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## 1 Electric Charge and Force

Charge is fundamentally a quantity related to an object. A proton has a positive charge while the electron has a negative charge. We can use charge to create an *attractive force* or *repulsive force*, depending on the sign of the charges involved. If the charges have different signs, the forces will attract. If they are different, they will repel. The force is called the *coulomb force*, *electric force*, or *electrostatic force*.

Charge is  $Q$  or  $q$ , and is measured in the unit Coulomb (C). Coulomb is defined as  $\frac{A}{S}$

An object with 0 coulombs of charge is called *Neutral*

### 1.1 Coulomb's Law

Given two forces,  $Q_1$  and  $Q_2$ , and the distance  $r$  (given in metres), the *coulomb force* can be calculated with the following equation:

$$F = k \frac{Q_1 \times Q_2}{r^2}$$

Where  $k$  is a constant at  $8.99 \times 10^9 N \frac{m^2}{C^2}$

If  $F < 0$ , the charges will attract.

If  $F > 0$ , the charges will repel.

#### 1.1.1 A new Foe has Appeared!

If we add more charges, let's say,  $Q_3$ , we must calculate the forces between all particles, in this case,  $Q_1$  and  $Q_2$ ,  $Q_1$  and  $Q_3$ , and  $Q_2$  and  $Q_3$ .

## 2 Elementary Charge

An object cannot have any charge, only integer multiples of the *elementary charge*,  $e$ .  $e = 1.60 \times 10^{-19} C$ .

The electron ( $e^-$ ) has a charge of  $-e$  while the proton has a charge of  $+e$

In a wire conducting 1A, there are  $\frac{1}{e}$  or approximately  $6 \times 10^{18}$  electrons passing every second.