Circuit theorems 001

Problem has been graded.

A linear system has two inputs, v_a and v_b, and one output, v_{out} .
When $v_a = v_1$ and $v_b = v_2$, then $v_{out} = v_3$.
When $v_a = v_4$ and $v_b = v_5$, then $v_{out} = v_6$.

What is v_{out}, when $v_a = v_7$ and $v_b = v_8$?

Given Variables:

v1 : 3 V

v2 : 6 V

v3 : 12 V

v4 : 3 V

v5 : 4 V

v6 : 48 V

v7 : 3 V

v8 : 2 V

Calculate the following:

vout (V) :

Hint: Use the fact that the system is linear

A linear system as two inputs, v_a and v_b, and one output, v_{out} .
When $v_a = v_1$ and $v_b = v_2$, then $v_{out} = v_3$.
When $v_a = v_4$ and $v_b = v_5$, then $v_{out} = v_6$.

What is v_{out}, when $v_a = v_7$ and $v_b = v_8$?

v1 = 8 V

v2 = 0 V

v3 = 56 V

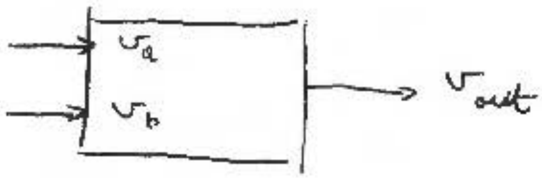
v4 = 0 V

v5 = -9 V

v6 = 45 V

v7 = 5 V

v8 = 8 V



$$a \cdot v_a + b v_b = v_{out}$$

$$\begin{cases} a \cdot 8 + b \cdot 0 = 56 \\ a \cdot 0 + b(-9) = 45 \end{cases}$$

$$\Rightarrow \begin{cases} a = \frac{56}{8} = 7 \\ b = \frac{45}{-9} = -5 \end{cases}$$

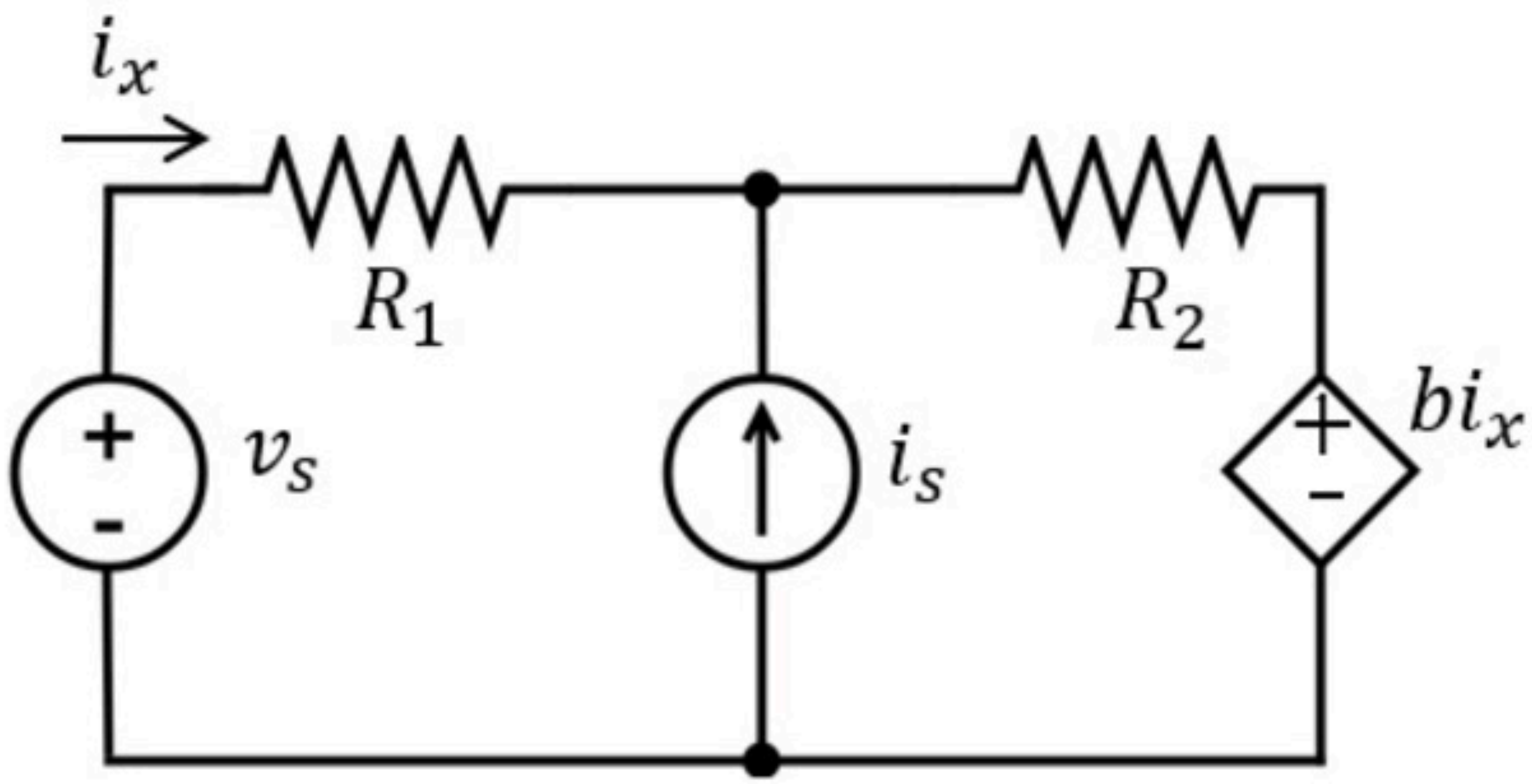
$$\Rightarrow a \cdot v_a + b v_b = 7 \cdot 5 + (-5) \cdot 8$$
$$= -5 V$$

$$\boxed{v_{out} = -5 V}$$

Circuit theorems 002

Problem has been graded.

Use superposition to find i_x.



Given Variables:

R1 : 3 ohm

R2 : 4 ohm

b : 4 V/A

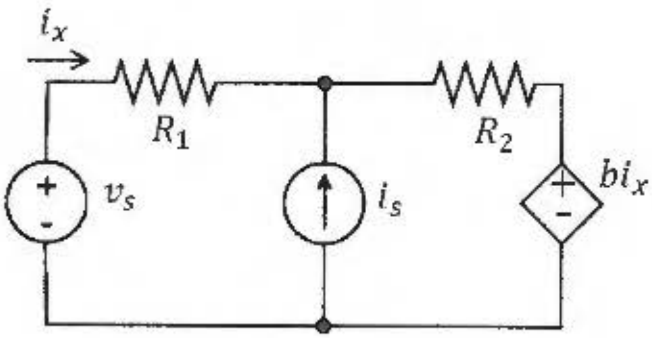
vs : 15 V

is : 1 A

Calculate the following:

ix (A) :

Use superposition to find i_x.



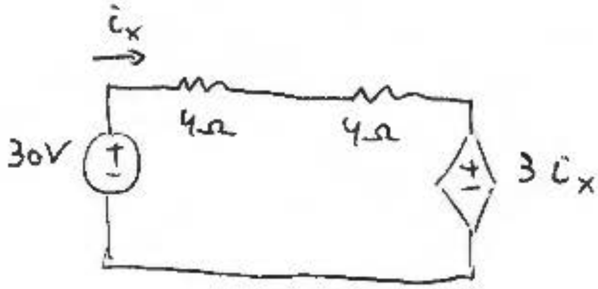
R1 = 4 ohm

R2 = 4 ohm

b = 3 V/A

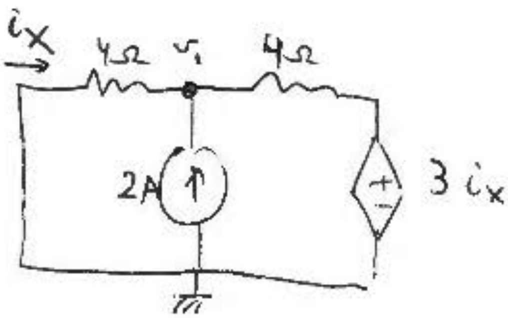
vs = 30 V

is = 2 A



$$\text{KVL: } 30 = i_x \cdot 4 + i_x \cdot 4 + 3i_x$$

$$i_x = \frac{30}{11} \text{ A}$$



$$i_x = -\frac{v_1}{4}$$

$$\text{nodal: } \frac{v_1}{4} - 2 + \frac{v_1 - 3i_x}{4} = 0$$

$$v_1 - 8 + v_1 - 3\left(\frac{-v_1}{4}\right) = 0$$

$$11 v_1 = 32$$

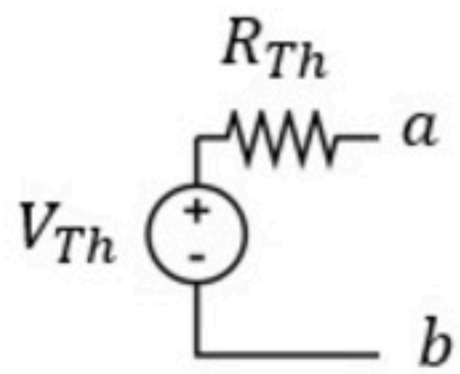
$$v_1 = \frac{32}{11} \Rightarrow i_x = -\frac{8}{11} \text{ A}$$

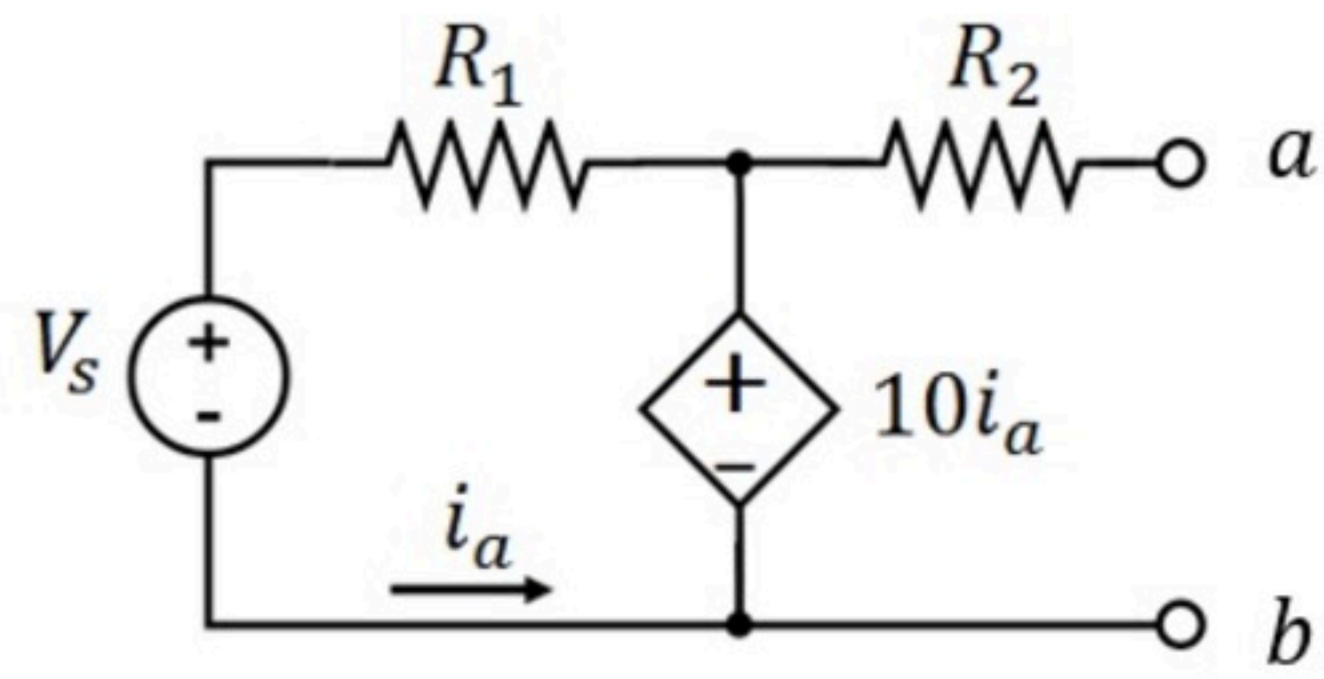
$$i_x = \frac{30}{11} - \frac{8}{11} = \frac{22}{11} \text{ A} \quad \Rightarrow \boxed{i_x = 2\text{A}}$$

Circuit theorems 003

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

R1 : 9 ohm

R2 : 2 ohm

Vs : 5 V

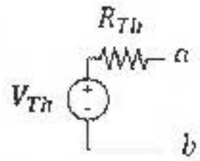
Calculate the following:

Vth (V) :

Rth (ohm) :

Hint: Find any two of Voc, Isc and Req

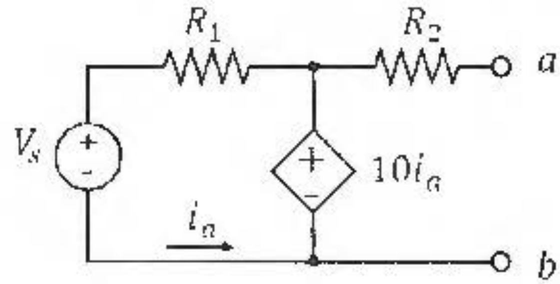
Find the Thevenin equivalent model of this circuit, as seen between a and b.

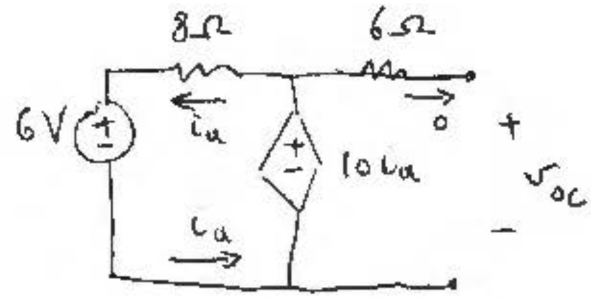


R1 = 8 ohm

R2 = 6 ohm

Vs = 6 V

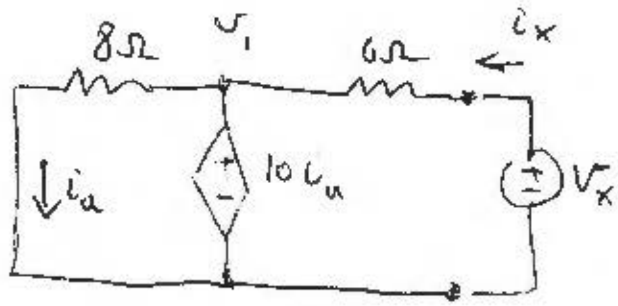




$$i_a = \frac{10 i_a - 6}{8}$$

$$2 i_a = 6 \Rightarrow i_a = 3\text{ A}$$

$$v_{oc} = 10 i_a = 30\text{ V}$$



$$v_1 = 10 i_a = 8 i_a$$

$$2 i_a = 0 \Rightarrow i_a = 0$$

$$\Rightarrow i_x = \frac{v_x - 0}{6}$$

$$\Rightarrow \frac{v_x}{i_x} = 6\ \Omega$$

$$\boxed{R_{TH} = 6\ \Omega}$$

$$\boxed{V_{TH} = 30\text{ V}}$$

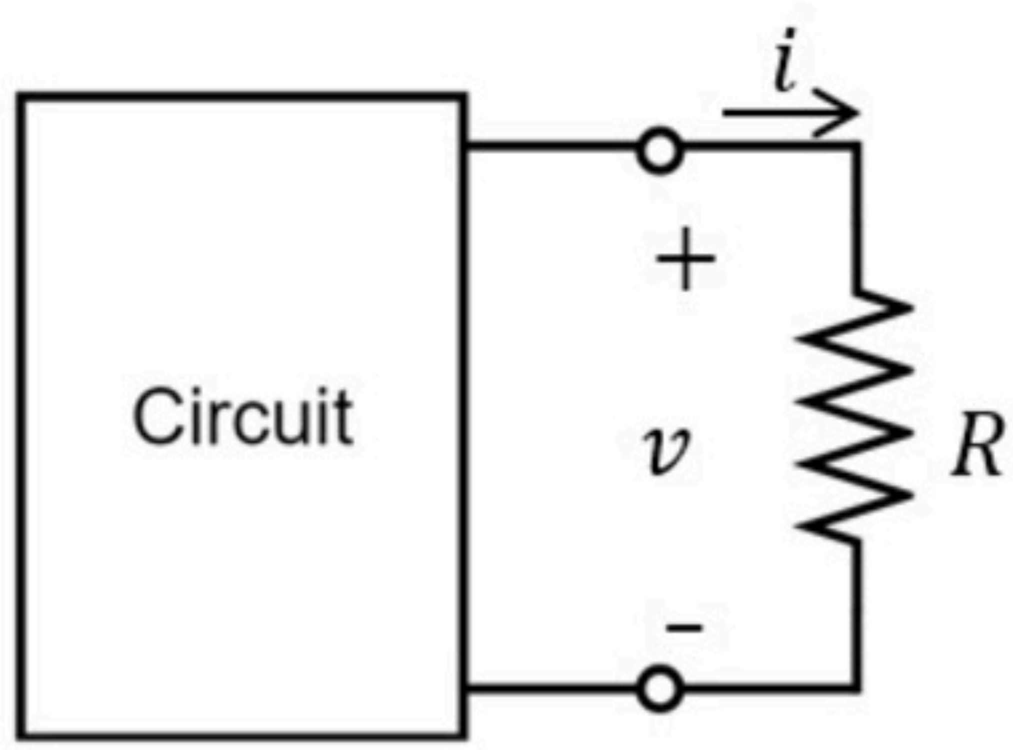
Circuit theorems 004

Unlimited Attempts.

The box contains a linear circuit.
When $R = R_1$, we measure $i = I_1$.
When $R = R_2$, we measure $i = I_2$.

What value of $R = R_3$ results in $i = I_3$?

What is the maximum value of $i = i_{max}$ that can be achieved (assuming of $R \geq 0$)?



Given Variables:

R1 : 1 ohm

R2 : 3 ohm

I1 : 10 A

I2 : 6 A

I3 : 2 A

Calculate the following:

R3 (ohm) :

imax (A) :

Hint: Replace the circuit by its Thevenin model

The box contains a linear circuit.
When $R = R_1$, we measure $i = I_1$.
When $R = R_2$, we measure $i = I_2$.

What value of $R = R_3$ results in $i = I_3$?

What is the maximum value of $i = i_{max}$ that can be achieved (assuming of $R \geq 0$)?

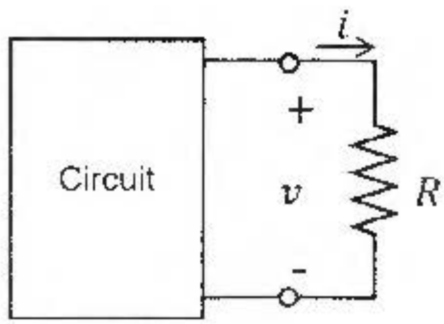
R1 = 5 ohm

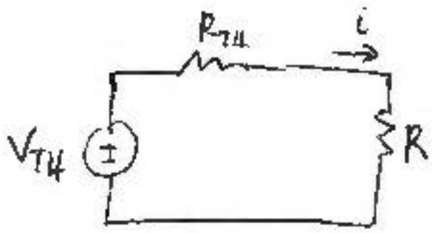
R2 = 8 ohm

I1 = 4 A

I2 = 3 A

I3 = 2 A





① $4 = \dfrac{V_{TH}}{R_{TH} + 5} \Rightarrow 4R_{TH} + 20 = V_{TH}$

② $3 = \dfrac{V_{TH}}{R_{TH} + 8} \Rightarrow 3R_{TH} + 24 = V_{TH}$

$\overset{(1)-(2)}{\Longrightarrow}$ $R_{TH} = 4\,\Omega$

$V_{TH} = 36\,V$

ⓐ $I_3 = 2 = \dfrac{V_{TH}}{R_{TH} + R} = \dfrac{36}{4 + R} \Rightarrow R + R_{TH} = 18 \Rightarrow \boxed{R = 14\,\Omega}$

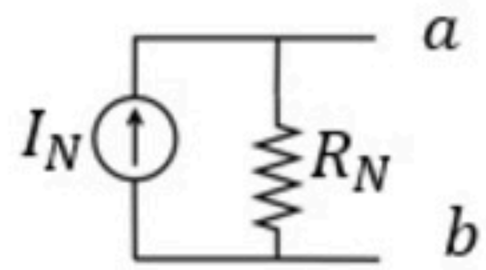
ⓑ i_{MAX} WHEN $R = 0 \Rightarrow i_{MAX} = \dfrac{V_{TH}}{R_{TH}} = \dfrac{36}{4} = 9$

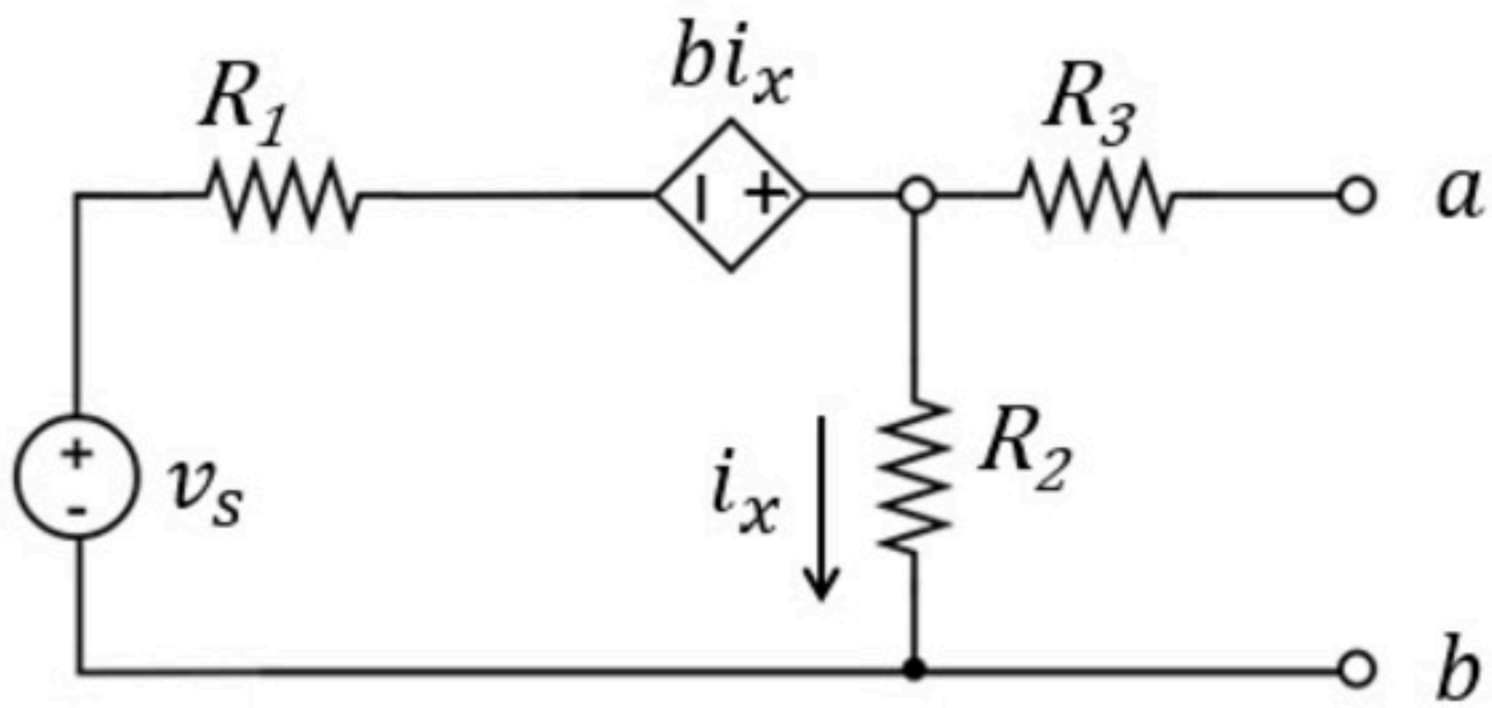
$\boxed{i_{MAX} = 9\,A}$

Circuit theorems 005

Problem has been graded.

