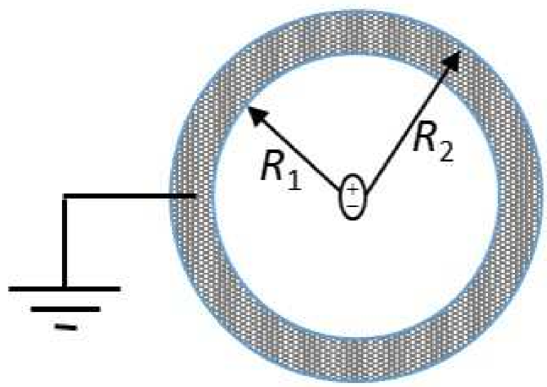
EMB The figure shows an ideal dipole of dipole moment p that lies in the center of a grounded conducting spherical shell of inner radius R_1 and outer radius R_2.



a) Obtain a fully explicit expression for $V(r, \theta)$ in the three regions $r \leq R_1$, $R_1 < r < R_2$, and $r > R_2$.
b) Compute the surface charge density $\sigma(\theta)$ on the **inner** surface of the grounded conductor.
c) Compute the surface charge density $\sigma(\theta)$ on the **outer** surface of the grounded conductor
d) Now suppose that in addition to the dipole a point charge q is placed in the center of the sphere. Repeat your calculation of the surface charge distributions on the inner and outer surfaces of the conducting shell.

Hint: Recall that the general axisymmetric solution to Laplace's equation can be written

$$V(r, \theta) = \sum_{n=0}^{\infty} \left(a_n r^n + \frac{b_n}{r^{n+1}} \right) P_n(\cos\theta)$$

and that $b_1 = p$ for an isolated dipole. See the formula sheet for explicit expressions for the $P_n(\cos\theta)$.