

Physics 106b: Electrodynamics

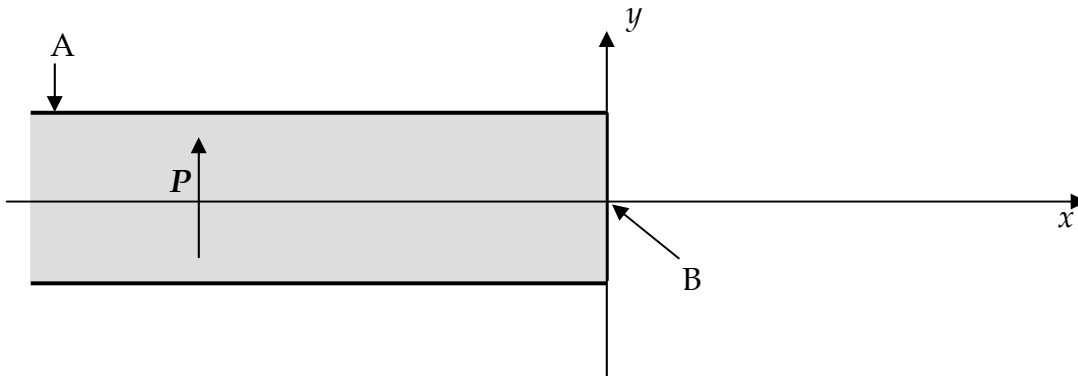
Problem Set 4

Due: Friday 4:00 pm, March 13, 2009

Reading: Griffiths Chapter 4

Problems:

1. Consider a sphere on whose surface there is a charge density $\sigma(\theta) = \sigma_0[\cos(2\theta) + 1/3]$ with σ_0 a constant and θ the polar angle. Find the first non-vanishing multipole moment (all components thereof) of the potential outside the sphere.
2. Consider the electric field near the edge of a semi-infinite slab of material defined by $-d/2 \leq y \leq d/2$ and $x \leq 0$, as indicated in cross-section in the diagram. The slab lies centered in the x - z plane, has thickness d in the y -direction, has one edge along the z -axis, and extends to $\pm \infty$ in the z -direction and to $-\infty$ in the x -direction. The slab is uniformly polarized in the $+y$ -direction.



- a) Find the electric field inside and outside the slab at large negative x , and the bound charge density everywhere.
- b) Find the electric field at B, ($x = y = 0$). Justify your answer.
- c) Find a relationship between the electric fields in the $y = 0$ plane at $x = a$ and $x = -a$.
- d) Sketch carefully the electric field \mathbf{E} and electric displacement \mathbf{D} along the x -axis from large negative to large positive x , at $y = 0$.