Shiley School of Engineering, University of Portland
EGR 221 - Materials Science, Exam 3 (closed book, closed notes, **NO calculator**)
November 5, 2015. Dr. Ken Lulay

On my honor, I acknowledge that the work I submit for this examination is completely my own. Sign:_____Print name:_____

1) {10 pts} Answer true (T) or false (F):

a) T F Lattice strains are caused by all of the following: interstitial impurities, dislocations, and other crystal defects.

b) T F Only axial normal stress, no shear stress, exists in a material loaded in uniaxial tension.

c) T F Critical resolved shear stress is a material property.

d) T F Since plastic deformation is caused by dislocation slip, having more dislocations will make it easier for plastic deformation to occur; resulting in lower yield strength.

e) T F Equilibrium phases are stable and will not change even if they are heated sufficiently to cause them to completely melt.

2) {15pts} Fill in the blanks with the correct terminology:

a) When a material is plastically deformed it may become stronger and harder. This is referred to as cold working, work hardening, strain hardening

b) What type of stress causes dislocation slip to occur: shear stress.

c) In order for a material, such as copper, to experience the processes of recovery, recrystallization, and grain growth, it must first be cold worked. It may then be heated to start these processes.

d) What critical but basic assumption is necessary with regard to reading a phase diagram: equilibrium

e) Both hot rolling and cold rolling involve plastic deformation. Hot rolling is done at a temperature above the recrystallization temperature.

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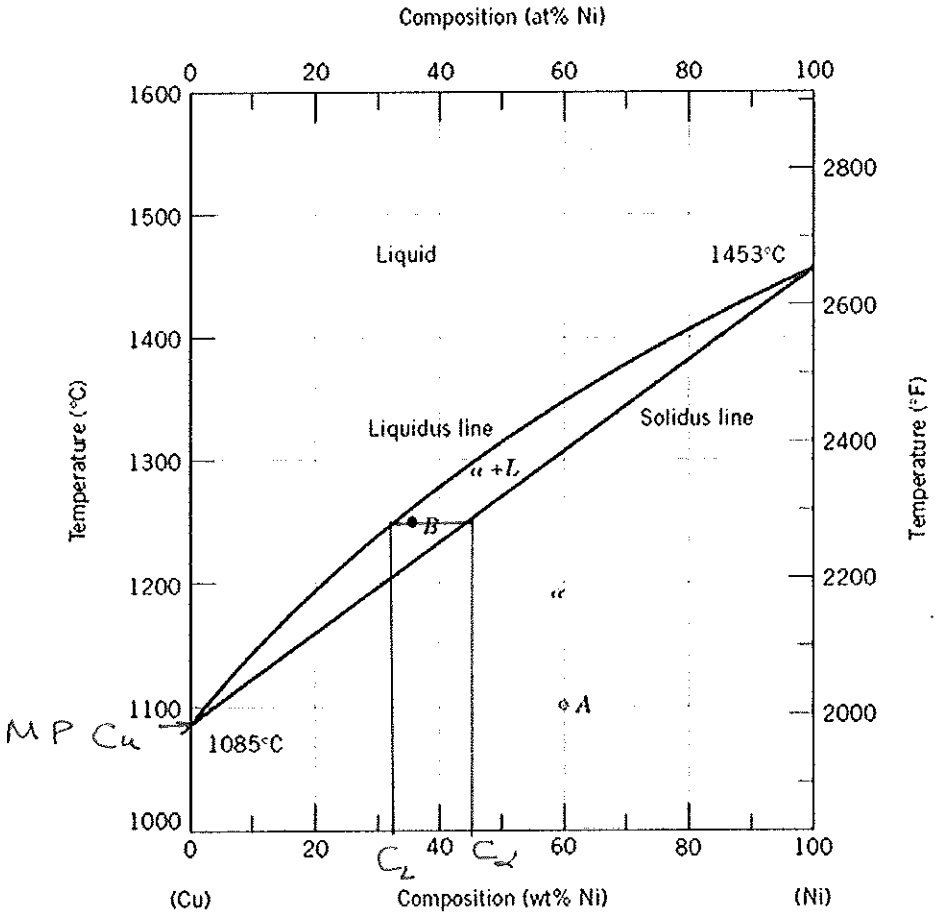

Using the Cu-Ni phase diagram provided here, answer the following questions.

BE SURE TO MARK APPROPRIATELY ON THE PHASE DIAGRAM!

3a. (10 pts) If an alloy at 1100°C is composed of 60wt% nickel and 40% copper, what phase(s) are present, and what is the composition of each phase?

100% α $C_\alpha = C_o =$ 60wt% Ni & 40wt% Cu

3b. (10 pts) If an alloy at 1250°C is composed of 38wt% nickel and 62% copper, what phase(s) are present, and what is the composition of each phase?

2 phases: α & L $C_\alpha =$ 42wt% Ni & 58wt% Cu

$C_L =$ 32wt% Ni & 68wt% Cu

3c. (10 pts) If the 38 pounds of nickel is alloyed with 62 pounds of copper, and is at 1250°C, how many pounds of liquid would be present?

$$wt\%\,L = \frac{C_\alpha - C_o}{C_\alpha - C_L} \times 100\,lb = \frac{42-38}{42-32} \cdot 100\,lb \qquad (40\,lb)$$

3d. (5 pts) What is the melting temperature of copper?

1085°C