Find the Norton equivalent model of this circuit, as seen between a and b.





Given Variables:

R1 : 2 ohm

R2 : 6 ohm

R3 : 3 ohm

vs : 18 V

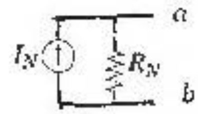
b : 6 V/A

Calculate the following:

IN (A) :

RN (ohm) :

Find the Norton equivalent model of this circuit, as seen between a and b.



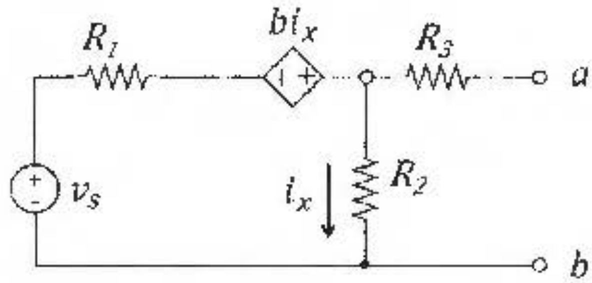
R1 = 2 ohm

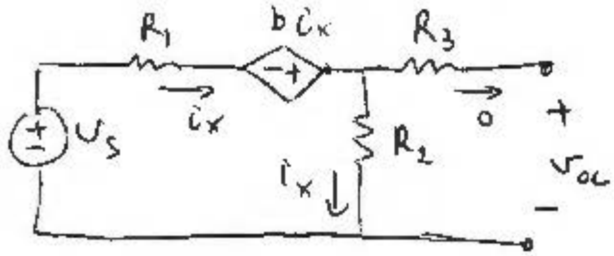
R2 = 4 ohm

R3 = 4 ohm

vs = 12 V

b = 2 A/V

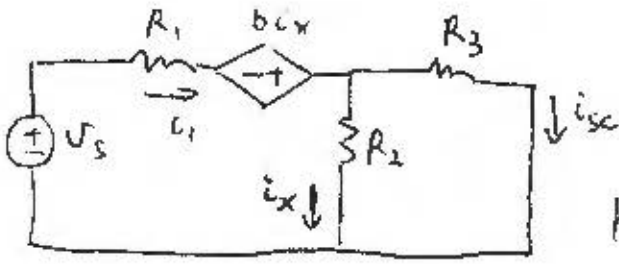




KVL: $v_s - R_1 i_x + b i_x - R_2 i_x = 0$

$12 - \cancel{2 i_x} + \cancel{2 i_x} - 4 i_x = 0$

$i_x = 3A \Rightarrow v_{oc} = R_2 i_x$
$= 12\,V$



$i_x = \frac{R_3}{R_2+R_3} i_1 = \frac{4}{8} i_1 \Rightarrow i_x = \frac{i_1}{2}$

KVL: $v_s - R_1 i_1 + b i_x - R_2 i_x = 0$

$12 - 2 \cdot 2 \cdot i_x + 2 \cdot i_x - 4 i_x = 0$

$6 i_x = 12 \Rightarrow i_x = 2A$

$i_{sc} = i_1 - i_x = 2A$

$v_{oc} = 12V$

$i_{sc} = 2A$

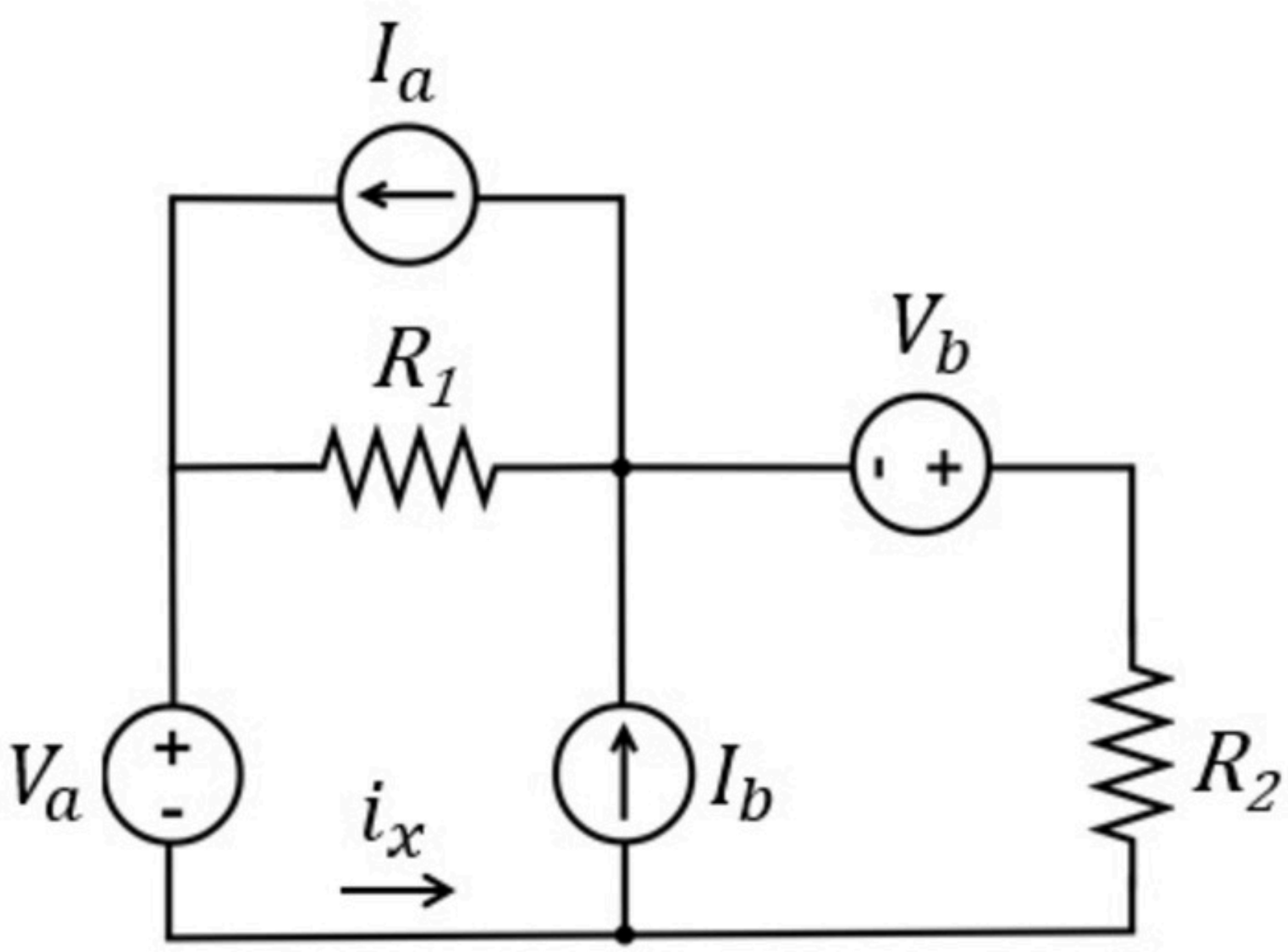
$\Rightarrow \boxed{I_N = 2A}$

$R_N = \frac{v_{oc}}{i_{sc}} = 6\,\Omega \Rightarrow \boxed{R_N = 6\,\Omega}$

Circuit theorems 006

Problem has been graded.

Use source transformations to find the current i_x.



Given Variables:

Va : 12 V

Vb : 6 V

Ia : 5 A

Ib : 2 A

R1 : 15 ohm

R2 : 12 ohm

Calculate the following:

ix (A) :

Use source transformations to find the current i_x.

Va = 12 V

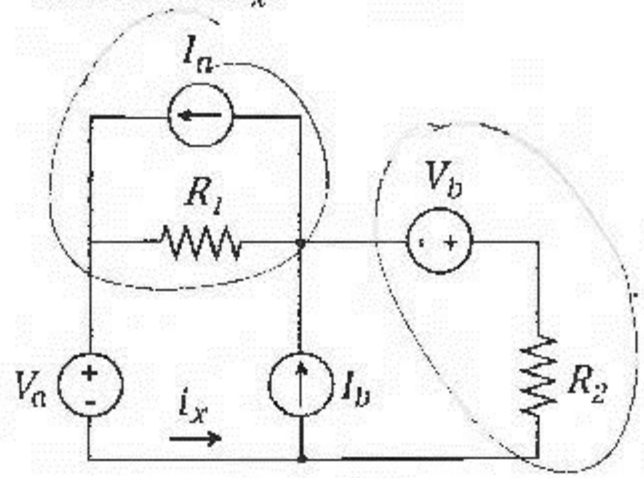
Vb = 6 V

Ia = 4 A

Ib = 6 A

R1 = 3 ohm

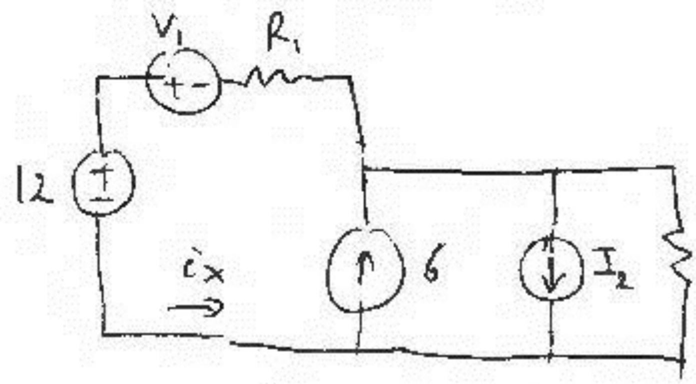
R2 = 3 ohm

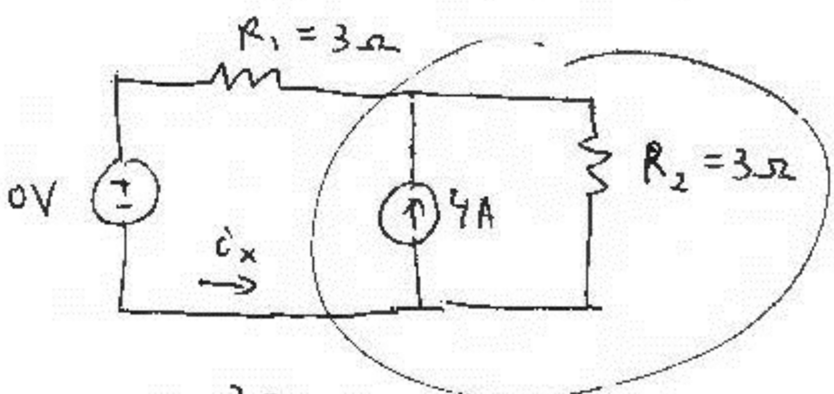


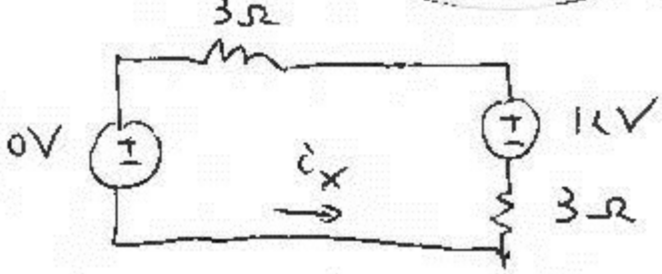
$$V_1 = I_a \cdot R_1 = 4 \cdot 3 = 12V$$

$$I_2 = \frac{V_b}{R_2} = \frac{6}{3} = 2A$$

R_2







$$i_x = \frac{12V}{6\Omega} = 2A$$

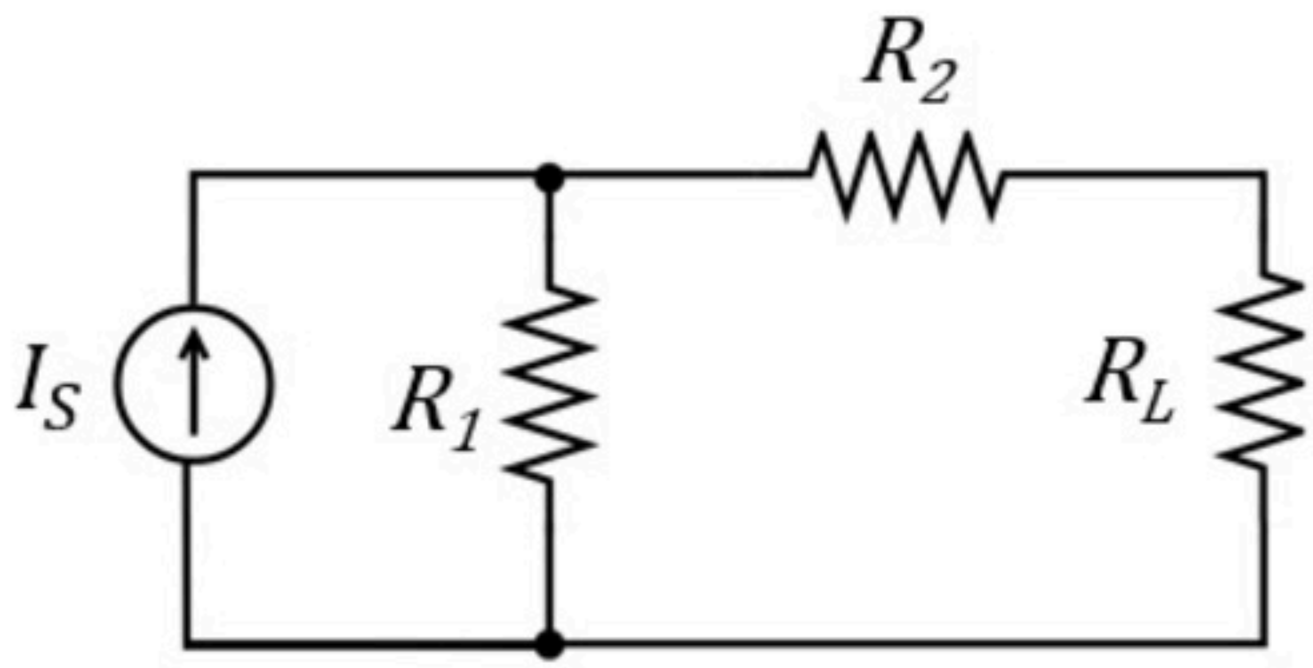
$$\boxed{i_x = 2A}$$

Circuit theorems 007

Unlimited Attempts.

Find the R_L for maximum power transfer.

Find the max power transferred to R_L.



Given Variables:

Is : 12 A

R1 : 4 ohm

R2 : 12 ohm

Calculate the following:

RL (ohm) :

Pmax (W) :

Hint: Replace the circuit (without the load) by its Thevenin model.

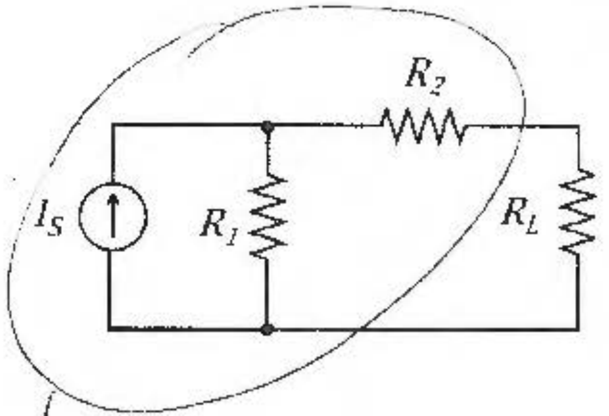
Find the R_L for maximum power transfer.

Given I_S , find the max power transferred to R_L.

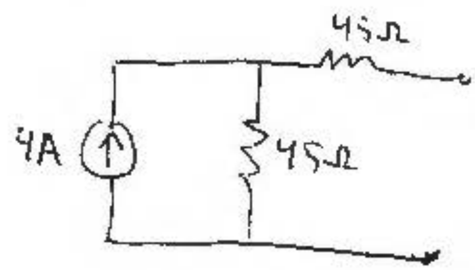
Is = 4 A

R1 = 45 ohm

R2 = 45 ohm

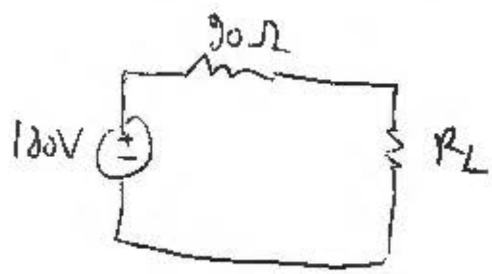


FIND THEVENIN MODEL



$v_{oc} = 4 \cdot 45 = 180V$

$R_{TH} = 45 + 45 = 90\Omega$



FOR MAX POWER TRANSFER

$R_L = R_{TH} = 90\Omega$

$\boxed{R_L = 90\Omega}$

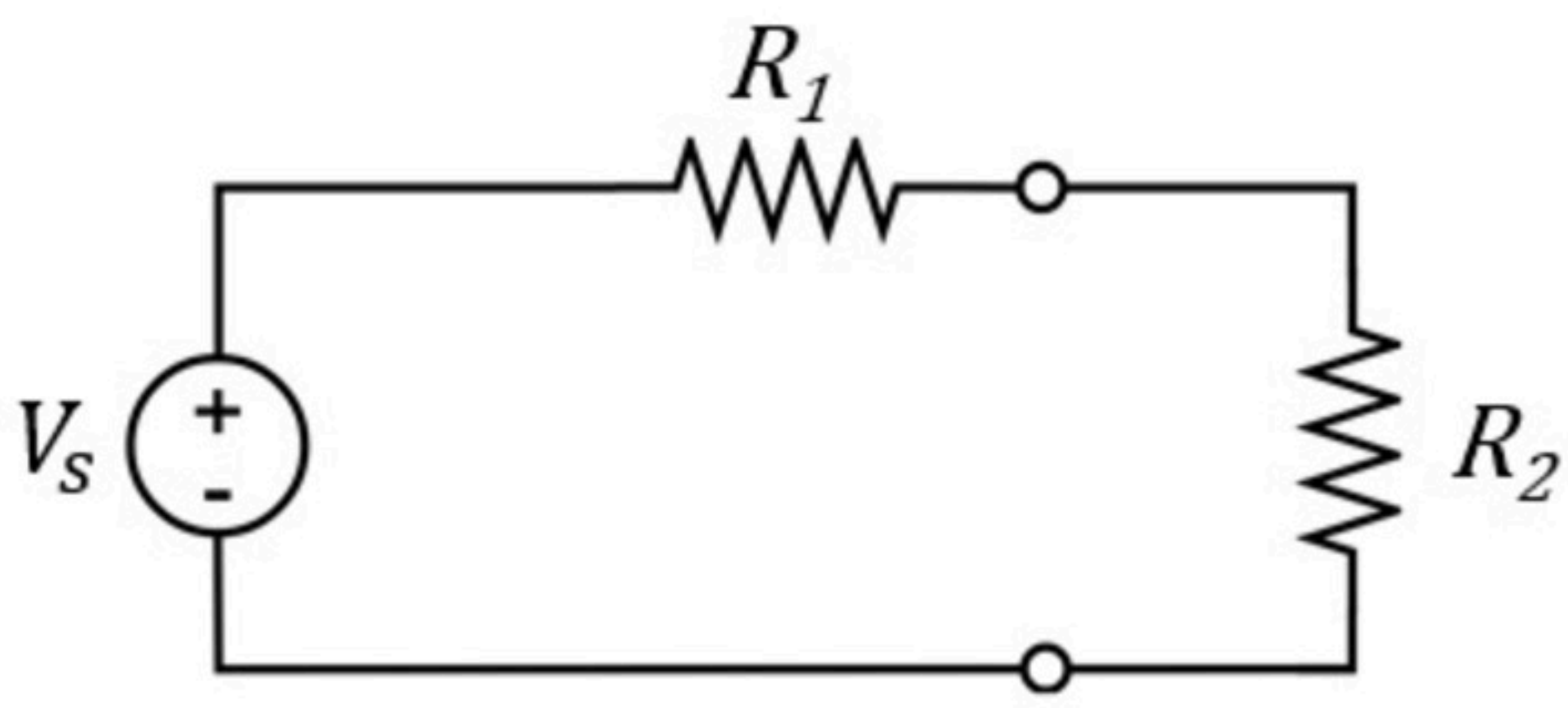
$P = R_L \cdot i^2 \qquad i = \frac{180}{90 + R_L} = 1A$

$\boxed{P_{MAX} = 90W}$

Circuit theorems 008

Problem has been graded.

Determine the resistance R_1 such that the power dissipated in R_2 is maximum.



