Charge and Electric Force

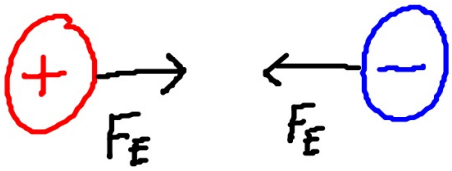
What do you know about charge?

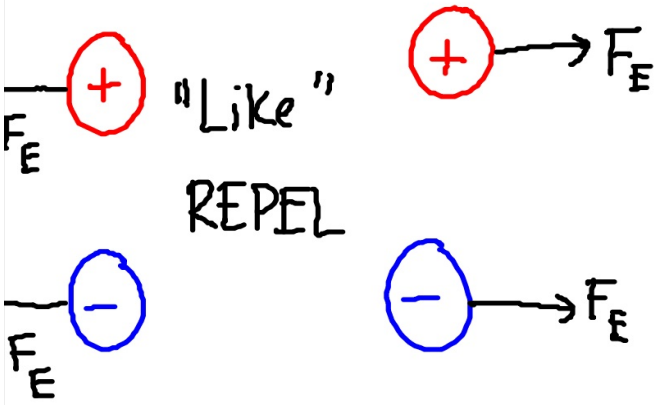
* power * energy * positive / negative

* protons * neutrons * electrons

* opposites attract

"Opposites" ATTRACT





Electric Force

↳ F_E

↳ units: Newtons (N)

↳ positive: repulsion

↳ negative: attraction

Electric Force : Coulomb's Law

$$F_E = \frac{K q_1 q_2}{d^2}$$

$q_1, q_2 \Rightarrow$ charges

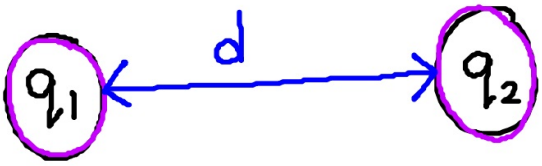
Units: Coulombs (C)

d is distance between q_1 and q_2

Units: meters (m)

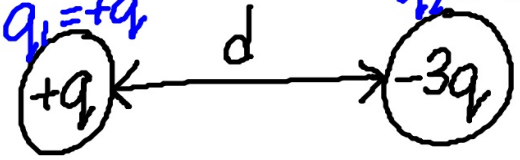
K is Coulomb's constant

$K = 8.99 \times 10^9 \frac{N m^2}{C^2}$



Ex. #1

$q_1 = +q$ $\quad$ $q_2 = -3q$



(a) attractive or repulsive

(b) $F_E =$?

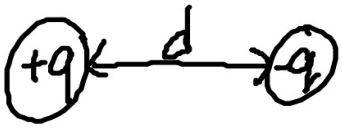
$$F_E = \frac{K q_1 q_2}{d^2} = \frac{K(+q)(-3q)}{(d)^2} = \boxed{\frac{-3Kq^2}{d^2}}$$

Given:

$q_1 = +q$ $\quad$ $K = 8.99 \times 10^9 \frac{N m^2}{C^2}$

$q_2 = -3q$ $\quad$ (* right now answer in variable form)

