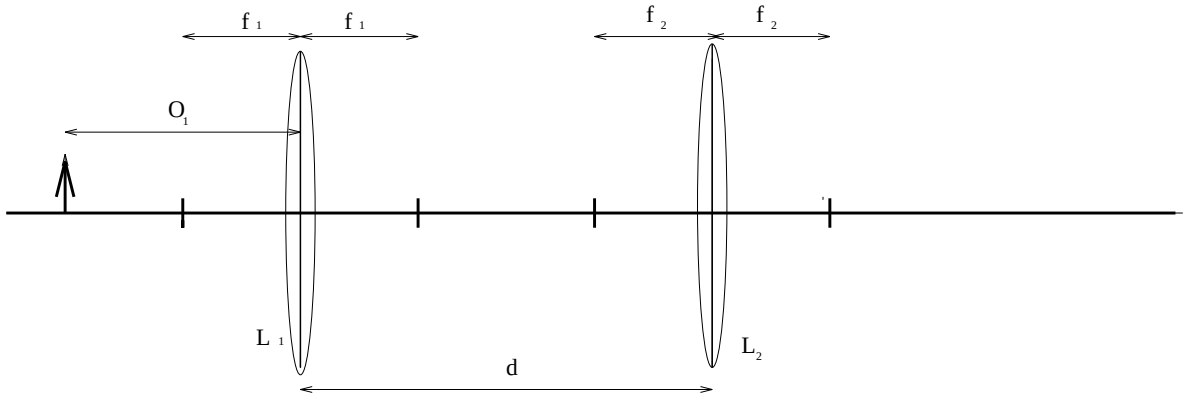
PHY6938 Optics and Thermodynamics Fall 2000

1. A solid contains N magnetic atoms having spin $\frac{1}{2}$. At sufficiently high temperature, each spin is completely randomly oriented, i.e. equally likely to be in either of its two possible states. But at sufficiently low temperature, the interaction between the magnetic atoms causes them to exhibit ferromagnetism, with the result that all their spins become oriented along the same direction as $T \to 0$. A very crude approximation suggests that the spin-dependent contribution $C(T)$ to the heat capacity of this solid has an approximate temperature dependence given by

$$C(T) = \begin{cases} C_1 \left(\frac{2T}{T_1} - 1\right) & \text{if } T_1/2 < T < T_1 \\ 0 & \text{otherwise} \end{cases}$$

Use entropy considerations to find the maximum possible value of C_1.

2. Two converging thin lenses, L_1 and L_2, each of focal length $f_1 = f_2 = 10$ cm, are separated by the distance $d = 35$ cm. An object (the upright arrow) is placed a distance $O_1 = 20$ cm to the left of the left-hand lens (L_1). See the figure. The check marks on the horizontal axis represent the focal points of the two lenses.



a) Draw a ray diagram, and also find the position of the final image using the thin-lens equation.

b) Is the final image real or virtual?

c) Is the final image upright or inverted?.

d) What is the magnification of the final image?