

- The isomerisation of glucose-6-phosphate (G6P) to fructose-6-phosphate (F6P) is a key step in the metabolism of glucose for energy.

Marks
6



At 298 K, the equilibrium constant for the isomerisation is 0.510. Calculate the value of ΔG° at 298 K.

$$\begin{aligned} \Delta G^\circ &= -RT \ln K = -(8.314 \text{ J K}^{-1} \text{ mol}^{-1}) \times (298 \text{ K}) \times \ln(0.510) \\ &= +1670 \text{ J mol}^{-1} = +1.67 \text{ kJ mol}^{-1} \end{aligned}$$

Answer: **+1.67 kJ mol⁻¹**

Calculate ΔG at 298 K when the $[\text{F6P}] / [\text{G6P}]$ ratio = 10.

The reaction quotient, for the reaction, is $Q = \frac{[\text{F6P}]}{[\text{G6P}]} = 10$

Using $\Delta G = \Delta G^\circ + RT \ln Q$,

$$\begin{aligned} \Delta G &= (+1.67 \times 10^3 \text{ J mol}^{-1}) + (8.314 \times 298 \text{ J mol}^{-1}) \times \ln(10) \\ &= +7400 \text{ J mol}^{-1} = +7.4 \text{ kJ mol}^{-1} \end{aligned}$$

Answer: **+7.4 kJ mol⁻¹**

In which direction will the reaction shift in order to establish equilibrium? Why?

As ΔG is positive, the forward reaction is non-spontaneous and the backward reaction is spontaneous. The reaction thus shift backwards, increasing $[\text{G6P}]$ and reducing $[\text{F6P}]$ until $Q = K$.

Sketch a graph of G_{sys} versus "extent of reaction", with a curve showing how G_{sys} varies as G6P is converted to F6P. Indicate the position on this curve corresponding to the point where $[\text{F6P}] / [\text{G6P}]$ ratio = 10. Indicate on the graph that section of the curve where $Q > K$.

