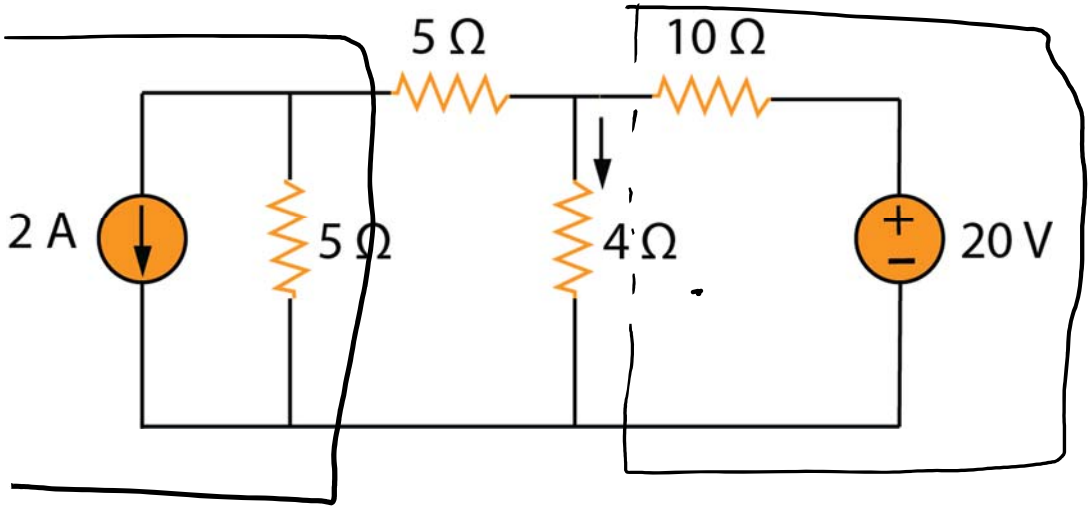
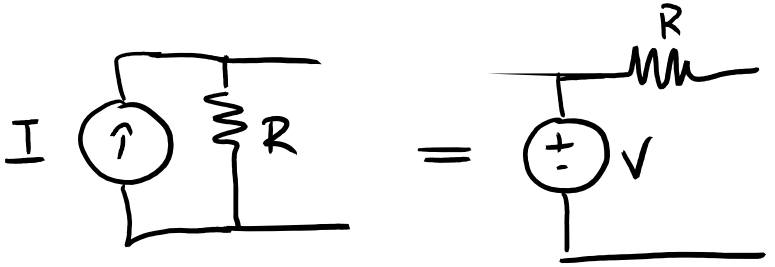
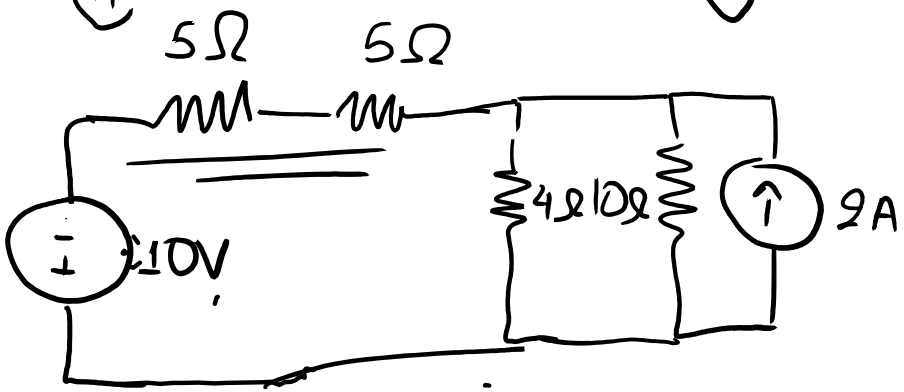
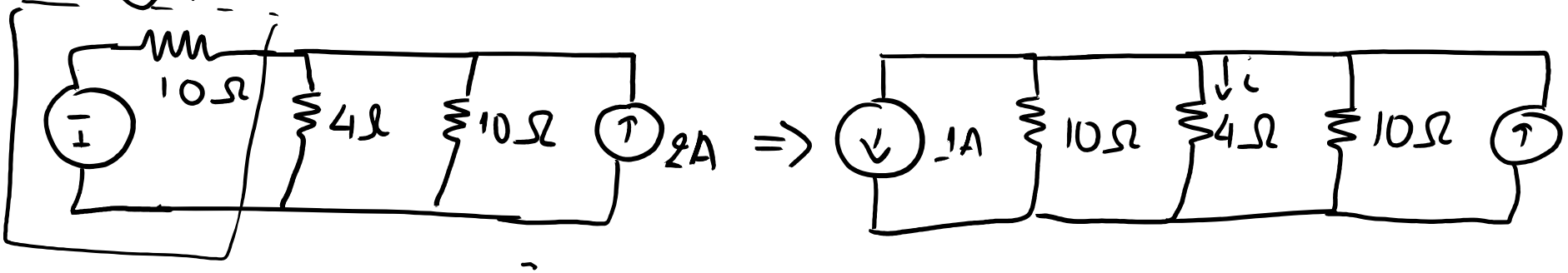


Source tranformation:



$V = IR$ or $I = \frac{V}{R}$





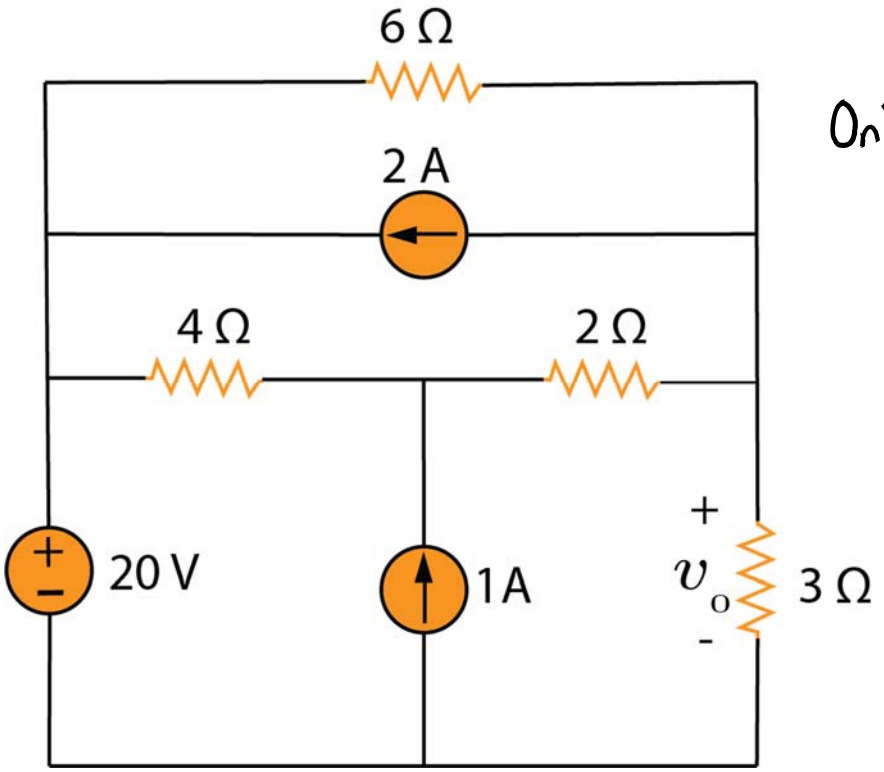
Method 1: $10 \| 10 = 5\,\Omega$

Current divider: $i = \frac{5}{5+4}(2-1) = \frac{5}{9}\,A = 0.555\,A$

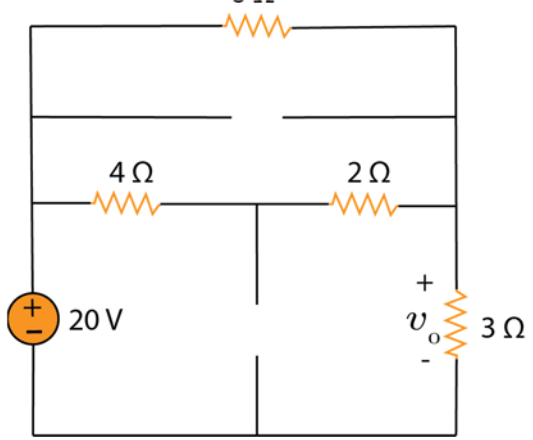
Method 2: Nodal Analysis:

KCL: $\frac{V}{10} + \frac{V}{10} + \frac{V}{4} + 1 = 2 \Rightarrow 4.5V = 10 \Rightarrow V = 2.22V$

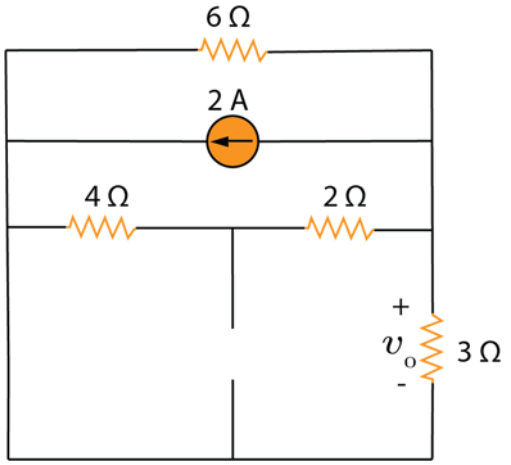
$i = \frac{V}{4} = 0.555\,A$



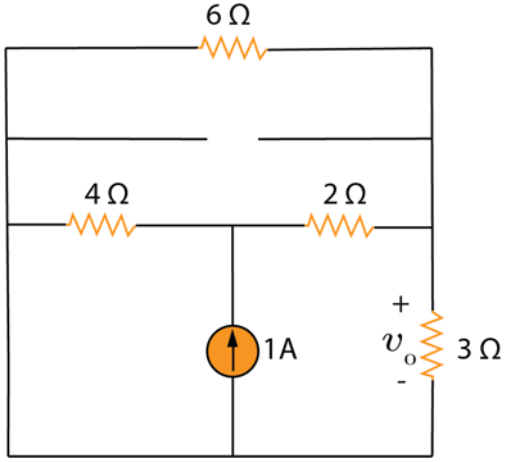
Only 20V source



Only 2A source



Only 1A source



Superposition theorem:

