

F322: Chains, Energy and Resources

2.4.2 Green Chemistry

1. Chemical companies are using catalysts to develop processes that are more sustainable. These processes reduce costs and are less harmful to the environment.

Suggest **two** ways in which the use of catalysts helps chemical companies to make their processes more sustainable.

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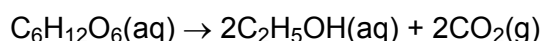
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[Total 4 marks]

2. Ethanol, C₂H₅OH, is manufactured on a large scale for a wide range of uses such as alcoholic drinks, as an industrial solvent and as a raw material for the synthesis of many organic compounds.

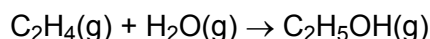
Ethanol, C₂H₅OH, is manufactured on a large scale by two methods:

- Fermentation, using yeast, of sugars, such as glucose, C₆H₁₂O₆.



The ethanol is then distilled off.

- Hydration of ethene, C₂H₄, with steam in the presence of an acid catalyst.



Compare the sustainability of these methods of manufacturing ethanol in terms of:

- availability of starting materials and energy requirements;
- atom economy.



In your answer, you should make clear how the atom economy of the processes links with chemical theory.

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[Total 7 marks]

3. Two workers decide to car-share on a 25 mile journey to work and back. On this journey, each of their cars uses petrol equivalent to 2.0 kg of heptane.

- (i) calculate the amount, in mol, of heptane, C_7H_{16} , saved;

[2]

(ii) calculate the energy saved ($\Delta H_c^\ominus [\text{C}_7\text{H}_{16}] = -4817 \text{ kJ mol}^{-1}$);

[1]

(iii) calculate the decrease in volume of $\text{CO}_2(\text{g})$ emitted into the atmosphere.

Assume that the conditions are the same as room temperature and pressure.

[2]

[Total 5 marks]