ECE 111 - Homework #5

Week #5: EE 206 Circuits I. - Due 8am Tuesday, February 15th

1) A resistor has the following volts / amps / resistance / power. Determine the missing parameters:

Volts	Amps	Ohms	Watts
24V	1.5A	**16 Ohms**	**36 W**
24V	**6A**	4	**144W**
20V	1.5A	**13.3 Ohms**	30
24V	**16.67A**	**1.44 Ohms**	400

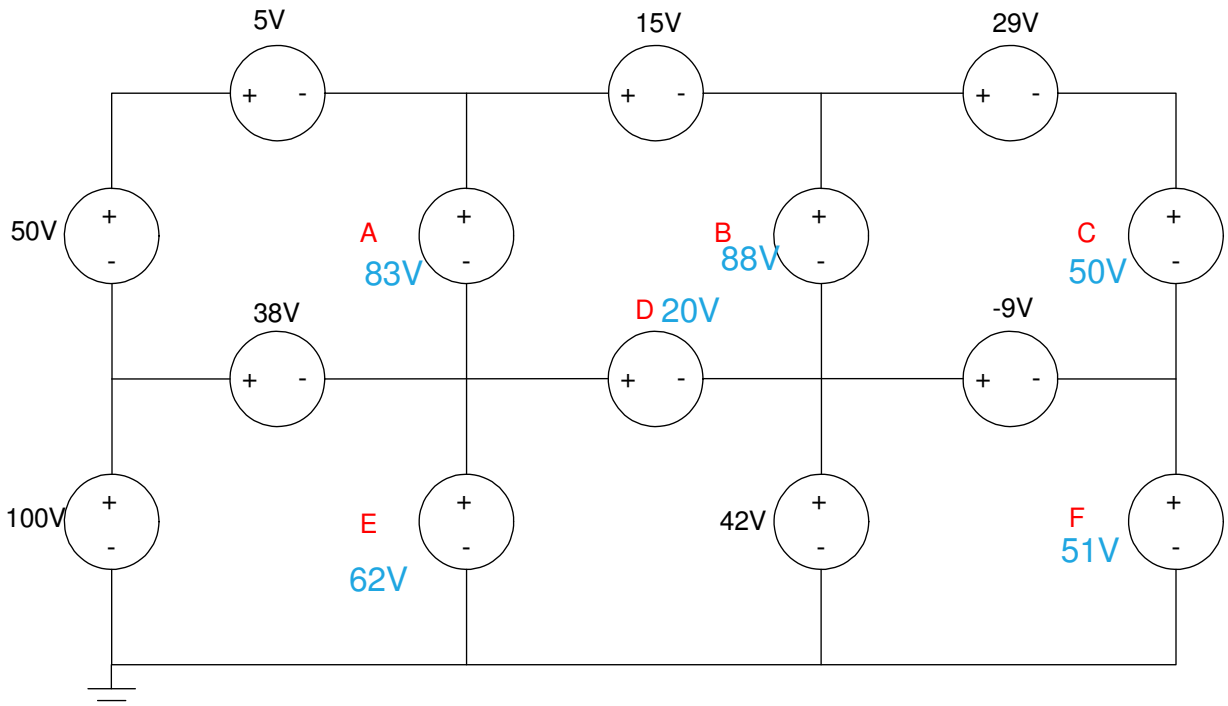
Note:

$$V = IR$$

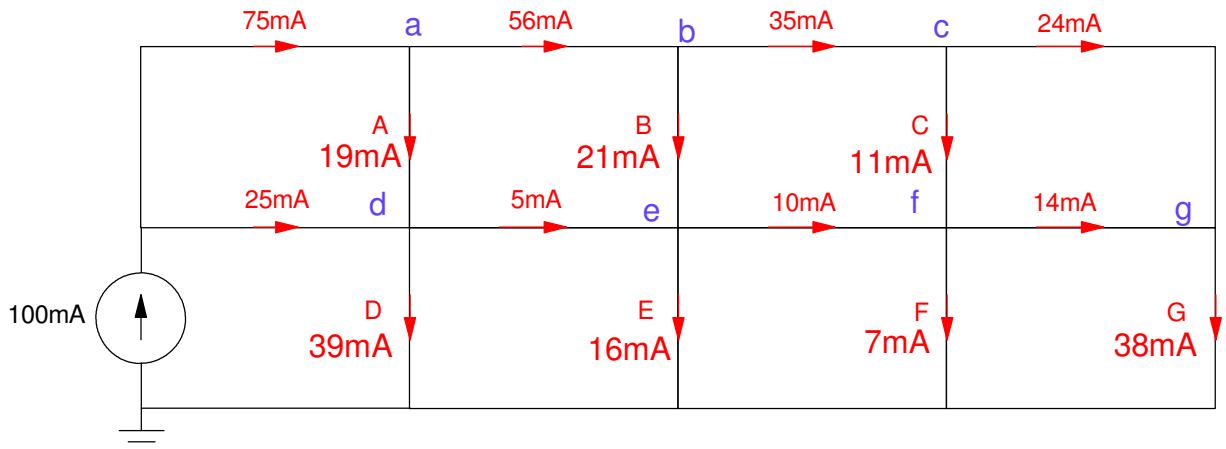
$$P = VI$$

Kirchoff's Laws:

2) Use conservation of voltage to determine the unknown voltages



3) Use conservation of current to determine the unknown currents



Current In = Current Out

node a)

75mA = A + 56mA A = 19mA

node b)

56mA = B + 35mA B = 21mA

node c)

35mA = C + 24mA C = 11mA

node d)

25mA + A = D + 5mA A = 19mA (from before)

D = 39A

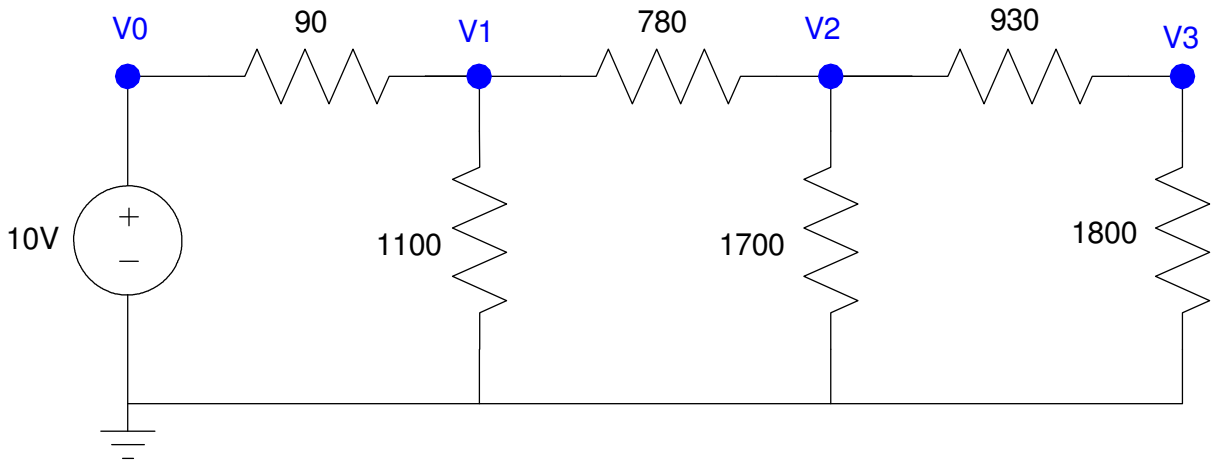
node e)

5mA + B = E + 10mA B = 21mA (from before)

E = 16mA

Resistors in Series and Parallel

4) Find the total resistance seen by the 10V source



The trick is to combine resistors in series and parallel.

In series (all the current through R1 also goes through R2)

$$R = R_1 + R_2$$

In parallel (both resistors are connected to Va on one side, Vb on the other side)

$$R_1 || R_2 = \left(\frac{1}{R_1} + \frac{1}{R_2} \right)^{-1}$$

930 & 1800 are in series (they add)

930 + 1800 = 2730

2730 & 1700 are in parallel

2730 || 1700 = 1047.63

1047.63 & 780 are in series (they add)

