Materials 2 Questions set 5
Phase diagrams and applications

Some of these questions are in the Phase Diagrams interactive activity, they are included here so you have an opportunity to discuss them in the seminar.

1. Consider the Cu-Ni phase diagram (see appendix)
Make representative annotated sketches of the microstructure of (i) pure nickel at 1500 ˚C, (ii) pure nickel at 1100 ˚C, and (iii) Cu50-Ni50 at 1300 ˚C.

2. (a) State the meaning of (i) eutectic and (ii) eutectoid, and label them on an Fe-C phase diagram (see appendix).
(b) What are austenite, ferrite, pearlite and cementite?

3. What is the maximum solubility of carbon in (i) ferrite; (ii) austenite?

4. Consider the Fe-C phase diagram make representative annotated sketches of the microstructure of eutectoid composition steel (i.e. at approximately 0.8wt%C)
(i) above the eutectoid temperature
(ii) below the eutectoid temperature, after slow cooling

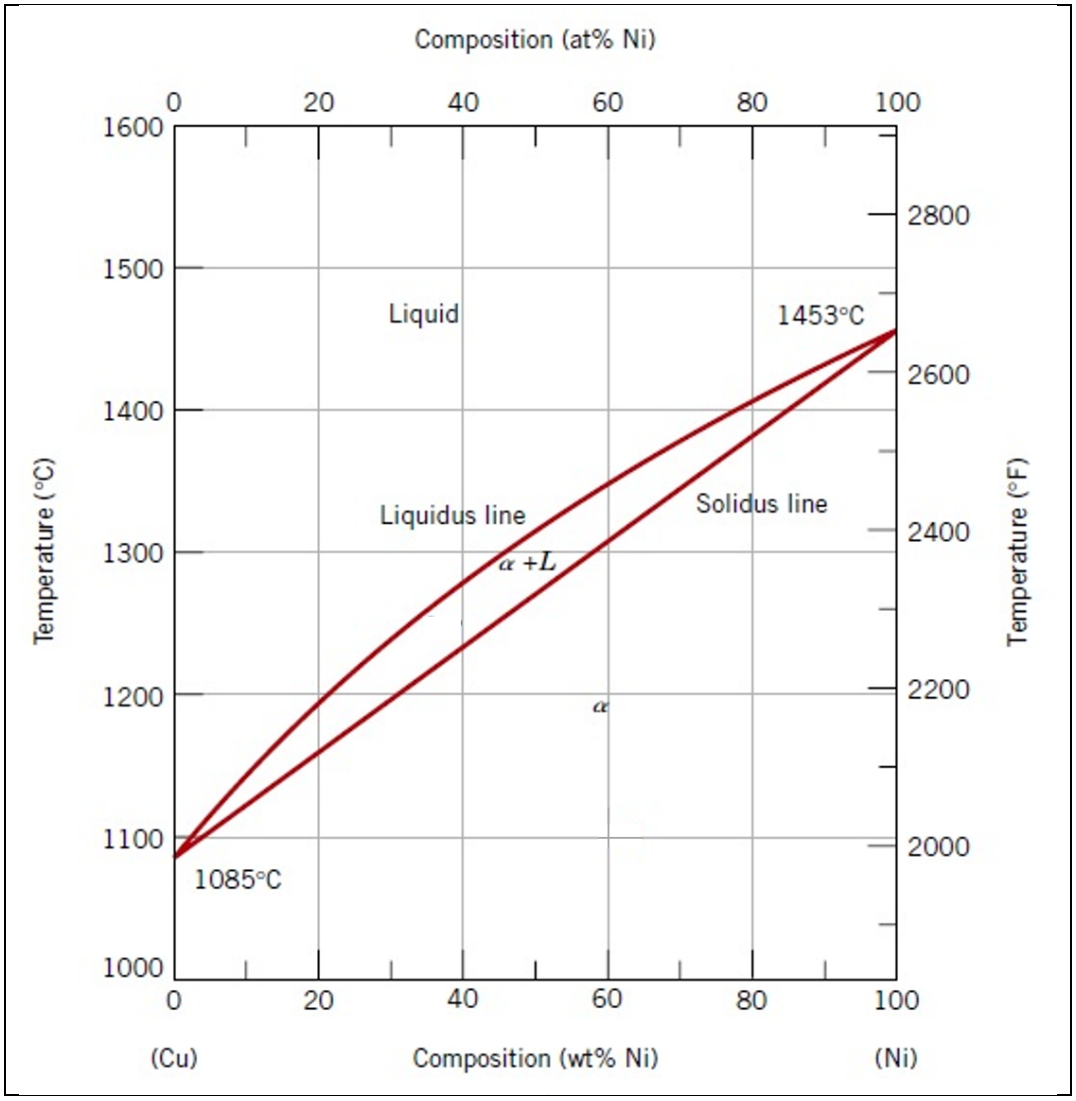
5. (i) In terms of composition define cast iron, and (ii) steel.
(iii) At what temperature and composition is the eutectic in the Fe-C system?
(iv) Cast irons have higher carbon content than most steels. Why is cast iron easier to cast than low carbon steel?

