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

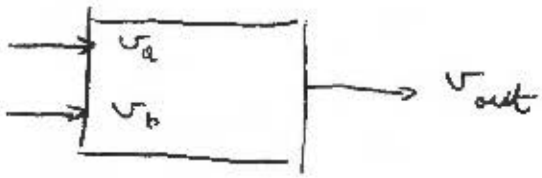
v4 = 0 V

v5 = -9 V

v6 = 45 V

v7 = 5 V

v8 = 8 V



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

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

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

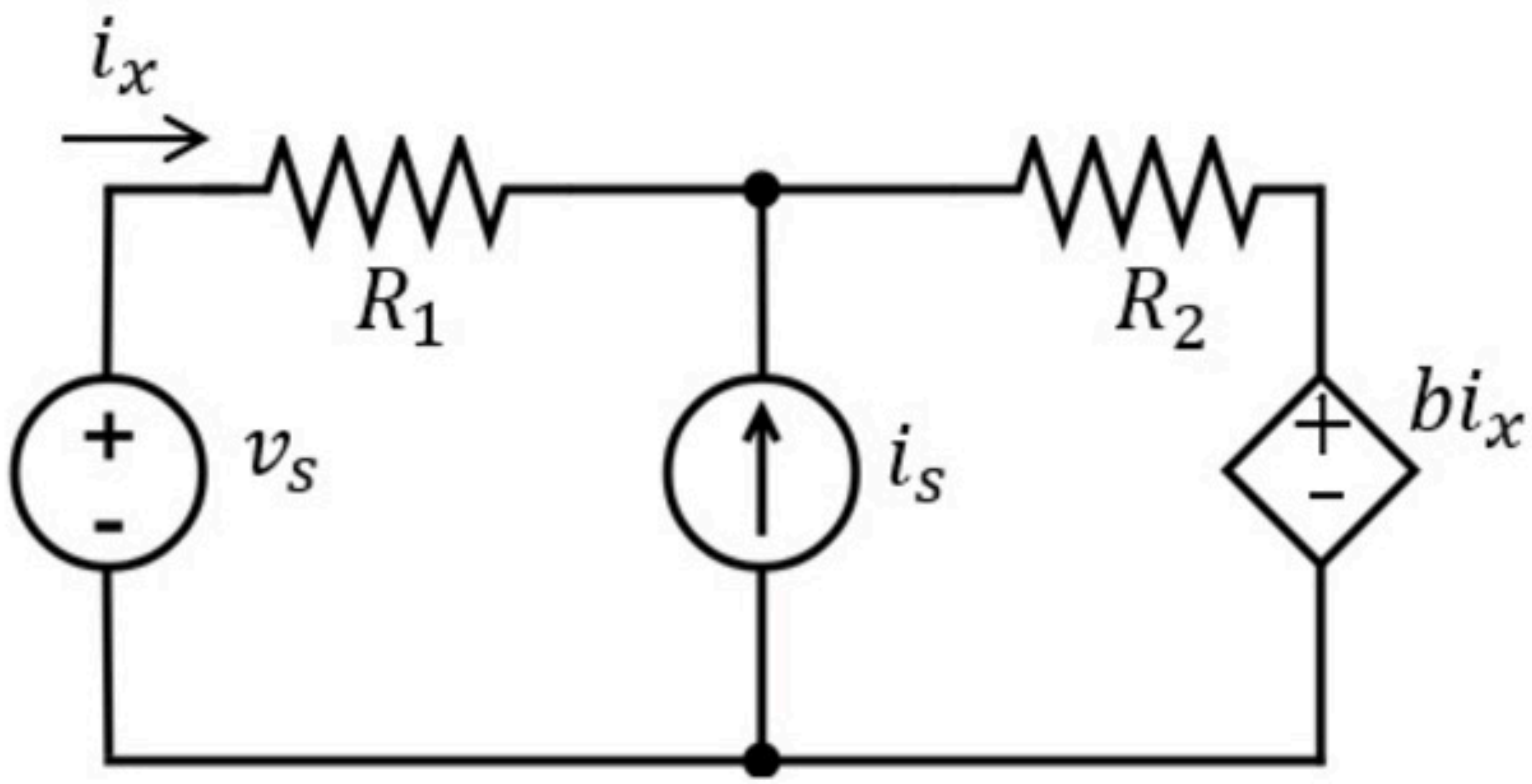
$$\Rightarrow a \cdot v_a + b v_b = 7 \cdot 5 + (-5) \cdot 8$$
$$= -5 V$$

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

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

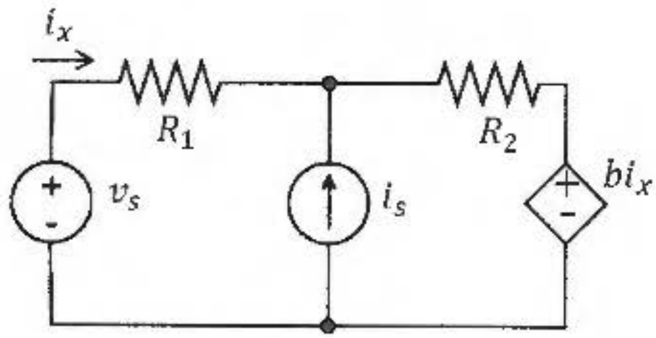
vs : 15 V

is : 1 A

Calculate the following:

ix (A) :

Use superposition to find i_x.



