Solutions

Each answer shows the steps, then the **result**.

2.1

- $\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus}$

2.2

- $\Delta G \leq 0$ (negative or zero)

2.3

- $-198 \div 1000 = \mathbf{-0.198}$ kJ $K^{-1}mol^{-1}$

2.4

- **positive**

3.1 A

- With $-\Delta$H and $+\Delta$S, ΔG is negative at all temperatures

3.2 B

- Temperature must be in kelvin

3.3

(a)

- $\Delta G = 120 - 298(0.200) = 120 - 59.6 = +60.4$ kJ mol^{-1}; not feasible (positive ΔG)

(b)

- feasible when $\Delta G = 0$: $T = \Delta H/\Delta S = 120/0.200 = 600$ K

3.4

- at low T the $T\Delta S$ term is small, so $\Delta G = \Delta H - T\Delta S$ stays positive; raising T increases $T\Delta S$ until it exceeds ΔH, making ΔG negative and the reaction feasible

3.5

(a)

- $\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus} = -92 - 298 \times (-0.198)$
- $\Delta G^{\ominus} = -92 + 59.0 = \mathbf{-33}$ kJ mol^{-1}

(b)

- the reaction stops being feasible when $\Delta G = 0$, so $T = \dfrac{\Delta H}{\Delta S} = \dfrac{-92}{-0.198}$
- $T = \mathbf{465}$ K

(c)

- the activation energy is high, so the rate is very slow