Problem 1: Gravity vs Electricity (10 pts)

Compare the magnitude of electrostatic repulsion between two electrons, with the magnitude of their gravitational attraction. That is, find the ratio between the respective forces. (Does the ratio depend on the distance between the electrons?)

Problem 2: A model of an electroscope (15 pts)

Two identical small spheres, each of mass \( m = 0.0001 \) kg, hang on two threads as shown in Fig. . At first, the two spheres touch each other. When some charge is transferred onto the spheres, the separation between them becomes \( d = 0.06 \) m. Determine the charge of each sphere, \( q \), if the length of each thread is \( \ell = 0.3 \) m, and the gravitational field of the Earth is directed downward in the figure.

Problem 3: Electric field of a disk (15 pts)

a) Calculate the electric field on the symmetry axis of an infinitely thin disk of radius \( a \) as a function of the distance to the disk, \( d \). (the axis is perp to the disk plane, piercing it through its middle.) The disk is charged with a uniform surface charge density of \( \sigma \).

b) Using the exact expression you obtained in (a), analyse the two limits: \( d \ll a \), and \( d \gg a \). Give a physical interpretation of the field magnitude dependence on \( d \) in these cases. That is, discuss how these limits are related to the simple example of electric fields discussed in the lecture notes.