ENGR 201 Homework Assignment #1

1.1 Use the SI system of prefixes to convert the following quantities. (If you're not familiar with a particular unit, focus on the prefix and the powers-of-10 structure of the SI systems of units. You might have to look up the definition of a coulomb in your textbook)

a) 104,000 Ω to kiloΩ b) $10.4\frac{g}{cm^3}$ to $\frac{\mu g}{mm^3}$ c) 25 coulombs per minute, to mA

1.2 A battery initially contains 8.40 coulombs of charge. It is then "recharged" for 10 seconds with an average current of 120 mA. How much charge does the battery contain after being "recharged"?

1.3 The charge in a device is represented by the equation: $q(t) = 1.28 - 8t^2\ C$ over the interval $0 < t < 0.4$ seconds. What is the equation which represents the current, $i(t)$, associated with the device during this time? (don't forget to include the units)

1.4 2.4 coulombs of charge move from one device to another. As the charge moves 12 joules energy is released as heat to the surroundings (the charge is doing work on the surroundings).

(a) Did the charge move from lower voltage to higher voltage, or from higher voltage to lower voltage? Make a simple sketch to illustrate the problem

(b) What was the magnitude of the voltage the charged moved through?

1.5 Batteries are often rated in mAh (milliamp-hours) which is actually a unit of charge (current x time = charge). If a small alkaline battery is rated at 2400 mAh, that means in theory it can provide 2400 mA of current continuously for 1 hour. Assuming the voltage is constant at 1.5V, how many Joules of energy can the battery provide as the battery completely discharges?

1.6 How many kilojoules of energy will be used by a 40 watt light bulb left on for 24 hours?

1.7 Battery powered flashlights often have multiple brightness levels, with the brighter mode draining the batteries much more quickly than dimmer settings. A flashlight which contains a battery capable of providing a total of 14500 J of energy is tested in the following manner:

1. First it is set to LOW and turned on for 12 minutes, after which time the battery contains 14400 J of energy.
2. Next it is set to MEDIUM and turned on for 9 minutes, after which time the battery contains 14137.5 joules of energy.
3. Finally, it is set to HIGH and turned on for 6 minutes, after which time the battery contains 11512.5 joules of energy.

Determine the power in milliwatts used by the flashlight in each of the three modes.

1.8 The voltage, $v(t)$, across a device and the current, $i(t)$, entering it are:

$$v(t) = 170\sin(377t)\ V\ \ (\sin arg.in\ radians)\ \text{ and }\ \ i(t) = 250\ e^{-0.1t}\ mA$$

(a) What is the power being consumed by the device at t = 1.5 s?

(b) What is the total charge that has entered the device during the interval $0\ \leq t\ \leq 3.0\ s$?

1.9 Use what you've learned about sources along with current, voltage, energy, and power to determine the unknown quantities: $I_1, V_1, P_1, P_2, and\ P_3$ in the following circuit.