Given Variables:

Vs : 12 V

R2 : 7 ohm

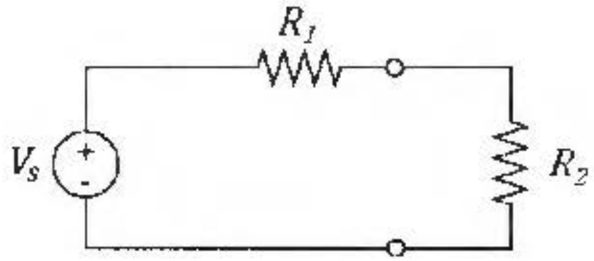
Calculate the following:

R1 (ohm) :

Determine the resistance R_1 such that the power dissipated in R_2 is maximum.

Vs = 12 V

R2 = 3 ohm



$$i = \frac{V_s}{R_1 + R_2}$$

$$P = R_2 \, i^2 = \frac{R_2 \, V_s^2}{(R_1 + R_2)^2}$$

$$P = \frac{3 \cdot 144}{(R_1 + 3)^2}$$

$$\frac{dP}{dR_1} = -2 \cdot \frac{3 \cdot 144}{(R_1 + 3)^3} = 0 \iff R_1 = \infty$$

$\rightarrow$ ALWAYS DECREASING

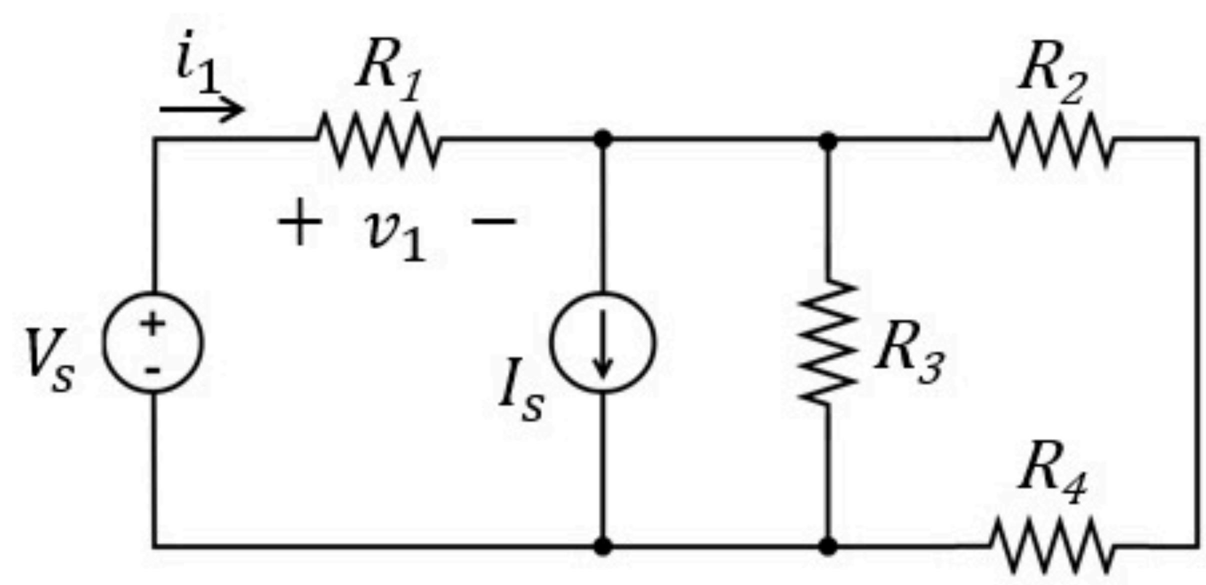
P_{MAX} WHEN $\boxed{R_1 = 0 \, \Omega}$

Circuit theorems 009

Unlimited Attempts.

The resistance R_1 is a variable resistor that can take on values in the range $0 \leq R_1 \leq 24\Omega$.

1. Find the value of $R_1 = R_{1a}$ that maximizes current i_1 and the resulting maximum current $i_1 = i_{1a}$.
2. Find the value of $R_1 = R_{1b}$ that maximizes voltage v_1 and the resulting maximum voltage $v_1 = v_{1b}$.
3. Find the value of $R_1 = R_{1c}$ that maximizes the power received by R_1 and the resulting maximum power P_{1c}.



Given Variables:

Vs : 36 V
Is : 2 A
R2 : 12 ohm
R3 : 18 ohm
R4 : 24 ohm

Calculate the following:

i1a (A) :

R1a (ohm) :

v1b (V) :

R1b (ohm) :

P1c (W) :

R1c (ohm) :

Hint: Replace the circuit (without R1) by its Thevenin model.

The resistance R_1 is a variable resistor that can take on values in the range $0 \leq R_1 \leq 24\Omega$.

Vs = 12 V

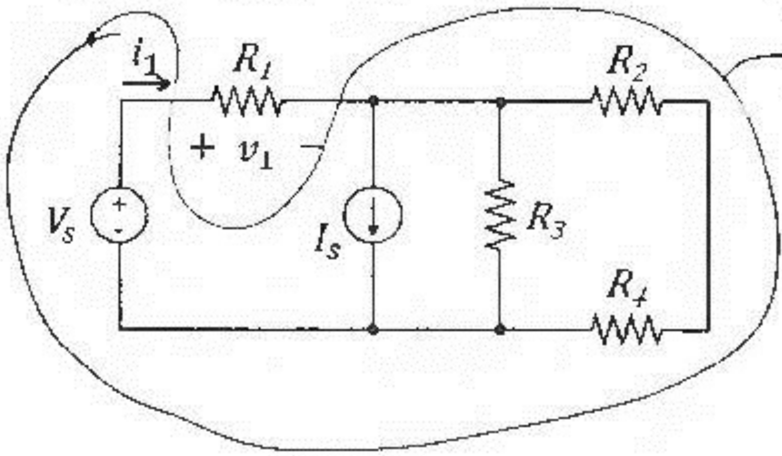
Is = 3 A

R2 = 12 ohm

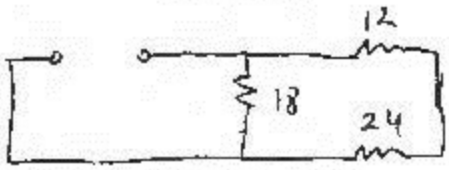
R3 = 18 ohm

R4 = 24 ohm

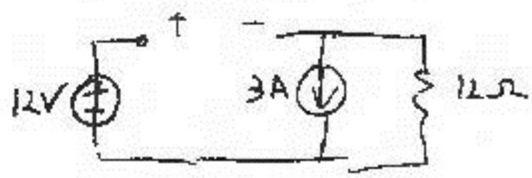
1. Find the value of $R_1 = R_{1a}$ that maximizes current i_1 and the resulting current $i_1 = i_{1a}$.
2. Find the value of $R_1 = R_{1b}$ that maximizes voltage v_1 and the resulting current $v_1 = v_{1b}$.
3. Find the value of $R_1 = R_{1c}$ that maximizes the power received by R_1 and the resulting power P_{1c}.



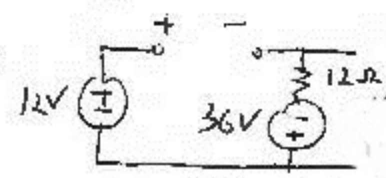
FIND THEVENIN MODEL



$$\Rightarrow \quad R_{TH} = 18 \,//\, (12+24) = \left(\frac{1}{18} + \frac{1}{36}\right)^{-1} = \left(\frac{3}{36}\right)^{-1} = 12\,\Omega$$

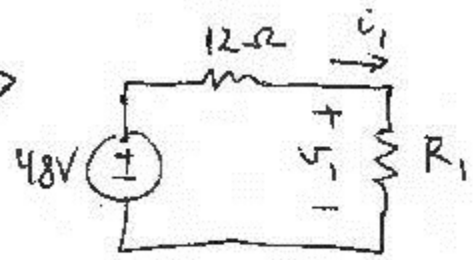


SOURCE TRANFORM



$v_{oc} = 48V$

$\Rightarrow$



① $\boxed{R_1 = 0}$ $\quad i_1 = \frac{48}{12} = 4 \Rightarrow \boxed{i_1 = 4A}$

② $\boxed{R_1 = 24\,\Omega}$ $\quad v_1 = 48 \cdot \frac{24}{24+12} = 48 \cdot \frac{2}{3} = 32$

$\boxed{v_1 = 32\,V}$

③ $R_1 = R_{TH} \Rightarrow \boxed{R_1 = 12\,\Omega}$

$i = \frac{48}{24} = 2A \Rightarrow P = i^2 R = 4 \cdot 12$

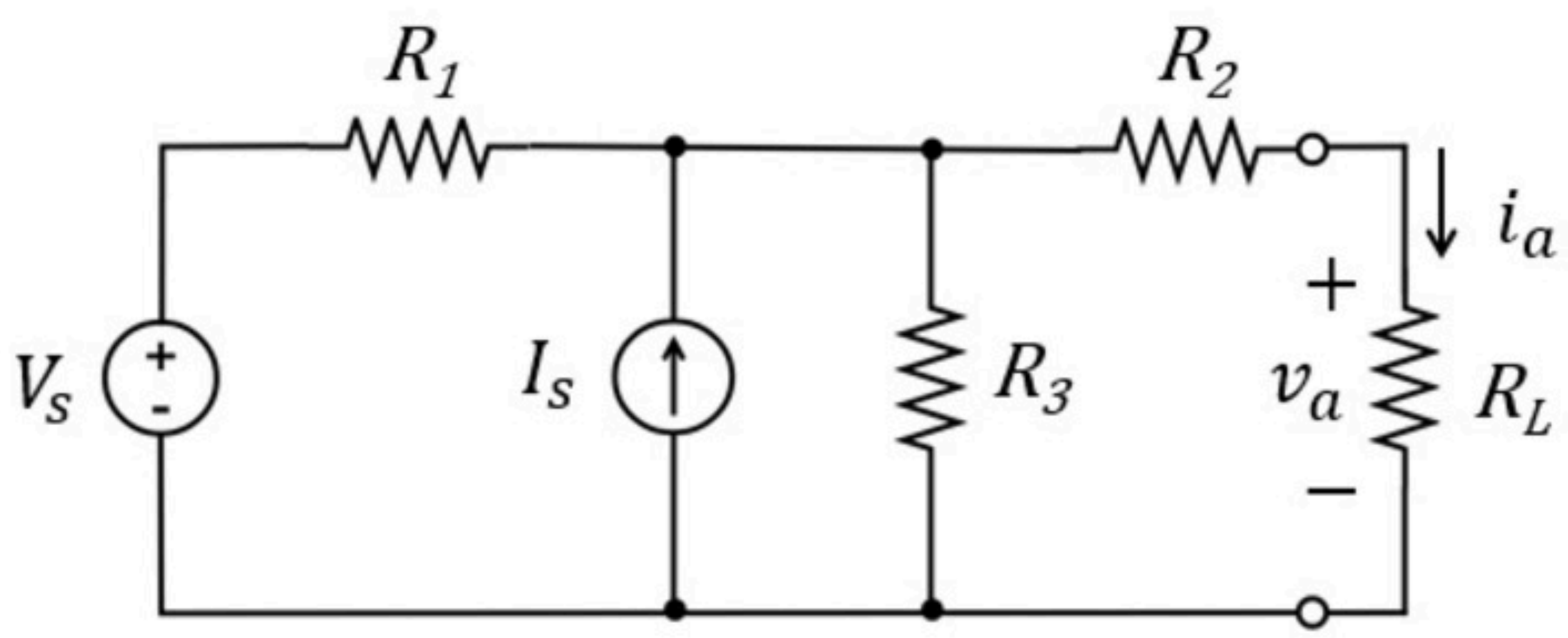
$\boxed{P = 48W}$

Circuit theorems 010

Unlimited Attempts.

Find (and think about how to minimize your calculations)

1. The value of $v_a = v_{a1}$ when R_L = 12 Ω
2. The value of $R_L = R_{L2}$ that results in v_a = 4 V
3. The value of $R_L = R_{L3}$ that results in i_a = 1 A



Given Variables:

Vs : 12 V

Is : 1 A

R1 : 6 ohm

R2 : 8 ohm

R3 : 12 ohm

Calculate the following:

va1 (V) :

RL2 (ohm) :

RL3 (ohm) :

Hint: Find the Thevenin model of the circuit (without RL) first

Find (and think about how to minimize your calculations)

1. The value of $v_a = v_{a1}$ when $R_L = 12\ \Omega$
2. The value of $R_L = R_{L2}$ that results in $v_a = 4$ V
3. The value of $R_L = R_{L3}$ that results in $i_a = 1$ A

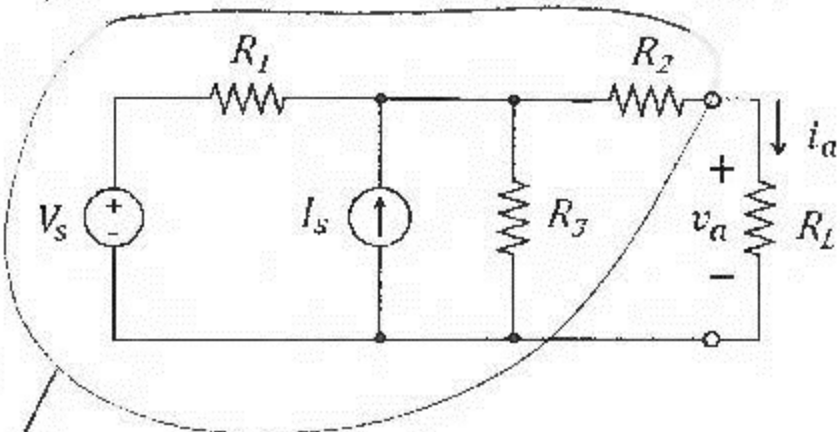
Vs = 12 V

Is = 2 A

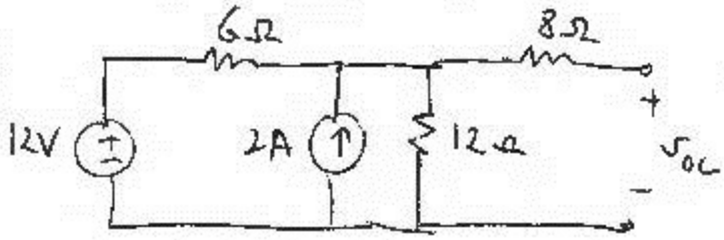
R1 = 6 ohm

R2 = 8 ohm

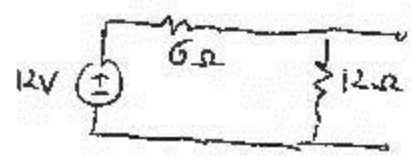
R3 = 12 ohm



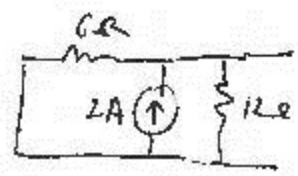
FIND THEVENIN MODEL



$\Rightarrow$ SUPERPOSITION

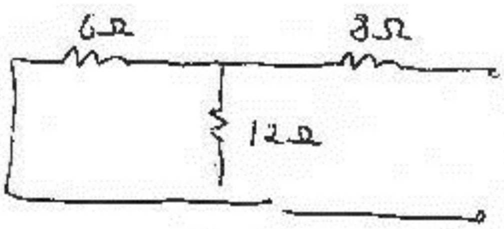


$v_{oc_1} = \frac{12}{18}\cdot 12 = 8V$

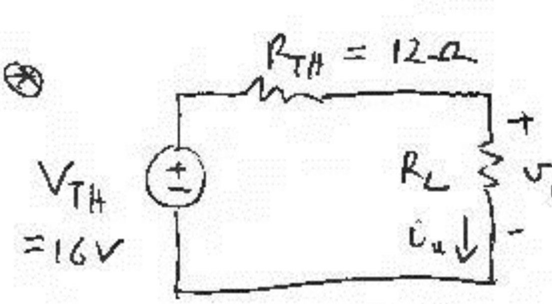


$v_{oc_2} = 2\cdot(12/\!/6) = 2\cdot 4 = 8V$

$\Rightarrow v_{oc} = 16\ V$



$R_{TH} = (6/\!/12) + 8 = 4 + 8 = 12\ \Omega$



(1) $v_a = \frac{16\cdot 12}{12+12} = \frac{16}{2} = 8$ $\boxed{v_a = 8V}$

(2) $v_a = 16\cdot\frac{R_L}{R_L+12} = 4 \Rightarrow 12R_L = 4\cdot 12$

$\Rightarrow \boxed{R_L = 4\ \Omega}$

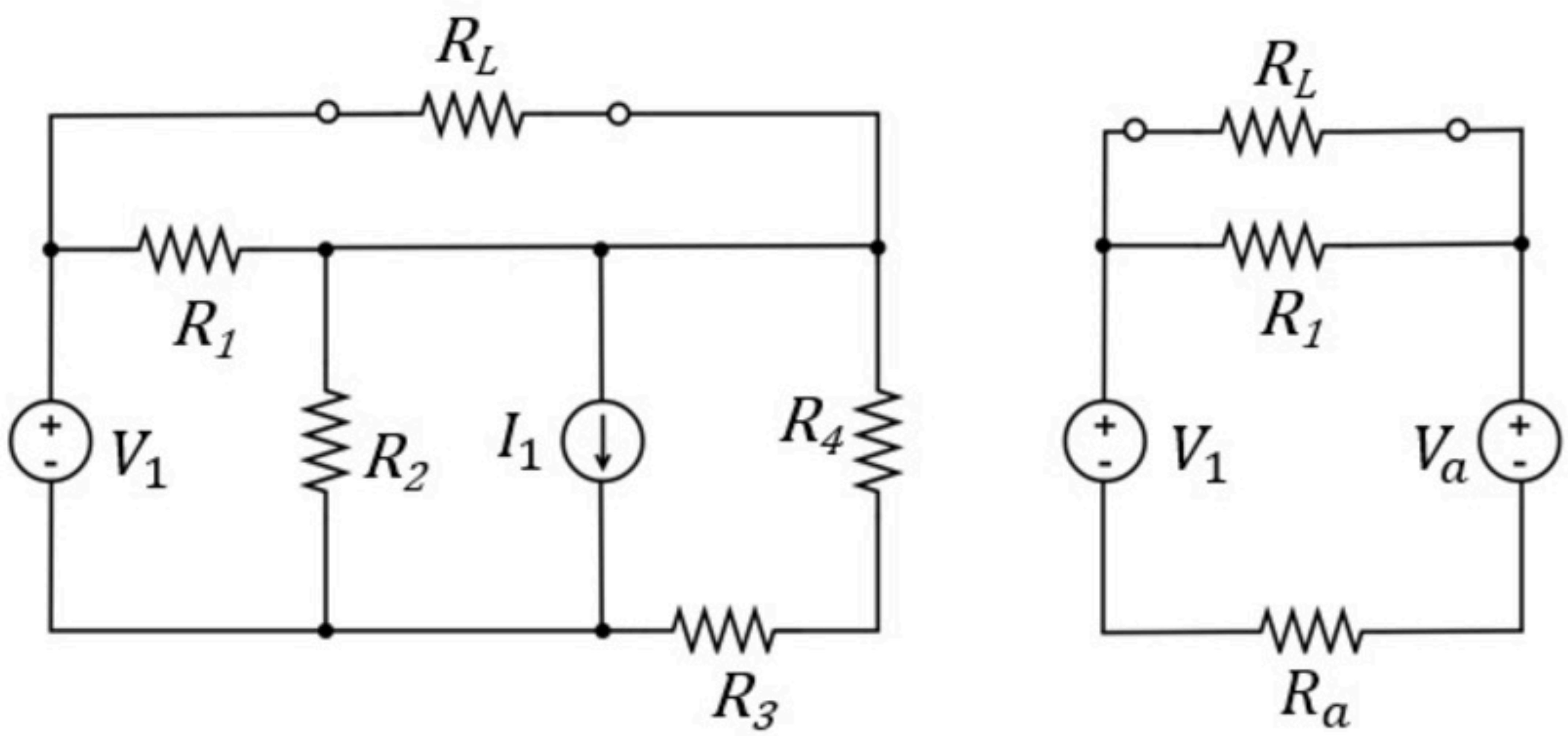
(3) $i_a = \frac{16}{R_L+12} = 1 \Rightarrow \boxed{R_L = 4\ \Omega}$

Circuit theorems 011

Unlimited Attempts.

The circuit on the right was created by applying source transformations to the circuit on the left.

Find the values of V_a and R_a .



Given Variables:

V1 : 20 V

I1 : 2 A

R1 : 14 ohm

R2 : 6 ohm

R3 : 1 ohm

R4 : 11 ohm

Calculate the following:

Ra (ohm) :

Va (V) :

Hint: Make sure you use the correct transformations.

The circuit on the right was created by applying source transformations on the left circuit.

Find the values of V_a and R_a.

