Objectives:

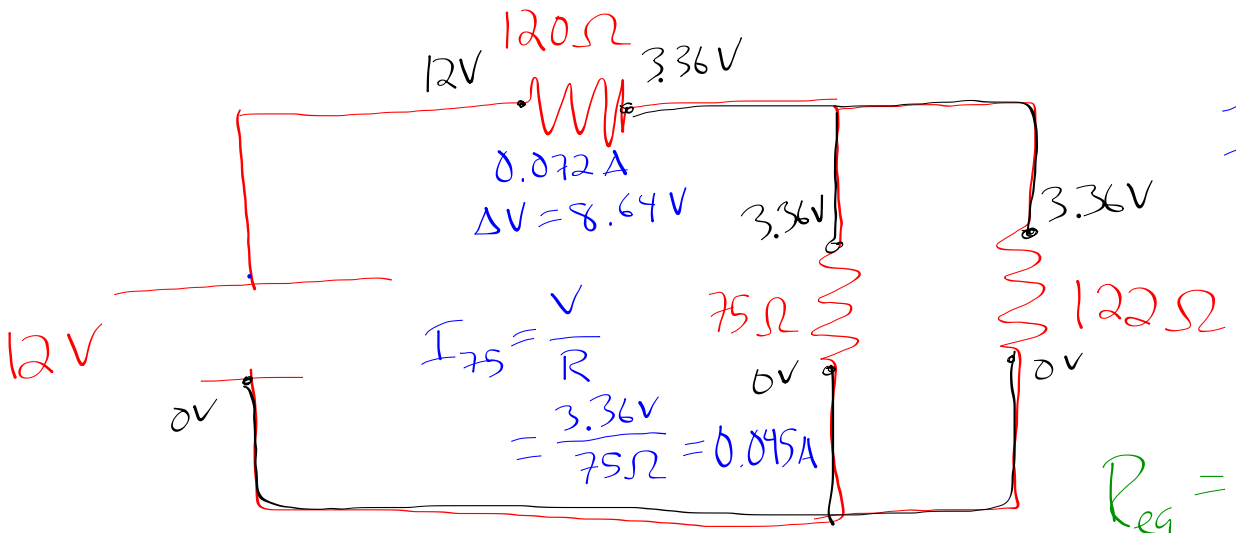
- Students will understand equivalent resistance and how to calculate it
- Students will be able to analyze parallel circuits
- Students will be able to design simple parallel circuits

Analyzing Parallel Circuits

- Start by finding "Equivalent Resistance" (R_{eq})
  - > For series paths, add the resistance together (do this first for all series paths!)
  - > For parallel paths, there is a different formula: $\frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$ $R_{tot} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots}$
  - > If necessary, redraw the circuit to make R_{eq} clear
  - > Continue finding R_{eq} for series and parallel paths as they emerge in your drawings

Next ...

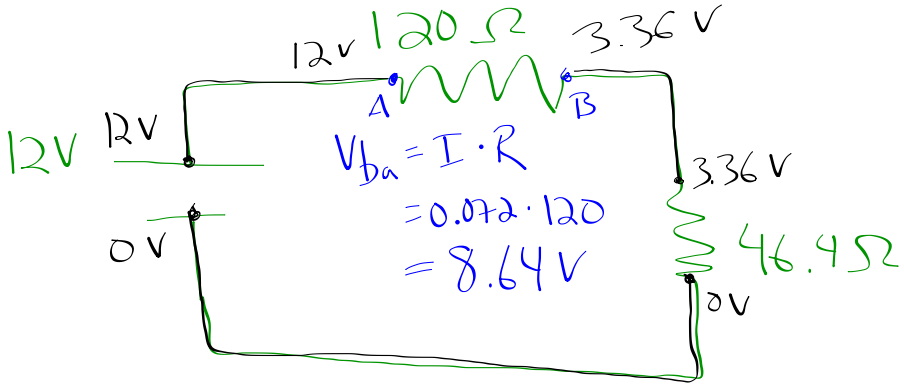
- After you've found R_{eq} for the entire circuit, you can find the total current (I_{tot}) for the circuit
- Remember that current:
  - > Is always the same in series paths
  - > Is conserved at **junctions** (incoming current = outgoing current)
- Remember that voltage:
  - > Stays (roughly) the same in wires
  - > Drops through resistors and other components according to Ohm's Law
- Use Ohm's Law to find
  - > Voltage changes (usually the first step)
  - > Current through parallel paths
  - > Any other quantities



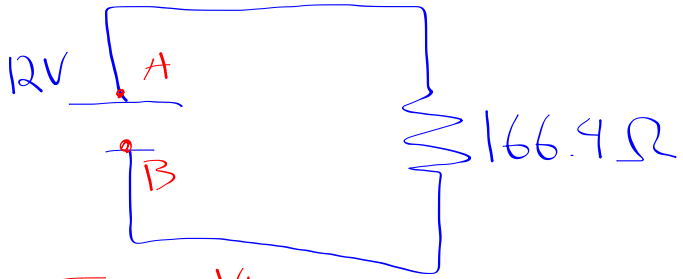
$$I_{122} = \frac{V}{R} = \frac{3.36\,V}{122\,\Omega}$$

