# Problem 26.11

For an air-filled parallel plate capacitor:

a.) The relationship between voltage differences and electric fields yields:

$$\Delta V = -\vec{E} \bullet \vec{d} = -V_C$$

$$\Rightarrow \quad \left|\vec{E}\right| = \frac{V_C}{d}$$

$$\Rightarrow \quad = \frac{(20.0 \text{ V})}{(1.80 \text{x} 10^{-3} \text{ m})}$$

$$= 1.11 \text{x} 10^{4} \text{ V/m} \quad \text{(toward the negative plate)}$$

b.) The charge density on the plates is:

For a conductor, $E = \frac{\sigma}{\varepsilon_o} \quad \Rightarrow \quad \sigma = \varepsilon_o E$

$$= (8.85 \text{x} 10^{-12} \text{ C}^2/\text{N}\bullet\text{m}^2)(1.11 \text{x} 10^{4} \text{ V/m})$$

$$= 9.83 \text{x} 10^{-9} \text{ C/m}^2$$



c.) For an air-filled, parallel plate capacitor:

$$C = \varepsilon_o \frac{A}{d}$$

$$= (8.85 \text{x} 10^{-12} \text{ C}^2/\text{N}\bullet\text{m}^2) \frac{(7.60 \text{x} 10^{-4} \text{ m}^2)}{(1.8010^{-3} \text{ m})}$$

$$= 3.74 \text{x} 10^{-12} \text{ F} \qquad \text{(or 3.74 pF)}$$

d.) For the charge on one plate (or the charge "on the capacitor")

$$C = \frac{Q}{V_C}$$

$$\Rightarrow \quad Q = CV_C (8.85 \text{x} 10^{-12} \text{ C}^2/\text{N}\bullet\text{m}^2) \frac{(7.60 \text{x} 10^{-4} \text{ m}^2)}{(1.8010^{-3} \text{ m})}$$

$$= (3.74 \text{x} 10^{-12} \text{ F})(20.0 \text{ V})$$

$$= 74.7 \text{x} 10^{-12} \text{ C}$$