

# ECE 111 - Homework #5

Week #5: EE 206 Circuits I - Due Tuesday, February 14th

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

Volts (V)	Amps (I)	Ohms (R)	Watts (P)
40V	2.6A	<b>15.38 Ohms</b>	<b>104W</b>
40V	<b>5.00A</b>	8	<b>200W</b>
<b>54.05V</b>	3.7A	<b>14.61 Ohms</b>	200W
40V	<b>3.00A</b>	<b>13.33 Ohms</b>	120W

Base equations:

$$V = IR$$

$$P = VI$$

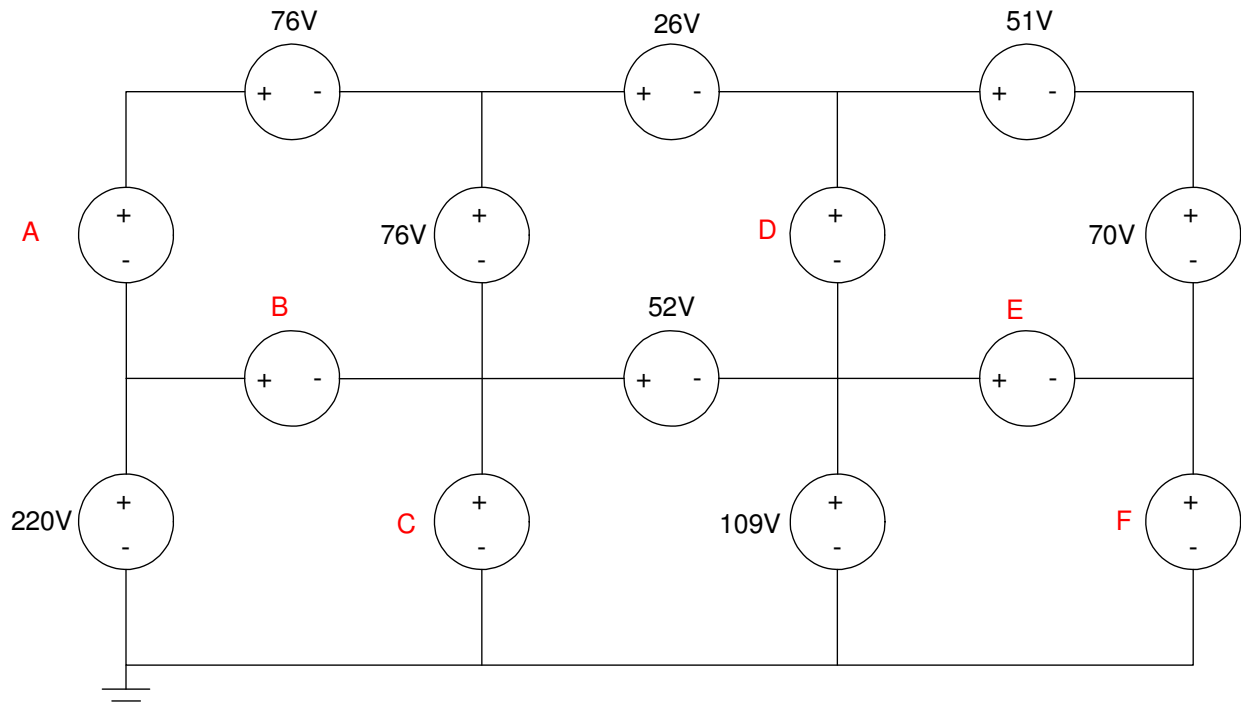
Example: a)

