PHYSICS 507 5th HOMEWORK-Solutions Prof. V. Lempesis Hand in: Friday 10th of April 2020, time: 23:59

- 1. Consider a dielectric sphere of radius R and permittivity ε , with a point charge Q embedded at the center of the sphere.
 - (i) Find the electric displacement **D** inside the sphere
 - (ii) Find the electric field inside the sphere.
 - (iii)Find the polarization inside the sphere.
 - (iv) Find the surface charge density (due to the polarization of the dielectric) on the surface of the sphere.
 - (v) Find the total amount of the bound charge on the surface of the sphere.
 - (vi)What is the volume charge density of the bound charge?

(12 marks)

2. The force per unit volume on a dielectric (permitivity ε) inside an electric field **E** is given by the relation $\mathbf{F}_{vol} = (\mathbf{P} \cdot \vec{\nabla})\mathbf{E}$. Start from this expression and show that this force is equal to

$$\mathbf{F}_{vol} = \frac{1}{2} (\varepsilon - \varepsilon_0) \vec{\nabla} E^2$$

Hint: You will need the relations $\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P}$, $\mathbf{D} = \varepsilon \mathbf{E}$, $\nabla \times \mathbf{E} = 0$. (8)

(8 marks)