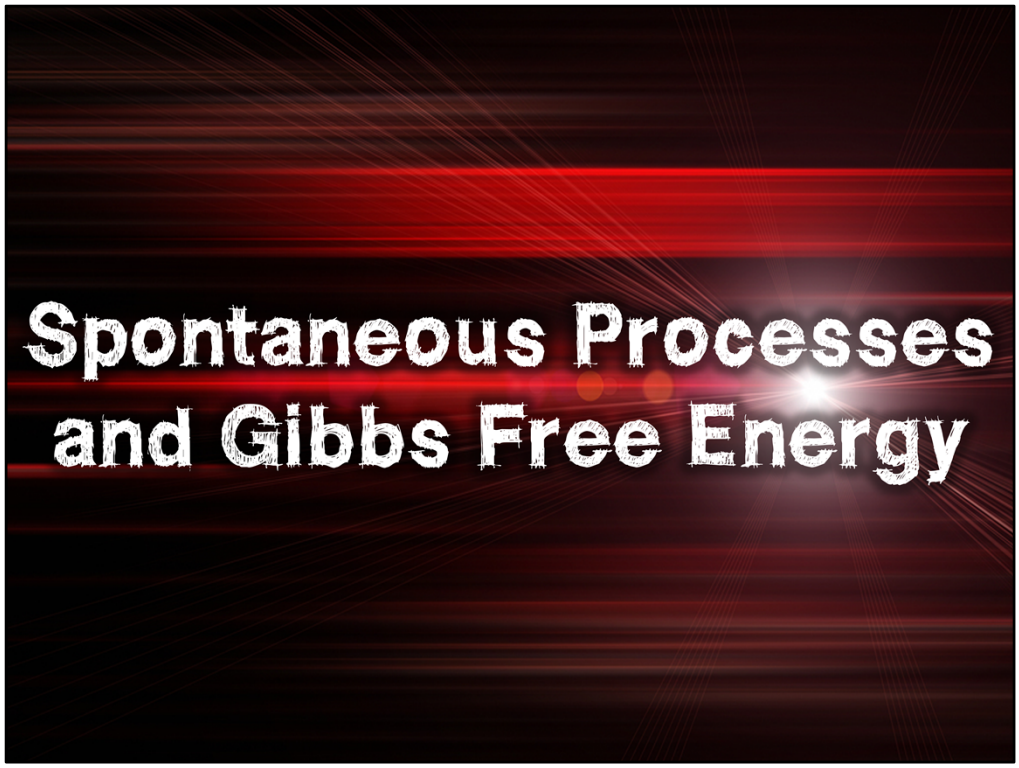
Module 8: Thermochemistry

Topic 5 Content: Spontaneous Processes and Gibbs Free Energy Presentation Notes



Spontaneous Processes and Gibbs Free Energy

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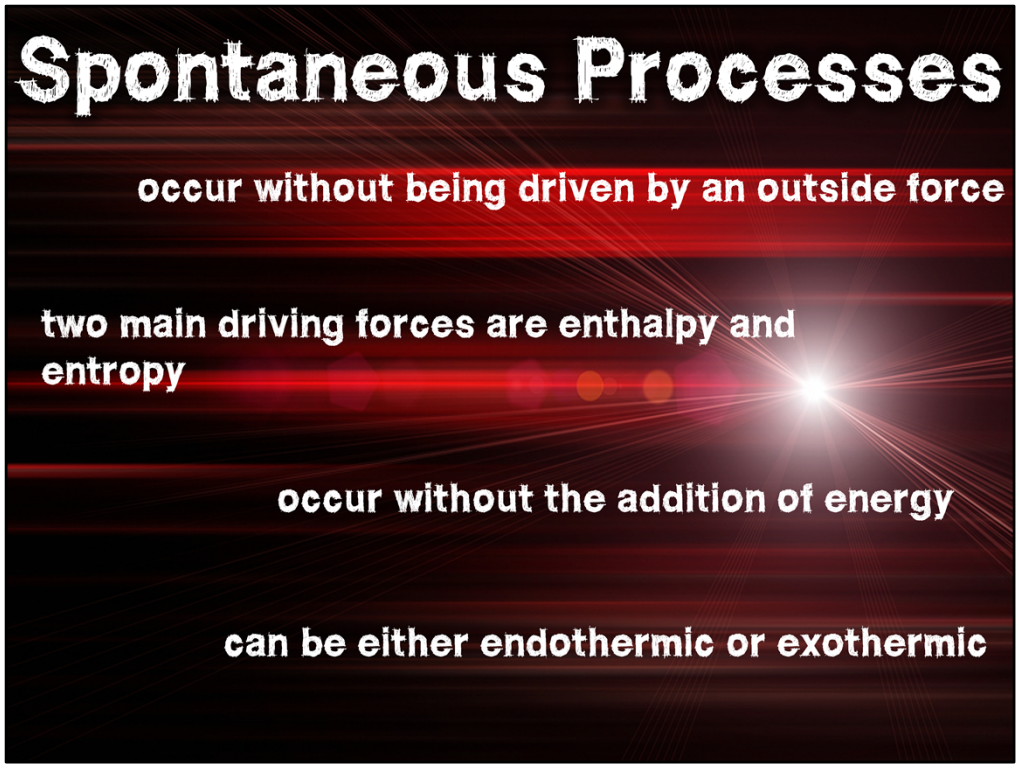

A reaction is spontaneous if it occurs without being driven by an outside force. The two main driving forces are enthalpy and entropy. Spontaneous reactions occur without the addition of energy. Non-spontaneous reactions