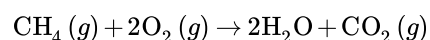


21.9: Standard Entropies Can Be Used to Calculate Entropy Changes of Chemical Reactions

Entropy is a state function, so we can calculate values for a process using any path. This allows us to calculate the entropy change of a chemical reaction using standard entropies. Specifically, we sum the entropies of the products and subtract the entropies of the reactants:

$$\Delta_{rxn} S^{\circ} = \sum_{\text{Products}} v_i S_i^{\circ} - \sum_{\text{Reactants}} v_i S_i^{\circ}$$

Where v_i is the stoichiometric coefficient. Let's look at the combustion of methane:



The standard entropies are:

| Molecule | Entropy $\left(\frac{\text{J}}{\text{mol}\cdot\text{K}}\right)$ |
|------------------|---|
| CH ₄ | 186.25 ¹ |
| O ₂ | 205.15 ¹ |
| H ₂ O | 188.84 ¹ |
| CO ₂ | 213.79 ¹ |

The entropy for the combustion of methane is:

$$\Delta S^{\circ} = [2(188.84) + 1(213.70)] - [1(186.25) + 2(205.15)] = -5.17 \frac{\text{J}}{\text{mol}\cdot\text{K}}$$

References

1. Chase, M.W., Jr., *NIST-JANAF Thermochemical Tables, Fourth Edition*, **J. Phys. Chem. Ref. Data, Monograph 9**, 1998, 1-1951.

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