# PHY 122 HW 5

1. A square parallel plate capacitor has sides with a length of 1cm and a separation between the plates of $1\mu m$. If we fill the capacitor with a dielectric in order to achieve a capacitance of $.1\mu F$, what does the dielectric constant K need to be?

2. A parallel-plate capacitor has an area of L^2 and a plate seperation of $D \ll L$. It is filled with a nonuniform dielectric whose dielectric constant varies linearly across the capacitor. At $x = 0$, $\kappa = \kappa_0$ and at $x = L$, $\kappa = \kappa_1$. We can express κ as a function of x : $\kappa = \kappa_0 + [(\kappa_1 - \kappa_o)x/L]$. What is the equivalent capacitance? (hint: In workshop we broke a capacitor of varying dielectric into two capacitors in series. If you break this capacitors into capacitors of different dielectric constants will they be in parallel or in series?)
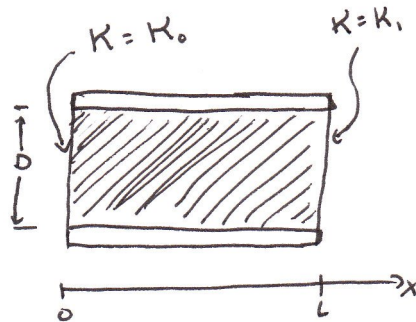

3. The same current passes through two similar wires of unequal area. Which wire will get hotter? Why? Now, if the same current passes through two wires of equal areas but of different materials, one aluminum and one copper, which will get hotter and why?

4. In the figure below, the drift velocity is smaller in Area 2 than in Area 1, yet the current is the same. How is that possible?
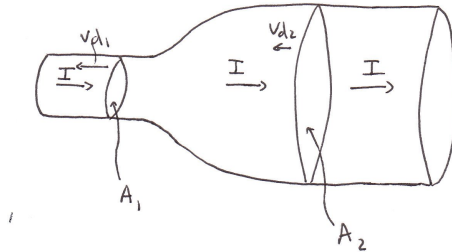
5. An accelerator is producing a cylindrical beam of electrons of radius .40 cm. If those electrons are carrying a current of 6mA and traveling at speeds of 3.5×10^7 m/s, what is the electron density in cm³?

6. At point P in the diagram below, the charge as a function of time is given by the expression $Q(t) = Q_0 \sin \omega t$. Find V across the resistor in terms of t, Q_0, ω and R.
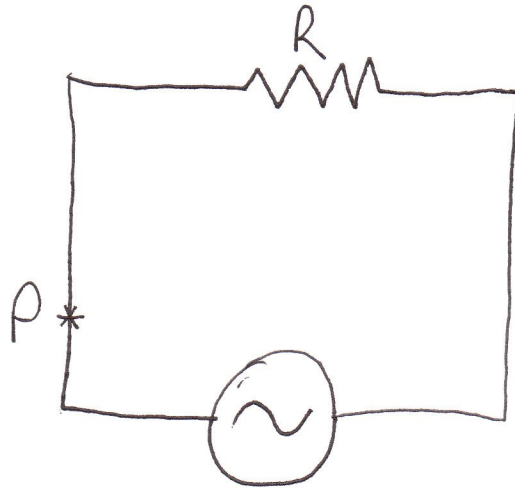
7. In a simple circuit containing a battery with voltage V and a single resistor with resistance R, the power dissipated is given by P_0. If we double the resistance, what is the power dissipated in terms of P_0?

8. Using the diagram below, complete parts (a) through (c):

2 Ω
3 Ω
5 Ω
6 Ω
2 Ω
12V
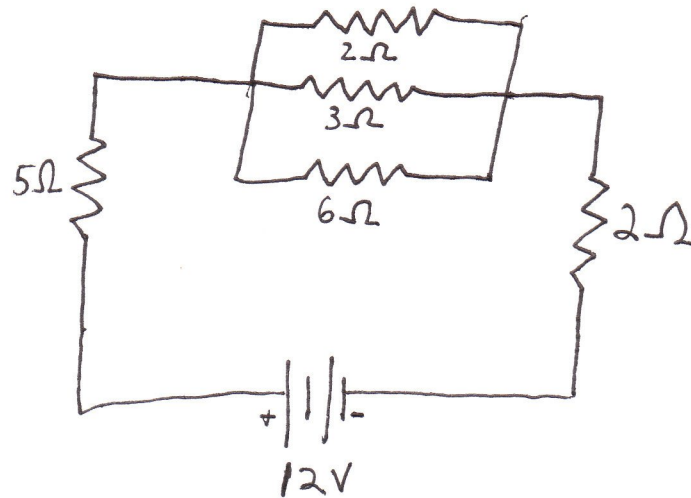
(a) What is the equivalent resistance of this circuit?

(b) What is the current at a point directly to the left of the battery?

(c) What is the total power dissipated by the circuit?