PHYS 3414 - Electricity and Magnetism- Homework Set 11

Practice for Test 3. Some of these problems are too difficult for a test, but parts of them would make good test questions.

1 A point charge, q, is a distance D from the center of a grounded conducting sphere of radius R. Compute the potential at a distance $D/2$ on a line between the point charge and the center of the sphere.

2 A capacitor is formed of two plates that are not quite parallel. One plate is in the $x-y$ plane and the other plate is tipped at an angle α from the $x-y$ plane. The nearest point between the two plates has separation d. The plates are square and have area of the plates is $A=\ell^2$ and they are filled with a dielectric with relative permittivity ϵ_r. Compute the capacitance ignoring fringing.

3 A sphere of radius a is held at potential V_0. Compute the potential and field at a distance $4a$ from the origin.

4 A sphere of radius a is held at a potential $V=V_0(\cos\theta+1)$. Compute the field inside the sphere.

5 A dielectric cylinder with radius a and relative permittivity ϵ_r is placed in a uniform field such that the field far from the cylinder is $\vec{E}=E_0\hat{x}$. Compute the field everywhere.

6 A thin infinite cylinder with radius a is covered with a surface charge density σ. The cylinder is parallel to an infinite grounded conducting plane and is a distance D from the plane. Compute the force per unit length on the cylinder.

7 A channel, infinite in the z direction, has potential on the surface $V(x,0)=0$, $V(a,y)=0$, $V(x,b)=0$, and $V(0,y)=V_0\sin(2\pi y/b)$. Compute the field at the center of the channel.

8 A cylindrical system with radius a has potential $V_i=A\rho^4\cos(4\phi)$ inside and $V_o=B\rho^{-4}\cos(4\phi)$ outside. Compute the charge density on the surface.

9 An infinite cylinder of radius a is held at potential V_0 for $0<\phi<\pi/2$ and zero for $\pi/2<\phi<2\pi$. Compute the potential outside the cylinder.

10 A sphere of radius a is held at potential V_0 for $0<\theta<\pi/4$ and zero for $\pi/4<\theta<\pi$. Compute the first two non-zero terms in the expansion of the potential outside the sphere.