1) Disable voltage source

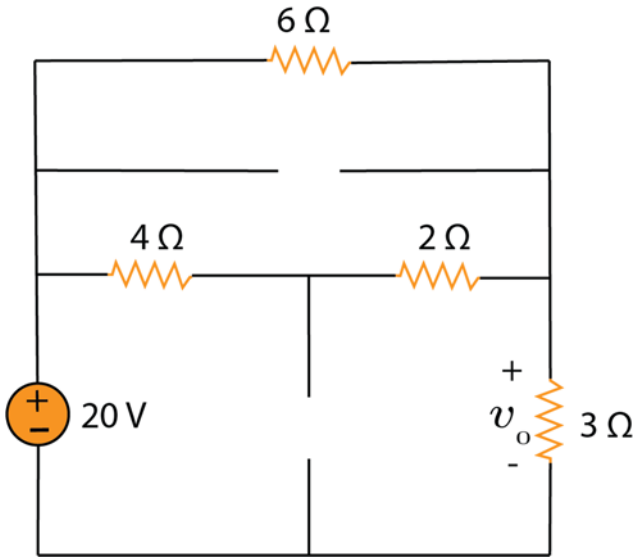
‼

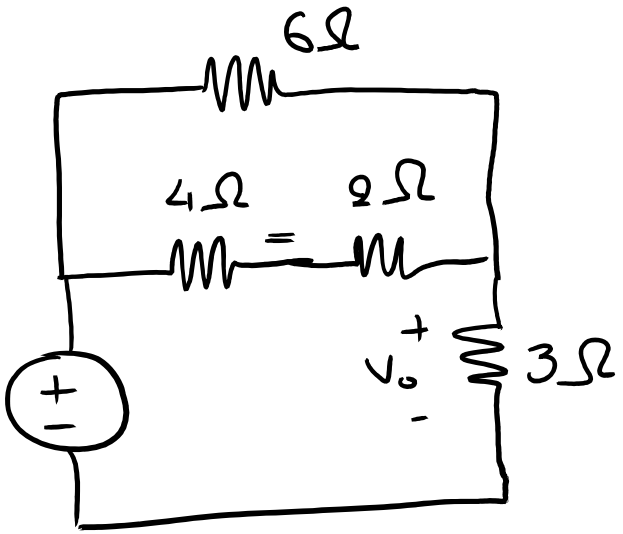
short circuit

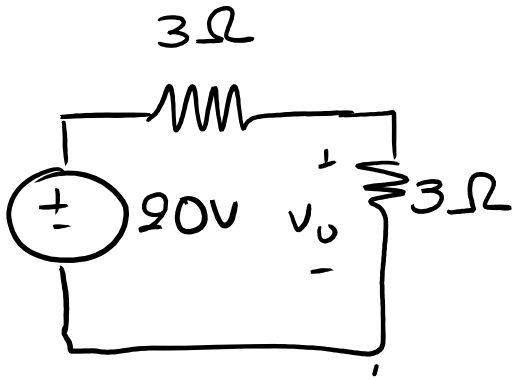
2) Disable current source

‼

open circuit

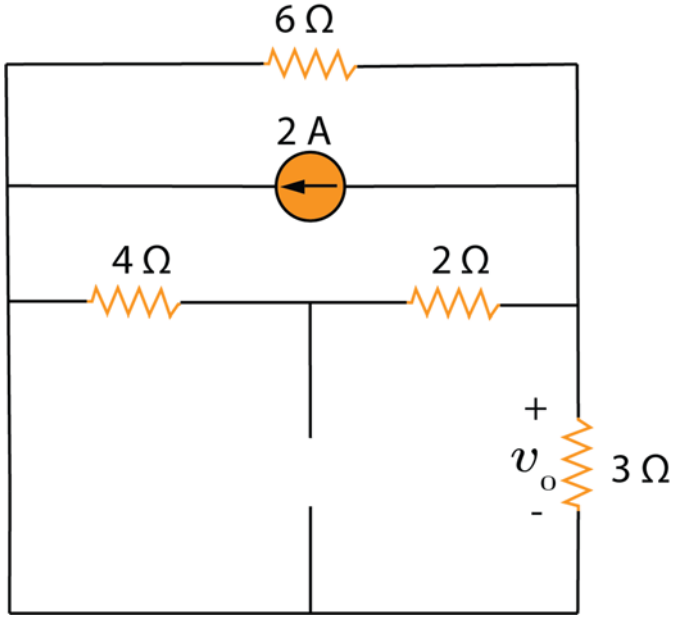


