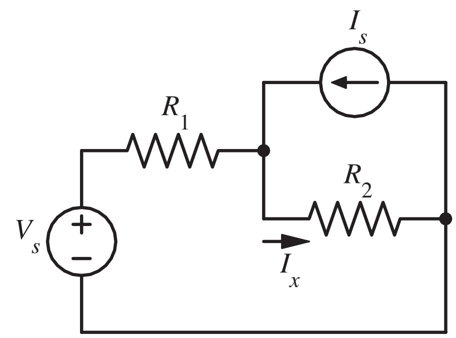
Solution of ECE 300 Test 2 S11

1. Find the numerical value of I_x with

(a) V_s acting alone $I_x = V_s / (R_1 + R_2) = \frac{14\text{V}}{12\Omega + 23\Omega} = 0.4\,\text{A}$

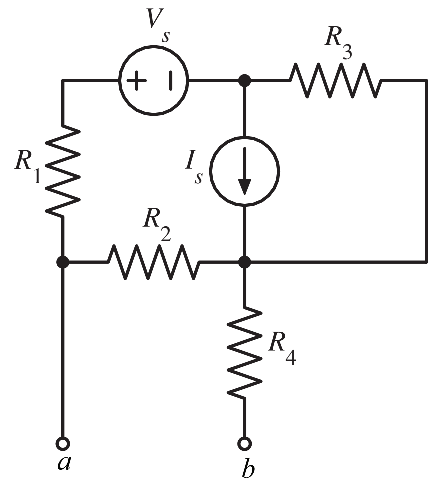
(b) I_s acting alone $I_x = \frac{R_1}{R_1 + R_2} I_s = \frac{12\Omega}{12\Omega + 23\Omega} 2.5\,\text{A} = 0.8571\ \text{A}$

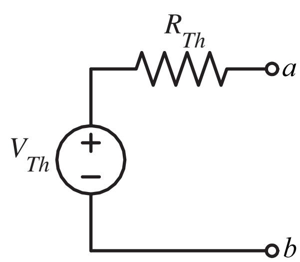
$V_s = 14\text{V}$, $I_s = 2.5\,\text{A}$, $R_1 = 12\Omega$, $R_2 = 23\Omega$



2. The Thevenin equivalent of the first circuit at terminals a and b is the second circuit shown below. Find the numerical values of V_{Th} and R_{Th}.

$$V_s = 15\text{V} \;,\; I_s = 2\text{A} \;,\; R_1 = 8\Omega \;,\; R_2 = 3\Omega \;,\; R_3 = 10\Omega \;,\; R_4 = 12\Omega$$

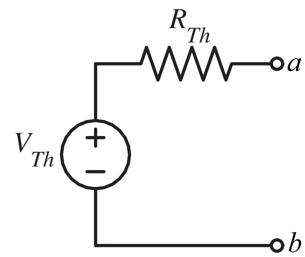




$$V_{Th} = V_s \frac{R_2}{R_1 + R_2 + R_3} - I_s \frac{R_3}{R_1 + R_2 + R_3} R_2 = 15\frac{3}{8+3+10} - 2\frac{10}{8+3+10}3 = \frac{45}{21} - \frac{60}{21} = -\frac{15}{21} = -0.7143 \text{ V}$$

$$R_{Th} = R_4 + \left(R_1 + R_3\right) \parallel R_2 = 12 + \frac{18 \times 3}{21} = 14.5714 \ \Omega$$

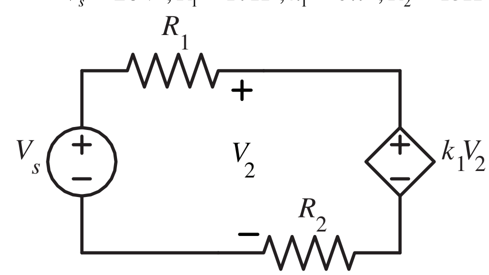
3. If $V_{Th} = 22\text{V}$ and $R_{Th} = 50\Omega$, what is the maximum amount of power that could be delivered to a resistive load R_L connected between *a* and *b* by this practical voltage source?

