Solutions

Each answer shows the steps, then the **result**.

2.1

- 2,4,6-tribromophenol

2.2

- a white precipitate forms / the bromine water decolourises

3.1 A

- The negative charge on the phenoxide ion is delocalised into the ring, stabilising it

3.2 B

- An oxygen lone pair feeds into the ring, making it more electron-rich and reactive

3.3

(a)

- $C_6H_5OH + NaOH \rightarrow C_6H_5ONa + H_2O$

(b)

- phenol is acidic (more acidic than an alcohol — it reacts with a base)

3.4

- a lone pair on the phenol oxygen is delocalised into the ring; this makes the ring more electron-rich, so it attracts electrophiles more strongly; benzene's ring is less electron-rich, so it needs a halogen carrier to make a strong enough electrophile

3.5

(a)

- $C_6H_5OH + NaOH \rightarrow C_6H_5O^-Na^+ + H_2O$; the salt is **sodium phenoxide**

(b)

- In the phenoxide ion a lone pair on the oxygen is delocalised into the ring's π system, so the negative charge is spread out and the ion is stabilised — the equilibrium therefore lies further to the right than for ethanol, whose ethoxide has no such delocalisation. In ethanoate the charge is delocalised over **two electronegative oxygens** only, which stabilises it far more effectively than spreading it round a carbon ring, so ethanoic acid is the strongest of the three

(c)

- $C_6H_5OH + 3Br_2 \rightarrow C_6H_2Br_3OH + 3HBr$ — white 2,4,6-tribromophenol. The oxygen's lone pair is donated into the ring, raising its electron density so it polarises an approaching bromine molecule by itself — no halogen carrier is needed

(d)

- Add neutral iron(III) chloride solution: phenol gives a violet/purple colour, ethanol gives no change. (Sodium carbonate is **not** a valid test — neither gives carbon dioxide.)