V1 = 17 V

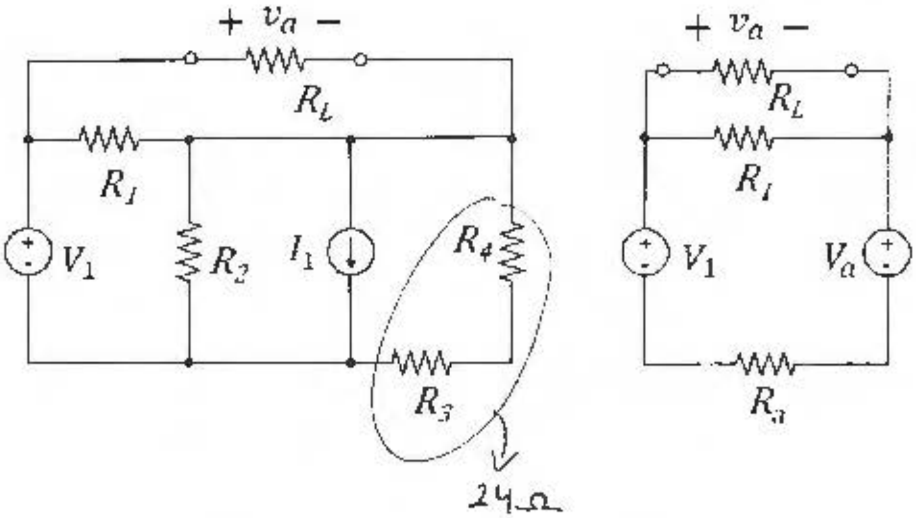
I1 = 2 A

R1 = 22 ohm

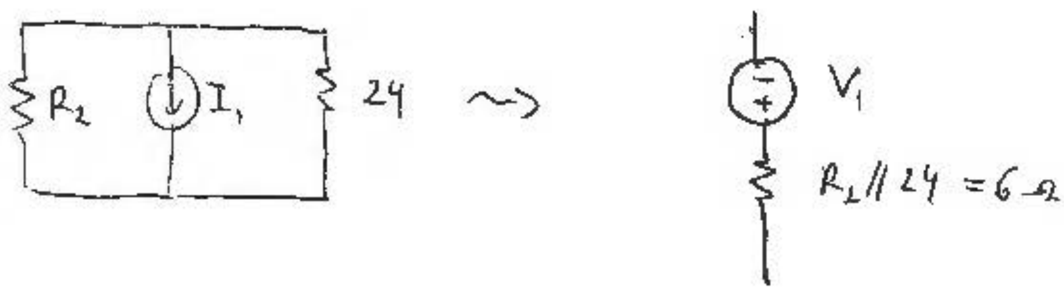
R2 = 8 ohm

R3 = 12 ohm

R4 = 12 ohm



$$R_2 // 24 = \left(\frac{1}{8} + \frac{1}{24}\right)^{-1} = \left(\frac{3}{24} + \frac{1}{24}\right)^{-1} = 6\,\Omega$$



$$V_1 = I_1 \cdot (R_2 // 24) = 2 \cdot 6 = 12V$$

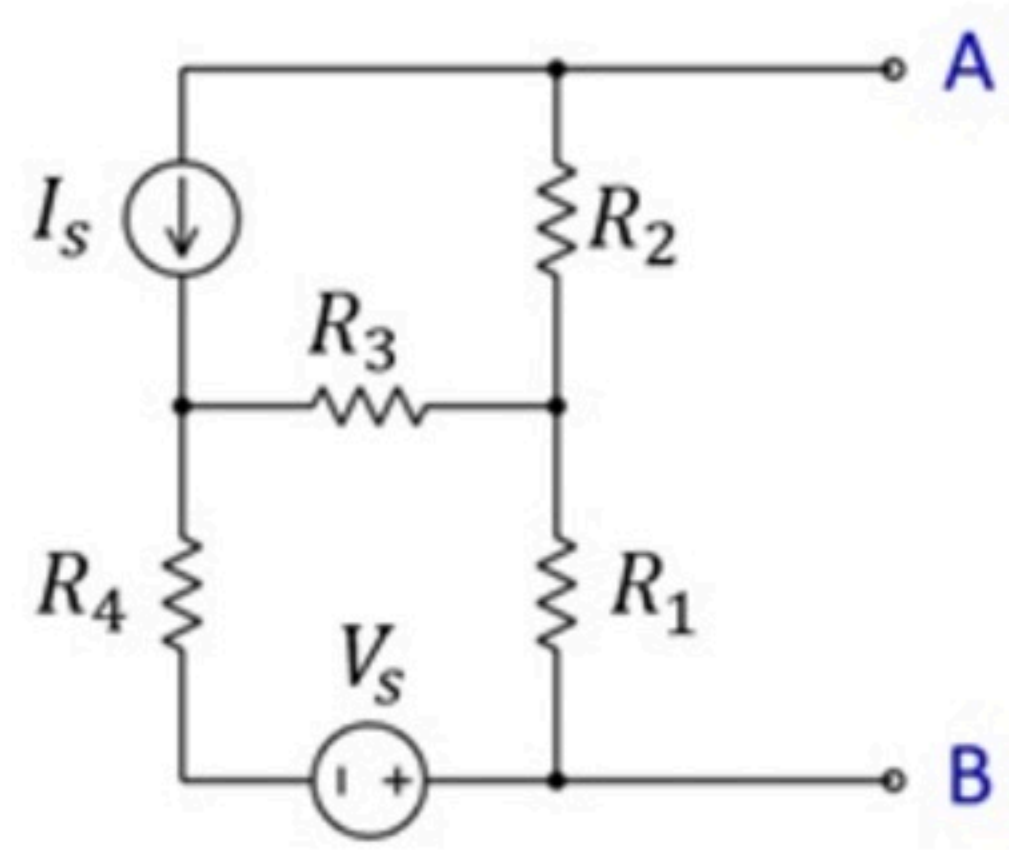
$$\boxed{V_a = -12V}$$

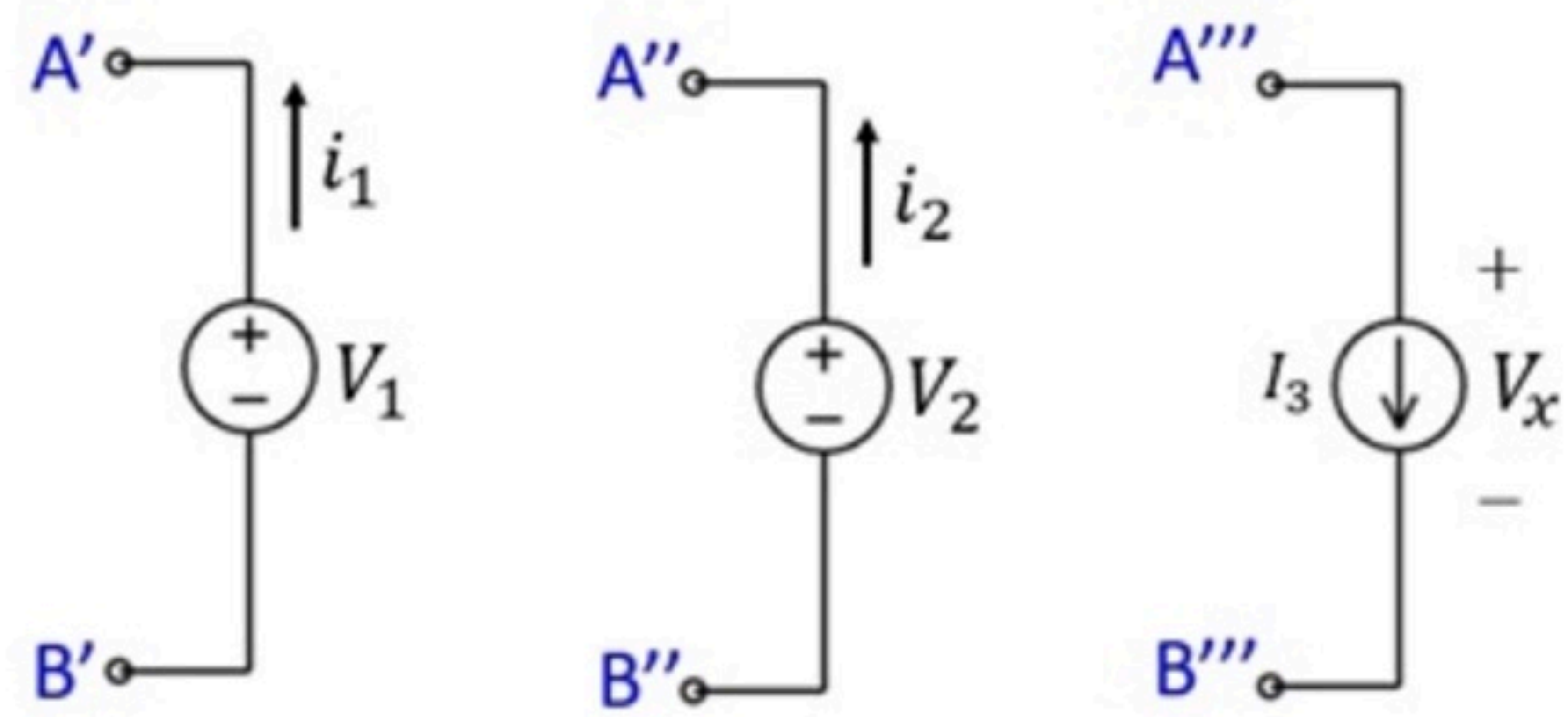
$$\boxed{R_a = 6\,\Omega}$$

Circuit theorems 013

No more attempts left.

Consider the circuit on the left. You are not given the values of V_S, I_S, R_1, R_2 or R_3.





You are told the value of current i_1 if V_1 is attached to this circuit, with A connected to A′ and B connected to B′.

You are also told the value of current i_2 if V_2 is attached, with A connected to A″ and B connected to B″. However, in this case, the independent sources were first turned off (i.e., $V_S = 0$ and $I_S = 0$).

Your task is to find V_x if current source I_3 is connected to the original circuit (i.e., with the independent sources V_S and I_S not turned off), with A connected to A‴ and B connected to B‴.

Given Variables:

V1 : 6 V

i1 : 12 A

V2 : 12 V

i2 : 12 A

I3 : -7 A

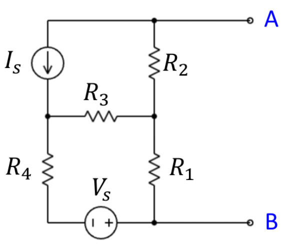
R4 : 2 ohm

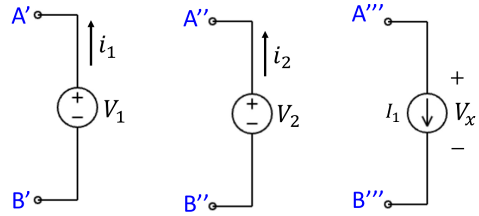
Calculate the following:

Vx (V) :

Hint: Redraw the circuit on the left as its Thevenin equivalent model

Consider the circuit on the left. You are not given the values of V_S, I_S, R_1, R_2 or R_3.





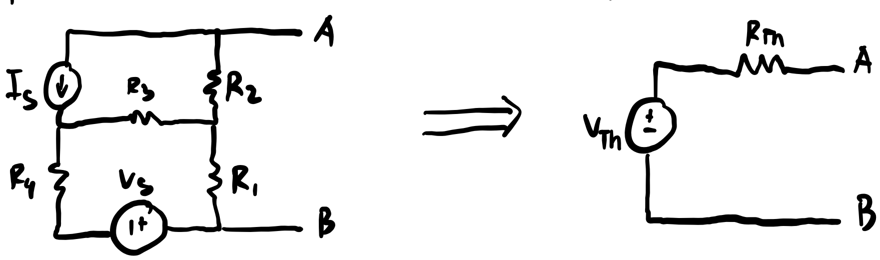
$V_1 = 15\text{ V}$
$i_1 = 6\text{ A}$
$V_2 = 10\text{ V}$
$i_2 = 5\text{ A}$
$I_1 = 5\text{ A}$
$R_4 = 2\Omega$

You are told the value of current i_1 if V_1 is attached to this circuit, with A connected to A' and B connected to B'.

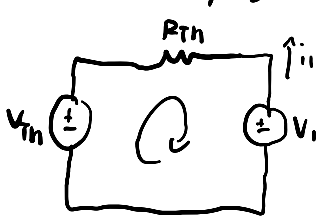
You are also told the value of current i_2 if V_2 is attached, with A connected to A'' and B connected to B''. However, in this case, the independent sources were first turned off (i.e., $V_S = 0$ and $I_S = 0$).

Your task is to find V_x if current source I_1 is connected to the original circuit (i.e., with the independent sources V_S and I_S not turned off), with A connected to A''' and B connected to B'''.

Represent the left circuit as its Thevenin equivalent circuit



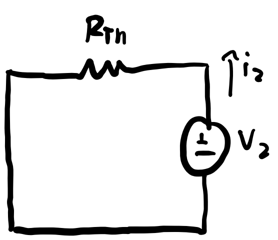
when $A \to A'$, $B \to B'$



KVL: $-V_{Th} - i_1 R_{Th} + V_1 = 0$

$V_{Th} = V_1 - i_1 R_{Th}$

when $A \to A''$, $B \to B''$ and $V_S = 0$, $I_S = 0$

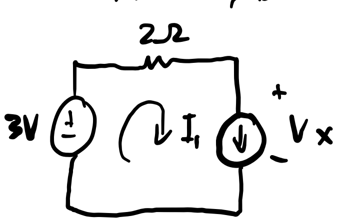


$R_{Th} = \frac{V_2}{i_2} = \frac{10}{5} = 2\Omega$

$V_{Th} = 15 - 6(2)$

$V_{Th} = 3V$

when $A \to A'''$, $B \to B'''$



KVL: $-3 + 2I_1 + V_x = 0$

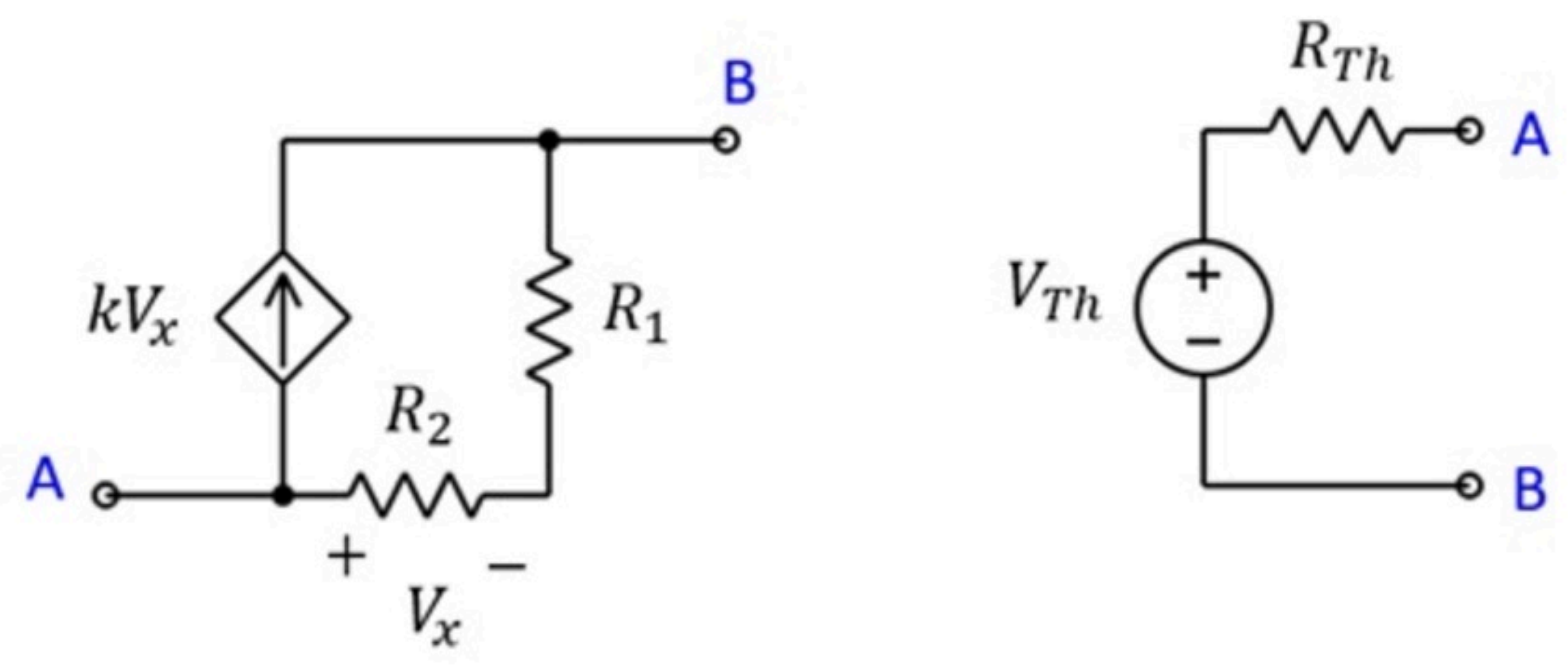
$V_x = 3 - 2(5)$

$\boxed{V_x = -7V}$

Circuit theorems 014

Problem has been graded.

The circuit on the right represent the Thevenin model of the circuit on the left. Find the value of V_{Th} and R_{Th}.



Given Variables:

R1 : 4 ohm

R2 : 2 ohm

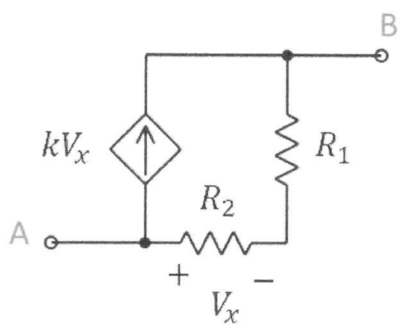
k : -2 A/V

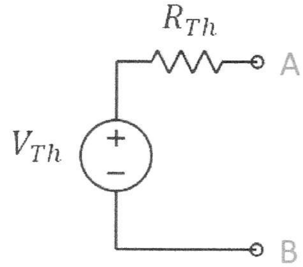
Calculate the following:

Vth (V) :

Rth (ohm) :

The circuit on the right represent the Thevenin model of the circuit on the left. Find the value of V_{Th} and R_{Th}.



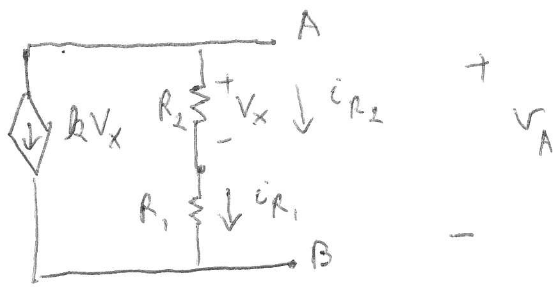


$R_1 = 4\,\Omega$

$R_2 = 2\,\Omega$

$k = -2\ A/V$

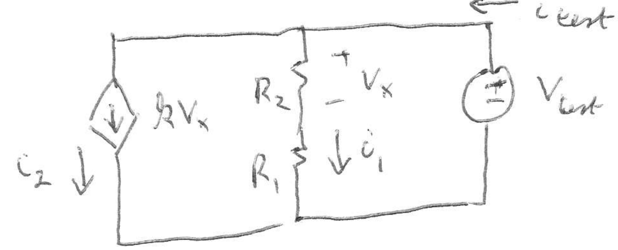
REDRAW:



(a) LEAVE A-B OPEN: KCL: $kV_x + \frac{V_x}{R_2} = 0 \Rightarrow \left(k + \frac{1}{R_2}\right)V_x = 0 \Rightarrow V_x = 0$

$\Rightarrow i_{R_2} = i_{R_1} = 0\,A \Rightarrow V_{AB} = 0 \Rightarrow \boxed{V_{TH} = 0\,V}$

(b) FOR R_{TH}, APPLY TEST VOLTAGE



$i_1 = \frac{V_{test}}{R_1 + R_2}$

voltage divider

$i_2 = kV_x = k\,V_{test}\frac{R_2}{R_1 + R_2}$

$i_{test} = i_1 + i_2 = V_{test}\frac{(1 + kR_2)}{R_1 + R_2}$

$\Rightarrow R_{TH} = \frac{V_{test}}{i_{test}} = \frac{R_1 + R_2}{1 + kR_2} = \frac{4 + 2}{1 + (-2)2} = \frac{6}{-3}$

$\boxed{R_{TH} = -2\,\Omega}$

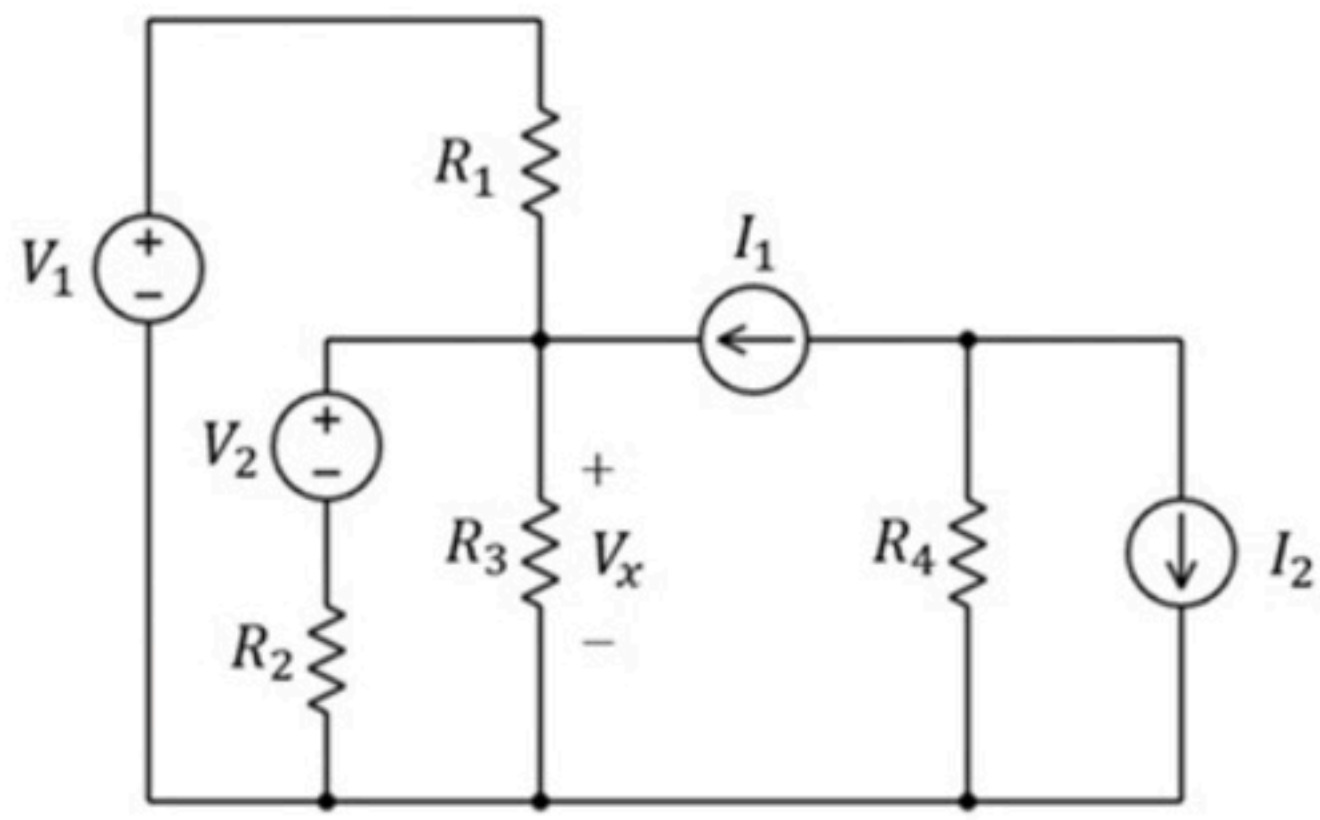
Circuit theorems 015

Problem has been graded.

