Physics 333 – Fall 2021
Due August 23.

Homework 01

Instructions:

Each problem should begin at the top of a new sheet of paper. (OK to use front and back if you want). The final answer (numerical or symbolic) should be copied into a box (or written in a different color) at the top right of your page. (For proofs, this isn't reasonable, so don't do it.) Each problem should have your name on the left and, below it, the *SPN*, circled. Problems should (usually) include a 3x3 inch sketch and begin with the general equations and the assumptions you make. For numerical answers, show numbers plugged into the equation before solving with a calculator. Numerical answers should include SI units.

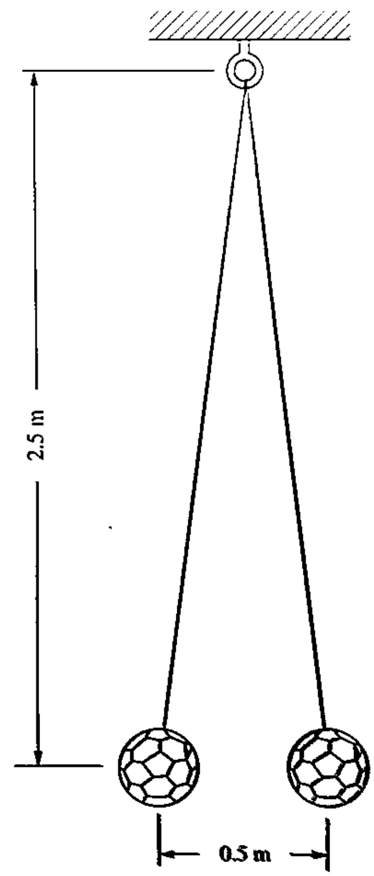
SPN 1–01. The distance between two protons in a helium nucleus is roughly one "fermi" (femtometer). How large is the electrical repulsion between them? Compare this repulsion with their gravitational attraction. Why does the nucleus stay together? (a sentence, not a calculation)

SPN 1–02. Point charges $q_1 = 3.0\ \mu C$, $q_2 = 4.0\ \mu C$, and $q_3 = -7.0\ \mu C$ are located at $\vec{r}_1 = 0\hat{\mathbf{x}} + 0\hat{\mathbf{y}}$ m, $\vec{r}_2 = 0.2\hat{\mathbf{x}} + 0.3\hat{\mathbf{y}}$ m, $\vec{r}_3 = 0.5\hat{\mathbf{x}} + 0\hat{\mathbf{y}}$ m. Find $\vec{E}$ at $\vec{r}_T = 0.5\hat{\mathbf{x}} + 0.5\hat{\mathbf{y}}$ meters.

SPN 1–03. Two regulation soccer balls are uniformly charged and hang as shown in the figure. What is their charge?

SPN 1–04. A very long solid cylinder of radius R has uniform charge density ρ and total charge Q. Use Gauss's Law to arrive at $E(r)$ for $r < R$ and $r > R$. Give your answer in two forms; in terms of ρ and in terms of Q.

SPN 1–05. Find the angle between the diagonal of a cube and one of the edges: (Hint: This is actually just a cute application of the dot-product. Consider the diagonal to be the vector $\vec{r} = \hat{\mathbf{x}} + \hat{\mathbf{y}} + \hat{\mathbf{z}}$.)



Problem 3: Uniformly charged soccer balls. Their centers are separated by 0.5 m.