**OBSERVATION:** Two charged conducting spheres hanging from a pivot repel each other.

**CONJECTURE:** If a plastic rod is rubbed with fur the rod will become negatively charged. If a conducting sphere comes into contact with the rod the sphere will become negatively charged. If another identical sphere comes into contact with the charged sphere the charge will be equally distributed between the two spheres. If both spheres are attached to string of equal length and are hung from the same pivot the spheres will repel each other as shown in Figure 1. If the mass of the spheres, the separation distance, and the length of the string are known the charge can be determined.

**EXPERIMENT:** For the following assume the conducting spheres are point-like, are of equal mass, and share charge equally following contact (this is not a bad assumption due to the symmetry).

1. Consider Figure 1 above and derive an expression relating the charge to the observables. (Hint: draw a free-body diagram for one of the charges and apply Newton’s Laws of Motion, and apply the small-angle approximation \( \tan \theta \approx \sin \theta \).)

2. Apply the error propagation formula you learned in the previous lab to the equation that you found in part 1. Make sure to clearly state all the variables (quantities to be measured) that need to be considered and their corresponding uncertainties.

3. Calculate the charge, \( Q \), of the charges. Describe your procedure, measurements, and discuss errors. Your data should be arranged neatly (perhaps in a table) and your measurement should be expressed in the form \( x = \bar{x} + \sigma_x \).

4. Do you think charge leakage from the conductors is significant? Why or why not? If so then estimate the charge leakage rate. Describe your procedure, measurements, and discuss errors. Your data should be arranged neatly (perhaps in a table) and your measurement should be expressed in the form \( x = \bar{x} + \sigma_x \).