Coulomb's Law weblab

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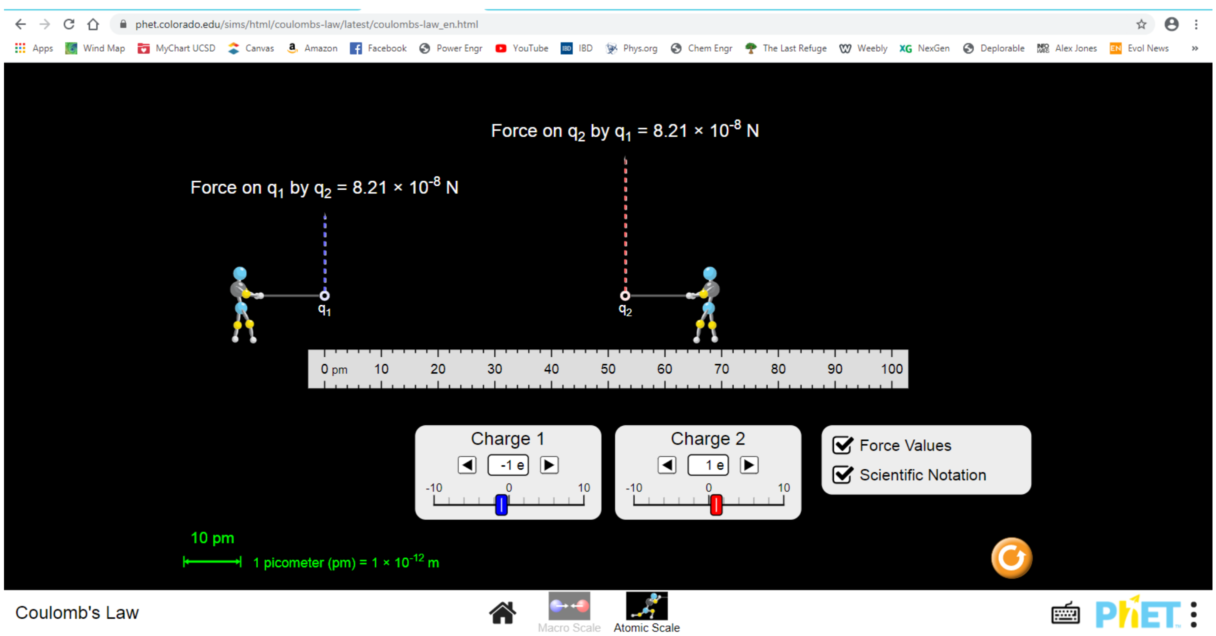
Open the PhET "Coulomb's Law" lab simulation https://phet.colorado.edu/en/simulations/coulombs-law

Select "Atomic Scale".

Purpose: You are comparing the forces within an atom.

Instructions: Create space in the Word document below, and write or type your answers to the questions. YOU MUST SHOW YOUR WORK where it is required.

(10 questions)



Equations: Coulomb's Law: $F_E = k\frac{q_1 q_2}{r^2}$

1 C = 6 x 10^{18} electrons,

1 e = -1.6 x 10^{-19} Coulomb

1 p = +1.6 x 10^{-19} Coulomb

1. Using Coulomb's Law, calculate the electrical repulsion between two protons in a nucleus if they are 1.00 x 10^{-15} m apart. (Hint: 200-300 N)

F = ((8.99 x 10^9 N m^2/C62) x (1.60 x 10^19 C)^2) / (1.00 x 10^-15 m) ^2

F = 2.3 x 10^2

F= 230 N

2. If you were holding these protons, do you think you could feel the effect of this force?

    I don't think you would notice the effects of this force because it is small compared to other forces we feel often; I may be wrong, though.

3. How many pounds would the force be? (Hint: 50-75 lbs)

    1 N = .225 lbs

    230 N x .225 lbs/N = 51.75 lbs

4. Now using the PhET simulation by positioning the 'atomic men' and adjusting the charges, find the electrical attraction that a proton in a nucleus exerts on an orbiting electron if the two particles are 1.00 x 10^{-10} m apart. (Hint: 1.0-5.0 x 10^{-8} N)

    2.30 x 10^-8 N

5. If you were holding the electron, do you think you could feel the effect of this force?

    If holding the electron, there is no way you would feel the effect of this force. It is a very tiny number.

6. Conclusion to the above: How do the forces in the nucleus of an atom compare with the forces that corral/ confine the electrons?

The forces in the nucleus of an atom are much stronger that the forces that corral/confine the electrons. The forces that confine the electrons are electromagnetic; the forces in the nucleus bind protons and neutrons together, which is a much stronger force than the electromagnetic force.

7. Use the PhET simulation to determine the electrostatic attraction between the lone electron and lone proton in a Hydrogen atom. The electron orbits at a distance of 0.529 Angstroms (1 Angstrom is 10^{-10} m) from the nucleus. You will need to convert this to picometers to use the simulation. (Hint: 8.0-10.0 x 10^{-8} N)

F = 8.24 x 10^-8 N

8. Use Newton's law of gravity $F_G = G\frac{m_1 m_2}{d^2}$ to compute the gravitational attraction in Newtons between the proton and electron above, using a distance of 0.529 x 10^{-10} m. You will need to look up the mass of a proton and electron, and the value for 'G', in the back of the book. (Hint: 1.00-2.00 x 10^{-47} N)

   F = 6.674 x 10^ -11 ((1.67 x 10^ -27)^2)/ (.529 x 10^-10)^2)

   F= 3.63 x 10^-36

9. Conclusion to the above: How does gravitational force compare with electrostatic force? Try to be specific as to 'order of magnitude'.

Comparing the gravitational force and the electrostatic force between a proton and an electron, it is found that the electrostatic force is approximately 10^27 times stronger than gravitational force.

10. Two electrons and one proton are in the configuration shown below. Use the PhET simulation to determine the attractive forces between e_1 and p, and e_2 and p, and calculate the magnitude and direction of the net electrostatic force they will exert on the proton.

I'm not really sure how to do this one. I could not figure this part out on the PhET simulation.