Consider the circuit below. You are not given the values of V_1, V_2 and I_2. However, you are told the values of the other components and that of V_x.

(a) What is the new value of V_x when all the source values (i.e., V_1, V_2, I_1 and I_2) are doubled? We will call this new value V_{x1}.

(b) What is the new value of V_x when only I_1 is doubled and the other sources are what they were originally? We will call this new value V_{x2}.



Given Variables:

R1 : 10 ohm

R2 : 10 ohm

R3 : 5 ohm

R4 : 7 ohm

I1 : 2 A

Vx : 16 V

Calculate the following:

Vx1 (V) :

Vx2 (V) :

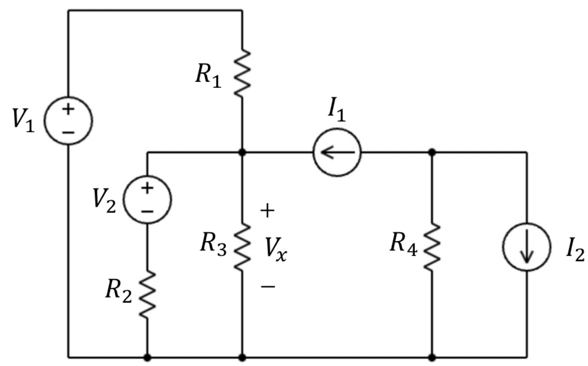
Hint: Use linearity and superposition to express Vx as a linear combination of all sources

Consider the circuit below. You are not given the values of V_1, V_2 and I_2. However, you are told the values of the other components and that of V_x.

(a) What is the new value of V_x when all the source values (i.e., V_1, V_2, I_1 and I_2) are doubled? We will call this new value V_{x1}.

(b) What is the new value of V_x when only I_1 is doubled and the other sources are what they were originally? We will call this new value V_{x2}.

$R_1 = 15\Omega$
$R_2 = 5\Omega$
$R_3 = 15\Omega$
$R_4 = 7\Omega$
$I_1 = 2A$
$V_x = 15$



a. Generally,

$V_x = aV_1 + bV_2 + cI_1 + dI_2$ from linearity and superposition

If all sources are doubled,

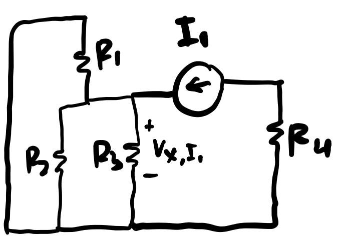
$$V_{x1} = a(2V_1) + b(2V_2) + c(2I_1) + d(2I_2) = 2(aV_1 + bV_2 + cI_1 + dI_2)$$
$$= 2V_x$$
$$= 2 \cdot 15$$
$$\boxed{V_{x1} = 30V}$$

b. If only I_1 is doubled

$$V_{x2} = aV_1 + bV_2 + c(2I_1) + dI_2 = (aV_1 + bV_2 + cI_1 + dI_2) + cI_1$$
$$= V_x + cI_1$$

find the contribution of I_1 using superposition

when only I_1 is on,



$$V_{x,I_1} = I_1 \underbrace{\left(\frac{R_1 // R_2}{R_1 // R_2 + R_3}\right) R_3}_{c}$$

$$V_{x,I_1} = 2\left(\frac{\frac{15}{4}}{\frac{15}{4} + 15}\right) 15$$
$$= 2\left(\frac{15}{15+60}\right) 15$$
$$= 2 \cdot \frac{1}{5} \cdot 15$$
$$= 6V \Rightarrow cI_1$$

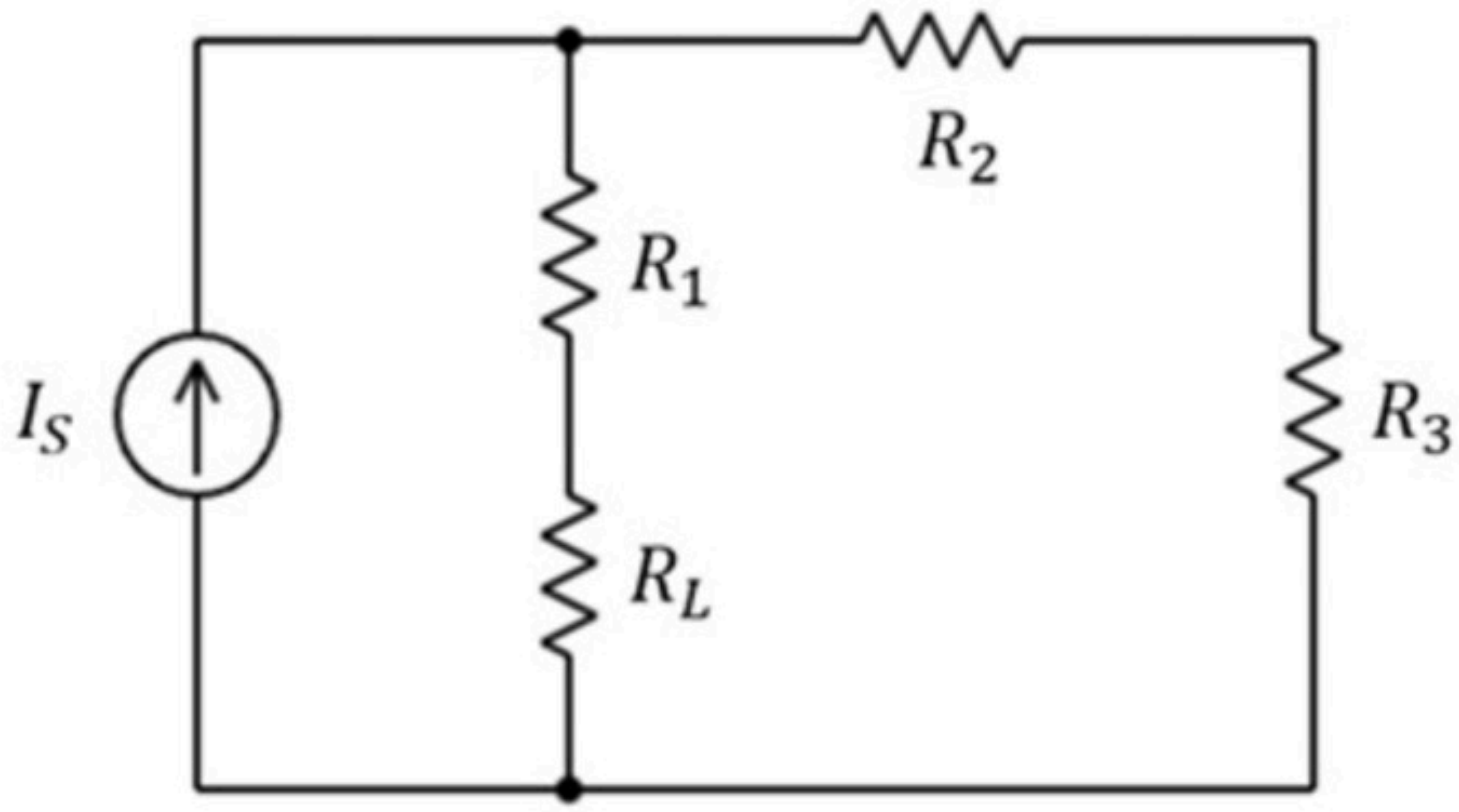
$$V_{x2} = V_x + cI_1$$
$$= 15 + 6$$
$$\boxed{V_{x2} = 21V}$$

Circuit theorems 016

Problem has been graded.

Find the value of R_L such that the power received by R_L is maximized.

Find the corresponding max power received by R_L.



Given Variables:

Is : 2 A

R1 : 2 ohm

R2 : 1 ohm

R3 : 1 ohm

Calculate the following:

RL (ohm) :

Pmax (W) :

Hint: Find the Thevenin equivalent model of the circuit after taking out RL

Find the value of R_L such that the power received by R_L is maximized.

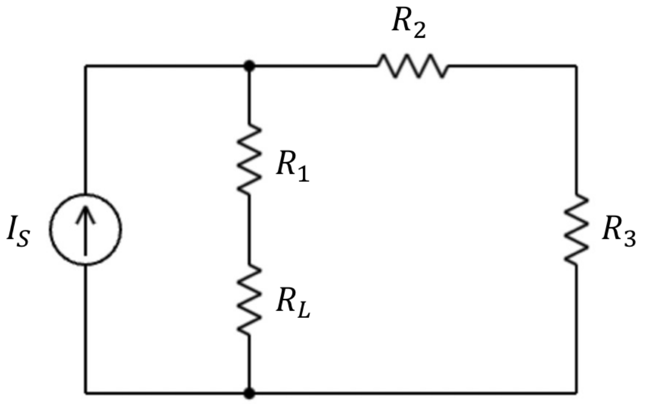
Find the corresponding max power received by R_L.

$I_S = 2A$

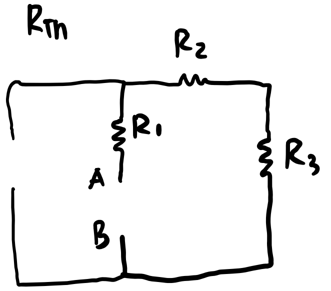
$R_1 = 12\Omega$

$R_2 = 2\Omega$

$R_3 = 2\Omega$



find R_{Th}



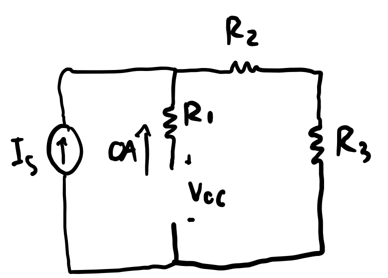
R_1, R_2, R_3 are in series

$R_{Th} = R_1 + R_2 + R_3$

$= 12 + 2 + 2$

$R_{Th} = 16\Omega$

find V_{Th}



$V_{OC} = I_S \cdot (R_2 + R_3)$

$= 2 \cdot (2 + 2)$

$V_{OC} = 8V$

$$P_{max} = \frac{V_{Th}^2}{4R_{Th}}$$

$$= \frac{8^2}{4(16)}$$

$$\boxed{P_{max} = 1W}$$

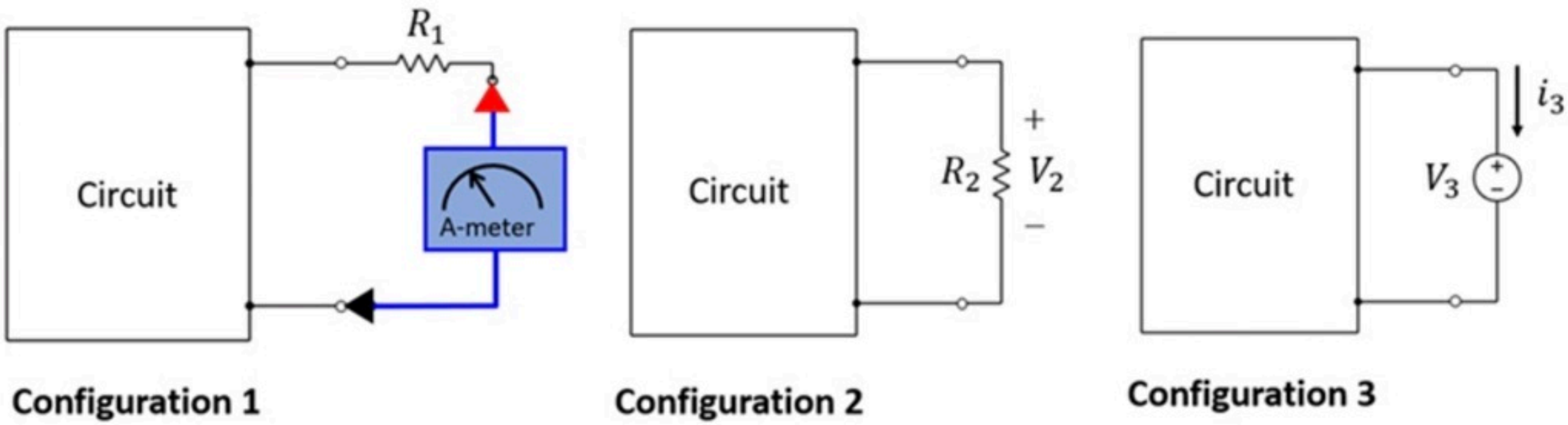
Circuit theorems 017

No more attempts left.

The box contains a linear circuit. This same circuit is placed into the three configurations shown below.

The reading of the ammeter in configuration 1 is given as X.

Find the current i_3 in configuration 3.



Given Variables:

X : 8 A

R1 : 1 ohm

V2 : 20 V

R2 : 10 ohm

V3 : 2 V

Calculate the following:

i3 (A) :

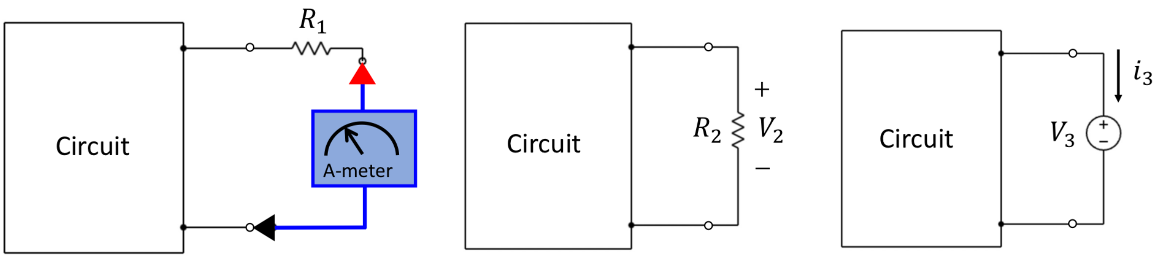
Hint: Replace the circuit in the box as its Thevenin equivalent model

The box contains a linear circuit. This same circuit is placed into the three configurations shown below.

The reading of the ammeter in configuration 1 is given as X.

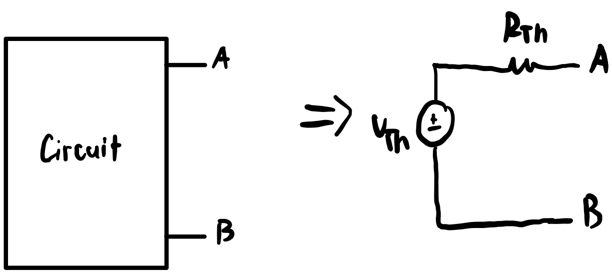
Find the current i_3 in configuration 3.

$X = 8A$
$R_1 = 1\Omega$
$V_2 = 16V$
$R_2 = 4\Omega$
$V_3 = 8V$

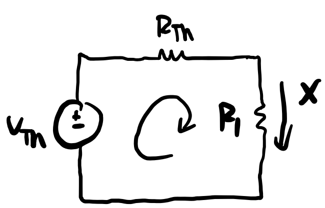


Configuration 1 **Configuration 2** **Configuration 3**

Replace the box by its Thevenin equivalent model



Configuration 1

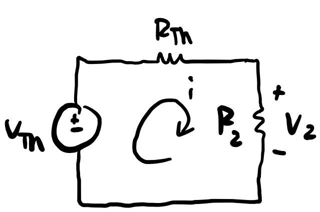


KVL 1: $-V_{Th} + XR_{Th} + XR_1 = 0$

$-V_{Th} + 8R_{Th} + 8 \cdot 1 = 0$

$-V_{Th} + 8R_{Th} = -8$ ①

Configuration 2



$i = \frac{V_2}{R_2}$

KVL 2: $-V_{Th} + iR_{Th} + V_2 = 0$

$-V_{Th} + \frac{V_2}{R_2} R_{Th} = -V_2$

$-V_{Th} + \frac{16}{4} R_{Th} = -16$

$-V_{Th} + 4R_{Th} = -16$ ②

Solve system of equations

① : $-V_{Th} = -8 - 8R_{Th}$

$V_{Th} = 8 + 8R_{Th}$

① → ② : $-(8 + 8R_{Th}) + 4R_{Th} = -16$

$-8 - 8R_{Th} + 4R_{Th} = -16$

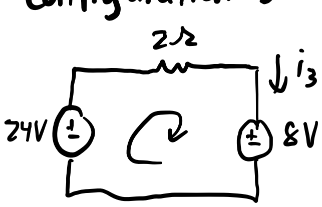
$-4R_{Th} = -8$

$R_{Th} = 2\Omega$

$R_{Th} \to$ ① : $V_{Th} = 8 + 8(2)$

$V_{Th} = 24V$

Configuration 3



KVL 3: $-24 + 2i_3 + 8 = 0$

$2i_3 = 16$

$\boxed{i_3 = 8A}$

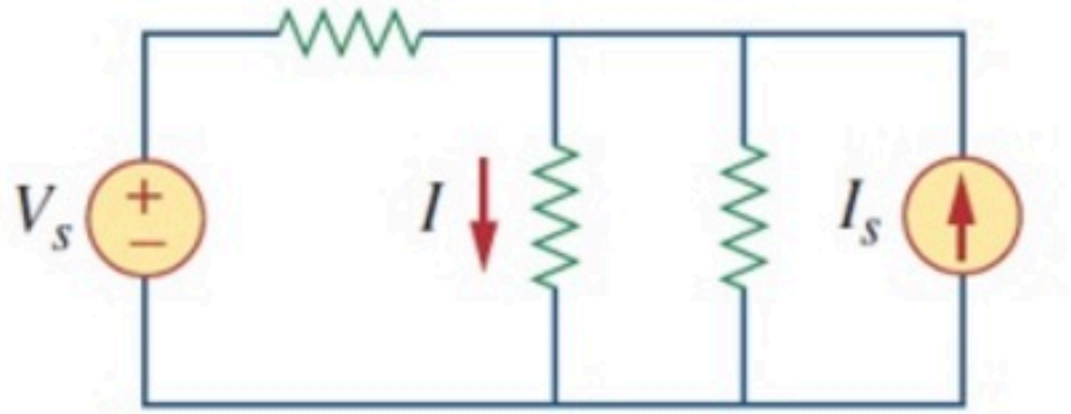
PP Circuit theorems 001

Unlimited Attempts.

When $V_S = 3$ V and $I_S = -2$ mA, you measure $I = 5$ mA.

When $V_S = 2$ V and $I_S = 0$ mA, you measure $I = 6$ mA.

When $V_S = 1$ V and $I_S = 3$ mA, what will I be?



Given Variables:

. : . .

Calculate the following:

I (A) :

0.009

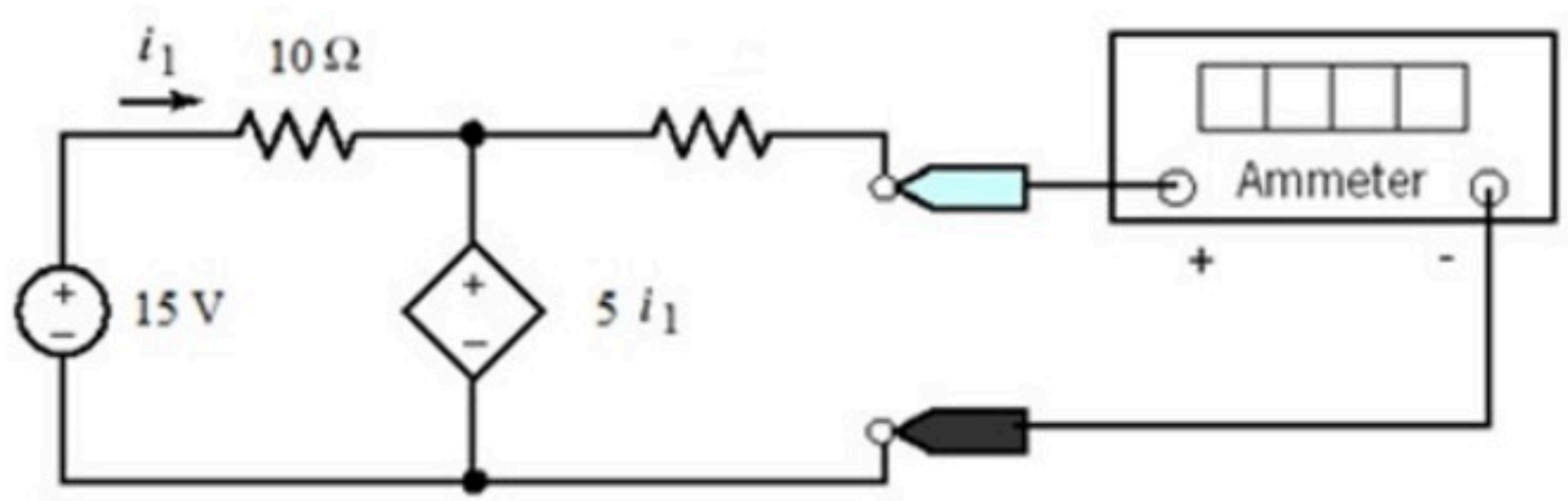
Hint: Check the units

PP Circuit theorems 002

Unlimited Attempts.

You build the circuit below and use an ammeter to measure the current through the unknown resistor. The ammeter reading is 0.1 A.

Now someone changes the voltage source from 15V to 30V, but leaves everything else unchanged. What will be the new reading X of the ammeter?



Given Variables:

. : . .

Calculate the following:

X (A) :

0.2

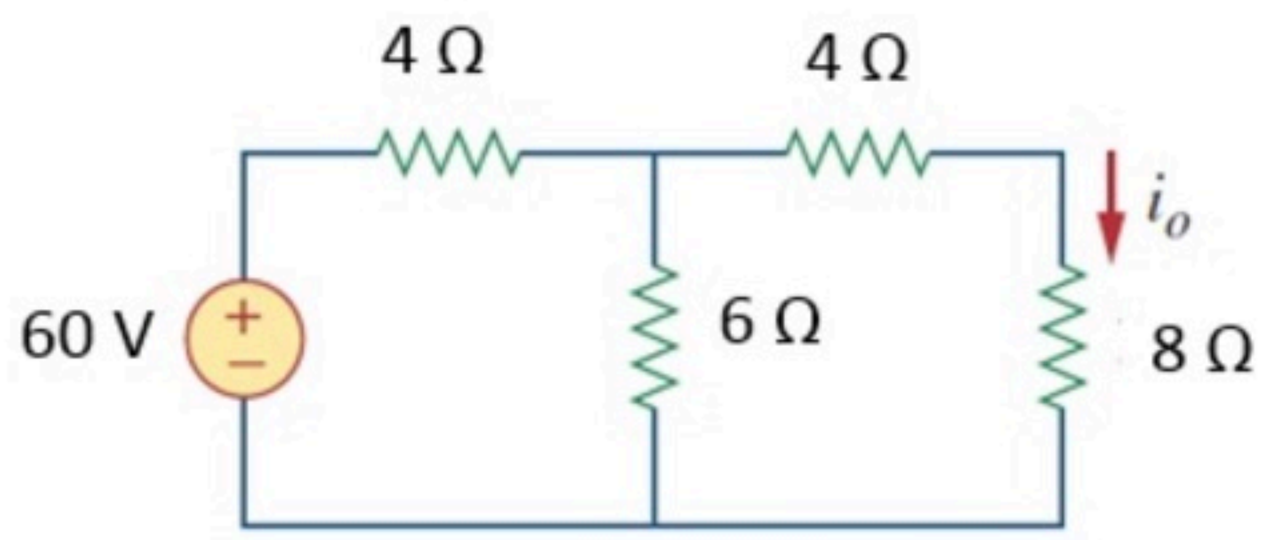
Hint: Is the system linear? What does that mean in terms of input - output?

