HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY

OFFICE FOR INTERNATIONAL STUDY PROGRAM

SEMESTER: 251

LAB 1 REPORT

INSTRUCTOR:

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Class ID: CC04

Ho Chi Minh city, October 16, 2025

6.1 Exercise 1

Given the following circuit. Calculate the value of the voltage v_0 and the current i. Then, simulate the circuit to check it out.

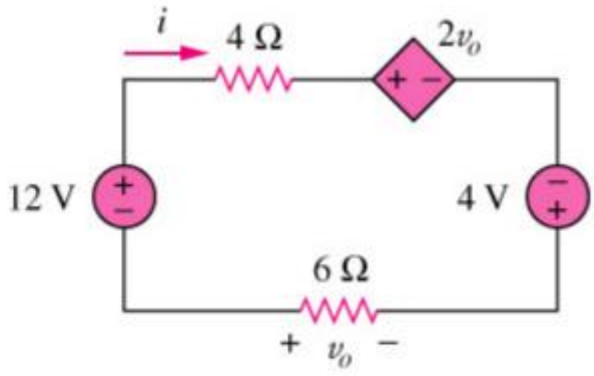


Figure 1.17: Find the voltage and the current in the given circuit using KVL

6.1.1 Calculation

Notes: Explanations, formulas, and equations are expected rather than only results.

According to KVL, we have we have the first equation:

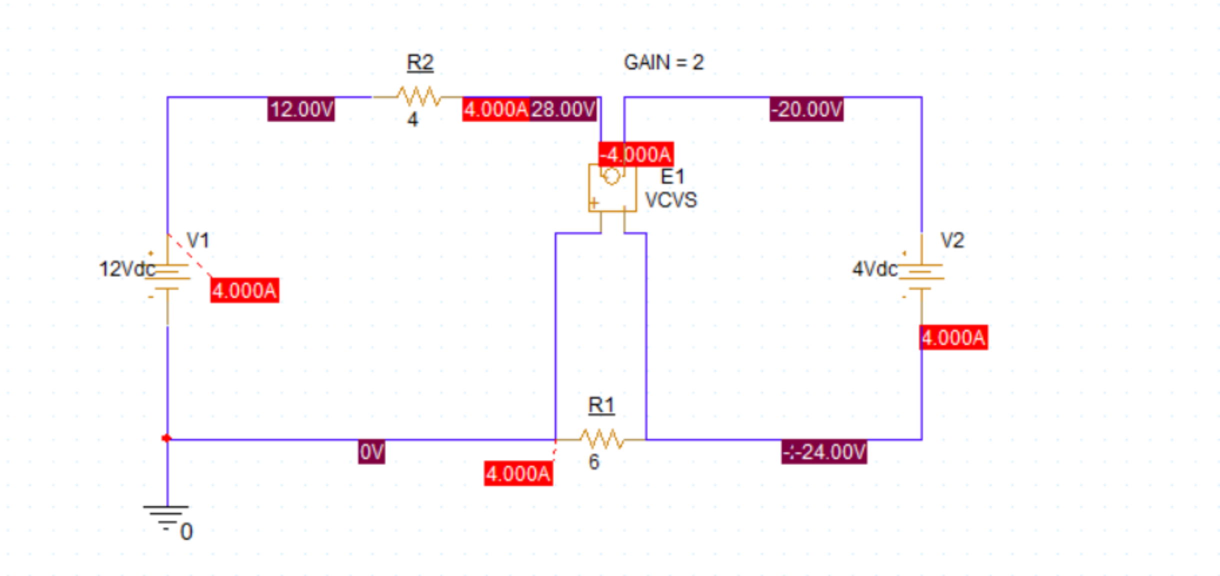
$-12 - 4I - 2V_0 + V_0 + 4 = 0$. Simplify: $4I + V_0 = 16(1)$

According to the Ohm's Law for the 6 Ω resistor we have: $v_0 = -6I(V)$

From (1) and (2) we have:

$4I - 6I = 16 \Leftrightarrow -2I = 16 \Leftrightarrow I = -8$ then $V_0 = -6I = 6.8 = 48(V)$

6.1.2 Stimulation



Result of exercise 1

6.2 Exercise 2

Given the following circuit, students rearrange the circuit to clarify its serial and/or parallel topology. Then, apply the knowledge you've learned to find the equivalent resistance value between two circuit terminals A and F. Finally, perform the simulation to check if the current through the whole circuit is correctly calculated.

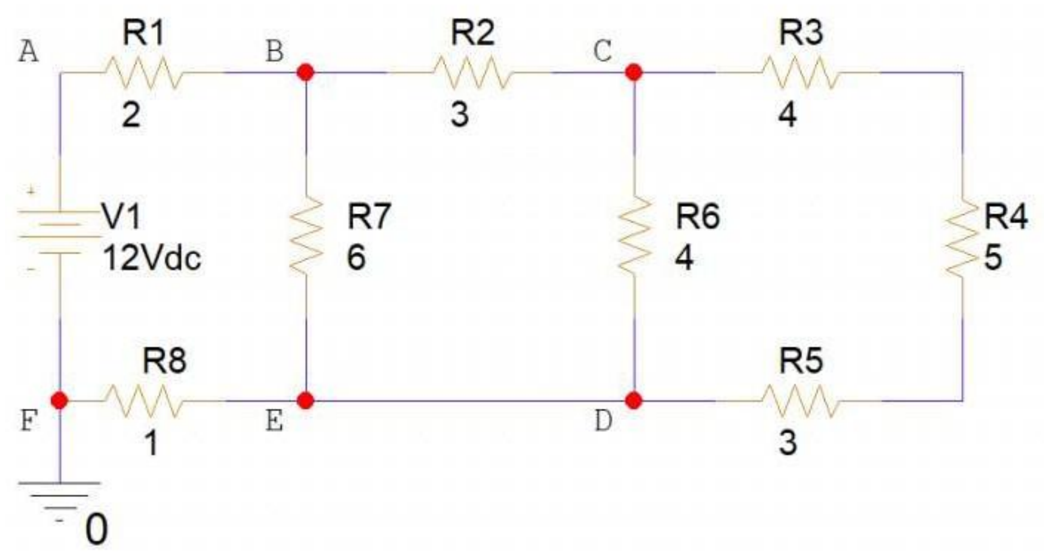
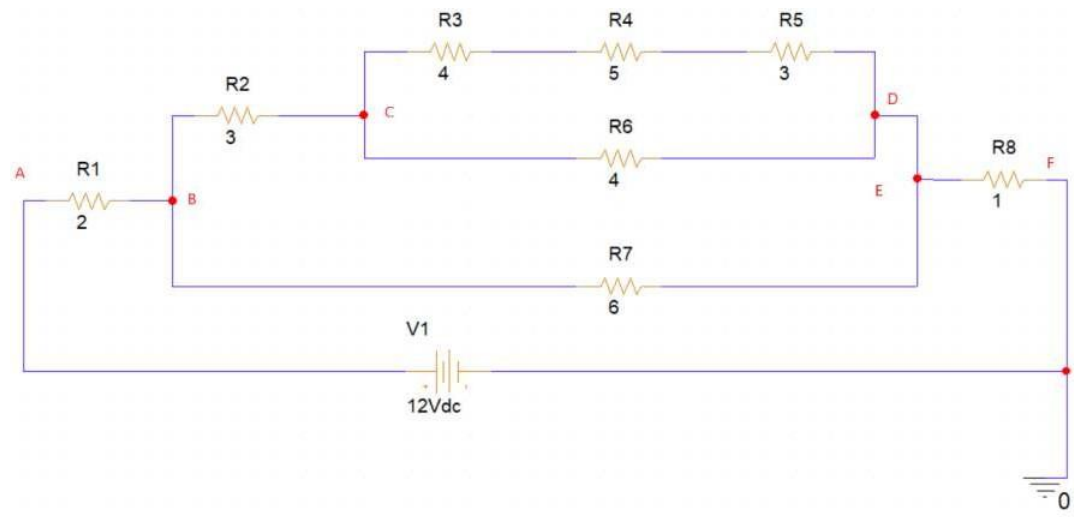


Figure 1.19: Find the equivalent resistance value between terminals A and F

6.2.1 Rearrange the circuit

Insert the rearranged circuit here. Don't forget the resistance values and the nodes' names



The rearranged circuit

6.2.2 Calculation

Because $\boldsymbol{R_3, R_4, R_5}$ are in series and they are parallel to $\boldsymbol{R_6}$, we have:

$$\boldsymbol{R_{345} = R_3 + R_4 + R_5 = 4 + 5 + 3 = 12(\Omega)}$$

$$\boldsymbol{R_{CD\_3456} = \frac{R_{345}.R_6}{R_{345} + R_6} = \frac{12.4}{12 + 4} = 3(\Omega)}$$

