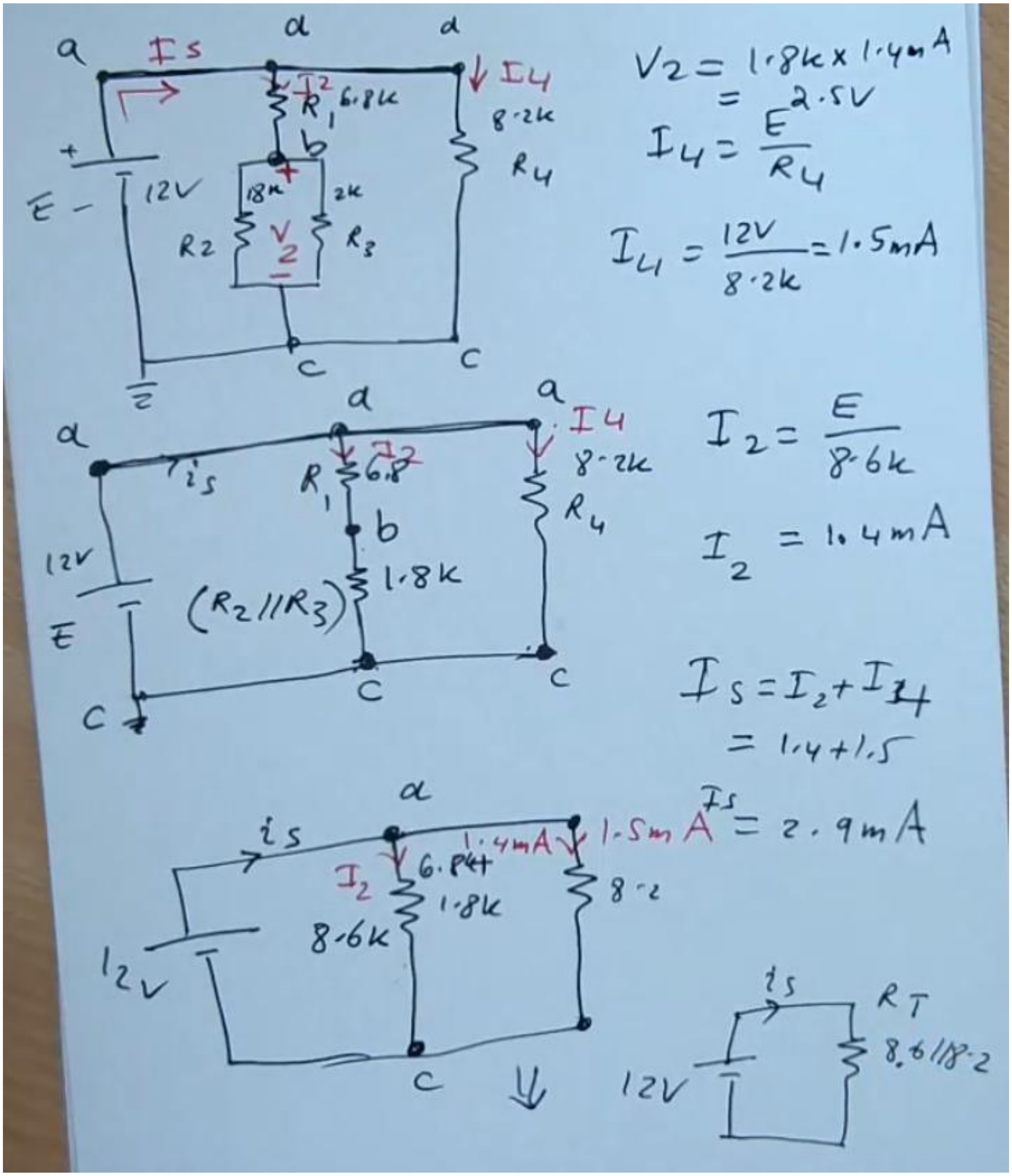
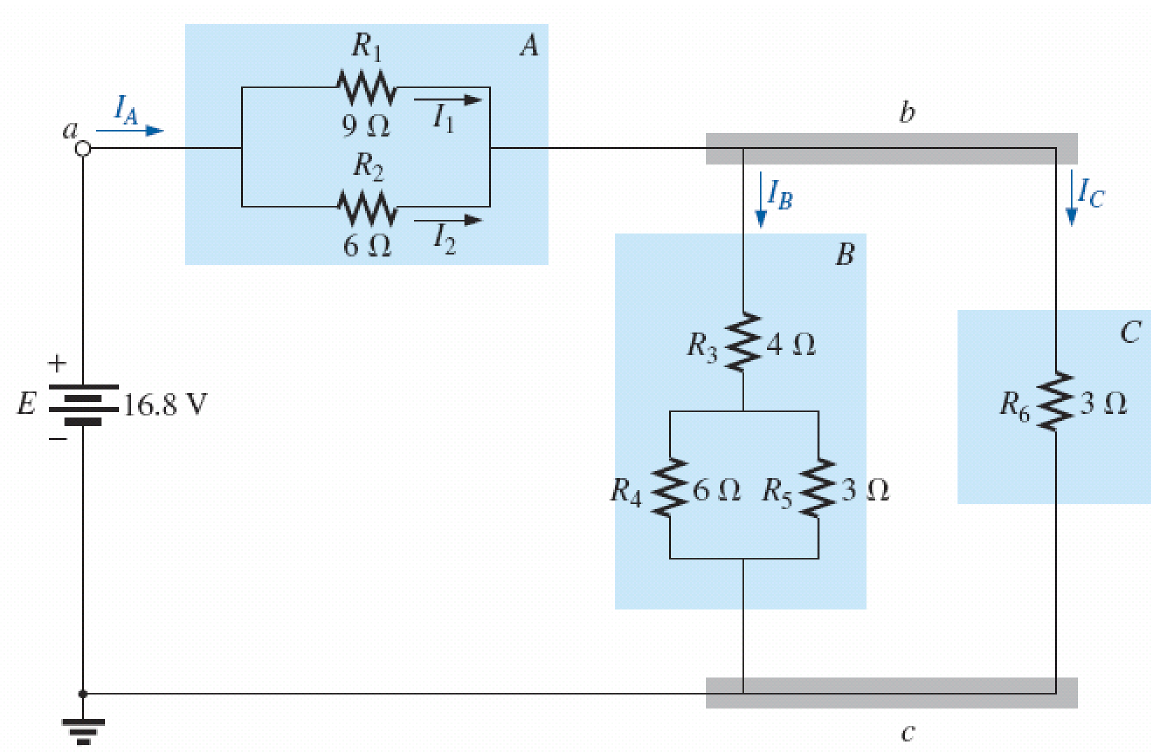
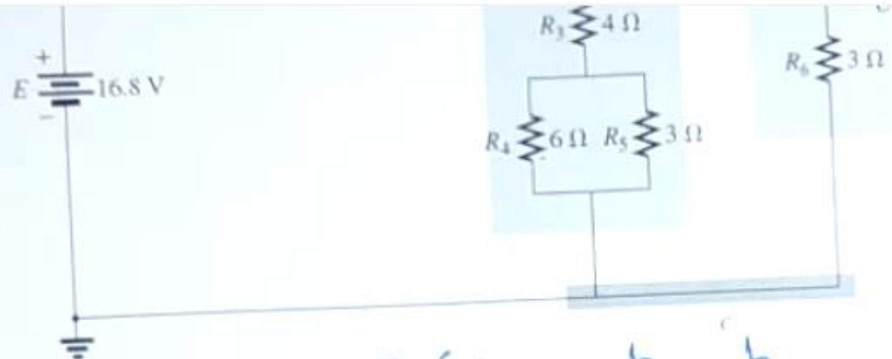
Attribution Nidhal Abdulaziz