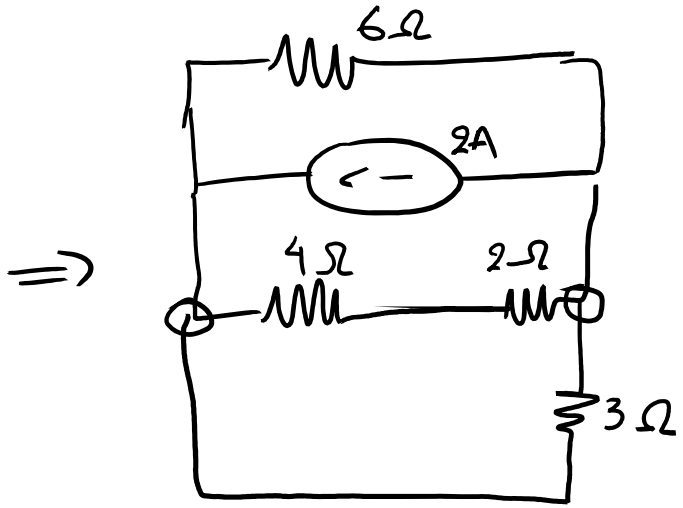




$$V_o = \frac{3}{3+3} \cdot 20 = 10V$$

↑ voltage divider

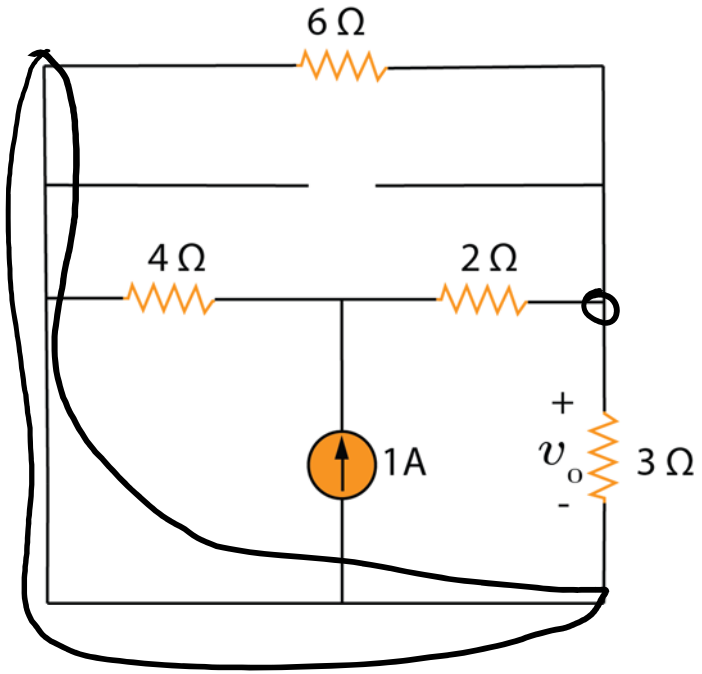


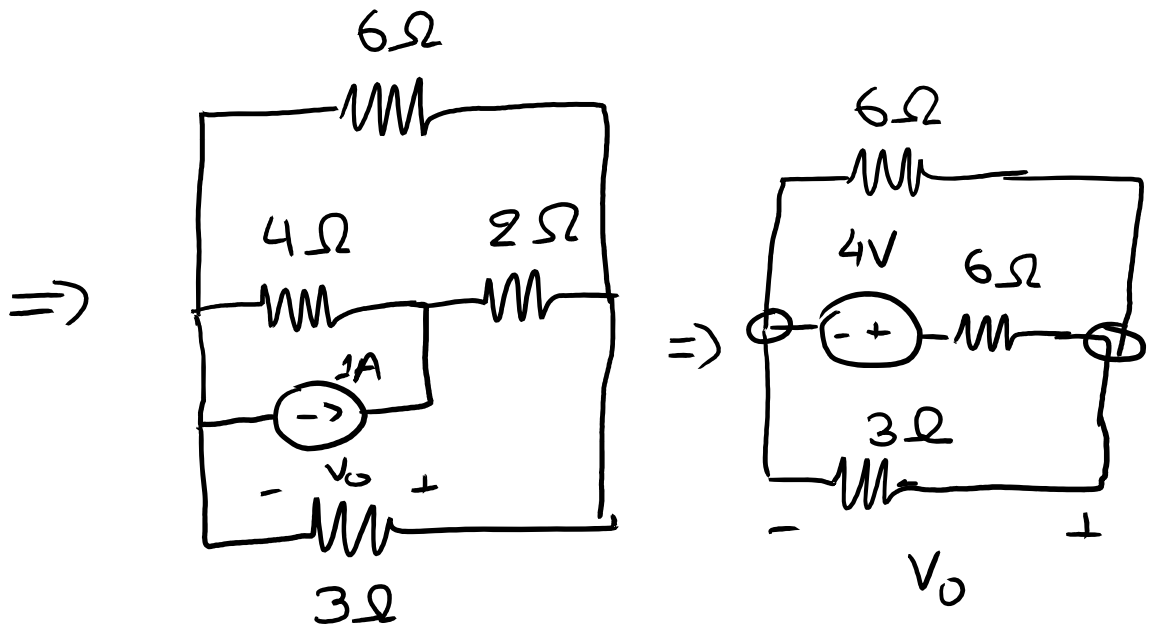


$6 // 6 = 3\,\Omega$

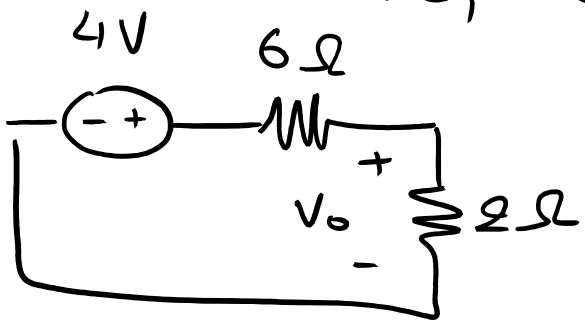
$$i_o = -\frac{3}{3+3} \cdot 2 = -1\,A$$