Because $\boldsymbol{R_2}$ series with $\boldsymbol{R_{CD\_3456}}$ and they are parallel to $\boldsymbol{R_7}$

$$\boldsymbol{R_{13456} = R_2 + R_{CD} = 3 + 3 = 6(\Omega)}$$

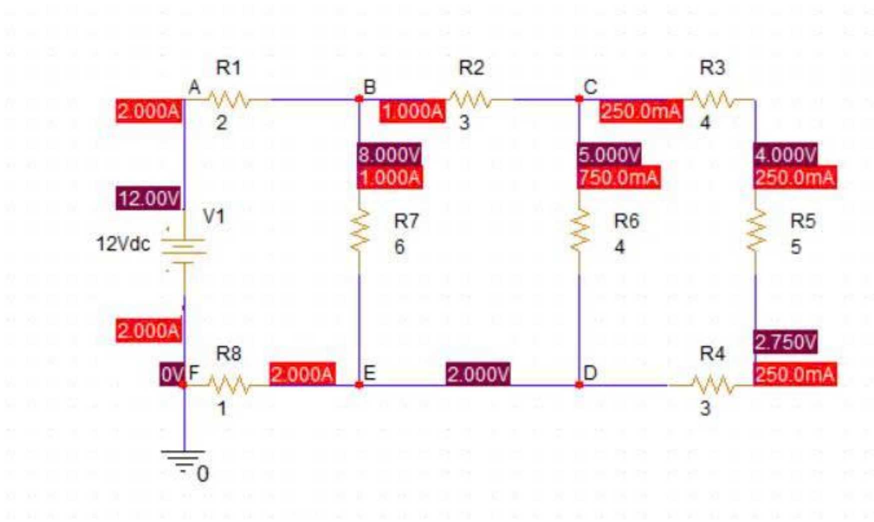
$$\boldsymbol{R_{BE} = \frac{R_{23456}.R_7}{R_{23456}+R_7} = 3(\Omega)}$$

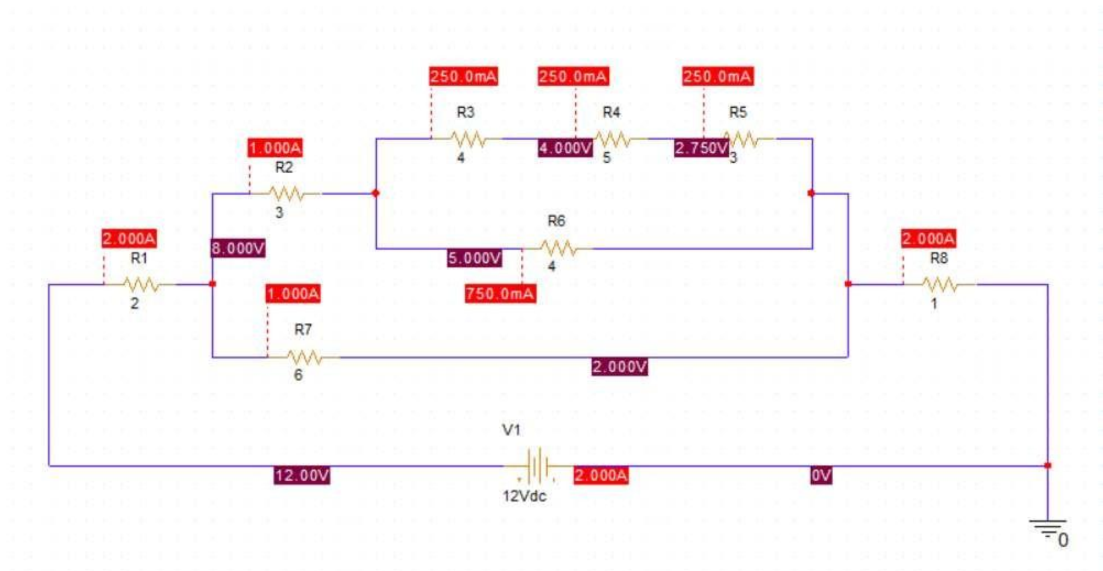
As $\boldsymbol{R_{BE}, R_1, R_6}$ are in series

$$\boldsymbol{R_{AF} = R_{BE} + R_1 + R_3 = 3 + 2 + 1 = 6(\Omega)}$$

$$\boldsymbol{I_{AB} = \frac{V}{R_{AF}} = \frac{12}{6} = 2(A)}$$

6.2.3 Stimulation





Results of both the rearranged circuit and the original circuit are the same

6.3 Exercise 3

Given the following circuit, students rearrange the circuit to clarify its serial and/or parallel topology. Next, apply the knowledge you've learned to find the equivalent resistance value between two circuit terminals A and F, the voltage values at A, B, C, D, and E. Finally, perform the simulation to check your calculation.

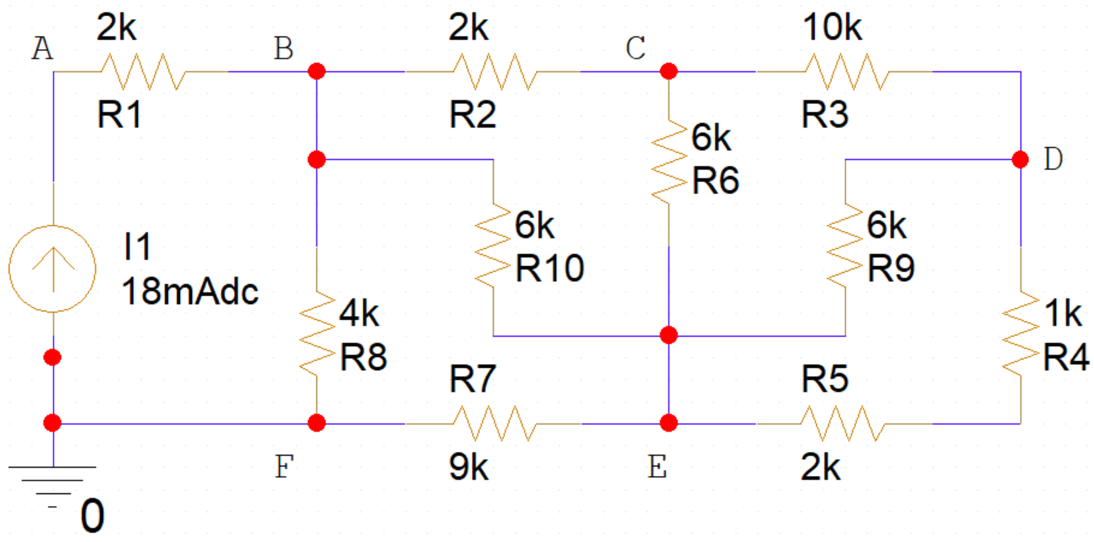
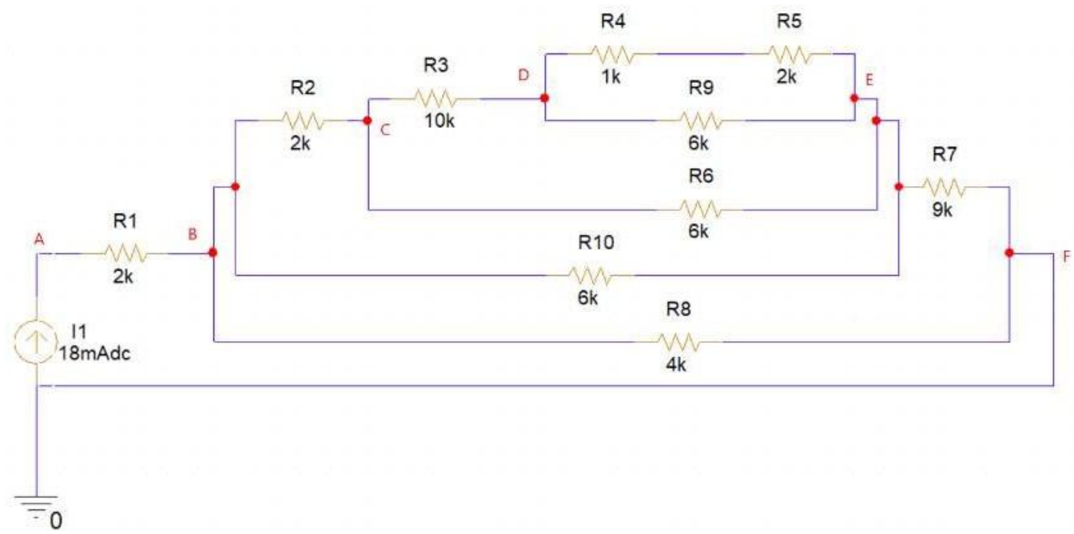


Figure 1.20: Find the whole-circuit equivalent resistance

and the voltages at A, B, C, D and E

6.3.1 Rearrange the circuit

Insert the rearranged circuit here. Don't forget the resistance values and the nodes' names



