Problem Set 1, 10 September 2018 Name: _______________ , Section: ___

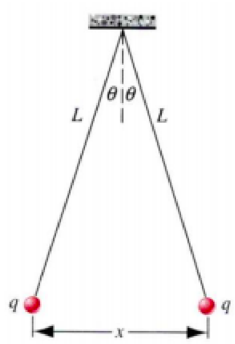
Problem – E25.30 Two physics students (Mary at 52.0 kg and John at 90.7 kg) are 28.0 m apart. Let each have a 0.01% imbalance in their amounts of positive and negative charge, one student being positive and the other negative. Estimate the electrostatic force of attraction between them. (Hint: Replace the students by spheres of water and use the result of Exercise 29.)

Solution:

Problem – P25.4(a)* Two similar tiny balls of mass m are hung from silk threads of length L and carry equal charges q as in the figure below. Assume that θ is so small that $\tan\theta$ can be replaced by approximate equal, $\sin\theta$. (a) To this approximation show that, for equilibrium,

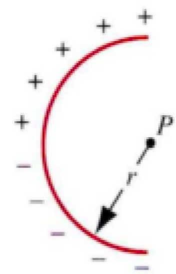
$$x = \left(\frac{q^2 L}{2\pi\epsilon_0 mg}\right)^{1/3},$$

where x is the separation between the balls.



Solution:

Problem – E26.16 A thin glass rod is bent into a semicircle of radius r. A charge $+q$ is uniformly distributed along the upper half and a charge $-q$ is uniformly distributed along the lower half, as shown in the figure below. Find the electric field $\mathbf{E}$ at P, the center of the semicircle.



Solution:

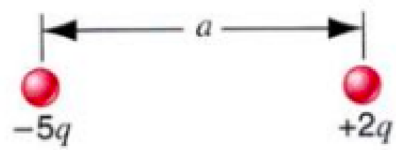
Problem – P25.8 Two positive charges $+Q$ are held fixed a distance d apart. A particle of negative $-q$ and mass m is placed mid-way between them, then is given a small displacement perpendicular to the line joining them and released. Show that the particle describes simple harmonic motion of period

$$\left(\epsilon_0 m\pi^3 d^3 / qQ\right)^{1/2}.$$

Hint: Remember the small angle approximation for $\sin x$ when x is small, and remember that for simple harmonic oscillations, restoring force is linearly proportional to displacement, as in $F = -kx$.

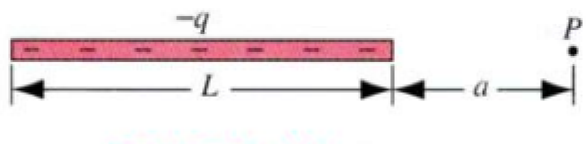
Solution:

Problem – E26.24 (a) In the figure below, locate the point (or points) at which the electric field is zero. (b) Sketch qualitatively the field lines.



Solution:

Problem – E26.18 An insulating rod of length L has charge $-q$ uniformly distributed along its length, as shown in the figure below. (a) What is the linear charge density of the rod? (b) Find the electric field at point P a distance a from the end of the rod. (c) If P were very far from the rod compared to L, the rod would look like a point charge. Show that your answer to (b) reduces to the electric field of a point charge for $a \gg L$.



Solution: