Name: _____

PHY 232 Summer 2016 Class Work

Class 14. Parallel plate capacitor

Given $\varepsilon_0=8.8542\times10^{-12}$ $C^2m^{-2}N^{-1}$ and e= 1.6022×10^{-19} C.

A capacitor is formed by putting two square plates each of $4m^2$ in area parallel to each other with a separation of 1mm. The two plates are kept at a potential difference of 12V.

(a) Calculate the capacitance of this parallel plate capacitor.

$$C=\frac{\varepsilon_0 A}{d}=\frac{8.854\times10^{-12}\times4}{0.001}=\underline{\underline{3.542\times10^{-8}\text{ F, or } 35.42\text{nF}}}$$

(b) What is the charge in one of the plate?

$$C=\frac{Q}{V}\Rightarrow Q=CV\Rightarrow Q=3.542\times10^{-8}\times12=\underline{\underline{4.250\times10^{-7}\text{ C, or } 0.425\,\mu\text{C}}}$$

(c) What is the electric field inside the gap between the plates?

$$V=Ed\Rightarrow E=\frac{V}{d}\Rightarrow E=\frac{12}{0.001}=\underline{\underline{1.2\times10^{4}\text{ V, or } 12\text{ kV}}}$$

(d) What is the energy stored in the capacitor?

$$U=\frac{1}{2}CV^2=\frac{1}{2}\times3.542\times10^{-8}\times12^2=\underline{\underline{2.550\times10^{-6}\text{ J, or } 2.55\mu\text{J}}}$$

(e) What is the energy density?

$$u_E=\frac{1}{2}\varepsilon_0 E^2=\frac{1}{2}\times8.854\times10^{-12}\times(1.2\times10^{4})^2=\underline{\underline{6.375\times10^{-4}\text{ J/m}^3}}$$