Linear Circuits

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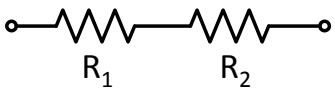
Module 2
Lesson 3: Series and Parallel Resistance

Series and Parallel Resistors

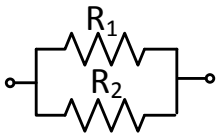
Objective:

- Simplify combinations

Series

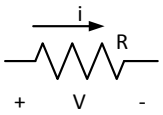


Parallel



Builds Upon:

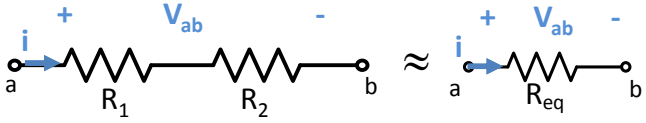
- Ohm's Law: V=iR



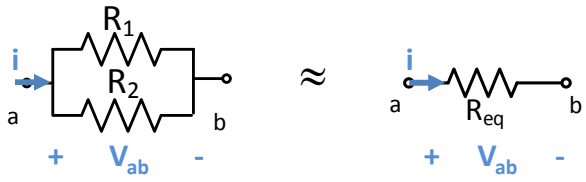
- KCL: $\sum i_{leaving} = 0$
- KVL: $\sum v_{loop} = 0$

Equivalent Resistance

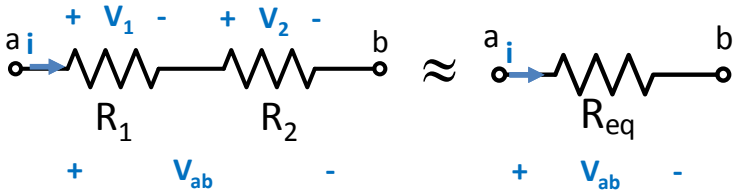
Series



Parallel



Resistors in Series



$$R_{eq} = R_1 + R_2$$

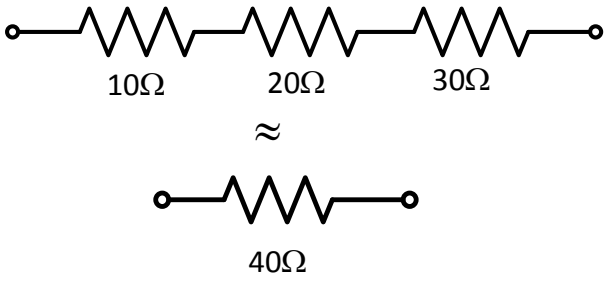
$V_{ab} = V_1 + V_2$

$V_{ab} = R_1 i + R_2 i$

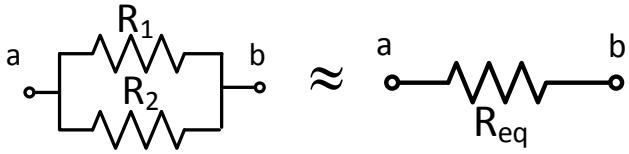
$V_{ab} = (R_1 + R_2) i$

Resistors in Series

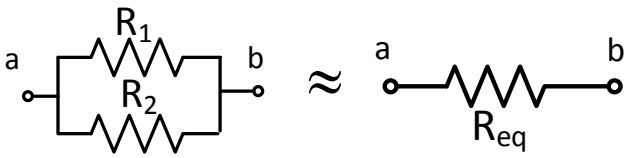
- K resistors in series: $R_{eq} = \sum R_k$
- Example:



Resistors in Parallel

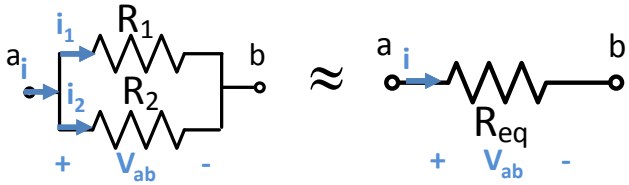


$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{R_1 R_2}{R_1 + R_2}$$



$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{R_1 R_2}{R_1 + R_2}$$

Resistors in Parallel



$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{R_1 R_2}{R_1 + R_2}$$

KCL: $i = i_1 + i_2 \Rightarrow i_1 = i - i_2$

KVL: $V_{ab} = R_1 i_1 = R_2 i_2$

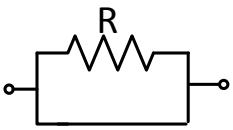
$$R_1(i - i_2) = R_2 i_2 \Rightarrow i_2 = \frac{R_1}{R_1 + R_2} i$$

KVL: $V_{ab} = R_2 i_2$

$$V_{ab} = R_2 \frac{R_1}{R_1 + R_2} i$$

Resistors in Parallel

- Shorted resistors:

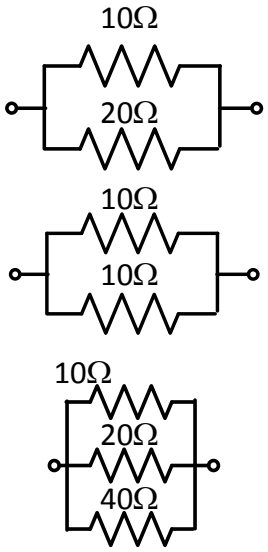


$$R_{eq} = 0$$

- K resistors in parallel:

$$R_{eq} = \frac{1}{\sum \frac{1}{R_k}}$$

Examples



Key Concepts

- Resistors in Series: $R_{eq} = \sum R_k$
- Resistors in Parallel: $R_{eq} = \dfrac{1}{\sum \dfrac{1}{R_k}}$

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

- R_{eq} = 0 for a short circuit in parallel with a resistor