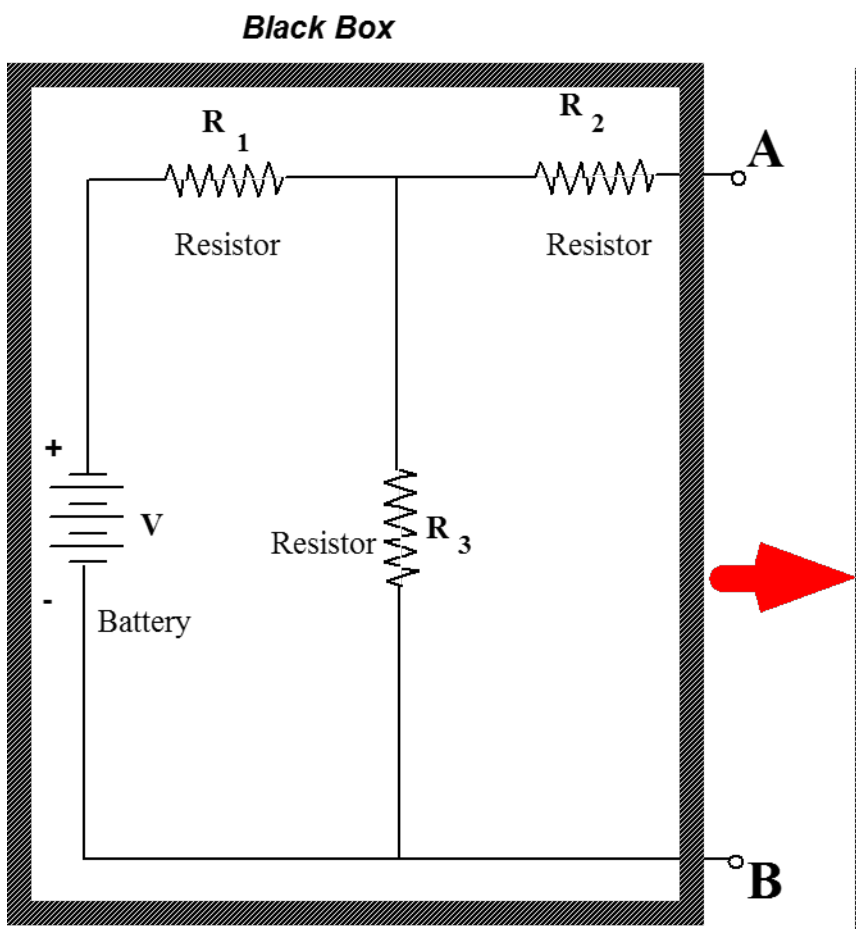
Homework 2: Due in Lab Week of Jan. 19-22.



For:

$V = 12\ Vdc$
$R_1 = 120\ \Omega$
$R_2 = 200\ \Omega$

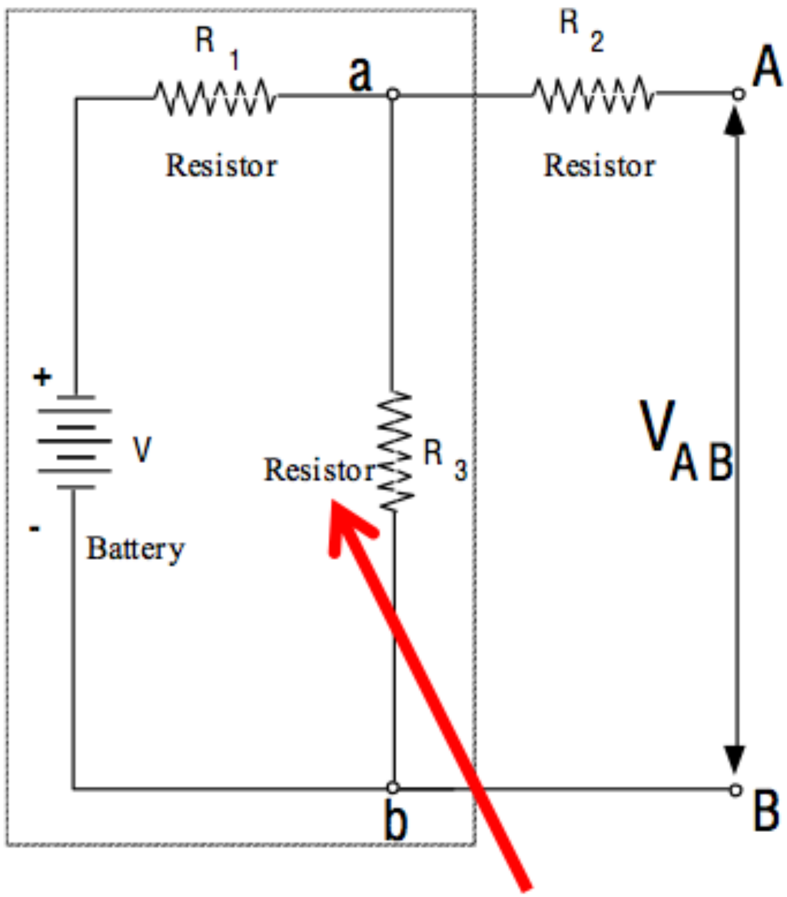
Calculate R_3 so that

$V_{AB} = 4\ Vdc$

How Much Current will be Drawn Through *AB* (R_2) when circuit is closed across *AB* *with no load* *(Short circuit)*

A More Complex Example

Thevenin's Equivalent Circuit (2)



$$V_{ab} = I \cdot R_3$$

↓

$$I = \frac{V}{(R_1 + R_3)}$$

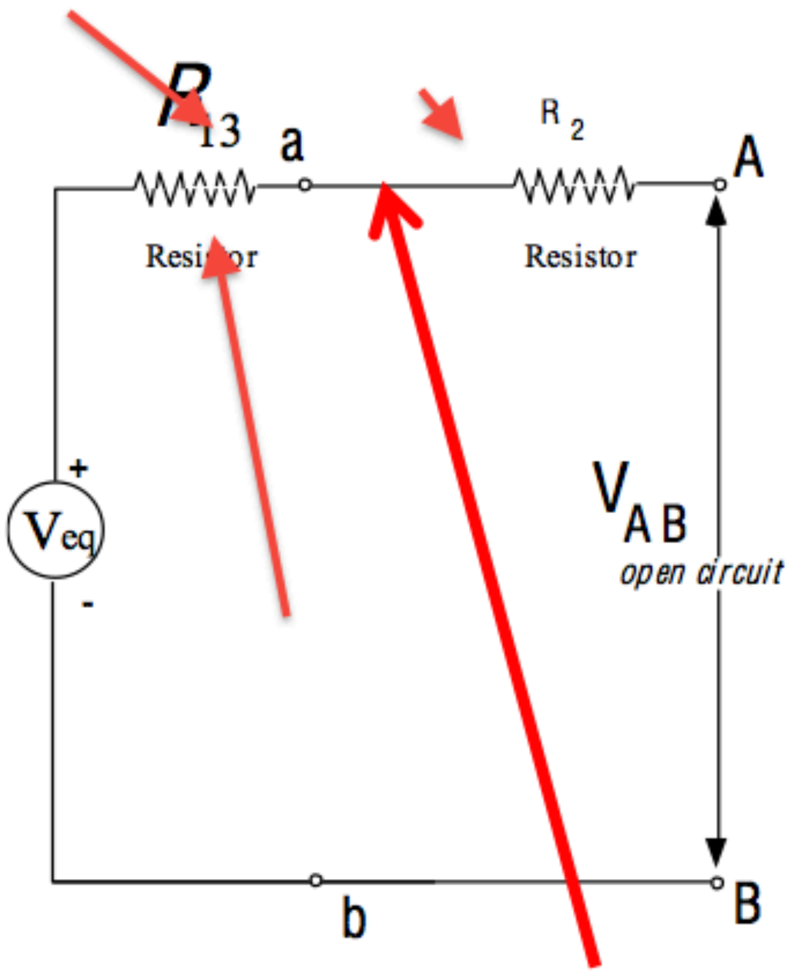
↓

$$V_{eq} = V_{ab} = V \cdot \frac{R_3}{(R_1 + R_3)}$$

- ***Replace with Thevenin Equivalent Circuit***

Parallel resistances

Thevenin's Equivalent Circuit (3)



