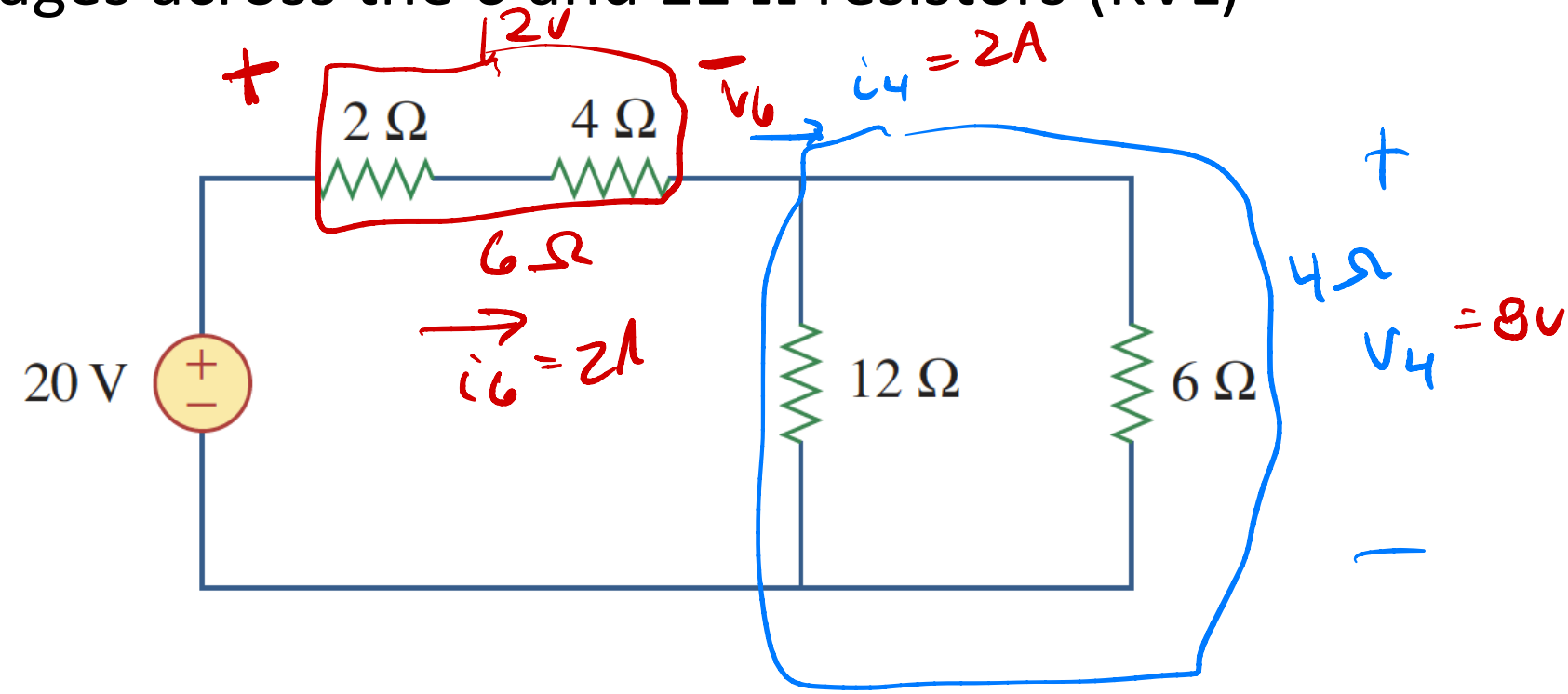
Lecture 4
Basics – 4 of 7

series/parallel resistance;
voltage/current division

Applying KCL and KVL

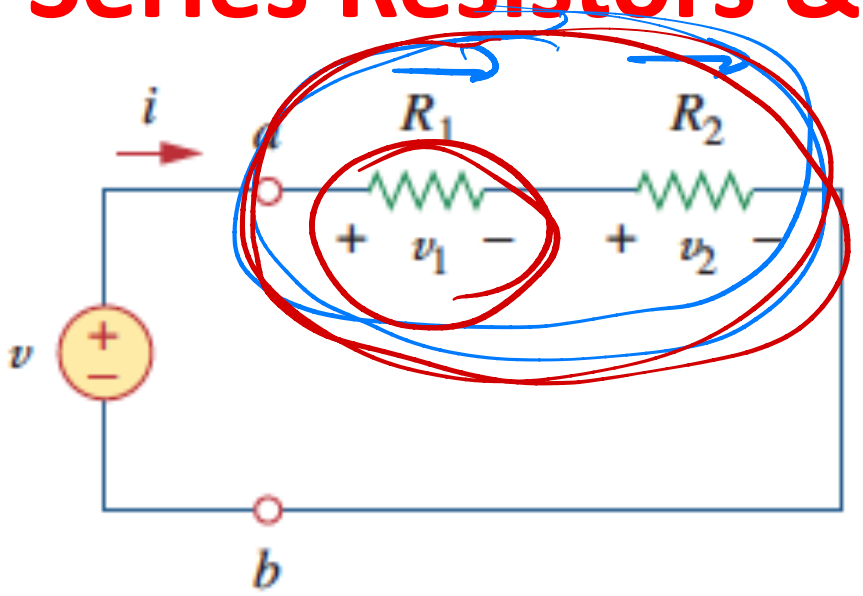
Consider:

- Currents in the 2 and 4 Ω resistors (KCL)
- Voltages across the 6 and 12 Ω resistors (KVL)



