

Charges Activity w/ PhET SIMs

This is an activity pulled from a lecture covering electric charges from PHYS1010 at CU Boulder exploring the nature of charges and forces. The applets used as part of the activity are the Electric Field Hockey, Charges and Fields, Balloons and Static Electricity, and John Travoltage. Five concept questions are integrated into the activity to check student understanding.

Electric Hockey Simulation!

$$\text{Force}_{\text{of B on A}} = \frac{kq_A q_B}{r^2}$$

Place charge (B), see charged "puck" (A) fly away when 2 cm away.

Now place charged "puck" (A) 1 cm away from placed charge (B).

Compared to previous situation, force on puck (A) will be:

- a. half as large.
- b. the same.
- c. twice as large.
- d. four times larger
- e. something else.

Demo and discuss

Answer: d. four times larger since force depends on
 $1/(\text{distance between charges})^2 \dots$
distance smaller, force larger

Add another charge to B, right on top of the first. Force on "puck" (A) will be:

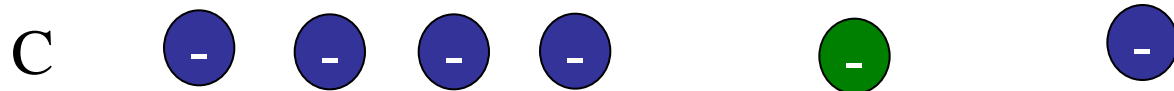
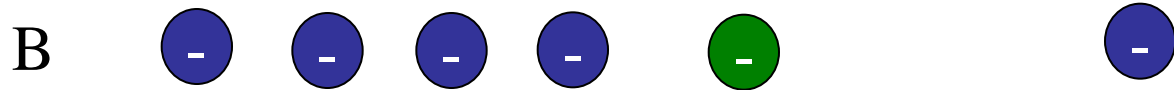
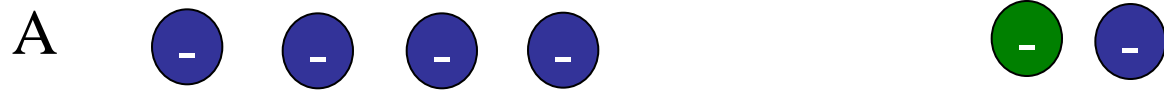
- a. /2.
- b. the same.
- c. * 2.
- d. * 4.
- e. something else.

demo and discuss

Blue charges are “nailed down” negative charges.

The green charge is the puck (free moving)

For which of these choices is puck most likely not to move (e.g. net force on puck is zero)?



Charges and Fields applet on PhET

If we put bunch of electrons in a box. They will

- a. clump together.
- b. spread out uniformly across box.
- c. make a layer on walls.
- d. do something else.

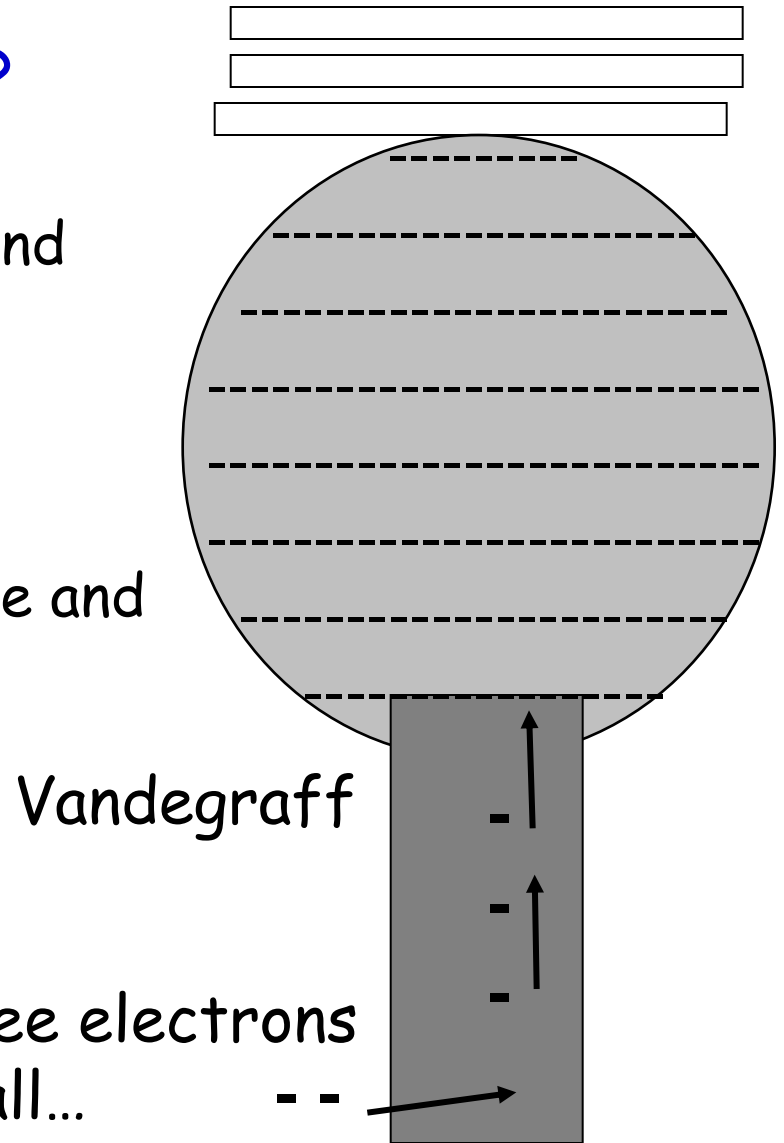
Experiment with the applet and discuss.

Pom-pom demo

Demo of pie plates stacked on Vandegraff.
Turn on VG - put lots of extra electrons on it.

What will happen to the pie plates?

- a. Nothing. The plates will stay there.
- b. They will fly off at the same time and stick together.
- c. The topmost will fly off, then the one underneath, then the next one underneath.
- d. They will all fly off at the same time and separate.



Belt moves free electrons
up to metal ball...

Balloon demo – rub a balloon stick it to a wall.
What attracts the balloon to the wall?

Sweater and Balloon applet

Predict what charges are on the balloon and the sweater.

- a. Both have extra plus charges.
- b. Both have extra minus charges.
- c. Balloon has extra plus or minus charges, sweater is neutral.
- d. Sweater has extra plus or minus charges, balloon is neutral.
- e. Either sweater has extra minuses and balloon extra pluses or balloon has extra minuses and sweater extra pluses.

Experiment with applet and find out.

Rub a second balloon on the sweater.

The two balloons will

- a. attract.
- b. repel.
- c. Do nothing; there is no force between them.

"Lightning" on a smaller scale
(*John Travoltage applet*)

Suppose we put a charge on Mr. Travolta by rubbing his foot on the carpet more times. Will his finger be closer or further away from the doorknob when the sparks fly?

- a) Closer.
- b) Further.
- c) Same distance.

Moral: Don't get back in your car while filling the tank, especially on a dry winter day.