1. Draw the following microstructures by hand (computer drawings are not acceptable):
   (a) a dendritic solidification front;
   (b) a eutectic structure;
   (c) a Widmanstätten structure;
   (d) a partially recrystallized, single phase metal.
Describe the features of each of these four microstructures that you regard as being distinctive.
2. For the example shown below of a Cu-1%Bi sample annealed at a temperature where the Bi is liquid, analyze the probable thermal history of the microstructure. You should copy or sketch the phase diagram and indicate temperatures and times on the diagram. Discuss the microstructure in terms of the volume fractions of the two phases and the relative interfacial energies, i.e. compare Cu-Cu and Cu-Bi boundaries.
3. For the example shown below of an Al-10%Cu sample etched in cold 10% ferric nitrate, analyze the probable thermal history of the microstructure. Identify the phases that are visible in the micrograph. You should copy or sketch the phase diagram and indicate temperatures and times on the diagram.

4. For the example shown below of a Fe-1.4 (wt.)%C sample etched in 2% nital, analyze the probable thermal history of the microstructure. Identify the phases present in the microstructure and where the grain boundaries lie. You should copy or sketch the phase diagram and indicate temperatures and times on the diagram.
5. For the example shown below of an electro-slag weld in a 3-inch thick mild-steel plate, analyze the probable thermal history of the microstructure. Where do you think the limits of the molten region lie? Why do you suppose there are large grains at either side of the region shown by the blue (shorter) arrow? What consequence for the mechanical properties of the weld might these large grains have? What do you think is microstructural significance of the dark streaks at the ends of the orange (longer) arrow?

Just in case you are worried by this question, you are not expected to know detailed answers to these questions but it is useful to get you thinking about more complicated thermal histories in materials.