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Welcome!

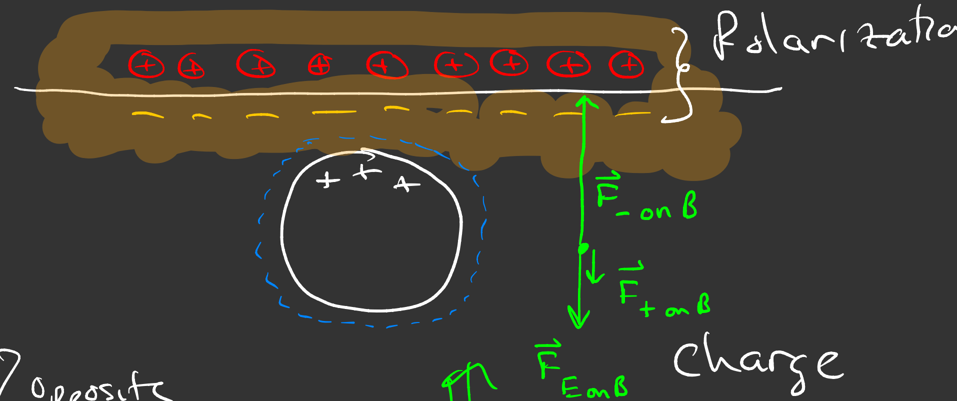
Physics 194 - Lecture 2

Have a question during class? Please ask it right away, even if it means interrupting in the middle of a thought. I want you to!

Agenda

- Recitations + help sessions
- Conductors + insulators
- Electric charge
- Electric force

Class starts @2:15 pm



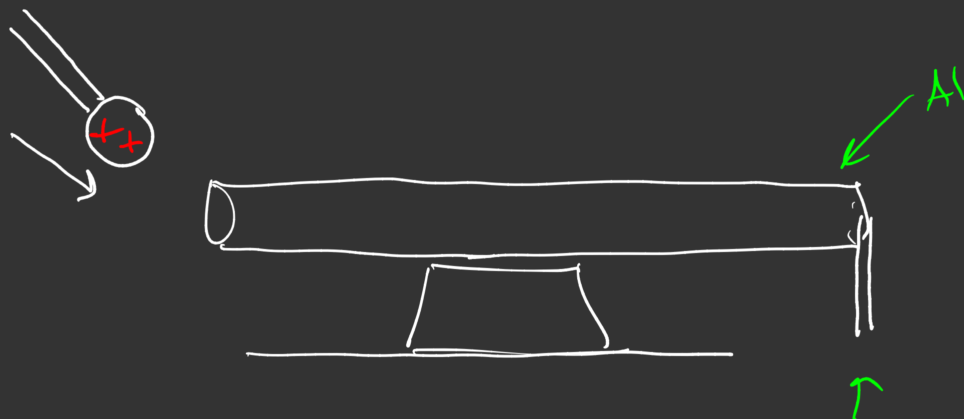
Charge diagram

Electric interaction

1) Protons attract electrons & vice versa } Opposite charges attract
2) Protons repel protons
3) Electrons repel electrons } Same sign charges repel
4) Electric interaction weakens with distance.

The attraction is greater than the repulsion (because the electrons are closer to the balloon)

5) Charged objects polarize other objects which then allows for (weak) attraction.



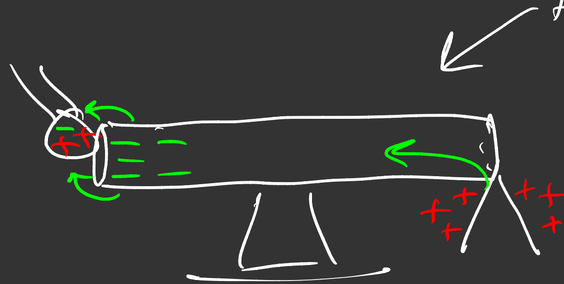
Standard

When glass is rubbed with silk the glass becomes + charged.

1) As the sphere approaches, the strips gradually separate.

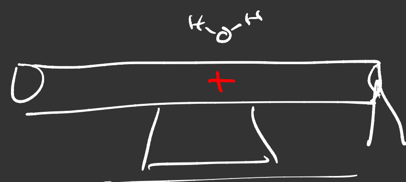
2) When the sphere touches the left side of the rod, the strips quickly separate further.