The rearranged circuit

6.3.2 Calculation

After rearranging the circult, we can obtain:

$$R_{DE}=\frac{(R_4+R_5).R_9}{(R_4+R_5)+R_9}=\frac{(1+2).6}{(1+2)+6}=2(k\boldsymbol{\Omega})$$

$$R_{3DE6}=\frac{(R_3+R_{DE}).R_6}{(R_3+R_{DE})+R_6}=\frac{(10+2).6}{(10+2)+6}=4(k\boldsymbol{\Omega})$$

$$R_{2C10}=\frac{(R_2+R_{3D56}).R_{10}}{(R_2+R_{3D56})+R_{10}}=\frac{(2+4).6}{(2+4)+6}=3(k\boldsymbol{\Omega})$$

$$R_{B78}=\frac{(R_{2C10}+R_7).R_8}{(R_{2C10}+R_7)+R_8}=\frac{(3+9).4}{(3+9)+4}=3(k\boldsymbol{\Omega})$$

$$\Rightarrow R_{AF}=R_1+R_{B78}=2+3=5(k\boldsymbol{\Omega})$$

$$V_A=IR_{AF}=18.10^{-3}.5.10^3=90(V)$$

$$V_B=IR_{B78}=18.10^{-3}.3.10^3=54(V)$$

Apply KVL for 3 inner loops:

$$\begin{cases} 6.10^3I_2+9.10^3(18.10^{-3}-I_1)=4.10^3I_1 \\ 2.10^3(18.10^{-3}-I_1-I_2)+6.10^3I_3=6.10^3I_2 \\ 12.10^3(18.10^{-3}-I_1-I_2-I_3)=6.10^3I_3 \end{cases}$$

$$\Rightarrow\begin{cases} I_1=0{,}027(A) \\ I_2=0{,}00225(A) \\ I_3=0{,}0015(A) \end{cases}$$

$$V_{BC}=R_2(I-I_1-I_2)=4{,}5(V)$$

$$\Rightarrow V_C=V_B-V_{BC}=54-4{,}5=49{,}5(V)$$

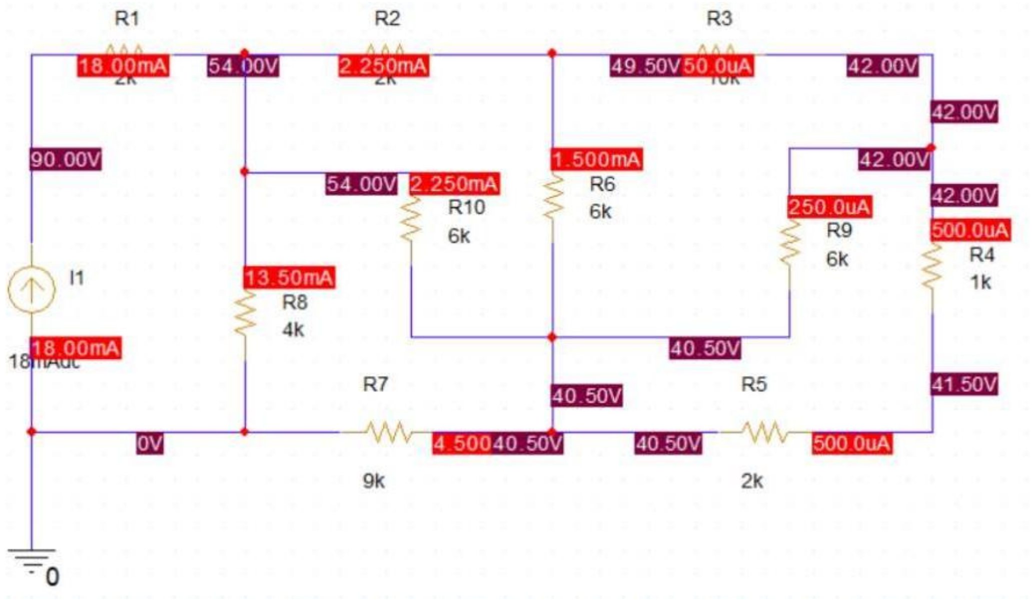
$$V_{CD}=R_3(I-I_1-I_2-I_3)=7{,}5(V)$$

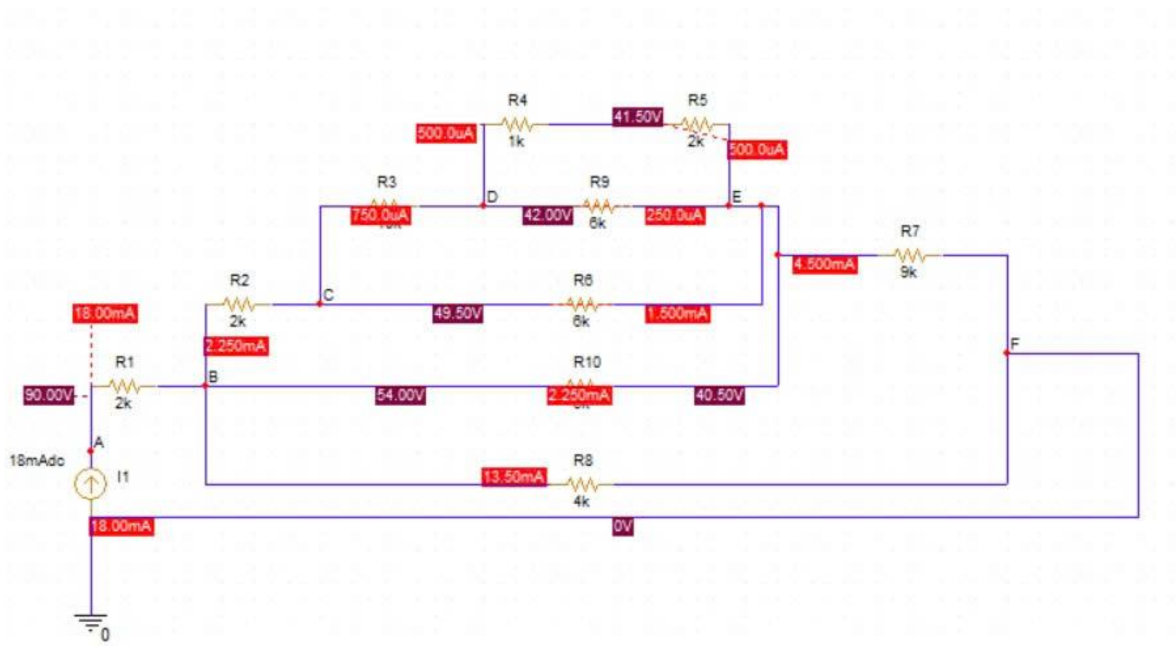
$$\Rightarrow V_D=V_C-V_{CD}=49{,}5-7{,}5=42(V)$$

$$V_{CD}=R_{10}.I_2=13{,}5(V)$$

$\Rightarrow V_E = V_B - V_{BE} = 54 - 13{,}5 = 40{,}5(V)$

6.3.3 Stimulation





Results of both the rearranged circuit and the original circuit are the same.

6.4 Exercise 4

Given the following circuit, find I_1, I_2, I_3, V_a, and V_b. Present your calculation steps and check them out by performing the simulation.

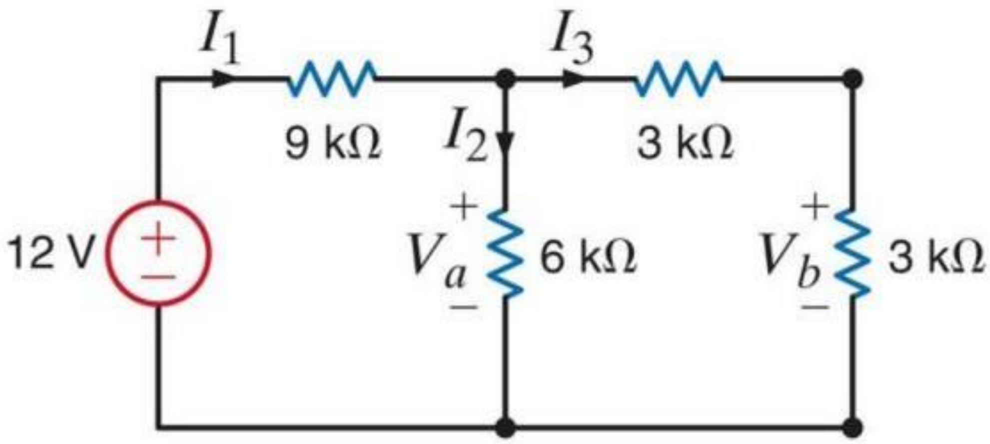


Figure 1.21: Find I_1, I_2, I_3, V_a, and V_b

6.4.1 Calculation

Notes: Explanations, formulas, and equations are expected rather than only results.

We first combine the two 3kΩ resistors in series, then that series branch is parallel with the 6kΩ branch, then add the series 9kΩ.