$$V_o = i_o \cdot R = -1 \cdot 3 = -3V$$



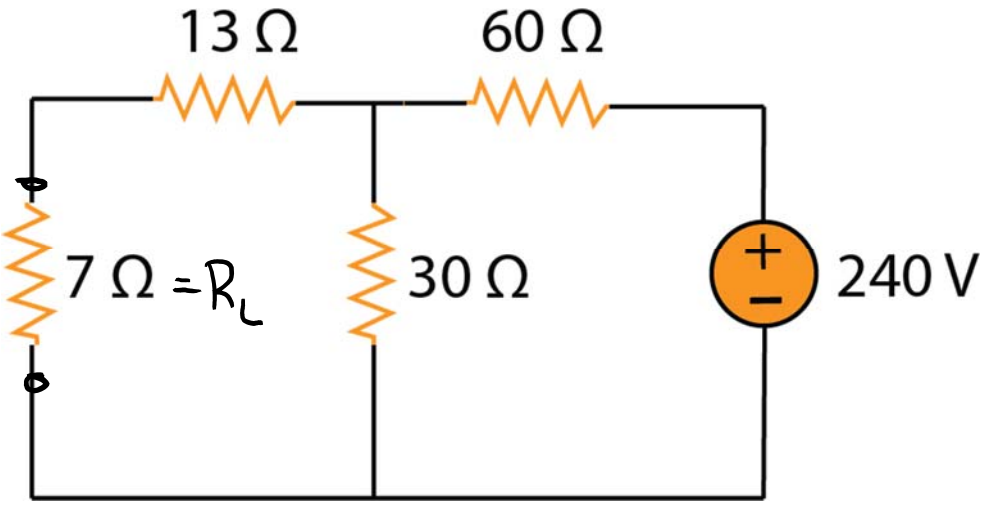


$$Req = 6 \| 3 = 2\,\Omega$$

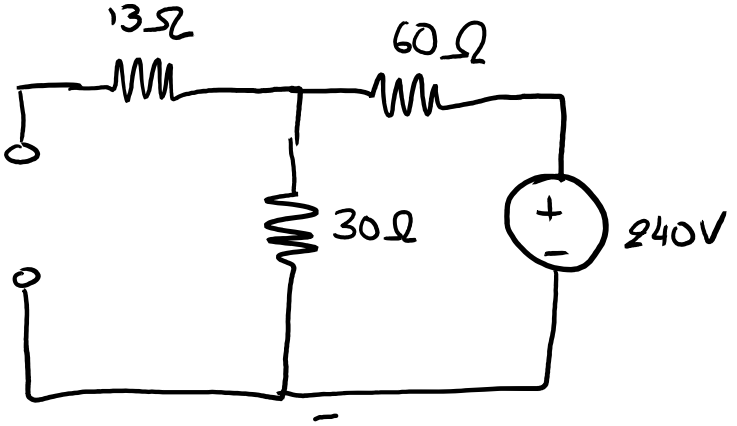


$$V_o = \frac{2}{6+2} \cdot 4 = \underline{1}\,V$$

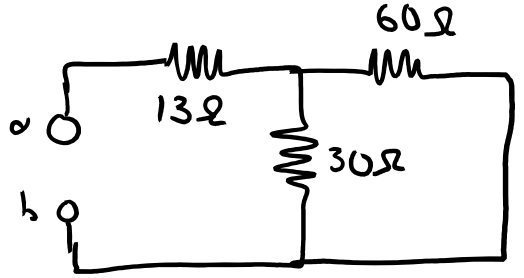
$$V_o^{Total} = \underline{1}0 - 3 + \underline{1} = \underline{\underline{8}}\,V$$



$\Rightarrow$



R_{Th} i) disable all independent sources



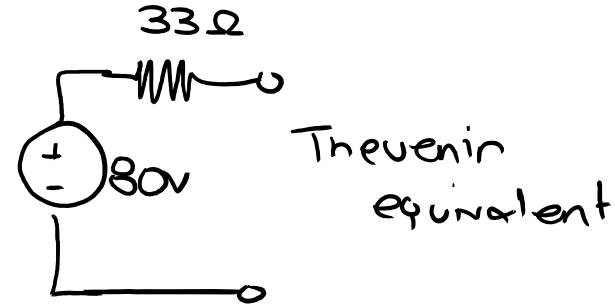
$R_{Th} = 13 + (30 \| 60)$

$= 13 + 20$

$= 33\,\Omega$

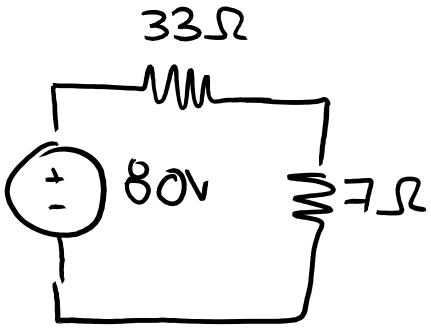
V_{Th}: a-b open - No current through 13 Ω

