

Electricity

Nicolas Cogniaux

27 novembre 2011

1 Electric field and electric charge

Two charges with the same sign are attracted. Two opposite charges are repelled.

1.1 Coulomb's law

The magnitude of the force between two charges is :

$$F = \frac{1}{4\pi\epsilon_0} \frac{|q_1 q_2|}{r^2}$$

$$\frac{1}{4\pi\epsilon_0} = k \cong 9.0 \times 10^9 \text{ N.m}^2/\text{C}^2$$

1.2 Electric Field and Electric Forces

The electric field is the electric Force per unit of charge

$$\vec{E} = \frac{\vec{F}}{q}$$

So \vec{E} can be written as :

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{r}$$

1.3 Electric Field Lines

Electric field lines starts at positive charge and go to negative charge.

- They never intersect
- The number of field lines can give an idea of the magnitude of the Electric Field.
- The electric field is tangeant with the electric field lines.

1.4 Electric Dipole

If two opposite charges are linked, they can form an electric Dipole. There is a rotation and so a couple.

The magnitude of the torque can be written as :

$$\tau = pE \sin \theta$$

$$\vec{\tau} = \vec{P} \times \vec{E}$$

The potential energy of an Electric Dipole is :

$$U = -\vec{p} \cdot \vec{E}$$

2 Gauss's Law

2.1 Electric Flux

The Electric flux is the quantity of electric charges passing through a defined surface.

$$\frac{dV}{dt} = vA \cos \theta = v \cdot A = \vec{v} \cdot \vec{A}$$