PHYS 1512 Discussion Section: Week 3

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Useful Equations

$$V := \frac{U}{q} = \frac{EPE}{Charge} \qquad \text{(Voltage: Definition)} \tag{1}$$

$$V = \frac{kq}{r} \qquad \text{(Voltage form a point source)} \tag{2}$$

$$\text{(Recall: } W = -\Delta U = \Delta KE\text{)}$$

$$Q = CV \qquad \text{(Capacitance charge voltage relation)} \tag{3}$$

$$C = \frac{\kappa \epsilon_o A}{d} \qquad \text{(Physical Quantity: Capacitance)} \tag{4}$$

$$E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{Q^2}{2C} \qquad \text{(Energy stored in a capacitor)} \tag{5}$$

Question #1

Potentially Geometric

Three point charges are fixed at different points along a circle. The total voltage at the center of the circle is -2100V. What is the radius of the circle if the three charges are as follows:

$$q_1 = -5.8nC$$
$$q_2 = -9.0nC$$
$$q_3 = +7.3nC$$

Question #2

Potential at a point

Consider a square with side length L = 0.25m. On the two bottom vertices are fixed different positive charges q_1 and q_2. If $q_1 = +1.5*10^{-9}C$ and $q_2 = +4.0 * 10^{-9}C$ find the electric potential energy at:

a) The top left corner

b) The top right corner

c) If one were to move $q_3 = -6.0 * 10^{-9}C$ from the top left to the top right, how much work would be done on the particle?

Question #3

Dexter's other laboratory

You are a mad scientist who creates an electron gun which accelerates electrons from rest through a massive potential difference ΔV. You aim your "doomsday" beam at a metal target for practice. Find an expression for the final speed of the electrons as they leave the weapon.

Question #4

Capacitor Fundamentals

A parallel plate capacitor has a capacitance C_1 with no dielectric. When filled with a dielectric with constant κ, it now has a capacitance of C_2.
a) Find an expression for κ
b) Find an expression for the amount of charge stored on C_2's plates if a known voltage V is applied. Write your expression in terms of V,κ and C_1

Figure: This is it Marty! The flux capacitor!

Question #5

Capacitors....Again!

Two capacitors have the same plate separation, but one has square plates and the other has circular plates. The square plates are a length L per side, while the circle plate has a radius L. The both have the same capacitance due to having different dielectric materials. The square plate has a dielectric constant of κ_{square}. Find an expression for $\kappa_{circular}$ in terms of κ_{square}