

Phenol

A-Level Chemistry ■ Topic 32

A-Level Chemistry



What we will cover

- 1 Alcohols with acyl chlorides
- 2 Phenol & its reactions
- 3 Acidity of phenol
- 4 Milder conditions



phenol oxidises pink in air

Alcohols with acyl chlorides



An alcohol reacts with an **acyl chloride** 酰氯 to make an **ester** 酯
– faster & more completely than with a carboxylic acid. Ethanol + ethanoyl chloride → ethyl ethanoate + HCl.

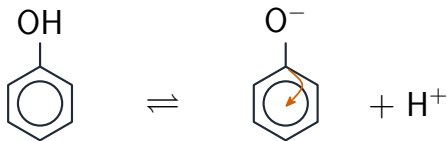
Phenol and its reactions



Phenol 苯酚 has —OH joined to a benzene ring:

- $+ \text{NaOH} \rightarrow$ sodium phenoxide (alcohols don't react!)
- $+ \text{Na} \rightarrow \text{H}_2$
- nitration (dilute) & **bromination** 溴化 at room temp
- $+ \text{diazonium} \rightarrow$ a coloured **azo dye** 偶氮化合物

Acidity of phenol



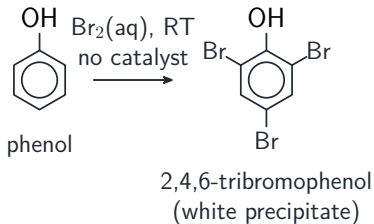
phenol ⇌ phenoxide (charge spread into ring)

acidity: ethanol < water < phenol

Phenol loses H^+ to a **phenoxide** 苯氧根 ion, stabilised by spreading the charge into the ring.

So acidity is: ethanol < water < **phenol** (but phenol is still weaker than a carboxylic acid).

Milder conditions than benzene



the ring is activated, so milder conditions than benzene

The O lone pair is **delocalised** 离域 into the ring, making it more electron-rich and **activated**.

So bromine water brominates phenol at the 2,4,6-positions at **room temperature, no catalyst** – a white precipitate.

Worked example – which is the stronger acid?

Explain why phenol is a stronger acid than ethanol but weaker than ethanoic acid.

- All three lose H^+ from an O–H. **Stabler anion $\Rightarrow$ stronger acid.**
- Ethoxide: charge **stuck on one O** $\Rightarrow$ unstable $\Rightarrow$ very weak acid.
- Phenoxide: charge **delocalised into the ring** $\Rightarrow$ stabler $\Rightarrow$ reacts with NaOH , not Na_2CO_3 .
- Ethanoate: charge spread over **two O** $\Rightarrow$ most stable $\Rightarrow$ **fizzes with Na_2CO_3 .**

Acid strength = **anion stability**. The carbonate test separates them: only the carboxylic acid gives CO_2 .

Topic 32 – key takeaways

1

Acyl chloride

+ alcohol $\rightarrow$ ester, fast & complete

2

Phenol

reacts with NaOH (more acidic than alcohol)

3

Acidity

ethanol $<$ water $<$ phenol

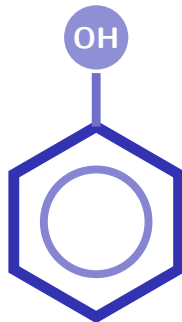
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Activated ring

brominates at room temp, no catalyst

Check yourself

- 1 What does an acyl chloride make with an alcohol?
- 2 Why is phenol more acidic than ethanol?
- 3 Does phenol react with NaOH?
- 4 What conditions brominate phenol?



Answers 1. an ester 2. the phenoxide charge spreads into the ring 3. yes
4. bromine water, room temperature, no catalyst