$$= 0.028\ A$$

$$R_{eq} = \frac{1}{\frac{1}{75} + \frac{1}{122}} = 46.4\,\Omega$$



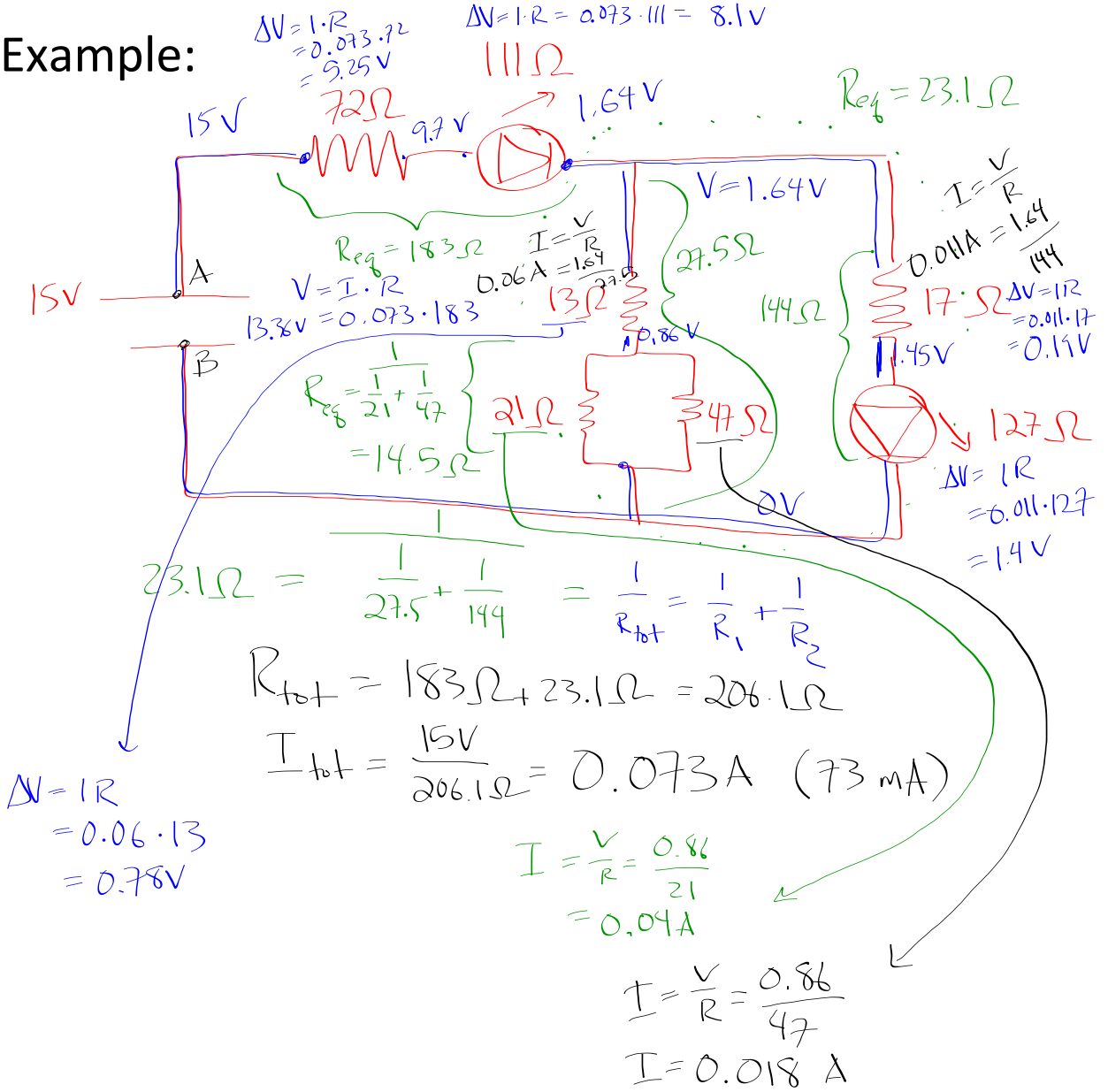
$I = 0.072\ A$



$$I_{tot} = \frac{V_{ba}}{R_{ba}} = \frac{12\,V}{166.4\,\Omega} = 0.072\,A$$

(72 mA)

Example:


15V
72Ω
9.7V
111Ω
1.64V
$R_{eq} = 23.1\Omega$
$\Delta V = I \cdot R = 0.073 \cdot 111 = 8.1V$
$\Delta V = I \cdot R = 0.073 \cdot 72 = 9.25V$
$R_{eq} = 183\Omega$
$I = \frac{V}{R}$
$V = I \cdot R$
$13.3V = 0.073 \cdot 183$
A
B
15V
$0.06A = \frac{1.64}{27.5}$
13Ω
V = 1.64V
27.5Ω
144Ω
$0.011A = \frac{1.64}{144}$
17Ω
$\Delta V = IR = 0.011 \cdot 17 = 0.19V$
0.86V
1.45V
$\frac{1}{R_{eq}} = \frac{1}{21} + \frac{1}{47}$
$= 14.5\Omega$
21Ω
47Ω
127Ω
$\Delta V = IR = 0.011 \cdot 127 = 1.4V$
0V
$23.1\Omega = \frac{1}{\frac{1}{27.5} + \frac{1}{144}} = \frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2}$
$R_{tot} = 183\Omega + 23.1\Omega = 206.1\Omega$
$I_{tot} = \frac{15V}{206.1\Omega} = 0.073A \ (73\ mA)$
$\Delta V = IR = 0.06 \cdot 13 = 0.78V$
$I = \frac{V}{R} = \frac{0.86}{21} = 0.04A$
$I = \frac{V}{R} = \frac{0.86}{47}$
$I = 0.018\ A$

INDIVIDUALLY:

① Design & draw the circuit you proposed for the 1st part of the preliminary lab (5 V, 15 mA, 1 LED ≅ 200 Ω)

② Build & test (with LED) & measure

- total current
- Voltage @ power supply (while on)
- calculate actual resistance of LED

draw → if you want