

# Electric charge

Electric charge is an intrinsic property of matter. An object can have positive or negative charge, or it can be neutral. In the international system of units (SI), the unit of charge is the “Coulomb”.

Nowadays, we believe that the fundamental unit of charge is that of the electron, which has a negative charge of  $1.6 \times 10^{-19}\text{C}$ .

$$e^- = 1.6 \times 10^{-19}\text{C}$$

## Coulomb's Law

Coulomb's law describes the force between charged particles. Coulomb found that it is given by:

$$F_{q_1q_2} = k \frac{q_1q_2}{r^2}$$

In this context, a positive force is a repulsive one, whereas a negative force is an attractive one. As a consequence,

Equal charges repel each other  
Opposite charges attract each other

# Homework

1. The number of atoms in a penny is about  $10^{22}$  and the total number of electrons is of the order of  $10^{24}$ . The charge of each electron is  $-1.6 \times 10^{-19}$  C. If you could possibly separate the electrons from all the nuclei in a single penny, how much total charge would you get?



2. The factor of  $r^2$  in the denominator of Coulomb's law has very important consequences. Forces that have this dependence on the distance are known as "inverse square laws". One of the most obvious consequences is the fact that as objects get closer and closer, the force becomes much stronger at each step. To see this, calculate the force between an electron and a proton at a distance of 1m, 1mm= $10^{-3}$ m and  $5.29 \times 10^{-11}$ m (this is the distance between the electron and the proton in a hydrogen atom).