

**Exam #1: Electrostatics & Waves**

1: A capacitor consists of two parallel conducting plates. One plate is held at 0.0 V while the other is held at 10.0 V. The plates are separated by a distance of 20cm. Consider the plates to have infinite area for the following analysis.

- a. Determine the electric field between the plates.
- b. Determine the charge per unit area,  $\sigma$  on each of the plates assuming they are equal in magnitude but of opposite charge.
- c. If an electron were released from rest half way between the two plates determine the electrostatic force on it and its acceleration.
- d. Which plate would the proton eventually crash into and what would be its velocity at the instant of striking the plate.

2: Consider a static charge distribution consisting of 2 mC at a position (1, 0) and -4 mC at a position (-2, 0).

Units of position are in centimeters.

a. Draw the charge distribution, electric field lines and equipotential lines in space. Include at least 5 equipotential lines.

b. Determine the potential energy of the configuration.

c. Calculate the electric field at the point (0,3).

d. Describe what the field around this distribution would look like 10 meters away. Draw it at this distant scale.

3: Consider a 0.50 meter long string with a mass of 10.0 grams. It is held taught at both ends and tuned to a fundamental frequency of 500 Hertz.

a. Determine the tension in the string.

b. Determine the speed of a wave propagating through the string.

c. Determine the power of the oscillation in the string if it vibrates with an amplitude of 1.2 mm.

d. Determine the  $n=2,3,4$  harmonic frequencies and wavelengths.