Chapter 2
1.   Consider an alloy containing 50% nickel and 50% copper. Assume equilibrium.
    a.   On cooling what is the composition of the first solid to form?
    b.   At 1300°C, what are the compositions of the two phases?
    c.   At 1300°C what fraction of the alloy is solid?
Soln: a. 70% Ni, 30% Cu; b solid contains 65% Ni, 35% Cu, liquid contains 45% Ni, 55% Cu;
Fraction solid = (55-50)/(55-35) = 25%

2.   Consider Figure 2.6.
    a.   Discuss the relative density of phases III and Ih (ice).
    b.   Discuss the relative density of phase III and Liquid (water)
soln: a Phase III is denser. An increase of pressure causes Ih to transform to III.
b. Phase III is denser than the liquid. An increase of pressure causes water to transform to III.

3. Consider Figure 2.12. At 120°C, what fraction of the mixture of polybutadiene and 40% polystyrene is in the form of liquid 1?

Figure 2.12   The polybutadiene- polystyrene phase diagram.

140
Liquid 1   Liquid 2
120
                          Liquid
100
80
0   20   40   60   80   100
% polystyrene
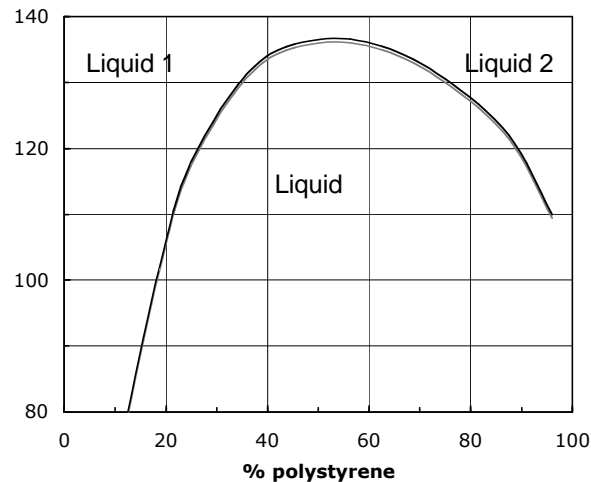
soln: F_{Liq1} = (90-40)/(90-28) = 81%

4.   If a steel containing 0.35% carbon is slowly cooled, what weight percent of the alloy will be in the form of Fe_3C? (See Figure 2.5)
Soln: F_{Fe3C} = (0.35-0)/6.7-0) = 52%

5.   If the average diameter of grains in a metal were 1 mm, what would the ASTM grain size number be?
Soln: The area of the grain would be $(1/25.4)^2$ in^2 = 1.55×10^{-3}in^2. At 200 magnification, 1 in^2 represents $(1/200)^2$ in^2, so n =(1/200)/6= 1.55×10^{-3}in^2 1.55×10^{-3} =   62. ln$n$ = (N-1)ln2, so N = ln(62)/ln2) + 1 = 7.

6. Name the invariant reactions that occur in the iron-iron carbide system at 727, 1148 and 1495°C.
 Soln: at 727°C there is a eutectoid reaction, at 1148°C there is a eutectic reaction, at 1495 there is a peritectic reaction.

7.   If the ratio of iron ions to oxygen ions in FeO is 0.99, what fraction of the Fe sites are filled with Fe^{+3} ions?

Soln: 1 percent of the iron sites are vacant. There must be 2 Fe^{+3} ions for each vacant Fe site so 2% of the iron sites are filled by Fe^{+3}.