

PHY505 - Classical Electrodynamics
Final Examination
Friday, December 20, 2002

1. Two infinite grounded conducting sheets both perpendicular to the x-y plane intersect at an angle of 60° . A charge q is placed equidistant from the conductors and at a distance a from their line of intersection. Find the force exerted on the charge by the conducting sheets.
2. A very large block of dielectric material with electric permittivity ϵ initially has a constant electric field $\vec{E}_0 = E_0 \hat{z}$. A small spherical cavity of radius a is cut out of the center of the dielectric. Find the resultant electric field in the cavity and in the bulk dielectric. What is the polarization charge on the surface of the cavity?
3. (a) A magnetostatic field is due entirely to a localized distribution of permanent magnetization \vec{M} . Show that

$$\int \vec{B} \cdot \vec{H} d^3x = 0$$

if the integral is taken over all space.

- (b) An infinitely long cylinder has a uniform magnetization \vec{M} parallel to its axis. Find the \vec{B} and \vec{H} fields inside and outside the cylinder.
4. A transmission line consists of a long thin cylindrical conducting shell of radius b and a parallel return wire of radius a centered on the axis inside. If the current is assumed distributed uniformly throughout the cross section of the return wire, calculate the self-inductance per unit length of the circuit. (Use the definition of inductance in terms of the energy.)