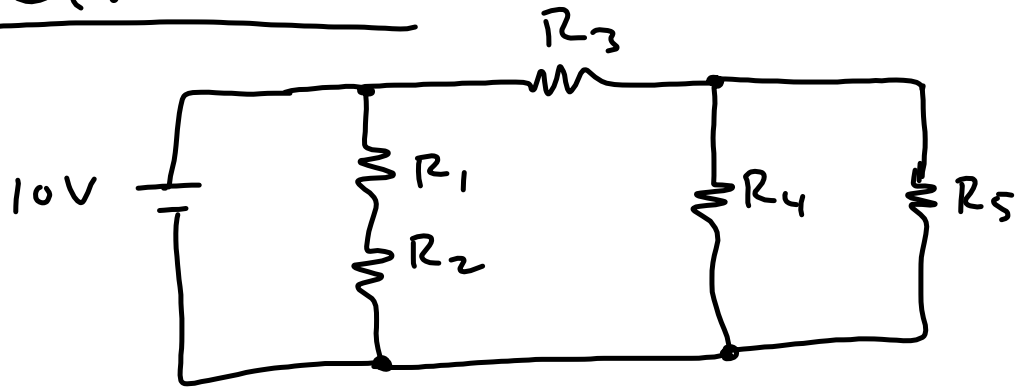
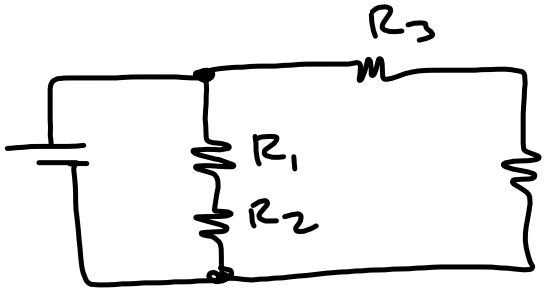
CIRCUITS