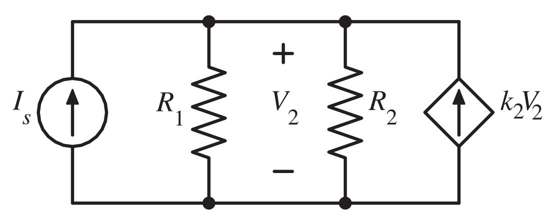


$$R_L = R_{Th} = 50\Omega \;,\; V_L = V_{Th}/2 = 11\text{V} \;,\; P_L = (11)^2/50 = 121/50 = 2.42 \text{ W}$$

4. The second circuit below was formed by source transformation on the first circuit below where V_s and R_1 form one practical voltage source and k_1V_2 and R_2 form the other practical voltage source. Find the numerical values of I_s and k_2.

$V_s = 28\text{V}$, $R_1 = 17\Omega$, $k_1 = 0.7$, $R_2 = 13\Omega$

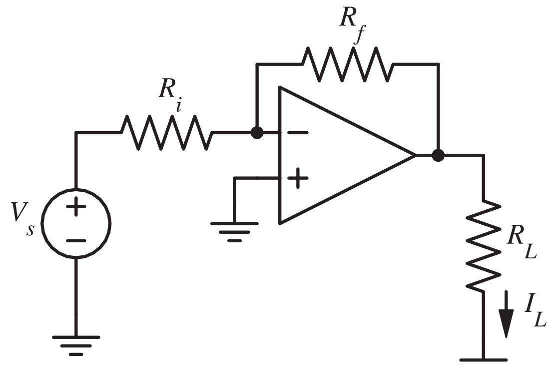




$$I_s = V_s / R_1 = \frac{28}{17} = 1.6471 \text{ A}$$

$$k_2V_2 = k_1V_2 / R_2 = \frac{0.7}{13}V_2 = 0.0538V_2 \Rightarrow k_2 = 0.0538$$

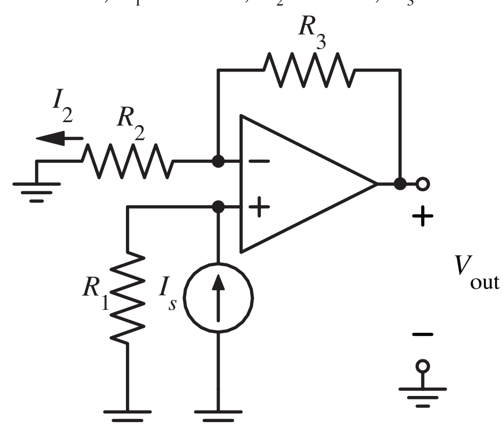
5. If $V_s = 18\text{V}$, $R_i = 10k\Omega$, $R_f = 85k\Omega$ and $R_L = 200\Omega$ find the numerical value of I_L .



$$I_L = \frac{V_s\left(-\frac{R_f}{R_i}\right)}{R_L} = \frac{18\left(-\frac{85}{10}\right)}{200} = -0.765 \text{ A}$$

6. Find the numerical values of I_2 and V_{out} .

$I_s = 10\text{mA}$, $R_1 = 200\Omega$, $R_2 = 2k\Omega$, $R_3 = 11k\Omega$

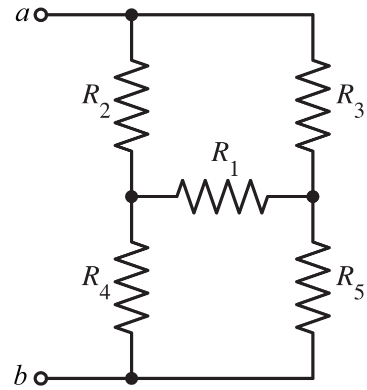


$$V_{out} = I_s R_1\left(1 + \frac{R_3}{R_2}\right) = 0.01 \times 200 \times (1 + 11/2) = 13 \text{ V}$$

$$I_2 = I_s R_1 / R_2 = 0.01 \times 200 / 2000 = 1\text{mA}$$

7. Find the numerical resistance between terminals *a* and *b*.

$R_1 = R_2 = R_3 = 10\Omega$, $R_4 = R_5 = 5\Omega$



If we convert the top π to a T, the three elements of the T are all equal and are all $\dfrac{10\times 10}{10+10+10} = \dfrac{10}{3}\Omega$. Then the *ab* resistance is