PP Circuit theorems 003

Unlimited Attempts.

Find the current i_o.

What voltage X do we need to change the 60 V voltage source to in order to make i_o = 7.5 A ?



Given Variables:

. : . .

Calculate the following:

io (A) :

2.5

X (V) :

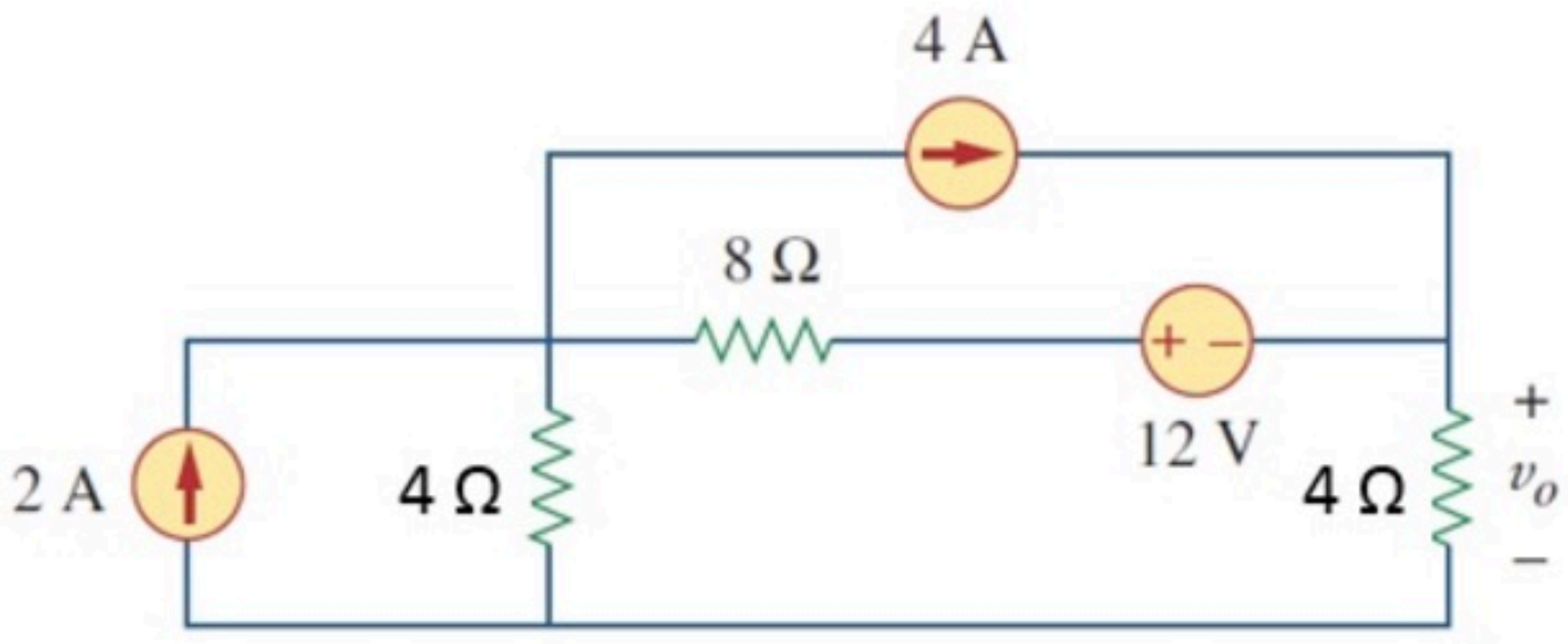
180

Hint: To find X, use linearity.

PP Circuit theorems 004

Unlimited Attempts.

Use superposition to find v_o.



Given Variables:

. : . .

Calculate the following:

vo (V) :

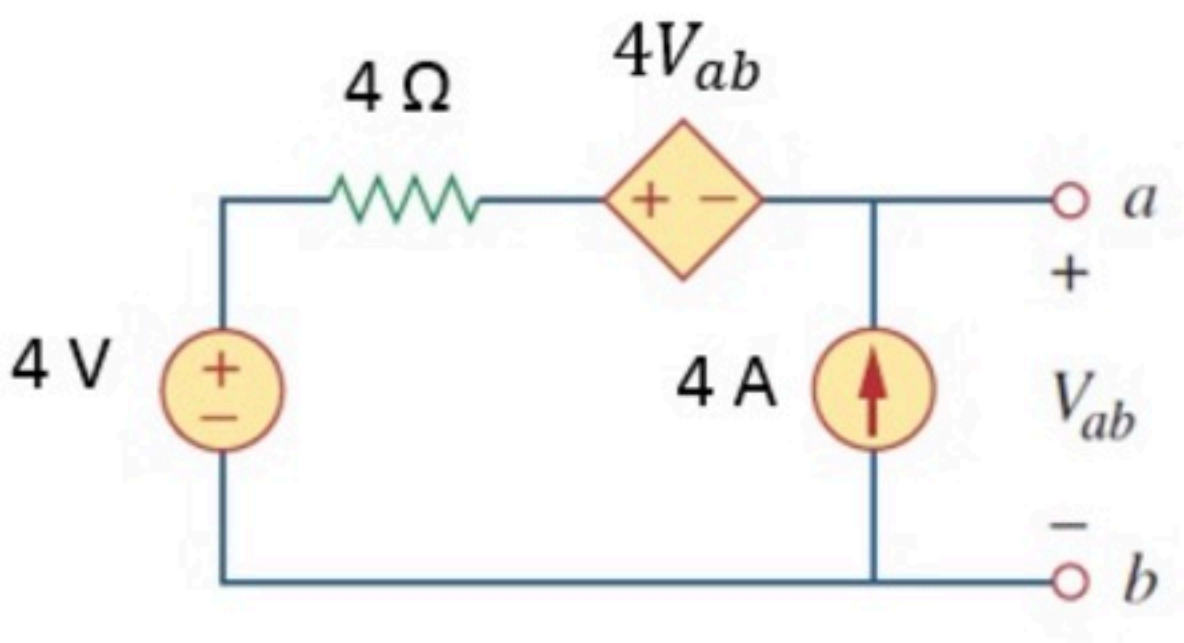
7

Hint: Mind the signs.

PP Circuit theorems 005

Unlimited Attempts.

Use superposition to find V_{ab}.



Given Variables:

. : . .

Calculate the following:

Vab (V) :

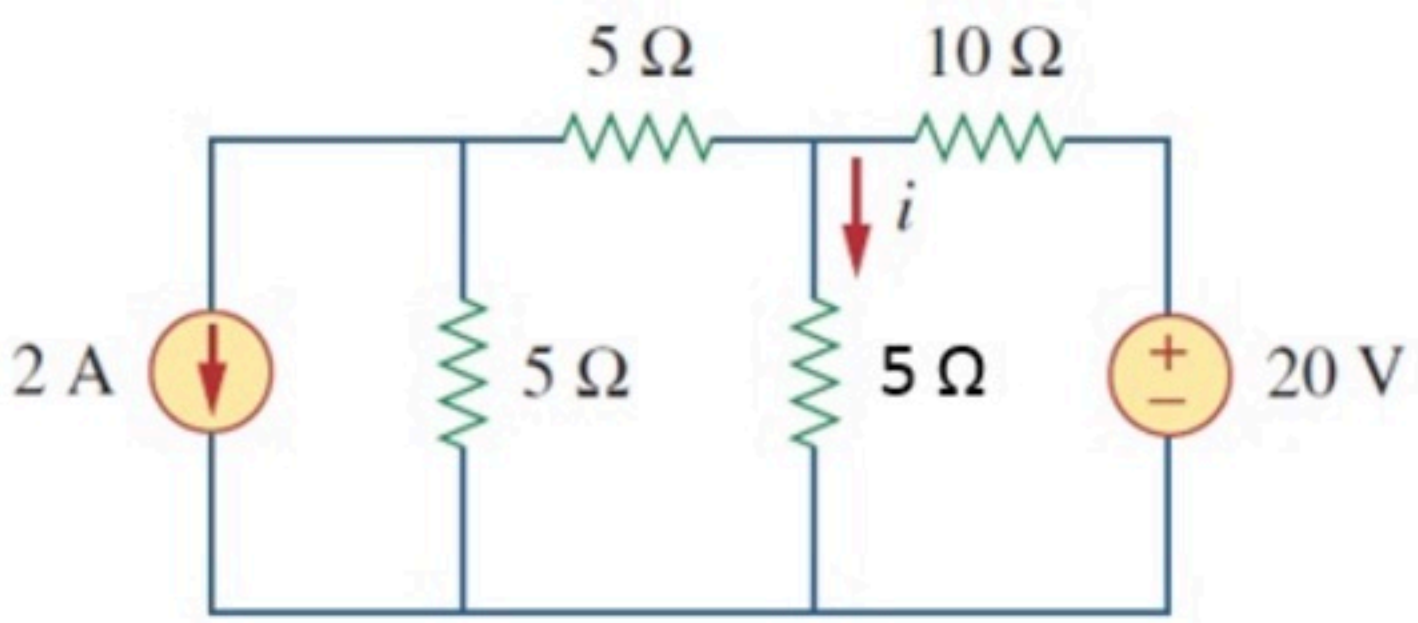
4

Hint: Always keep the dependent source.

PP Circuit theorems 006

Unlimited Attempts.

Use source transformations to find i.



Given Variables:

. : . .

Calculate the following:

i (A) :

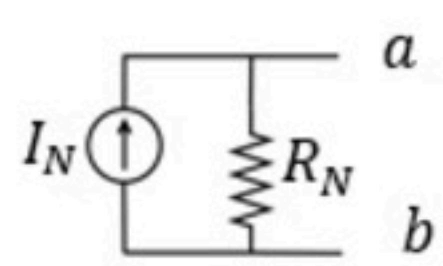
0.5

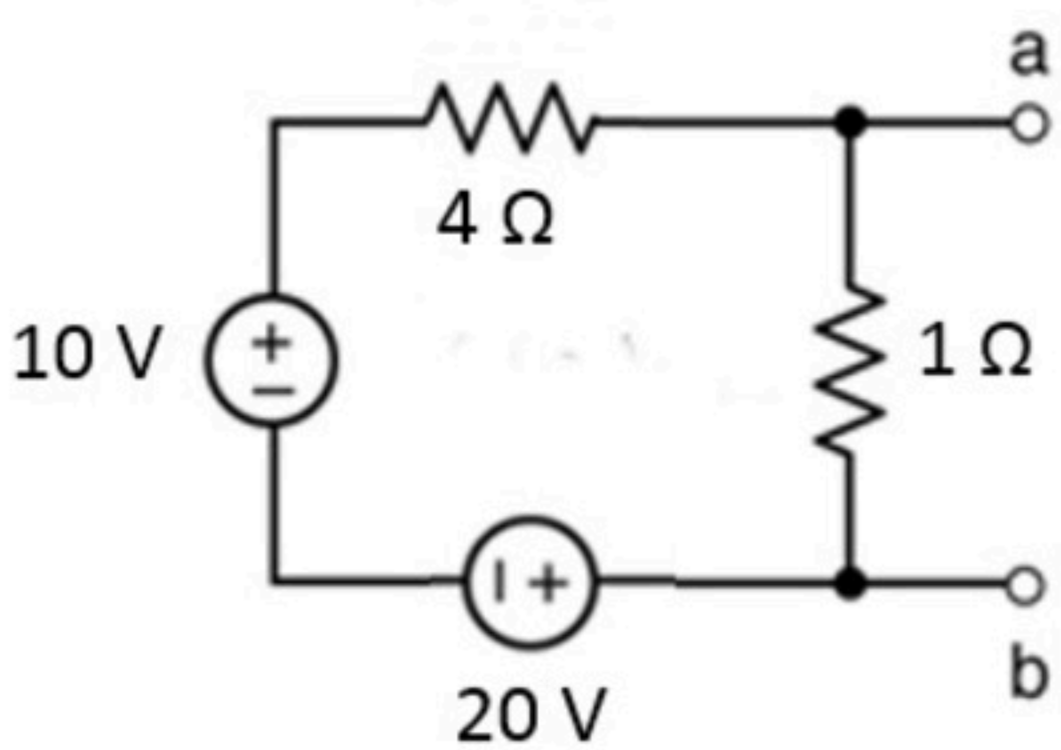
Hint: Make sure you use the correct transformations.

PP Circuit theorems 007

Unlimited Attempts.

Find the Norton equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

RN (ohm) :

0.8

IN (A) :

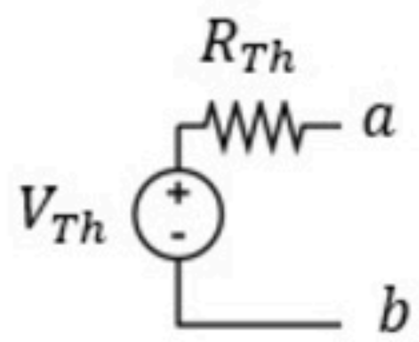
-2.5

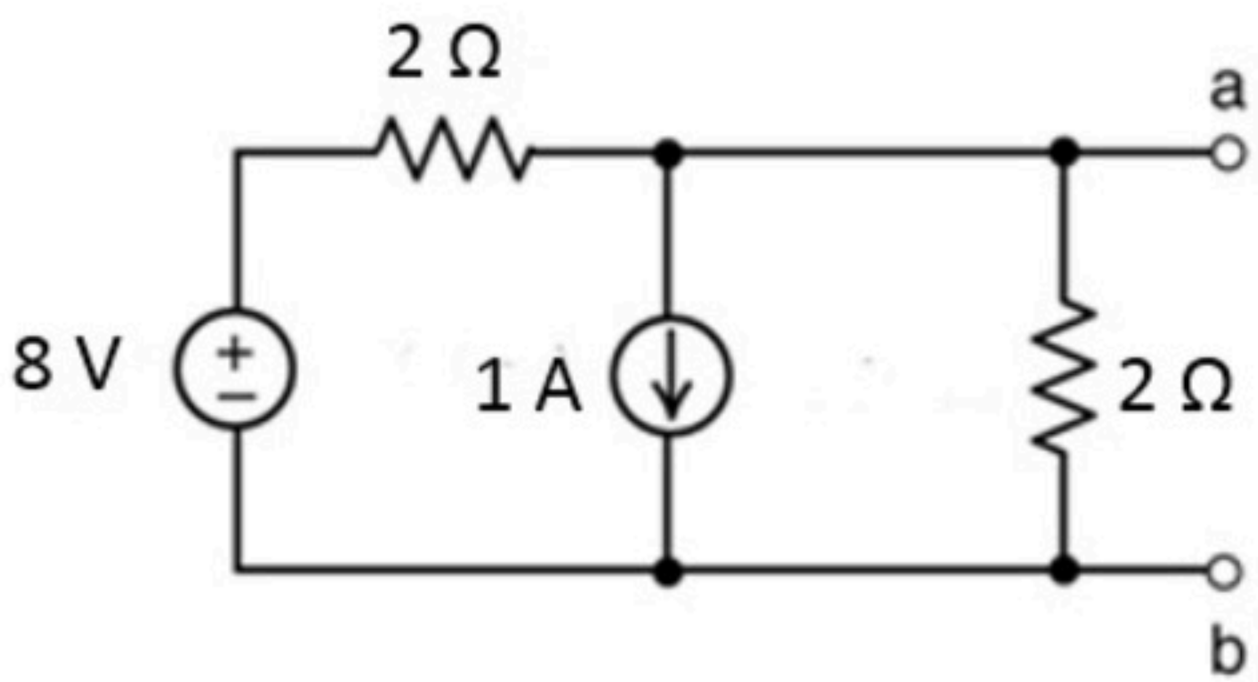
Hint: Try finding RN directly. Mind the sign of IN.

PP Circuit theorems 008

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Vth (V) :

3

Rth (ohm) :

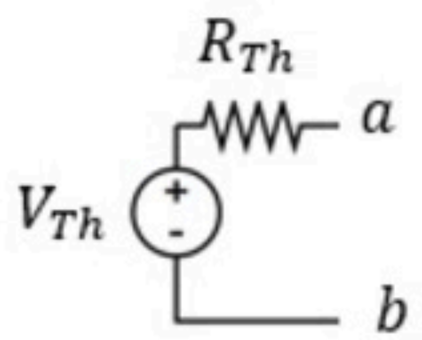
1

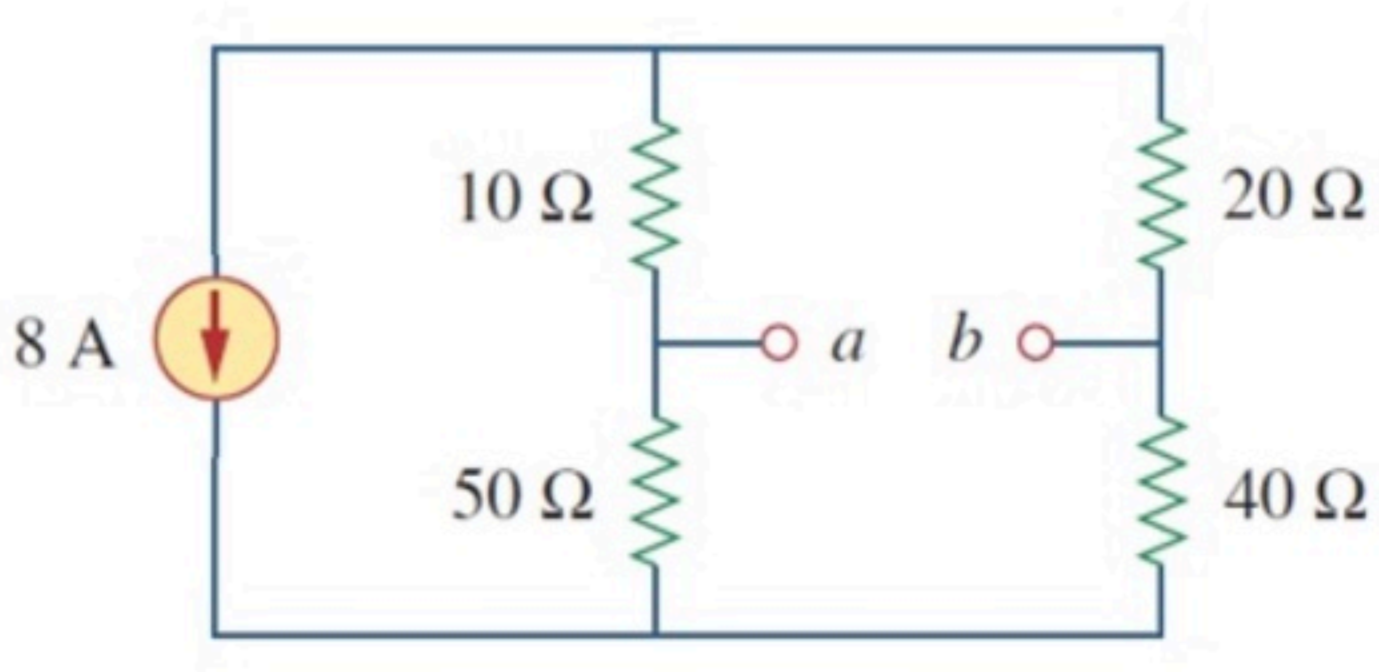
Hint: Try finding Rth directly. Find Voc with superposition.

PP Circuit theorems 009

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Vth (V) :

-40

Rth (ohm) :

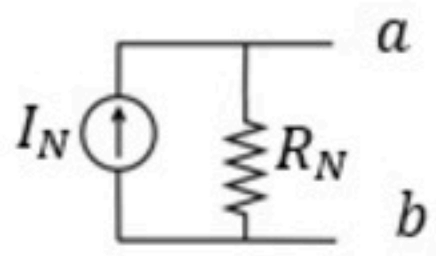
22.5

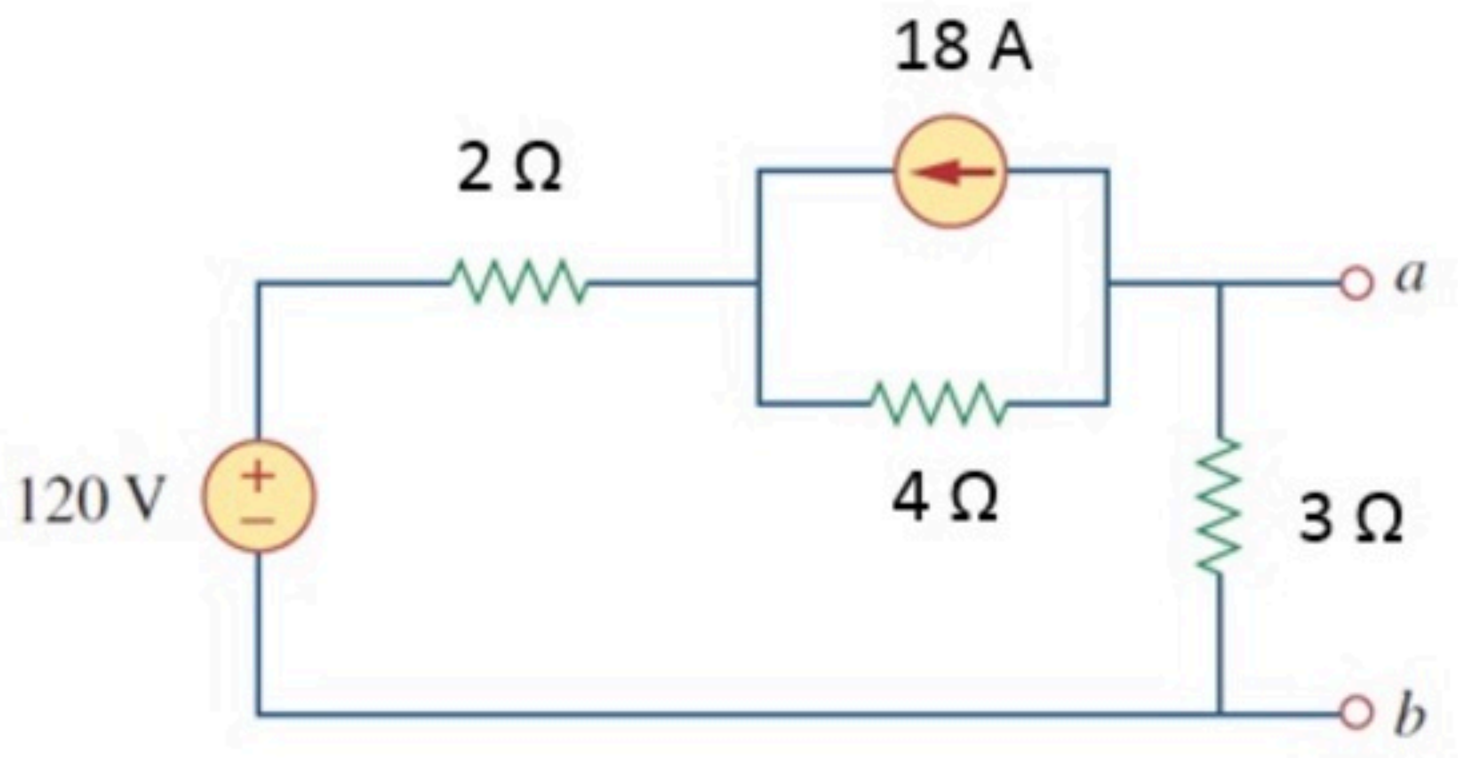
Hint: Find Voc using current dividers.