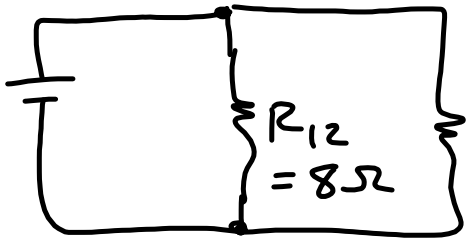


$R_1 = 5\Omega$ $R_3 = 3\Omega$ $R_5 = 6\Omega$

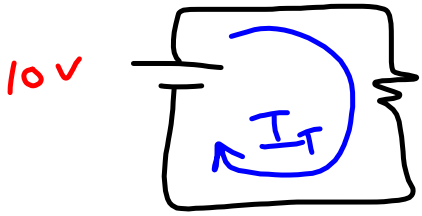
$R_2 = 3\Omega$ $R_4 = 7\Omega$



$R_{45} = 3.23\Omega$

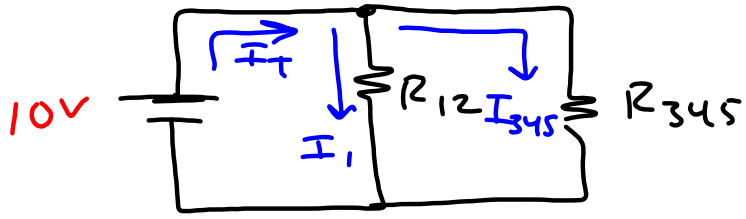


$R_{345} = 6.23\Omega$



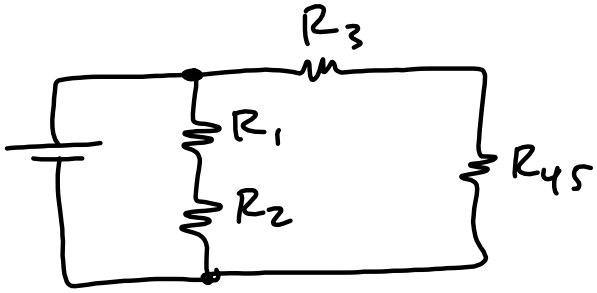
$R_{eq} = 3.50\Omega$

$$I_T = \frac{V_T}{R_{eq}} = 2.85A$$



$$I_1 = \frac{V_T}{R_{12}} = 1.25\,A$$

$$I_{345} = 1.6\,A$$

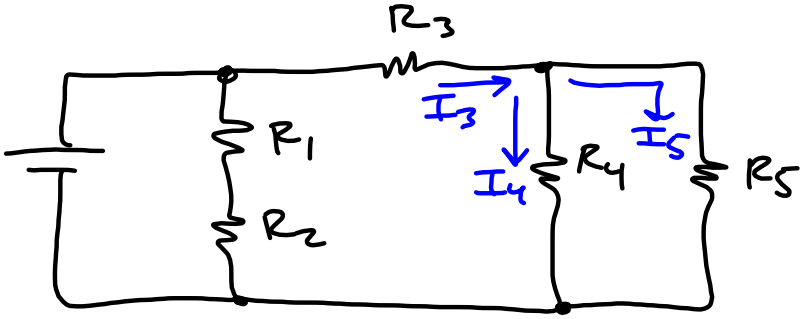


$$V_1 = I_1 R_1 = 6.25\,V$$

$$V_2 = 3.75\,V$$

$$V_3 = I_2 R_3 = 4.8\,V$$

$$V_{45} = I_2 R_{45} = 5.2\,V$$



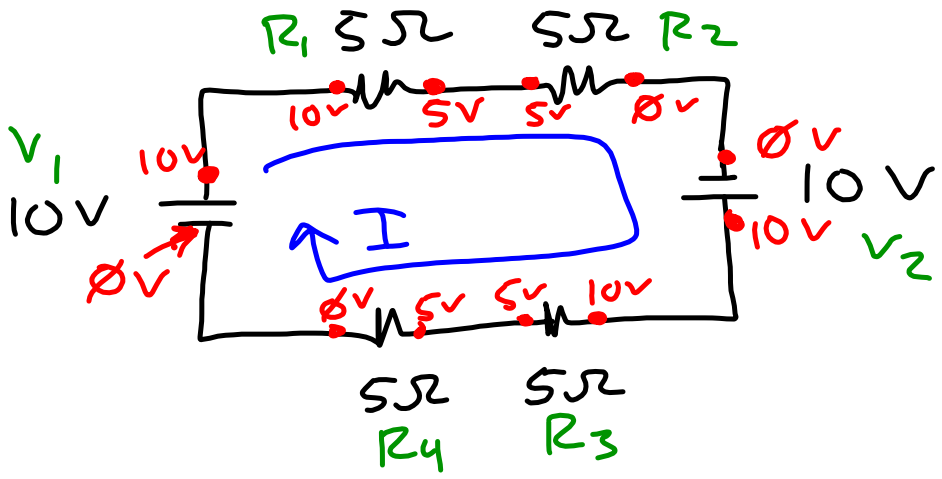
$$I_4 = \frac{V_{45}}{R_4} = 0.74\,A$$

$$I_5 = 0.86\,A$$

$$P_3 = I_3 V_3 = (1.6\,A)(4.8\,V) = 7.68\,W$$

Energy Conservation:
(Loop Rule) [Kirchhoff's Loop Rule]

$$\Delta V_1 + \Delta V_2 + \ldots = \emptyset$$



$$V_1 - IR_1 - IR_2 + V_2 - IR_3 - IR_4 = \emptyset$$

$$I = \frac{V_1 + V_2}{R_1 + R_2 + R_3 + R_4}$$

- $\mathcal{E}$ = emf = electromotive force

  * this is a bad name.

  emf is actually energy per unit charge.

- There is internal resistance of a battery.

KIRCHHOFF'S RULES:

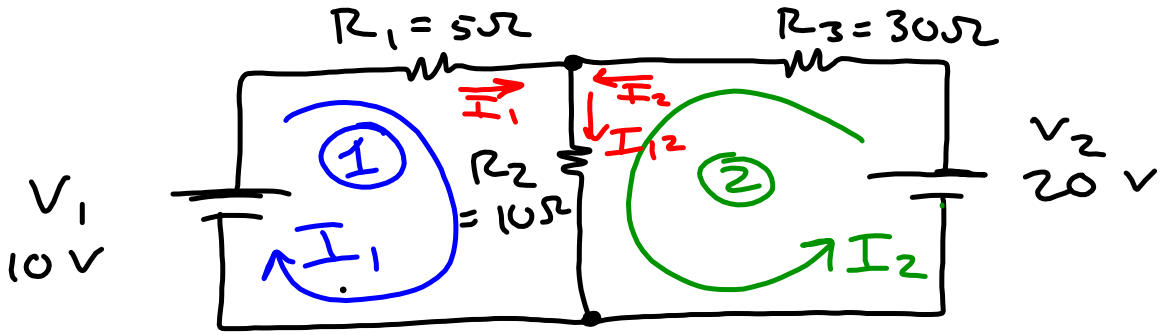
1. Current Node Rule

   Current into node = current out of node

2. Loop Rule

   For a round-trip path,

   $\Delta V_1 + \Delta V_2 + \ldots = \emptyset$



Loop

① $+V_1 - I_1R_1 - I_1R_2 = \emptyset$

② $+V_2 - I_2R_3 - I_2R_2 = \emptyset$

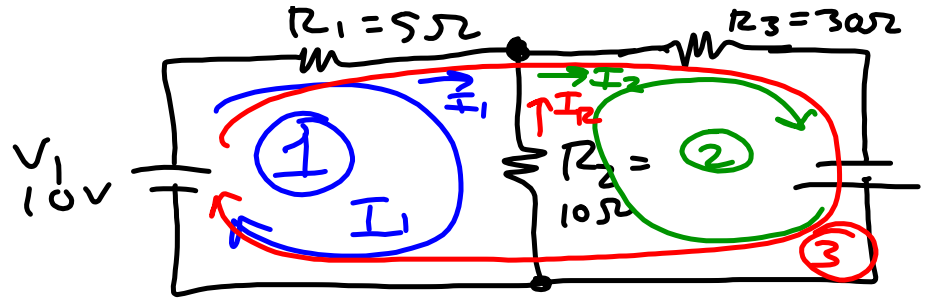
$I_1 + I_2 = I_{12}$

$I_1 = \frac{V_1}{R_1+R_2}$

$I_2 = \frac{V_2}{R_3+R_2}$

$$\frac{V_1}{R_1+R_2} + \frac{V_2}{R_3+R_2} = I_{12}$$

$$I_{12} = 1.167\ A$$



Find the current in R_2.

* I chose direction of I_{12} → if I get a negative answer, I chose wrong.

① $+V_1 - I_1 R_1 - I_1 R_2 = \emptyset$

② $+V_2 - I_2 R_3 - I_2 R_2 = \emptyset$

$$I_1 + I_{12} = I_2$$

$$I_1 = \frac{V_1}{R_1 + R_2} \qquad I_2 = \frac{V_2}{R_3 + R_2}$$

$$I_{12} = I_2 - I_1$$

$$= \frac{V_2}{R_3 + R_2} - \frac{V_1}{R_1 + R_2}$$

$$= -0.17\,A$$ → this is actually in the other direction!