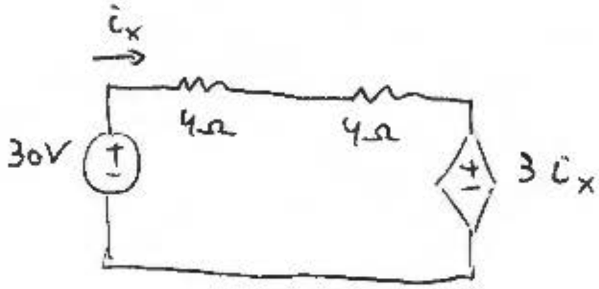
R1 = 4 ohm

R2 = 4 ohm

b = 3 V/A

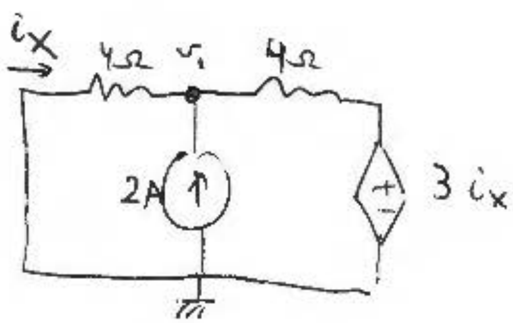
vs = 30 V

is = 2 A



KVL: $30 = i_x \cdot 4 + i_x \cdot 4 + 3i_x$

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



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

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

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

$$11 v_1 = 32$$

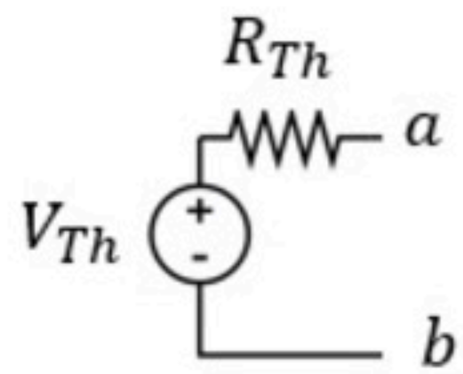
$$v_1 = \frac{32}{11} \Rightarrow i_x = -\frac{8}{11} \text{ A}$$

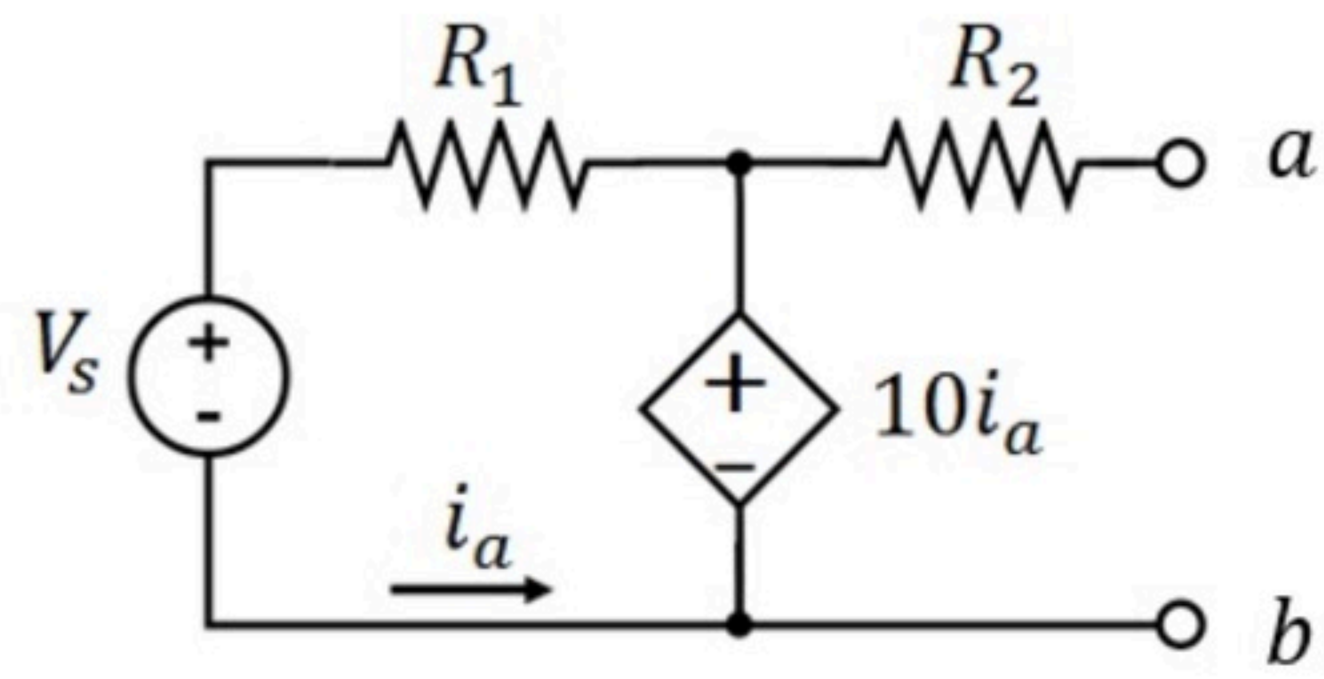
$$i_x = \frac{30}{11} - \frac{8}{11} = \frac{22}{11} \text{ A} \Rightarrow \boxed{i_x = 2\text{A}}$$

