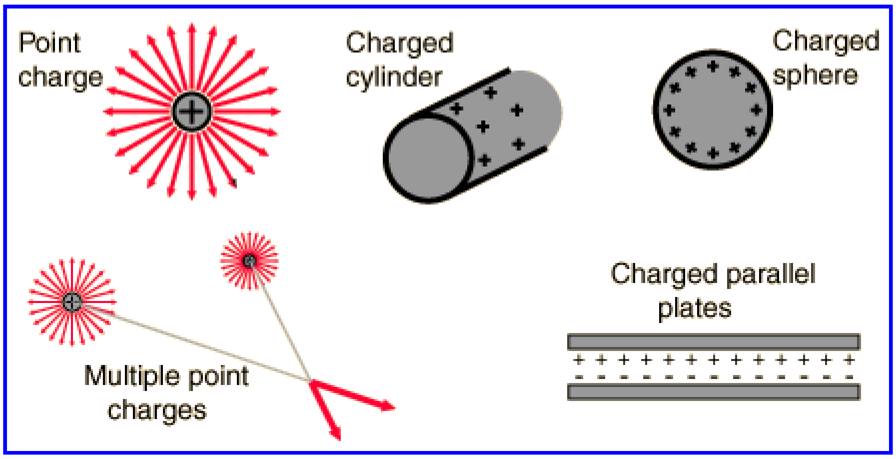
Electric Field

Electric field is defined as the electric force per unit charge. The direction of the field is taken to be the direction of the force it would exert on a positive test charge. The electric field is radially outward from a positive charge and radially in toward a negative point charge.



Using Gauss' law for electric field calculation

Index

Electric field concepts

Electromagnetic force

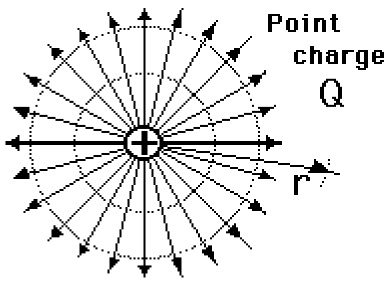
HyperPhysics***** Electricity and Magnetism *R Nave*

Go Back

Electric Field of Point Charge

The electric field of a point charge can be obtained from Coulomb's law:

$$E = \frac{F}{q} = \frac{kQ_{source}\,q}{qr^2} = \frac{kQ_{source}}{r^2}$$



The electric field from any number of point charges can be obtained from a vector sum of the individual fields. A positive number is taken to be an outward field; the field of a negative charge is toward it.

This electric field expression can also be obtained by applying Gauss' law.

Other electric field geometries | Multiple point charges

Index

Electric field concepts

HyperPhysics***** Electricity and Magnetism *R Nave*

Go Back

Electric and Magnetic Constants

In the equations describing electric and magnetic fields and their propagation, three constants are normally used. One is the speed of light c, and the other two are the electric permittivity of free space ε_0 and the magnetic permeability of free space, μ_0. The magnetic permeability of free space is taken to have the exact value

$\mu_0 = 4\pi \times 10^{-7}\ N/A^2$	See also relative permeability

and then the electric permittivity takes the value given by the relationship

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \quad \text{where} \quad c = 2.99792458 \times 10^8\ m/s\ (\text{exact}) \approx 3 \times 10^8\ m/s$$

This gives a value $\varepsilon_0 = 8.854187817 \times 10^{-12}\ F/m \approx 8.85 \times 10^{-12}\ F/m$

$$k = \frac{1}{4\pi\varepsilon_0} = 8.987552 \times 10^9\ N\,m^2/C^2 = \text{Coulomb's constant}$$

In the presence of polarizable or magnetic media, the effective constants will have different values. In the case of a polarizable medium, called a dielectric, the comparison is stated as a relative permittivity or a dielectric constant. In the case of magnetic media, the relative permeability may be stated.

Index

Electric field concepts