Voltage Division

Spring 2022

$V = V_1 + V_2$

$i = \frac{V}{R_1 + R_2}$

$V_1 = iR_1 = V \cdot \frac{R_1}{R_1 + R_2}$

$V_2 = iR_2 = V \cdot \frac{R_2}{R_1 + R_2}$

now expand this case to n resistors.

$V_k = \frac{R_k}{R_1 + R_2 + \dots + R_N} V$

Current Division

Exercises 03
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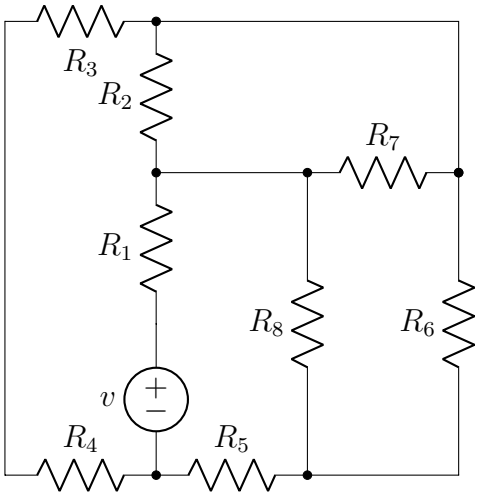
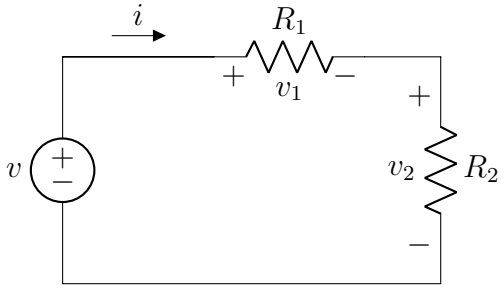
Series and parallel equivalences
Voltage and current division

Exercise 1 - Series and parallel connections



- Which elements are connected in series? R_3, R_4
- Which elements are connected in parallel? R_2 R_7

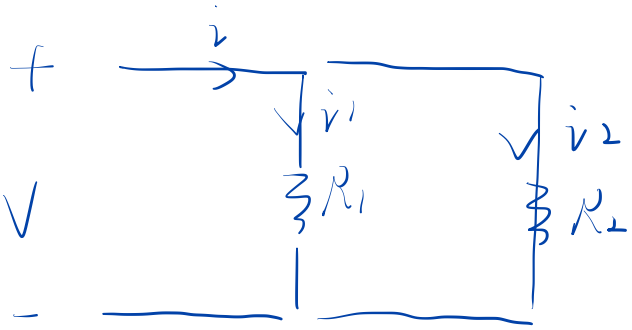
Exercise 2 - Voltage division



- Determine v_1 and v_2 as a function of v and the resistances.
- The voltage divided over the resistors. Which resistor exhibits the highest voltage knowing that $R_1 > R_2$?

