Question Sheet 1

1. Show that a system which contains concentration gradients can be at equilibrium.
2. Show that in a binary A, B solution,

$$\frac{\partial G}{\partial x} = \mu_B - \mu_A.$$

3. What factors contribute to the heat capacity of a polymer?
4. Explain why ordered crystals become disordered at a sufficiently high temperature.
5. What is an ideal solution? What is the probability of finding an A atom next to a B atom in an equiatomic ideal solution?
6. Calculate the equilibrium carbon concentration at any point given a fixed manganese concentration gradient in austenite. Austenite is an allotrope of iron. Assume that the activity (a) of carbon will tend to become uniform:

$$\ln\{a_C^0\} = \ln\{a_C^{Mn}\}$$
$$\ln\{\Gamma_C^0\} + \ln\{x_C^0\} = \ln\{\Gamma_C^{Mn}\} + \ln\{x_C^{Mn}\}$$

where a_C^0 is the activity of carbon at zero Mn, a_C^{Mn} is the activity of carbon at a finite Mn concentration, x_C^0 and x_C^{Mn} are the corresponding mole fractions of carbon, Γ_C^0 and Γ_C^{Mn} are the corresponding activity coefficients. The activity coefficients can be expanded as follows (Kirkaldy and Baganis, Metall. Trans. 9A, 1978, 495):

$$\ln\{\Gamma_C\} = 8.1 \times x_C - 5 \times x_{Mn}$$

where x_{Mn} is the concentration of manganese.