Physics 102 - Fall 2009 - Recitation 3

(1) Red light has a wavelength of 700 nm.
Light in a vacuum travels at 3×10^8 m/s
What is the frequency of red light?
What is the period of the electric and magnetic field oscillations in red light?
What is the frequency and period of radio waves with a wavelength of 100 km?

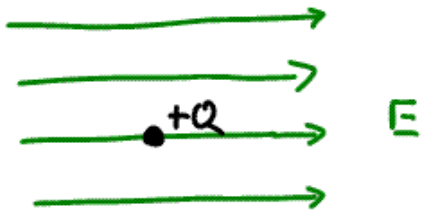
(2) Every grade schooler knows that if you mix yellow with blue you can get green ...
Does this mean if I shoot a beam of yellow light ($\lambda = 550$ nm) into a beam of blue light ($\lambda = 450$ nm) that I get a beam of green light ($\lambda = 500$ nm)?
Why or why not?

(3)

insulator ≡ material where electric charge will NOT flow freely (Rubber, Plastic, glass, etc)

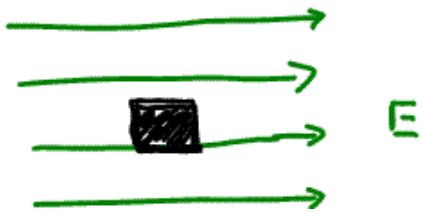
Conductor ≡ material where electric charge flows freely (metals)

Suppose we have a region of uniform electric field.



What would happen to a charge +Q placed in this electric field and released?

What would happen if a conducting block were placed in a uniform electric field?



(4) A charged insulator and an uncharged metal object

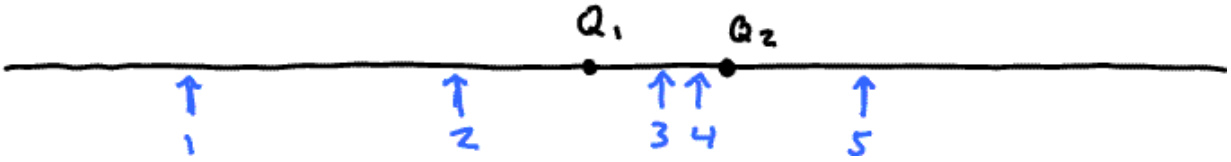
(a) always repel one another.

(b) exert no electromagnetic force on one another.

(c) always attract one another.

(d) may attract or repel, depending on the sign of the charge on the insulator.

(5) Charges $Q_1 = -q$ and $Q_2 = +4q$ are placed as shown. Of the positions shown by the numbered arrows the one at which the electric field will be approximately zero is



(6)

Calculate the gravitational force of attraction between the proton and the electron in the Hydrogen Atom. Assume the particles are separated by a distance of 10^{-10} m.

Now calculate the electrical force of attraction between the same particles.

How do these forces compare?

How might you decide which force is responsible for holding together the hydrogen atom?

gravitational force

$$F = \frac{G m_1 m_2}{r^2}$$

$$G = 6.67 \times 10^{-11} \frac{(\text{Newton})(\text{meter})^2}{kg^2}$$

$m_e = 9 \times 10^{-31}$ kg

$m_p = 1.7 \times 10^{-27}$ kg

Electric force

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

unit of charge in MKS system is coulombs

$$k = 9 \times 10^9 \frac{(\text{Newton})(\text{meter})^2}{(\text{Coulomb})^2}$$

$q_2 = q_1 = 1.6 \times 10^{-19}$ Coulombs

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Your TA will supply you with Two little Aluminum foil balls attached to bits of fishing line and a balloon

Blow up and tie off the balloon.
Rub the balloon on your head and touch it to each ball while the balls are separated widely.

Bring balls near each other ... NOT touching
What do you see?

Now touch balls then bring them together so that they touch while suspended

Now - after recharging the balloon by rubbing it on your head bring it close to one of the balls (without touching)

Now separate the balls (while balloon still near).

Bring balls close together (but not touching)
What do you observe?

If this latter exercise worked right for you ...
you should observe the little balls attracting each other.

Can you explain these observations?

Do these observations support the idea that there are two types of electric charge?