Homework 7 for September 9 2008
Due 8AM on September 10 2008
Physics 221 with Professor Jeff Terry

Thank you to every one who has responded to the test email. Those of you who have done so should start receiving a weekly grade report. If you haven't responded yet, no worries… but please be sure to do so. If you did not receive the test email, let me know so I can rectify the situation.

1. What are the magnitudes and directions of the electric field that will balance the weight of (a) an electron?

2. (b) a proton?

(In other words, assume that the particle is at the surface of the Earth and experiences two forces: the gravity of the Earth and the force from the electric field and we want the particle to experience 0 net force.)

We want the force of gravity to be equal in magnitude and opposite in direction to the electric force. We'll define down to be positive and up to be negative.

$$\vec{F}_E = q\vec{E}$$

$$\vec{F}_G = m\vec{g} = +mg\hat{y}$$

$$\hat{y}: qE_y + mg = 0$$

$$\hat{y}: E_y = \frac{-mg}{q}$$

$a)$

$$E_y = \frac{-mg}{q} = \frac{-8.93*10^{-30}N}{-1.60*10^{-19}C}$$

$$E = \frac{8.93*10^{-30}N}{1.60*10^{-19}C}(+y.direction) = 5.58*10^{-11}\frac{N}{C}(down)$$

$b)$

$$E_y = \frac{-mg}{q} = \frac{-1.64*10^{-26}N}{+1.60*10^{-19}C}$$

$$E = \frac{1.64*10^{-26}N}{1.60*10^{-19}C}(-y.direction) = 1.02*10^{-7}\frac{N}{C}(up)$$

Comments:

Some students use the letter e as shorthand for *10^. For example, instead of saying $3*10^5$ they say 3e5. I discourage this because e has an agreed upon meaning in math and science as the natural base. I haven't been taking points for this as yet but I may do so in the future.

Some students called the electric field direction either "attractive" or "repulsive", neither of which works in this context. Any electric field (except |E|=0) can be attractive, if the test charge is the appropriate sign. For example if we see a field pointing to the right (in a 1D system) then there could be negative charge to our right or there could be positive charge to our left.

Some students are using the directions "radially inward" and "radially outward". Again, if we don't know what/where the source is we can't know whether the field points toward or away from it.

Some students are still using both a negative sign and the "correct" direction (that is, the direction in which the magnitude is positive). For example, for -5N Force to the Right they are saying -5N to the Left. They reverse the direction but keep the sign. When you flip the sign, you reverse the direction! So if you flip the sign you need to flip the direction too in order to still be talking about the same vector!

Most students are now including appropriate diagrams and grades have improved dramatically as a result. The average grade on this homework is 83%! Keep up the good work!