reverse of the S_N2/Williamson reactivity order.

Ans: Acid-catalysed dehydration proceeds via a **carbocation intermediate (E1-type mechanism)**, so its rate depends on how stable that carbocation is: tertiary carbocations are the most stable (hyperconjugation/inductive donation from three alkyl groups) and form fastest, so 3° alcohols dehydrate most readily. This is the opposite of the steric-hindrance-driven S_N2 order used in Williamson synthesis, where unhindered (primary) substrates react fastest.

Q7. Why is picric acid (2,4,6-trinitrophenol) a much stronger acid than phenol itself?

Ans: Each of the three **–NO₂ groups is strongly electron-withdrawing** by both resonance and induction; with three such groups (at the 2, 4 and 6 positions, all ortho/para to the –OH), the resulting picrate ion's negative charge is extensively delocalised and stabilised, making picric acid acidic enough (pK_a ≈ 0.4) to rival many mineral/carboxylic acids, far stronger than unsubstituted phenol (pK_a ≈ 10).

Higher Order Thinking Skills (HOTS)

Q8. A student attempts to prepare tert-butyl methyl ether by reacting sodium tert-butoxide with iodomethane, and separately attempts to prepare it by reacting sodium methoxide with tert-butyl iodide. Only one route succeeds well. Identify which, and explain why the other fails.

Ans: **Sodium tert-butoxide+iodomethane succeeds:** the bulky alkoxide is paired with an unhindered (methyl) halide, so S_N2 attack proceeds smoothly. **Sodium methoxide+tert-butyl iodide fails** as a synthesis: methoxide is a small, strong base, and tert-butyl iodide is far too sterically hindered for backside S_N2 attack, so the methoxide instead abstracts a β -hydrogen, giving **isobutylene (E2 elimination)** as the major product rather than the ether. This illustrates why the bulkier group in Williamson synthesis must always be introduced as the alkoxide, never as the halide.

Q9. Explain, using resonance structures in words, why the –OH group of phenol is an ortho/para director in electrophilic aromatic substitution even though oxygen is more electronegative than carbon.

Ans: Although oxygen's electronegativity would suggest it should withdraw electron density (a $-I$ effect that alone would deactivate and direct meta), one of oxygen's lone pairs can be donated into the ring through resonance. This places extra electron density specifically at the carbons **ortho and para** to the –OH group (as seen in the additional resonance structures with negative character at those positions), making those positions most nucleophilic and hence most reactive toward an incoming electrophile. Since this resonance ($+M$) donation effect is much stronger than the inductive ($-I$) withdrawal, phenol is overall activating and ortho/para-directing, not deactivating or meta-directing.

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