PP Circuit theorems 010

Unlimited Attempts.

Find the Norton equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

IN (A) :

8

RN (ohm) :

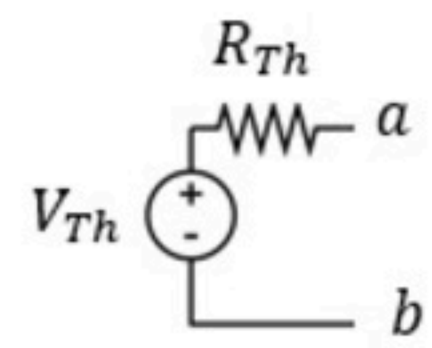
2

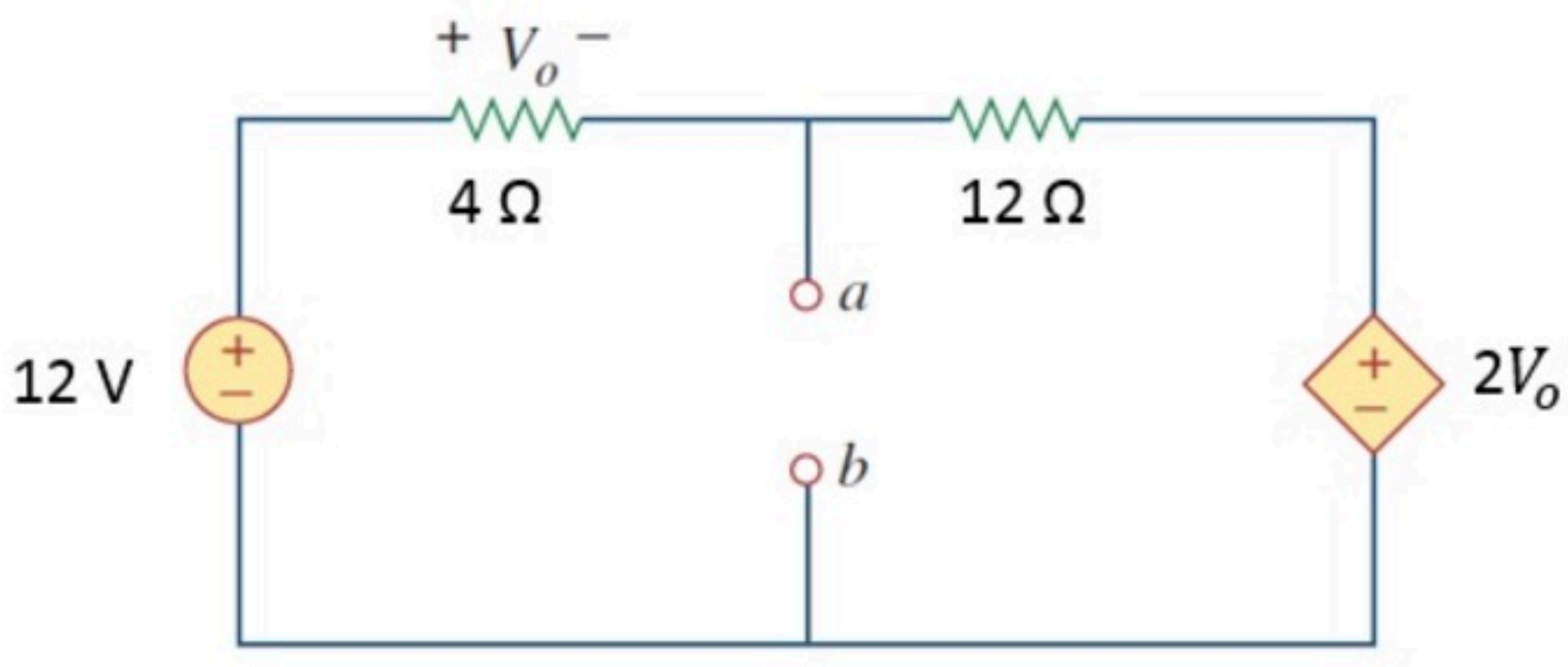
Hint: You can find Isc using superposition.

PP Circuit theorems 011

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Vth (V) :

10

Rth (ohm) :

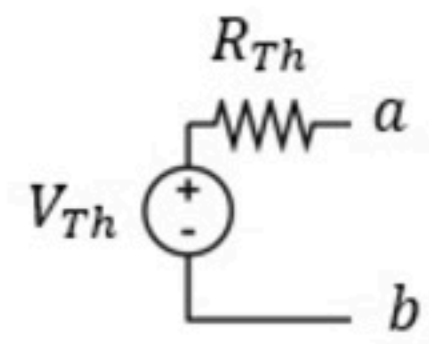
2

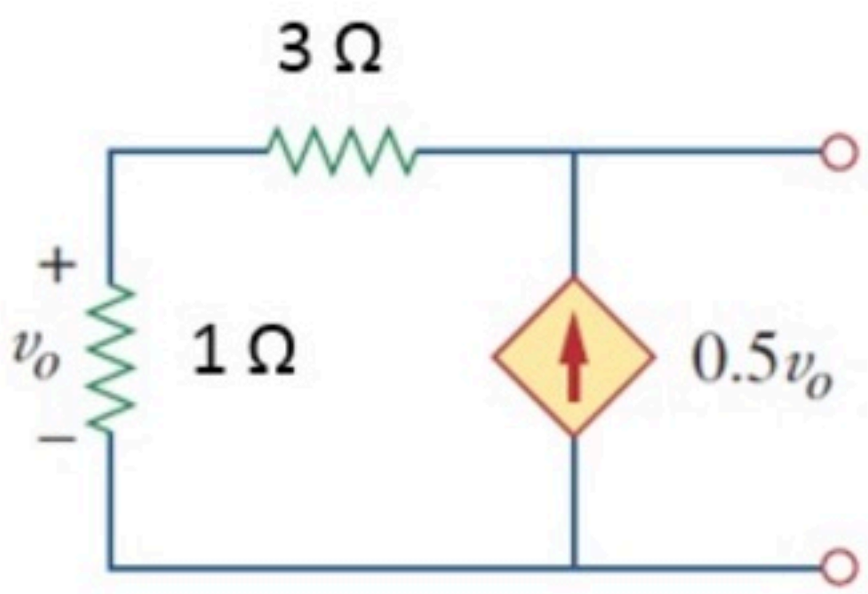
Hint: Find Voc; and then Isc or use a test source to find Rth.

PP Circuit theorems 012

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Vth (V) :

0

Rth (ohm) :

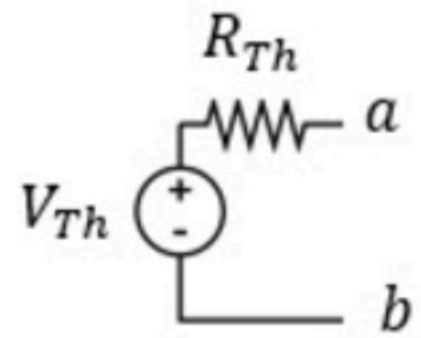
8

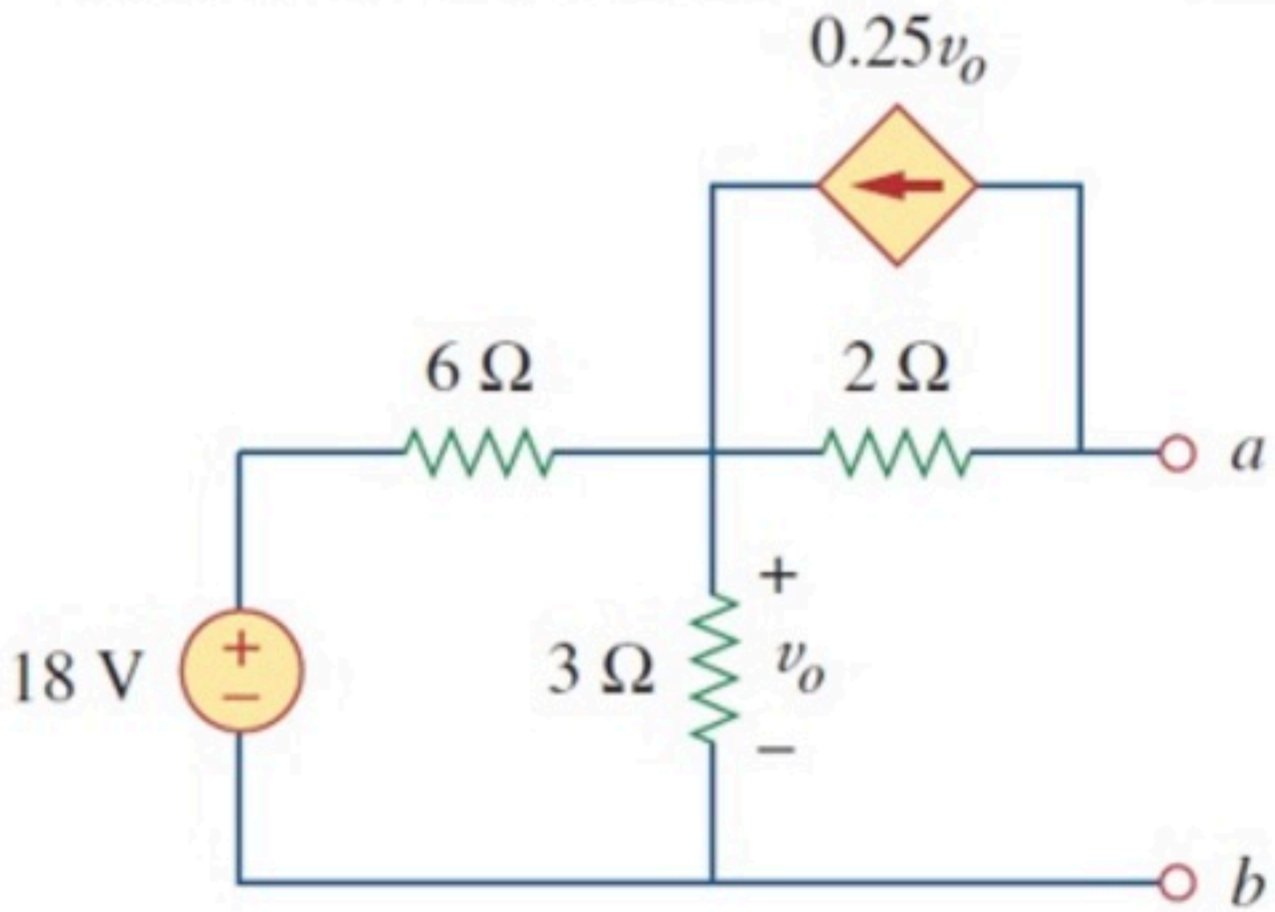
Hint: What do you expect Vth to be? Use test source for Rth.

PP Circuit theorems 013

Unlimited Attempts.

Find the Thevenin equivalent resistance of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Rth (ohm) :

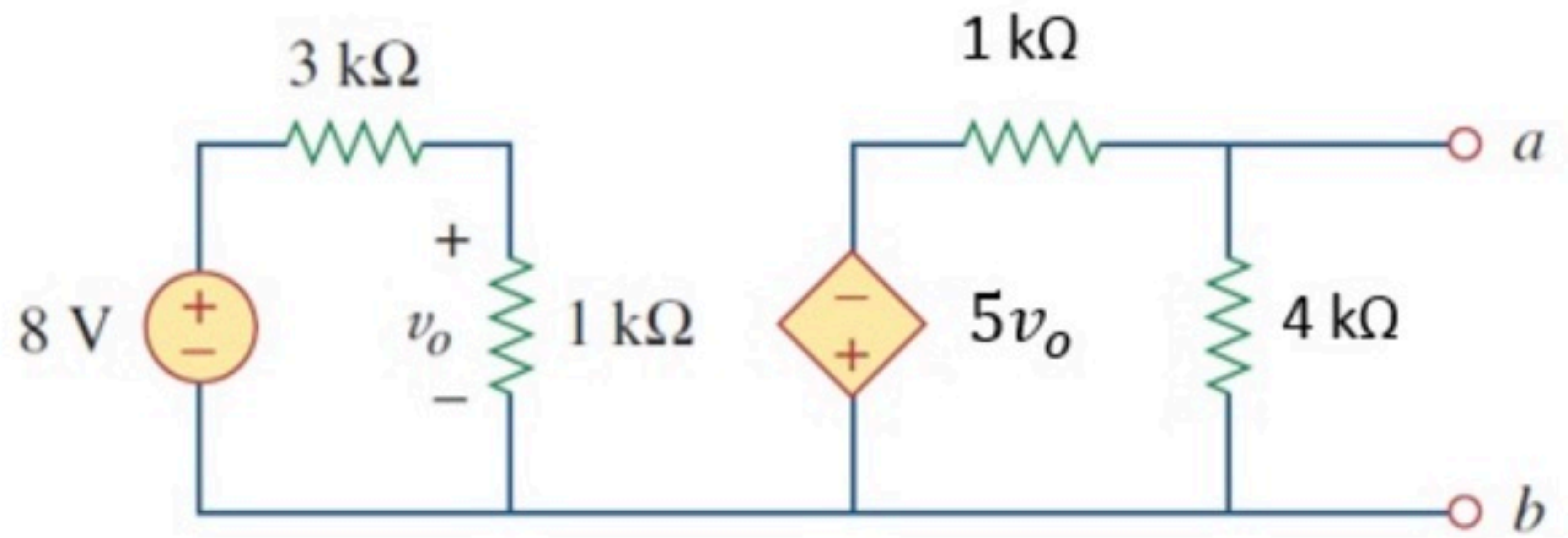
3

Hint: Try using a test source. Would you use a voltage or current test source?

PP Circuit theorems 014

Unlimited Attempts.

What resistor *R* connected between a
and b will absorb maximum power?
What is this power *P*?
[Do not look up the equation for power.]



Given Variables:

. : . .

Calculate the following:

R (ohm) :

800

P (mW) :

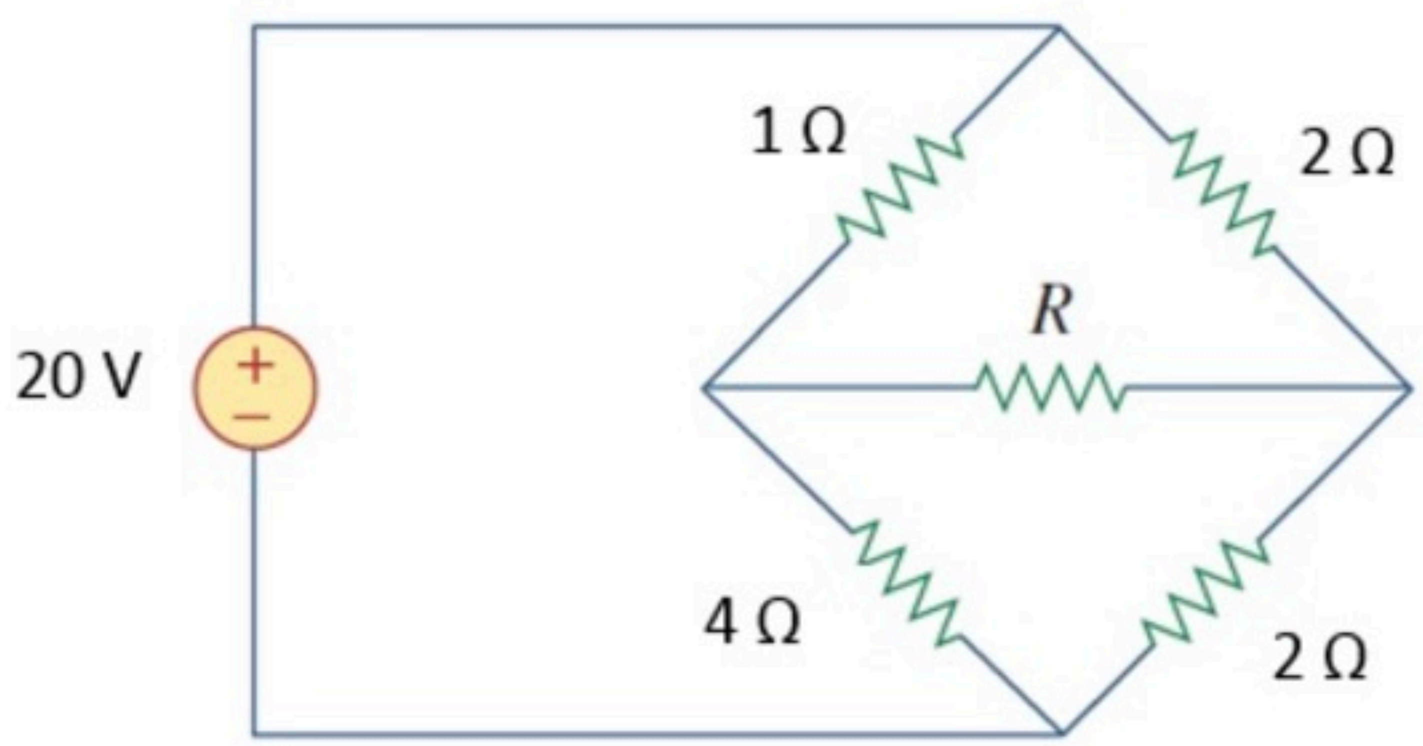
20

Hint: Find the Thevenin model first.

PP Circuit theorems 015

Unlimited Attempts.

What is the maximum power *P* that can be delivered to the variable resistor *R*? [Do not look up the equation for power.]



Given Variables:

. : . .

Calculate the following:

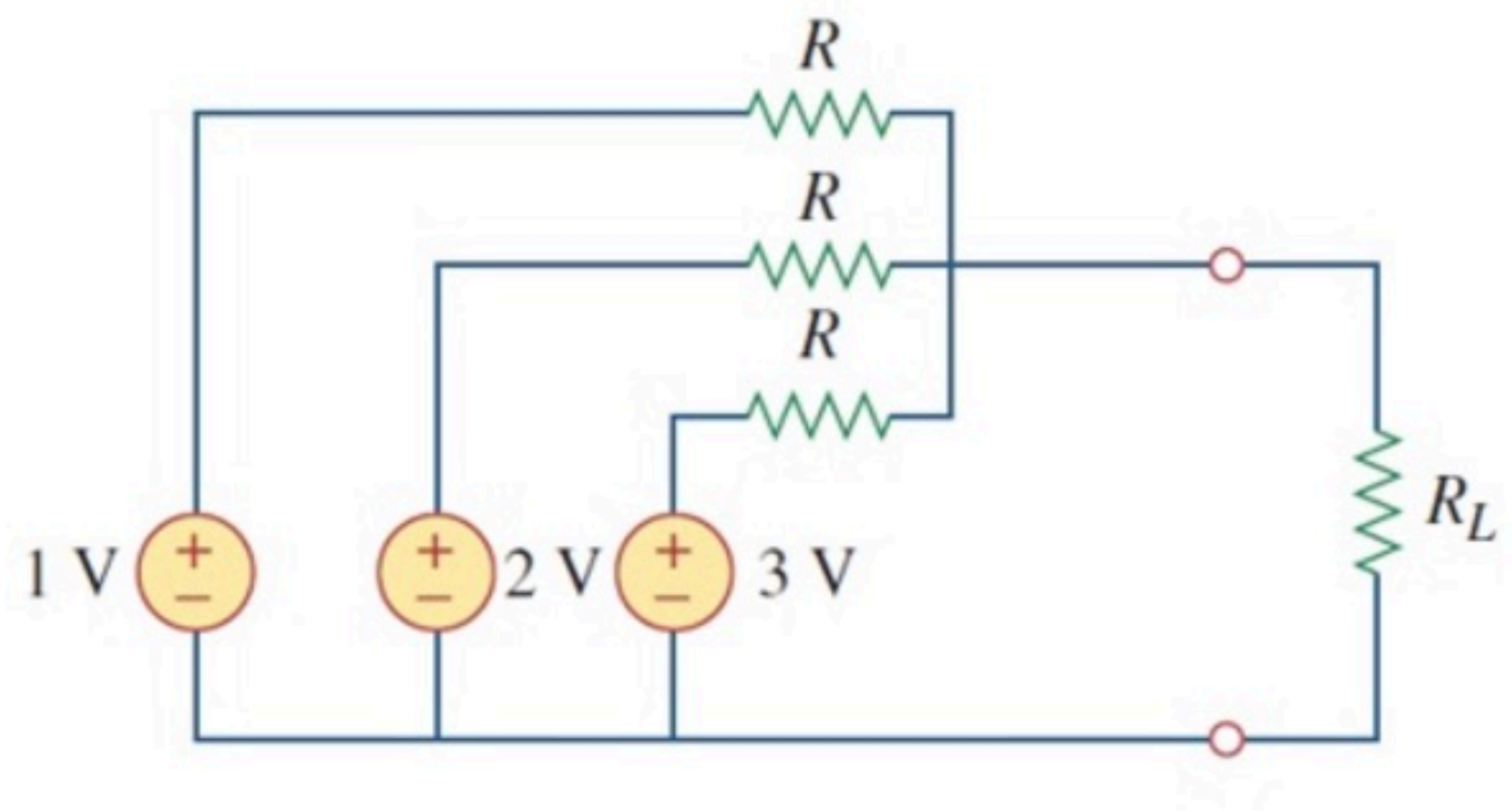
P (W) :

5

PP Circuit theorems 016

Unlimited Attempts.

