Answers to Exercise 6.3
Entropy Calculations

1. **Step 1: Write a balanced chemical equation for the reaction.**

$H_2O_{(l)} \rightarrow H^+_{(aq)} + OH^-_{(aq)}$

Step 2: Calculate standard entropy change for the reaction from standard entropies

$\Delta_r S° = \sum S°(products) - \sum S°(reactants)$

$\Delta_r S° = \left[S°\left(H^+_{(aq)}\right) + S°\left(OH^-_{(aq)}\right)\right] - S°\left(H_2O_{(l)}\right)$

$\Delta_r S° = \left[\left(0\ \frac{J}{mol·K}\right) + \left(-10.75\ \frac{J}{mol·K}\right)\right] - \left(69.91\ \frac{J}{mol·K}\right)$

$\Delta_r S° = -80.66\ \frac{J}{mol·K}$

Step 3: Check your work

Does your answer seem reasonable? Are sig. fig. correct?

Not counting $S°\left(H^+_{(aq)}\right)$ *– which is defined as exactly* $0\frac{J}{mol·K}$ *– the fewest number of decimal places for any value used in this calculation is two. Therefore, since the numbers are added/subtracted, the answer should have two decimal places.*

This process has a negative standard entropy change so it is not favoured by entropy (under standard conditions).

2. **Step 1: Write a balanced chemical equation for the reaction.**

$2\ Cl_{(g)} \rightarrow Cl_{2(g)}$

Step 2: Calculate standard entropy change for the reaction from standard entropies

$\Delta_r S° = \sum S°(products) - \sum S°(reactants)$

$\Delta_r S° = S°\left(Cl_{2(g)}\right) - 2\ S°\left(Cl_{(g)}\right)$

$\Delta_r S° = \left[\left(223.1\ \frac{J}{mol·K}\right)\right] - 2\left(165.2\ \frac{J}{mol·K}\right)$

$\Delta_r S° = -107.3\ \frac{J}{mol·K}$

Step 3: Check your work

Does your answer seem reasonable? Are sig. fig. correct?

The fewest number of decimal places for any value used in this calculation is one. Therefore, since the numbers are added/subtracted, the answer should have one decimal place.

This process has a negative standard entropy change so it is not favoured by entropy (under standard conditions). This makes sense since the order of the system is increased when two gas particles combine to make one larger gas particles.