

Concept Question: Changing Dimensions

A parallel-plate capacitor has plates with equal and opposite charges $\pm Q$, separated by a distance d , and **is not** connected to a battery. The plates are pulled apart to a distance $D > d$. What happens?

1. V increases, Q increases
2. V decreases, Q increases
3. V is the same, Q increases
4. V increases, Q is the same
5. V decreases, Q is the same
6. V is the same, Q is the same
7. V increases, Q decreases
8. V decreases, Q decreases
9. V is the same, Q decreases

Concept Question Answer: Changing Dimensions

Answer: 4. V increases, Q is the same

With no battery connected to the plates the charge on them has no possibility of changing.

In this situation, the electric field doesn't change when you change the distance between the plates, so:

$$V = E d$$

As d increases, V increases.

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Concept Question Answer: Changing Dimensions

Answer: 9. V is the same, Q decreases

With a battery connected to the plates the potential V between them is held constant

In this situation, since

$$V = E d$$

As d increases, E must decrease.

Since the electric field is proportional to the charge on the plates, Q must decrease as well.

Concept Question: Changing Dimensions

A parallel-plate capacitor, disconnected from a battery, has plates with equal and opposite charges, separated by a distance d .

Suppose the plates are pulled apart until separated by a distance $D > d$.

How does the final electrostatic energy stored in the capacitor compare to the initial energy?

1. The final stored energy is smaller
2. The final stored energy is larger
3. Stored energy does not change.

Concept Question Answer: Changing Dimensions

Answer: 2. The stored energy increases

As you pull apart the capacitor plates you increase the amount of space in which the E field is non-zero and hence increase the stored energy. Where does the extra energy come from? From the work you do pulling the plates apart.

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