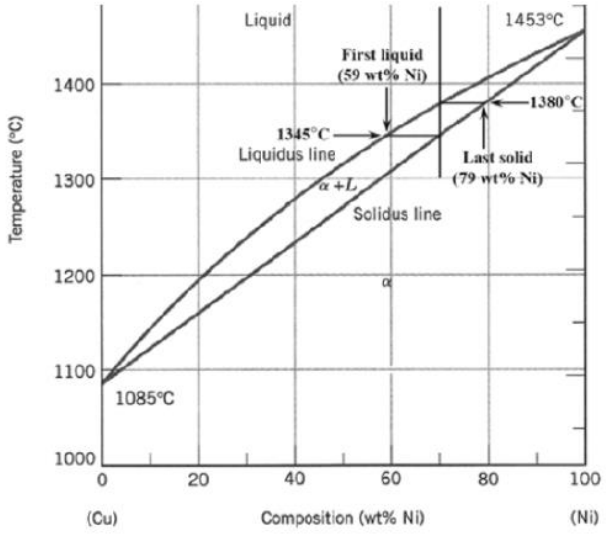
PHASE DIAGRAMS

1) What are the three variables that determine the microstructure of an alloy?

2) A copper-nickel alloy of composition 75 wt.% Ni -25 wt.% Cu is slowly heated from a temperature of 1300ºC
(a) At what temperature does the first liquid phase form?
(b) What is the composition of this liquid phase?
(c) At what temperature does complete melting of the alloy occur?
(d) What is the composition of the last solid remaining prior to complete melting?



3) Given here are the solidus and liquidus temperatures for the germanium-silicon system. Construct the phase diagram for this system and label each region.

Composition (wt% Si)	*Solidus Temperature (°C)*	*Liquidus Temperature (°C)*
0	938	938
10	1005	1147
20	1065	1226
30	1123	1278
40	1178	1315
50	1232	1346
60	1282	1367
70	1326	1385
80	1359	1397
90	1390	1408
100	1414	1414

4) Metal Y melts at 750ºC and metal X at 1000ºC. X and Y form a eutectic at 600ºC with a composition of 60% Y. Also, Y dissolves in X, 10% at the eutectic 4% at room temperature. On the other hand X dissolves in Y at the eutectic by 5% and 1% at room temperature. X and Y form a lamellar type eutectic phase mixture.

a) Carefully plot X-Y equilibrium phase diagram. Give a full microstructural analysis (composition and fraction of phases) of the alloy X-70% Y as it cools down to room temperature, 650ºC and 850ºC.

b) Determine the primary and secondary a phases in a hypoeutectic X-Y alloy containing 20% β phase at room temperature.

5) A 2.0 kg specimen of an 85 wt. % Pb-15 wt. % Sn alloy is heated to 200°C, at which temperature it is entirely an α-phase solid solution. The alloy is to be melted to the extent that 50% of the specimen is liquid, the remainder being the α-phase. This may be accomplished wither by heating the alloy or changing its composition while holding the temperature constant.

a) To what temperature must the specimen be heated?

b) How much tin be added to the 2.0 kg specimen at 200°C to achieve this state?

6) For an annealed (cooled in equilibrium conditions after austenization) hypoeutectoid steel:

a) Determine the composition of the steel (C wt. %) if quantitative metallographic analyses revealed 22% secondary ferrite (assume solubility of carbon in ferrite is nil)

b) Calculate the weight fraction ratio of secondary ferrite and cementite present in pearlite

c) Determine the total amount of carbon dissolved in secondary ferrite at room temperature for the corresponding steel if the total weight of the steel part in kg is equal to 80. (Room temperature solubility of carbon in ferrite is 0.008%)

7) The mass fraction of eutectoid cementite in iron carbon alloy is 0.109. On the basis of this information, is it possible to determine the composition of the alloy? If so, what is its composition?