Electromagnetism (PHYS 295): Week 1

Spring 2024 v1.0

Intro:

We start off with Coulomb's law and the definition of electric fields. We see that there is a nice way to find these fields in symmetric situations using Gauss's law. It turns out that we can associate energy directly with the field.

Here's an image of stamp with Coulomb and his torsion balance:

Reading:

- PM: Chapter 1
- We will be moving into Chapter 2 next week

Problems: Due Friday, January 26 at the beginning of class

Questions 3 and 4 are "problems" in Purcell and Morin and so have full solutions in the text. The rest are traditional problems.

(1) **Play electric hockey!** Follow the hockey link here (also available on the course webpage). Select a version of the simulator (I chose the "browser-compatible" version.) Adjust the mass to 20. Add the depiction of the electric field by selecting "field". The game opens with a practice page. Try it out!

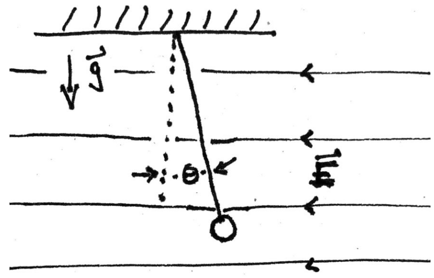
Note: For the purposes of this problem I define "elegant solutions" as those with the *minimal* number of charges.

  (a) Click on the 1st level of difficulty. Find an elegant solution. When you have one, make a pdf of a screen shot of the configuration. Describe your method of solution.

  (b) Move on to the second level of difficulty and find an elegant solution. Capture a screen shot of your solution.

(2) A light bob of a pendulum hangs in a uniform electric field. It has a mass of m and an equilibrium angle of θ.

(3) Here's a sketch:



(a) What is the sign of the charge on the pendulum?
(b) Find the algebraic expressions for the charge on the pendulum. Be sure to draw a free body diagram.
(c) If $m = 25$ g, $|\vec{E}| = 45$ N/C, and $\theta = 14^\circ$ then what is the numerical value of the charge on the pendulum?
(d) I drew $\vec{g}$ as we often do but how would you draw this field with a field line diagram like I used for $\vec{E}$. Add this to you sketch of the apparatus.

(4) 1.2 Finding a location for a $\sum F = 0$ charge

(5) 1.8 This one rings of 195!

(6) 1.36. Statics for charged volley balls

(7) 1.38 simple harmonic motion

(8) 1.47

(9) 1.48 The maximum field of a ring of charge

(10) 1.69 Superposition!