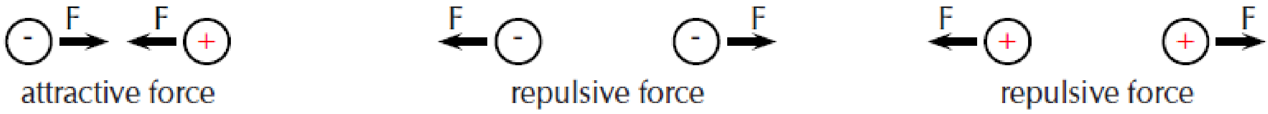
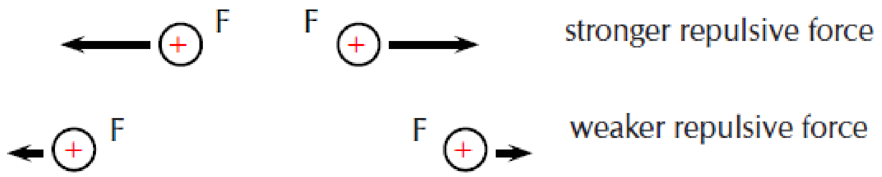
Static charges apply a force (a push or a pull) on each other:

- **like** charges is **repulsive**
- **opposite** (unlike) charges is **attractive**.

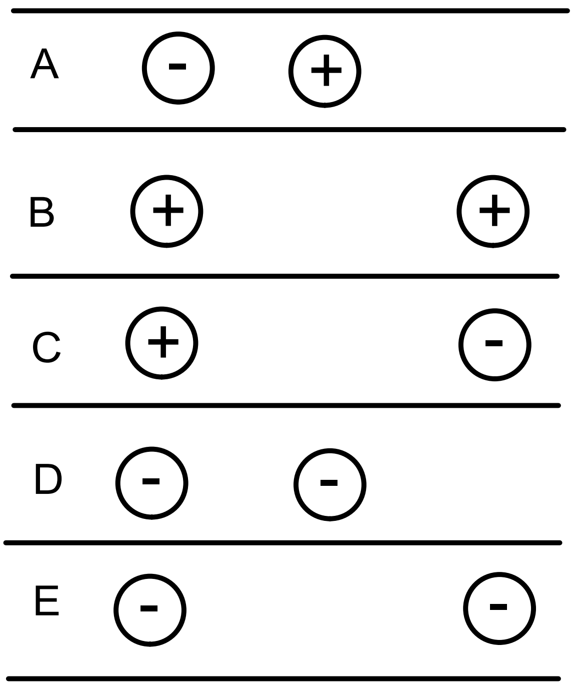
In other words, like charges repel each other while opposite charges attract each other.



The *closer* together the charges are, the *stronger* the electrostatic force between them.



Examples (assume each metal sphere has the same charge)



Weak repulsive force: B, E

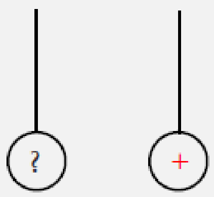
Strong repulsive force: D

Strong attractive force: A

Weak attractive force: C

QUESTION

Two charged metal spheres hang from strings and are free to move as shown in the picture below. The right hand sphere is positively charged. The charge on the left hand sphere is unknown.



The left sphere is now brought close to the right sphere.

1. *If the left hand sphere swings towards the right hand sphere, what can you say about the charge on the left sphere and why?*
2. *If the left hand sphere swings away from the right hand sphere, what can you say about the charge on the left sphere and why?*

SOLUTION

Conservation of Charge Pg. 265

DEFINITION: Principle of conservation of charge
The principle of conservation of charge states that the net charge of an isolate system remains constant during any physical process, e.g. two charge objects making contacting and separating.

The charge on a single electron is $q_e = 1.6 \times 10^{-19}$ C. All other charges in the universe consist of an integer multiple of this charge. This is known as charge quantisation.

$$Q = nq_e$$

Charge is measured in units called coulombs (C). A coulomb of charge is a very large charge. In electrostatics we therefore often work with charge in micro-coulombs ($1\ \mu C = 1 \times 10^{-6}$ C) and nanocoulombs ($1\ nC = 1 \times 10^{-9}$ C).

Example Problems

Determine the resulting net charge of each metal sphere.

1.) A: 7.0 C B: 19.0 C

After A and B touch: A = 13 C B= 13 C

2.) A: -10.5 C B: -4.5 C

After A and B touch: A = -7.5 B= -7.5

3.) A: -8.0 C B: 11.0 C

After A and B touch: A = 1.5 B= 1.5

4.) A: 20 C B: -12 C C: - 15 C

A and B touch: A = 4 B = 4 C = -15

B and C touch: A = 4 B = -5.5 C = -5.5

A and B touch: A = -0.75 B = -0.75 C = -5.5

Total Charge: -7

A, B, and C touch at the same time: = -7 ÷ 3

A = -2.33 B = -2.33 C = -2.33

5.) A: 6.0 C B: 4.0 C C: - 8.0 C D: 5.0 C

Total of Charges: +7

C and D touch: A = 6 B = 4 C = -1.5 D = -1.5

A and C touch: A = 2.25 B = 4 C = 2.25 D = -1.5

B and C touch: A = 2.25 B = 3.125 C = 3.125 D = -1.5

B and D touch: A = 2.25 B = 0.8125 C = 3.125 D = 0.8125

All four spheres are touched together at the same time:

A = 1.75 B = 1.75 C = 1.75 D = 1.75