Name: _____ Lab section/TA: _____

Problem Set 1

These problems are intended to help you practice and understand the material from the first week of class: Kirchoff's Current Law (KCL), Kirchoff's Voltage Law (KVL), Ohm's law, power, and diodes.

The convention used in these diagrams (and for the this class) is that the '+' and '-' signs next to an element indicate the positive and negative points for a voltage measurement. That is, the labeled number is the voltage of the (+) terminal relative to the (-) terminal. While people often put the references so the resulting voltages are positive, that is not always true, so don't be surprised if some of the voltages you calculate are negative.

Arrows represent current flow. A negative current indicates that current flows opposite the direction of the arrow.

Sign conventions

Problem 1:

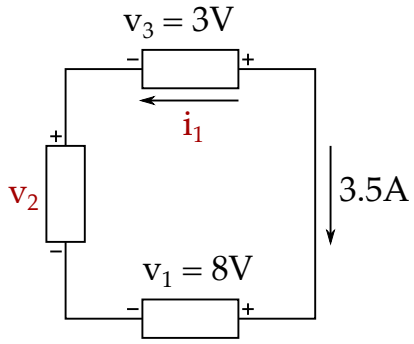
(5 Points)

Redraw each element such that the numerical value of current and voltage are positive (this can entail changing the direction of the arrow indicating current flow and/or the voltage sign convention). After this indicate whether the element is dissipating or supplying power.

KCL, KVL, and Ohm's law

Problem 2:

(5 Points)



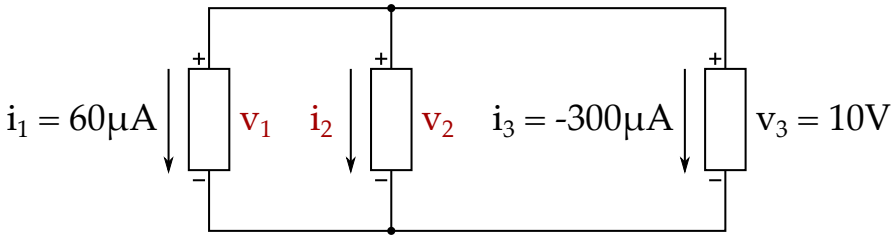
Find the current i_1:

Find the voltage v_2:

Find the power dissipated by each element in the circuit. Use the convention that positive power means that the device absorbs energy from the circuit, and negative power means it supplies energy.

Problem 3:

(6 Points)



Find the current i_2:

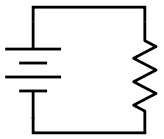
Find the voltage v_1:

Find the voltage v_2:

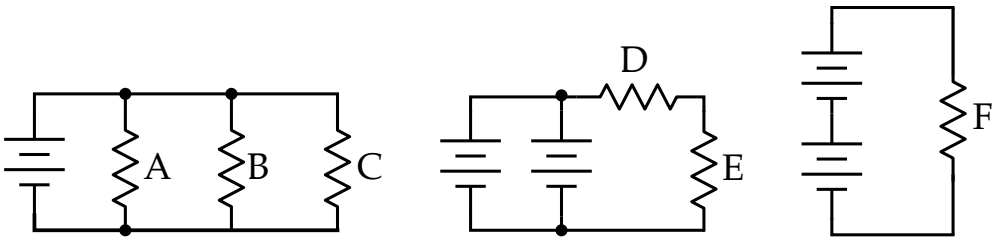
Find the power dissipated by each element in the circuit:

Problem 4:

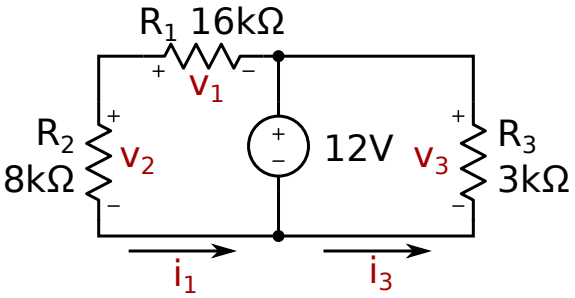
(6 Points) In the circuit below, the resistor dissipates power P.



Below we want to know how much power each resistor dissipates. Express your answer as a power/fraction of P (e.g., P, $2P$, $0.5P$, etc.)? All of the batteries have the same voltage as the circuit above, and all of the resistors have the same resistance as the circuit shown above. It will help you solve this problem if you first write power as $i \cdot V$ and figure out what both are for each of the resistors.



Problem 5:
(9 Points)



Find the voltages v_1, v_2 and v_3:

Find the currents i_1 and i_3:

Find the power dissipated by each resistor:

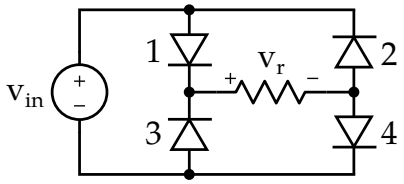
Find the power supplied by the voltage source (i.e., the negative of the power dissipated by the voltage source):

Diodes

Assume that the diodes are ideal (i.e., they have zero forward voltage).

Problem 6:

(4 Points)



Suppose $v_{in} = 6\,\text{V}$. Which diodes turn on? What is the resistor voltage, v_r?

What if v_{in} is reversed, to $-6\,\text{V}$? Which diodes turn on now, and what is the resistor voltage, v_r?

Bonus: Can you think of any uses for a circuit like this? Here the resistor just represents a load (i.e., it's a substitute for any power-consuming circuit).

Problem 7: Reflection

(2 Points)

How long did it take you to complete this assignment?

Which problem was the most difficult?