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

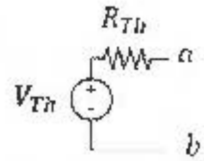
Calculate the following:

Vth (V) :

Rth (ohm) :

Hint: Find any two of Voc, Isc and Req

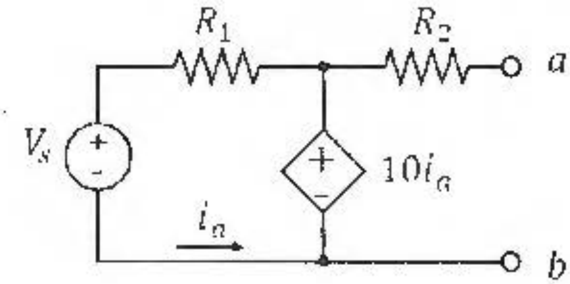
Find the Thevenin equivalent model of this circuit, as seen between a and b.

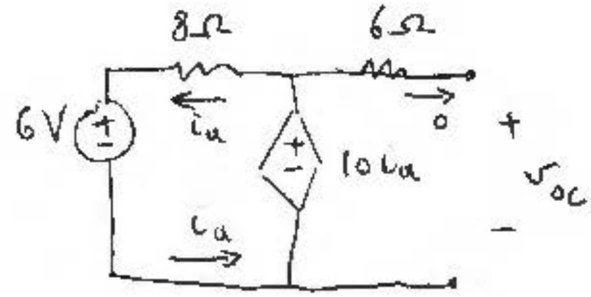


R1 = 8 ohm

R2 = 6 ohm

Vs = 6 V

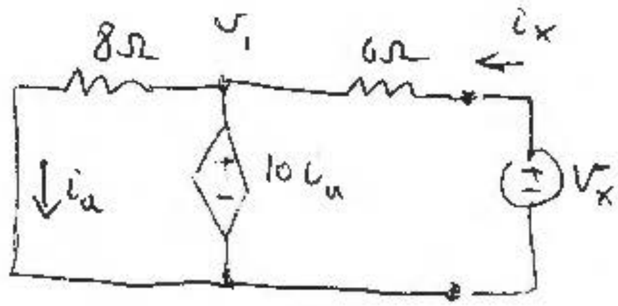




$$i_a = \frac{10 i_a - 6}{8}$$

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

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



$$v_1 = 10 i_a = 8 i_a$$

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

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

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

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

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

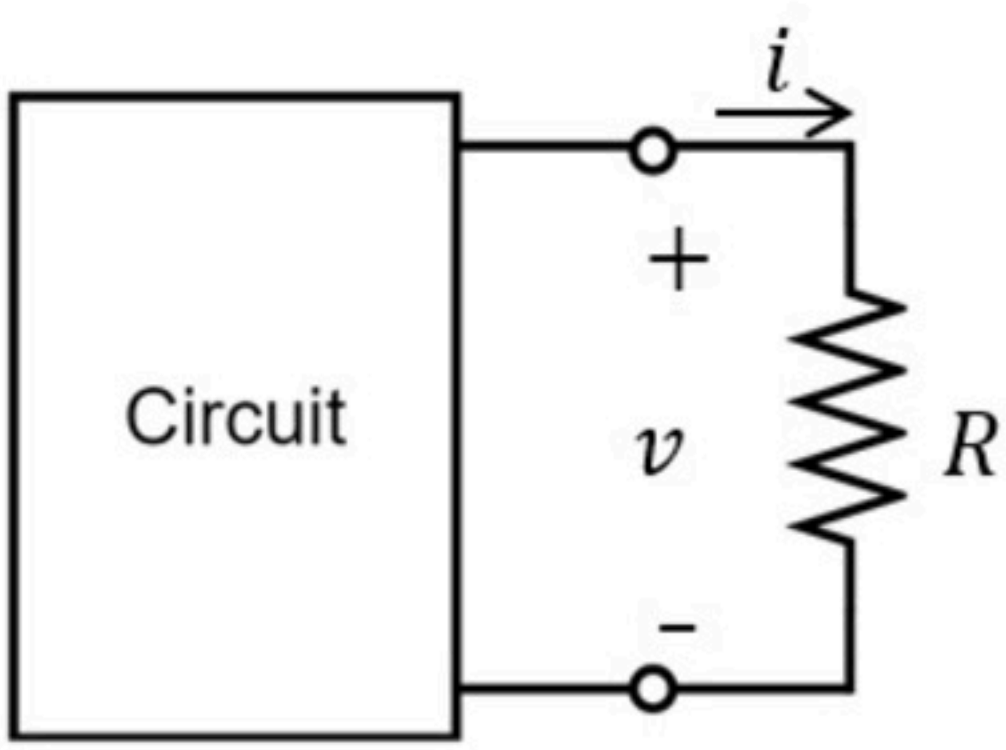
Circuit theorems 004

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 $R \geq 0$)?