$$R_{ab} = (5+10/3) \,||\, (5+10/3) + 10/3 = 22.5/3 = 7.5\Omega$$

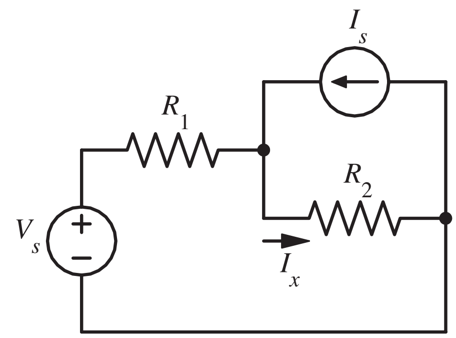
Solution of ECE 300 Test 2 S11

1. Find the numerical value of I_x with

(a) V_s acting alone $I_x = V_s / (R_1 + R_2) = \frac{7\text{V}}{12\Omega + 23\Omega} = 0.2\text{A}$

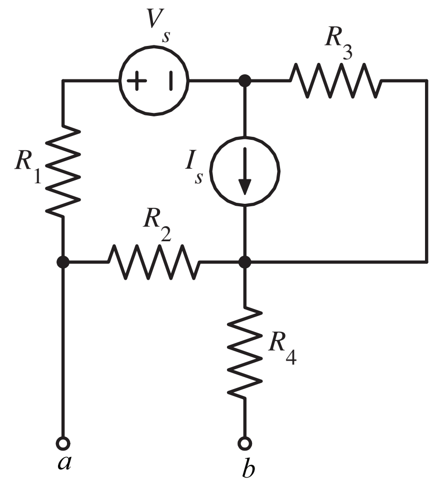
(b) I_s acting alone $I_x = \frac{R_1}{R_1 + R_2} I_s = \frac{12\Omega}{12\Omega + 23\Omega} 5\text{A} = 1.7142 \text{ A}$

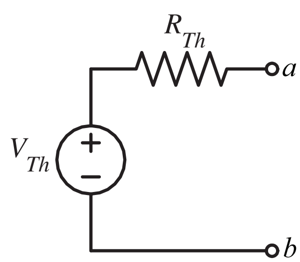
$V_s = 7\text{V}$, $I_s = 5\text{A}$, $R_1 = 12\Omega$, $R_2 = 23\Omega$



2. The Thevenin equivalent of the first circuit at terminals a and b is the second circuit shown below. Find the numerical values of V_{Th} and R_{Th}.

$$V_s = 10\text{V} \;,\; I_s = 1\text{A} \;,\; R_1 = 11\Omega \;,\; R_2 = 6\Omega \;,\; R_3 = 8\Omega \;,\; R_4 = 7\Omega$$

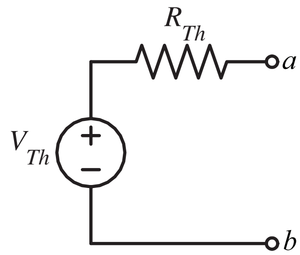




$$V_{Th} = V_s \frac{R_2}{R_1 + R_2 + R_3} - I_s \frac{R_3}{R_1 + R_2 + R_3} R_2 = 10 \frac{6}{11+6+8} - \frac{8}{11+6+8} 6 = \frac{60}{25} - \frac{48}{25} = \frac{12}{25} = 0.48 \text{ V}$$

$$R_{Th} = R_4 + \left(R_1 + R_3\right) \| R_2 = 7 + \frac{17 \times 6}{23} = 11.4348 \ \Omega$$

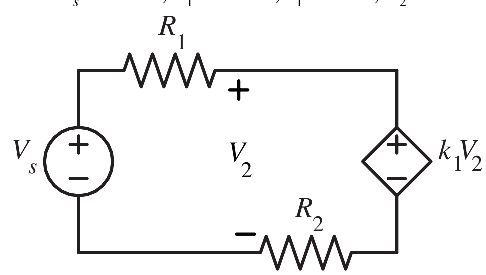
3. If $V_{Th} = 11\text{V}$ and $R_{Th} = 50\Omega$, what is the maximum amount of power that could be delivered to a resistive load R_L connected between *a* and *b* by this practical voltage source?

