

Electromagnetic Theory I

Problem Set #4

Due: 10-23-2015

① The surface of a charged spherical shell has the following potential

$$\Phi(r=a, \theta) = \begin{cases} -V_0 & 0 < \theta < \pi/3 \\ V_0 & \pi/3 < \theta < 2\pi/3 \\ -V_0 & 2\pi/3 < \theta < \pi \end{cases}$$

The volume inside the sphere is empty.

The volume outside the sphere is empty.

Find $\Phi(r, \theta)$ everywhere. The answer will be an infinite series. Each term in the series will have θ dependence $P_l(\cos\theta)$. Write out the $l=0, 1, 2, 3$ terms.

2. A hollow cube has conducting walls defined by six planes $x = -a, y = -a, z = -a$, and $x = a, y = a, z = a$. The walls $z = -a$ and $z = a$ are held at a constant potential V . The other four sides are grounded.

- Find the potential $\Phi(x, y, z)$ at any point inside the cube. Express your answer as a sum of orthogonal functions.
- Evaluate the potential at the center of the cube numerically, accurate to three significant figures (you may use Python, Mathematica, Matlab, or any other math programs).
- Find the surface-charge density on the surface $z = a$.