+ 10V -

Series Resistors & Voltage Division



$R_1 + R_2$

$$V_1 = \frac{R_1}{R_1+R_2} \cdot 10$$

$$V_2 = \frac{R_2}{R_1+R_2} \cdot 10$$

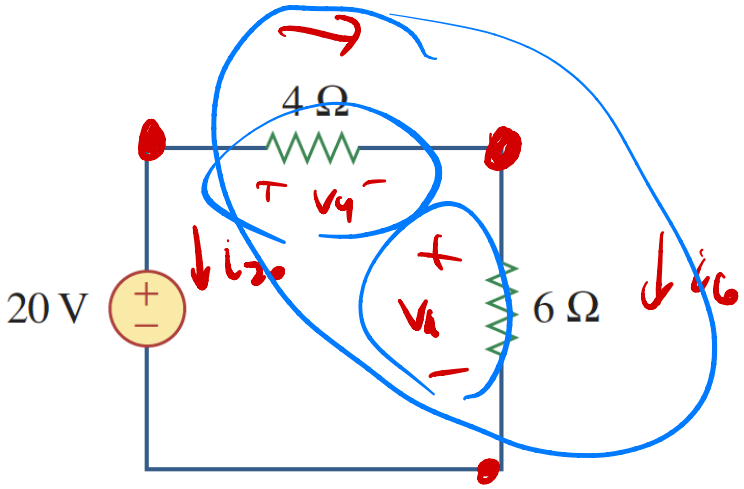
$$V_1 = R_1 \cdot I$$

$$V_2 = R_2 \cdot I$$

$$V_1 + V_2 = R_1 I + R_2 I$$

$$\boxed{V_{12} = (R_1 + R_2) I}$$

Examples



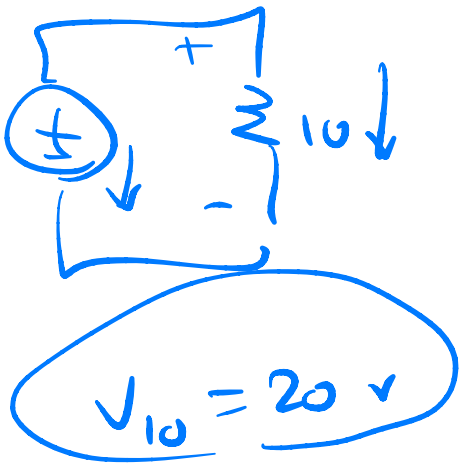