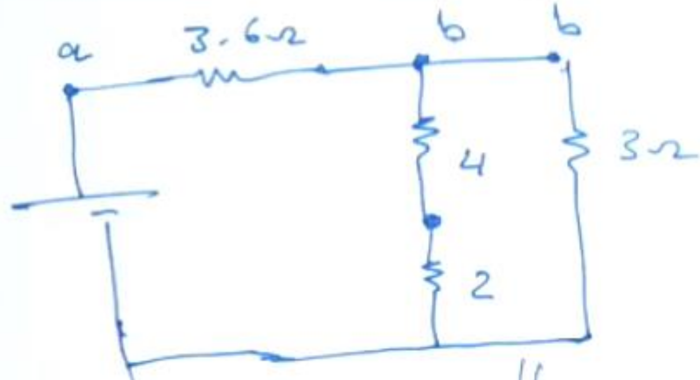
Lecture 4 additional solutions





R1
9 Ω
I1
R2
6 Ω
I2
A
IA
a
b
IB
IC
B
R3
4 Ω
R4
6 Ω
R5
3 Ω
C
R6
3 Ω
E
16.8 V
+
−
c

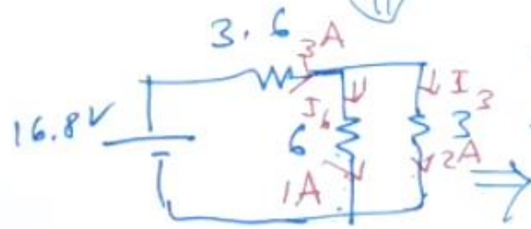


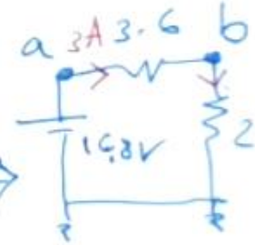


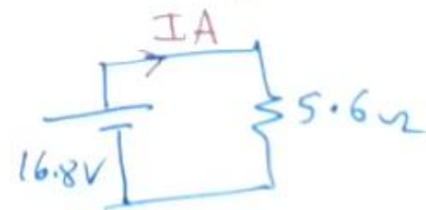
$$I_A = \frac{16.8}{5.6} = 3\,A$$

$$I_6 = 3A \times \frac{3}{6+3}$$

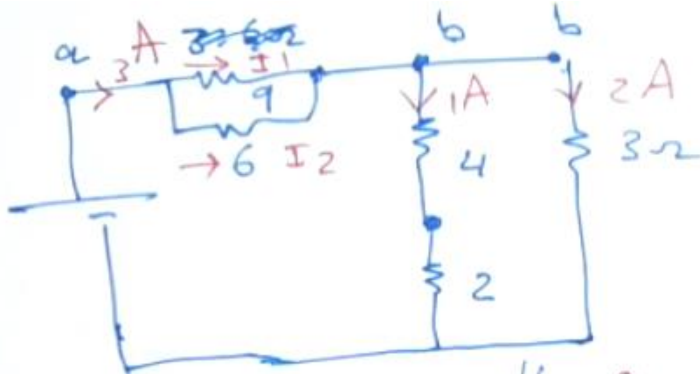
$$I_6 = 1\,A$$







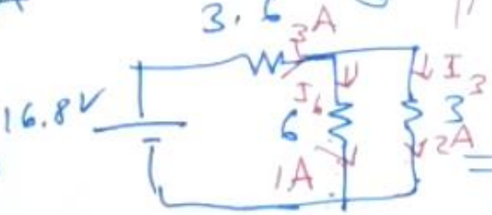
$$I_A = \frac{16.8}{5.6} = 3\,A$$

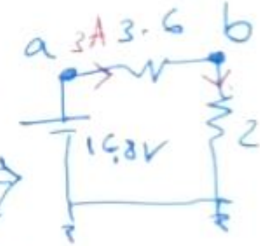


$$I_6 = 3A \times \frac{3}{6+3}$$

$$I_6 = 1\,A$$

$$I_1 = 3 \times \frac{6}{6+9} = 1.2\,A$$

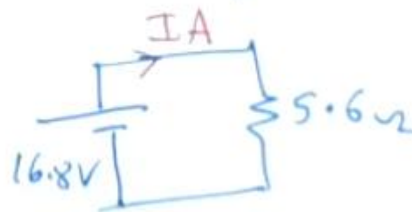




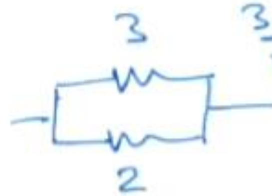
$$I_2 = 3 \times \frac{9}{6+9} = 1.8\,A$$

