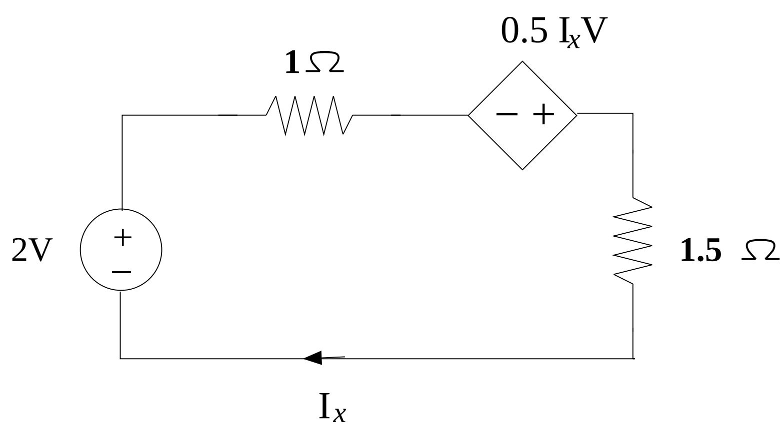
ECE 53a	Quiz #1 SOLUTIONS	Pamela Cosman	1/29/08

Problem 1: (This is problem 1 from homework 2.) V_a is just the same as the source voltage. It is 8V. And for V_o, we see it is just a voltage divider. We have to notice that V_o has the opposite polarity from $V_a = 8V$, so we need to include a minus sign in the voltage division equation:

$$V_o = -\frac{2}{2+3+3} \times 8 = -2V$$

Problem 2: (This is similar to problem 3 in the practice quiz.)



First to find the current, we note that the total voltage powering the circuit is the sum of the two voltage sources in series: $2 + 0.5I_x$. The total resistance in the circuit is the sum of the two series resistors: $1 + 1.5 = 2.5$.
By Ohm's law, the current that flows will be the ratio:

$$I_x = \frac{2 + 0.5I_x}{2.5}$$

and we solve this equation to obtain:

$$I_x = 1A$$

The fastest way to answer this for the resistors is to remember that one expression for power absorbed by a resistor is

$$p = Ri^2$$

Since $I_x = 1$, and it is the same current throughout the circuit, the power absorbed by the 1 Ohm resistor is

$$p_1 = 1 \times 1^2 = 1W$$

and for the other resistor the power absorbed is

$$p_2 = 1.5 \times 1^2 = 1.5W$$

For the independent voltage source, the power absorbed is

$$p_i = -2 \times 1 = -2W$$

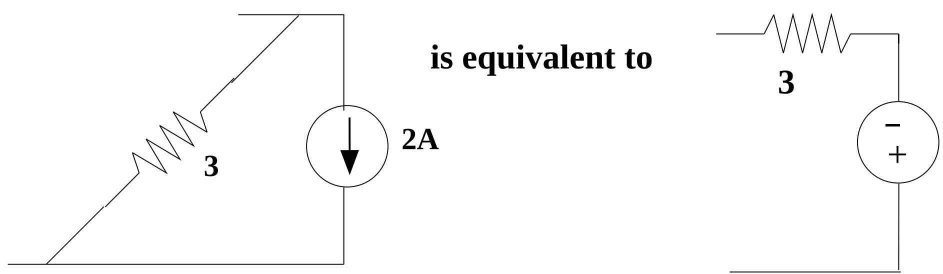
where we had to write p=-vi because the current I_x is going from minus to plus across the resistor. Lastly for the dependent voltage source,

$$p_d = -0.5 \times 1 \times 1 = -0.5W$$

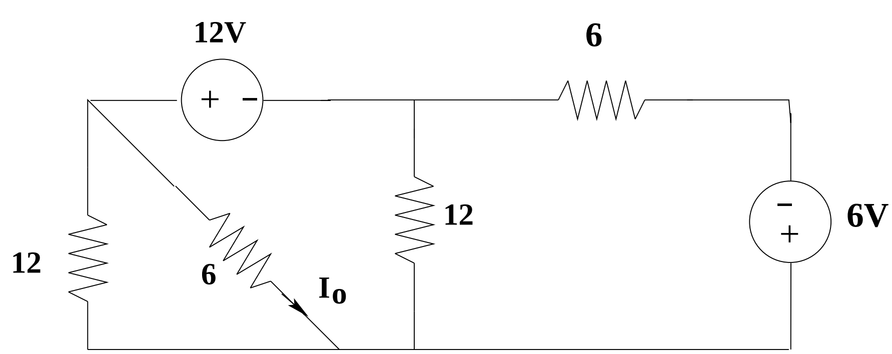
As a check of all these, we can see that the total power absorbed sums to zero:

$$1 + 1.5 - 2 - 0.5 = 0$$

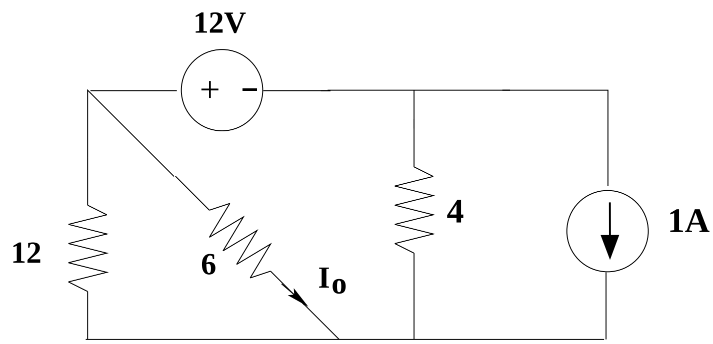
Problem 3: (This is one that I gave in class.)
First we can transform the 2A current source on the right, which is in parallel with a 3Ω resistor:



