

## 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  $\theta$  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  $z = a$ .