So the circuit equivalent resistance: $R_{eq} = \frac{(3+3).6}{(3+3)+6} + 9 = 12(k\Omega)$

According to the Ohm's Law and KCL at the top node, we have the second equation: $I_1 = \frac{V_S}{R_{eq}} = \frac{12}{12.10^3} = 12mA$

Node voltage at the top node $V_A = I_1.R_{parallel} = 1mA.3k\Omega = 3V$ with $R_{parallel} = \frac{6.6}{6+6} = 3k\Omega.$

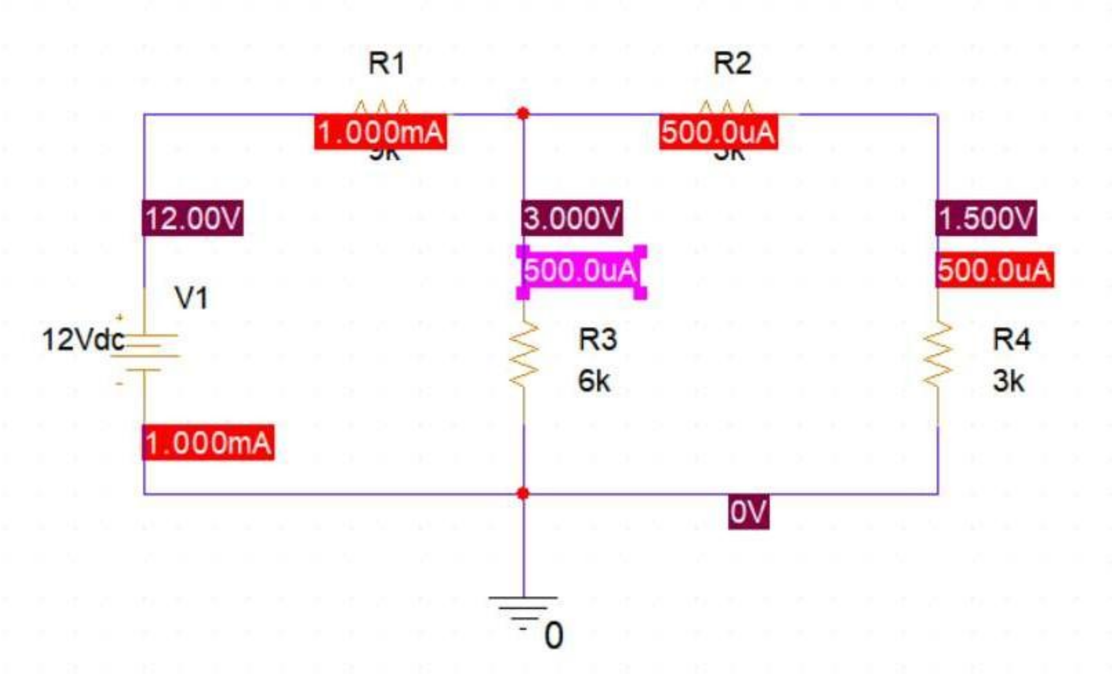
Each branch from that node has the same total resistance (kΩ), so the current split equally:

$$I_2 = \frac{V_a}{6k\Omega} = \frac{3V}{6k\Omega} = 0{,}5mA$$

$$I_3 = \frac{V_a}{6k\Omega} = 0{,}5mA$$

Therefore we have: $R_{eq} = 12k = 12k\Omega, I_1 = 1mA, I_2 = 0{,}5mA, I_3 = 0{,}5mA,$ $V_a = 3V,\ V_b = I_3.3k\Omega = 1{,}5V$

6.4.2 Simulation



The result using simulation tool.

6.5 Exercise 5

Given the network as shown below:

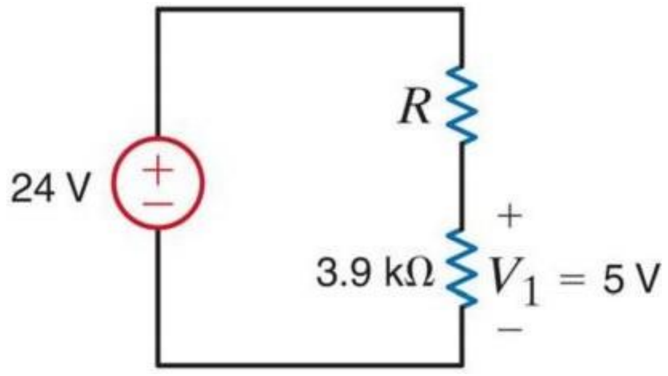


Figure 1.22: Select resistor R from the standard resistors list and do the following requirement.

Notes: Explanations, formulas, and equations are expected rather than only results.

a. Find the required value for the resistor R.

$$I_1 = \frac{V_1}{R_1} = \frac{5}{3900} = \frac{1}{780}(A)$$

$$\Rightarrow R_1 = \frac{V}{I_1} = \frac{24-5}{\frac{1}{780}} = 14820(\boldsymbol{\Omega})$$

b. We have :

$$R_a = 14820.90\% = 13338(\boldsymbol{\Omega})$$

$$R_b = 14820.110\% = 16302(\boldsymbol{\Omega})$$

c. $I_a = \frac{V}{R_a+R_{V_1}} = \frac{24}{13398+3900} = 1{,}39(mA)$

$$V_a = I_a.R_{V_1} = 1{,}39.10^{-3}.3900 = 5{,}429(V)$$

$$I_b = \frac{V}{R_b + R_{V_1}} = \frac{24}{16302 + 3900} = 1{,}188(mA)$$

$$V_b = I_b.R_{V_1} = 1{,}188.10^{-3}.3900 = 4,633(V)$$

d. The percent error in the voltage:

$$E_a = \left|\frac{5{,}459 - 5}{5}\right|.100\% = 8{,}58\%$$

$$E_b = \left|\frac{4{,}633 - 5}{5}\right|.100\% = 7{,}34\%$$

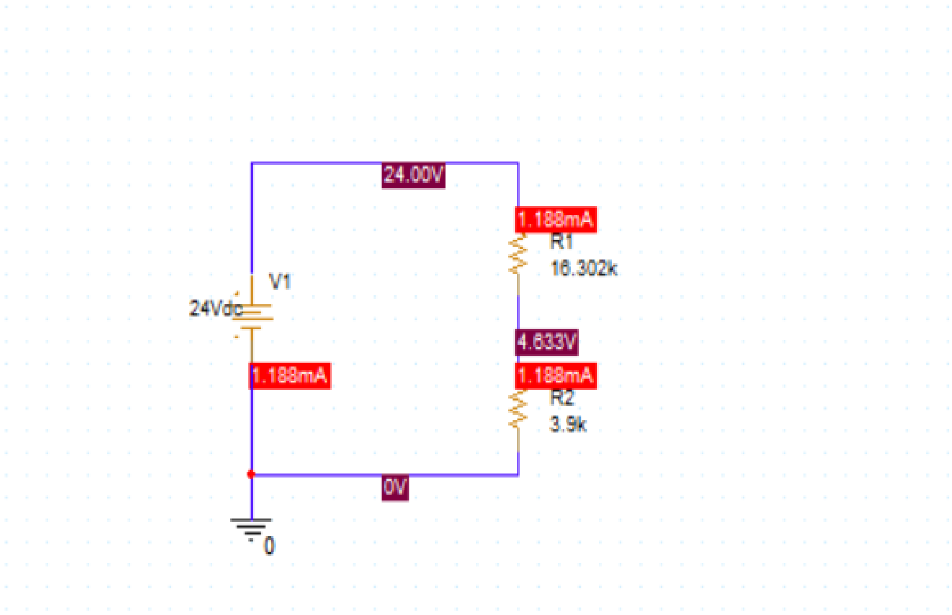
e. The power ratings:

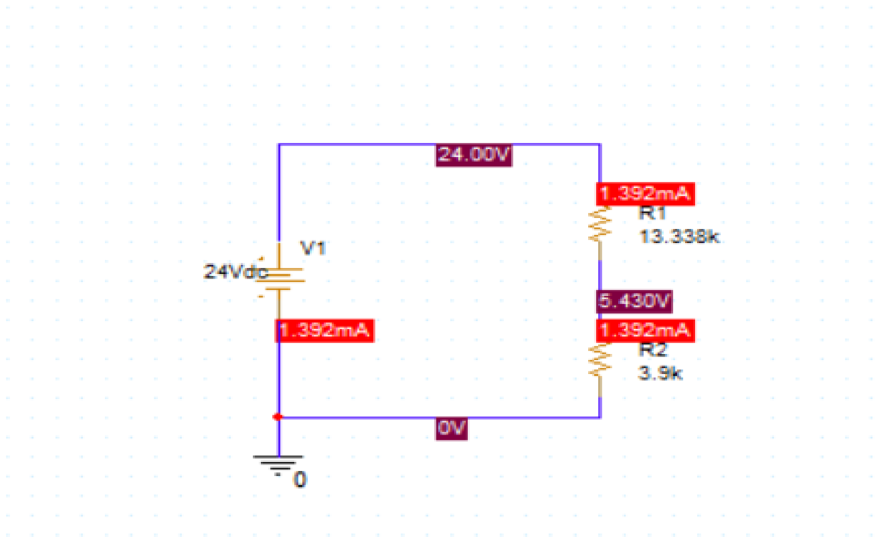
$$P_a = I^2{}_a.R = (1{,}39.10^{-3})^2(13338 + 3900) = 0{,}03(W)$$

$$P_b = I^2{}_b.R = (1{,}188.10^{-3})^2(16302 + 3900) = 0{,}028(W)$$

6.5.1 Simulation

Simulation result (image)





Results on simulation are the same with the calculation above.

6.6 Exercise 6

Given the following circuit. Apply the knowledge you've learned to transform it into another form in which you can find total equivalent resistance R_{ab} more easily. Next, find the value of the current i through the circuit and perform a simulation to check it out.

