Chapter A - Problems

Blinn College - Physics 2426 - Terry Honan

Problem A.1

(a) The size of an atomic nucleus is on the order of 10^{-15} m. What is the magnitude of the electric force between two protons separated by 10^{-15} m?

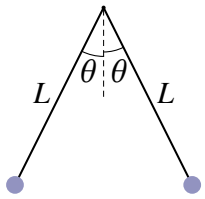
(b) What is the magnitude of the gravitational force between two protons separated by 10^{-15} m?

(c) What is the ratio of the electric to gravitational force magnitudes? Show that this number is independent of the distance between the two.

(d) Two identical particles have the same charge Q and same mass m. If the electric repulsion exactly cancels the gravitational attraction, what must be the value of $|Q|/m$?

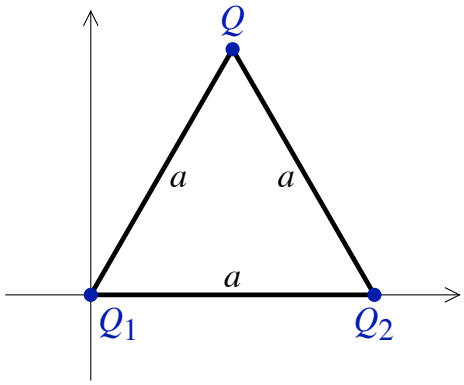
Problem A.2

Two identical small light spheres of mass m hang from strings of length L from the same pivot point so that the strings are vertical and the spheres touch. Both are then given the same positive charge causing the spheres to separate as shown. If each string makes an angle of θ from vertical then what is the charge Q?



Problem A.3

Three charges $Q = 7.0\,\mu\text{C}$, $Q_1 = 2.0\,\mu\text{C}$ and $Q_2 = -4.0\,\mu\text{C}$ are arranged around the corners of and equilateral triangle as shown. Each side of the triangle is $a = 0.5$ m. What is the net force of the charge Q (at the top)?



Problem A.4

A small sphere with a 2 gram mass sits in an upward electric field of 60 $\frac{\text{N}}{\text{C}}$ in the Earth's gravitational field. For the electric force to cancel the weight of the sphere what charge must be given to the sphere? How many electrons must be removed from a neutral sphere to give this charge?

Problem A.5

A 5 μC charge sits at the origin and a -8 μC charge sits at (2 m, -3 m).

(a) What is the force on the -8 μC charge?

(b) What is the electric field at (0, -2 m)?

Problem A.6

A charge 3 Q is at $x = 0$ and a charge of $-Q$ is at $x = d$. Where, other than infinity, is the electric field zero?

Problem A.7

What is the electric field at the origin due to a line of charge from x_0 to ∞ along the positive x-axis with a uniform linear charge density (charge/length) of λ.

Problem A.8

Consider a ring of radius $R = 0.10$ m uniformly charged with $Q = 75$ μC. The ring sits in the xy-plane with its center at the origin.

(a) What is the magnitude of the electric field at $z = 1$ cm, 5 cm and 30 cm?

(b) Where is the field its maximum and what is that maxum value?

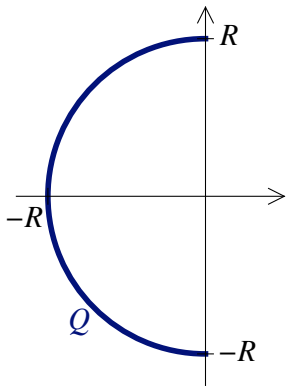
Problem A.9

Consider a uniformly charged cylindrical shell (a hollow thin-walled tube) of radius R, length L and with a total charge Q.

(a) What is the electric field at the geometrical center of the tube?

(b) What is the magnitude of the electric field along the central axis at one end of the tube? Leavc your answer in the form of a well-defined definite integral. Do not integrate.

Problem A.10



What is the field at the origin due to a uniformly charged semicircular charge distribution of radius R with charge Q as shown?

Problem A.11

An electron accelerates from rest to $2\times10^6\ \frac{\text{m}}{\text{s}}$ in an electric field of magnitude 800 $\frac{\text{N}}{\text{C}}$.

(a) What is the magnitude of the accelerarion of an electron in this electric field?

(b) How long does it take for an electron to accelerate to that speed?

(c) How far does the electron move in this time?

(d) What is the kinetic energy of the electron after this acceleration?

(e) What is the work done by the electric field?