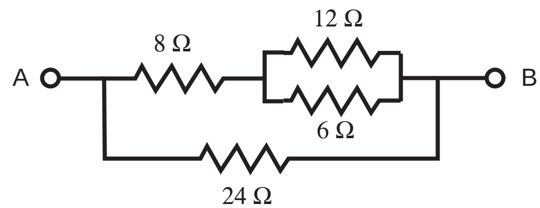
ELEC 243
Problem Set 1
Due: January 24, 2015

Homework Problems.

H1.1 Consider the following combination of resistors:



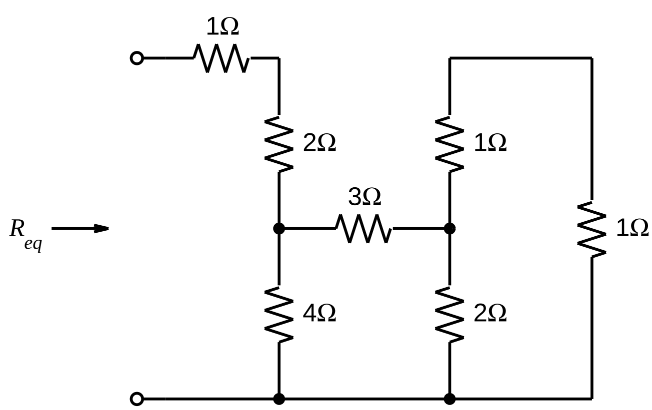
(a) Find the equivalent resistance between terminals A and B.

(b) When $V_{AB} = 16$V, the current through the 24Ω resistor is $\frac{2}{3}$A. What is it when $V_{AB} = 12$V?

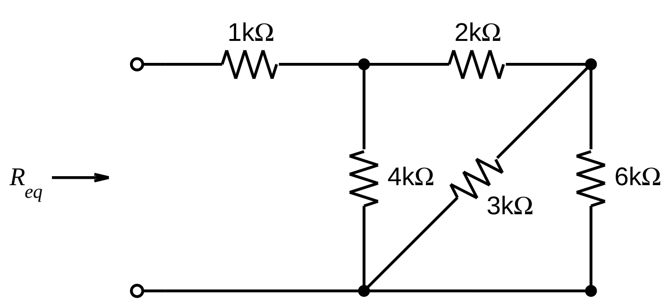
(c) Find the power dissipated in the 24Ω resistor in this case.

H1.2 Compute the equivalent resistance (R_{eq}) of the following circuits:

(a)



(b)



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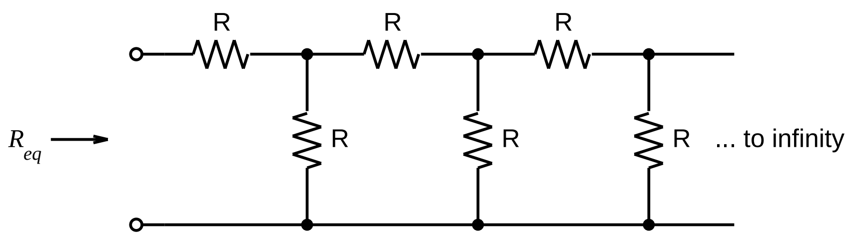
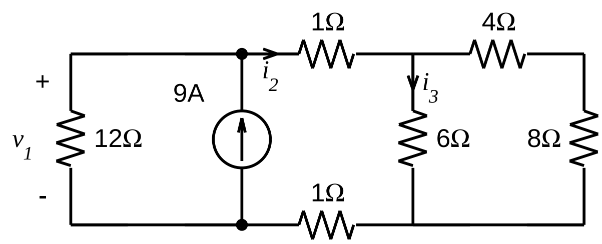
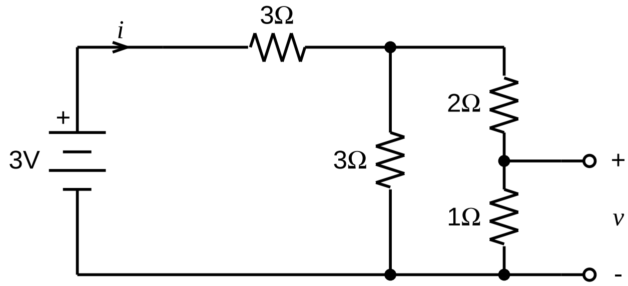
(c)



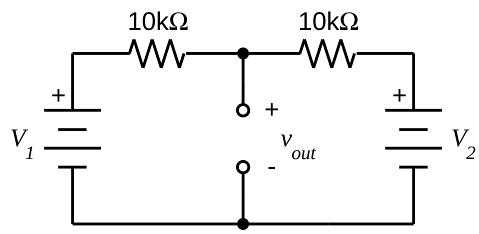
H1.3 In the circuit below, find: v_1, i_2, i_3, and the power supplied by the current source.



H1.4 Find i and v.



H1.5 Find v_{out} in the circuit below.



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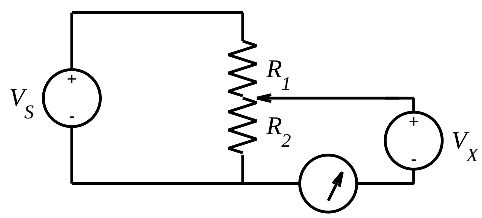
H1.6 The circuit below uses a type of adjustable resistor called a *potentiometer* (or *pot* for short). The resistance between the top and bottom terminals is fixed, but the middle terminal (denoted by the arrow) is movable, dividing the total resistance into two portions, R_1 and R_2, whose sum is equal to the total resistance. If the resistance material is uniform, R_1 and R_2 can be determined from the position of the movable terminal.

In the early days of electricity, there were no instruments for directly measuring voltage, so this circuit was used to measure an unknown voltage (V_X) indirectly, by comparing it to a known standard voltage source (V_S). To make the measurement, the circuit is connected as shown and the movable terminal adjusted until the current in the ammeter is zero.

Show that the unknown voltage is then determined as:

$$V_X = V_S \frac{R_2}{R_1 + R_2}$$



H1.7 Temperature-sensitive resistors may be made of either metals or semiconductors. For a metal resistor, the resistance *increases* with increasing temperature. Assume that the resistance of such an element is given by $R(T) = R_0[1+\alpha(T-T_0)]$ where T is temperature, R_0 is the resistance value at a temperature of $T_0(\deg \mathrm{C})$, and α is a constant called the temperature coefficient. Assume $\alpha = 0.01$, $R_0 = 1\mathrm{k}\Omega$. If the device is connected to a constant current source, what must the value of that source be so that the voltage change across it will be 0.05 V when the temperature change is 10 degrees?

H1.8 A thermistor is a temperature-sensitive resistor made of semiconducting material in which resistance *decreases* as the temperature increases. Although the actual relationship between temperature and resistance is nonlinear, for sufficiently small changes in temperature we can use the linear model of the previous problem. In this case the temperature coefficient will be negative. Assume such a device shows a decrease in resistance of 7% per degree increase in temperature. If the room temperature current is 2 mA when connected across a 3 V source, what is the expected current when the temperature is lowered 5 degrees?

Exam Problems.
None this week.