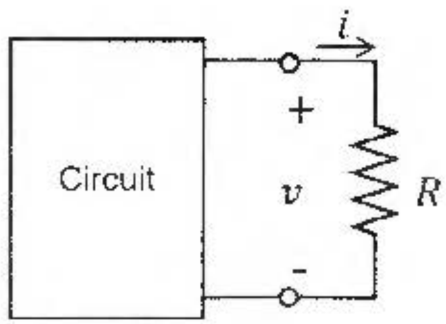
R1 = 5 ohm

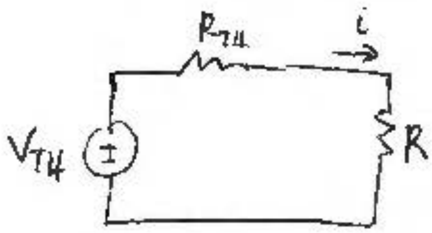
R2 = 8 ohm

I1 = 4 A

I2 = 3 A

I3 = 2 A





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

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

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

$V_{TH} = 36\,V$

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

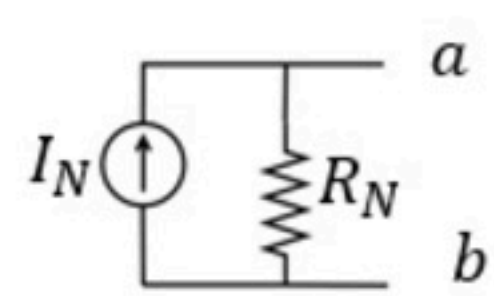
ⓑ i_{MAX} WHEN $R=0 \Rightarrow i_{MAX} = \dfrac{V_{TH}}{R_{TH}} = \dfrac{36}{4} = 9$

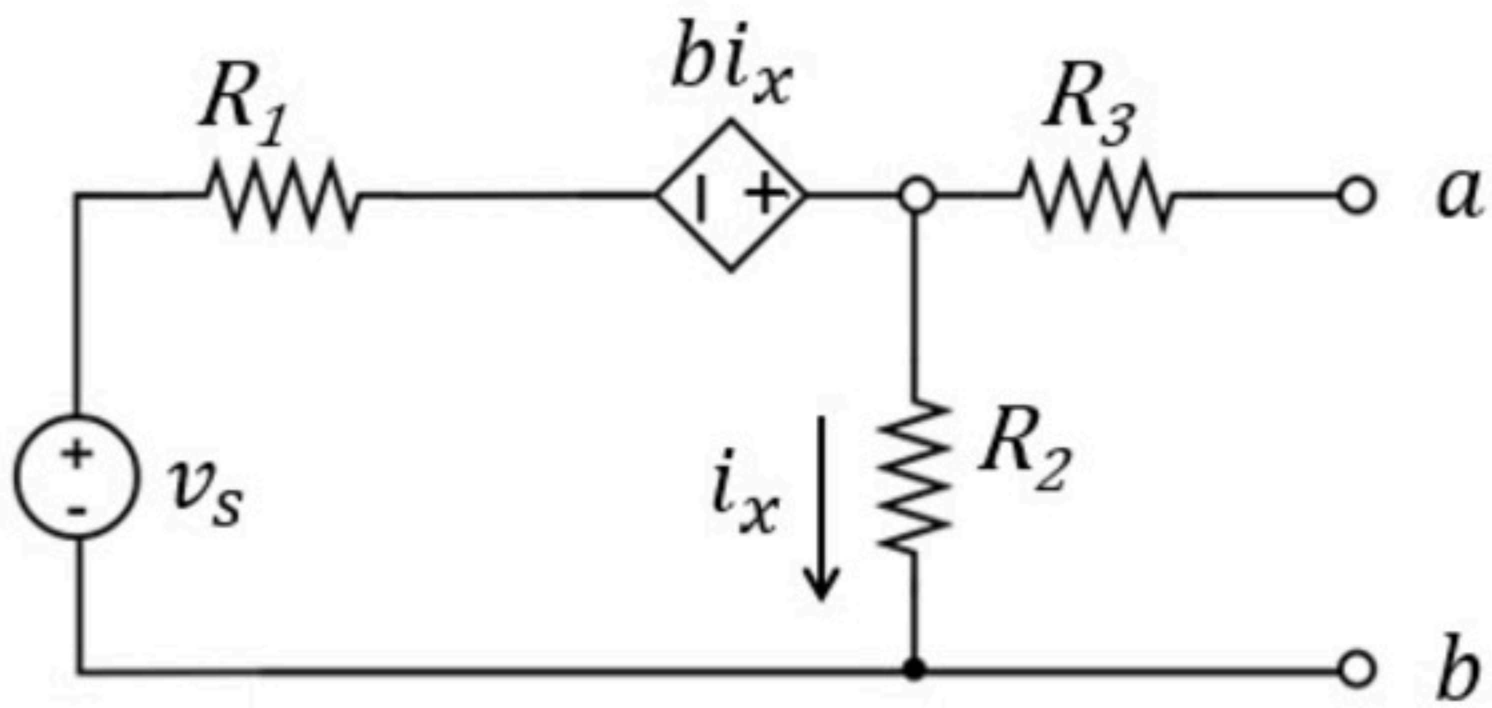
$\boxed{i_{MAX} = 9\,A}$

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

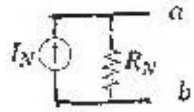
b : 6 V/A

Calculate the following:

IN (A) :

RN (ohm) :

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



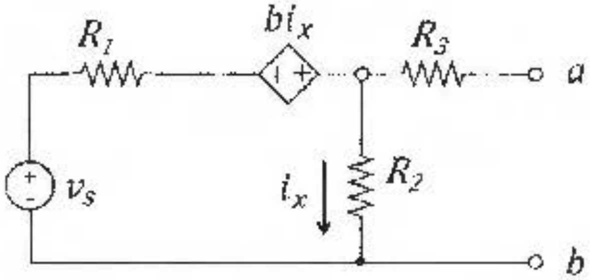
R1 = 2 ohm

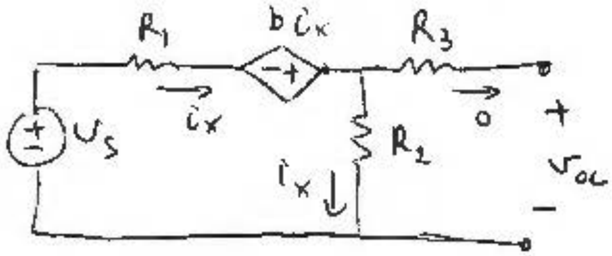
R2 = 4 ohm

R3 = 4 ohm

vs = 12 V

b = 2 A/V



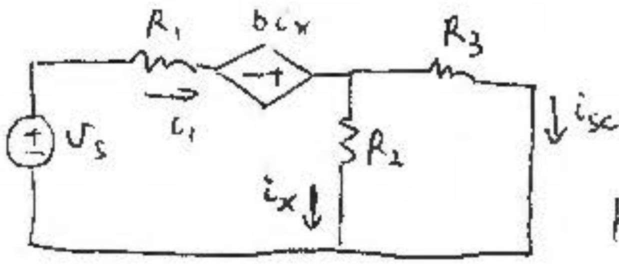


$$\text{KVL: } v_s - R_1 i_x + b i_x - R_2 i_x = 0$$

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

$$i_x = 3\text{A} \Rightarrow v_{oc} = R_2 i_x$$

$$= 12\text{ V}$$



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

$$\text{KVL: } v_s - R_1 i_1 + b i_x - R_2 i_x = 0$$

