

My Lectures from : Purcell Chapter 2

Web Notes : Lecture Notes #2

Other Notes: Fields; Coulomb Law; Gauss Law

Purcell Problems:

- 2.01 Line integrals and gradients
- 2.04 \vec{E} and ρ from ϕ
- 2.08 Cylindrical charge distribution
- 2.12 Potential from a triangle
- 2.18 prove a vector identity
- 2.19 How does the charge distribute?
- 2.20 Potential of a sphere
- 2.27 Energy stored and work done
- 2.29 Two charged nonconducting spherical shells
- 2.30 Potential of a cube

1. Energy of a radial charge distribution - A spherically symmetric charge distribution has charge density

$$\rho = \begin{cases} \rho_0 \frac{r}{a} & r < a \\ 0 & r \geq a \end{cases}$$

- (a) Find the electric field \vec{E} everywhere
- (b) Find the electrostatic potential ϕ everywhere
- (c) Determine the energy needed to assemble the charge distribution using 2 different approaches.

2. Electrostatic potentials

- (a) Find the electric field \vec{E} from the electrostatic potential

$$\phi = \frac{\alpha z}{r}$$

where α is a constant and r is the distance from the origin.

- (b) An electrostatic potential has the form:

$$\phi = \begin{cases} -2\pi a l(x+l/4) & x < -l/2 \\ 2\pi a x^2 & -l/2 < x < l/2 \\ 2\pi a l(x-l/4) & l/2 < x \end{cases}$$

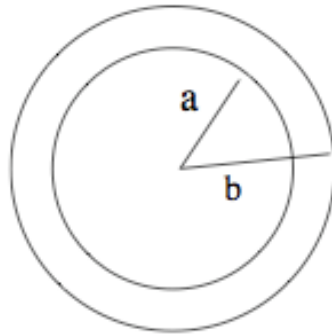
where a and l are constants. Find the charge distribution which gives this potential.

- (c) Give the electric field of the charge distribution you found in part(b)

3. Electric field, potential and flux - A hollow spherical shell carries charge density

$$\rho = \frac{k}{r^2}$$

in the region $a \leq r \leq b$ (see figure).



- (a) Find the electric field \vec{E} everywhere in space.
- (b) Find the potential ϕ everywhere in space.
- (c) Calculate the flux:
 - i. through the concentric sphere with radius $r_1 > b$
 - ii. through the concentric sphere with radius $a < r_2 < b$
 - iii. through the concentric sphere with radius $r_3 < a$
 - iv. through the nonconcentric sphere with radius $r_4 = 2b$, centered at any arbitrary point on the outer surface of the shell.