

Physics 880.06: Problem Set 1

Due Friday, October 4, 2002

1. Ashcroft and Mermin, Chapter 1, Problem 4 (a), (c), and (d).
2. Consider a small spherical metal particle (“small” meaning of radius much less than a wavelength). Show that the “surface plasmon frequency” (i. e. the natural frequency of oscillation) of an electron gas in such a small particle is $\omega_p/\sqrt{3}$, where ω_p is the bulk plasma frequency.
Hint: assume that the electron gas is immersed in a uniform positive background, and calculate the restoring force when the electron gas is displaced a small amount from equilibrium.
3. Using typical resistivity values of metals, and typical electron densities, estimate the dimensionless parameter $\omega_p\tau$ for a typical metal around room temperature.

Note: each homework problem is worth 10 points, unless otherwise specified.