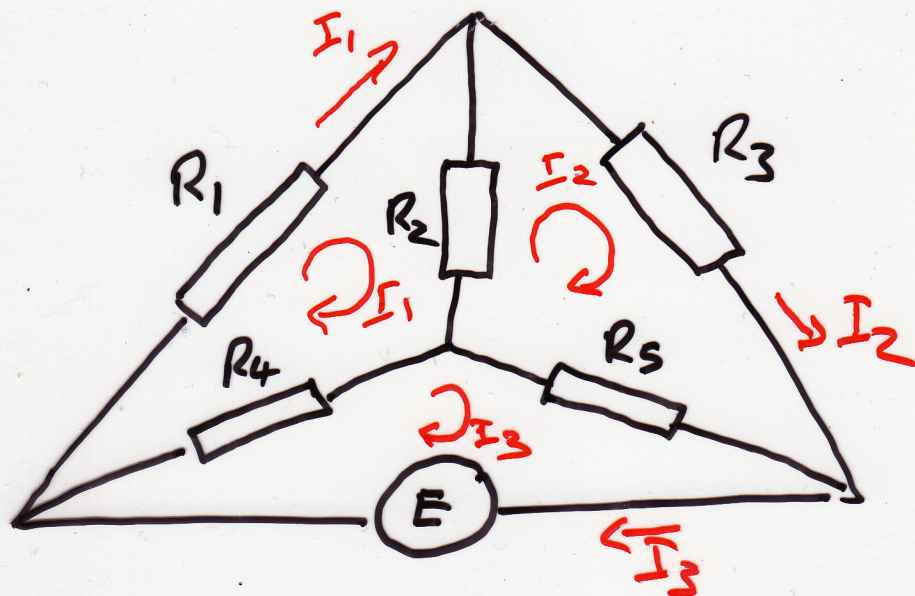


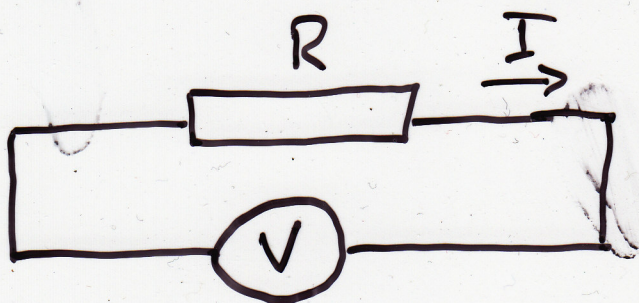
Example



Suppose $R_1=1$, $R_2=2$, $R_3=2$, $R_4=4$, $R_5=8$
(all ohms).

Question: what voltage should E
be if I_3 is to be 5 amps?
for this value of E what
are I_1 and I_2 ?

Solⁿ
Need Ohm's Law:



$$V = IR$$

$$R_1 I_1 + R_2(I_1 - I_2) + R_4(I_1 - I_3) = 0$$

$$R_3 I_2 + R_5(I_2 - I_3) + R_2(I_2 - I_1) = 0$$

$$R_4(I_3 - I_1) + R_5(I_3 - I_2) = E$$

Let's rearrange these equations:

$$(R_1 + R_2 + R_4)I_1 - R_2 I_2 - R_4 I_3 = 0$$

$$-R_2 I_1 + \overset{R_2}{\cancel{R_2}} + (R_3 + R_5)I_2 - R_5 I_3 = 0$$

$$-R_4 I_1 - R_5 I_2 + (R_4 + R_5)I_3 = E$$

thus

$$7I_1 - 2I_2 - 4I_3 = 0$$

$$-2I_1 + \overset{2}{\cancel{10}}I_2 - 8I_3 = 0$$

$$-4I_1 - 8I_2 + 12I_3 = E$$

Equivalently

$$\underbrace{\begin{pmatrix} 7 & -2 & -4 \\ -2 & 12 & -8 \\ -4 & -8 & 12 \end{pmatrix}}_M \begin{pmatrix} I_1 \\ I_2 \\ I_3 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ E \end{pmatrix}$$

or

$$\begin{pmatrix} I_1 \\ I_2 \\ I_3 \end{pmatrix} = M^{-1} \begin{pmatrix} 0 \\ 0 \\ E \end{pmatrix}$$

$$\begin{pmatrix} 4 \\ 32/7 \\ 33/7 \end{pmatrix} = M^{-1} \begin{pmatrix} 0 \\ 0 \\ 4 \end{pmatrix}$$

Slip. $E = 12$

$$= M^{-1} \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$