# 32. Hydroxy compounds

## 32.2 Phenol

## Paper 4

Question Paper

**1** **(a)** Samples of phenol, $C_6H_5OH$, are reacted separately with sodium and with dilute nitric acid.

phenol

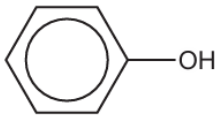


**Fig. 9.1**

**(i)** Write the equation for the reaction of $C_6H_5OH$ with Na.

..... [1]

**(ii)** Draw the structures of the **two** major isomeric organic products formed in the reaction of phenol with dilute $HNO_3$.

[1]

**2** **(a)** Explain why phenol is brominated much more easily than benzene is brominated.

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.....

.....

.....

..... [3]

**3** **(c)** Fig. 7.1 shows some reactions of phenol.

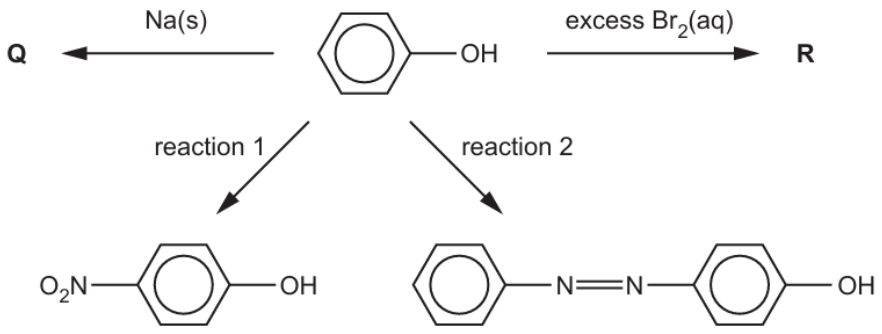



**Fig. 7.1**

**(i)** Give an equation for the reaction of phenol with Na(s).

..... [1]

**(ii)** Draw the structure of the organic product, **R**, formed when phenol reacts with an excess of $Br_2$(aq).

[1]

**(iii)** State the reagents and conditions for reaction 1 and reaction 2 in Fig. 7.1.

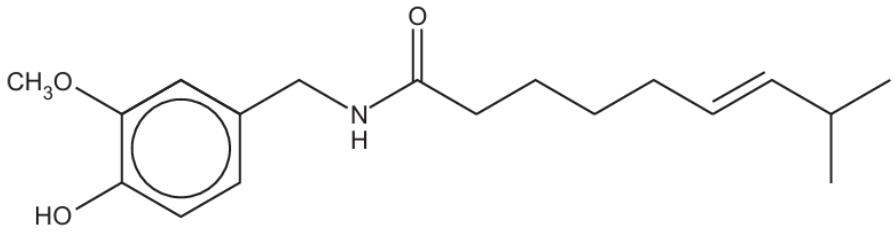
reaction 1 .....

reaction 2 .....

[2]

**4** Capsaicin is found in chilli peppers.

capsaicin

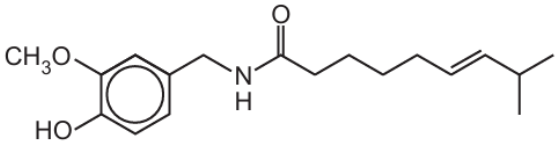



You should assume the $CH_3O$ group is unreactive in the reactions involved in this question.

**(b)** Complete the equation for the reaction of capsaicin with an excess of $Br_2(aq)$ in the dark.

Draw the structure of the organic product in the labelled box.

capsaicin



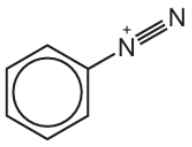
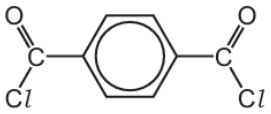

+ .....$Br_2$ ⟶

organic product

+ .....

[3]

**5** **(a)** Complete the table to show the structure of the organic product from each reaction of phenol, $C_6H_5OH$.

| reaction | reaction mixture | structure of organic product |
|---|---|---|
| 1 | phenol + NaOH(aq) | |
| 2 | phenol + Na(s) | |
| 3 | phenol +  (aq) + NaOH, at 4 °C | |
| 4 | an excess of phenol +  | |

[4]

**(b)** Identify **two** reactions from the table in which ethanol would behave in a similar way to phenol.

..... [1]

**6** **(b)** Suggest why bromination of phenol occurs more readily than bromination of benzene.

.....

.....

.....

.....

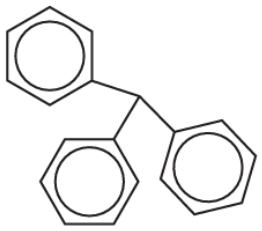
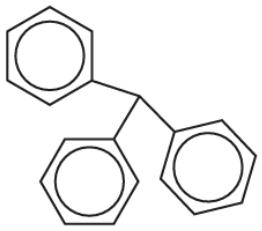
..... [2]

**7** **(d)** **(i)** Name the functional groups, in addition to the benzene ring, present in a phenolphthalein molecule.

..... [1]

**(ii)** Phenolphthalein reacts separately with the two reagents shown in the table.

Complete the table by:
- drawing the structures of the organic products formed (part of the structure has been given for you)
- stating the types of reaction.

| reagent | organic product structure | type of reaction |
|---|---|---|
| an **excess** of hot NaOH(aq) |  | |
| an **excess** of $Br_2$(aq) |  | |

[4]

**8** Phenol, $C_6H_5OH$, is a weak acid.

**(a)** Phenol can be made from phenylamine, $C_6H_5NH_2$.

Give the reagents and conditions for this reaction.

.....

..... [2]

**(b)** Phenol reacts with dilute aqueous nitric acid under room conditions to give a mixture of two isomeric products with molecular formula $C_6H_5NO_3$.

Use the *Data Booklet* to draw the structural formulae of these two products in the boxes and name each product.

name .....

name .....

[2]

**(c)** Phenol reacts with an excess of aqueous bromine.

**(i)** Draw and name the organic product of this reaction in the box.

name .....

[2]

**(ii)** Describe **two** visual observations that can be made when phenol reacts with an excess of aqueous bromine.

observation 1 .....

observation 2 .....

[1]

**(d)** Write an equation for a neutralisation reaction in which phenol behaves as an acid.

..... [1]

**(e)** Water, phenol and ethanol can all behave as acids.

Place these three compounds in order of acidity, starting with the **most** acidic.
Explain your answer.

..... > ..... > .....

most acidic least acidic

.....

.....

.....

.....

.....

.....

[3]