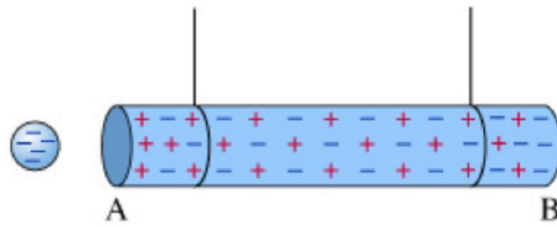


1. A small metal ball is given a negative charge, then brought near (i.e., within a few millimeters) to end A of the rod.



What happens to end A of the rod when the ball approaches it closely this first time?

Since the rod is an insulator, electric charges cannot move around within the rod very easily. If there is a strong enough force, the charges can move a small distance. When the negatively-charged ball is brought close to the insulating rod, the electrons in the rod are repelled and will move to the right, but only a little bit. This will leave a very small net positive charge at the end of the rod (at A). So the negatively-charged ball will be **weakly attracted** to the end of the rod, at end A.

2. Now consider what happens when the small metal ball is *repeatedly* given a negative charge and then brought *into contact* with end A of the rod. After several contacts with the charged ball, how is the charge on the rod arranged?

When the negatively-charged ball is brought into contact with end A of the rod, the slight positive charge at that end of the rod will attract some electrons from the ball and pull them onto the end of the rod. Then the ball will be refilled with electrons, brought close to end A of the rod, cause end A to be slightly positively charged again, and end A will attract more electrons onto it. In the end, the electrons will spread out evenly as much as they can but they can't move far because the rod is an insulator. So the rod will have **negative charge on end A with end B remaining almost neutral.**

3. How does end A of the rod react when the ball approaches it after it has already made several contacts with the rod, such that a fairly large charge has been deposited at end A?

Since end A now holds a negative charge, the negatively-charged ball will be repelled by the rod at end A. How strong that repulsion is will depend on how much negative charge is at end A, which will depend on how many times it was brought into contact with the rod in part 2. So the answer to this can be either **strongly repelled** or **weakly repelled**.