$v_4 = 4 i_4$ $\quad 20 = v_4 + v_6$

$v_6 = 6 i_6$

$i_4 = i_6$

$i_4 + i_{20} = 0$

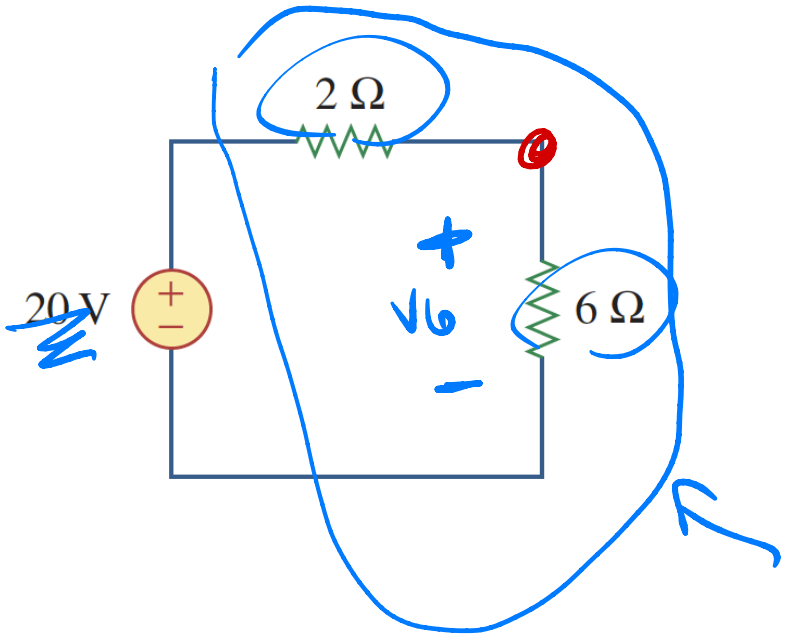
$i_6 + i_{20} = 0$



$V_{10} = 20\ V$

$i_{10} = 2A$

$i_{20} = -2A$

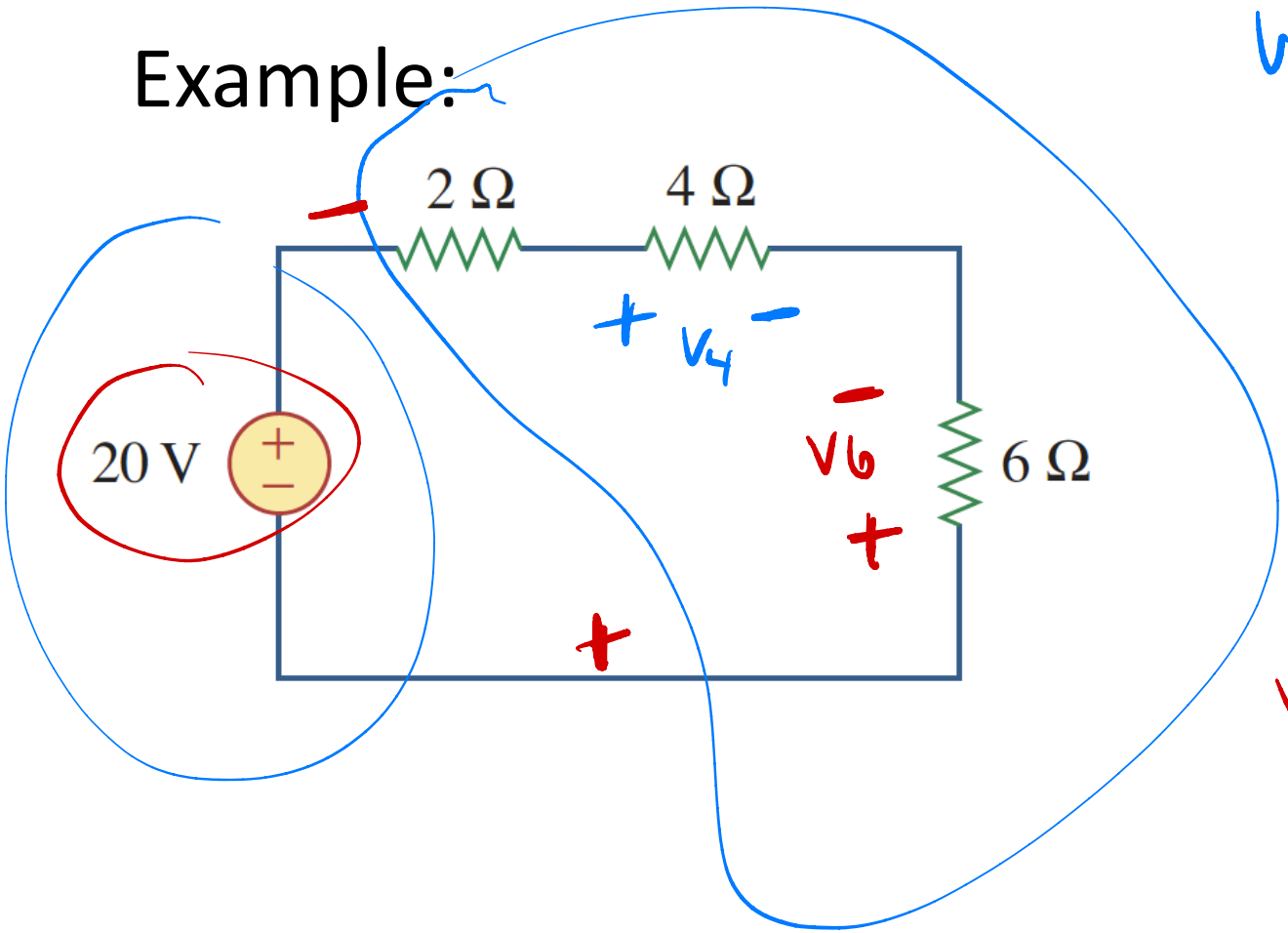


$v_4 = \frac{4}{10} \cdot 20 = 8V$

$v_6 = \frac{6}{10} \cdot 20 = 12V$

