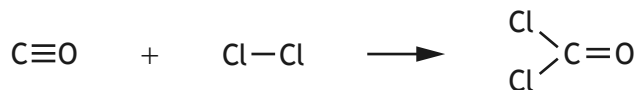


7. Carbon monoxide is a gas used in industry.

- (a) Carbon monoxide can be used to produce carbonyl dichloride, a chemical used in manufacturing plastics.

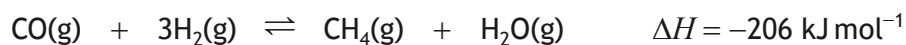


The enthalpy change,  $\Delta H$ , for this reaction is  $-107.6 \text{ kJ mol}^{-1}$ .

Using this data and the bond enthalpy values shown in the data booklet, calculate the bond enthalpy, in  $\text{kJ mol}^{-1}$ , of the  $\text{C}\equiv\text{O}$  bond.

2

- (b) Carbon monoxide can react with hydrogen to form methane.



Cooling the reaction mixture from  $400^\circ\text{C}$  to  $80^\circ\text{C}$  moves the position of equilibrium to the right, increasing the yield of methane.

State **two** reasons why the yield of methane is increased.

2



\* X 8 1 3 7 6 0 1 2 0 \*

7. (continued)

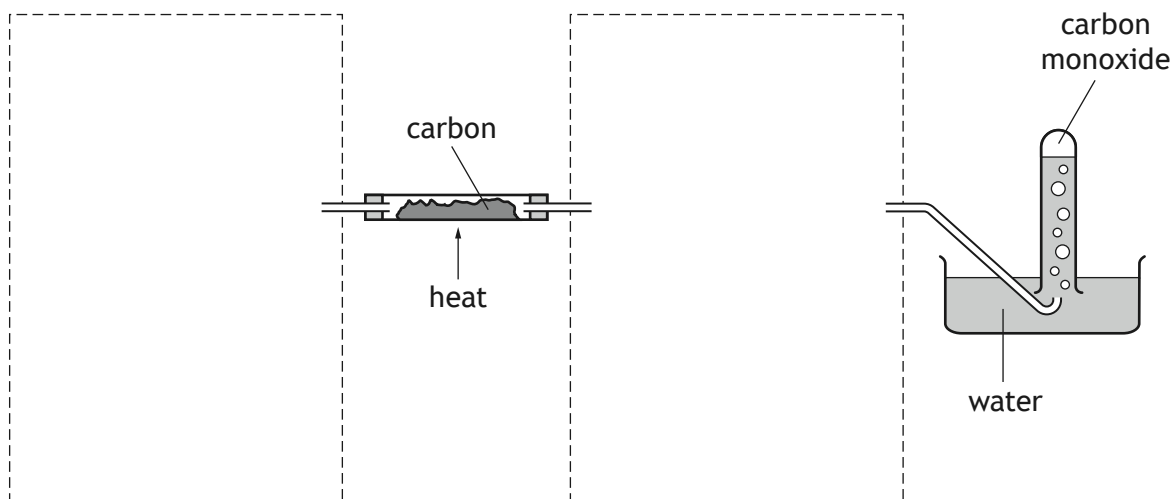
MARKS DO NOT WRITE IN THIS MARGIN

(c) Carbon monoxide can be produced in several ways.

- (i) One method of producing carbon monoxide is to react carbon dioxide with hot carbon.

The carbon dioxide is made by the reaction of dilute hydrochloric acid with solid calcium carbonate.

Unreacted carbon dioxide is removed by passing through a sodium hydroxide solution before the carbon monoxide is collected by displacement of water.



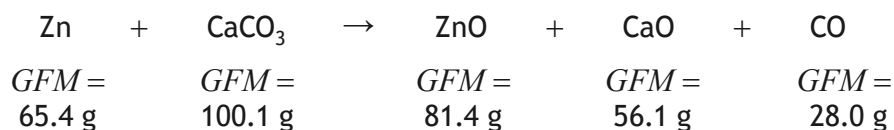
Complete the diagram to show how the carbon dioxide can be produced and how the unreacted carbon dioxide can be removed.

Your answer should include labels.

2

(An additional diagram, if required, can be found on page 34.)

- (ii) Carbon monoxide can also be produced by the reaction of zinc with calcium carbonate.



Calculate the atom economy for the production of carbon monoxide.

2

