Electric Field

WHAT IS AN ELECTRIC FIELD?

An **electric field** is an alteration of space surrounding a charge. The electric field is defined by its effect in a test charge, q:

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

The units for the electric field are N/C or V/m. The electric field exerts a force on a charge which is given by:

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

MULTIPLE, SINGLE POINT CHARGES

In the case of a **single point charge**, the electric field generated is defined as:

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

In the case of a **multiple point charges**, the electric field generated is defined as:

$$\vec{E}_{net} = \sum_i \frac{1}{4\pi\epsilon_0}\frac{q_i}{r_i^2}\hat{r}_i$$

where $\hat{r}_i$ is the unit vector of the *position.*

The **charge densities** for extended charged objects are defined in three ways depending on the shape of the charge density:

Linear change density (C/m) $\lambda = Q/L$

Surface charge density (C/m^2) $\eta = Q/A$

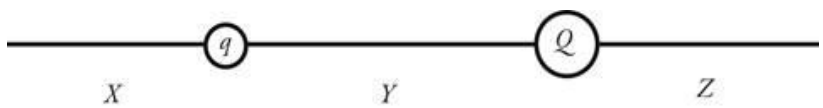
Volume charge density (C/m^3) $\rho = Q/V$

SAMPLE PROBLEMS

1) What is the electric field due to a point charge of 20μC at a distance 1m away from it? [1.8x105 N/C]

2) In the vicinity of a point charge, *q*, a 0.2 μC charge was placed so that a force of $5x10^{-5}$ N is applied to it due to the charge. Find the electric field produced by this unknown charge. [250 N/C]

3) The figure shows two unequal point charges, q and Q, of the same sign. Charge Q has greater magnitude than charge q. In which of the regions will there be a point at which the net electric field due to these two charges is zero?



4) The electric field strength in the space between two closely spaced parallel disks is 1.0 × 105 N/C. This field is the result of transferring 3.9 × 109 electrons from one disk to the other. What is the diameter of the disks? [3.00 cm]

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