$v_6 = 20 \cdot \frac{6}{6+2} = 15V$

Example:

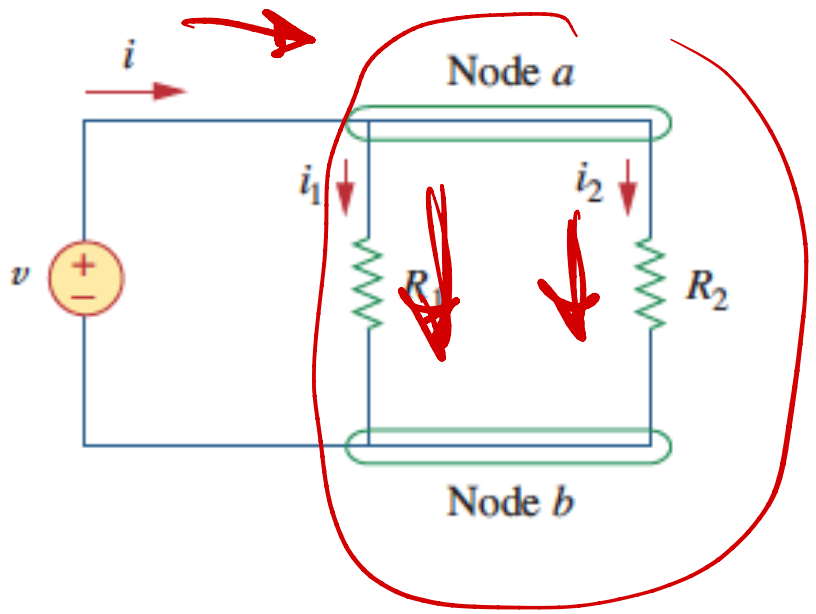


$$v_4 = \frac{4}{12} \cdot 20 = \frac{20}{3} V$$

$$v_6 = \frac{6}{12}(-20)$$

$$= -10 \text{ V}$$

Parallel Resistors & Current Division



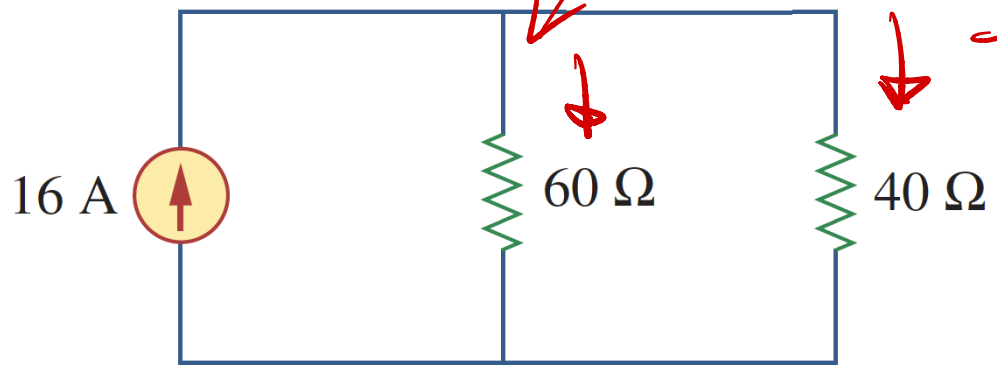
$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

