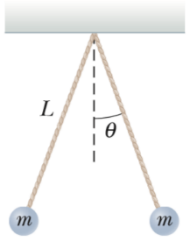
Review Problems for Unit 6 Test (Ch 23,24,25)

1. Two protons are held together at a distance of 1.2 m between them. When they are released they fly away from each other. Find the speed of one of the protons with respect to their center of mass when the distance between them becomes 2.2 m. **(0.23 m/s)**

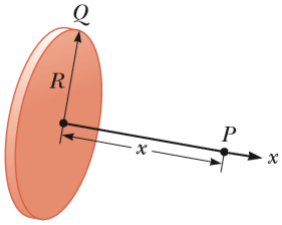
2. Three charges, Q_1: -1.5μC, Q_2: 1.5μC and Q_3: 2.5μC are placed at the x-y plane at (-3.0 cm, 0.0), (3.0 cm. 0.0) and (0.0, 4.0) respectively.
   a. Find the net force on charge Q_3. **(16.2 N)**
   b. Find the total energy of the system. **(-0.337 J)**
   c. Find the work done by an external agent to bring a 4th charge Q_4: 2.2μC from very far away to origin. **(1.24J)**

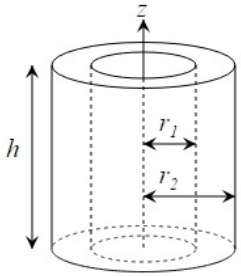
3. Two small metallic spheres, each of mass m = 0.220 g, are suspended as pendulums by light strings of length L. The spheres are given the same electric charge of 5.25 nC, and they come to equilibrium when each string is at an angle of θ= 5.00° with the vertical. How long are the strings? **(0.206 m)**



4. Two conducting spheres with charges q_1= 6mC and q_2= -2mC apply a force of 20.0 N onto each other when they are separated by a distance D. Radius of the spheres are 3.0 cm and 4.0 cm respectively. The two spheres are brought into contact with each other then separated to the same distance D. Find the new force between them. **(6.53 N)**

5. A circular disk of radius R has a charge +Q on it, with uniform area charge density, σ. Find the magnitude and direction of the electric field at a distance x from the center of the disk on the axis of the disk.





6. Consider a long insulating hollow cylinder with positive volume charge density ρ. Derive the expression for the electric field near the middle of the cylinder at a distance x from the axis of the cylinder
   a. For x < r1
   b. For r2> x > r1
   c. For x > r2

7. Find an expression
   a. for the electric potential at a point P located on the perpendicular central axis of a uniformly charged ring of radius a and total charge Q.
   b. for the magnitude of the electric field at point P using the electric potential.

8. A solid insulating sphere of radius a carries a net positive charge Q uniformly distributed throughout its volume. A conducting spherical shell of inner radius b and outer radius c is concentric with the solid sphere and carries a net charge -2Q. Using Gauss's law, find the electric field in the regions labeled 1,2,3 and 4 and the charge distribution on the shell when the entire system is in electrostatic equilibrium.