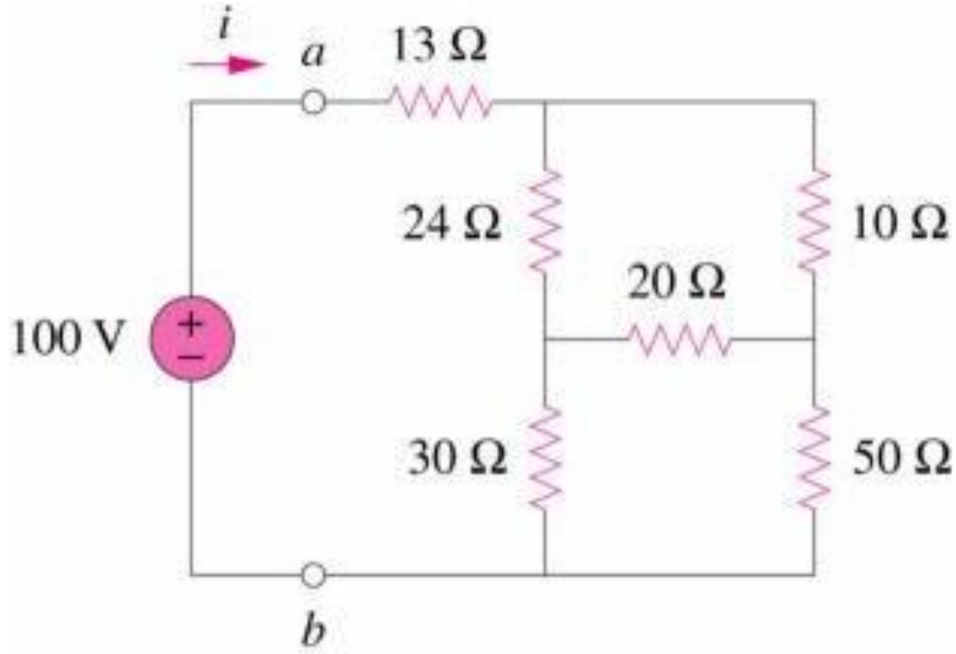
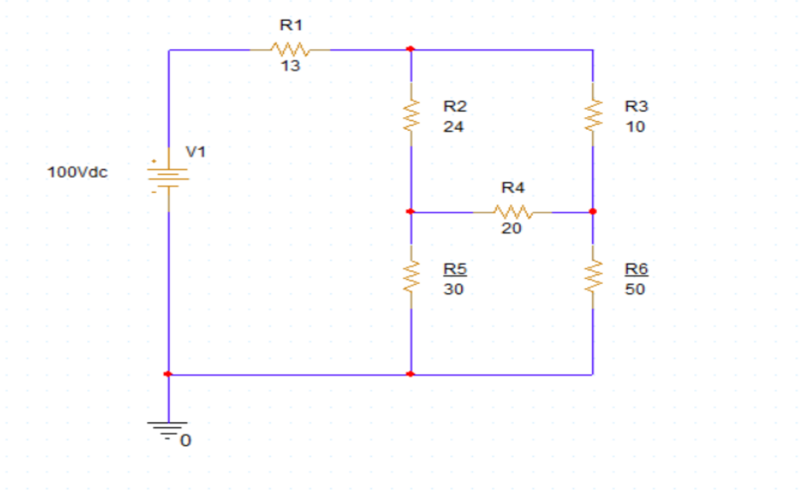


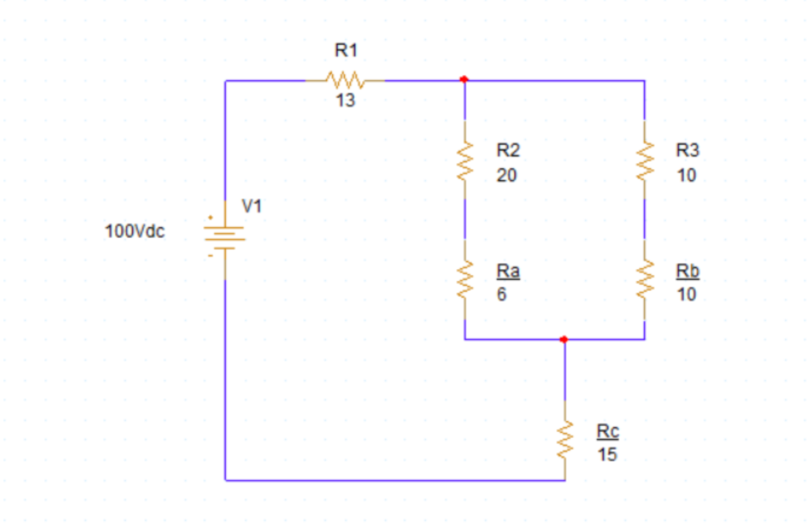
Figure 1.23: Transform the circuit, then find the equivalent resistance R_{ab} and the current i through the circuit.

6.6.1 Circuit transformation

Original Circuit:



Transformed circuit:



Since we have R_4, R_5, R_6 are in delta shape we can turn it into wye shape:

$$R_a = \frac{R_4.R_5}{R_4 + R_5 + R_6} = \frac{20.30}{20 + 30 + 50} = 6(\mathbf{\Omega})$$

$$R_b = \frac{R_4.R_6}{R_4 + R_5 + R_6} = \frac{20.50}{20 + 30 + 50} = 10(\mathbf{\Omega})$$

$$R_a = \frac{R_5.R_6}{R_4 + R_5 + R_6} = \frac{30.50}{20 + 30 + 50} = 15(\mathbf{\Omega})$$

6.6.2 Calculation

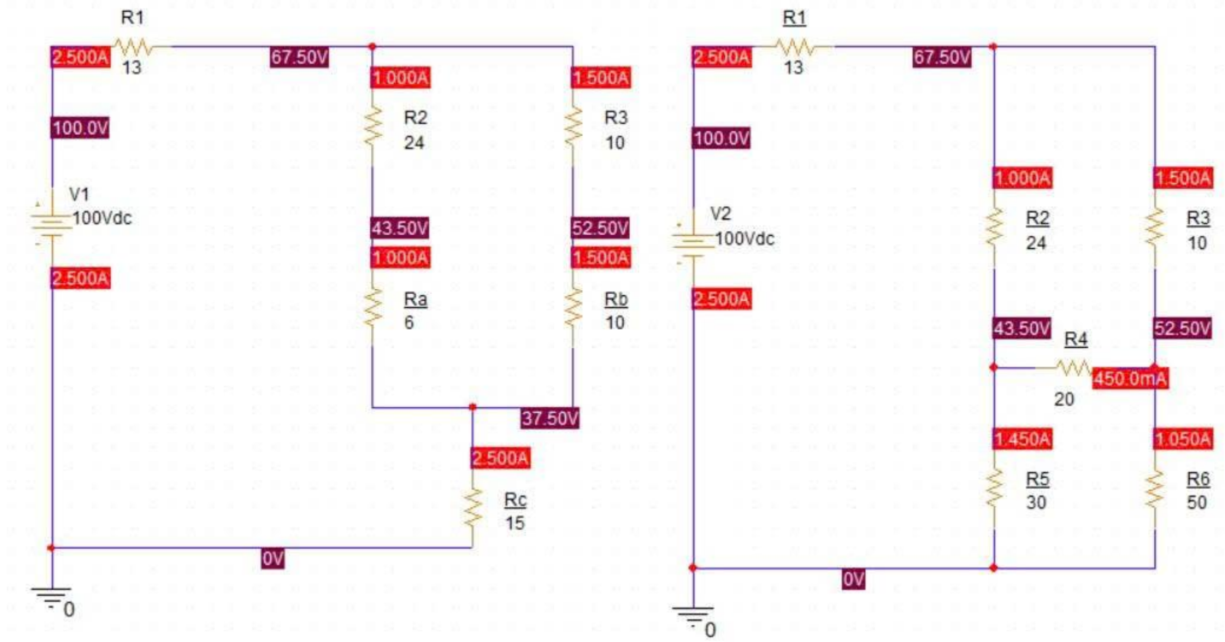
Notes: Explanations, formulas, and equations are expected rather than only results

$$R_{ab} = R_1 + \frac{R_{2a}.R_{3b}}{R_{2a} + R_{3b}} + R_C = 13 + \frac{30.20}{30 + 20} + 15 = 40(\mathbf{\Omega})$$

$$\mathrm{I} = \frac{U}{R_{ab}} = \frac{100}{40} = 2{,}5(A)$$

6.6.3 Simulation

Simulation result (image):



6.7 Exercise 7

Given the following circuit. Apply the knowledge you've learned to transform it into another form in which you can find total equivalent resistance more easily. Next, find the value of the current IS through the circuit and perform a simulation to check it out.

