Exercise 24.10 - Enhanced - with Feedback

A cylindrical capacitor has an inner conductor of radius 2.6 mm and an outer conductor of radius 3.8 mm. The two conductors are separated by vacuum, and the entire capacitor is 2.6 m long.

Review | Constants

Part A

What is the capacitance per unit length?

Express your answer in picofarads per meter.

$\frac{C}{L}$ = 150 $\mathrm{pF/m}$

Submit Previous Answers

Correct

Correct answer is shown. Your answer $146\ \mathrm{pF/m}$ was either rounded differently or used a different number of significant figures than required for this part.

Part B

The potential of the inner conductor relative to that of the outer conductor is 370 mV. Find the charge (magnitude and sign) on the inner conductor.

Express your answer with the appropriate units.

Part C

The potential of the inner conductor relative to that of the outer conductor is 370 mV. Find the charge (magnitude and sign) on the outer conductor.

Express your answer with the appropriate units.

Q_2 = *Value* *Units*

Exercise 24.11 - Enhanced - with Solution

A spherical capacitor contains a charge of 3.10 nC when connected to a potential difference of 220.0 V. Its plates are separated by vacuum and the inner radius of the outer shell is 4.20 cm.

For related problem-solving tips and strategies, you may want to view a Video Tutor Solution of A spherical capacitor.

Review | Constants

Part A

Calculate the capacitance.

Express your answer in picofarads.

C = 14.1 pF

Submit Previous Answers

Correct

Correct answer is shown. Your answer $14\ \mathrm{pF}$ was either rounded differently or used a different number of significant figures than required for this part.

IDENTIFY: We can use the definition of capacitance to find the capacitance of the capacitor, and then relate the capacitance to geometry to find the inner radius.

SET UP: By the definition of capacitance, $C = Q/V$.

EXECUTE: $C = \frac{Q}{V} = \frac{3.10\times10^{-9}\ \mathrm{C}}{220.0\ \mathrm{V}} = 1.41\times10^{-11}\ \mathrm{F} = 14.1\ \mathrm{pF}$

Part B

Calculate the radius of the inner sphere.

Express your answer in centimeters.

Part C

Calculate the electric field just outside the surface of the inner sphere.

Express your answer in newtons per coulomb.

Exercise 24.26 - Enhanced - with Feedback

A parallel-plate vacuum capacitor has 7.72 J of energy stored in it. The separation between the plates is 3.00 mm.

Review | Constants

Part A

If the separation is decreased to 1.50 mm, what is the energy now stored if the capacitor was disconnected from the potential source before the separation of the plates was changed?

Express your answer in joules.

$U =$ J

Submit Request Answer

Part B

If the separation is decreased to 1.50 mm, what is the energy now stored if the capacitor remained connected to the potential source while the separation of the plates was changed?

Express your answer in joules.

$U =$ J

Exercise 24.40 - Enhanced - with Feedback

Polystyrene has dielectric constant 2.6 and dielectric strength 2.0×10^7 $\mathrm{V/m}$. A piece of polystyrene is used as a dielectric in a parallel-plate capacitor, filling the volume between the plates.

Review | Constants

Part A

When the electric field between the plates is 82% of the dielectric strength, what is the energy density of the stored energy?

Express your answer with the appropriate units.

$u =$ Value Units

Submit Request Answer

Part B

When the capacitor is connected to a battery with voltage 500.0 V, the electric field between the plates is 82% of the dielectric strength. What is the area of each plate if the capacitor stores 0.150 mJ of energy under these conditions?

Express your answer with the appropriate units.

$A =$ Value Units

Problem 24.47

In one type of computer keyboard, each key holds a small metal plate that serves as one plate of a parallel-plate, air-filled capacitor. When the key is depressed, the plate separation decreases and the capacitance increases. Electronic circuitry detects the change in capacitance and thus detects that the key has been pressed. In one particular keyboard, the area of each metal plate is 49.5 mm^2, and the separation between the plates is 0.650 mm before the key is depressed.

Review | Constants

Part A

Calculate the capacitance before the key is depressed.

Express your answer in farads.

$C =$ F

Submit Request Answer

Part B

If the circuitry can detect a change in capacitance of 0.240 pF, how far must the key be depressed before the circuitry detects its depression?

Express your answer in millimeters.

$h =$ mm