Dept of Physics, IIT Kanpur

PHY103 Quiz 2nd Sept. 2015

1. A metallic sphere of radius R is surrounded by a thin spherical shell (non conducting) of radius $3R$ having a surface charge density $\sigma = \sigma_0 \cos\theta$. Find the magnitude of the electric field at the point with $r = 2R,\ \theta = \cos^{-1}(3/5)$. [8]
2. A dielectric cylinder of dielectric constant $K = 3$, radius R and length L is placed with its center at the origin and the axis along the z-axis. It has a uniform polarization $\mathbf{P} = P_0\hat{k}$.

(a) Write the bound charges in and on the cylinder. [1]

(b) Consider three points A, B and C with Cartesian coordinates (O,R,O), $(O,O,-L/2)$ and $(O,O,L/2)$

(i) At which of these points $\nabla\bullet P$ is zero? [1]

(ii) At which of these points $\nabla\bullet P$ is infinity in magnitude? Justify in brief. [2]

(iii) At which of these points $\nabla\times P$ is zero? [1]

(iv) At which of these points $\nabla\times P$ is infinity in magnitude? Justify in brief. [1]

(v) At which of these points $\nabla\times D$ is zero? [1]