

Answer on Question 65293, Physics, Electric Circuits

Question:

It's Friday night, and you've got big party plans. What will you do? Why, make a capacitor, of course! You use aluminum foil as the plates, and since a standard roll of aluminum foil is 30.5 cm wide you make the plates of your capacitor square, each a 30.5 cm by 30.5 cm. You separate the plates with regular paper, which has a thickness of 0.100 mm and a dielectric constant of $\kappa = 3.7$. What is the capacitance of your capacitor? If you connect it to a 9 V battery, how much charge is stored on either plate?

Solution:

a) We can find the capacitance of the capacitor from the formula:

$$C = \kappa \epsilon_0 \frac{A}{d},$$

here, κ is the dielectric constant of the paper, ϵ_0 is the permittivity of free space, A is the area of plate overlap, d is the plate separation. Then, we get:

$$\begin{aligned} C &= \kappa \epsilon_0 \frac{A}{d} = 3.7 \cdot 8.854 \cdot 10^{-12} \frac{F}{m} \cdot \frac{0.305 \text{ m} \cdot 0.305 \text{ m}}{0.1 \cdot 10^{-3} \text{ m}} = 30475 \cdot 10^{-12} \text{ F} = \\ &= 0.0305 \mu\text{F}. \end{aligned}$$

b) We can find how much charge is stored on either plate from the formula:

$$Q = CV,$$

here, C is the capacitance of the capacitor, V is the voltage across the plates of the capacitor.

Then, we get:

$$Q = CV = 30475 \cdot 10^{-12} \text{ F} \cdot 9.0 \text{ V} = 0.274 \mu\text{C}.$$

Answer:

a) $C = 0.0305 \mu\text{F}$.

b) $Q = 0.274 \mu\text{C}$.