$$V_{th} = V_{30\Omega} = \frac{30}{30+60} \cdot 240 = 80V$$



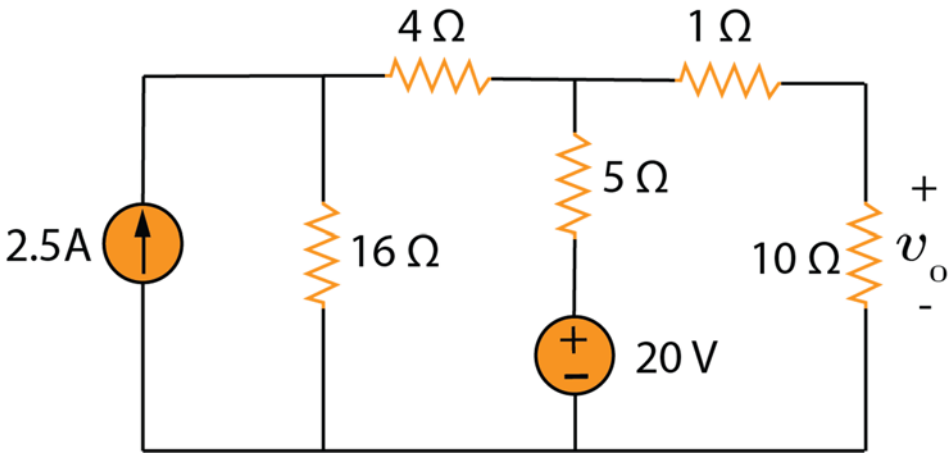
Thevenin equivalent

Current through 7 Ω



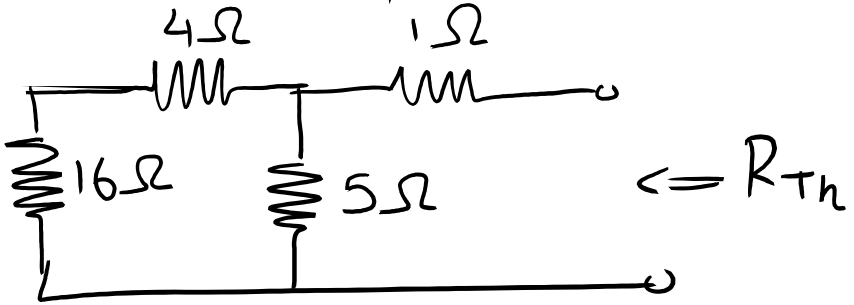
$$i = \frac{80}{33+7}$$

$= 2A$



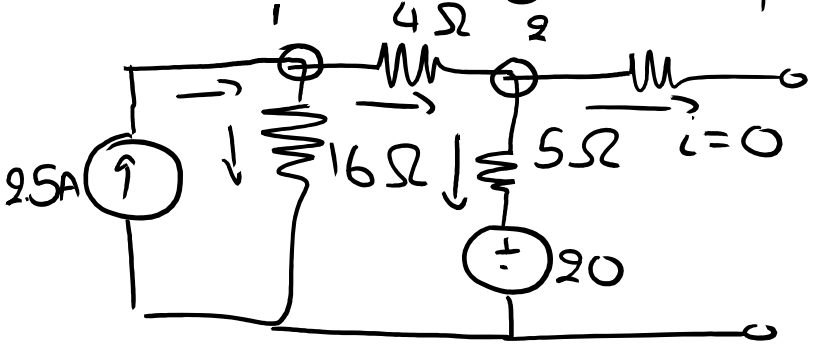
i) Remove 10Ω resistor

ii) disable independent sources



$$R_{Th} = 1 + (5 \| (16+4)) = 1 + (5 \| 20) = 1 + 4 = 5\Omega$$

Thevenin Voltage → open circuit voltage



KCL at node 1

$$2.5 = \frac{V_1}{16} + \frac{V_1 - V_2}{4}$$

KCL at node 2

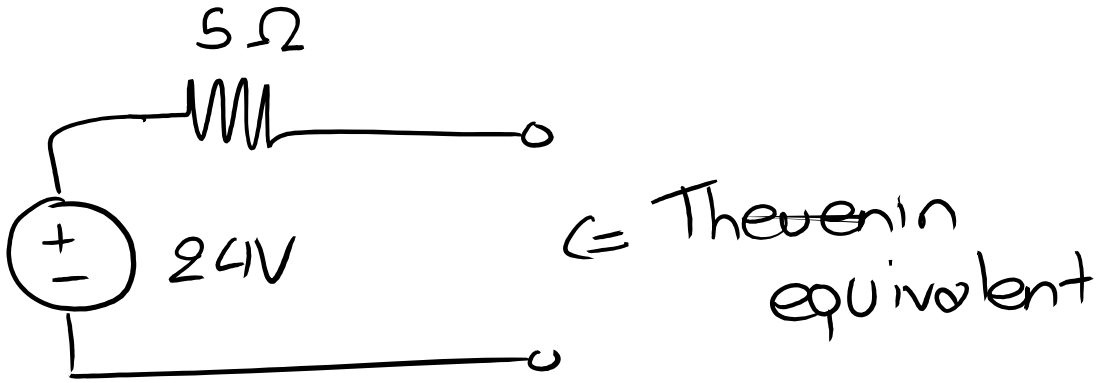
$$\frac{V_1 - V_2}{4_1} = \frac{V_2 - 20}{5}$$