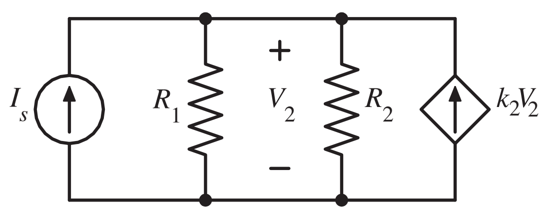


$$R_L = R_{Th} = 50\Omega \;,\; V_L = V_{Th}/2 = 5.5\text{V} \;,\; P_L = (5.5)^2/50 = 0.605 \text{ W}$$

4. The second circuit below was formed by source transformation on the first circuit below where V_s and R_1 form one practical voltage source and k_1V_2 and R_2 form the other practical voltage source. Find the numerical values of I_s and k_2.

$V_s = 38\text{V}$, $R_1 = 17\Omega$, $k_1 = 0.4$, $R_2 = 13\Omega$

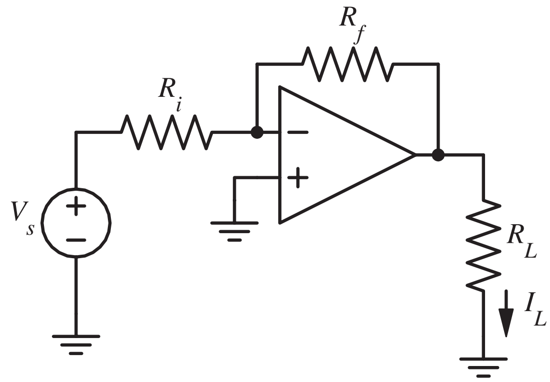




$$I_s = V_s / R_1 = \frac{38}{17} = 2.2353 \text{ A}$$

$$k_2V_2 = k_1V_2 / R_2 = \frac{0.4}{13}V_2 = 0.0538V_2 \Rightarrow k_2 = 0.0308$$

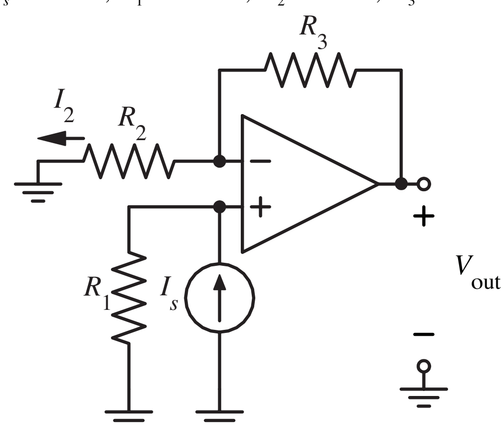
5. If $V_s = 14\text{V}$, $R_i = 10k\Omega$, $R_f = 85k\Omega$ and $R_L = 200\Omega$ find the numerical value of I_L .



$$I_L = \frac{V_s\left(-\frac{R_f}{R_i}\right)}{R_L} = \frac{14\left(-\frac{85}{10}\right)}{200} = -0.595\ \text{A}$$

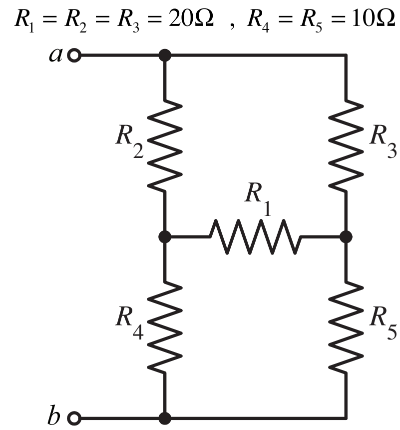
6. Find the numerical values of I_2 and V_{out} .

$I_s = 5\text{mA}$, $R_1 = 200\Omega$, $R_2 = 2k\Omega$, $R_3 = 11k\Omega$



$$V_{out} = I_s R_1\left(1 + \frac{R_3}{R_2}\right) = 0.005 \times 200 \times (1 + 11/2) = 6.5\ \text{V}$$
$$I_2 = I_s R_1 / R_2 = 0.005 \times 200 / 2000 = 0.5\text{mA}$$

