8.5 A specimen of a 4340 steel alloy with a plane strain fracture toughness of 54.8 MPa (50 ksi ) is exposed to a stress of 1030 MPa (150,000 psi). Will this specimen experience fracture if the largest surface crack is 0.5 mm (0.02 in.) long? Why or why not? Assume that the parameter Y has a value of 1.0.

8.13 The following tabulated data were gathered from a series of Charpy impact tests on a tempered 4340 steel alloy.

Temperature (°C) Impact Energy (J)

0 105

–25 104

–50 103

–75 97

–100 63

–113 40

–125 34

–150 28

–175 25

–200 24

(a) Plot the data as impact energy versus temperature. (b) Determine a ductile-to-brittle transition temperature as the temperature corresponding to the average of the maximum and minimum impact energies. (c) Determine a ductile-to-brittle transition temperature as the temperature at which the impact energy is 50 J.

8.22 The fatigue data for a brass alloy are given as follows:

Stress Amplitude (MPa) Cycles to Failure

170 3.7 ×

148 1.0 ×

130 3.0 ×

114 1.0 ×

92 1.0 ×

80 1.0 ×

74 1.0 ×

(a) Make an S–N plot (stress amplitude versus logarithm of cycles to failure) using these data. (b) Determine the fatigue strength at 4 × 106 cycles. (c) Determine the fatigue life for 120 MPa.

8.30 Give the approximate temperature at which creep deformation becomes an important consideration for each of the following metals: tin, molybdenum, iron, gold, zinc, and chromium.

8.45 Cite three metallurgical/processing techniques that are employed to enhance the creep resistance of metal alloys.

9.22 A 40 wt% Pb–60 wt% Mg alloy is heated to a temperature within the α + liquid-phase region. If the mass fraction of each phase is 0.5, then estimate: (a) the temperature of the alloy (b) the compositions of the two phases in weight percent (c) the compositions of the two phases in atom percent

9.31 It is desirable to produce a copper–nickel alloy that has a minimum non-cold-worked tensile strength of 380 MPa (55,000 psi) and a ductility of at least 45%EL. Is such an alloy possible? If so, what must be its composition? If this is not possible, then explain why.

9.46 The room-temperature tensile strengths of pure copper and pure silver are 209 and 125 MPa, respectively. (a) Make a schematic graph of the room-temperature tensile strength versus composition for all compositions between pure copper and pure silver. (Hint: You may want to consult Sections 9.10 and 9.11, as well as Equation 9.24 in Problem 9.79.) (b) On this same graph schematically plot tensile strength versus composition at 600°C. (c) Explain the shapes of these two curves, as well as any differences between them.

9.51 What is the principal difference between congruent and incongruent phase transformations?

9.60 What is the proeutectoid phase for an iron–carbon alloy in which the mass fractions of total ferrite and total cementite are 0.86 and 0.14, respectively? Why