

### 3a. Making esters with acid anhydrides

This reaction can again be used to make esters from both alcohols and phenols. The reactions are slower than the corresponding reactions with acyl chlorides, and you usually need to warm the mixture. In the case of a phenol, you can react the phenol with sodium hydroxide solution first, producing the more reactive phenoxide ion.

Taking ethanol reacting with ethanoic anhydride as a typical reaction involving an alcohol: There is a slow reaction at room temperature (or faster on warming). There is no visible change in the colorless liquids, but a mixture of ethyl ethanoate and ethanoic acid is formed.



The reaction with phenol is similar, but will be slower. Phenyl ethanoate is formed together with ethanoic acid.

If the phenol is first converted into sodium phenoxide by adding sodium hydroxide solution, the reaction is faster. Phenyl ethanoate is again formed, but this time the other product is sodium ethanoate rather than ethanoic acid.

### b. Making esters from carboxylic acids

This method can be used for converting alcohols into esters, but it doesn't work with phenols - compounds where the -OH group is attached directly to a benzene ring. Phenols react with carboxylic acids so slowly that the reaction is unusable for preparation purposes.

Esters are produced when carboxylic acids are heated with alcohols in the presence of an acid catalyst. The catalyst is usually concentrated sulphuric acid. Dry hydrogen chloride gas is used in some cases, but these tend to involve aromatic esters (ones where the carboxylic acid contains a benzene ring). The esterification reaction is both slow and reversible.

4. A small but important use of ethylene oxide is the sterilization of medical equipment, including the sterilization of personal protective equipment used by doctors and hospitals across the country.

Most ethylene oxide is used as an intermediate in the production of other chemicals used to manufacture products, such as fabrics for clothes, upholstery, carpet and pillows.

Ethylene glycol, which is derived from ethylene oxide, is used to manufacture fiberglass used in products ranging from jet skis to bathtubs to bowling balls, as well as polyethylene terephthalate (PET) plastic resin to make beverage containers and packaging film.

H1. Give the IUPAC names of the following organic compounds



2. Discuss the properties of ethers

3. Discuss explicitly two methods of preparing ethers and show equations of reaction

4. State three uses of ethylene oxide

Answers

1a.  $\text{CH}_3\text{OCH}_3$ : Methoxymethane

b.  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ : Ethoxyethane

c.  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2)_2\text{O}$ : Pentanamide

d.  $\text{CH}_3\text{CH}_2\text{OCH}_3$ : Methoxychane

e.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_3$ : Ethoxyproane

2a. Physical Properties:

An ether molecule has a net dipole moment due to the polarity of C-O bonds.

The boiling point of ethers is comparable to the alkanes but much lower than that of alcohols of comparable molecular mass despite the polarity of the C-O bond.

The miscibility of ethers with water resembles those of alcohols.

Ether molecules are miscible in water. This is attributed to the fact that like alcohol, the oxygen atom of ether can also form hydrogen bonds with a water molecule.

b. Chemical Properties:

Doesn't react with bases, active metals, oxidizing agents and reducing agents

Strong acids will cleave esters at elevated temperatures

When stored in presence of oxygen, esters will form explosive