

Electrostatics 1

1. Sketch the arrangement and the direction of the forces acting on each of the following objects.

- Two positively charged spheres are held close to one another without touching.
- A positively charged sphere is held close to a negatively charged sphere.
- Two negatively charged spheres are held close to one another without touching.

2. An insulating sphere with charge $+4q$ is brought close to an initially neutral insulating sphere. What direction is the net electrostatic force on each sphere?

3. A conducting sphere with charge $+4q$ is brought close to, and allowed to touch, an initially neutral conducting sphere.

- Sketch the charge distribution in each sphere when the spheres are close to one another, but have not yet touched.
- What direction is the net electrostatic force on each sphere when the spheres are close to one another, but have not yet touched?
- Sketch the charge distribution as the spheres are in contact with one another.
- What direction is the net electrostatic force on each sphere when the spheres are in contact with one another?
- Sketch the charge distribution in each sphere when the spheres are close to one another, after the spheres have touched with one another.
- What direction is the net electrostatic force on each sphere when the spheres are close to one another, after they have touched one another?

4. A conducting sphere with a $+8q$ charge is brought close to, and allowed to touch, a conducting sphere with an initial $-2q$ charge.

- Sketch the charge distribution in each sphere when the spheres are close to one another, but have not yet touched.
- What direction is the net electrostatic force on each sphere when the spheres are close to one another, but have not yet touched?
- Sketch the charge distribution as the spheres are in contact with one another.
- What direction is the net electrostatic force on each sphere when the spheres are in contact with one another?
- Sketch the charge distribution in each sphere when the spheres are close to one another, after the spheres have touched with one another.
- What direction is the net electrostatic force on each sphere when the spheres are close to one another, after they have touched one another?

5. As a comb moves through hair, it acquires a negative charge. What does this mean for the hair?

6. A charged sphere has a net charge of $+2.0\ \mu\text{C}$.
- Did it gain or lose particles in charging?
 - How many charges were transferred during charging?
7. A sphere with a net charge of $+2.0\ \mu\text{C}$ is held $5.0\ \text{cm}$ from a sphere with a net charge of $-2.0\ \mu\text{C}$.
- Sketch the arrangement and the net electrostatic force on each charge.
 - Calculate the net electrostatic force on each charge.
8. A sphere with a net charge of $-4.0\ \mu\text{C}$ is held $5.0\ \text{cm}$ from a sphere with a net charge of $-2.0\ \mu\text{C}$.
- Sketch the arrangement and the net electrostatic force on each charge.
 - Calculate the net electrostatic force on each charge.
9. Two charged spheres experience net electrostatic forces of $8.0\ \text{N}$ directed toward the other charge when they are held $20.0\ \text{cm}$ apart.
- What do you know about the charges from the problem description?
 - Where would you need to place the charges to have the force decrease to $2.0\ \text{N}$?
10. Three $+4.0\ \mu\text{C}$ charges are arranged in a line with a $2.0\ \text{cm}$ gap between consecutive charges.
- Sketch the arrangement.
 - Find the net electrostatic force on each charge.
11. Two $-3.0\ \mu\text{C}$ spheres are placed $4.0\ \text{cm}$ apart on a line. A third sphere with charge $+2\ \mu\text{C}$ is placed $4.0\ \text{cm}$ to the right of the rightmost $-3.0\ \mu\text{C}$ charge.
- Sketch the arrangement.
 - Find the net electrostatic force on each charge.
12. Three charges are arranged in a plane. They each have a net charge of $+5.0\ \mu\text{C}$. The coordinates of the locations are $(0.0\ \text{cm}, 0.0\ \text{cm})$, $(4.0\ \text{cm}, 0.0\ \text{cm})$ and $(0.0\ \text{cm}, 4.0\ \text{cm})$.
- Sketch the arrangement.
 - Find the net electrostatic force on each charge.