Electrostatics Notes

2 – Electric Field on a Single Charge

There are many similarities between **gravitational** and *electrostatic* forces. One such similarity is that both forces can be exerted on objects that are not in contact.

In the same way that any mass is surrounded by a **gravitational field**, we will imagine that any charge object is surrounded by an **electric field**.

Similar to gravitational fields, an electric field will depend on:
size of ________ and distance to ________ the charge.

In fact we define an electric field as the force per unit charge:

this is just like grav fields: $g = \frac{\vec{F_g}}{m}$

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

Where: E = electric field (N/C)
F_E = electrostatic force (N)
q = test charge (C)

We can substitute in Coloumb's Law to get:

$$\vec{E} = \frac{Kq}{r^2}$$

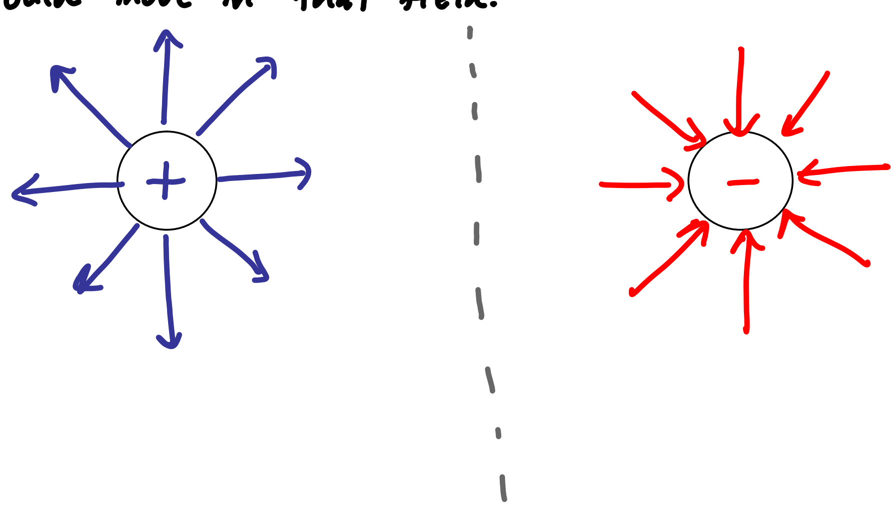
In the case of electric fields we are dealing with another example of a force ________ field ________.

Therefore the field is a vector ________ quantity ________.

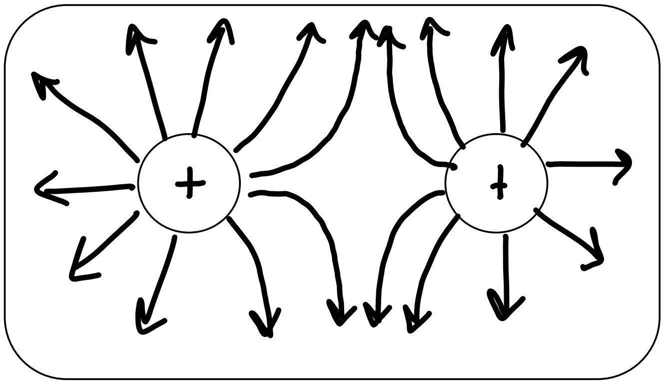
In order to show this we always draw the field lines as arrows ________.

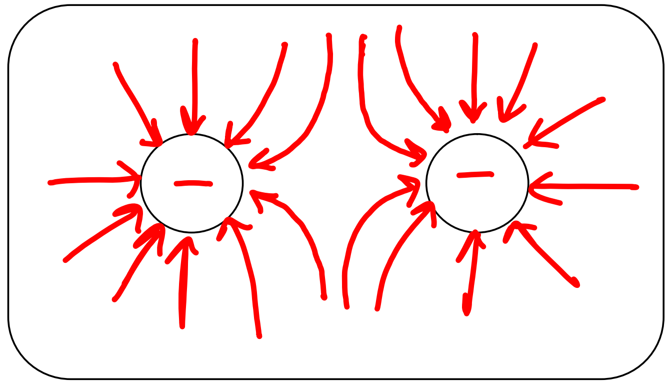
Again there is an important difference between gravitational fields and electric fields due to the fact that…

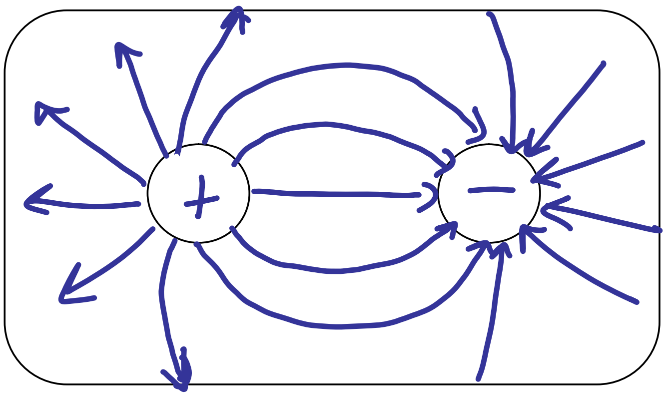
We therefore define the direction of an electric field as… the direction a positive charge would move in that field.



You will remember that the strength of a vector field is indicated by the density of the arrows, therefore the field is always strongest…







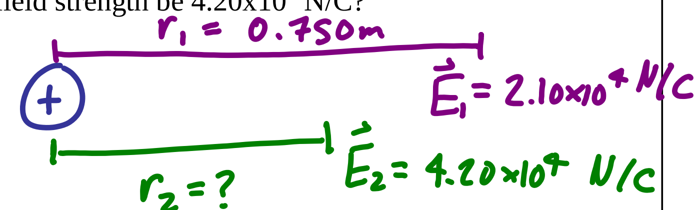
Example:
What is the electric field strength at a point where a -2.00 uC charge experiences an electric force of 5.30×10^{-4} N?

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

$$\vec{E} = \frac{F_E}{q} = \frac{5.30 \times 10^{-4}\,N}{2.00 \times 10^{-6}\,C}$$

$$= 265\ N/C$$

Example:
At a distance of 7.50×10^{-1} m from a small charged object the electric field strength is 2.10×10^{4} N/C. At what distance from this same object would the electric field strength be 4.20×10^{4} N/C?



$$\vec{E}_1 = \frac{kq}{r_1^2} \qquad q = \frac{\vec{E}_1 r_1^2}{k} = 1.3125 \times 10^{-6}\,C$$

$$\vec{E}_2 = \frac{kq}{r_2^2} \qquad r_2 = \sqrt{\frac{kq}{E_2}} = \underline{0.53\,m}$$