

4420: Midterm

1. Can the following static field be a true electric field realized in some real system (cylindrical coordinates are being used, C is some constant)

$$E_\rho = 0, \quad E_\phi = \frac{C}{\rho}, \quad E_z = 0,$$

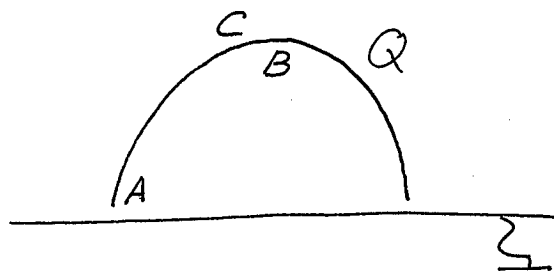
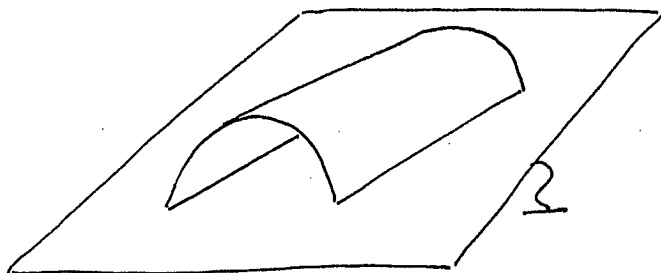
a) for all angles ϕ ?

b) within some finite range of angles $0 < \phi < \pi$?

c) If yes to a) or b), what kind of system could realize such a field? [15 points]

2. Find electric field of a linear wire of length $2L$ charged with (total) charge Q at some distance z from its center (see Fig. 2.34(b), page 86). [15 points]

3. A semi-cylindrical sheet of metal is put close to a metallic grounded plane (without direct contact). Some charge is placed on the sheet. Draw a qualitative picture of electric field lines. Pay attention to the density of the lines. Consider points A, B, C . Where is the electric field maximal? minimal? Why? [15 points]



4. Infinite cylindrical wire (radius R) made of a non-magnetic material ($\mu = \mu_0$) has a cylindrical hollow of radius r centered some distance $a > r$ from the main axis. Current I is driven through the wire so that the current density is homogeneous everywhere across the wire. Find magnetic field B inside the hollow. Hint: solving this problem in vector notations might be helpful. [15 points]

