Chapter 6 Problems

1. Use program STEAM to calculate the Joule-Thompson coefficient μ_{JT} from 165 to 365 bars ar 350°C, and use these values to calculate the amount of cooling in the boxed example on page 156.

2. At what pressure will graphite be converted to diamond at 25°C? At 100°C?

3. Calculate the pressure at which jadeite is in equilibrium with low albite and nepheline at 300°C.

4. At what temperature does gibbsite break down (dehydrate) to form corundum and water? Assume a pressure of 1 bar. Actually, because the temperature is greater than 100°C and liquid water is present, the pressure will be somewhat greater than 1 bar, but this will not greatly affect the Gibbs energies.

5. Show that dolomite is stable relative to calcite plus magnesite at 25°C and 1 bar.

6. Above what temperature will α-cristobalite become the stable form of SiO_2 (i.e., more stable than α-quartz) at 1 bar?

7. Calculate the pressure and temperature of the triple point in Figure 6.4. You can do this

   (a) using the data in Appendix B,

      i. graphically, by finding the location of at least two boundaries at at least two different pressures;

      ii. by obtaining an equation for at least two of the boundaries in the form $y = ax + b$, and solving for P and T;

   (b) by using the univariant curve option in SUPCRT92 for at least two of the boundaries, and plotting them.

8. Consider these data for the two polymorphic compounds, α and β:

	$\Delta_f H^\circ$ kJ mol^{-1}	$\Delta_f G^\circ$ kJ mol^{-1}	S° J mol^{-1} deg^{-1}	V° cm^3 mol^{-1}
α (s)	-2600	-2440	90.0	50.0
β (s)	-2598	-2437	93.4	49.0
α (aq)		-2415		

   (a) Which polymorph is more stable at 25°C, 1 bar? Why?

   (b) Which is the high temperature form? Why?

   (c) Which is the high pressure form? Why?

   (d) Calculate the slope of the phase boundary in bars/degree.

   (e) Calculate the equilibrium pressure at 25°C.

   (f) Sketch the P–T phase diagram showing the location of 25°C, 1 bar, and the phase boundary between α and β.

(g) Sketch a G–T and a G–P section through the phase boundary.

(h) What is the solubility of α?

$$\alpha(s) = \alpha(aq)$$

(i) Does β have a greater or smaller solubility? Explain.