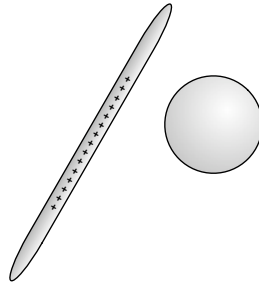


1. When you rub an electrically neutral balloon with wool, the balloon
  - (a) becomes negatively charged.
  - (b) becomes positively charged.
  - (c) stays neutral.
2. When an ordinary object becomes positively charged,
  - (a) it gains electrons.
  - (b) it loses electrons.
  - (c) it gains protons.
  - (d) it loses protons.
3. A positively charged piece of plastic is brought near one end of an aluminum rod resting on top of a glass beaker. A “click” is heard.
  - (a) What kind of charge does the rod acquire, if any at all? How do you know?
  - (b) Describe what must have occurred at the atomic level in this process.
  - (c) What will happen to any electric charge on the aluminum if you touch it at one point with your finger? Describe this in terms of electrons.
4. Four styrofoam balls A, B, C, and D are suspended by threads. Ball A has been touched by a plastic rod that was rubbed with a woolen cloth. When the balls are brought close together without making contact, the following observations are made:
  - Balls B, C, and D, are attracted to ball A.
  - Balls B and D have no effect on each other.
  - Ball B is attracted to ball C.

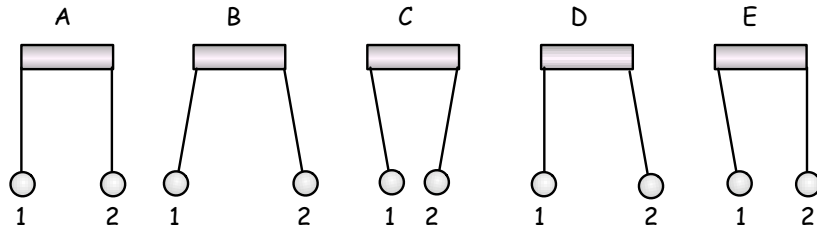
What are the charge states (+, −, or neutral) of balls A, B, C, and D? Justify your choices.

5. An plastic golf club tube that has been rubbed by wool and a pane of plexiglass that has been rubbed by a plastic grocery bag are each suspended by a thread.
  - (a) A third object repels the golf club tube. Can you predict what this object will do to the plexiglass? If not, why not? If so, how do you know?
  - (b) A fourth object attracts the plexiglass. Can you predict what this second object will do to the ebonite rod? If not, why not? If so, how do you know?
6. Can an insulating material be electrically charged? If so, how would you charge it? If not, why not?
7. Can an conducting material be electrically charged? If so, how would you charge it? If not, why not?

8. A styrofoam ball is hanging from a thread. A positively charged Van de Graaf generator is brought near the ball. The ball is attracted to the generator, touches it, and then it flies away from the rod. Explain what is going on here.



9. The figure above shows a positively charged rod held near, but not touching, a neutral sphere.
- Add plus signs and minus signs to show how charges are distributed on the sphere as a result.
  - Sketch and label a qualitative force diagram for the sphere. Does the sphere experience a non-zero net electric force? If not, why not? If so, in which direction?



10. Two identical, lightweight, electrically neutral conducting balls hang from threads. Choose the diagram in the figure above that shows how the balls will be hanging after the processes described in each of the four following independent cases:
- Both are touched by a negatively charged rod.
  - Ball 1 is touched by a negatively charged rod and ball 2 is touched by a positively charged rod.
  - Both are touched by a negatively charged rod but ball 2 picks up more negative charged than ball 1.
  - Only ball 1 is touched by a negatively charged rod.
11. How is it that charged objects lose their charge more quickly in humid air than in dry air? Use a basic molecular model and a sketch for your explanation.