

Chemical Reaction	w	ΔH	ΔS_r	ΔG	Spontaneous at high, low, all, or no T?
$\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l})$					
$2 \text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2 \text{H}_2\text{O}(\text{g})$					
$\text{C}_2\text{H}_5\text{OH}(\text{l}) + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{CO}_2(\text{g}) + 3 \text{H}_2\text{O}(\text{l})$					
$\text{CCl}_4(\text{l}) \rightarrow \text{C}(\text{s}) + 2 \text{Cl}_2(\text{g})$ This is a non-spontaneous reaction					
$\text{Ba}(\text{OH})_2 \cdot (\text{H}_2\text{O})_8(\text{s}) + 2 \text{NH}_4\text{NO}_3(\text{s})$ $\rightarrow \text{Ba}(\text{NO}_3)_2(\text{s}) + 2 \text{NH}_3(\text{g}) + 10 \text{H}_2\text{O}(\text{l})$ This is a spontaneous, endothermic reaction.					
$2 \text{O}_3(\text{g}) \rightarrow 3 \text{O}_2(\text{g})$ This is a spontaneous, slightly exothermic reaction.					
$\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l})$					
$\text{CO}_2(\text{g}) \rightarrow \text{CO}_2(\text{s})$					
$\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$ This is a spontaneous reaction.					
$2 \text{H}_2\text{O}_2(\text{l}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$ This is a spontaneous, exothermic reaction					

For each reaction, indicate whether w, enthalpy change, entropy change, and Gibbs free energy would be negative, positive, or zero. Assume standard conditions. Predict when it is likely to be spontaneous.

The real focus here is to understand the concepts and be able to make predictions without doing the calculations. If you want extra practice on the calculations, you can *later*, after making your predictions, calculate actual numbers for each column using thermodynamic values from Appendix 4 (and some provided). We will post the numerical answers later so you can check your work.