Physics 102 Spring 2007: Suggested Problems # 5

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1. Problem 25-54. (**+10 pts**)

   i. +2 pts - Correct expression for the electric field within the dielectric, $\vec{\mathbf{E}}_1$, in terms of the electric field in free-space, $\vec{\mathbf{E}}_0$.

   $$\vec{\mathbf{E}}_1 = \frac{\vec{\mathbf{E}}_0}{\kappa}$$

   ii. +6 pts - Correct setup for potential difference across the two regions (Region1: without the dielectric, and Region 2: with the dielectic).

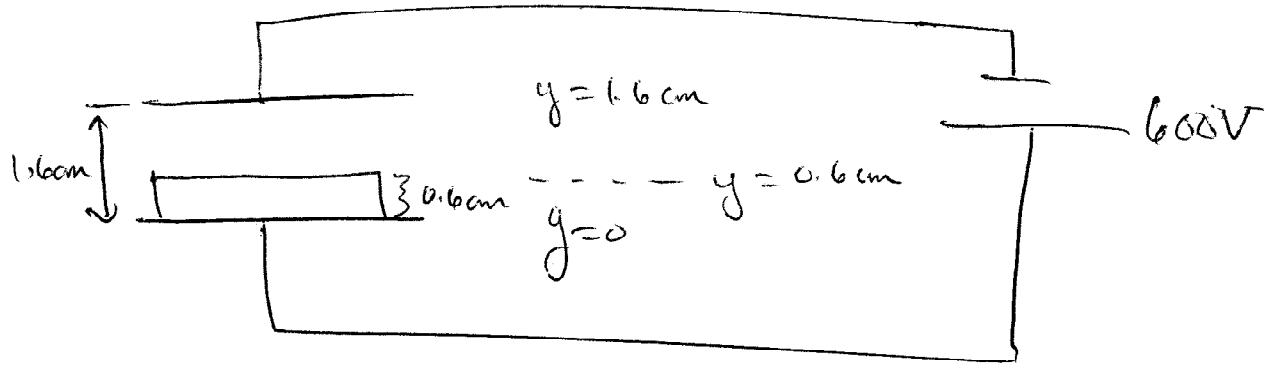
   $$\Delta V = -\int_{\text{empty space}} \vec{\mathbf{E}}_0 \cdot d\vec{\mathbf{l}} - \int_{\text{space with dielectric}} \frac{\vec{\mathbf{E}}_0}{\kappa} \cdot d\vec{\mathbf{l}}$$

   $$600V = E_0 \left(1cm + \frac{0.6cm}{\kappa}\right)$$

   iii. +1 pt - Correct answer for $E_0 = 4.5 \times 10^4$ V/m.

   iv. +1 pt - Correct answer for $E_1 = 2.5 \times 10^4$ V/m.

25-54



Empty space between plates: $\vec{E}_0$

Dielectric between plates: $\vec{E}_1 = \vec{E}_0/K$

$$\Delta V = -\int_{1.6}^{0} \vec{E}\cdot d\vec{l} = -\int_{1.6\,cm}^{0.6\,cm} \vec{E}_0 \cdot d\vec{l} + -\int_{0.6\,cm}^{0} \vec{E}_0/K \cdot d\vec{l}$$

$$|\Delta V| = E_0(1.0\ cm) + \frac{E_0}{K}(0.6\ cm)$$

$K = 1.8$

$$600\,V = E_0\left(1\,cm + \frac{0.6\ cm}{1.8}\right)$$

$$E_0 = 4.5 \times 10^4\ V/m$$

$$\Rightarrow E_1 = \frac{4.5 \times 10^4\ V/m}{1.8} = 2.5 \times 10^4\ V/m$$