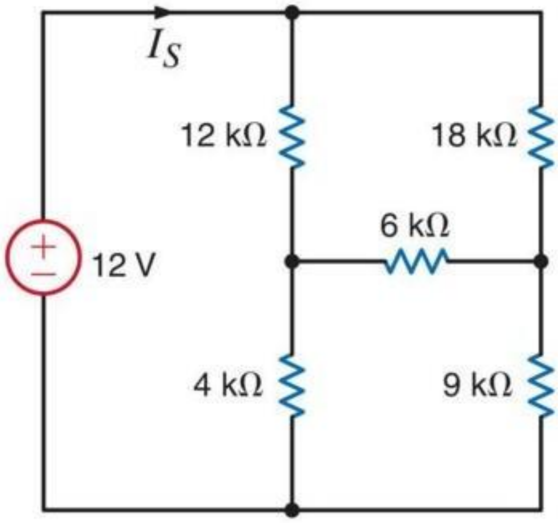
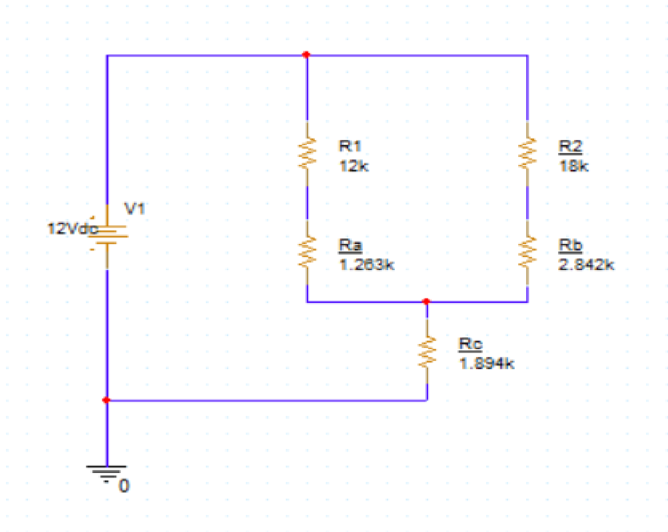


Figure 1.24: Transform the circuit, then find the equivalent resistance and the current I_S through the circuit.

6.7.1 Circuit transformation



The transformed circuit

Since we have R_3, R_4, R_5 are in delta shape, we can turn it into wye shape:

$$R_a = \frac{R_3.R_4}{R_3 + R_4 + R_5} = \frac{6000.4000}{6000 + 4000 + 9000} = 1263(\boldsymbol{\Omega})$$

$$R_b = \frac{R_3.R_5}{R_3 + R_4 + R_5} = \frac{6000.9000}{6000 + 4000 + 9000} = 2842(\boldsymbol{\Omega})$$

$$R_c = \frac{R_4.R_5}{R_3 + R_4 + R_5} = \frac{4000.9000}{6000 + 4000 + 9000} = 1894(\boldsymbol{\Omega})$$

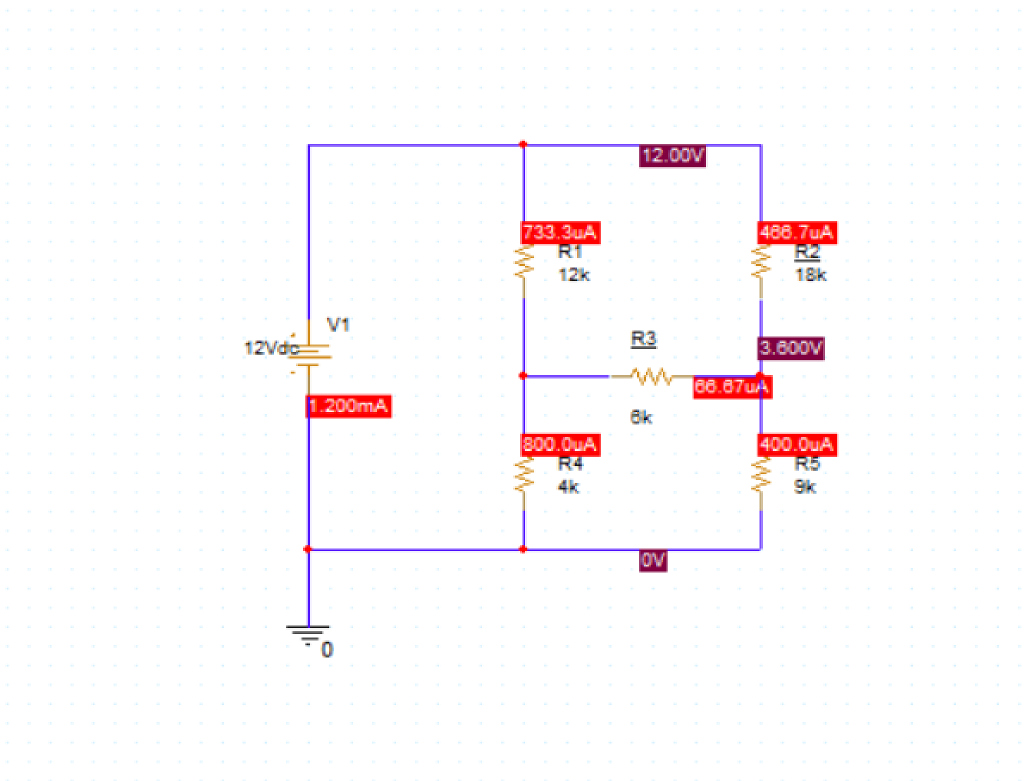
6.7.2 Calculations

$$R_{eq} = \frac{(R_1 + R_a)(R_2 + R_b)}{(R_1 + R_a) + (R_2 + R_b)} + R_C = 10(k\boldsymbol{\Omega})$$

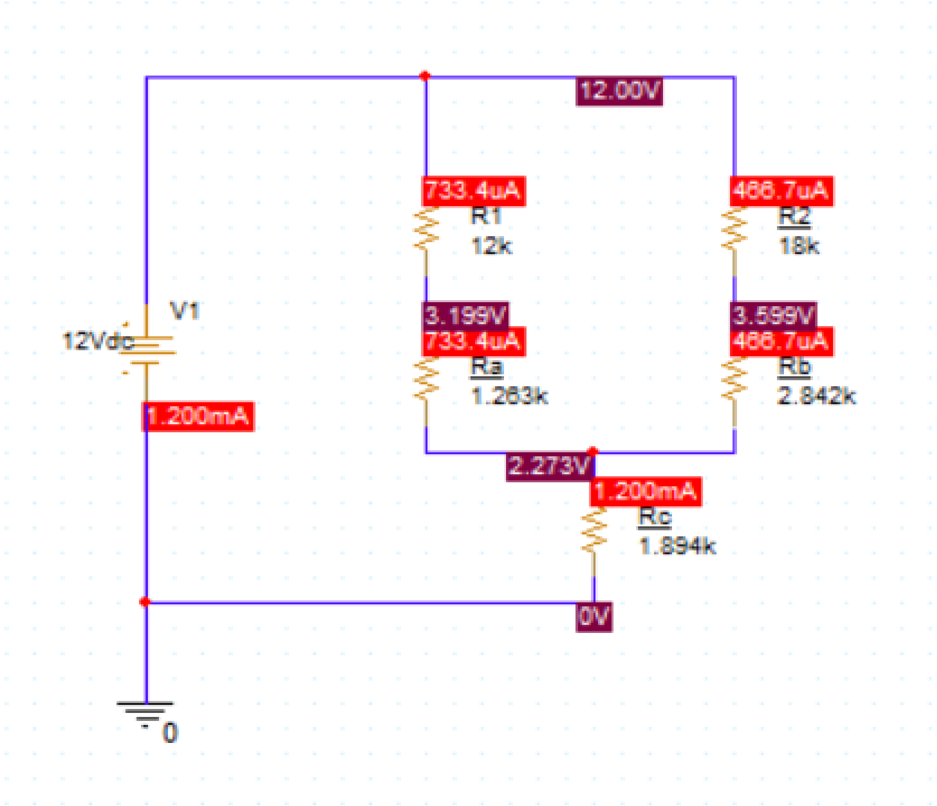
$$I = \frac{V}{R_{eq}} = \frac{12}{10000} = 1{,}2(mA)$$

6.7.3 Simulation

Simulation result (image):



The original circuit



The transformation circuit

6.8 Exercise 8

Given the following circuit with p_2, p_3, and p_4 are absorbing powers of unknown electrical elements. First, use the knowledge you've learned to identify whether they are active or passive elements (supplying or absorbing power). To an element absorbing power, use a pure resistor with a proper value as a representative. To a power element, use an ideal DC voltage source with the corresponding value as a representative. Next, redraw the circuit and calculate the power that each element absorbs. Note that here we use the passive sign convention. Then, perform a simulation with the elements determined by the previous step.

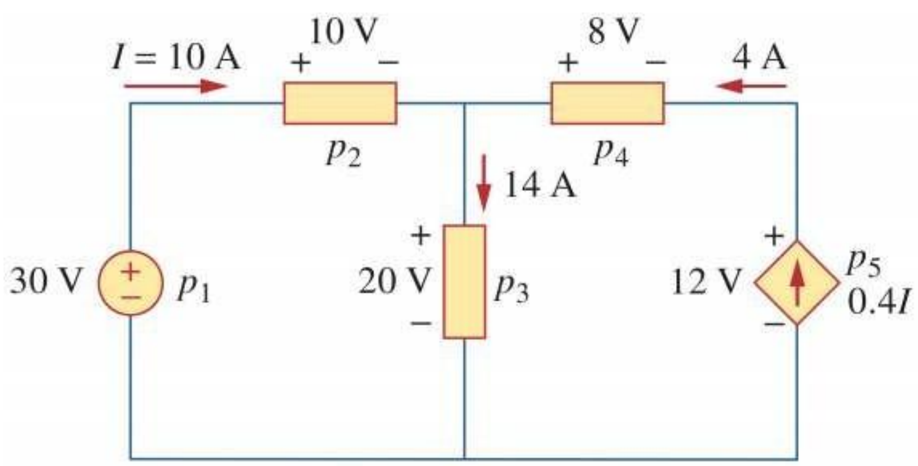


Figure 1.25: Determine the unknown elements and calculate the absorbing power of each

6.8.1 Identifying the unknown elements

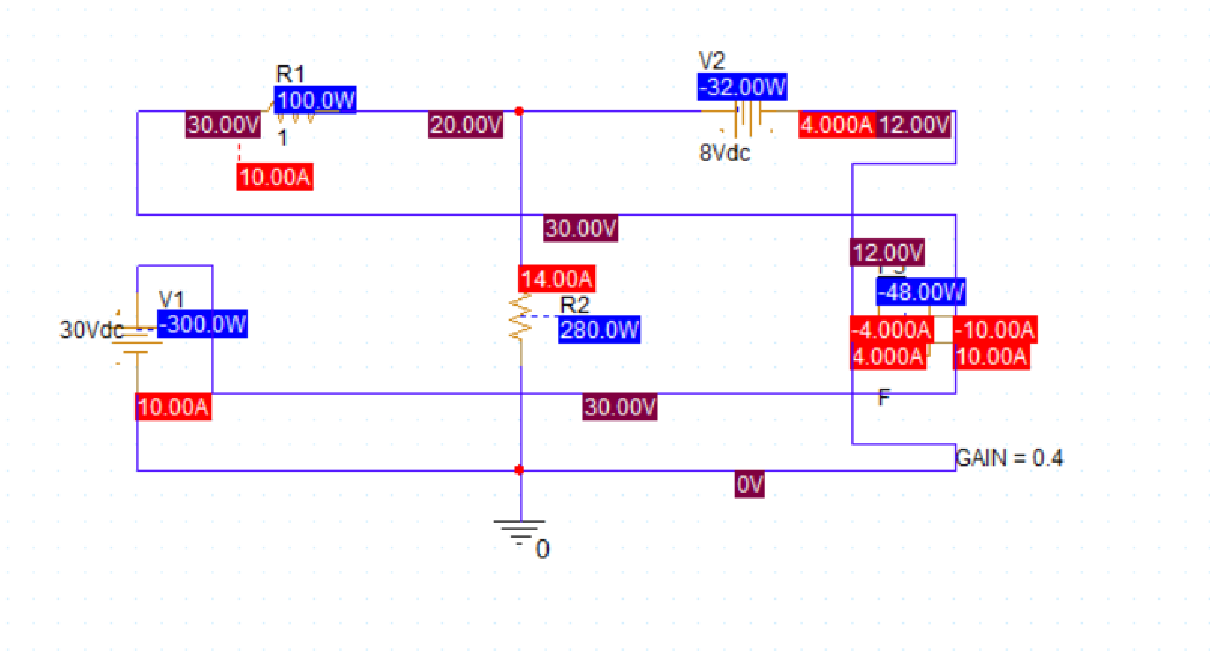
From the figure 1.2.5, we can see that the current 10A go into the positive pole at P_2 so we have $P_2 = U.I = 10.10 = 100(W)$(postive) so P_2 is absorbing. The same with P_3 so $P_2 = U.I = 14.20 = 280(W)$. But we have the current 4A enter the negative pole of P_4 so $P_4 = 4.8 = 32(W)$ so P_4 is a supply element.

6.8.2 Redraw the circuit for simulation

$R_2 = \frac{U_2}{I} = \frac{10}{10} = 1(\mathbf{\Omega})$, $R_3 = \frac{U_3}{I_3} = \frac{20}{14} = \frac{10}{7}(\mathbf{\Omega})$

We replace the P_2, P_3 with pure resistors with resistance $1\mathbf{\Omega}$ and $\frac{10}{7}(\mathbf{\Omega})$ respectively

We replace the P_4 with DC have 8V.



The simulation's result

6.9 Exercise 9

Given the following circuit. Find the voltage v and the current i_x. According to the result, determine the elements whose absorbing power respectively p_1 and p_2 are active or passive (calculations are required). Note that here we use the passive sign convention. If an element consumes power, use a pure resistor with an appropriate value as a representative. If it is a power supply element, use a corresponding ideal DC voltage source to represent it. Perform a simulation to check how the circuit works.

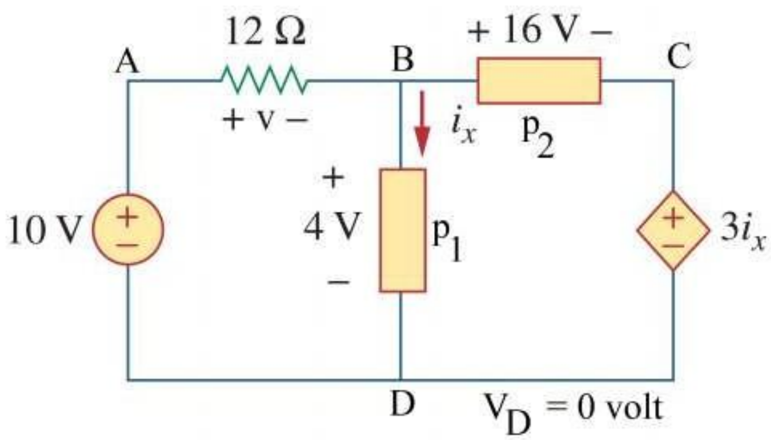


Figure 1.26: Find the unknown elements and variables, then check them out by simulation

6.9.1 Calculation

Notes: Explanations, formulas, and equations are expected rather than only results.

We have:

V= voltage across the 12 Ω resistor (marked + at A, -at B)

Formula $V = V_A - V_B$

So $V = V_A - V_B = 10 - 4 = 6(V)$

I_x= current defined in the problem as the current through the vertical 4-V element, positive downward (B→D)

Relation from dependent source: the right-hand dependent voltage source gives $V_C - V_D = 3I_x$

Also $V_D = 0$ (and from the 16-V source $V_B - V_C = 16$ so $V_C = V_B - 16$. With $V_B = 4V$ we get

$V_C = 4 - 16 = -12(V)$

So $I_x = \frac{V_C - V_D}{3} = \frac{-12-0}{3} = -4(A)$

We have: P_1 = power for the 4V element using passive sign convention $P_1 = V_{BP}.I$ where $V_{BP} = +4V$ and I is the current entering the + terminal

So $P_1 = 4.I_x = 4.(-4) = -16(W)$

Interpretation $P_1 < 0$ so the element is supplying 16W.

I_{AB}=current through the 12 Ω resistor from A→B (positive from A to B). Use Ohm's law

$$I_{AB} = \frac{V_A - V_B}{12} = \frac{6}{12} = 0{,}5(A)$$

I_{BC} = current through the 16W source (top branch) from B→C. Use KCL at node B. Current is leaving node B through resistor B→A in $\frac{V_B - V_A}{12}$, through the top source I_{16}(B→C), and through the downward 4-V element (B→D) which is I_x. KCL given:

$\frac{V_B - V_A}{12} + I_{16} + I_x$=0

So $I_{16} = -\frac{V_B - V_A}{12} - I_x = -\frac{4-10}{12} - (-4) = 4{,}5(A)$

So $I_{BC} = I_{16} = 4.5(A)$ (B→C)

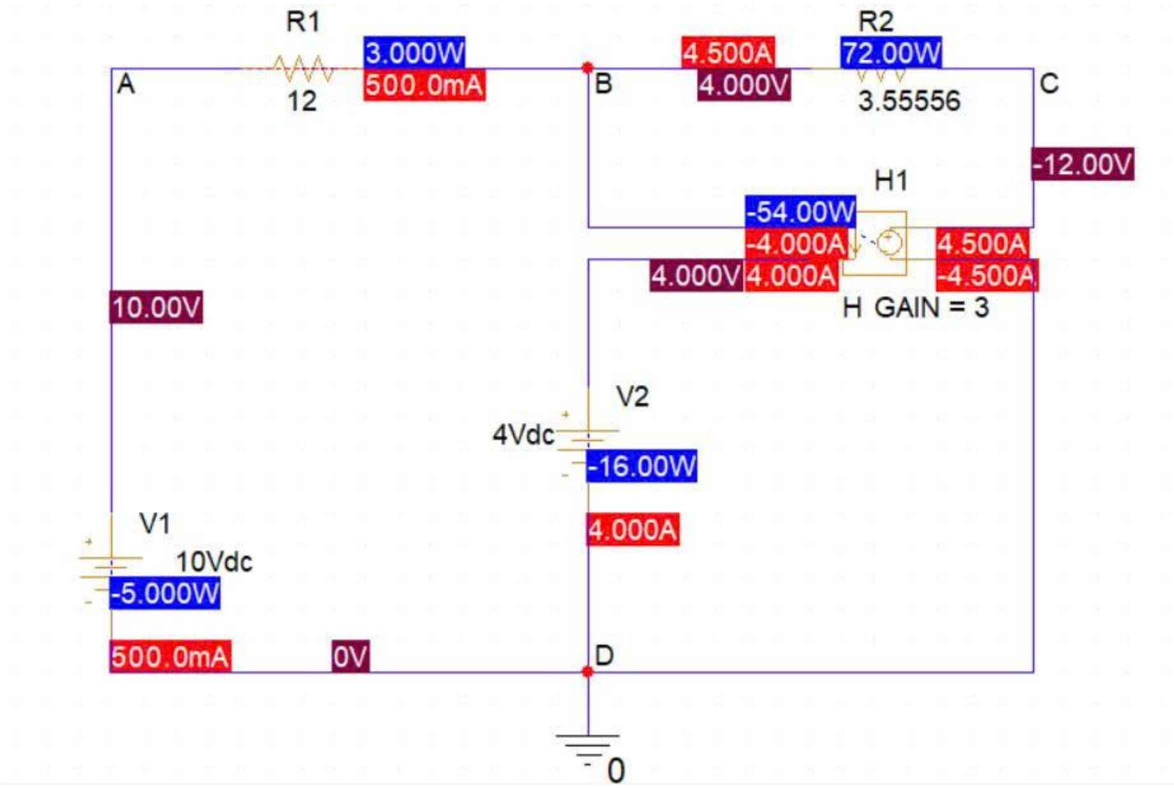
P_2= power for the 16V element (+at A, - at C) using passive sign convention

