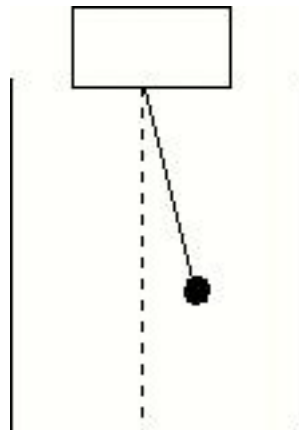


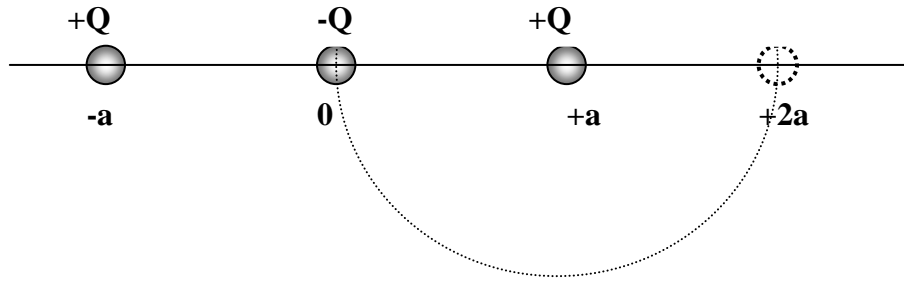
Workshop module 3 - Physics 142, Fall 2010

1. A hydrogen atom can be considered as having a central point-like proton of positive charge $+e$ and an electron of negative charge $-e$ that is distributed about the proton according to the volume charge density $\rho = A \exp(-2r/a_0)$. Here A is a constant, a_0 is the Bohr radius equal to 5.3×10^{-9} m and r is the distance from the center of the atom. (a) find A . (b) Find the electric field produced by the atom at the Bohr radius.
2. A small sphere with a mass of 3.20 g hangs by a thread between two parallel vertical plates 6.00 cm apart. The charge on the sphere is $q = 7 \times 10^{-6}$ C. What potential difference between the plates will cause the thread to assume an angle of 20.0 degrees with the vertical.



3. If the electric field is zero in a region of space, which of the following is always true:
 - a. the potential is zero
 - b. the potential is constant
 - c. the potential is negative
 - d. the potential depends on the size of the region of space
4. The source of a star's energy is thermonuclear fusion taking place in the core of the star. Estimate the temperature at the center of a star when nuclear fusion reactions begin. (*Hints: Fusion is when two protons (or nuclei) bond together due to the strong nuclear force which has an effective range of about 10^{-15} m.*)

5. A positive point charge $+Q$ is located at $x = -a$.
- (a) How much work is required to bring a second equal positive point charge $+Q$ from infinity to $x = +a$?
- (b) With the two equal positive point charges at $x = -a$ and $x = +a$, how much work is required to bring a third charge $-Q$ from infinity to the origin?
- (c) How much work is required to move the charge $-Q$ from the origin to the point $x = 2a$ along the semicircular path shown in the sketch below?



6. A thin wire segment with charge $+Q$ uniformly distributed along its length, L , is lying on the x -axis with its midpoint at the origin. Calculate the electric potential at a point P on the x axis, where $P > L/2$. From the electric potential, calculate the electric field. Use limiting cases to confirm that the form of the potential and the electric field that you have calculated make sense.