6. From interactive guide to phase diagrams: *"Phase diagrams are useful in understanding why materials, particularly metallic alloys, behave as they do. They are used in processing for example in casting metal alloys, and in heat treatments."*
Discuss instances where phase diagrams have limited applicability.

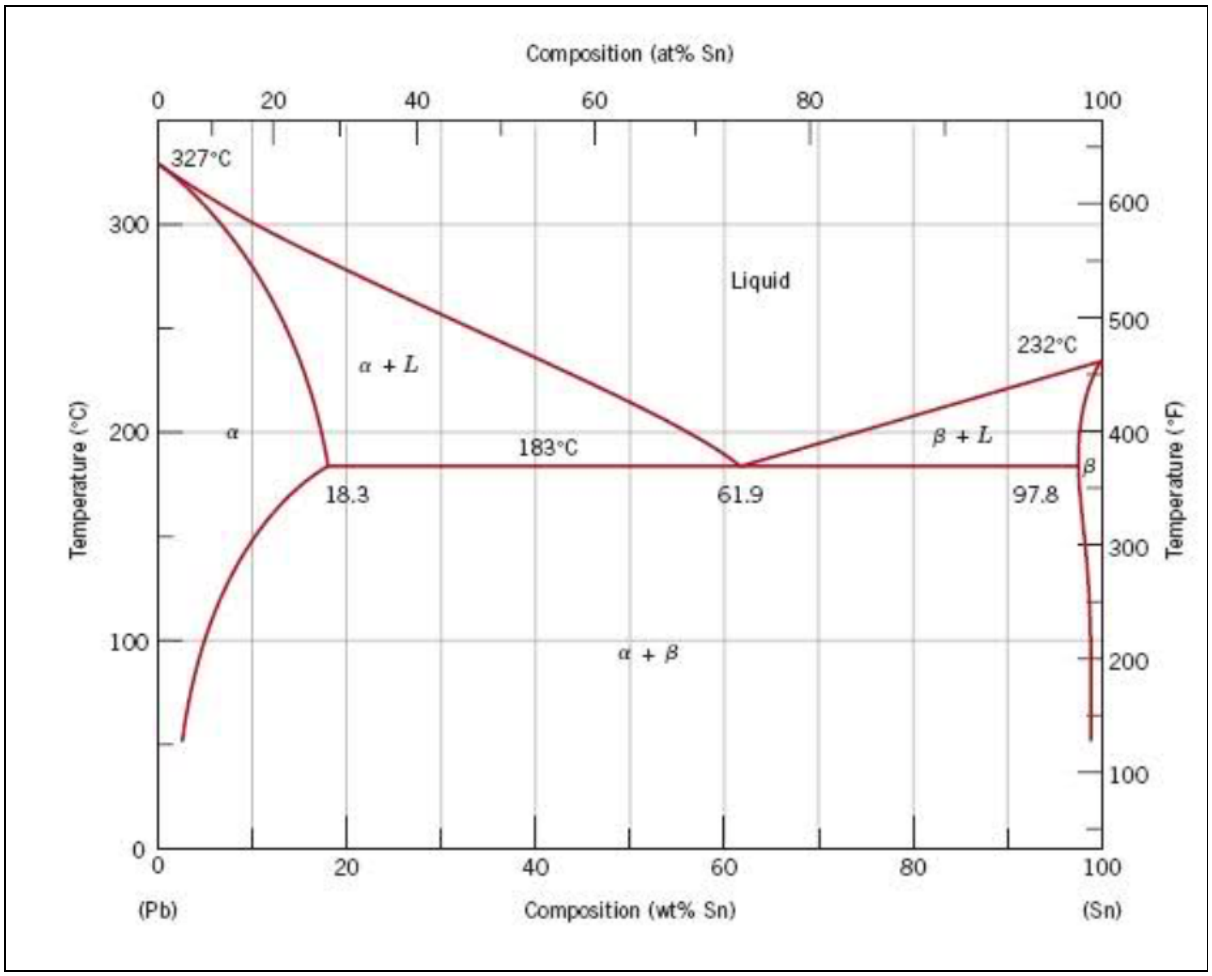
7. Briefly discuss how the mechanical properties, and microstructure, of steel to change with: (i) carbon content, (ii) work hardening of annealed material and (iii) rapid cooling, rather than slow cooling.

Appendix of phase diagrams: Copper-nickel, lead-tin, iron-carbon

Copper-nickel phase diagram



Lead (Pb) – tin (Sn) phase diagram



Iron-carbon phase diagram