Chapter 14 - Fields + Forces

§14-1 Laws of Force

Coulomb discovered that the force of attraction/repulsion depends directly with the charges and is inversely related to the square of the separation distance:

$$F_Q \propto q_1$$
$$F_Q \propto q_2$$
$$F_Q \propto \frac{1}{r^2}$$

$$F_Q \propto \frac{q_1 q_2}{r^2}$$

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

Coulomb's Law

Where F_Q is the electrostatic force of attraction/repulsion (N)

magnitude only, use attraction/repulsion to figure out direction.

q_1 and q_2 are the charges (C) Coulomb

DO NOT PUT SIGNS ON THE CHARGES!

r is the separation (m)

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

Comparing F_g and F_Q:

$$F_g = \frac{G m_1 m_2}{r^2} \qquad F_Q = \frac{k q_1 q_2}{r^2}$$

attractive masses

$G = 6.67 \times 10^{-11} \frac{N \cdot m^2}{kg^2}$

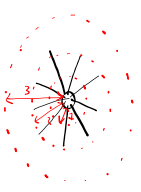
inverse square $\left(F \propto \frac{1}{r^2}\right)$

attractive/repulsive charges

$k = 9.0 \times 10^9 \frac{N \cdot m^2}{C^2}$

inverse square $\left(F \propto \frac{1}{r^2}\right)$

Think about: 1000 skewers stuck in a styrofoam ball.



$SA = 4\pi r^2$

r	SA	$\frac{\#\text{skewers}}{SA}$
1	4π	$1000/4\pi$
2	16π	$1000/16\pi$
3	36π	$1000/36\pi$
4	64π	$1000/64\pi$

(×2 from 1 to 2, ×3 from 2 to 3; ×$\frac{1}{9}$ from 16π to 36π; ×$\frac{1}{4}$ from 4π to 16π)

This shows an inverse-square relationship.

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$q_1 = -8.0\,mC$

$q_2 = +5.0\,mC$ or ~~$-5.0\,mC$~~

$F_Q = 0.50\,N$ (attractive)

$F_Q = \frac{kq_1q_2}{r^2}$

$r^2 = \frac{kq_1q_2}{F_Q}$

a) Sign for q_2? (+)

b) $r = ?$

$$r^2 = \frac{\left(9.0\times10^9\,\frac{N\cdot m^2}{C^2}\right)\left(8.0\times10^{-6}\,C\right)\left(5.0\times10^{-6}\,C\right)}{0.50\,N}$$

$r = 0.85\,m$

TO DO

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