Seminar 6: Lectures 11-12

Electric Flux:

1. The Earth possesses an electric field of (average) magnitude 150 N/C near its surface. The field points radially inward. Calculate the net electron flux outward through a spherical surface surrounding, and just beyond, the Earth's surface.

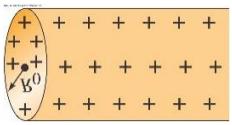
Gauss's Law:

2. The total electric flux from a cubical box 28.0 cm on a side is 1.84×10^3 N·m^2/C. What charge is enclosed by the box?

Applications of Gauss's Law:

3. A flat square sheet of thin aluminum foil, 25 cm on a side, carries a uniformly distributed 275 nC charge. What, approximately, is the electric field (a) 1.0 cm above the centre of the sheet and (b) 15 m above the centre of the sheet?

4. A very long solid nonconducting cylinder of radius R_0 and length l ($R_0 << l$) possesses a uniform volume charge density ρ_E (C/m^3), as shown in the figure below. Determine the electric field at points (a) outside the cylinder ($R > R_0$) and (b) inside the cylinder ($R < R_0$). Do this only for points far from the ends, and for which $R << l$.



Electric Potential:

5. How much work does the electric field do in moving a proton from a point with a potential of +185 V to a point where it is -55 V?

6. The work done by an external force to move a -9.10 µC charge from point a to point b is 7.00×10^{-4} J. If the charge was started from rest and had 2.10×10^{-4} J of kinetic energy when it reached point b, what must be the potential difference between a and b?

Potential Related to Electric Field:

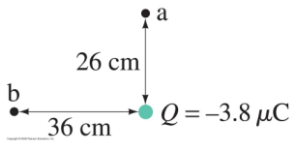
7. The electric field between two parallel plates connected to a 45 V battery is 1300 V/m. How far apart are the plates?

8. A manufacturer claims that a carpet will not generate more than 5.0 kV of static electricity. What magnitude of charge would have to be transferred between a carpet and a shoe for there to be a 5.0 kV potential difference between the shoe and the carpet? Approximate the shoe and the carpet as large sheets of charge separated by a distance d = 1.0 mm.

Potential Due to Point Charges:

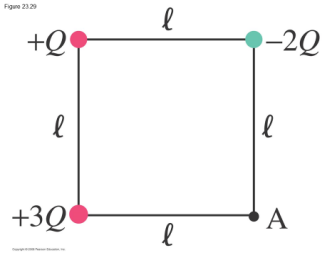
9. A point charge *Q* creates an electric potential of +185 V at a distance of 15 cm. What is *Q* (let *V* = 0 at *r* = ∞)?

10. Point a is 26 cm north of a -3.8 μC point charge, and point b is 36 cm west of the charge (as shown in the figure below). Determine (a) $V_b - V_a$ and (b) $\vec{\mathbf{E}}_b - \vec{\mathbf{E}}_a$ (magnitude and direction).



Potential Due to Charge Distribution:

11. Three point charges are arranged at the corners of a square of side l as shown in the figure below. What is the potential at the fourth comer (point A), taking *V* = 0 at a great distance?



Equipotentials:

12. A metal sphere of radius r_0 = 0.44 m carries a charge *Q* = 0.50 μC. Equipotential surfaces are to be drawn for 100 V intervals outside the sphere. Determine the radius *r* of (a) the first, (b) the tenth, and (c) the 100th equipotential from the surface.