

Ph 12c

Homework Assignment No. 6 Due: 5pm, Thursday, 24 May 2012

Do Problems 2, 4, 5 in Chapter 9 and Problems 5, 8 in Chapter 10 of Kittel and Kroemer, plus this additional problem:

1. Latent heat of melting

Consider a substance which can exist in either one of two phases, labeled A and B . If the number of molecules is N , the heat capacity of the A phase at temperature τ is

$$C_A = N\alpha\tau^3,$$

while the heat capacity of the B phase is

$$C_B = N\beta\tau.$$

- a) Assuming the entropy is zero at zero temperature, find the entropies σ_A , σ_B of the two phases at temperature τ .
- b) Suppose that, for both the A phase and the B phase, the internal energy is $U_0 = N\epsilon_0$ at zero temperature. Find the internal energies U_A , U_B of the two phases at temperature τ .
- c) Using the thermodynamic identity $dU = \tau d\sigma + \mu dN$, find the chemical potentials μ_A , μ_B of the two phases, expressed as functions of τ .
- d) Which phase is favored at low temperature? At what “melting” temperature τ_m does a transition occur to the other phase?
- e) At the melting temperature, how much heat must be added to transform the low-temperature phase to the high-temperature phase?