$$I_B = 1\,A$$

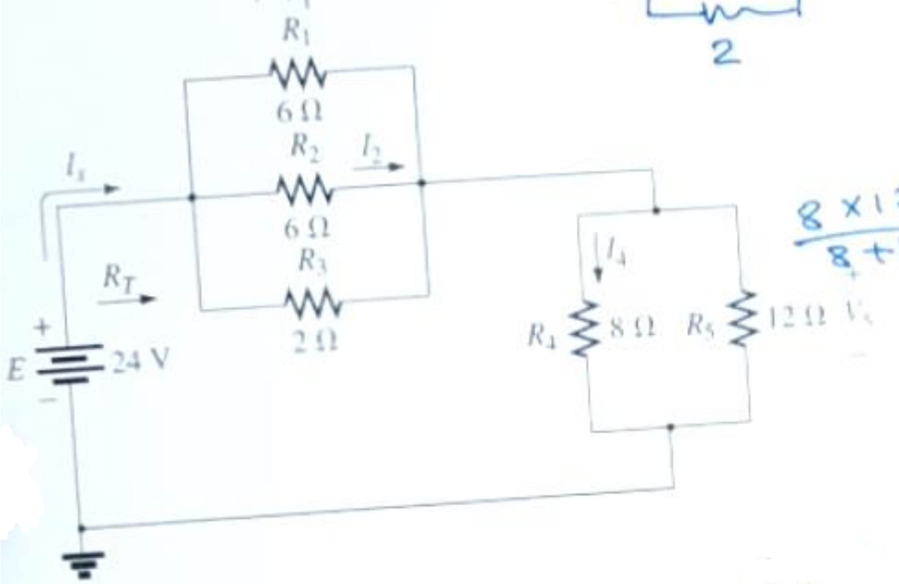
$$I_C = 2\,A$$



Lecture 4 example

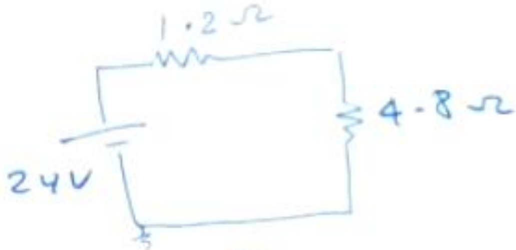


$$\frac{3\times 2}{3+2} = 1.2\,\Omega$$

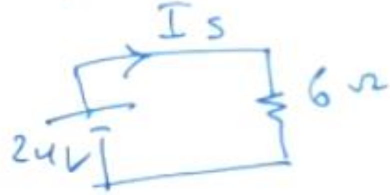


$$\frac{8\times 12}{8+12}$$

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$



$$I_S = \frac{24V}{6\Omega} = \underline{4A}$$



$$I_2 = I_s \times \frac{R_T}{R_2} = 4A \times \frac{1.2}{6}$$

$$I_2 = 0.8\ A$$

$$V_2 = I_2 . R_2 = 0.8\ A \times 6\Omega = 4.8\ V = \underline{\underline{V_1}}$$

$$I_4 = I_s \times \frac{12}{8+12} = 4 \times \frac{12}{8+12} = 2.4\ A$$

$$V_4 = I_4 . R_4 = 2.4A \times 8\Omega = 19.2\ V = \underline{\underline{V_5}}$$