Find R such that the maximum power delivered to the load is 12 mW.
[Do not look up the equation for power.]



Given Variables:

. : . .

Calculate the following:

R (ohm) :

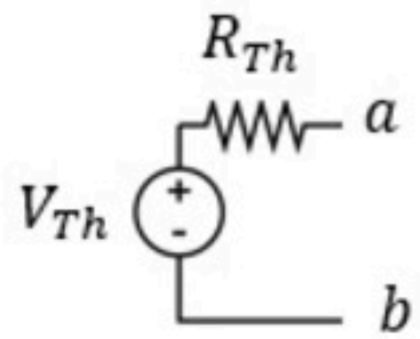
250

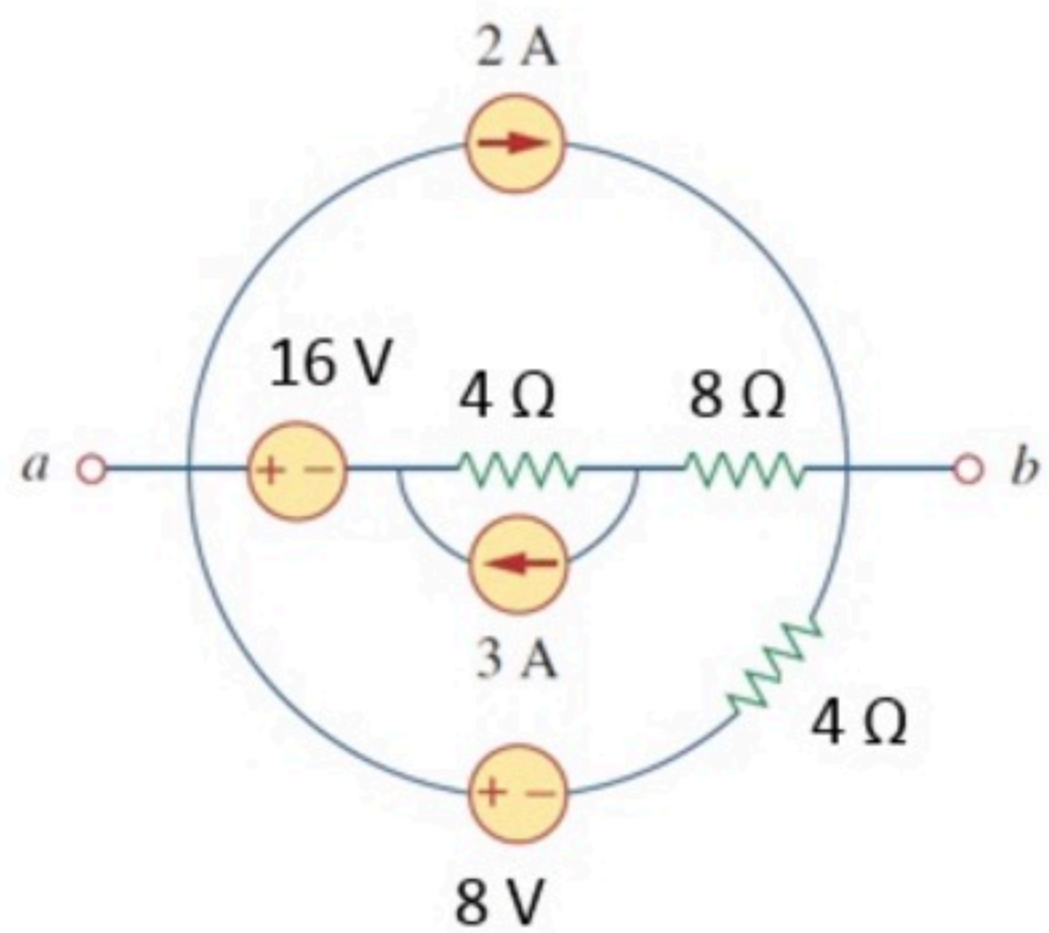
Hint: Find the Thevenin model first.

PP Circuit theorems 017

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Vth (V) :

7

Rth (ohm) :

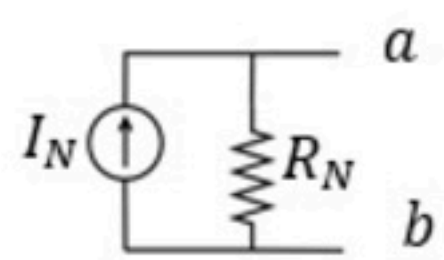
3

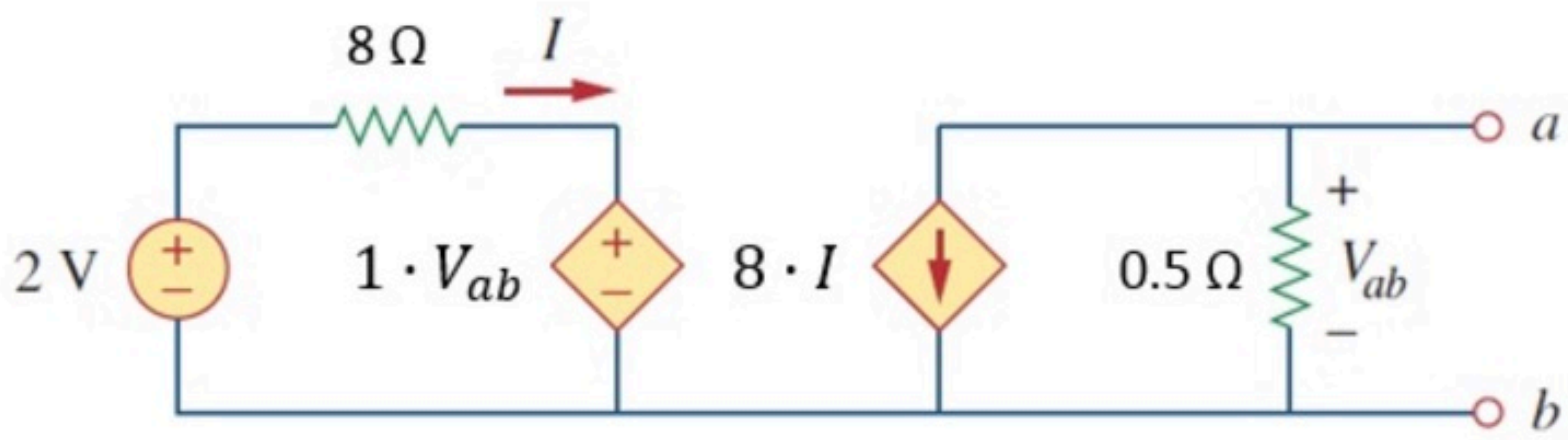
Hint: Use superposition to find Voc.

PP Circuit theorems 018

Unlimited Attempts.

Find the Norton equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

IN (A) :

-2

RN (ohm) :

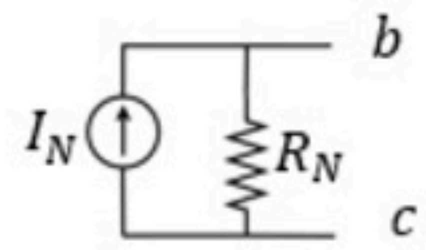
1

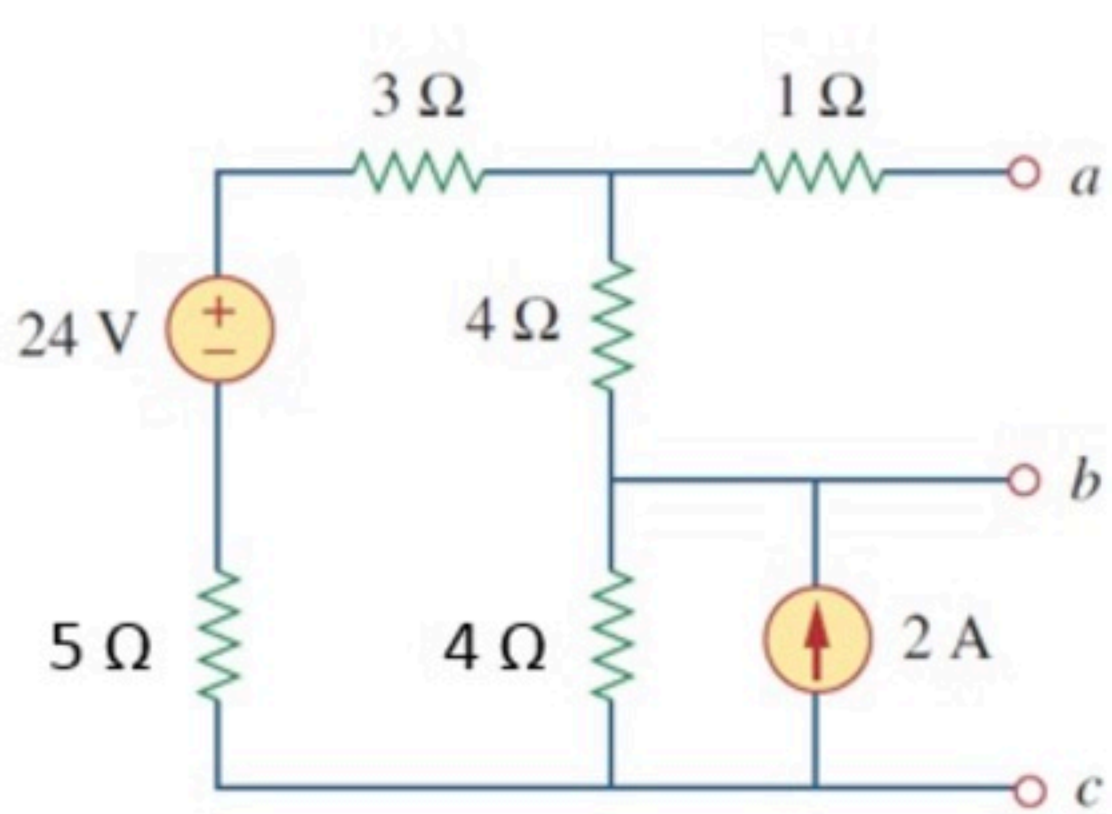
Hint: Find Isc and Voc

PP Circuit theorems 019

Unlimited Attempts.

Find the Norton equivalent model of this circuit, as seen between b and c.





Given Variables:

. : . .

Calculate the following:

IN (A) :

4

RN (ohm) :

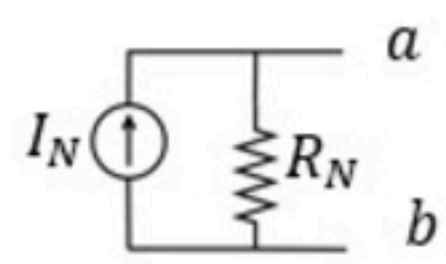
3

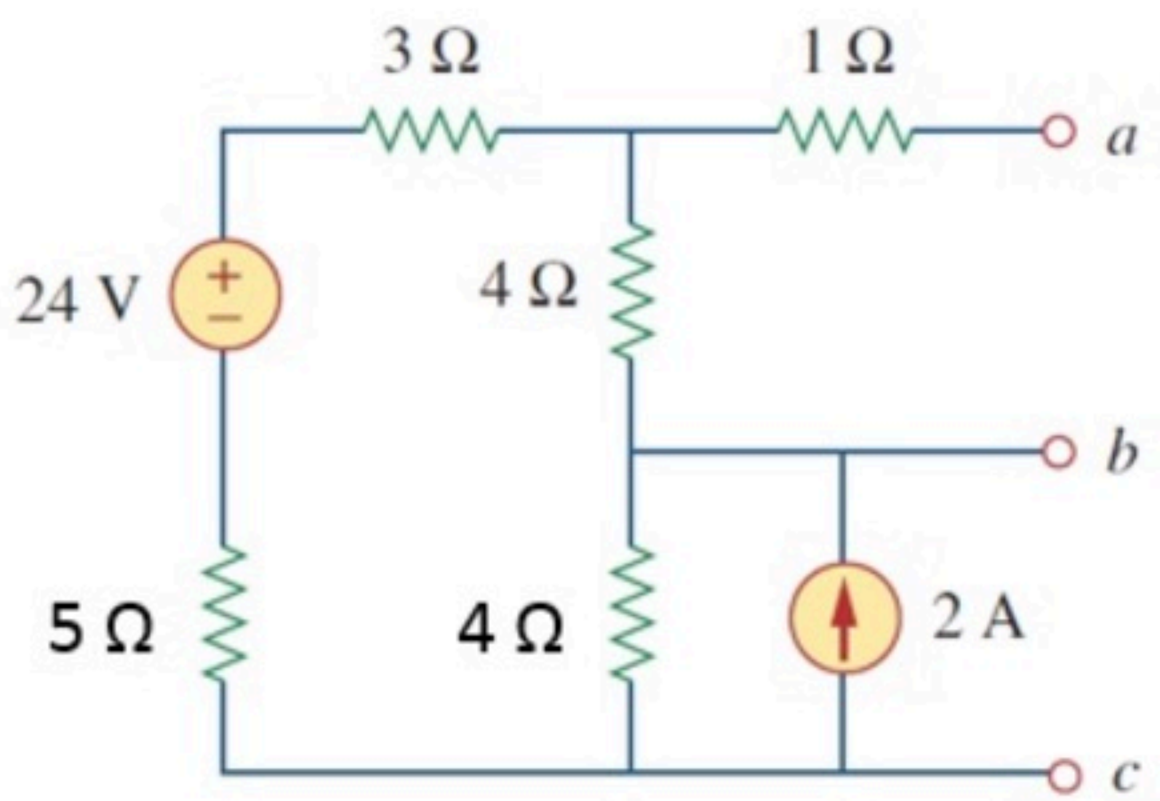
Hint: Does the 1 ohm resistor impact your calculations?

PP Circuit theorems 020

Unlimited Attempts.

Find the Norton equivalent model of this circuit, as seen between a and b. [Hint: if you have difficult numbers, try to use different tests]





Given Variables:

. : . .

Calculate the following:

IN (A) :

1

RN (ohm) :

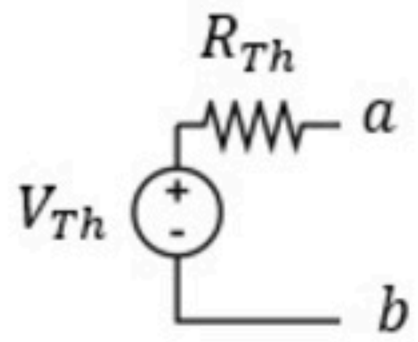
4

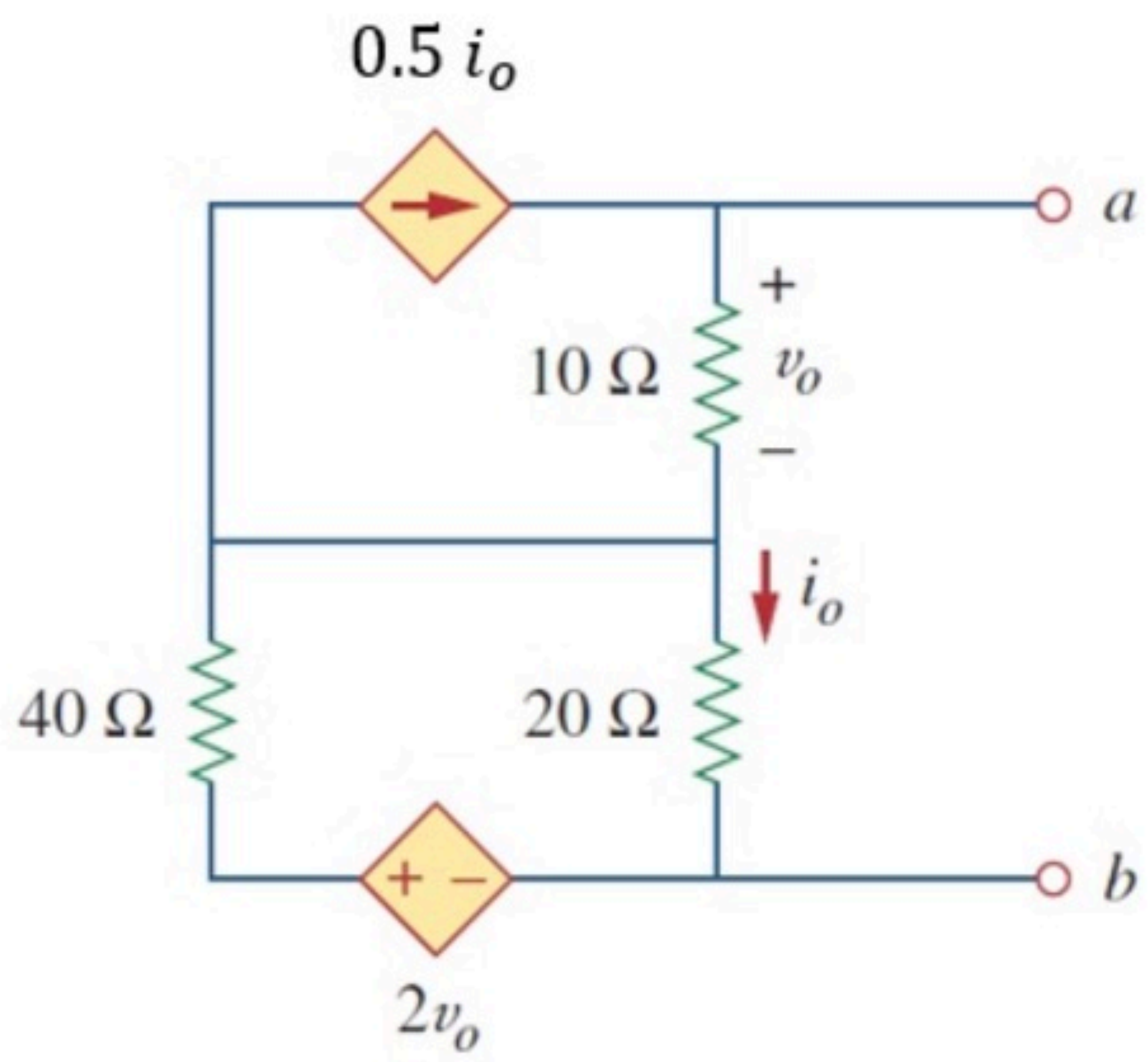
> Hint: Can you plug in the 1 ohm resistor afterwards?

PP Circuit theorems 021

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Vth (V) :

0

Rth (ohm) :

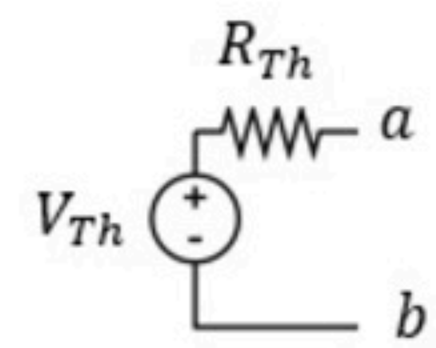
40

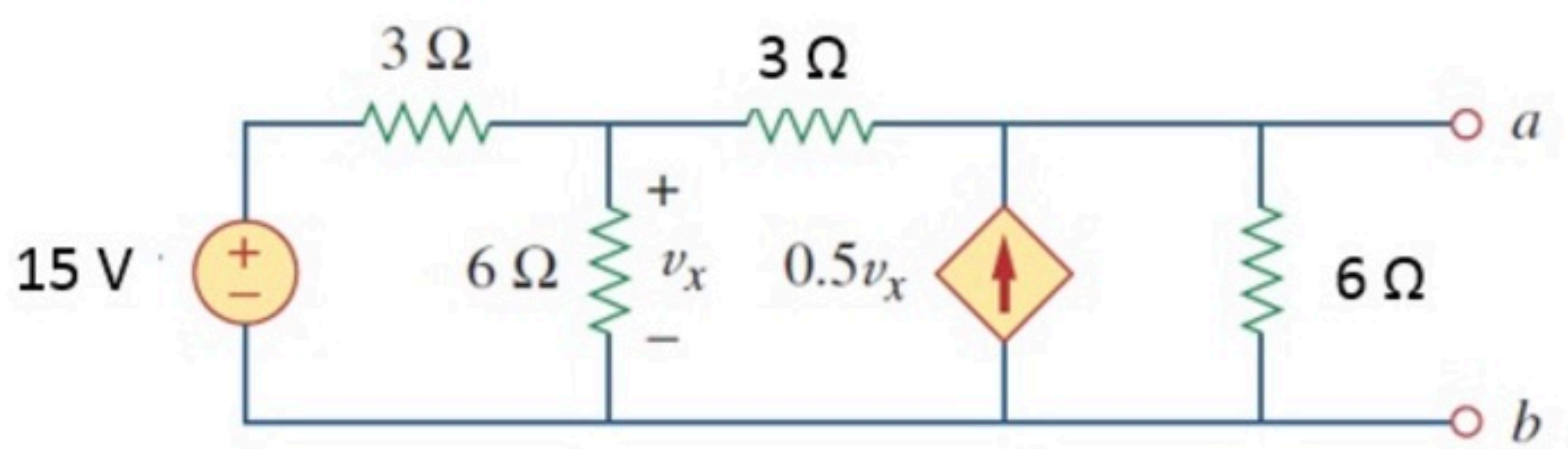
Hint: Use a test source to find Rth.

PP Circuit theorems 022

Unlimited Attempts.

Find the Thevenin equivalent model of this circuit, as seen between a and b.





Given Variables:

. : . .

Calculate the following:

Vth (V) :

30

Rth (ohm) :

6

Hint: Find Isc and Voc.