Quiz #2

PHYSICS 102

Feb 9, 2000

1) In a large flat area, in the absence of conductors, a vertical electric field of magnitude roughly 100 V/m points into the Earth.
   a) What is the sign of the charge on the Earth’s surface? (1 pt)
      \[ \text{negative} \]

   b) How much work is done by this electric field on an electron that is raised from the surface a vertical distance of 1.2 m? Don’t forget the sign! (3 pts)
      \[ U = qV = 1.6 \times 10^{-19} \times 100 \, \text{V/m} \times 1.2 \, \text{m} = 1.9 \times 10^{-17} \, \text{J} \]
      An electron naturally moves up from the surface in this field. Thus, the field does work on it.

2) A parallel plate capacitor is filled with a material whose dielectric constant is 3.5.
   The separation between the plates is 5.0x10⁻² m. We produce a field of 9.0x10⁶ N/C with a charge of 1.8x10⁻⁴ C on each plate of the capacitor.
   a) What is the voltage difference between the plates? (1 pt)
      \[ E = \frac{\Delta V}{\Delta x} \Rightarrow \Delta V = E \Delta x = \left(9.0 \times 10^6 \, \text{N/C}\right) \times 5 \times 10^{-2} \, \text{m} = 4.5 \, \text{V} \]

   b) What is the area of each plate? (\( \varepsilon_0 = 8.85 \times 10^{-12} \, \text{F/m} \), 4 pts)
      \[ C = \kappa \varepsilon_0 A \]
      \[ Q = CV = \frac{\kappa \varepsilon_0 A V}{\Delta x} \Rightarrow A = \frac{\kappa \varepsilon_0 V}{\kappa \varepsilon_0 V} \times \frac{5 \times 10^{-2} \times 1.8 \times 10^{-4} \, \text{C}}{3.5 \times 8.85 \times 10^{-12} \, \text{F/m}^2} = 6.5 \times 10^{-3} \, \text{m}^2 \]

Rewrite and sign the honor pledge: “I pledge my honor that I have not violated the Honor Code during this examination.”