$$2.5 \cdot 16 = V_1 + 4V_1 - 4V_2 \Rightarrow 5V_1 - 4V_2 = 40 \quad (1)$$

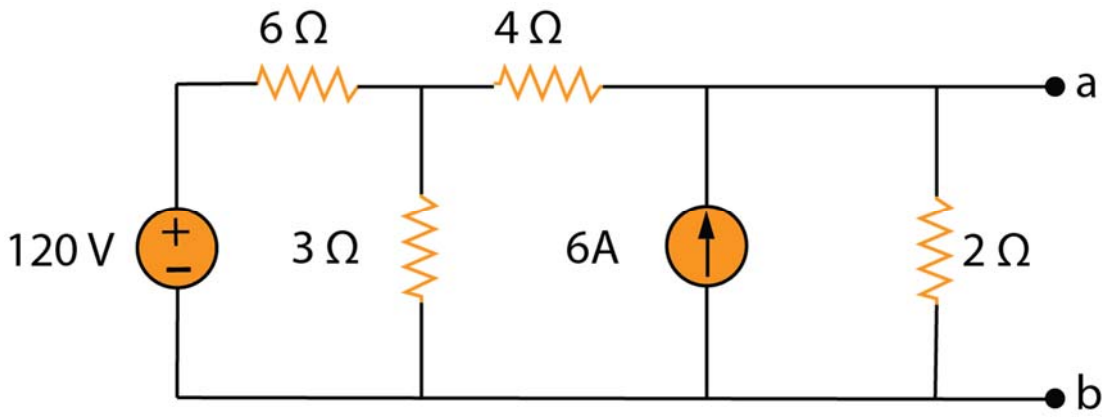
$$5V_2 - 5V_1 + 4V_2 - 80 = 0 \Rightarrow 9V_2 - 5V_1 = 80 \quad (2)$$

Solving the system

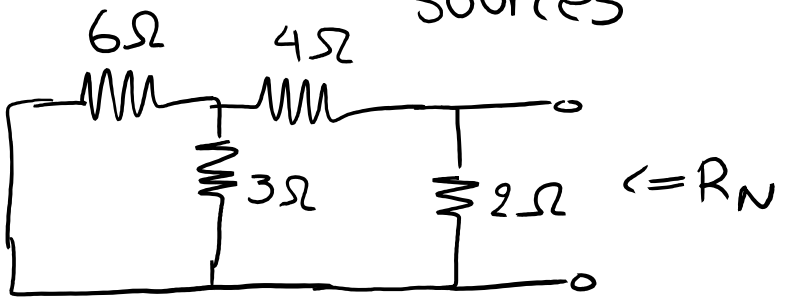
$$V_2 = V_{Th} = \underline{\underline{24V}}$$