$P_2 = V_{BC}.I_{16} = 16.4{,}5 = 72(W)$

$P_2 > 0$, the 16 V source is absorbing 72W

V_{CD} =voltage from C to D. We got $V_C = -12V$, $V_D = 0$. So $V_{CD} = V_C - V_D = -12(V)$

6.9.2 Simulation



The result in the simulation match with what we found

6.10 Exercise 10

Given the following circuit. Find the voltage V. You can do this in any way but remember to explain it in detail. Then simulate the circuit to check the result.

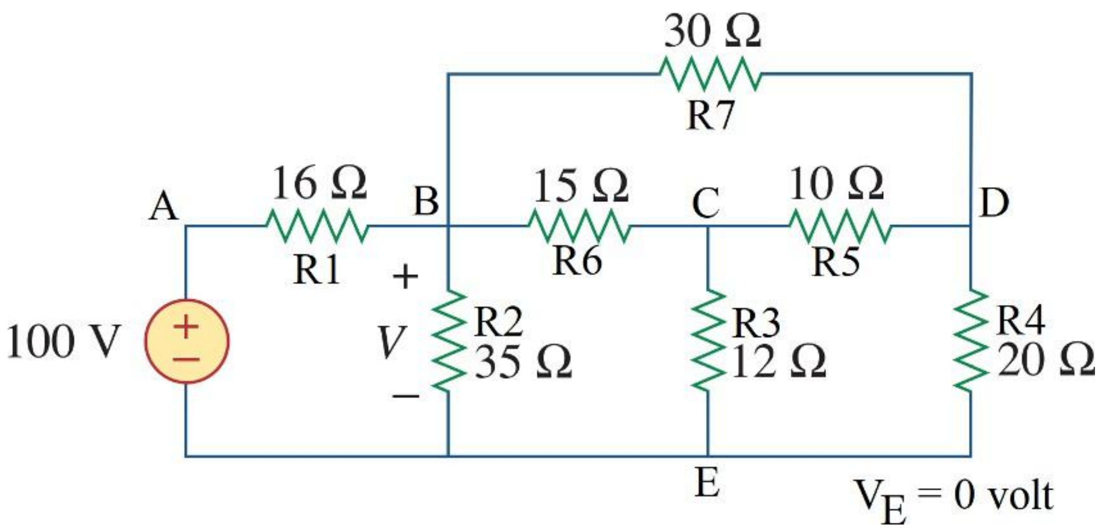
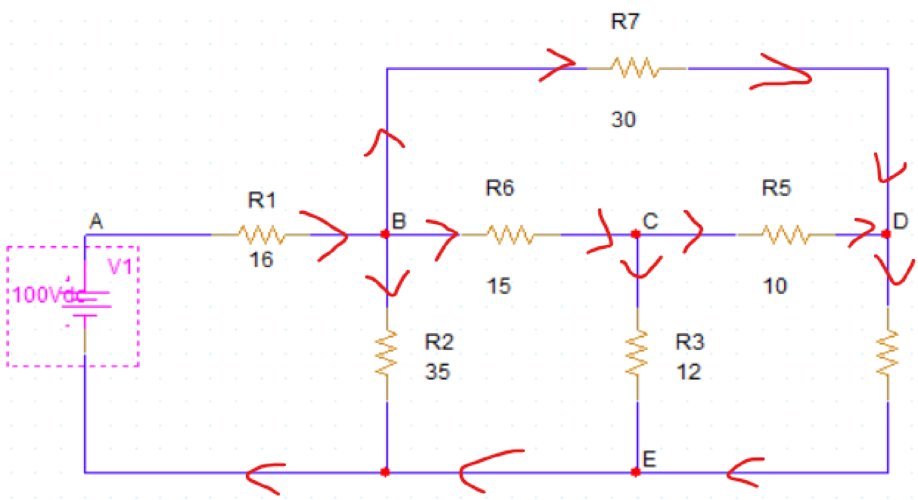


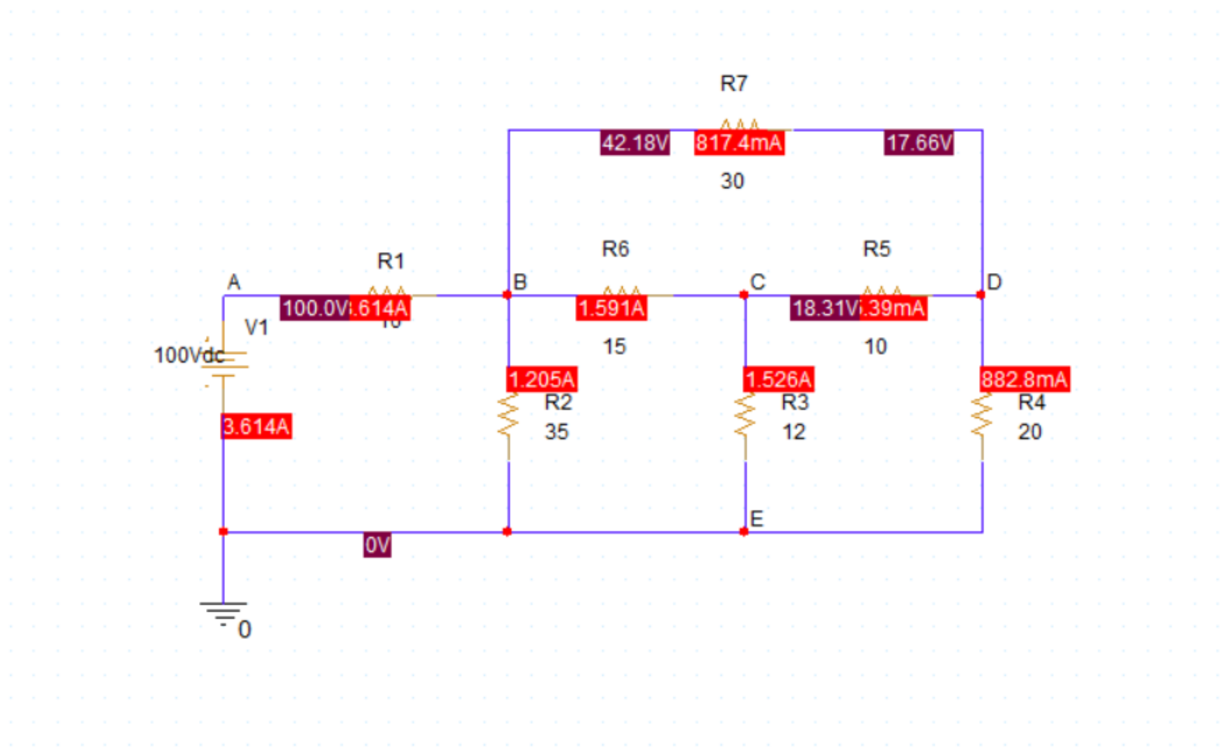
Figure 1.28: Find the voltage V

Answer:



Apply KVL for each loop, we have:
(1) $16I_1 + 35(I_1 - I_4) - 100 = 0$
$\Longrightarrow 51I_1 - 35I_4 = 100$
(2) $15I_2 + 10(I_2 - I_3) + 30(I_2 - I_4) = 0$
$\Longrightarrow 55I_2 - 10I_3 - 30I_4 = 0$
(3) $12I_3 + 10(I_3 - I_2) + 20(I_3 - I_4) = 0$
$\Longrightarrow -10I_2 + 42I_3 - 20I_4 = 0$
(4) $30(I_4 + I_2) + 10(I_4 - I_3) + 35(I_4 - I_1) = 0$
$\Longrightarrow -35I_1 - 30I_2 - 20I_3 + 85I_4 = 0$
From (1), (2), (3), (4) $\Longrightarrow I_1 = 3{,}61\ A, I_2 = 1{,}59\ A, I_3 = 1{,}52\ A, I_4 = 2{,}4\ A$
$\Rightarrow V = R_2.I_{R_2} = 35.(3{,}613 - 2{,}408) = 42{,}175(V)$

Checking the results using simulation:



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