

Exercise 6: Thermodynamics of combustion

1. Write the **balanced** equation for the complete combustion of propane at room temperature (298 K). Recall that one of the products is *liquid* water.

2. Use the table below to show that the combustion of propane is a **spontaneous** reaction at standard conditions.

Compound	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S_f° (J/mol·K)
C ₂ H ₆ (g)	- 84.5	- 32.9	229.5
C ₃ H ₈ (g)	- 104	- 23.0	269.9
C ₄ H ₁₀ (g)	- 126	- 17.0	310.2
CO ₂ (g)	- 394	- 394.4	213.6
O ₂ (g)	0	0	205.0
H ₂ O (g)	- 242	- 228.6	188.7
H ₂ O (l)	- 286	- 237.2	69.96

3. Use the table on the previous page to show that the combustion of propane is a spontaneous reaction at standard conditions in a manner **different** than what you did in problem 2.

4. Reconsider the problem if the reaction occurred at 65°C ($= 338\text{ K}$); assess whether the reaction is more spontaneous or less spontaneous than at 25°C from the previous problems.

5. Reconsider the problem if the reaction occurred at 105°C ($= 378\text{ K}$); assess whether the reaction is more spontaneous or less spontaneous than at 25°C from the previous problems. **Caution:** What other factor, besides the temperature, changes?

6. In general, then, for exothermic reactions, as the temperature of the reaction increases, the reaction itself is (more/less) spontaneous.