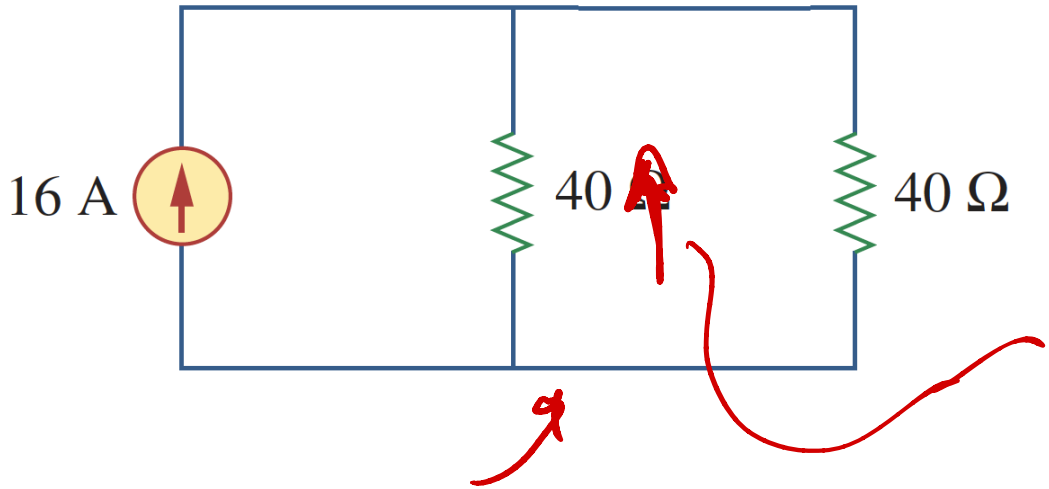
$$= \frac{R_1 \cdot R_2}{R_1 + R_2}$$

$$i_1 = \frac{R_2}{R_1 + R_2} \cdot I$$

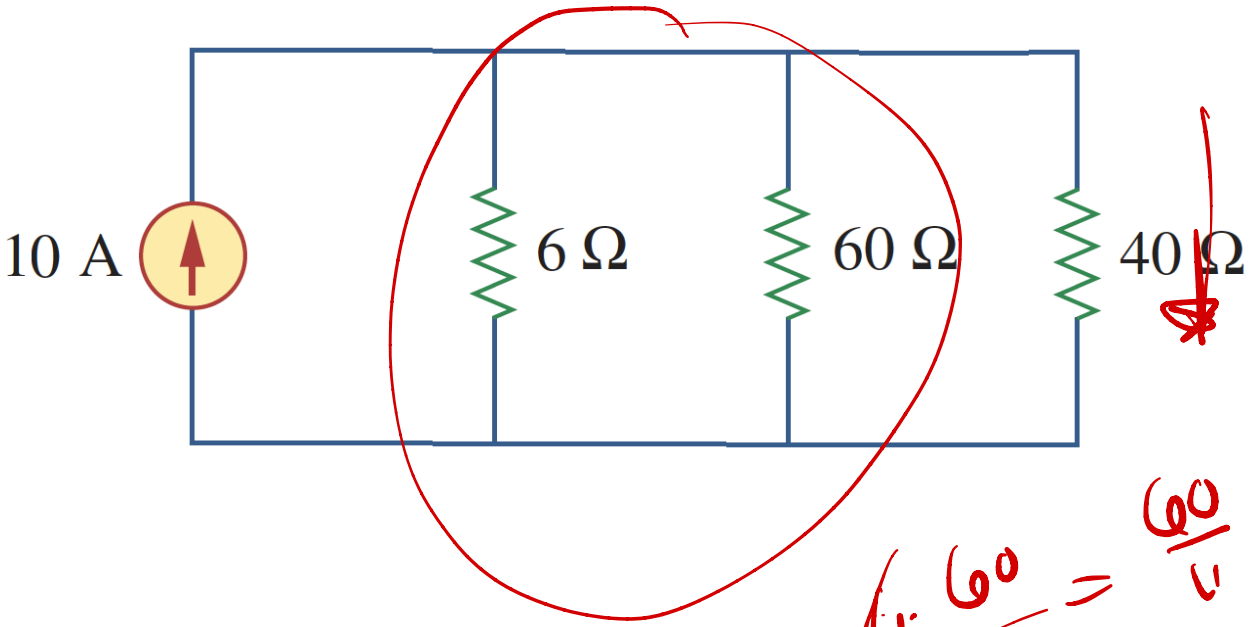
$$i_2 = \frac{R_1}{R_1 + R_2} \cdot I$$

Examples:





Example:



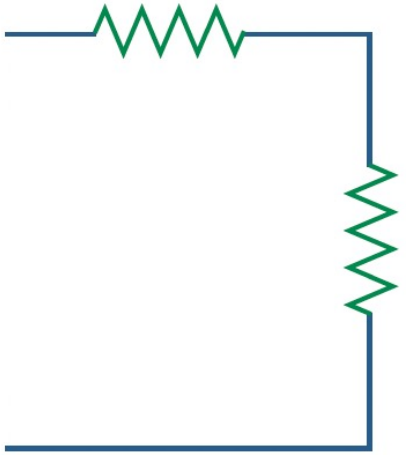
$= ?$

$\frac{\frac{60}{11}}{40 + \frac{60}{11}} \cdot 10A$

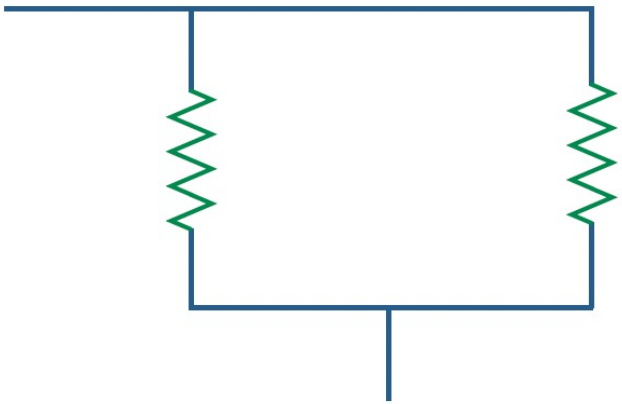
