

Physics 102 Rec  
Quiz #7  
Chapter 26

Name:

Key

Id#:

Sect#:

A parallel plate air-filled capacitor has plates of dimensions 2.0 cm x 3.0 cm separated by 1.0 mm. If a 20 V battery is connected across the capacitor in order to charge it and after charging, the battery is disconnected and paper ( $\kappa = 3.7$ ) is inserted between the plates.

(a) What is the capacitance of this device after paper is inserted?

$$C_0 = \epsilon_0 \frac{A}{d} = \frac{8.85 \times 10^{-12} \times 2 \times 3 \times 10^{-4}}{1 \times 10^{-3}} = 5.31 \times 10^{-12} \text{ F}$$

$$C = \kappa C_0 = 3.7 \times 5.31 \times 10^{-12} = \boxed{1.96 \times 10^{-11} \text{ F}}$$

(b) What is the charge stored in the device after paper is inserted?

$$q = q_0 = C_0 V_0 = 5.31 \times 10^{-12} \times 20 = \boxed{1.1 \times 10^{-10} \text{ C}}$$

(c) What is the energy stored in this device after paper is inserted?

$$U = \frac{1}{2} \frac{q^2}{C} = \frac{1}{2} \frac{(1.1 \times 10^{-10})^2}{1.96 \times 10^{-11}} = \boxed{3.1 \times 10^{-10} \text{ J}}$$

(d) What is the value of the electric field between the plates before inserting paper?

$$E = \frac{V_0}{d} = \frac{V_0}{d} = \frac{20}{1 \times 10^{-3}} = \boxed{20 \times 10^3 \frac{\text{V}}{\text{m}}}$$