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

$$6 i_x = 12 \Rightarrow i_x = 2\text{ A}$$

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

$$v_{oc} = 12\text{V}$$

$$i_{sc} = 2\text{A}$$

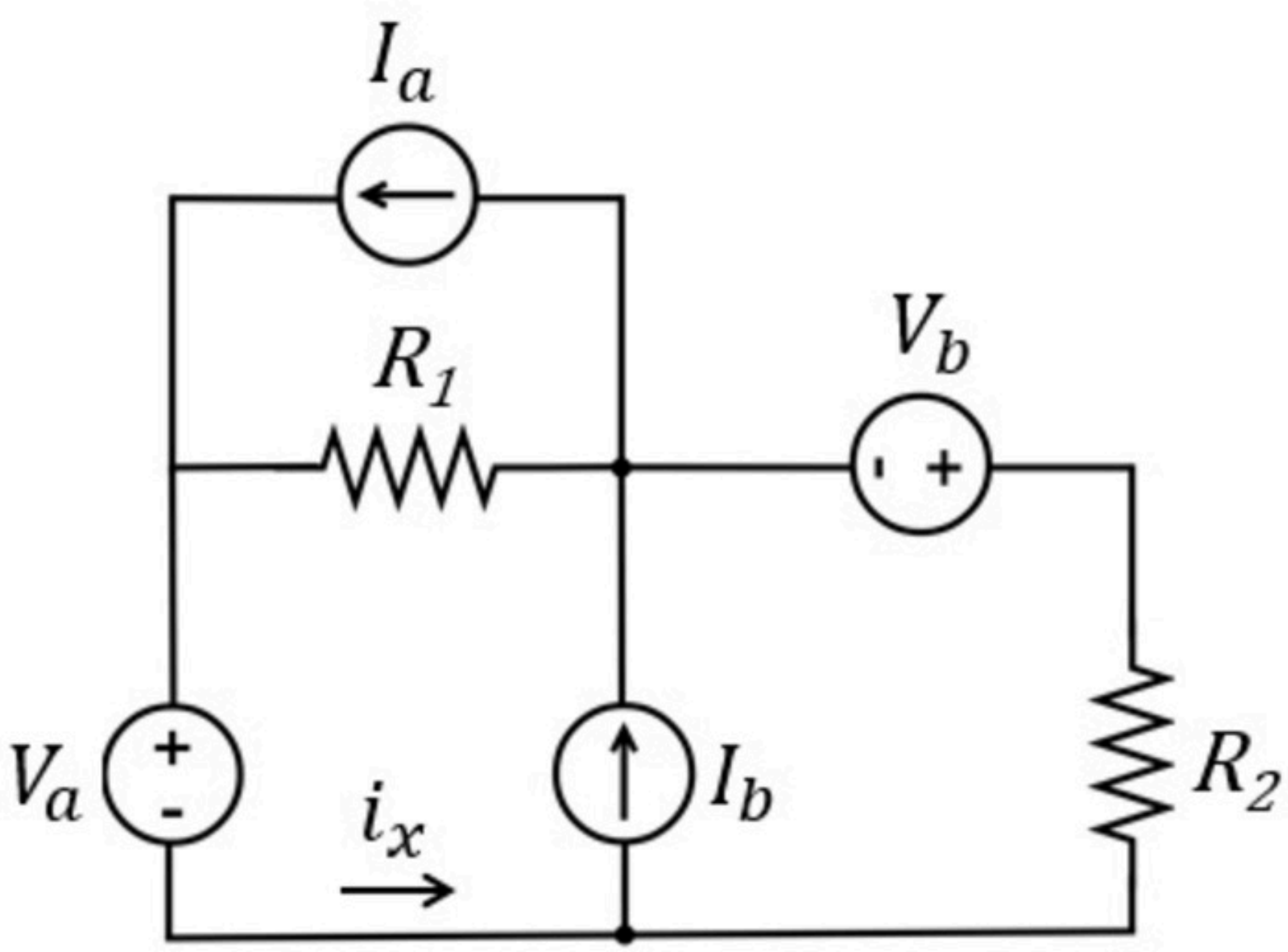
$$\Rightarrow \boxed{I_N = 2\text{A}}$$

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

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

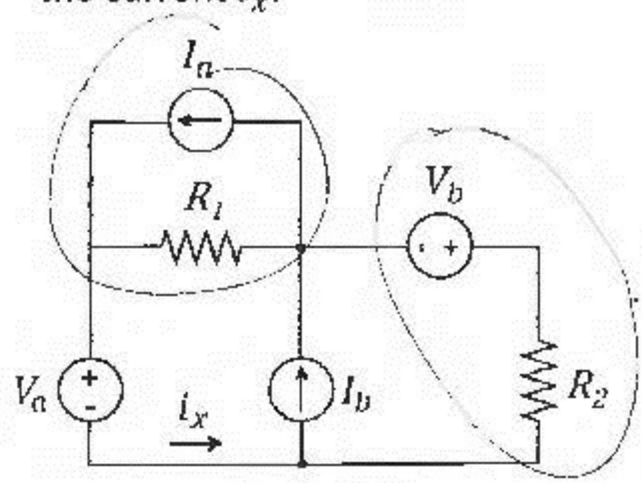
Vb = 6 V

Ia = 4 A

Ib = 6 A

R1 = 3 ohm

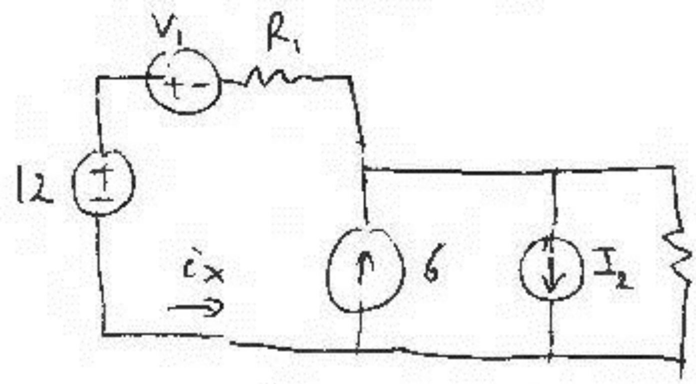
