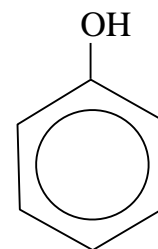


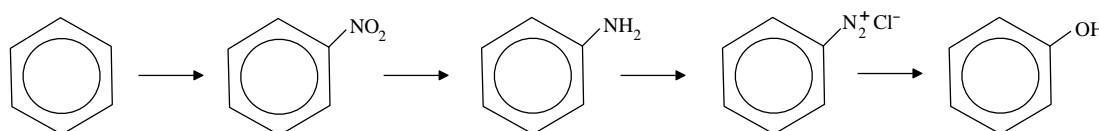
PHENOL

- Structure**
- phenol is an aromatic alcohol
 - the OH group is attached directly to the benzene ring
 - it is an almost colourless crystalline solid of formula C_6H_5OH



- Uses**
- production of
 - plastics
 - antiseptics
 - disinfectants
 - resins for paints

- Preparation**
- you cannot put an OH group directly onto benzene by electrophilic substitution
 - phenol is synthesised in a multi-stage process



Nitration of benzene

<i>reagents</i>	conc. nitric acid and conc. sulphuric acid (catalyst)
<i>conditions</i>	reflux at $55^{\circ}C$
<i>equation</i>	$C_6H_6 + HNO_3 \rightarrow C_6H_5NO_2 + H_2O$
<i>mechanism</i>	electrophilic substitution

Reduction of nitrobenzene

<i>reagents</i>	tin and conc. hydrochloric acid
<i>conditions</i>	reflux
<i>equation</i>	$C_6H_5NO_2 + 6 [H] \rightarrow C_6H_5NH_2 + 2H_2O$

Diazotisation of phenylamine

<i>reagents</i>	nitrous acid and hydrochloric acid (use sodium nitrite)
<i>conditions</i>	keep below $10^{\circ}C$
<i>equation</i>	$C_6H_5NH_2 + HNO_2 + HCl \rightarrow C_6H_5N_2^+ Cl^- + 2H_2O$
<i>reaction type</i>	diazotisation

Substitution

<i>reagents</i>	water
<i>conditions</i>	warm above $10^{\circ}C$
<i>equation</i>	$C_6H_5N_2^+ Cl^- + H_2O \rightarrow C_6H_5OH + N_2 + HCl$

CHEMICAL REACTIONS OF PHENOL

Reactions of the -OH group

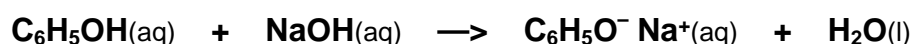
Water

- phenol is a **weak acid**
- it is a stronger acid than aliphatic alcohols
- the aromatic ring helps weaken the O-H bond and stabilises the resulting anion
- it dissolves very slightly in water to form a weak acidic solution



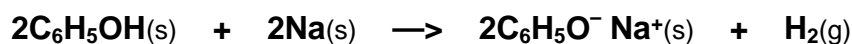
NaOH

- phenol reacts with sodium hydroxide to form a salt - sodium phenoxide
- it is ionic and water soluble



Sodium

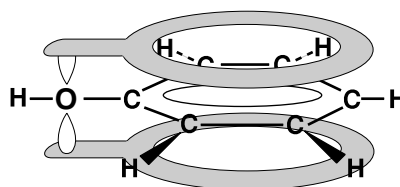
- phenol reacts with sodium to form an ionic salt - sodium phenoxide
- hydrogen is also produced
- this reaction is similar to that with aliphatic alcohols such as ethanol



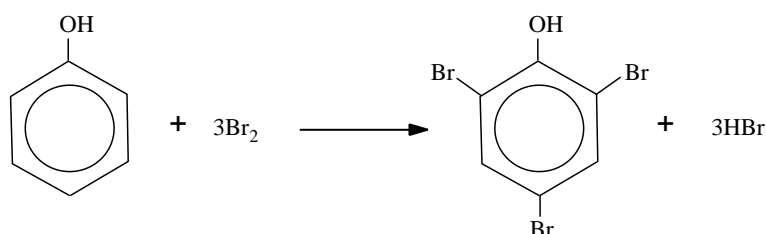
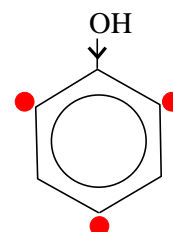
Reactions of the benzene ring ELECTROPHILIC SUBSTITUTION

Bromine

- the OH group is electron releasing
- electron pair donation takes place from a p orbital on oxygen



- it increases the electron density of the delocalised system
- it makes substitution much easier compared to benzene
- the electron density is greatest at the 2,4 and 6 positions
- substitution takes place at the 2,4 and 6 positions
- phenol reacts readily with bromine water **WITHOUT A CATALYST**
- it is so easy that multiple substitution takes place



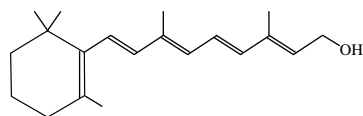
- other electrophiles such as NO_2^+ react in a similar way

Q.1 For each of the following compounds...

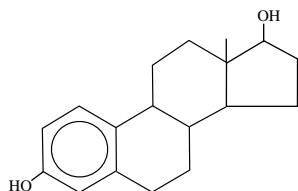
(a) work out the molecular formula (b) state its use or importance

(c) classify as 1°, 2° or 3° aliphatic alcohols or phenols (or both)

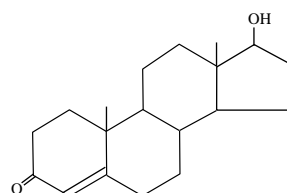
Vitamin A



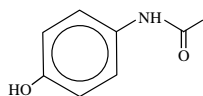
Estradiol



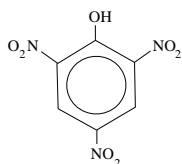
Testosterone



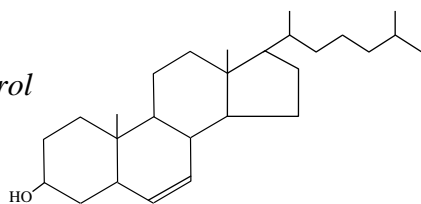
Paracetamol



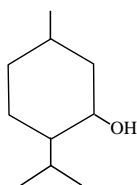
Picric acid



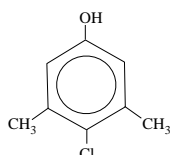
Cholesterol



Menthol



4-chloro-3,5-dimethylphenol
'Dettol'



Ethane-1,2-diol

