Physics 1320 – Spring 2025 Due Monday March 10.

March 10.

Homework 06 - Rev A

SPN 4–01 Parallel plate capacitor – Two 5 m square metal plates are separated by one mm of air. The top one is charged with one microCoulomb and the bottom one is charged with negative one microCoulomb.

- [a] Sketch the plates, show the charges, and show electric field vectors between the plates.
- [b] Calculate the electric field between the plates
- [c] Setting the voltage of the bottom plate to zero, what is the voltage of the top plate? (This is an easy calculation because the electric field is constant inside the gap)
- [d] Using the definition of capacitance Q = CV, calculate the capacitance of this arrangement.
- [e] Now calculate the capacitance using the formula for a parallel plate capacitor with an air gap $C = \epsilon_0 A/d$

SPN 4–02 Cylindrical capacitor – A cylindrical capacitor (also known as a coaxial cable) consists of a wire with radius 1 mm surrounded by a plastic insulator and another cylinder (called a "shield") with a radius of 1 cm. The wire has a charge of $\lambda = +200 \ nC/m$ and the "shield" has $\lambda = -200 \ nC/m$.

- [a] Write an expression for the electric field between the wire and the shield.
- [b] Calculate the potential at the wire relative to zero potential at the shield.
- [c] Assume the cable is 3 m long. What is the total charge on the wire?
- [d] Using the definition of capacitance Q = CV, calculate the capacitance of this arrangement.

SPN 4–03 [10 pts] – Three capacitors of $2\mu F$ each are combined into three different combinations.

- [a] All three capacitors are placed in parallel and connected to a 9 V battery. Sketch this circuit and then calculate the "equivalent capacitance" of this circuit.
- [b] Now all three capacitors are placed in series with eachother and connected to a battery. Sketch the circuit and calculate the equivalent capacitance now.
- [c] Now two capacitors are placed in series and the third is placed in parallel with the series combination. Sketch this circuit and calculate the equivalent capacitance now.