Homework 06 (Phys333 – Fall 2016 – R.Sonnenfeld)

Due November 9, 2016 in class

Instructions:

Each problem should begin at the top of a new sheet of paper kept in a binder. Each problem should have your name on the left and the *SPN* on the right, circled. For numerical answers, show numbers plugged into the equation before solving with a calculator. Numerical answers should include SI units. One star problems are easier than two star.

*** SPN 6–07.** Does it make economic sense to pay $5 for a compact fluorescent bulb when an incandescent only costs $0.50? Assume electricity costs $0.12 per kilowatt hour and compare a 60 Watt incandescent to a 15 Watt fluorescent (they both produce about the same amount of light). If both lightbulbs last about 10,000 hours, compare the amount you ended up spending (purchase + electricity cost) on the two bulbs.

*** SPN 6–08.** A 2.2-m-long, wire is one mm in diameter and its resistivity is variable.

$$\rho(x) = (3.8 \times 10^{-6}\ [1 + (\frac{x}{1.0m})^2]\ \Omega\ m \tag{1}$$

Where x is measured from one end of the wire. How much current does the wire carry if hooked up to a twelve volt battery?

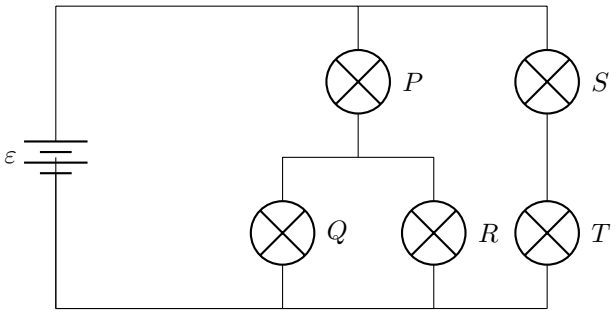
*** SPN 6–09.** An RC circuit has an eight millisecond time constant. How long after discharge begins are

(a) The charge on the capacitor reduced to half its initial value?

(b) The energy stored in the capacitor is reduced to half its initial value?

**** SPN 6–10.** A capacitor charging circuit with a 50 μF capacitor has a 40 ms time constant. The capacitor has zero charge at t=0 and the initial current to the capacitor is 65 mA. What is the capacitor's voltage after 20 ms?

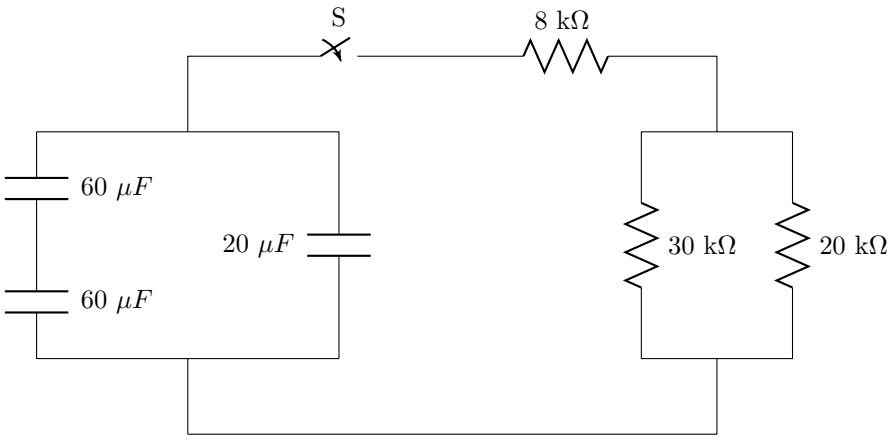
*** SPN 6–11.** All the light bulbs in the circuit below are identical and the battery is ideal. Rank the light bulbs from brightest to dimmest (indicate any that are equal in brightness to eachother).

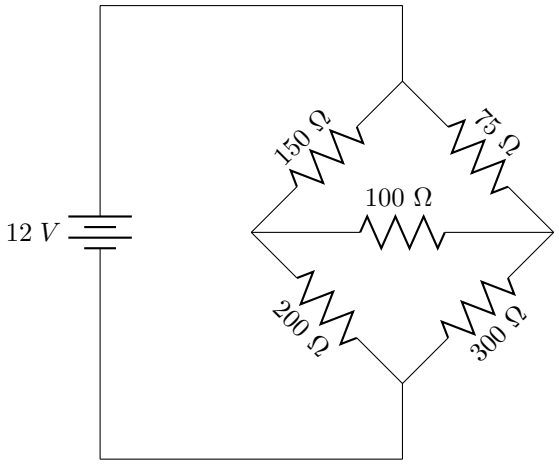


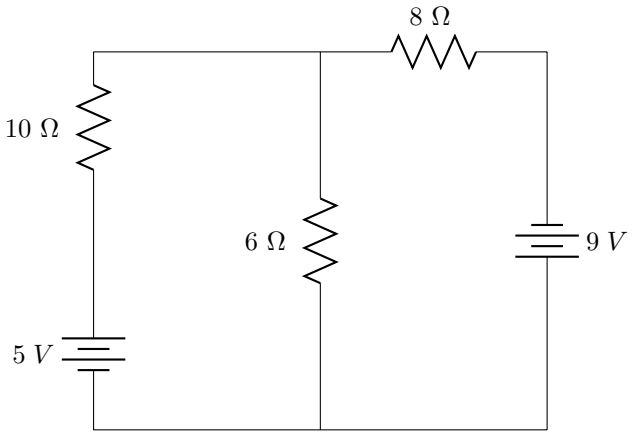
*** SPN 6–12.** The capacitors below are fully charged and the switch is closed at $t = 0$. At what time has the current in the 8 kΩ resistor decayed to half the value it had $t = 0$?

**** SPN 6–13.** What is the equivalent resistance of the Wheatstone bridge circuit below? What is the current through each resistor? (Make a 5x5 matrix $\boldsymbol{A}$ using KVL and KCL. Use Matlab or Octave to invert for I using $I = \boldsymbol{A}\backslash b$.)

**** SPN 6–14.** Make a table of the current through (and voltage across) each resistor in the circuit below. Indicate with arrows the direction of positive current flow for each resistor. (Make a 3x3 matrix $\boldsymbol{A}$ using KVL and KCL. Use Matlab or Octave to invert for I using $I = \boldsymbol{A}\backslash b$.)


S
8 kΩ
60 μF
20 μF
60 μF
30 kΩ
20 kΩ


12 V
150 Ω
75 Ω
100 Ω
200 Ω
300 Ω


8 Ω
10 Ω
6 Ω
9 V
5 V