8) When you remove the sphere, the strips stay separated. If you don't touch the rod with the sphere the strips return to their initial state.

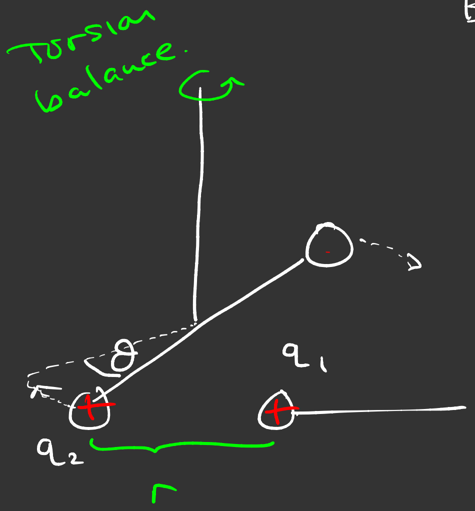


Aluminum is an electric conductor: There are "free electrons"

Materials that don't have "free electrons" are electric insulators.

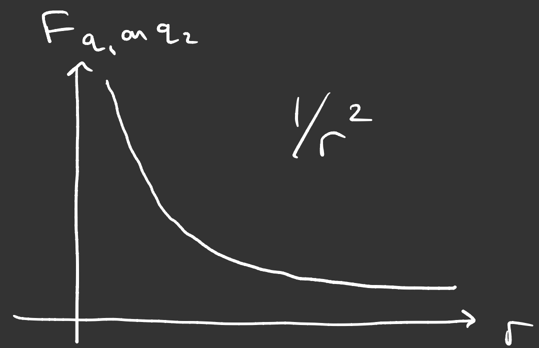


Electric Force



Double r and $F_{q_1 \text{ on } q_2}$ drops by $\frac{1}{4}$

Charles Coulomb's experiment



$$F_{1 \text{ on } 2} = K \frac{|q_1 q_2|}{r^2}$$

(N) kg·m/s² (C) (C) (m²)

Coulomb's constant: $8.99 \times 10^9 \frac{N \cdot m^2}{C^2}$

Coulomb's law

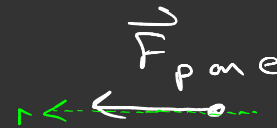
The unit of electric charge is the Coulomb (C)

electric charge quantum

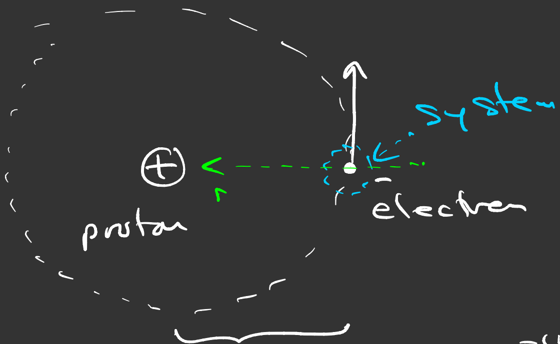
proton charge: $q_p = 1.6 \times 10^{-19} C = +e$

electron charge: $q_e = -1.6 \times 10^{-19} C = -e$

The hydrogen atom



How fast is the electron moving?



$r = 5.29\times10^{-11}\ m$

$$a_r = \frac{1}{m_e}\sum F_{on\ e,r}$$

$$\frac{v^2}{r} = \frac{1}{m_e}\left(k\frac{|q_p q_e|}{r^2}\right)$$

$$v^2 = \frac{1}{m_e}\left(k\frac{|(+e)(-e)|}{r}\right) \quad (e^2)$$

$$v = \sqrt{\frac{ke^2}{m_e r}}$$

$$v = \sqrt{\frac{(9\times10^9\ Nm^2/C^2)(1.6\times10^{-19}\ C)^2}{(9.11\times10^{-31}\ kg)(5.29\times10^{-11}\ m)}} = 2.19\times10^6\ m/s$$

$$= 0.007\ c$$

($c = 3\times10^8\ m/s$)