Serial resistances

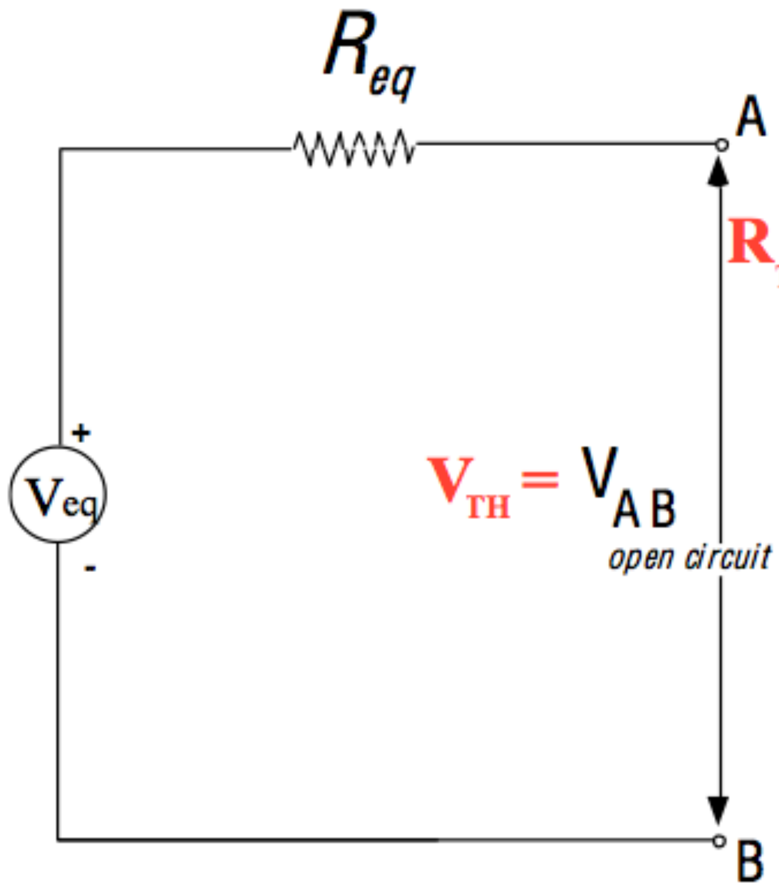
$$V_{eq} = V \cdot \frac{R_3}{(R_1 + R_3)}$$

$$R_{13} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_3}} = \frac{R_1 R_3}{(R_1 + R_3)}$$

- ***Replace again with Thevenin Equivalent Circuit***

Thevenin's Equivalent Circuit (4)

