Electric Force / Coulomb Force

$$\vec{F}_g = \frac{G\, m_1 m_2}{r^2}\,(-\hat{r})$$ ← Force of gravity

$$\boxed{\vec{F}_E = \frac{k\, q_1 q_2}{r^2}\,(\hat{r})}$$ ← Electric Force

default is positive

While gravity is always attractive, electric force can either be attractive or repulsive

q_1 and q_2 can be either positive or negative.

q for small charge. Q for large charge

▷ Use this if you're not using calculus & doing simple vector/force problems

k = electric force constant

$$\boxed{k = 9\times10^{9}\ \frac{Nm^2}{C^2}}$$

$$\boxed{\vec{F}_E = \frac{q_1 q_2}{4\pi\epsilon_0 r^2}\,(\hat{r})}$$ ϵ_0 : permittivity constant for a vacuum

$4\pi\epsilon_0$ → new k value when doing calculus.

permittivity constant (how well do electric forces penetrate through materials)

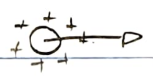
$k = 9\times10^{9}\ \frac{Nm^2}{C^2} = \frac{1}{4\pi\epsilon_0}$

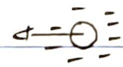
$\epsilon_0 = \frac{1}{4\pi\,(9\times10^{9}\ Nm^2/C^2)}$

$\boxed{\epsilon_0 = 8.85\times10^{-12}\ C^2/Nm^2}$

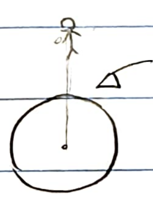
forces aren't instantaneous, so if two objects are far away, it will take time for one to be affected by another.

↳ time it takes for light to travel the distan



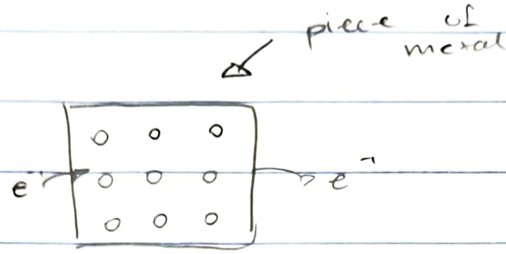


the force/interaction between the charges (force) is mediated by particles (photons)



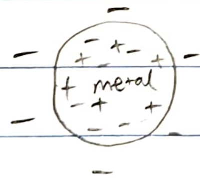
for F_g, "gravitons" are exchanged

Insulators: materials that doesn't conduct electrons.



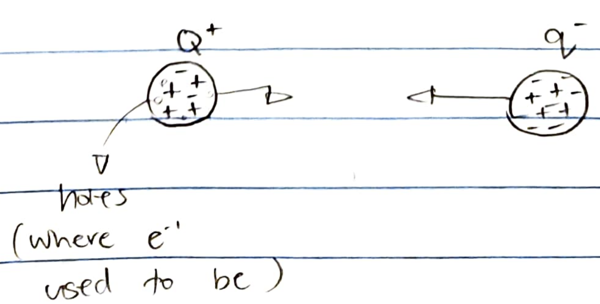
if you insert an electron to a piece of metal, e^{-1} will cause the e^{-1} in the e^{-1} pool of the metal will be impacted and an electon will pop out.
(this is possible due to the non-directional covalent bonds of metals forming e^{-1} pool.)

charges on conductors will move to the surface



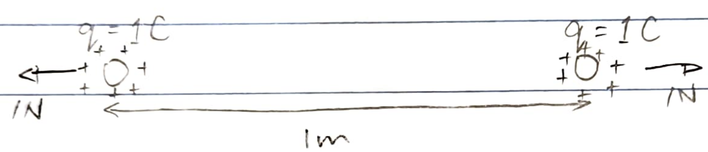
when additional charges are applied to a piece of metal, the charges will spread out throughout the surface.

for non-conductors:



we can add or remove e^{-1} to non-conductors like plastic.

1 Coulomb: the amount of charge required to be placed to cause two equally charged objects at a distance of 1 meter to have an electric force of 1 N.



1 Ampere (1 Amp) : 1 Coulomb / 1 sec

the fundamental charge

$q_{e^{-1}}$ (charge on e^{-1}) $= -1.6 \times 10^{-19}$ C

q_p (charge on photon) $= 1.6 \times 10^{-19}$ C

$$Q_{1\text{ mole of } e^{-1}} = \left(\frac{1 \text{ mol } e^{-1}}{1}\right)\left(\frac{6.022 \times 10^{23}\ e^{-1}}{1 \text{ mol } e^{-1}}\right)\left(\frac{-1.6 \times 10^{-19}\ C}{1\ e^{-1}}\right)$$

$$= \boxed{-96352\ C} = 1 \text{ Faraday}$$