$$R = \left(\frac{V}{I}\right) = \left(\frac{40V}{2.6A}\right) = 15.38\Omega$$

$$P = VI = (40V)(2.6A) = 104W$$

## Kirchoff's Laws:

2) Use conservation of voltage to determine the unknown voltages



Find a loop where there is one unknown

$$-C + 52 + 109 = 0$$

$$C = 161V$$

$$-220V + B + C = 0$$

$$B = 59V$$

$$-A + 76 + 76 - B = 0$$

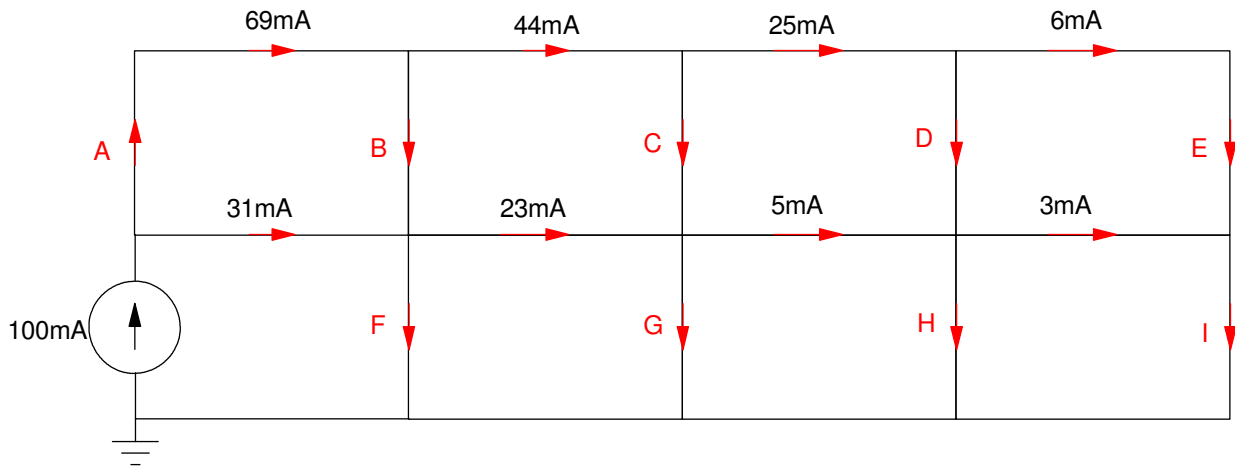
$$A = 93V$$

etc.

Result:

- A = 93V
- B = 59V
- C = 161V
- D = 102V
- E = 19V
- F = 90V

3) Use conservation of current to determine the unknown currents



Sample Calculations:

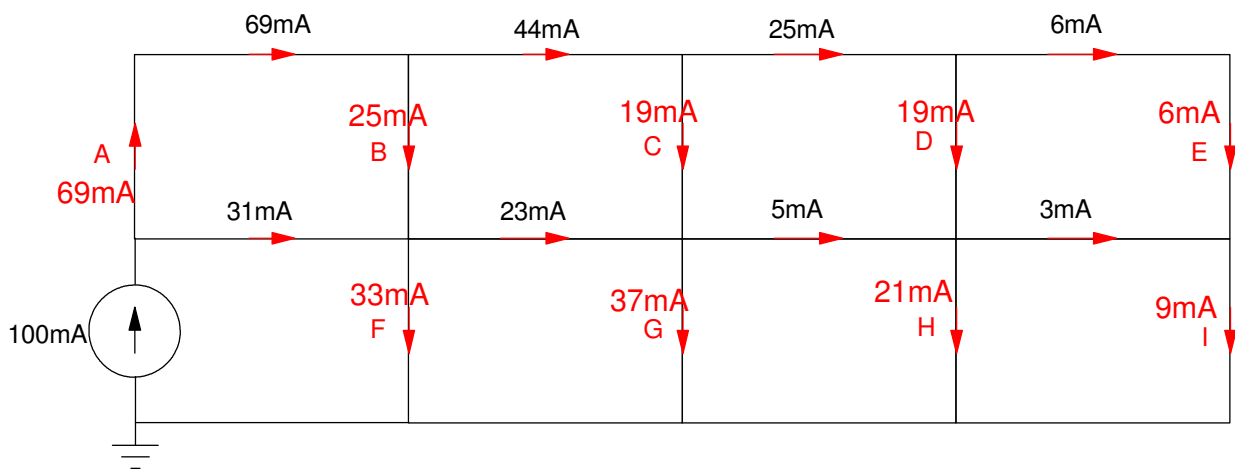
$$A = 69\text{mA (current in = current out)}$$

