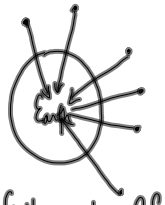
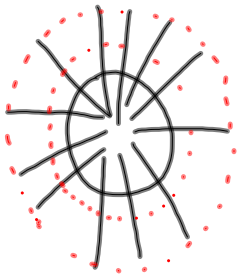
§14-2 Fields

- a property of space





- infinite number of force lines (vectors) that make up a field.

Let's say we have 1000 toothpicks

← At 1cm from centre.

SA: $4\pi r^2$

$\frac{1000}{4\pi(1cm)^2} = \frac{1000}{4\pi}$ toothpicks/cm^2 $\times \frac{1}{4}$

$\times 2$ ($\frac{1000}{4\pi(2cm)^2} = \frac{1000}{16\pi}$ toothpicks/cm^2

radius

↑ field intensity

$$\text{field intensity} \propto \frac{1}{r^2}$$

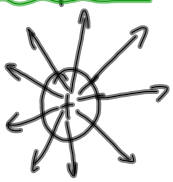
↑ inverse square relationship

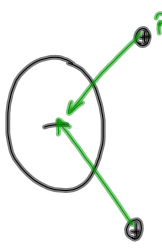
field (intensity) - force per unit mass (gravitational)
force per unit charge (electric)

Electric Fields

positive test charge.

Positive source charges have an electric field directed radially outward.





A negative source charge has a field directed radially inward.

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

Where $\vec{E}$ is the electric field intensity (strength) $\left(\frac{N}{C}\right)$
$\vec{F}_e$ is the electrostatic force (N)
q is the charge that experiences the field (C)

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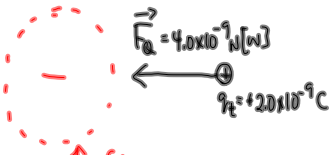
$q_t = +2.0 \times 10^{-9} C$

$\vec{F}_a = 4.0 \times 10^{-9} N\ [W]$

a) $\vec{E} = ?$

b) $\vec{F}_a = ?$ if $q = +9.0 \times 10^{-6} C$



If this were the source charge it would be +ve

If this were the source charge, it would have to be -ve

$$\vec{E} = \frac{\vec{F}_a}{q}$$ ← do not use +/-

$$\vec{E} = \frac{4.0 \times 10^{-9} N [W]}{2.0 \times 10^{-9} C}$$

This means every coulomb of positive charge will experience a force of 2.0N [W]

$$\vec{E} = 2.0 \frac{N}{C} [W]$$

OR

Every coulomb of negative charge experiences a force of 2.0N [E]

b) $$\vec{E} = \frac{\vec{F}_a}{q}$$

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

$$\vec{F}_a = (9.0 \times 10^{-6} C)\left(2.0 \frac{N}{C} [W]\right)$$

$$\vec{F}_a = 1.8 \times 10^{-5} N [W]$$

Gravitational Field Intensity

$$\vec{g} = \frac{\vec{F}_g}{m} \quad (\vec{F}_g = m\vec{g})$$

↖ always radially inward.

where $\vec{g}$ is the gravitational field intensity (N/kg)

$\vec{F}_g$ is the force of gravity (weight) (N)

m is the mass that experiences the field (kg)

To DO
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