$\frac{6 \cdot 60}{6 + 60} = \frac{6 \cdot 60}{66} = \frac{60}{11}\ \Omega$

Series/Parallel Summary

- Series: resistances add
  - Nothing connected in the middle
  - **Same current (KCL)**
  - Voltage divides proportionally

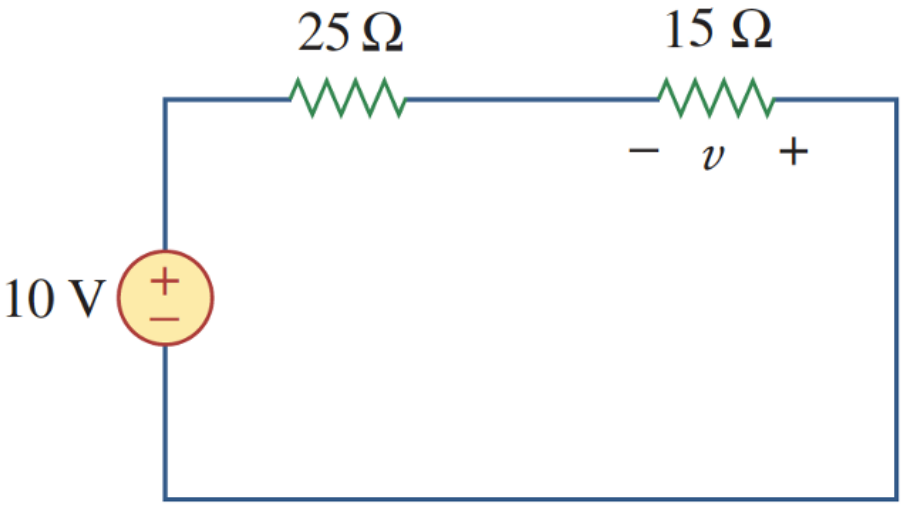


- Parallel: resistances add inversely
  - Connected at both ends
  - **Same voltage (KVL)**
  - Current divides proportionally



