

Chemguide – questions

ALCOHOLS: MANUFACTURE

1. One way of manufacturing ethanol is by the direct hydration of ethene with steam. The mixture is passed over a suitable catalyst at a raised temperature and pressure. Only about 5% of the mixture reacts at each pass over the catalyst, and so the ethanol is separated and the unreacted gases passed through again.
- Write the equation for the reaction.
 - How is the ethanol separated from the reaction mixture?
 - Give the following conditions for the reaction:
 - the catalyst;
 - the pressure;
 - the temperature.
 - If you reacted other alkenes with steam under similar conditions, there may appear to be more than one possible alcohol that could be formed. But in practice, most of the product will be only one of those possibilities.

What would be the major product if you reacted the following alkenes with steam?

- propene: $\text{CH}_3\text{CH}=\text{CH}_2$
 - but-1-ene: $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$
2. Ethanol can also be made by fermentation. Starch in the raw material is treated in such a way as to produce a solution containing simpler carbohydrates. Yeast is added and the mixture left in the warm, and in the absence of air, until fermentation is complete.
- Name a possible raw material for this process.
 - Fermentation is under the control of enzymes in the yeast, and these first split whatever carbohydrates you have into very simple ones like fructose or glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ (fructose and glucose are isomers, and so have the same molecular formula). Write an overall equation to show the formation of ethanol from these simple carbohydrates.
 - The yeast is killed when the alcohol content gets to about 15%. How is the alcohol purified?
 - Give two advantages of this process over the direct hydration of ethene in question 1.
 - Give an advantage of the direct hydration process over this one.