⇐ Thevenin equivalent



i) R_N disable all ~~independent~~ sources

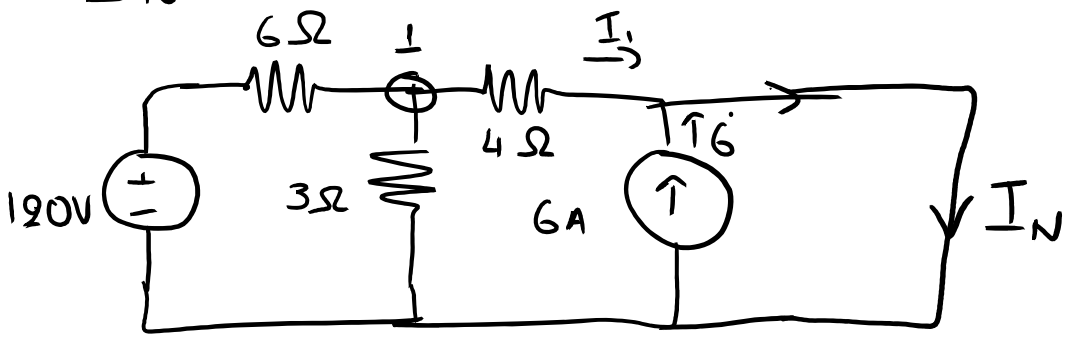


$<= R_N$

$R_N = 2 \| (4+6 \| 3) = 2 \| (4+2)$

$= 2 \| 6 = 1.5\,\Omega$

I_N -oshortcircuit current



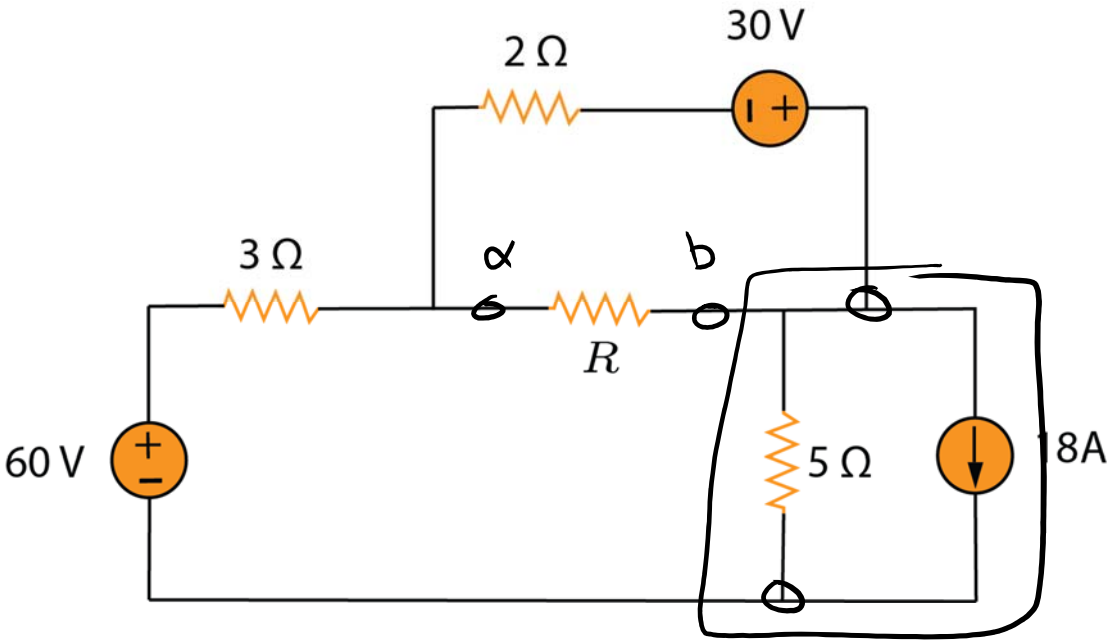
$I_N = I_1 + 6A$

To find I_1 : KCL at node 1 : $\frac{120 - V_1}{6} = \frac{V_1}{3} + \frac{V_1}{4} \Rightarrow$

$\Rightarrow 480 = V_1(8+4+6) \Rightarrow V_1 = 26.67\ V$

$I_1 = \frac{26.67}{4} = 6.6675\,A$

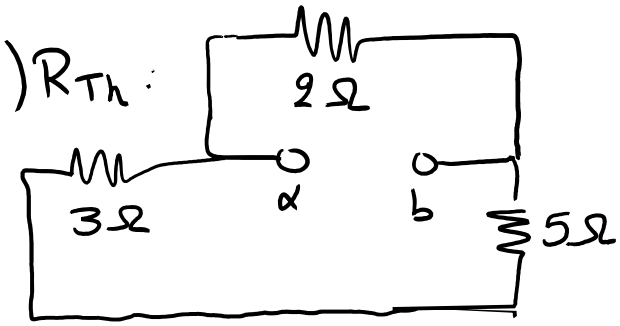
$I_N = 6 + 6.6675 = 12.6675\,A$



Maximum Power Transfer:

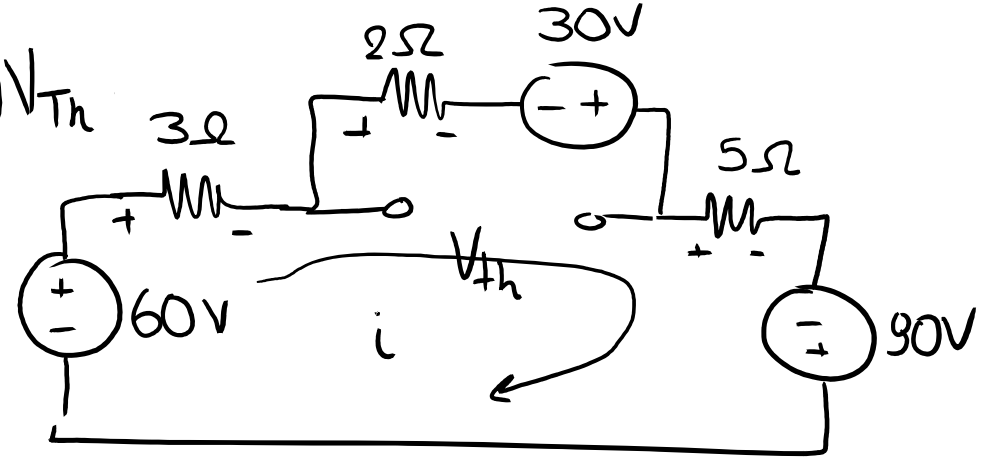
→ Thevenin equivalent

i) R_{Th}:



$R_{Th} = 2 \| (3+5) = 2 \| 8 = 1.6\Omega$

ii) V_{Th}



$3i + 2i + 5i = 60 + 30 + 90$

$\Rightarrow 10i = 180 \Rightarrow i = 18A$

$V_{th} = V_{ab} = 2i - 30 = 36 - 30 = 6V$

$$P_{max} = \frac{V_{Th}^2}{4 \cdot R_{Th}} = \frac{6^2}{4 \cdot 1.6} = \frac{36}{6.4} = 5.625\,W$$