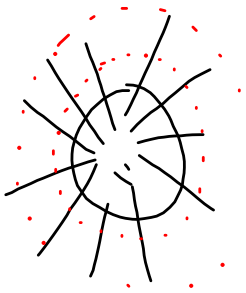
Chapter 14 ~ Fields + Forces

§14-1 Laws of Force



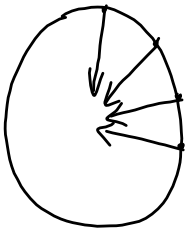
Imagine stabbing a styrofoam ball with 100 long sticks.

radius (m)	SA (m^2)	$\frac{\#sticks}{SA}$ ($/m^2$)
1	$4\pi(1)^2 = 4\pi$	$\frac{100}{4\pi} = \frac{25}{\pi}$
2	$4\pi(2)^2 = 16\pi$	$\frac{100}{16\pi}$
3	$4\pi(3)^2 = 36\pi$	$\frac{100}{36\pi}$
4	$4\pi(4^2) = 64\pi$	$\frac{100}{64\pi}$

x2, x3, x4 between radius values; $\times \frac{1}{4}$, $\times \frac{1}{9}$, $\times \frac{1}{16}$ between SA values.

$SA = 4\pi r^2$ (sphere)

$$\text{ratio}\left(\frac{\#sticks}{SA}\right) \propto \frac{1}{r^2}$$ Inverse square law.



The sticks are really representing the the force vectors.

Coulomb's Law

Like charges repel
Unlike charges attract.

$F_q \propto q_1$

$F_q \propto q_2$

$F_q \propto \frac{1}{r^2}$ (inverse square law)

Combining: $F_q \propto \frac{q_1 q_2}{r^2}$

Coulomb's Law

$$F_q = \frac{k q_1 q_2}{r^2}$$

Where F_q is the electrostatic force of attraction or repulsion (N)
(magnitude)

DO NOT PUT SIGNS ON THE CHARGES → q_1 and q_2 are the charges (C) coulomb

r is the separation (m)

k is Coulomb's Constant $\left(9.0 \times 10^9 \frac{N \cdot m^2}{C^2}\right)$

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$q_1 = -8.0 \mu C$

$q_2 = \pm 5.0 \mu C$??

$F_q = 5.0 N$ (attractive)

$\mu = 10^{-6}$ micro

a) ± ?? for q_2 → $+5.0 \mu C$ since it is attracted to $-8.0 \mu C$

b) $r = ?$

$$F_q = \frac{k q_1 q_2}{r^2}$$

$$r^2 = \frac{k q_1 q_2}{F_q}$$

no signs!

$$r^2 = \frac{\left(9.0 \times 10^9 \frac{N \cdot m^2}{C^2}\right)\left(8.0 \times 10^{-6} C\right)\left(5.0 \times 10^{-6} C\right)}{0.50 N}$$

$r = 0.85 m$

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