$$V_{eq} = V \cdot \frac{R_3}{(R_1 + R_3)}$$

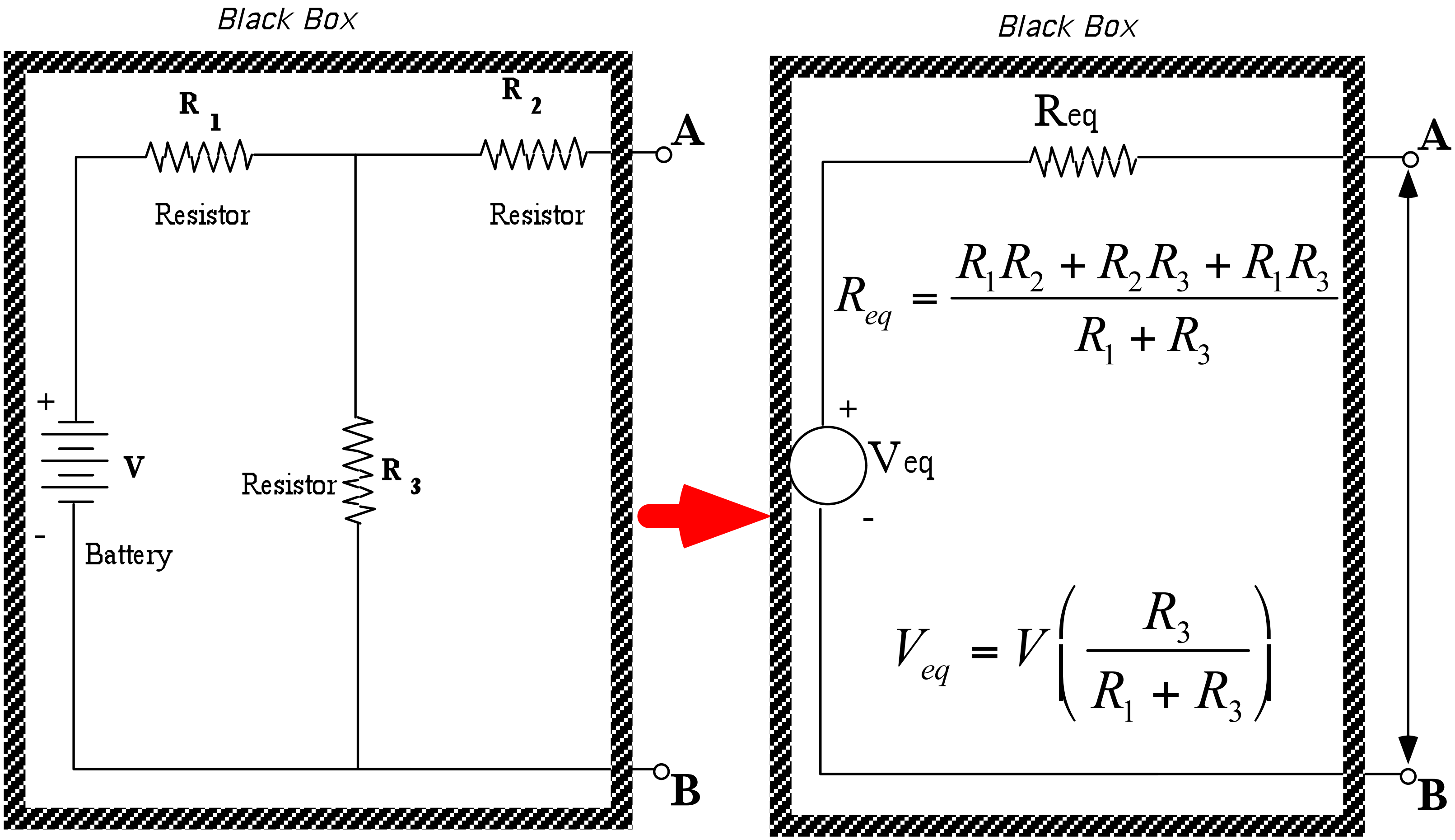


$$R_{TH} = R_{eq} = R_2 + \frac{1}{\frac{1}{R_1} + \frac{1}{R_3}} = R_2 + \frac{R_1 R_3}{(R_1 + R_3)}$$

$$= \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_1 + R_3}$$

- ***Final Thevenin Equivalent Circuit***

Thevenin's Equivalent Circuit



• Allows Circuits of Components to be Simplified for Modeling and analysis

Second Circuit far More simple … "but equivalent"

Thevenin's Equivalent Circuit …

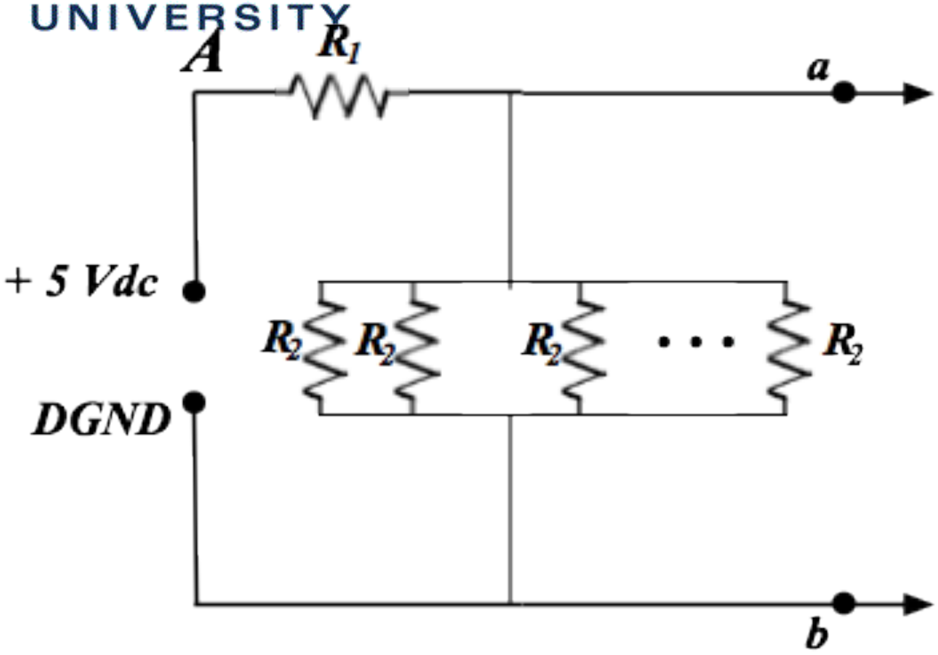
$$V_{eq} = V \cdot \left(\frac{R_3}{R_1 + R_3} \right) \rightarrow R_3 = R_1 \cdot \left(\frac{V_{eq}/V}{1 - V_{eq}/V} \right)$$

