

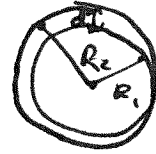
## Ch. 8. Prob; 67

Earth as a capacitor

$$R_1 = R_e = 6.38 \times 10^6 \text{ m}$$

$$R_2 = R_e + d \\ = 6.38 \times 10^6 + 7.0 \times 10^4 \text{ m}$$

$$R_2 = 6.45 \times 10^6 \text{ m}$$



$$d = 70 \text{ km} \\ = 7.0 \times 10^4 \text{ m}$$

$$\Delta V = 350,000 \text{ V}$$

a) Assume the air between the plates is a vacuum or dielectric constant of  $K=1$

Then the capacitance is

$$C = 4\pi\epsilon_0 \frac{R_1 R_2}{R_2 - R_1} = 4\pi (8.85 \times 10^{-12} \frac{\text{C}^2}{\text{Nm}^2}) \frac{(6.38 \times 10^6 \text{ m})(6.45 \times 10^6 \text{ m})}{(6.45 \times 10^6 \text{ m} - 6.38 \times 10^6 \text{ m})}$$

$$C = 0.0654 \text{ F}$$

b) Find charge on the capacitor

$$C = \frac{Q}{\Delta V} \rightarrow Q = C \cdot \Delta V = (0.0654 \text{ F})(350,000 \text{ V})$$

$$Q = 2.29 \times 10^4 \text{ C}$$

c) Find the energy stored in this system

$$U_E = \frac{1}{2} C V^2 = \frac{1}{2} (0.0654 \text{ F})(350,000 \text{ V})^2$$

$$= 4.01 \times 10^9 \text{ J}$$

$$= 4.0 \text{ GJ}$$