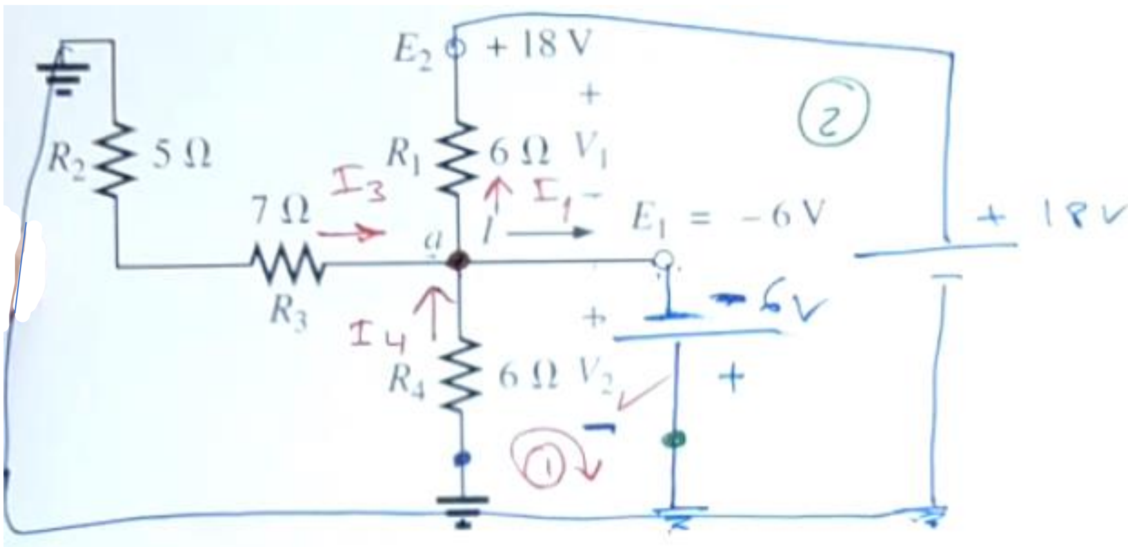


FIG. 7.22 *Example 7.8*

KVL 1

$$-V_2 - 6V = 0 \qquad V_2 = -6V$$

$$+6V - V_1 + 18V = 0 \Rightarrow V_1 = 24V$$

KCL a $\quad I_3 + I_4 = I_1 + I \Rightarrow$

$$I_4 = \frac{V_2}{R_4} = \frac{-6}{6} = +1\,A$$

$$I_3 = \frac{V_a}{12\Omega} = \frac{-6V}{12} = -0.5\,A$$

$$I_1 = \frac{V_1}{R_1} = \frac{-24}{6} = -4\,A$$

OR

For the network in Fig. 7.22, determine the voltages V_1 *and* V_2 and the current I.

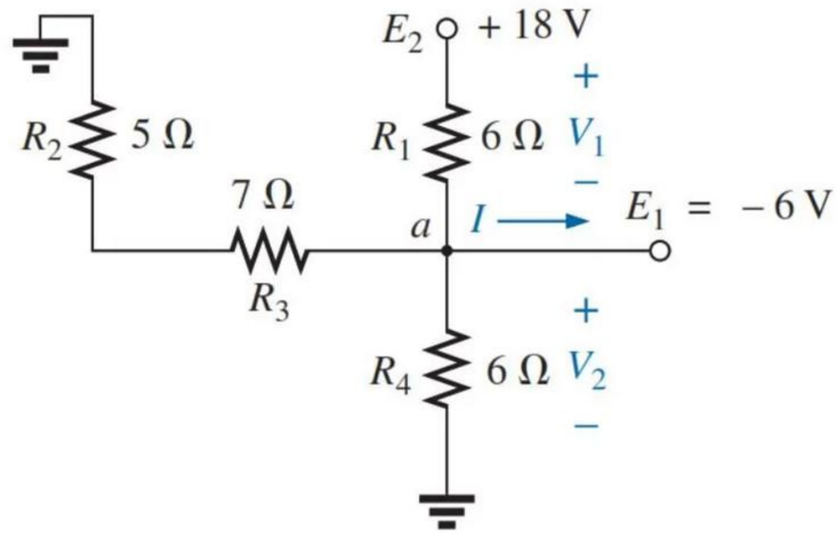


FIG. 7.22
Example 7.8.