$$69\text{mA} = B + 44\text{mA}$$

$$B = 25\text{mA}$$

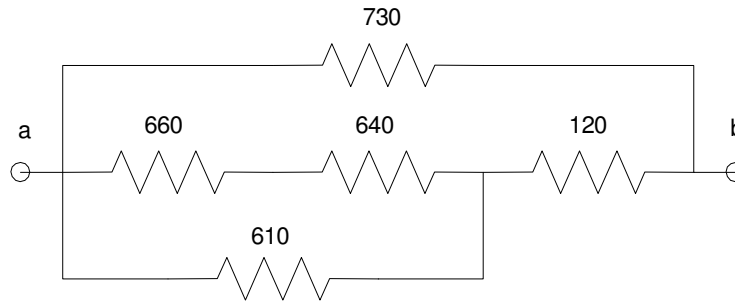
$$44\text{mA} = C + 25\text{mA}$$

$$C = 19\text{mA}$$



## Resistors in Series and Parallel

4) Find the total resistance  $R_{ab}$



$$660 + 640 = 1300 \quad \text{series}$$

$$1300 \parallel 610 = 415.1832 \quad \text{parallel}$$

$$415.1832 + 120 = 535.1832 \quad \text{series}$$

$$535.1832 \parallel 730 = 308.79 \text{ Ohms} \quad \text{parallel}$$

**ans:  $R_{ab} = 308.79 \text{ Ohms}$**

**Problem 5)** Find  $R_{ab}$  using CircuitLab

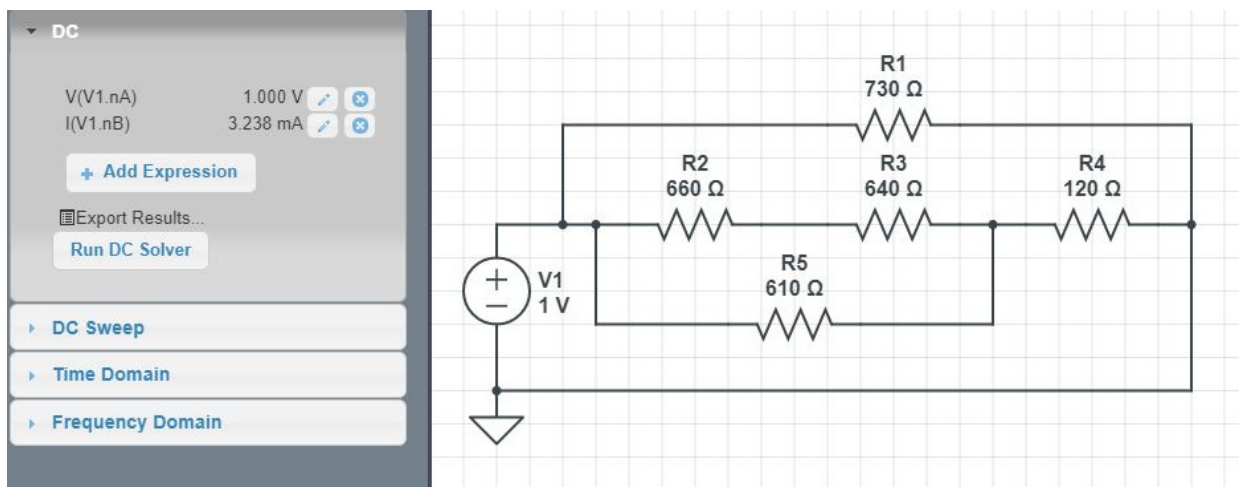
- Apply a 1V source, measure the current, compute R from  $R = V/I$