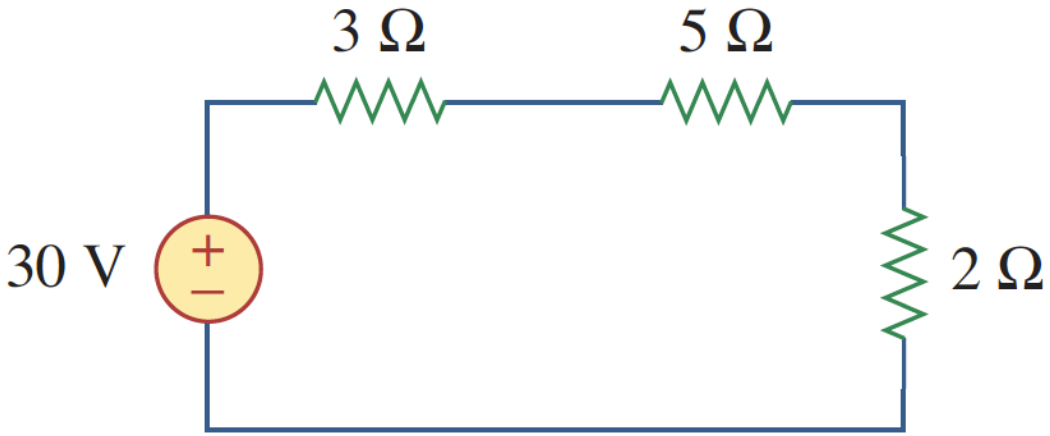
$-3.75\ V$

Example: find v



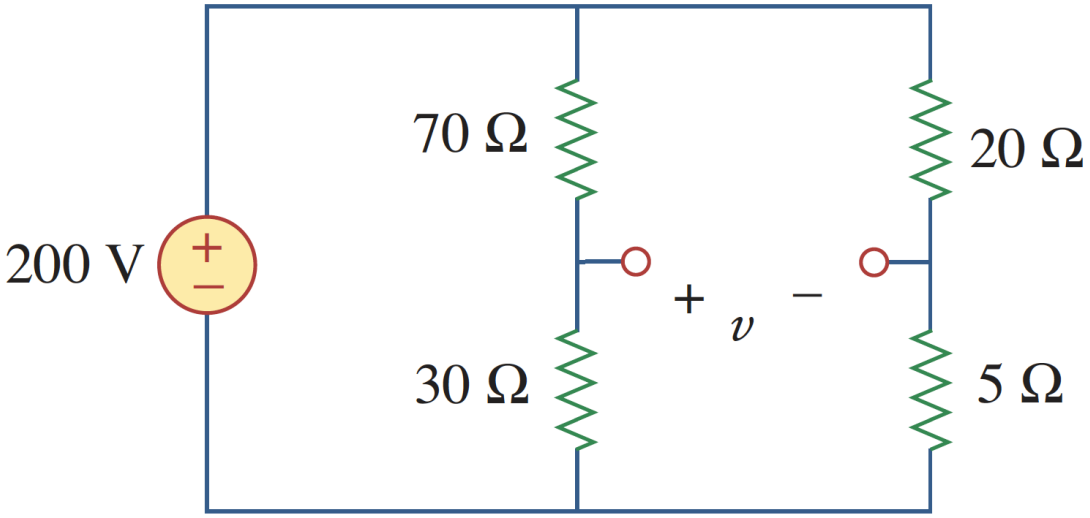
$27\ W$

Practice problem: find the power in the 3 Ω resistor



$20\ V$

Practice problem: find v



$1152\ W$

Practice problem: find the power in the 50 Ω resistor