$d = d$

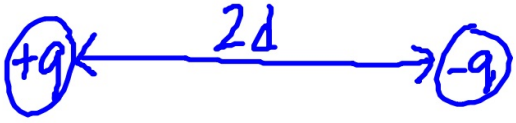


$$F_E = \frac{K(+q)(-q)}{d^2}$$

$$F_E = \frac{-Kq^2}{d^2}$$

So as $d \uparrow$, $F_E \downarrow$

So if d increase by a factor of a, then F_E will decrease by a factor of q^2



$$F_E = \frac{K(+q)(-q)}{(2d)^2}$$

$(2d)^2 = 2^2 d^2 = 4d^2$

$$F_E = \frac{-Kq^2}{4d^2}$$

$$F_E = \frac{F_E}{4}$$

$$F_E = \frac{K(+q)(+q)}{d^2}$$

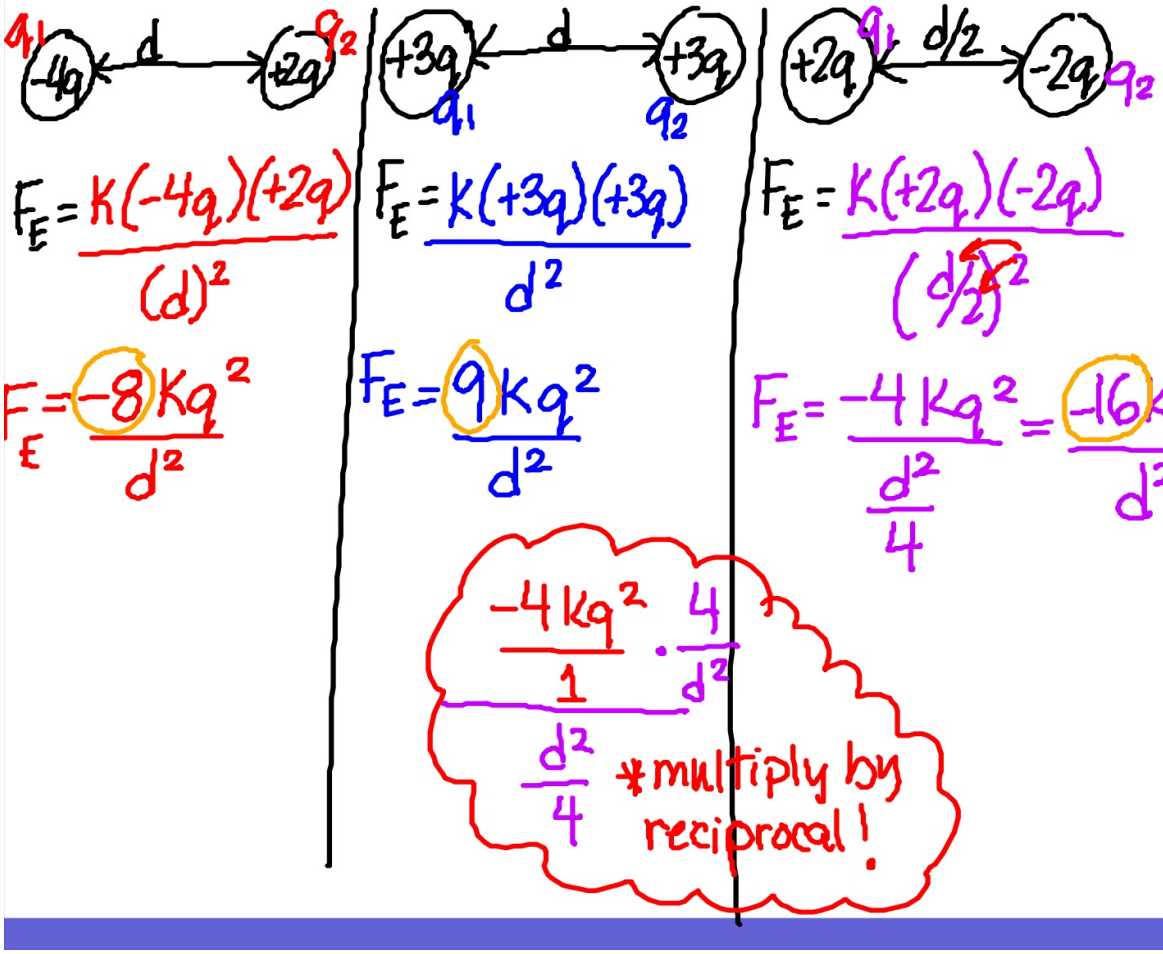
$$F_E = \frac{Kq^2}{d^2}$$

So when $q \uparrow$, $F_E \uparrow$

$$F_E = \frac{K(+2q)(+2q)}{d^2}$$

$$F_E = 4\frac{Kq^2}{d^2}$$

$$F_E = 4F_E$$



⑤

Given:

$d = 0.3\,m$

$q_1 = 2.0 \times 10^{-4} C$

$q_2 = 8.0 \times 10^{-4} C$

$K = 8.99 \times 10^9 \frac{Nm^2}{C^2}$

Unknown:

$F_E = \_\_\_\_ N$

Eqn:

$$F_E = \frac{Kq_1q_2}{d^2}$$

Finish #6-9 for HW!!!

Substitute/Solve

$$F_E = \frac{\left(8.99 \times 10^9 \frac{Nm^2}{C^2}\right)\left(2.0 \times 10^{-4} C\right)\left(8.0 \times 10^{-4} C\right)}{(.3m)^2}$$

$F_E = 15982.\overline{2} = \boxed{1.6 \times 10^4\ N}$

2 SF!