R2 = 3 ohm

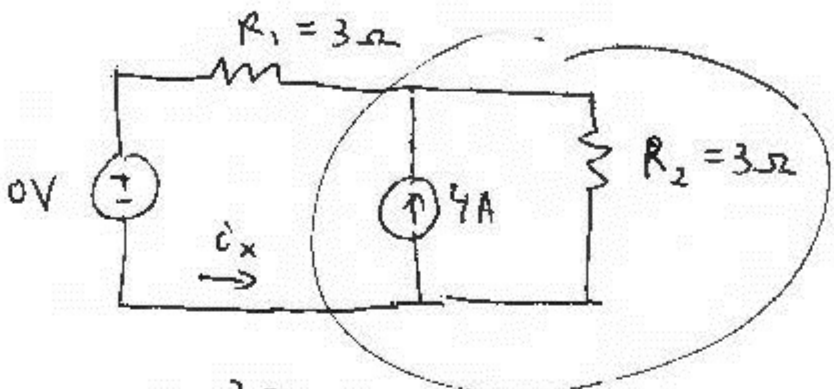


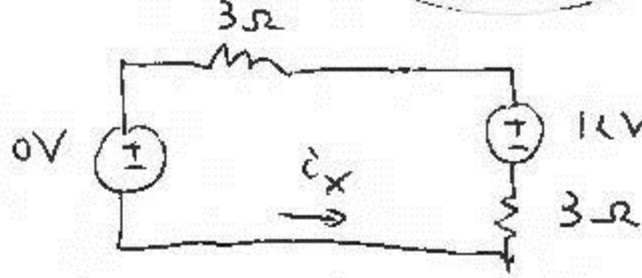
$V_1 = I_a \cdot R_1 = 4 \cdot 3 = 12V$

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

R_2







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

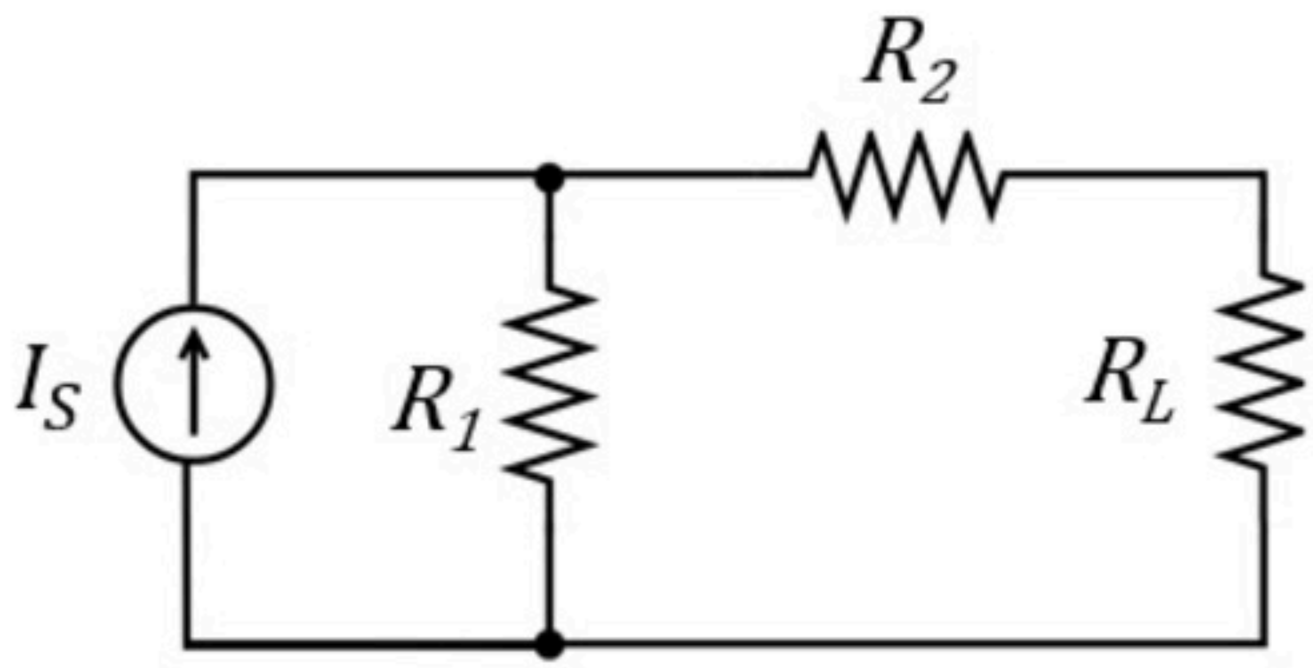
$\boxed{i_x = 2A}$

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.

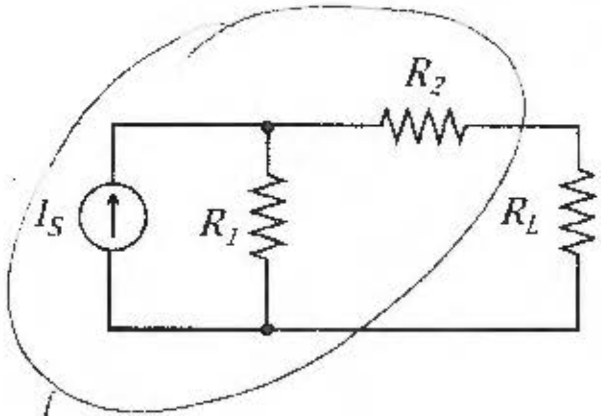
Find the R_L for maximum power transfer.

Given I_S , find the max power transferred to R_L.

