Lab 02 – Pre-Lab – Electricity Generation

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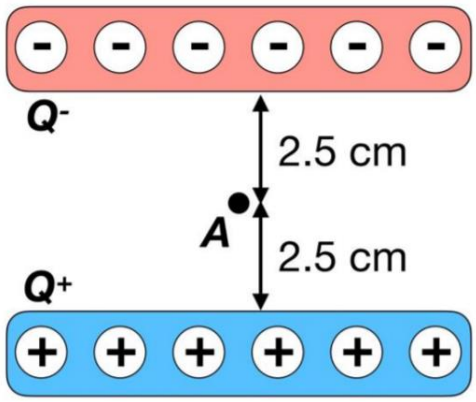
Section 109

1. Use Coulomb's Law (equation below) to calculate the approximate force felt by an <u>electron</u> at point A in the schematic below. For the sake of simplicity, assume that the charge reservoirs, Q^- and Q^+, can be treated as point charges each 2.5 cm away from point A and 5.0 cm away from each other. Make sure to denote which direction the force will act. The red and blue regions indicated in the schematic are conductors. Here Q^- is equal to the charge of six electrons, and Q^+ is equal to the charge of six protons.

Coulomb's Law: $|F| = \frac{1}{4\pi\epsilon_0}\frac{Qq}{r^2}$

$e = 1.6 \times 10^{-19} C$



$|Q| = 6 * e$

$$\left|F_{Q_-\to q}\right| = \frac{1}{4\pi\epsilon_0}\left(\frac{|Q|\,|q|}{r^2}\right)$$

$$\left|F_{Q_+\to q}\right| = \frac{1}{4\pi\epsilon_0}\left(\frac{|Q|\,|q|}{r^2}\right)$$

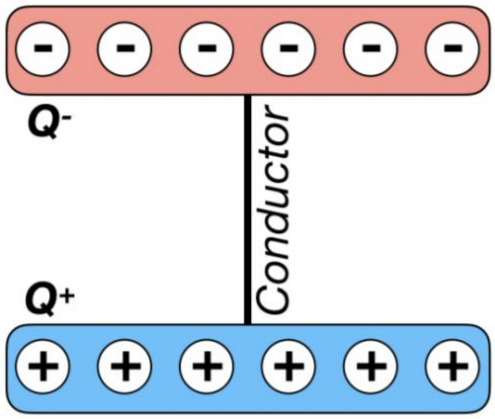
(- denotes downward, + denotes upward)

$$\left|F_{Q_\pm\to q}\right| = \left|F_{Q_-\to q}\right| + \left|F_{Q_+\to q}\right|$$

$$\left|F_{Q_\pm\to q}\right| = \frac{1}{2\pi\epsilon}\left(\frac{|Q|\,|q|}{r^2}\right) \approx 4.43 * 10^{-24}\ N$$

$$F_{Q_\pm\to q} = -\left|F_{Q_\pm\to q}\right| = -4.43 * 10^{-24}\ N$$

2. If we were to connect the Q^- and the Q^+ charge reservoirs with a conducting wire, as shown below, describe what you would expect to happen regarding the movement of the charges. Note that the negative charges are *electrons* and the positive charges are *protons* and cannot freely move.



- Since positive charges are protons, which are not free to move through conductors, the protons will not move. However, the electrons are free to move since the conductor was placed in between. This will cause the electrons to self-arrange until equilibrium is reached. Since $|Q_-| = |Q_+|$, the electrons will self-arrange throughout the conductor until there is no net charge.