



## Enthalpy, Entropy, and Free Energy Calculations

4. Consider these thermodynamic values for hypothetical compounds:

Species (state)	$\Delta H_f^\circ$ (kJ/mol)	$S^\circ$ (J/mol K)
A(g)	-386.5	177.0
B(g)	-139.9	234.8
Y(g)	33.6	277.1
Z(g)	-295.2	301.3

Is the reaction  $A + B \rightarrow Y + Z$  spontaneous? Is the reaction  $Y + Z \rightarrow A + B$  spontaneous? Briefly and clearly explain your answers.

*Use data from the thermodynamic tables in your textbook or other resource as necessary to answer the questions.*

5. Determine the free energy change when 1.00 L of ethane,  $C_2H_6(g)$ , at  $25^\circ C$  and 1.0 atm pressure, is completely oxidized.
6. Consider the decomposition of solid ammonium chloride to ammonia and hydrogen chloride gases. What do you predict for the sign of  $\Delta S^\circ$ ? *positive* or *negative* Calculate the value of  $\Delta S^\circ$  for the reaction. Show your calculation.

Now consider the decomposition of aqueous ammonium chloride to aqueous ammonia and hydrochloric acid. What do you predict for the sign of  $\Delta S^\circ$ ? *positive* or *negative* Compare your prediction to the calculated value. Show your calculation.