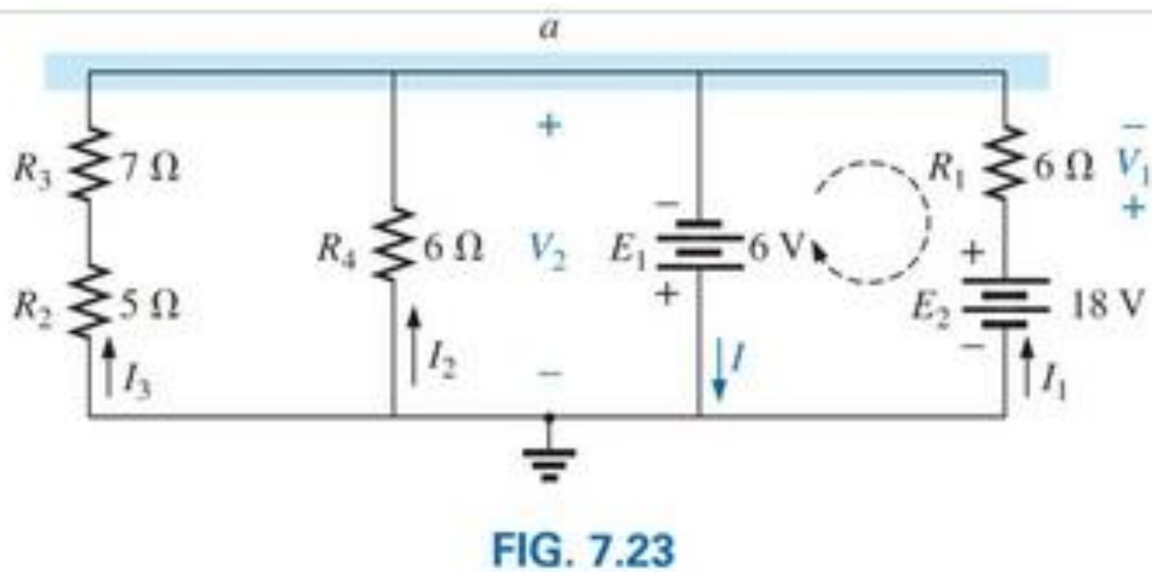


FIG. 7.23
Network in Fig. 7.22 redrawn.

It would indeed be difficult to analyze the network in the form in Fig. 7.22 with the symbolic notation for the sources and the reference or ground connection in the upper left corner of the diagram. However, when the network is redrawn as shown in Fig. 7.23, the unknowns and the relationship between branches become significantly clearer. Note the common connection of the grounds and the replacing of the terminal notation by actual supplies.

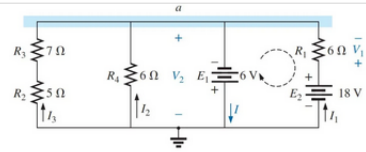


FIG. 7.23
Network in Fig. 7.22 redrawn.

It is now obvious that

$$V_2 = -E_1 = -6V$$

The minus sign simply indicates that the chosen polarity for V_2 in Fig. 7.22 is opposite to that of the actual voltage. Applying Kirchhoff's voltage law to the loop indicated, we obtain

$$-E_1 + V_1 - E_2 = 0$$

and $$V_1 = E_2 + E_1 = 18V + 6V = 24V$$

$$-E_1 + V_1 - E_2 = 0$$

and $$V_1 = E_2 + E_1 = 18V + 6V = 24V$$

Applying Kirchhoff's current law to node a yields

$$I = I_1 + I_2 + I_3$$

$$= \frac{V_1}{R_1} + \frac{E_1}{R_4} + \frac{E_1}{R_2+R_3}$$

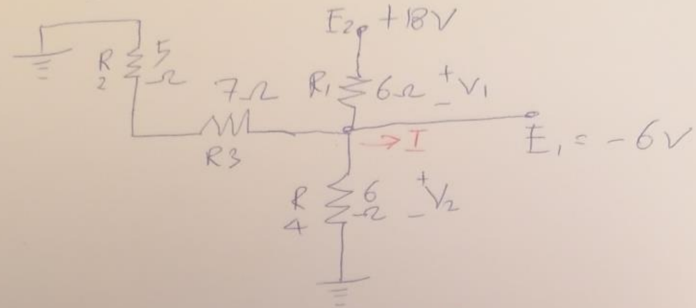
$$= \frac{24V}{6\Omega} + \frac{6V}{6\Omega} + \frac{6V}{12\Omega}$$

