Physics 112, spring2014 Exam 1 50 pts

Dr. Jared Workman, Friday

RULES

You may use an equation sheet with whatever you want on both sides, you may not use a tablet or a smartphone or a laptop as a calculator. Do not forget to include direction in all answers.

Conceptual

1:) Three protons are placed at the corners of an equilateral triangle. An electron is placed in the center. (see figure 1) Answer the following questions and supply a drawing to support your reasoning.

A) In which direction does the electron move? (2 pts)

B) The top proton is removed, in which direction does the electron now move? (1 pts)

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2:) A uniform electric field exists between two plates resulting in a potential difference ΔV between them. (see figure 2) Answer the following questions and supply a drawing to support your reasoning.

A) An electron is shot into the space between the plates from the right. Sketch it's subsequent trajectory. (1.5 pts)

B) An electron is shot into the space between them from the left, sketch it's subsequent trajectory. (1.5 pts)

C) A hole is carved out from the bottom plate with a hole in the same location on the top plate. Describe how you would go about quantitatively determining if a proton shot through from the bottom would make it out. Be specific, the more detail the better. (3 pts)

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3:) What is the physical reason why resistance depends on temperature, use formulas to support your case. (2 pts)

Problems

1:)An electron and a proton are pinned down on the x axis with the electron at $x = -.1m$ and the proton at $x = +.1m$.

A) Determine the electric field $\vec{E}$ at $x = .05m$ (8 pts)

B) Determine the force on an electron at this point and it's acceleration. (3 pts)

C) Determine the force on a charge $q = +2e$ and $m = 2m_p$ and it's acceleration. (3 pts)

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2:) Consider the earth and a cloud layer above it to be a parallel plate capacitor. The cloud layer has an area of $1 \times 10^6 m^2$ and the maximum electrical field the air can support is $3 \times 10^6 \frac{N}{C}$. The cloud is 800 meters above the earth.

A) Determine the capacitance of this system. (2 pts)

B) Determine the maximum charge the cloud can hold. (3 pts)

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3:) A point charge of $q_1 = 2\mu C$ is paced at the origin.

A) Using energy, determine the change in kinetic energy of an electron as it moves (at rest initially) from $x = 1m$ to $x = .5m$ under the influence of this potential. These are source charges for the potential, the electron is influenced by the potential of these two. (6 pts)

B)Determine the velocity of the electron at $x = .01m$ (2 pts)

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4:) A $100km$ long copper wire with a cross sectional area of $8 \times 10^{-5}m^2$ is used to transmit power. The voltage at the power company is 500 kV and the line transmits 1000 amperes. Assume 20 degrees C

A) What is the voltage at the end of the line? (4 pts)

B) What is the power lost over the course of the line? (2 pts)

C) When the temperature rises to 40 degrees C what is the power lost? (6 pts)

Constants

$k = 9 \times 10^9 \frac{Nm^2}{C^2}$

$\epsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{Nm^2}$

$m_e = 9.1 \times 10^{-31} kg$

$m_p = 1.67 \times 10^{-27} kg$

$|e| = 1.6 \times 10^{-19} C$

$\rho_c = 1.7 \times 10^{-8} \Omega m$

$\alpha_c = 3.9 \times 10^{-3} C^{-1}$