7. Find the numerical resistance between terminals *a* and *b*.



If we convert the top π to a T, the three elements of the T are all equal and are all $\frac{20 \times 20}{20+20+20} = \frac{20}{3}\Omega$. Then the *ab* resistance is

$$R_{ab} = (10 + 20/3) \parallel (10 + 20/3) + 20/3 = 45/3 = 15\Omega$$

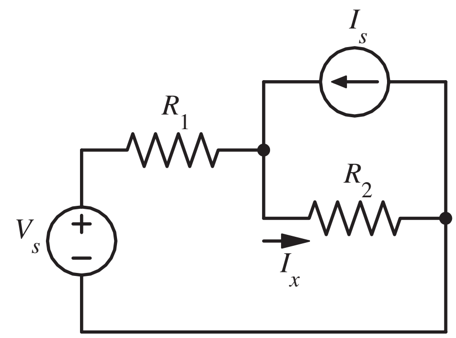
Solution of ECE 300 Test 2 S11

1. Find the numerical value of I_x with

(a) V_s acting alone $\quad I_x = V_s/(R_1 + R_2) = \dfrac{21\text{V}}{12\Omega + 23\Omega} = 0.6\text{A}$

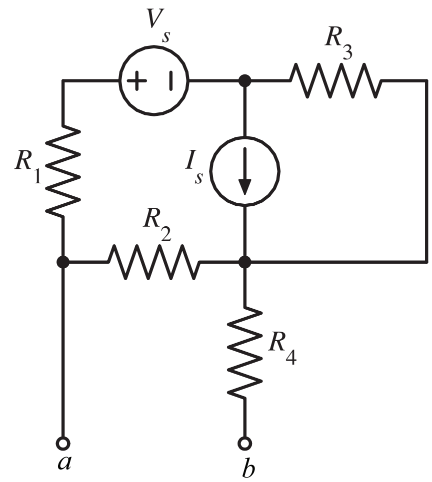
(b) I_s acting alone $\quad I_x = \dfrac{R_1}{R_1 + R_2} I_s = \dfrac{12\Omega}{12\Omega + 23\Omega} 4\text{A} = 1.3714\ \text{A}$

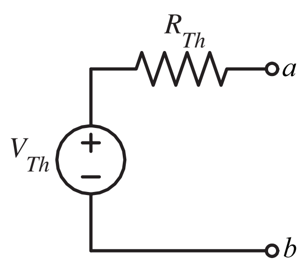
$V_s = 21\text{V}$, $I_s = 4\text{A}$, $R_1 = 12\Omega$, $R_2 = 23\Omega$



2. The Thevenin equivalent of the first circuit at terminals a and b is the second circuit shown below. Find the numerical values of V_{Th} and R_{Th}.

$V_s = 9\text{V}$, $I_s = 3\text{A}$, $R_1 = 4\Omega$, $R_2 = 12\Omega$, $R_3 = 8\Omega$, $R_4 = 14\Omega$

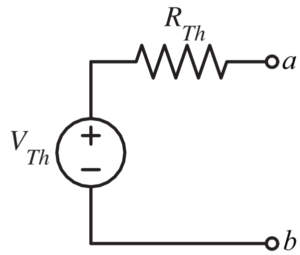




$$V_{Th} = V_s \frac{R_2}{R_1 + R_2 + R_3} - I_s \frac{R_3}{R_1 + R_2 + R_3} R_2 = 9\frac{12}{4+12+8} - 3\frac{8}{4+12+8}12 = \frac{108}{24} - \frac{288}{24} = -\frac{180}{24} = -7.5 \text{ V}$$

$$R_{Th} = R_4 + \left(R_1 + R_3\right) \parallel R_2 = 14 + \frac{12 \times 12}{24} = 20\ \Omega$$

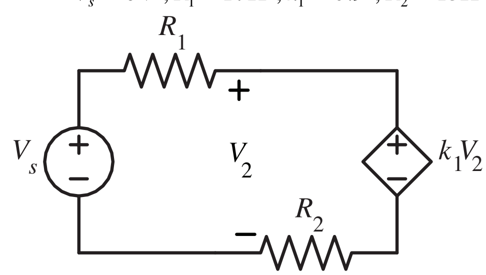
3. If $V_{Th} = 35\text{V}$ and $R_{Th} = 50\Omega$, what is the maximum amount of power that could be delivered to a resistive load R_L connected between *a* and *b* by this practical voltage source?