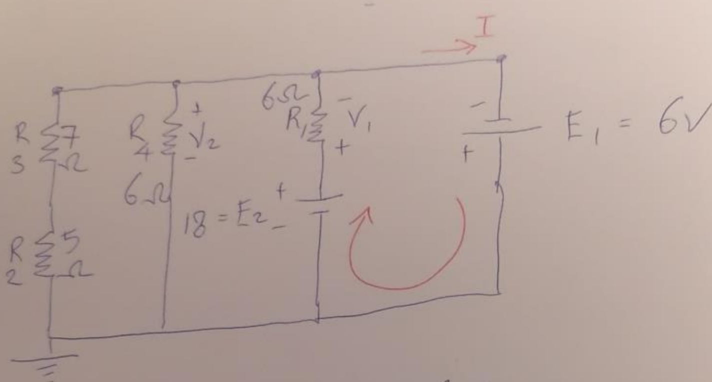
$$= 4A + 1A + 0.5A$$

$$I = 5.5A$$

OR

Lecture 4, Challenge 1, page 10





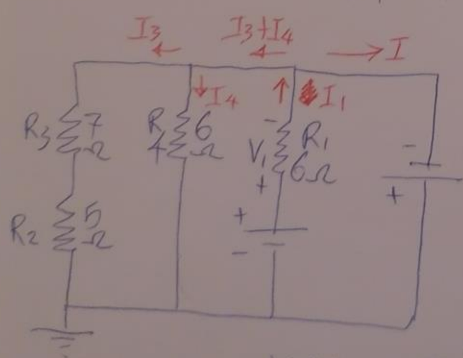
$V_2 = -6V$

KVL

$$E_2 - V_1 + E_1 = 0$$

$$18 - V_1 + 6 = 0$$

$$V_1 = 24V$$



$$I_4 = \frac{-6V}{6\Omega} = -1A$$

$$I_3 = \frac{-6V}{12\Omega} = -0.5A$$

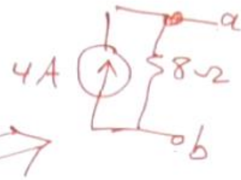
$$I_1 = \frac{V_1}{6} = \frac{24}{6} = 4A$$

