

**Marks**  
**5**

- For the reaction  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$  at 25 °C

$$\Delta H^\circ = -198.4 \text{ kJ mol}^{-1} \text{ and } \Delta S^\circ = -187.9 \text{ J K}^{-1} \text{ mol}^{-1}$$

Show that this reaction is spontaneous at 25 °C.

**A reaction is spontaneous if  $\Delta G^\circ < 0$ . Using  $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$ :**

$$\begin{aligned} \Delta G^\circ &= (-198.4 \times 10^3 \text{ J mol}^{-1}) - ((25 + 273) \text{ K}) \times (-187.9 \text{ J K}^{-1} \text{ mol}^{-1}) \\ &= -142000 \text{ J mol}^{-1} = -142 \text{ kJ mol}^{-1} \end{aligned}$$

**Hence,  $\Delta G^\circ < 0$  and the reaction is spontaneous.**

If the volume of the reaction system is increased at 25 °C, in which direction will the reaction move?

**In the reaction, three moles of gas are converted into two moles of gas. Increasing the volume lowers the pressure. The system responds by acting to increase the pressure – it shifts to the left (more reactants).**