Benzene in naphthalene. The calculation is done in the same manner:

$$\ln x_B = -\frac{9866.3 \text{ (J/mol)}}{(8.314 \text{ J/mol K})(278.63 \text{ K})}\left(\frac{278.63 \text{ K}}{273.15 \text{ K}} - 1\right) = -0.0854468,$$

from which we find

$$x_N = 0.918.$$

Comments Even though naphthalene and benzene in pure form at 0 °C are both solid, upon mixing them they form a liquid that can contain up to 91.8% benzene by mol. This is demonstration of freezing-point depression and is discussed further in the next section.

Phase Diagram and Freezing Point Depression

13.10

The calculation of Example 13-14 can be repeated at other temperatures to obtain the solubility of naphthalene and benzene in each other. Figure 13-14 shows the calculated solubility lines plotted against the mole fraction of naphthalene (the solubility of benzene is plotted against $x_N = 1 - x_B$). Point A corresponds to the solubility of naphthalene in benzene at 40 °C and point A' to the solubility of benzene in naphthalene at 0 °C. Both solubilities increase with increasing temperature, as eq. (13.30) indicates. The solubility lines also indicate the phase boundary of the system. To see why this is so, let us examine point A, which gives the solubility (maximum mole fraction) of naphthalene in benzene at 40 °C. To the left of this point we have a homogenous solution because the mol fraction of naphthalene is less

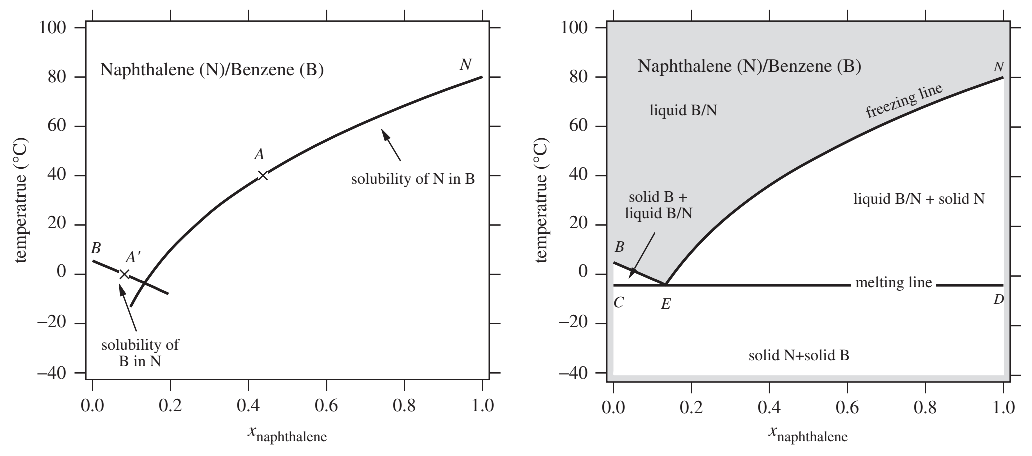

Figure 13-14: Ideal solubility between naphthalene (N) and benzene (B). Left: solubility curves; right: phase diagram. (See Example 13.10.)