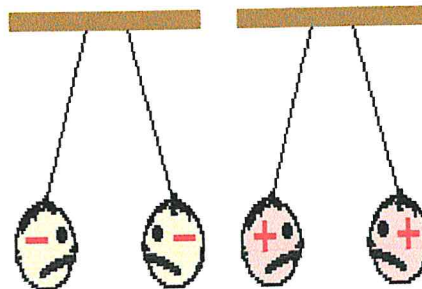


# ELECTRIC CHARGE AND ELECTRIC FORCE

In the world of static electricity ...



oppositely-charged objects attract AND



objects with like charges repel

## Coulomb's Law

= the fundamental law of force between two charged particles. It states that like charges repel one another and opposite charges attract one another.

$$F_e = \frac{k \cdot |q_1| |q_2|}{r^2}$$

➤ Charge can either be positive or negative

k = Coulomb's constant = \_\_\_\_\_

|q<sub>1</sub>| = magnitude of charge one

|q<sub>2</sub>| = magnitude of charge two

r = separation distance between the two charges (straight line) in meters

F<sub>e</sub> = electric force

Units of k : \_\_\_\_\_

Units of q<sub>1</sub> and q<sub>2</sub>: \_\_\_\_\_

Units of F<sub>e</sub>: \_\_\_\_\_

Electric force is directly proportional to \_\_\_\_\_

and inversely proportional to \_\_\_\_\_.

### Direction of Electric Force

Electric force is a field force = like gravity, it acts at a distance

Electric force can be either \_\_\_\_\_ = toward the other charge or it can be \_\_\_\_\_ = away from the other charge

Direction of the force is always along a line that connects two charges.

Like charges always \_\_\_\_\_ each other, while  
opposite charges always \_\_\_\_\_ each other.

- A particle or an object becomes negatively charged when it accepts \_\_\_\_\_ and contains more \_\_\_\_\_ than \_\_\_\_\_.
- A particle or an object becomes positively charged when it loses \_\_\_\_\_ and the number of \_\_\_\_\_ is greater than the number of \_\_\_\_\_.
- Electrically neutral object = object with a balanced number of \_\_\_\_\_ and \_\_\_\_\_.

### Law of Conservation of Electric Charge

Electric charge is always conserved. That is, charge is never created or destroyed; instead, negative charge is transferred from one object to another. In other words, one object loses charge while the other gains it.

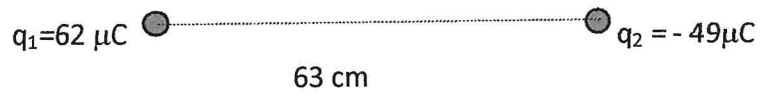
- Electric charge of an isolated system is constant

Electric charge of 1 electron = \_\_\_\_\_

Electric charge of 1 proton = \_\_\_\_\_

unit charge = \_\_\_\_\_

Example: Find the electric force (magnitude and direction) on  $q_1$  due to  $q_2$  if the charges are placed as shown below.



Assignment: textbook p 536 #1-3, p 542#7 – Explain through a diagram.

# ELECTRIC FIELD

➤ Single charge

➤ Electric dipole. **Electric dipole = two charges of equal magnitude but opposite charge.**

- Two identical charges (magnitude and charge)

Positive:

Negative:

- Electric field between two oppositely charged parallel plates

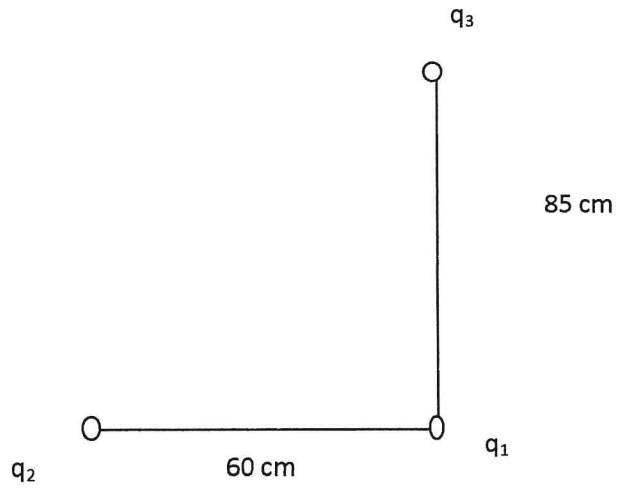
### **Electric field lines:**

**Imagine placing a positive unit charge in the vicinity of the given charge; the arrows of the field lines represent the electric force the unit charge would experience.**

- Electric field lines are always directed away from the positive charge and towards the negative charge.
- The stronger the charge, the more lines are drawn.
- Keep in mind that electric field is 3D so it is more like a sphere rather than a circle.
- Electric field is stronger where the lines are closer to each other.

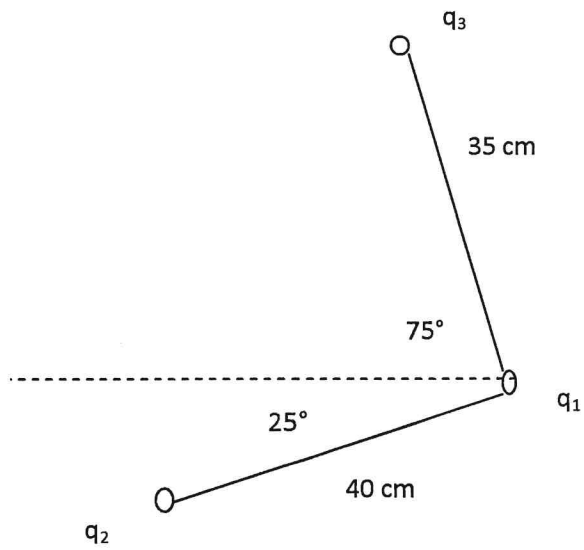
Electric Force - Practice

1. Determine the electric force (magnitude and direction) on a point charge  $q_1$  ( $-40 \mu\text{C}$ ) due to  $q_2$  ( $+55 \mu\text{C}$ ) and  $q_3$  ( $-85 \mu\text{C}$ ).



2. Determine the electric force (magnitude and direction) on  $q_2$  due to  $q_1$  and  $q_3$ .

3. . Determine the electric force (magnitude and direction) on a point charge  $q_1$  ( $-80 \mu\text{C}$ ) due to  $q_2$  ( $+15 \mu\text{C}$ ) and  $q_3$  ( $-85 \mu\text{C}$ ).





4. Find the charge on  $q_1$  provided that  $q_1$  is 25cm away from  $q_2$  ( $q_2 = 40\mu\text{C}$ ) and experiences repulsive electric force of 465N.

5. Consider point charges of  $35\mu\text{C}$  and  $-89\mu\text{C}$ . What is the distance of separation between two point charges if the attractive force experienced by one of the charges is 57N?