**Homework 1 – For your own education, not to be handed in.**

**1.** An electric heater is powered by a 24V battery. The heater draws 2A. (Assume the battery is a perfect voltage source and the heater is a resistor)

**A.** Draw the circuit labeling the values of the resistor and perfect voltage source. Make sure that the circuit is complete.

**B**. What is the resistance of the heater?

**C.** What is the power dissipated by the heater?

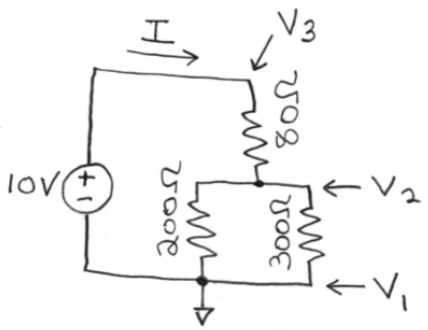
**D.** Is the current through the heater the same direction as the voltage across it?

**E.** Is the current through the battery the same direction as the voltage across it?

**F.** What is the power (in watts) "dissipated" by the battery? (Recall that power can be positive or negative.)

**G.** How much energy (in Joules) dissipated by the heater in one minute?

**2.** In the following circuit, voltages are defined relative to ground.




**A**. Redraw the circuit.

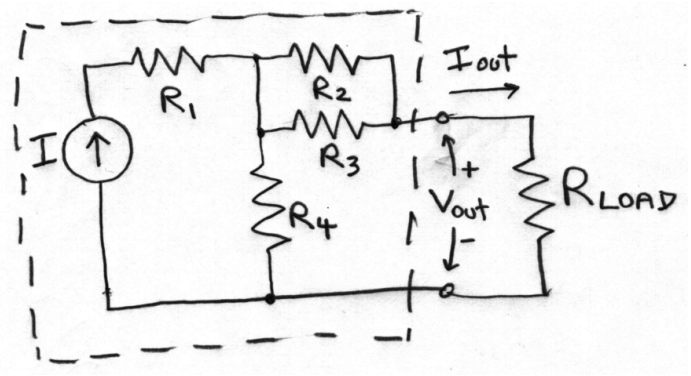
**B.** What is $V_1$?

**C.** What is $V_2$? (show calculations)

**D.** What is $V_3$?

**E**. What is I?

**3.** In the following circuit, $I = 3$ mA, $R_1 = 3$ KΩ, $R_2 = R_3 = 8$ KΩ, $R_4 = 2$ KΩ,




**A**. Redraw the circuit with the above values shown for each component.

**B.** What is the current through $R_1$ (explain using one of Kirchhoff's Laws)?

**C.** To find the Norton Equivalent current, $I_{NORTON,}$ of the circuit within the dashed-line box, what value should be assigned to $R_{LOAD}$?

**D.** What is $I_{OUT} = I_{NORTON}$ computed as the current through $R_{LOAD}$ assigned the resistance value in question C? (show your calculations)

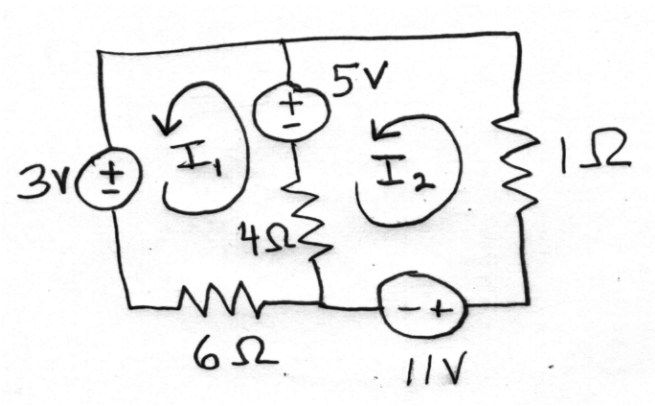
**E.** To find the Thevenin Equivalent voltage, $V_{THEVENIN,}$ of the circuit within the dashed-line box, what value should be assigned to $R_{LOAD}$?

**F.** What is $V_{OUT} = V_{THEVENIN}$ computed as the voltage across $R_{LOAD}$ assigned the resistance value in question E? (show your calculations).

**G.** What is $R_{THEVENIN} = R_{NORTON}$ (they are always the same value), as calculated from your values computed for $V_{THEVENIN}$ and $I_{NORTON}$ ? (show calculation).

**H.** Using Superposition, find $R_{THEVENIN} = R_{NORTON}$ by setting $I = 0$ and computing the resistance of the resulting circuit "looking into" the dashed-line box (show calculations). This value should match your answer to question G.

**4.** The following circuit has two unknowns, $I_1$ and $I_2$, which may be determined using Mesh Analysis.




**A**. Draw the circuit.

**B.** Using Kirchhoff's Voltage Law, write two simultaneous equations of the form

$$aI_1 + bI_2 = c$$
$$dI_1 + eI_2 = f$$

determining values for *a, b, c, d, e,* and *f.* (Note: this requires careful consideration of the directions of the voltage sources and the voltages created by $I_1$ and $I_2$ in the various resistors).

**C.** Solve the equations in question B for $I_1$ and $I_2$ (hint: for this particular circuit, these turn out to be integer values).

**D.** Plug the values of $I_1$ and $I_2$ from question C into the equations from question B and show they are solved (and thus, that Kirchhoff's Voltage Law has been obeyed).