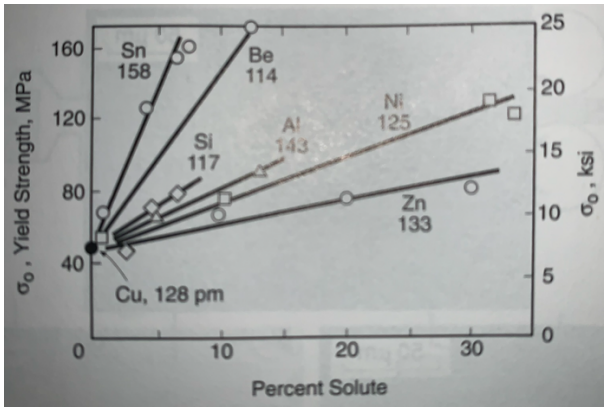
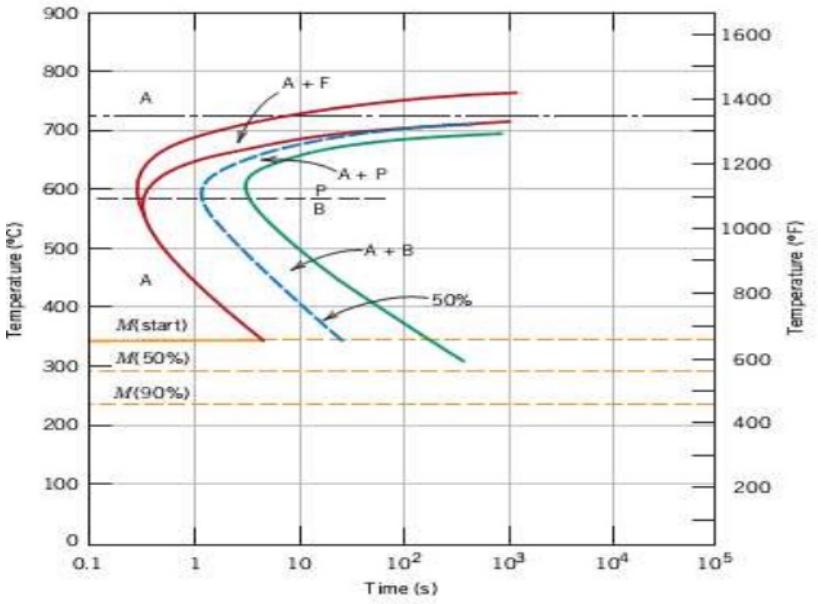
ME108, Spring 2020
Homework 2
Prof. Grace O'Connell

All Homework assignments are individual, but you may work with other students. Please provide the names of other students that you worked with here (submit with your Answer to question 1):

1. In your own words, describe why x-ray diffraction would be used and what it would tell you about a material with respect to material properties.
2. For FCC and BCC crystal structures, find the maximum radius *r* of an impurity atom that would fit into the interstitial site along the unit cell edges.
3. Which of the following systems (i.e., pair of metals) would you expect to exhibit complete solid solubility? Explain your answers.
    a. Cr-V
    b. Mg-Zn
    c. Al-Zr
    d. Ag-Au
    e. Pb-Pt
4. List the three classifications of steels and describe the general properties and applications for each.
5. In your own words explain why an edge or screw defect is related to material failure.
6. Cold working a metal by rolling it to a lesser thickness or hammering it introduces a large number of dislocations into the crystal structure. Would you expect the yield strength to be affected by this and if so, should it increase or decrease and why? Also answer the same question for the elastic modulus?
7. Nickel and copper are mutually soluble in all percentages as substitutional alloys with an FCC crystal structure. The effect of up to 30% nickel on the yield strength of copper is shown in the figure below (Dowling, Figure 3.3). Draw a qualitative graph showing how to expect the yield strength of otherwise pure Cu-Ni alloys to vary as the nickel content is varied from zero to 100%.



8. A specimen of A36 steel is heated to 760°C and held for 1 hour, then cooled to 560°C (2-minute hold) before quenching to room temperature. On the TTT diagram below draw a solid line for that heat treatment.
    a. For this heat treatment, identify the final microstructure.
    b. Design a new heat treatment protocol that will increase the overall strength of the specimen while maintaining ductility. Plot your heat transformation protocol on the TTT diagram above, using a dashed line.
    c. For your new protocol, provide the final expected microstructure, cooling times, and temperature.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300
200
100
0
1600
1400
1200
1000
800
600
400
200
A
A + F
A + P
P
B
A + B
50%
A
M(start)
M(50%)
M(90%)
0.1
1
10
10²
10³
10⁴
10⁵
Time (s)
Temperature (°C)
Temperature (°F)