occur when outside energy, such as a catalyst, heat, or pressure, start the reaction. Spontaneous and non-spontaneous reactions can be either endothermic or exothermic.

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Gibbs free energy is defined as the maximum energy available to do work. To determine Gibbs free energy you must combine the change in enthalpy of a system and the change of entropy of a reaction.

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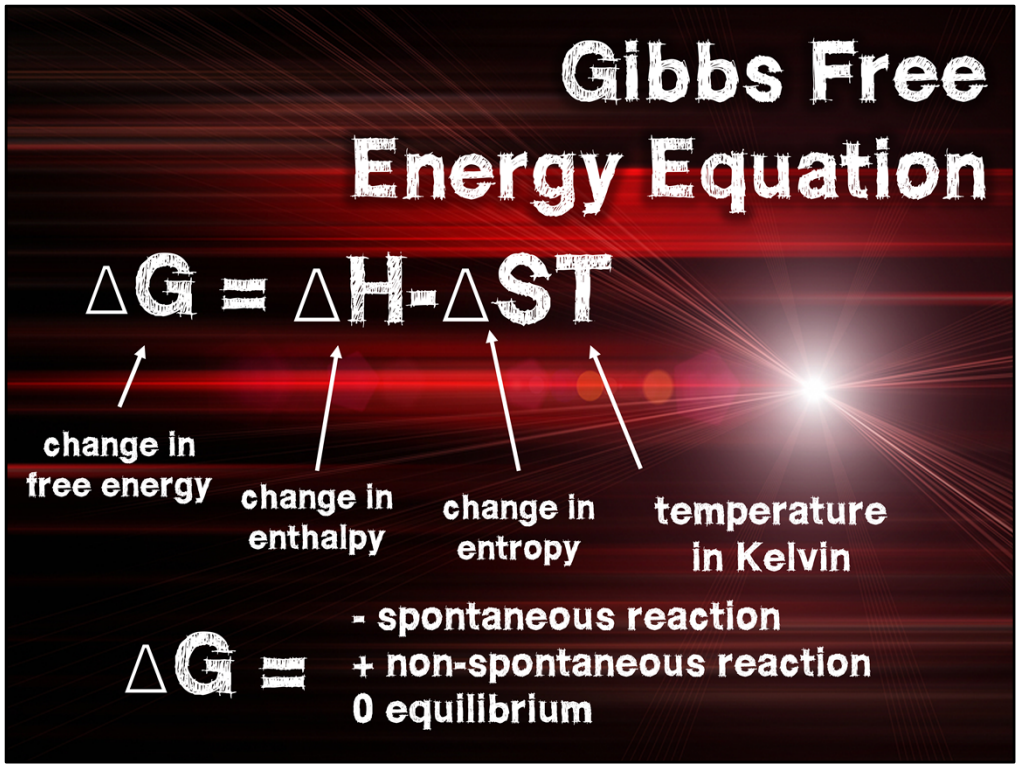

