CAIE IGCSE Chemistry

11.6 Alcohols

Notes

Describe the manufacture of ethanol by…

(a) Fermentation

- Ethanol can be manufactured through the fermentation of aqueous glucose in the following conditions:
  - In the absence of oxygen (anaerobic conditions)
  - At an optimum temperature of 25-30˚C
  - Using the enzymes in yeast
- The word and chemical equations for the fermentation of aqueous glucose to ethanol is:
  Glucose (+ Yeast) -> Ethanol + Carbon dioxide
  $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

(b) Catalytic addition of steam to ethene

- Ethanol can also be manufactured by reacting ethene with steam H_2O (g) in the following conditions:
  - In the presence of a phosphoric acid catalyst
  - At a temperature at 300˚C
  - At a pressure of 60 atm (6000kPa)
- The word and chemical equations for the catalytic addition of steam to ethene
  Ethene + Steam -> Ethanol
  $C_2H_4 + H_2O \rightarrow C_2H_5OH$

Describe the combustion of ethanol

- Ethanol can be burnt in air or oxygen (complete combustion) to produce carbon dioxide and water
- The balanced chemical equation for the complete combustion of ethanol is:
  $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$
- Can be used as a fuel in this way since ethanol releases a lot of energy when burnt in a good supply of oxygen

State the uses of ethanol as…

- A solvent
- A fuel

(Extended only) Outline the advantages and disadvantages of these two methods of manufacturing ethanol

Manufacturing method	Advantages	Disadvantages
Fermentation	▪ Renewable raw materials ▪ Warm, normal pressure (inexpensive) ▪ Little energy needed	▪ Batch process (stop-start) ▪ A lot of workers needed ▪ Slow ▪ Impure – needs treatment
Catalytic addition of steam to ethene	▪ Continuous process (runs all the time) ▪ Few workers needed ▪ Fast ▪ Pure	▪ Non-renewable raw materials ▪ High temperature and pressure (expensive) ▪ A lot of energy needed