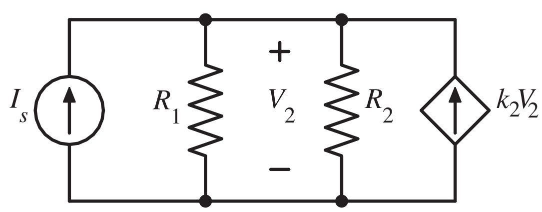


$$R_L = R_{Th} = 50\Omega \ , \ V_L = V_{Th} / 2 = 17.5\text{V} \ , \ P_L = (17.5)^2 / 50 = 6.125 \text{ W}$$

4. The second circuit below was formed by source transformation on the first circuit below where V_s and R_1 form one practical voltage source and $k_1 V_2$ and R_2 form the other practical voltage source. Find the numerical values of I_s and k_2.

$V_s = 6\text{V}$, $R_1 = 17\Omega$, $k_1 = 0.9$, $R_2 = 13\Omega$

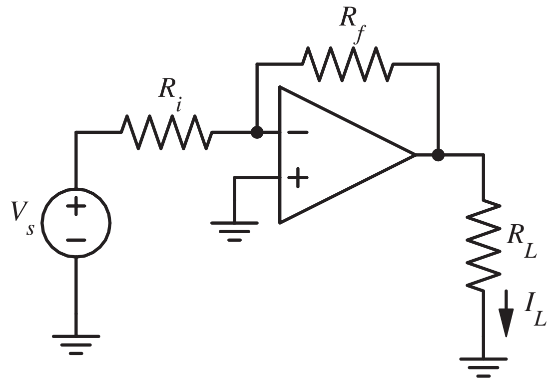




$$I_s = V_s / R_1 = \frac{6}{17} = 0.3529 \text{ A}$$

$$k_2 V_2 = k_1 V_2 / R_2 = \frac{0.9}{13} V_2 = 0.0392 V_2 \Rightarrow k_2 = 0.0692$$

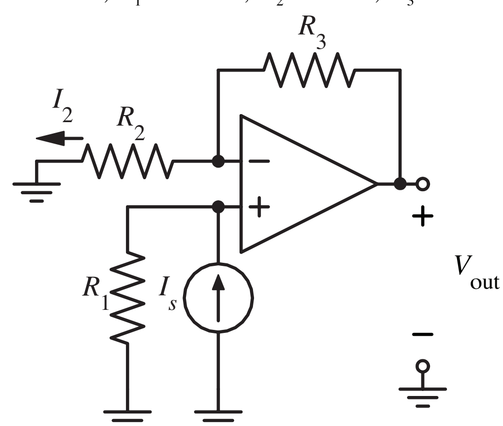
5. If $V_s = 24\text{V}$, $R_i = 10k\Omega$, $R_f = 85k\Omega$ and $R_L = 200\Omega$ find the numerical value of I_L .



$$I_L = \frac{V_s\left(-\frac{R_f}{R_i}\right)}{R_L} = \frac{24\left(-\frac{85}{10}\right)}{200} = -1.02 \text{ A}$$

6. Find the numerical values of I_2 and V_{out} .

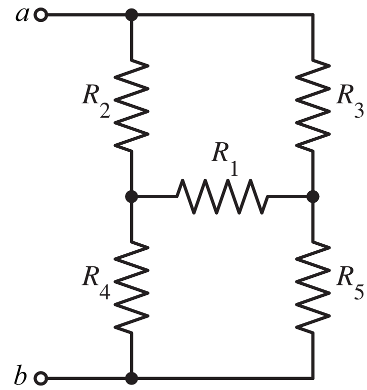
$I_s = 15\text{mA}$, $R_1 = 200\Omega$, $R_2 = 2k\Omega$, $R_3 = 11k\Omega$



$$V_{out} = I_s R_1\left(1+\frac{R_3}{R_2}\right) = 0.015\times 200\times\left(1+11/2\right) = 19.5 \text{ V}$$
$$I_2 = I_s R_1 / R_2 = 0.015\times 200 / 2000 = 1.5\text{mA}$$

7. Find the numerical resistance between terminals *a* and *b*.

$R_1 = R_2 = R_3 = 40\Omega$, $R_4 = R_5 = 20\Omega$



If we convert the top π to a T, the three elements of the T are all equal and are all $\frac{40 \times 40}{40+40+40} = \frac{40}{3}\Omega$. Then the *ab* resistance is

$$R_{ab} = (20 + 40/3) \parallel (20 + 40/3) + 40/3 = 90/3 = 30\Omega$$