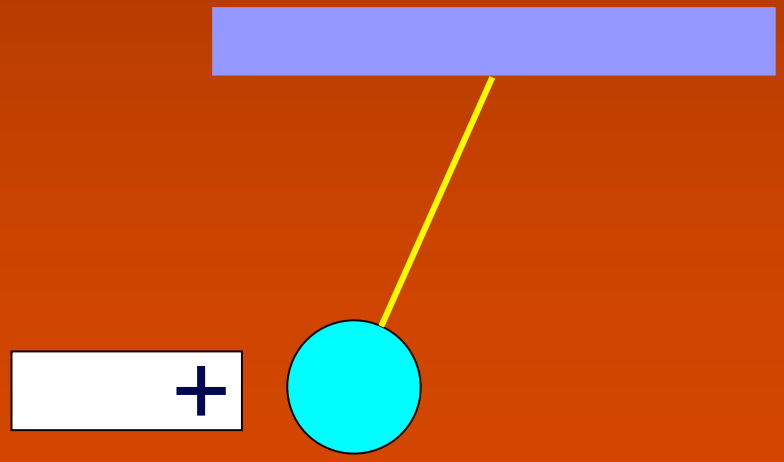
ConcepTest 21.2a Conductors I

A metal ball hangs from the ceiling by an insulating thread. The ball is attracted to a positive-charged rod held near the ball. The charge of the ball must be:

1) positive
2) negative
3) neutral
4) positive or neutral
5) negative or neutral

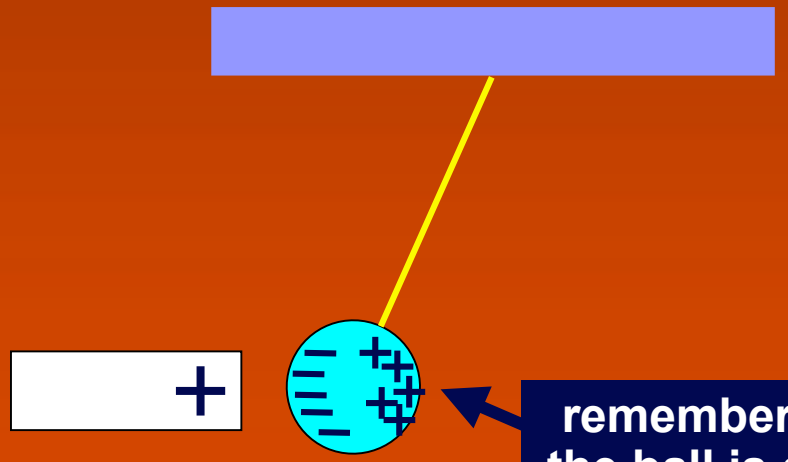


ConcepTest 21.2a Conductors I

A metal ball hangs from the ceiling by an insulating thread. The ball is attracted to a positive-charged rod held near the ball. The charge of the ball must be:

1) positive
2) negative
3) neutral
4) positive or neutral
5) negative or neutral

Clearly, the ball will be attracted if its charge is negative. However, even if the ball is neutral, the charges in the ball can be separated by induction (polarization), leading to a net attraction.

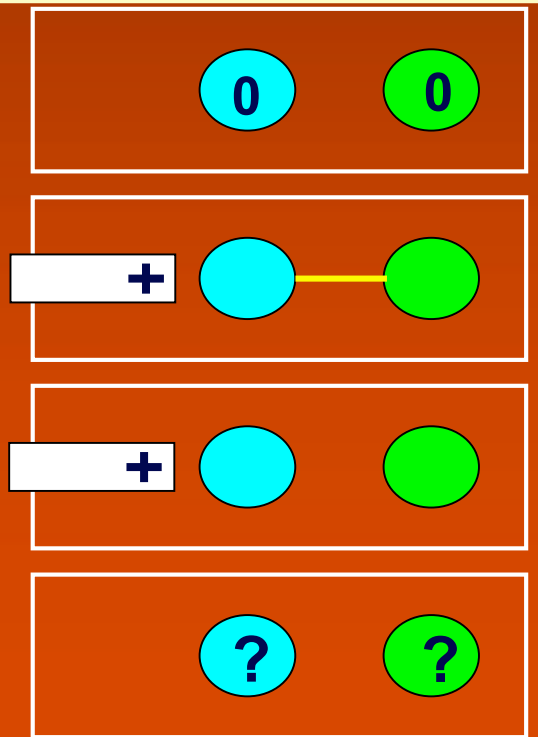


Follow-up: What happens if the metal ball is replaced by a plastic ball?

