

PHYSICS 321- Fall 2019
CLASSICAL ELECTRODYNAMICS

Oct 3 Problem Set 2 These problems are due 10 am Thursday, Oct 10 in the boxes outside the north entrance of PAB (same as tutorial boxes). Please label your homework with name, section, and HW#.

1. *Comparing gravitational and electrostatic forces*

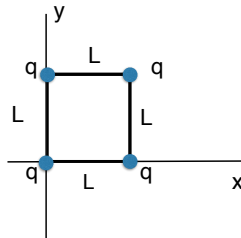
- (a) Calculate the gravitational force on a proton at the surface of the Sun.
 (b) How many electrons placed at the center of the Sun yield the same electrostatic force on the proton?

2. *Force between point charge and line charge*

A uniform linear distribution (of infinite extent) of charge of λ Coulombs/meter is situated at a distance r from a point charge Q of opposite sign.

- (a) Calculate the force of attraction. (b) Show that the force is the same as if the linear distribution were replaced by a single charge $Q' = 2\lambda r$ situated at the foot of the perpendicular drawn from Q .

3. Four point charges, each of charge q and mass m are located at the four corners of a square of side L .



- (a) Determine the magnitude of the force on one of the charges. (Hint: does it matter which one?)
 (b) Use the force in part (a) to find the velocity of one of the charges a long time after the four charges are released from rest in the original configuration.
4. This problem concerns the electric field a distance D above the center of a flat circular plate of radius R . The surface charge density is given as σ , so the total charge on the plate is $Q = \pi\sigma R^2$. Define the vertical direction to be the z -axis.
- (a) Determine the x and y components of E .
 (b) Find an expression for \mathbf{E} as a two-dimensional integral.
 (c) Carry out the integral to determine $\mathbf{E}(D)$.
 (d) Check that your expression has the correct limit for $D \rightarrow \infty$.
 (e) Check that your expression has the limit for correct limit for $D \rightarrow 0$.