To solve for free energy, or ΔG, use the equation shown here. This equation tells you that the change in free energy is equal to the change in enthalpy minus the change in entropy times temperature. When calculating Gibbs free energy, the temperature must be converted to Kelvin. A negative value of ΔG indicates a spontaneous reaction. A positive value indicates a non-spontaneous reaction. If ΔG is equal to zero, the reaction is in equilibrium.

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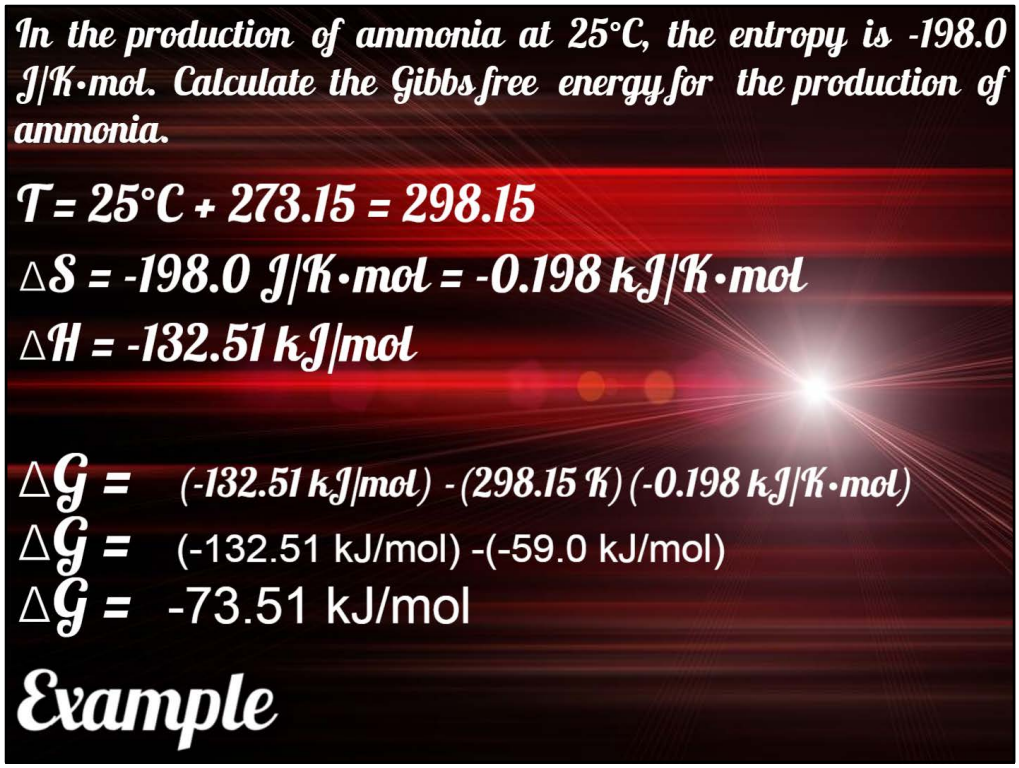

Please view how this example problem is solved:

In the production of ammonia at 25°C, the entropy is -198.0 J/K·mol. Calculate the Gibbs free energy for the production of ammonia.

To start this problem, it is best to list the known and unknown variables. Since the temperature was given in degrees Celsius, you will need to convert this value to Kelvin. The change in entropy is converted from J/K·mol to kJ/K·mol. The enthalpy of ammonia is determined using the Standard Enthalpy of Formation for Various Compounds Table. Once you found and listed these variables, plug them into the Gibbs free energy equation and solve the problem. This example has a negative value for entropy. A negative value represents a spontaneous reaction.