ConcepTest 21.2b Conductors II

Two neutral conductors are connected by a wire and a charged rod is brought near, but *does not touch*. The wire is taken away, and then the charged rod is removed. What are the charges on the conductors?

1) 0 0
2) + –
3) – +
4) + +
5) – –

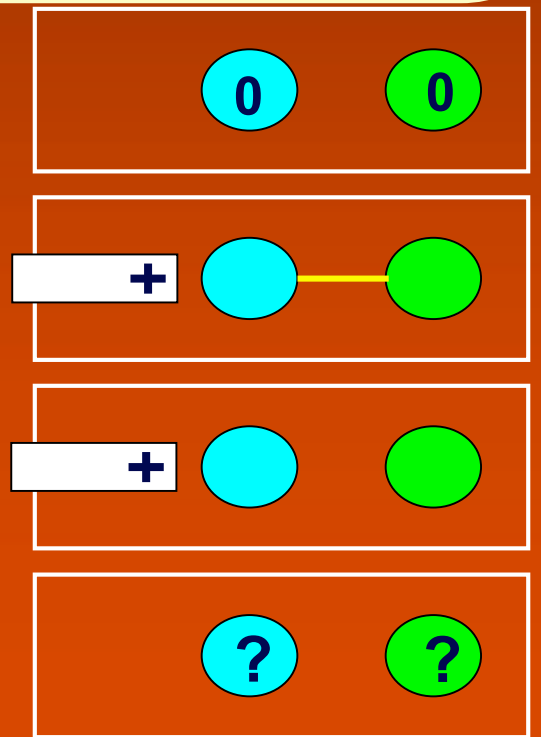


ConcepTest 21.2b Conductors II

Two neutral conductors are connected by a wire and a charged rod is brought near, but *does not touch*. The wire is taken away, and then the charged rod is removed. What are the charges on the conductors?

1) 0 0
2) + –
3) – +
4) + +
5) – –

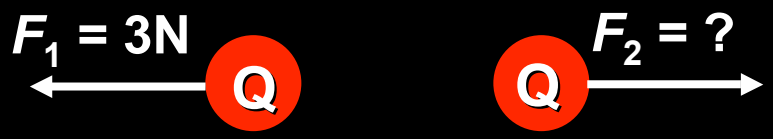
While the conductors are connected, positive charge will flow from the blue to the green ball due to polarization. Once disconnected, the charges will remain on the separate conductors even when the rod is removed.



Follow-up: What will happen when the conductors are reconnected with a wire?

ConcepTest 21.3a Coulomb's Law I

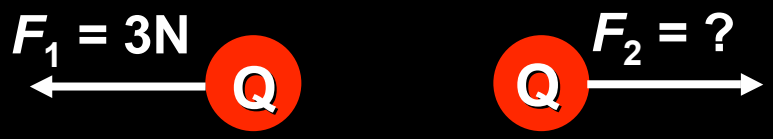
What is the magnitude of the force F_2?



1) 1.0 N
2) 1.5 N
3) 2.0 N
4) 3.0 N
5) 6.0 N

ConcepTest 21.3a Coulomb's Law I

What is the magnitude of the force F_2?



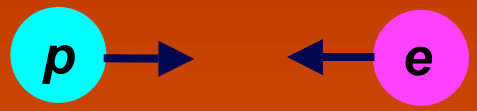
1) 1.0 N
2) 1.5 N
3) 2.0 N
4) 3.0 N
5) 6.0 N

The force F_2 must have the *same magnitude* as F_1. This is due to the fact that the form of Coulomb's Law is totally symmetric with respect to the two charges involved. The force of one on the other of a pair is the same as the reverse. Note that this sounds suspiciously like Newton's 3rd Law!!

ConcepTest 21.5c Proton and Electron III

A proton and an electron are held apart a distance of 1 m and then let go. Where would they meet?

1) in the middle
2) closer to the electron's side
3) closer to the proton's side



ConcepTest 21.5c Proton and Electron III

A proton and an electron are held apart a distance of 1 m and then let go. Where would they meet?

1) in the middle
2) closer to the electron's side
3) closer to the proton's side

By Newton's 3rd Law, the electron and proton feel the same force. But, since $F = ma$, and since the proton's mass is much greater, the proton's acceleration will be much smaller!

Thus, they will meet closer to the proton's original position.

Follow-up: Which particle will be moving faster when they meet?