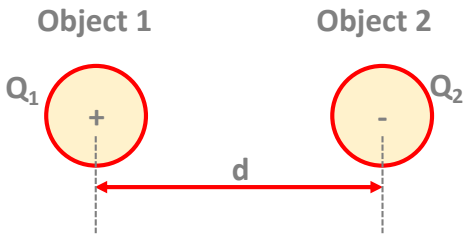
Coulomb's Law
Video Notes

Coulomb's Law predicts the effect that variations in the quantity of charge upon and the distance of separation between charged objects has upon the force of attraction or repulsion between those objects.

Coulomb's Law

The electrostatic force acting between charged objects is

- directly proportional to the quantity of charge (Q_1 and Q_2) on either of the objects ,and
- inversely proportional to the square of the distance (d) between the object's centers



$$F_{elect} \propto \frac{Q_1 \bullet Q_2}{d^2}$$

Q = quantity of charge
d = separation distance

Electrostatic Force (F_{elect}) and Charge (Q)

Electrostatic force is (F_{elect}) is directly proportional to the quantity of charge (Q) on either object.

- As Q_1 ↑ or Q_2 ↑, F_{elect} ↑
- As Q_1 ↓ or Q_2 ↓, F_{elect} ↓
- the factor by which a Q value is changed is equal to the factor by which the F_{elect} is changed.
- Double Q ➔ Double F_{elect}
- Triple Q ➔ Triple F_{elect}
- Halve Q ➔ Halve F_{elect}

$$F_{elect} \propto \frac{Q_1 \bullet Q_2}{d^2}$$

Example 1

Objects 1 and 2 attract each other with a force of 32.0 units. If the charge of Object 1 is tripled AND the charge of object 2 is halved, then the new electrostatic force will be _____ units.

$F_{elect\text{-}new}$ = 32.0 units • 3 • ½ = **48.0 units**

Since Q_1 is tripled

Since Q_2 is halved

Electrostatic Force (F_{elect}) and Distance (d)

Electrostatic force is (F_{elect}) is inversely proportional to the square of the separation distance (d) between objects.

$$F_{elect} \propto \frac{Q_1 \bullet Q_2}{d^2}$$

- As d ↑, F_{elect} ↓
- As d ↓, F_{elect} ↑
- The factor by which F_{elect} is decreased is the square of the factor by which d is increased.
- Double d ➔ F_{elect} ↓ by factor of 4 (2^2)
- Triple d ➔ F_{elect} ↓ by factor of 9 (3^2)
- Halve d ➔ F_{elect} ↑ by factor of 4 (2^2)

Example 2

Objects 1 and 2 attract each other with a force of 32.0 units. If the separation distance is changed to one-third the original value, then the new electrostatic force will be _____ units.

$F_{elect\text{-}new}$ = 32.0 units • 9 = **288 units**

Since d is decreased by a factor of 3

Example 3

When all three independent variables – Q_1, Q_2, and **d** are changed, three changes must be made of the force. Make the changes in step-wise fashion as shown below.

Objects 1 and 2 attract each other with a force of 32.0 units. If the charge of Object 1 is quadrupled AND the charge of object 2 is tripled AND the separation distance is doubled, then the new electrostatic force will be _____ units.

$F_{elect\text{-}new}$ = 32.0 units • 4 • 3 ÷ 4 = **96.0 units**

Since Q_1 is 4X larger

Since Q_2 is 3X larger

Since d is 2X larger