Set #3 - for Thurs Oct. 23

Read

HR&K, Vol. 2 — Ch. 28 (pay attention to the examples)

Purcell — Ch. 2

Feynman Vol. 2 — Ch. 4, 5, 6

Solve

From HR&K

Ch. 27 Exercise 24, Problems 14

Ch. 28 Problems 4, 8, 9, 10

From Purcell

Ch. 1 Problems 1.72, 1.77, 1.78

Problem 1. Which ones of these are impossible electrostatic fields in empty space?

a) $\vec{E} = a\left(xy\hat{i} + 2yz\hat{j} + 3xz\hat{k}\right)$

b) $\vec{E} = b\left(y^2\hat{i} + (2xy + z^2)\hat{j} + 2yz\hat{k}\right)$

c) $\vec{E} = E(r)\hat{r}$

d) $\vec{E} = E(r)\hat{\theta}$

Go to page 2

Set #3 - for Thurs Oct. 23

Problem 2. Calculate electric pressure on the surface of a sphere with the uniform charge density σ.

Problem 3. Calculate the electric potential at the center of a square sheet of uniform charge density σ.

Problem 4. A particle of mass m, charge q **>** 0, and initial kinetic energy K is projected (from infinity) toward a heavy nucleus of charge Q, assumed to have a fixed position in our reference frame.

(a) If the aim is "perfect", how close to the center of the nucleus is the particle when it comes instantaneously to rest?

(b) With a particular imperfect aim, the particle's closest approach to the nucleus is twice the distance determined in part (a). Show that the speed of the particle at this closest distance of approach is $\sqrt{\frac{K}{m}}$.

Go to page 3

Set #3 - for Thurs Oct. 23

Problem 5. A conducting spherical shell with inner radius a and outer radius b has a positive point charge Q located at its center. The total charge on the shell is **–**$3Q$, and it is insulated from its surroundings as shown below.

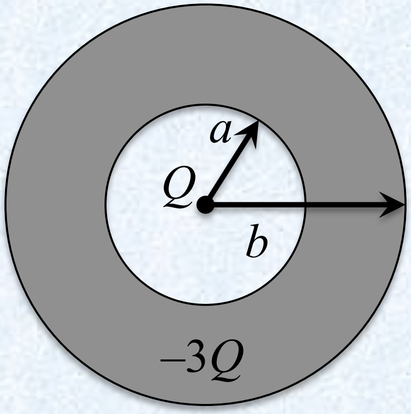
a) Derive expressions for the electric field magnitude in terms of the distance r from the center for the regions $r < a$; $a < r < b$ and $r > b$.

b) What is the surface charge density on the inner surface of the conducting shell?

c) What is the surface charge density on the outer surface of the conducting shell?

d) Draw a sketch showing electric field lines and the locations of all charges.

e) Draw a graph of the electric field magnitudes as a function of r.



Problem 6. Use the subscript notation and show:

a) $\nabla \times \left(\nabla \times \vec{A}\right) = \nabla\left(\nabla \cdot \vec{A}\right) - \nabla^2 \vec{A}$

b) $\nabla \times \nabla\phi = 0$

c) $\nabla \cdot \left(\nabla \times \vec{A}\right) = 0$

Good Luck, Dr. B