Current Division

$i_1 + i_2 = \frac{V}{R_1} + \frac{V}{R_2} = i$



unknown i_1 i_2

known i R_1 R_2

$$i_1 = \frac{V}{R_1} = \frac{i(R_1 \| R_2)}{R_1}$$

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

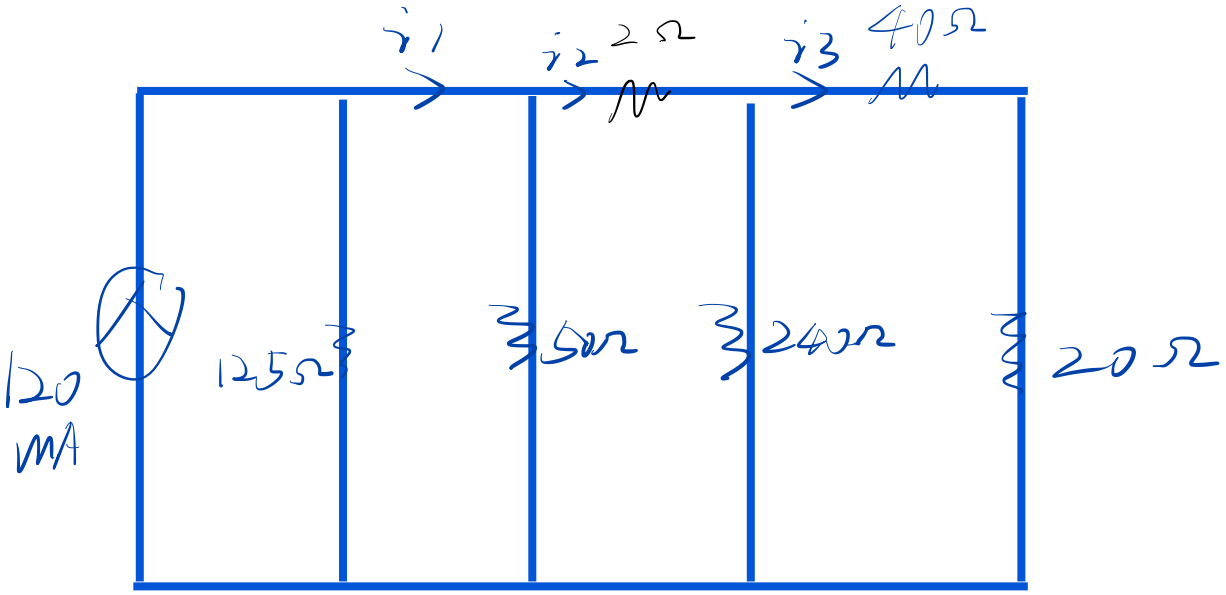
$$\boxed{R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}}}$$

$$i_2 = i \frac{R_1}{R_1 + R_2}$$ (when there's only two parallel resistors).

n-Parallel Resistors

$$i_k = \frac{V}{R_k} = \frac{i \cdot \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}}}{R_k}$$

$$= i \frac{\frac{1}{R_k}}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}}$$



Sometime Current Division simplify the analysis.

240Ω 60Ω

$i_2 \cdot \frac{240}{300} = i_3 = 40\ mA$

$i_3 = i_2 \times \frac{240}{300}$

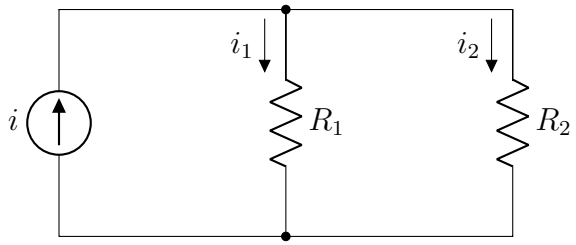
$i_2 = i_1 \cdot \frac{50}{50+50} = \frac{i_1}{2} = 50\ mA$

$i_1 = 120\ mA \cdot \frac{125\Omega}{150\Omega} = 100\ mA$

not $\frac{25\Omega}{150\Omega}$ but $\frac{125\Omega}{150\Omega}$

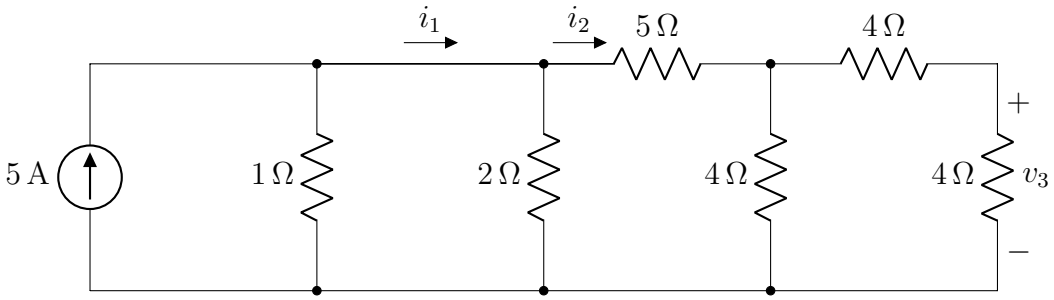
it's current Division.

Exercise 3 - Current division



- Determine i_1 and i_2 as a function of i and the resistances.
- The current divided over the resistors. Which resistor exhibits the highest current knowing that $R_1 > R_2$?

Exercise 4 - Current and voltage division - Resistor equivalence



- Determine values for i_1, i_2 and v_3. Give the equivalent circuit for each case.