From CircuitLab

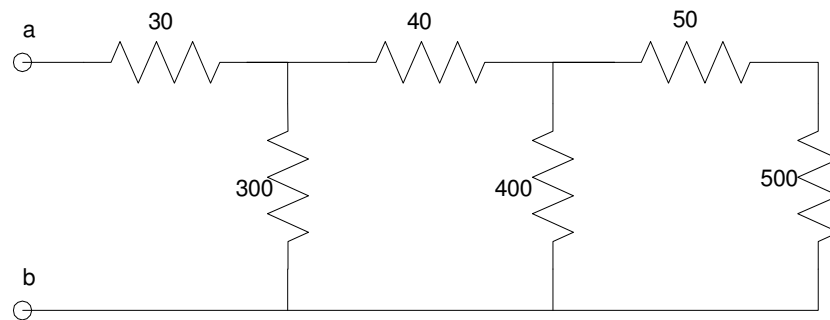
$$I = 3.238 \text{ mA}$$

$$R = \left( \frac{1V}{3.238 \text{ mA}} \right) = 308.8326 \Omega$$

The difference is rounding error



6) Find the total resistance Rab



$$500 + 50 = 550$$

*series*

$$550 \parallel 400 = 231.5789$$

*parallel*

$$231.5789 + 40 = 271.5789$$

*series*

$$271.5789 \parallel 300 = 142.5414$$

*parallel*

$$142.5414 + 30 = 172.5414$$

*series*

**ans: Rab = 172.5414 Ohms**

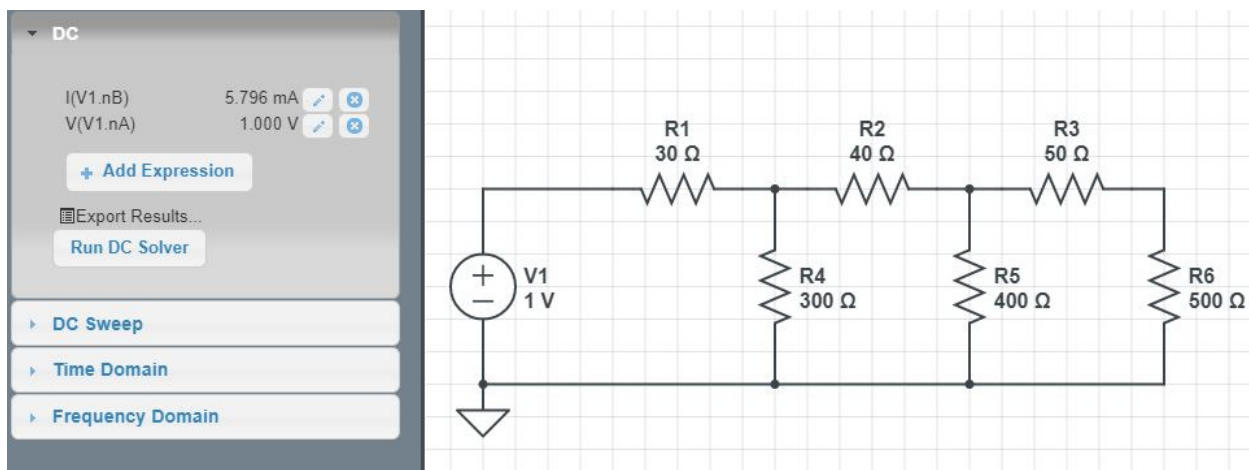
7) Find Rab using CircuitLab

Apply a 1V source to Vab, measure the current, compute R

$$I = 5.7696\text{mA}$$

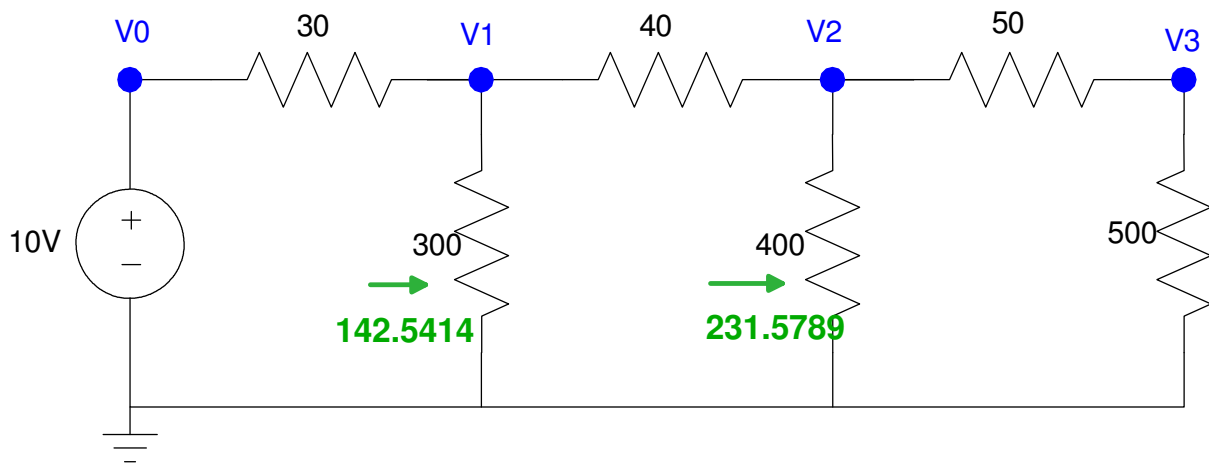
$$R = \left(\frac{V}{I}\right) = \left(\frac{1\text{V}}{5.7696\text{mA}}\right) = 173.3222\Omega$$

The difference is rounding errors



## Voltage Division

7) Use voltage division to find  $V_1$ ,  $V_2$ , and  $V_3$ .



From before, the resistance looking right is shown in green.

From voltage division

$$V_1 = \left( \frac{142.5414}{142.5414 + 30} \right) V_0$$

$$V_1 = 8.2613V$$

$$V_2 = \left( \frac{231.5789}{231.5789 + 40} \right) V_1$$

$$V_2 = 7.0445V$$

$$V_3 = \left( \frac{500}{500 + 50} \right) V_2$$

$$V_3 = 6.4041V$$

8) Use CircuitLab to find V1, V2, V3.

The answers are the same as problem #7

