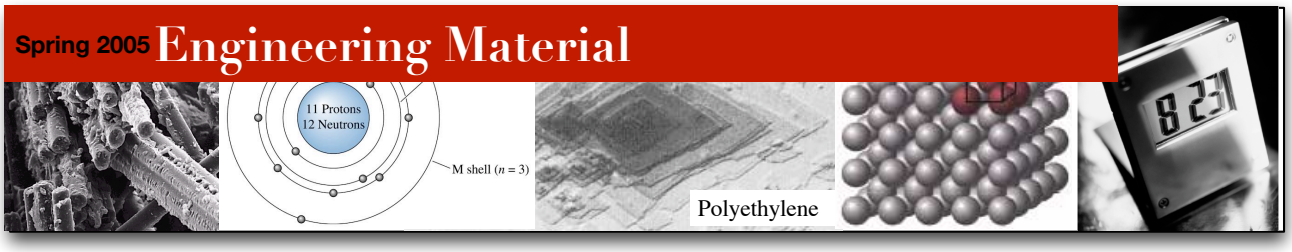

Exam IIB

Wednesday, 18, May 2005

Duration: 60 minutes

Closed Book Exam

Write clearly your derivations and answers on the question sheet

Name:

ID#:

Miscellaneous Formulas

$$\tau_R = \sigma \cos\phi \cos\lambda \qquad \sigma_y = \sigma_0 + k_y d^{-1/2} \qquad \sigma_m = \sigma_0 \left[1 + 2\left(\frac{a}{\rho_t} \right)^{1/2} \right]$$

$$\%CW = \left(\frac{A_0 - A_d}{A_0} \right) \times 100 \qquad d^n - d_0^n = Kt$$

I Phase Diagram: Composition [20 Pts]

One kilogram of an alloy of 60 weight % Pb and 40 weight % Sn is slowly cooled from 300^o C. Refer to the lead-tin phase diagram of the Figure 1 and calculate the following:

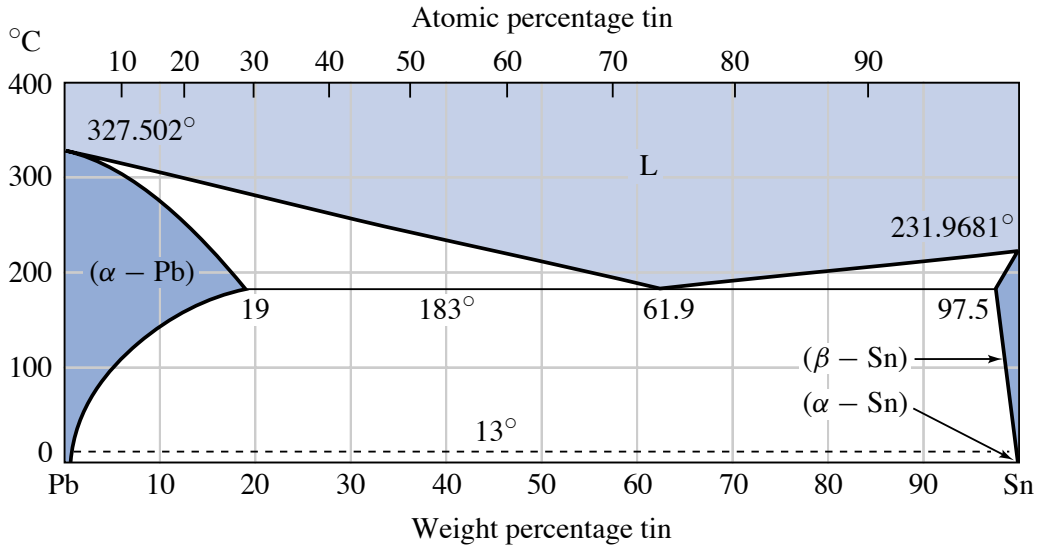

Figure 1: The lead-tin equilibrium phase diagram.

(a) (5 points) The weight percent of the liquid and proeutectic alpha just above the eutectic temperature (183^o C) and the weight in kilograms of these phases.

(b) (5 points) The weight in kilograms of alpha and beta formed by the eutectic reaction.

II Phase Diagram [30 Pts]

A hypoeutectoid plain carbon steel which was slow-cooled from the austenitic region to room temperature contains 9.1% weight eutectoid ferrite. Compute the % carbon content of the steel assuming no change in structure on cooling from just below the eutectoid temperature to room temperature (see Fig. 2 for the Fe-C phase diagram).

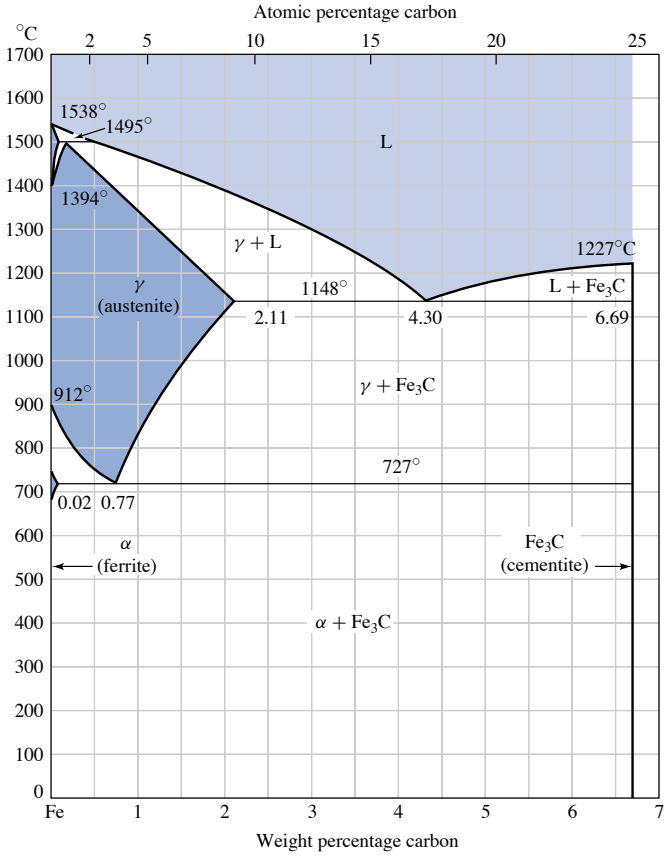

FIGURE 5-26

Figure 2: The Fe-C equilibrium phase diagram.

III Mechanical Properties [25 Pts]

A tensile specimen is machined to a gage diameter of 0.505-in. When subjected to a tensile test, the following results were found: (i) yield load = 4,000 lbf and (ii) area reduction at the maximum load = 20 %

(a) (2 points) What is the yield stress for this specimen?

(b) (4 points) After completing this test, you are informed that the tensile specimen had been cold-worked (plastically deformed) some amount before it was machined and tested, and that in the 'annealed' state $\sigma = K\ \epsilon^n$ with n=0.45. How much strain was induced by the unknown amount of cold work?

(c) (4 points) Find K.

IV Dislocations [25 Pts]

Calculate the resolved shear stress on the $(111)[0\bar{1}1]$ slip system of a unit cell in an fcc nickel crystal if a stress of 13.7 MPa is applied in the [001] direction of a unit cell.