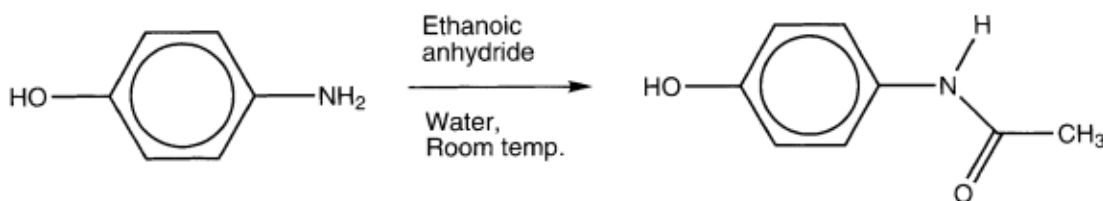
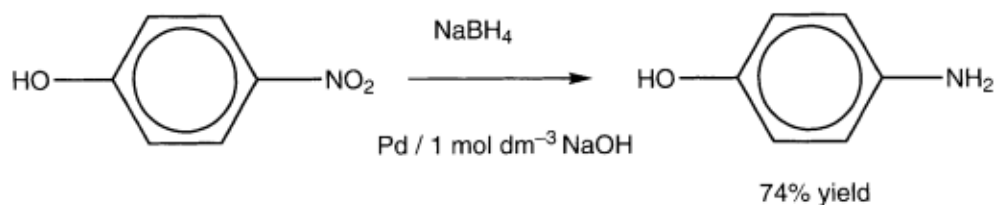
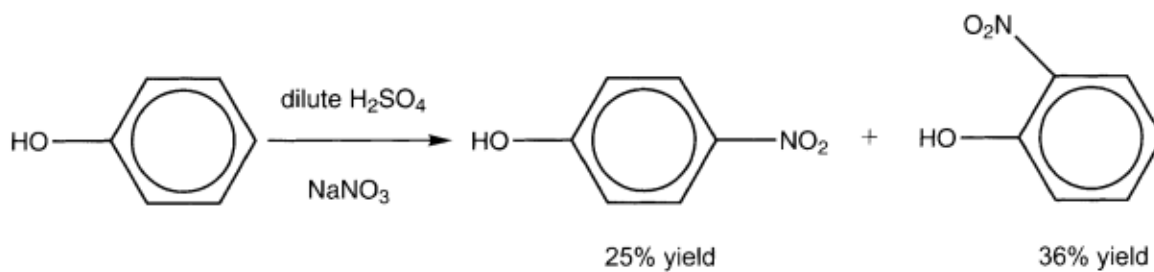


HL Paper 3 Section A Data Response (6)

Paracetamol, an over the counter pain-killer, can be synthesised from phenol in three separate steps.



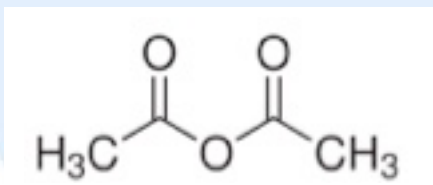
(a) (i) In Step 1 phenol is converted into a mixture of 4-nitrophenol and 2-nitrophenol. Identify the mechanism of this reaction by stating its name. **[1]**

(ii) The two products from Step 1 can easily be separated by a process known as steam distillation. Suggest why the boiling point of 2-nitrophenol (216 °C) is considerably lower than the boiling point of 4-nitrophenol (279 °C). **[2]**

(b) (i) In Step 2 the 4-nitrophenol is converted into 4-aminophenol. Identify the type of chemical reaction that occurs in this step. **[1]**

(ii) 4-aminophenol is soluble in aqueous solutions of strong acids. Deduce the structural formula of the product formed when 4-aminophenol dissolves in dilute hydrochloric acid. **[1]**

(c) The structural formula of ethanoic anhydride is:



(i) Deduce the structural formula of the product, other than paracetamol, formed in Step 3. **[1]**

(ii) Other than hydroxyl and phenyl, state the name of a functional group present in paracetamol. **[1]**

(iii) 10.00 g of phenol produced 2.47 g of paracetamol. Assuming the percentage yields of Steps 1 and 2 are as listed, calculate the percentage yield for Step 3. **[3]**