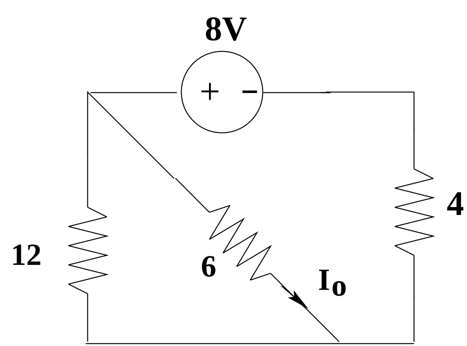
That gives us a 6V voltage source in series with a 3Ω resistor, which we can combine with the other 3Ω resistor to give the following circuit:



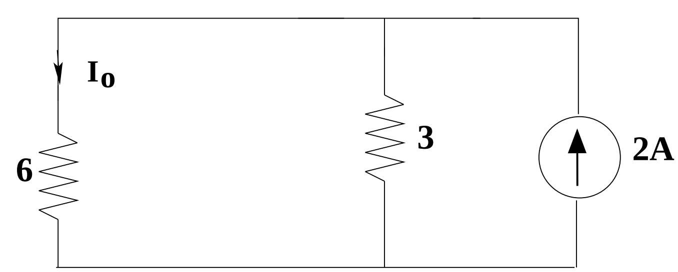
We transform this voltage source (in series with a 6Ω resistor) back into a current source (in parallel with a 6Ω resistor) and then combine the 6Ω and 12Ω parallel resistors to obtain:



Going back to a voltage source:



And then one last time, going back to a current source:

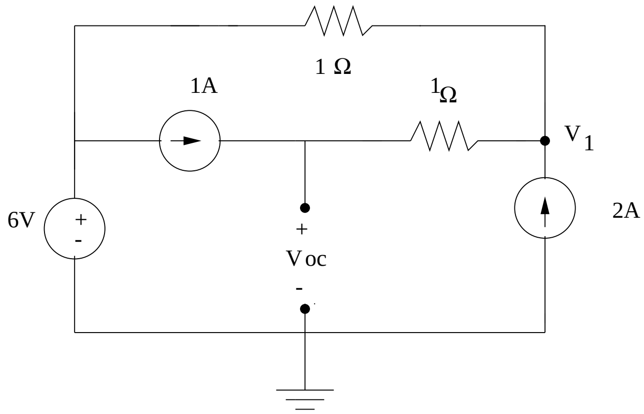


From this we can see it is a current divider, so

$$I_o = \frac{2 \times 3}{6+3} = \frac{2}{3}A$$

Problem 4: Here there are only independent sources, so we can find any two of the three items: V_{oc}, i_{sc} and R_{th}. I will find V_{oc} and R_{th}.

We find v_{oc} using the following circuit:



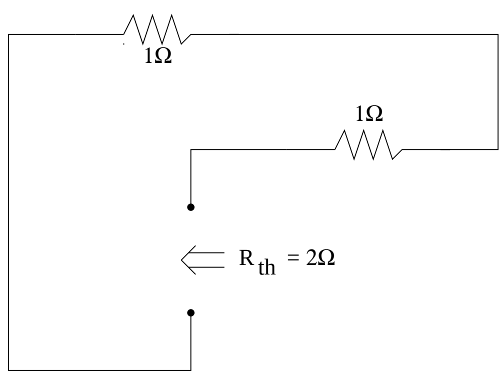
KCL at node v_1 yields

$$2 + 1 + \frac{6 - V_1}{1} = 0 \qquad \Rightarrow \qquad v_1 = 9$$

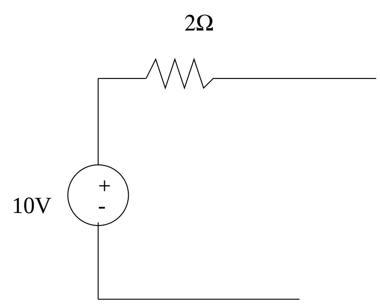
That 1Ω resistor to the left of node V_1 must have 1A across it, so

$$v_{oc} = 9 + 1 \times 1 = 10V$$

To find R_{th}, we need to zero out all the independent sources. The current sources become open circuits, so those branches can be erased. The voltage source becomes a wire.



The Thevenin equivalent circuit is therefore



and the current I_0 in the 3Ω load is

$$I_0 = \frac{10}{2+3} = 2A$$