PROBLEM 14.74

**KNOWN:** The system is a two-phase liquid-vapor mixture at 100°C, (b) water at 20°C.

**FIND:** Using tabulated property data show that $g_f = g_g$.

**ANALYSIS:**

(a) At 100°C, Table A-2 gives

\[
\begin{align*}
  h_f &= 419.04 \text{ kJ/kg} \\
  h_g &= 2676.1 \text{ kJ/kg} \\
  s_f &= 1.2069 \text{ kJ/kg·K} \\
  s_g &= 7.2549 \text{ kJ/kg·K}
\end{align*}
\]

Then, with $q = h - T_s$

\[
\begin{align*}
  g_f &= h_f - T_f s_f = 419.04 - (373.15)(1.2069) = -6.487 \text{ kJ/kg} \\
  g_g &= h_g - T_g s_g = 2676.1 - (373.15)(7.2549) = -6.487 \text{ kJ/kg}
\end{align*}
\]

(b) At 20°C, Table A-10 gives

\[
\begin{align*}
  h_f &= 77.26 \text{ kJ/kg} \\
  h_g &= 258.96 \text{ kJ/kg} \\
  s_f &= 0.2924 \text{ kJ/kg·K} \\
  s_g &= 0.9102 \text{ kJ/kg·K}
\end{align*}
\]

Then, with $q = h - T_s$

\[
\begin{align*}
  g_f &= 77.26 - (293.15)(0.2924) = -8.457 \text{ kJ/kg} \\
  g_g &= 258.96 - (393.15)(0.9102) = -8.445 \text{ kJ/kg}
\end{align*}
\]

1. As developed in Sec. 6.3.1, $s_g - s_f = (h_g - h_f) / T$ for a change in phase from saturated liquid to saturated vapor at $T$. Thus $h_g - T s_g = h_f - T s_f$, or $g_g = g_f$. The slight difference in the calculated values of $g_g$ and $g_f$ owes to table roundoff and signifies a slight inconsistency in table values.