Hydroxy compounds

A-Level Chemistry

Alcohols with acyl chlorides

At A Level you meet one more reaction of an **alcohol** 醇: it reacts with an **acyl chloride** 酰氯 to make an **ester** 酯. This works faster and more completely than using a carboxylic acid. For example, ethanol and ethanoyl chloride give ethyl ethanoate, plus fumes of HCl.

Phenol

Phenol 苯酚 has an –OH group joined directly to a **benzene** 苯 ring. This changes the chemistry of both the –OH group and the ring.

Phenol is a low-melting solid; it slowly turns pink as it oxidises in air

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Making phenol

Cool **phenylamine** 苯胺 with $NaNO_2$ and dilute acid below 10 °C to make a **diazonium salt** 重氮盐. Warming this salt with water then gives phenol (and nitrogen gas).

Reactions of phenol

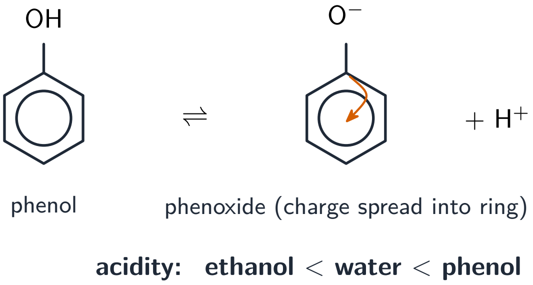
- with a base such as NaOH(aq): phenol reacts to give sodium phenoxide and water. (Ordinary alcohols do **not** react with NaOH —this shows phenol is more acidic.)
- with sodium metal: gives sodium phenoxide and hydrogen.
- with a diazonium salt in NaOH(aq): forms a coloured **azo compound** 偶氮化合物 (used in dyes).
- **nitration** 硝化 with **dilute** HNO_3 at room temperature: gives a mixture of 2-nitrophenol and 4-nitrophenol.

- **bromination** 溴化 with bromine water at room temperature (no catalyst): gives a white precipitate of 2,4,6-tribromophenol.

Acidity of phenol

Phenol loses its H^+ to form a phenoxide ion. This ion is stabilised because its negative charge is spread (delocalised) into the ring. So phenol's **acidity** 酸性 is higher than that of water or ethanol:

$$\text{ethanol} < \text{water} < \text{phenol}$$

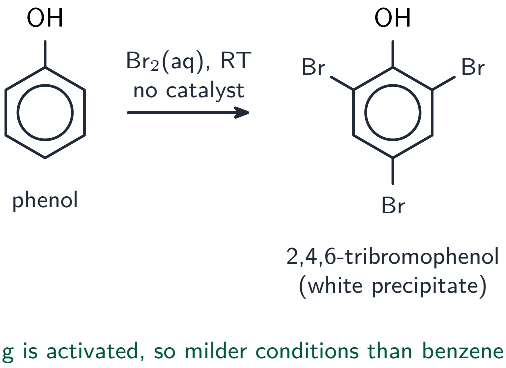


Phenol is more acidic than water or an alcohol: losing H^+ gives a phenoxide ion whose negative charge spreads into the ring, stabilising it

(Phenol is still a weak acid —weaker than a carboxylic acid.)

Why the conditions are milder than for benzene

A lone pair on the phenol oxygen is partly **delocalised** 离域 into the ring. This makes the ring more electron-rich, so it attracts electrophiles more strongly. Phenol therefore reacts faster and under much milder conditions than benzene —no catalyst is needed, and dilute reagents work at room temperature.



Phenol's ring is activated, so bromine water brominates positions 2, 4 and 6 at room temperature with no catalyst, giving a white precipitate

The –OH group directs new substituents to the 2-, 4- and 6-positions. The same ideas apply to other phenolic compounds, such as naphthol.

Carbolic soap contains phenol, which was one of the first antiseptics

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