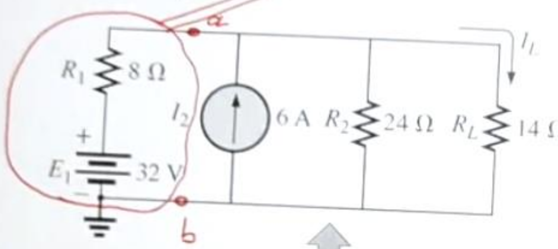
KCL: $I - I_1 + (I_3 + I_4) = 0$

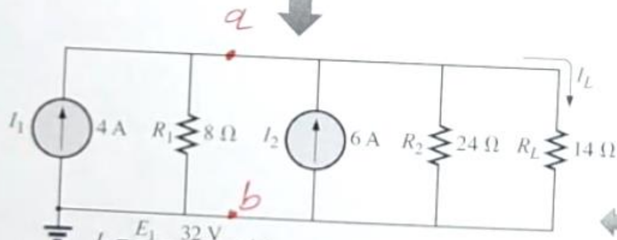
$$I - 4A + (-1.5A) = 0$$

$$I = +5.5A$$

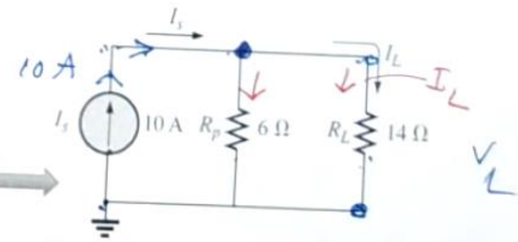
Example 2







$$I_1 = \frac{E_1}{R_1} = \frac{32\text{ V}}{8\ \Omega} = 4\text{ A}$$



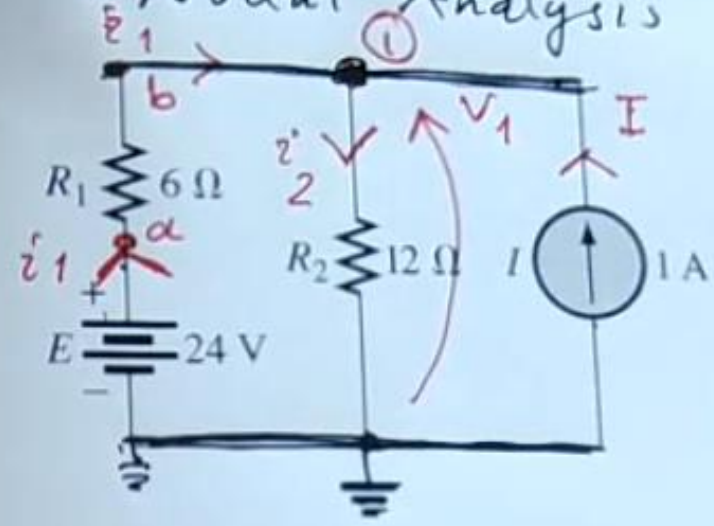
$I_S = 10A$

$$I_L = I_S \times \frac{R_P}{R_P + R_L}$$

$$= 10A \times \frac{6}{6+14}$$

$I_L =$

Nodal Analysis



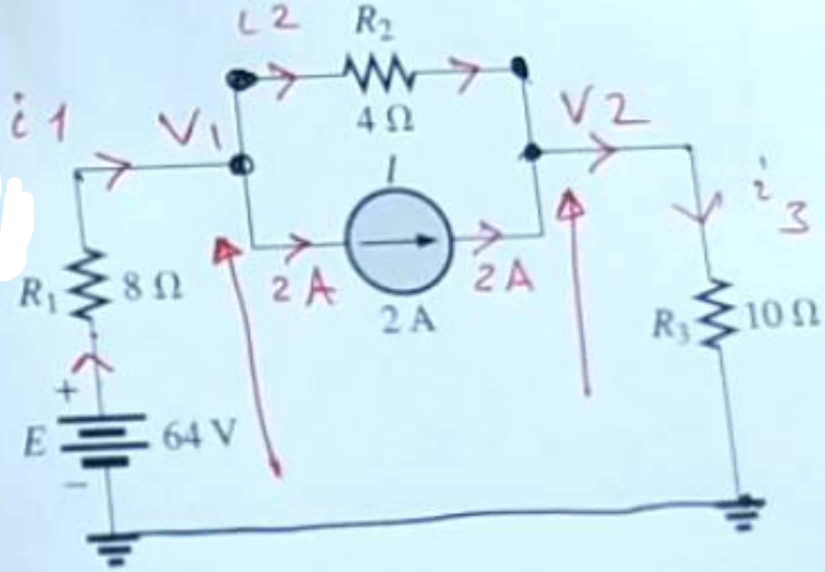
KcL ①

$$i_1 + I = i_2 \quad \text{— ①}$$

$$i_1 = \frac{V_a - V_b}{R_1} = \frac{24V - V_1}{6\,\Omega} \quad \text{— ②}$$

$$i_2 = \frac{V_1 - 0}{12\,\Omega} \quad \text{— ③}$$

$$\frac{24 - V_1}{6} + 1A = \frac{V_1}{12}$$



KCL node ①

$$i_1 = 2A + i_2$$

$$\frac{64 - V_1}{8\Omega} = 2 + \frac{V_1 - V_2}{4} \quad — ②$$

KCL node ②

$$2A + i_2 = i_3$$

$$2 + \frac{V_1 - V_2}{4} = \frac{V_2}{10\Omega} \quad — ③$$