1047.63 + 780 = 1827.63

1827.63 & 1100 are in parallel

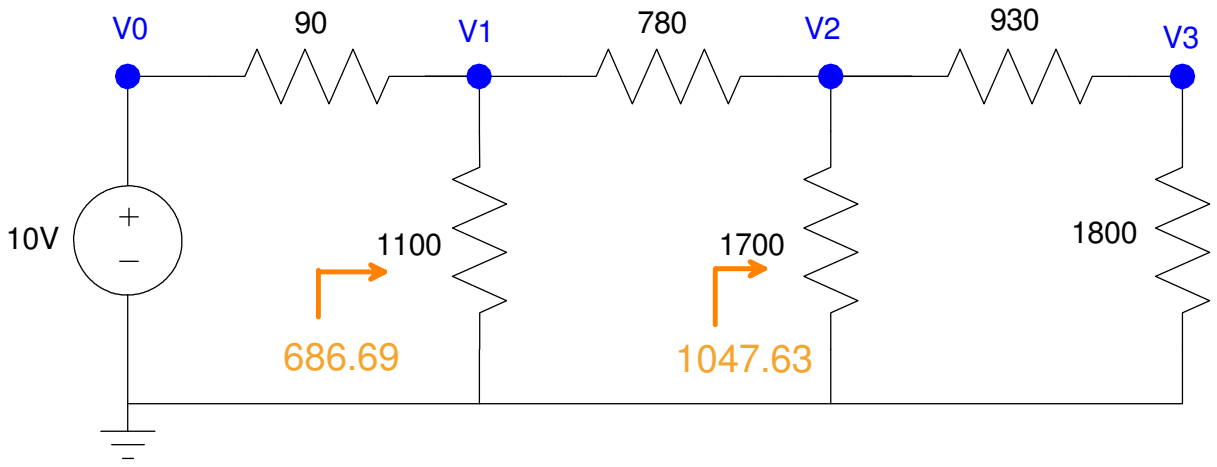
1827.63 || 1100 = 686.69

686.69 & 90 are in series (they add)

686.69 + 90 = 776.69

answer: 776.69 Ohms

5) Use voltage division to find V1, V2, and V3.



By inspection

$$V_0 = 10$$

Find the net resistance looking right at V1 (686.69 ohms from problem #4).

V1: By voltage division

$$V_1 = \left(\frac{686.69}{686.69+90}\right) V_0$$

$$V_1 = 8.841V$$

V2:

$$V_2 = \left(\frac{1047.63}{1047.63+780}\right) V_1$$

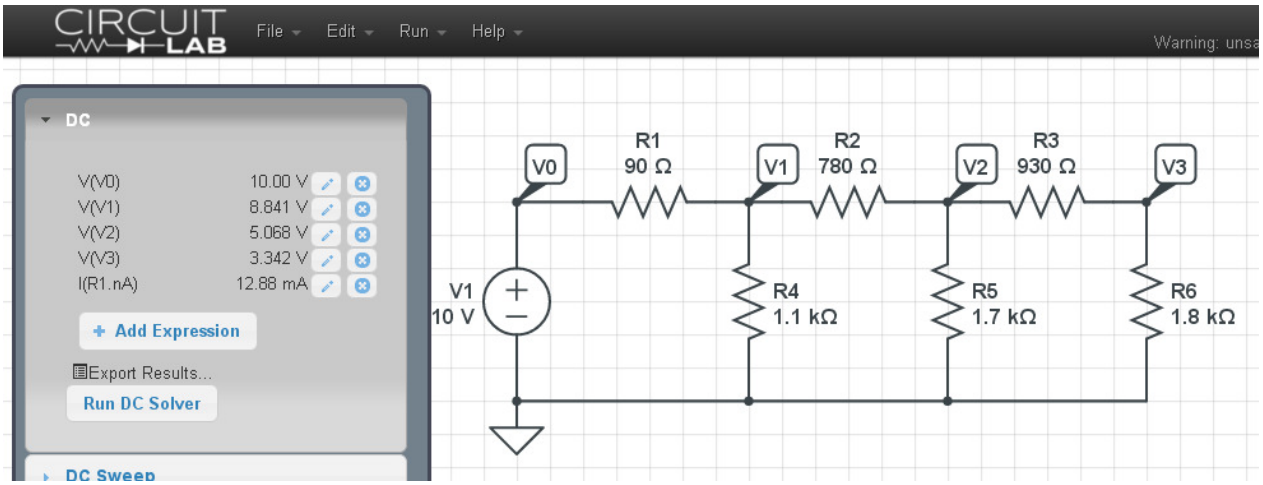
$$V_2 = 5.068V$$

V3:

$$V_3 = \left(\frac{1800}{1800+930}\right) V_2$$

$$V_3 = 3.342V$$

6) Use CircuitLab to find V1, V2, V3, and the total resistance seen by the 10V source.



	V0	V1	V2	V3
Calculated	10.00V	8.841V	5.068V	3.342V
Simulated	10.00V	8.841V	5.068V	3.342V

The current through R1 tells you the net resistance as well:

$$I = 12.88mA$$

$$R = \left(\frac{V}{I}\right) = \left(\frac{10V}{12.88mA}\right) = 776.40\Omega$$

In problem #4, the resistance was calculated as

$$R = 776.69\Omega$$

The difference is rounding error with the current

$$I = \left(\frac{10V}{776.69\Omega}\right) = 12.875mA$$

which is rounded to 12.88mA (resulting in the difference in the resistances)