A capacitor is...  
The simplest capacitor is...

\[ \Delta V = \frac{Q}{C} \]

\[ E_{\text{inside}} = \quad E_{\text{inside}} = \quad E_{\text{outside}} = \]

The capacitance of any 2 conductors is the...

\[ C = \quad \text{unit: } 1 \text{F} = \]

NB: The capacitance of any pair of conductors never changes. As the potential across them changes, so does the...

Q. Two parallel metal plates are separated by 2.0 mm. What area should they have to form a 1.0 F capacitor?

A.

Analyze: This takes square plates of ___ per side!
Q. What is the capacitance of a pair of shells with 
\( R_1 = 2.0 \text{ cm} \) and \( R_2 = 3.0 \text{ cm} \), \( Q = 1 \text{ nC} \)?

A.

From Gauss' law, the \( E \)-field between the shells is only due to the charge on the outer shell.

\[
\mathbf{E} = \frac{Q}{\varepsilon_0} \mathbf{e}_r
\]

\[
\Delta V = V_1 - V_2 = -\int_{R_1}^{R_2} \mathbf{E} \cdot d\mathbf{l} = \frac{Q}{2\pi \varepsilon_0}
\]

Q. What is the capacitance per unit length of a coaxial cable if its inner wire has radius \( 1.5 \text{ mm} \) and its outer conductor has (inner) radius \( 4.5 \text{ mm} \)?

A.

From Gauss law, between the conductors, \( \mathbf{E} = \frac{Q}{\varepsilon_0} \mathbf{e}_r \)

\[
\Delta V = V_1 - V_2 = -\int_{r_1}^{r_2} \mathbf{E} \cdot d\mathbf{l} = \frac{Q}{2\pi \varepsilon_0}
\]

\[
C = \frac{Q}{\Delta V} \Rightarrow \frac{dC}{dr} = \frac{dQ/dr}{\Delta V} = \frac{Q}{\Delta V} \frac{d\epsilon_0}{dr}
\]