$$R_3 = 120\Omega \cdot \left(\frac{4/12}{1 - 4/12} \right) = 60\Omega$$

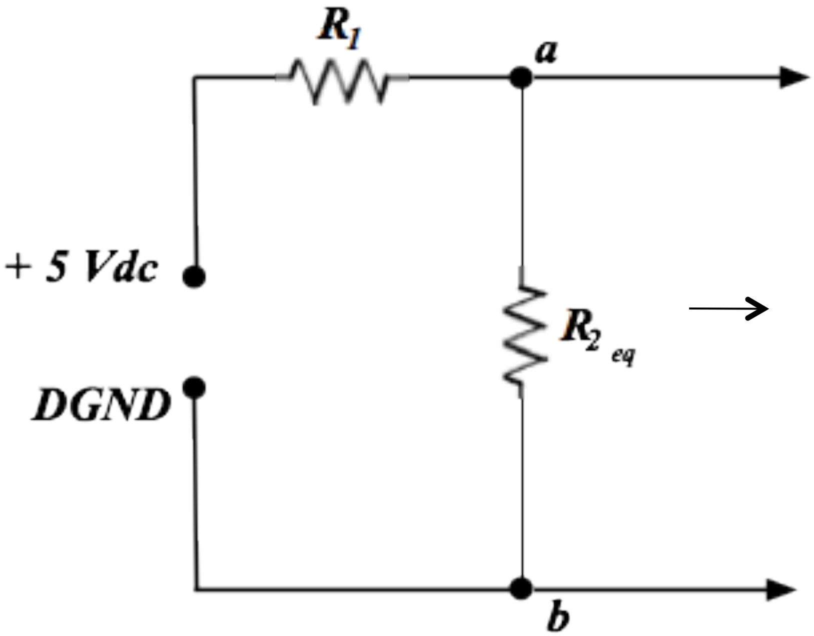
$$I_2 = I_{AB} = \frac{V_{eq}}{R_{eq}} = \frac{V_{eq}}{\frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_1 + R_3}} = \frac{V \cdot \frac{R_3}{R_1 + R_3}}{\frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_1 + R_3}} =$$

$$\frac{R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3} \cdot V = \left(\frac{60}{120 \cdot 200 + 200 \cdot 60 + 120 \cdot 60} \right)_{1/\Omega} \cdot 12_V = 0.01667\ V$$

Lab 3 Circuit Solution



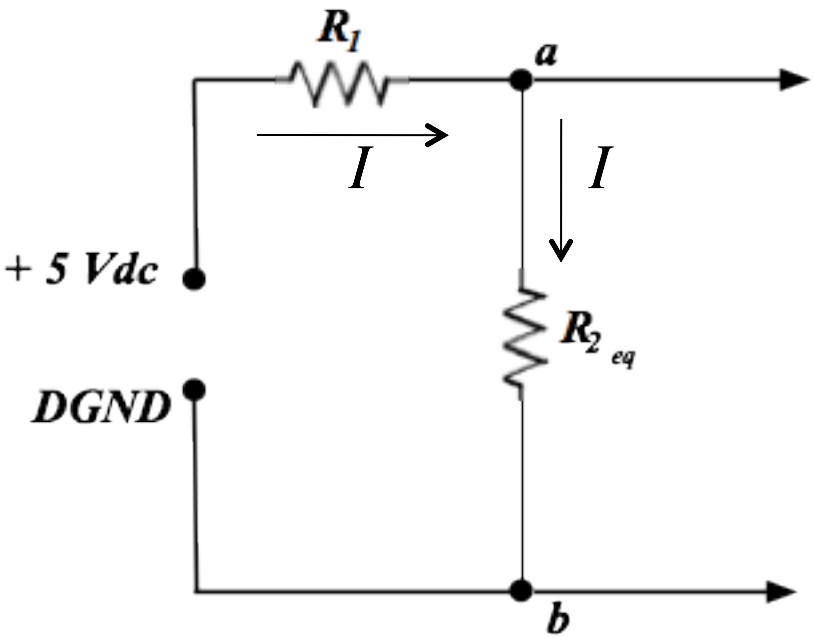
Equivalent Circuit (1)



$$R_{2_{eq}} = \frac{1}{\frac{1}{R_2}+\frac{1}{R_2}+\frac{1}{R_2}+\ldots\frac{1}{R_2}} = \frac{1}{n}\cdot R_2$$

'EMS

Lab 3 Circuit Solution (2)



$$R_{2_{eq}} = \frac{1}{\frac{1}{R_2}+\frac{1}{R_2}+\frac{1}{R_2}+\ldots\frac{1}{R_2}} = \frac{1}{n}\cdot R_2$$

$$V_{ab} = \frac{R_{2_{eq}}}{R_1 + R_{2_{eq}}} = \frac{\frac{1}{n}\cdot R_2}{R_1 + \frac{1}{n}\cdot R_2} = \frac{R_2}{n\cdot R_1 + R_2}$$

$$I = \frac{V}{R_1 + R_{2_{eq}}} = \frac{V}{R_1 + \frac{1}{n}\cdot R_2} = \frac{n\cdot V}{n\cdot R_1 + R_2}$$

As n grows … R_{2eq}
Approaches a short circuit