Homework 18-1: Ch. 18.1-18.4: Spontaneous Processes; Entropy; Second Law of Thermodynamics
Problems pg. 790 #2, 4, 5, 10, 12, 13

18.2 Which of the following processes are spontaneous and which are nonspontaneous?
(a) dissolving table salt in hot soup
(b) climbing Mt. Everest
(c) spreading fragrance in a room
(d) separating helium and neon from a mixture

18.4 Define entropy. What are the units of entropy?

18.5 How does the entropy of a system change for each of the following processes?
(a) A solid melts
(b) A liquid freezes
(c) A liquid boils
(d) A vapor is converted to a solid
(e) A vapor condenses to a liquid
(f) A solid sublimes
(g) Urea dissolves in water

18.10 Arrange the following substances (1 mole each) in order of increasing entropy at 25°C and describe each substance to explain:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Ne(g)</td>
<td></td>
</tr>
<tr>
<td>(b) SO₂(g)</td>
<td></td>
</tr>
<tr>
<td>(c) Na(s)</td>
<td></td>
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<tr>
<td>(d) NaCl(s)</td>
<td></td>
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<tr>
<td>(e) H₂(g)</td>
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</tbody>
</table>

18.12 Using the data in Appendix 3, calculate the standard entropy changes for the following reactions at 25°C:

\[
\Delta S_{\text{rxn}}^\circ = \Sigma n S^\circ(\text{products}) - \Sigma m S^\circ(\text{reactants})
\]

(a) \( \text{H}_2(\text{g}) + \text{CuO}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{H}_2\text{O}(\text{g}) \)

(b) \( 2 \text{Al}(\text{s}) + 3 \text{ZnO}(\text{s}) \rightarrow \text{Al}_2\text{O}_3(\text{s}) + 3 \text{Zn}(\text{s}) \)
18.13  Without consulting Appendix 3, predict whether the entropy change is positive or negative for each of the following reaction. Give reasons for your predictions.

(a) 2 KClO₄(s) → 2 KClO₃(s) + O₂(g)

(b) H₂O(g) → H₂O(l)

(c) 2Na(s) + 2 H₂O(l) → 2 NaOH(aq) + H₂(g)

(d) N₂(g) → 2 N(g)