Sample Test 2
Physics 132

Short Answer

1. What is the electric potential at a distance of 10 angstroms from a proton? What electric potential energy does an electron have if it is placed at that same distance?
2. A doubly charged ion is accelerated from rest through a potential difference of 100 MV. What is its energy after the acceleration?
3. Consider an electric dipole. Where is the potential zero and why?
4. What area is required to make a 1 mF capacitor. Assume parallel plates separated by a distance of 0.1 mm and a dielectric with $\kappa = 3$
5. Explain briefly how a dielectric works to raise the capacitance of a capacitor. You may wish to use the definition of capacitance and how the potential is related to the electric field to do this. Assume parallel plates.
6. You have three 10mF capacitors. What is the maximum capacitance you can create with them and how do you do this? What is the minimum capacitance you can create with them and how do you do this?
7. Four protons are arranged at the corners of a square with side 1 angstrom. What is the total stored energy?
8. Two 10 mF capacitors are in series. These caps are in parallel with a single 20 mF capacitor. Draw the circuit, compute the equivalent capacitance. If this array of capacitors is hooked up to a 12V battery, what is the charge on each capacitor?
10. A 1F capacitor is charged to 100V. How much energy is stored in this capacitor? What is the charge stored on this capacitor?
11. Consider a 100 m length of copper wire that has a radius of 1 mm. What is its resistance? If it is connected to a 10V ideal battery, compute the current and the power.
12. A beam of protons has a bunch with 10^{31} particles. The length of the beam is 100 m and the diameter is 1 micron. The proton speed is 0.01 c. What is the charge density in the beam? What is the current density? What is the current?
13. A 100 ohm resistor is connected to a 10 volt power supply. Compute what the current is if the power supply is an ideal battery.
14. An electric potential is given below. What is the electric field?

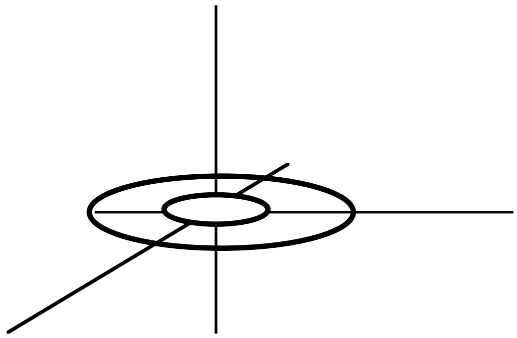
$$V = 5x^3 + 2xy$$

15. An electric field is given below. Assuming that the potential is zero at the origin, what is the electric potential at a point (x, y)

$$\vec{E} = -x\,\hat{i} - y\,\hat{j}$$

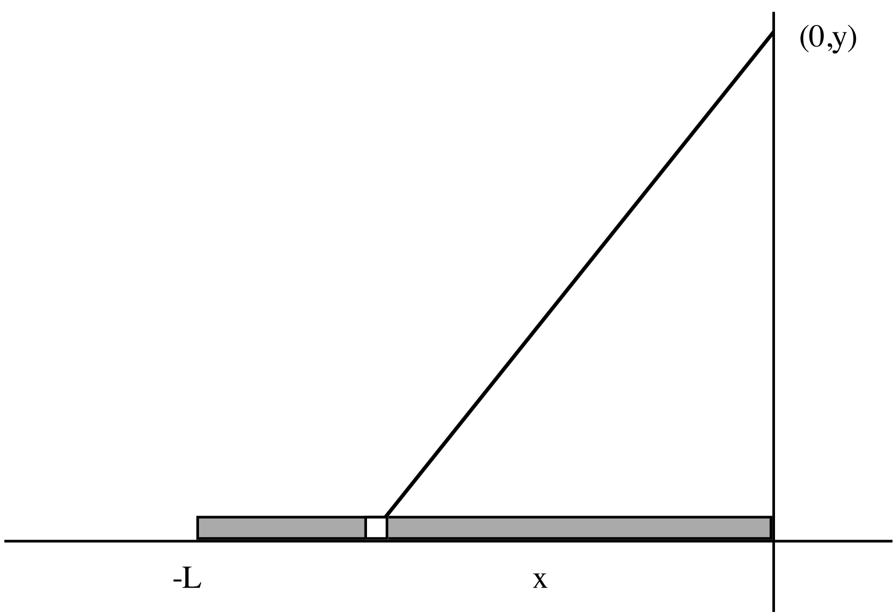
Problems.

1. Consider an "annular ring" of charge that has an inner radius a and an outer radius b. It has a surface charge density σ



a) Derive an expression for the potential along its axis.

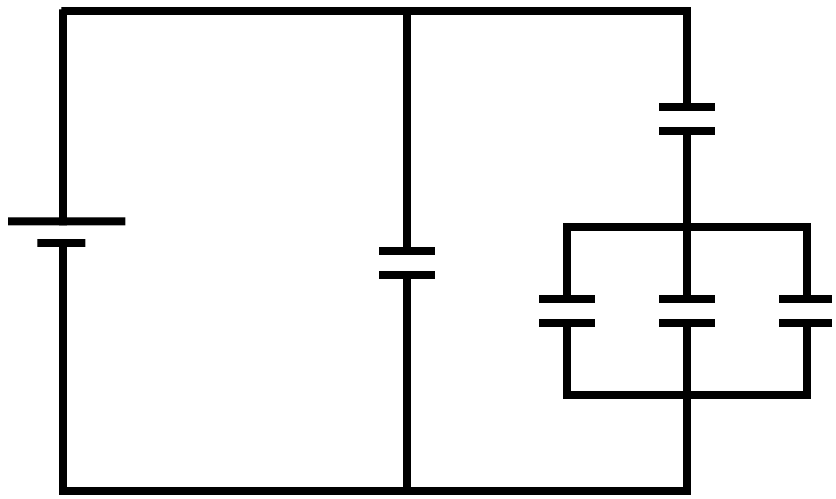
2. Consider the charged rod below. Assume that it is uniformly charged with charge per unit length λ.



a) Write an expression for the electric potential due to a small charge dq at the point p?
b) Write an expression for the dq and the r in terms of x and the distance y.
c) What is the potential at the point indicated? You may need the integral

$$\int_{-L}^{0} \frac{dx}{\sqrt{x^2 + y^2}} = \ln[L + \sqrt{L^2 + y^2}] - \ln[y]$$

3. Consider the circuit shown below. Assume all capacitors are 1 mF and the battery is 10 V



a) What is the equivalent capacitance?
b) What is the charge on each capacitor?
c) How much energy is stored in the capacitors?
d) If all of the capacitors were 10 Ohm resistors instead, what would the equivalent resistance be and how much current would flow through it?
e) What power would the equivalent resistor be dissipating as heat?