Interactive Problem Set 9, SP212 Spring 2013

Topic: 24.1 - 24.5, Electric Potential

IPS 9.1 (in-class) An infinite sheet with surface charge density $\sigma = -3.00 \times 10^{-6}$ C/m^2 occupies the xy plane. A helium nucleus ($q = +2e$) executes a projectile type trajectory starting at $(0, 0, 5.00)$ cm and finishing at $(8.00, 0, 7.00)$ cm.

- Over this trajectory, by how much did the helium nuclei's *electric* potential energy ΔU change?
- What is the difference in electric potential ΔV between start and finish?
- How would the above answers change if we replaced the nucleus with a proton? an electron?

IPS 9.2 (in-class) Continuing with an analysis of just the infinitely charged sheet described above.

- Create a system sketch for the sheet. Draw electric field lines to describe the electric field above and below the sheet. Add in equipotential surfaces separated by 0.02 cm starting with the sheet itself as an equipotential surface.
- What is the potential difference ΔV between neighboring equipotential surfaces? General Tip to keep in mind with these types of problems: Electric field lines run *DOWNHILL!*

IPS 9.3 (homework) Consider a system composed of two parallel infinite sheets: One in the xy plane with surface charge density $\sigma_{\text{bottom}} = -3.00 \times 10^{-6}$ C/m^2; the other passing through $(0, 0, 10.0)$ cm, has $\sigma_{\text{top}} = +3.00 \times 10^{-6}$ C/m^2.

- Setting the bottom sheet at a reference voltage of $V = 0$, what is the voltage of the top sheet?
- What are the voltages on each of the surfaces containing $z = 0$, 2.00 cm, 4.00 cm, 6.00 cm, 8.00 cm, 10.0 cm).
- What can we conclude about the electric field and the electric potential above the top sheet? below the bottom sheet?
- If we move a proton from the bottom sheet to the top sheet, by how much does it's electric potential energy change?
- What if we move an electron from bottom to top instead?

Reading (prior to this week's lab!): From the text, study figure 24-3 on page 632 and its caption. Anything that is unclear, dig into the text for clarification. Reread WPC Chapter 24.