9.17 This problem asks if a noncold-worked Cu-Ni solid solution alloy is possible having a minimum tensile strength of 380 MPa (55,000 psi) and also a ductility of at least 45%EL. From Figure 9.5a, a tensile strength greater than 380 MPa is possible for compositions between about 34 and 87 wt% Ni. On the other hand, according to Figure 9.5b, ductilities greater than 45%EL exist for compositions less than about 7 wt% and greater than about 71 wt% Ni. Therefore, the stipulated criteria are met for all compositions between 71 and 87 wt% Ni.

9.19 It is possible to have a Cu-Ag alloy, which at equilibrium consists of an α phase of composition 5 wt% Ag-95 wt% Cu and a β phase of composition 95 wt% Ag-5 wt% Cu. From Figure 9.6 a horizontal tie can be constructed across the α + β region at 690°C which intersects the α-(α + β) phase boundary at 5 wt% Ag, and also the (α + β)-β phase boundary at 95 wt% Ag.

9.20 Upon heating a lead-tin alloy of composition 30 wt% Sn-70 wt% Pb from 150°C and utilizing Figure 9.7:
(a) the first liquid forms at the temperature at which a vertical line at this composition intersects the eutectic isotherm--i.e., at 183°C;
(b) the composition of this liquid phase corresponds to the intersection with the (α + L)-L phase boundary, of a tie line constructed across the α + L phase region just above this eutectic isotherm--i.e., \( C_L = 61.9 \) wt% Sn;
(c) complete melting of the alloy occurs at the intersection of this same vertical line at 30 wt% Sn with the (α + L)-L phase boundary--i.e., at about 260°C;
(d) the composition of the last solid remaining prior to complete melting corresponds to the intersection with α-(α + L) phase boundary, of the tie line constructed across the α + L phase region at 260°C--i.e., \( C_\alpha \) is about 13 wt% Sn.

9.22 (a) In order to determine the temperature of a 65 wt% Ni-35 wt% Cu alloy for which α and liquid phases are present with the α phase of composition 70 wt% Ni, we need to construct a tie line across the α + L phase region of Figure 9.2a that intersects the solidus line at 70 wt% Ni; this is possible at about 1340°C.
(b) The composition of the liquid phase at this temperature is determined from the intersection of this same tie line with liquidus line, which corresponds to about 59 wt% Ni.

(c) The mass fractions of the two phases are determined using the lever rule, Equations (9.1) and (9.2) with \( C_o = 65 \text{ wt}\% \text{ Ni} \), \( C_L = 59 \text{ wt}\% \text{ Ni} \), and \( C_\alpha = 70 \text{ wt}\% \text{ Ni} \), as

\[
W_\alpha = \frac{C_o - C_L}{C_\alpha - C_L} = \frac{65 - 59}{70 - 59} = 0.55
\]

\[
W_L = \frac{C_\alpha - C_o}{C_\alpha - C_L} = \frac{70 - 65}{70 - 59} = 0.45
\]

9.28 It is not possible to have a 50 wt% Pb-50 wt% Mg alloy which has masses of 5.13 kg and 0.57 kg for the \( \alpha \) and Mg\( _2 \)Pb phases, respectively. In order to demonstrate this, it is first necessary to determine the mass fraction of each phase as follows:

\[
W_\alpha = \frac{m_\alpha}{m_\alpha + m_{\text{Mg}_2\text{Pb}}} = \frac{5.13 \text{ kg}}{5.13 \text{ kg} + 0.57 \text{ kg}} = 0.90
\]

\[
W_{\text{Mg}_2\text{Pb}} = 1.00 - 0.90 = 0.10
\]

Now, if we apply the lever rule expression for \( W_\alpha \)

\[
W_\alpha = \frac{C_{\text{Mg}_2\text{Pb}} - C_o}{C_{\text{Mg}_2\text{Pb}} - C_\alpha}
\]

Since the Mg\( _2 \)Pb phase exists only at 81 wt% Pb, and \( C_o = 50 \text{ wt}\% \text{ Pb} \)

\[
W_\alpha = 0.90 = \frac{81 - 50}{81 - C_\alpha}
\]

Solving for \( C_\alpha \) from this expression yields \( C_\alpha = 46.6 \text{ wt}\% \text{ Pb} \). From Figure 9.18, the maximum concentration of Pb in the \( \alpha \) phase in the \( \alpha + \text{Mg}_2\text{Pb} \) phase field is about 42 wt% Pb. Therefore, this alloy is not possible.
9.35 We are given a hypothetical eutectic phase diagram for which $C_{\text{eutectic}} = 64\, \text{wt}\%\, \text{B}$, $C_\alpha = 12\, \text{wt}\%\, \text{B}$ at the eutectic temperature, and also that $W_{\beta'} = 0.367$ and $W_\beta = 0.768$; from this we are asked to determine the composition of the alloy. Let us write lever rule expressions for $W_{\beta'}$ and $W_\beta$

$$W_\beta = \frac{C_o - C_\alpha}{C_\beta - C_\alpha} = \frac{C_o - 12}{C_\beta - 12} = 0.768$$

$$W_{\beta'} = \frac{C_o - C_{\text{eutectic}}}{C_\beta - C_{\text{eutectic}}} = \frac{C_o - 64}{C_\beta - 64} = 0.367$$

Thus, we have two simultaneous equations with $C_o$ and $C_\beta$ as unknowns. Solving them for $C_o$ gives $C_o = 75\, \text{wt}\%\, \text{B}$.

9.55 The mass fractions of proeutectoid ferrite and pearlite that form in a $0.25\, \text{wt}\%\, \text{C}$ iron-carbon alloy are considered in this problem. From Equation (9.18)

$$W_p = \frac{C_o' - 0.022}{0.74} = \frac{0.25 - 0.022}{0.74} = 0.31$$

And, from Equation (9.19)

$$W_\alpha = \frac{0.76 - C_o'}{0.74} = \frac{0.76 - 0.25}{0.74} = 0.69$$