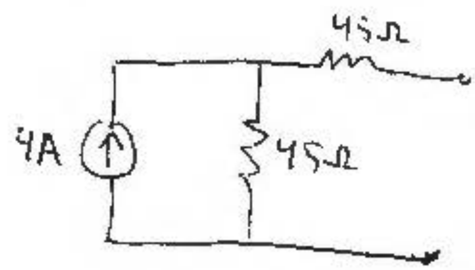
Is = 4 A

R1 = 45 ohm

R2 = 45 ohm

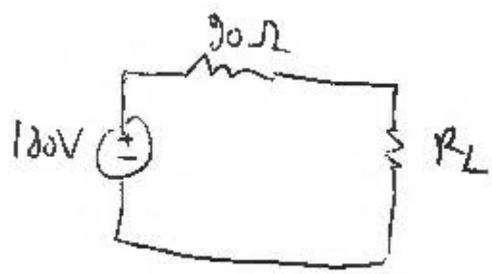


FIND THEVENIN MODEL



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

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



FOR MAX POWER TRANSFER

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

$$\boxed{R_L = 90\,\Omega}$$

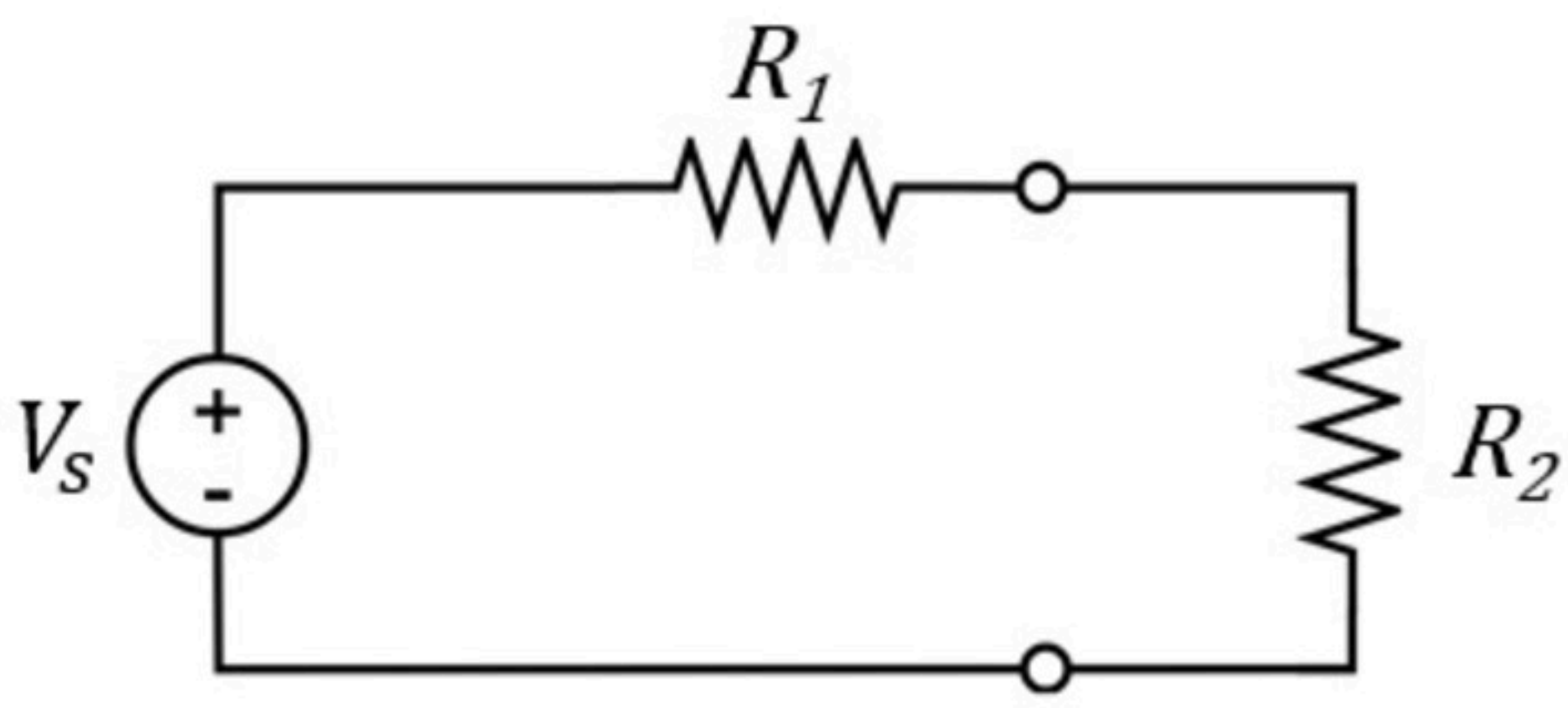
$$P = R_L \cdot i^2 \qquad i = \frac{180}{90 + R_L} = 1\,A$$

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

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

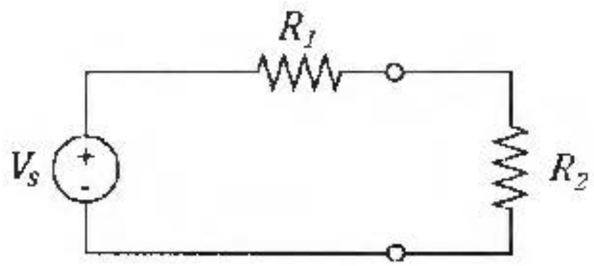
Calculate the following:

R1 (ohm) :

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

Vs = 12 V

R2 = 3 ohm



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

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

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

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

ALWAYS DECREASING

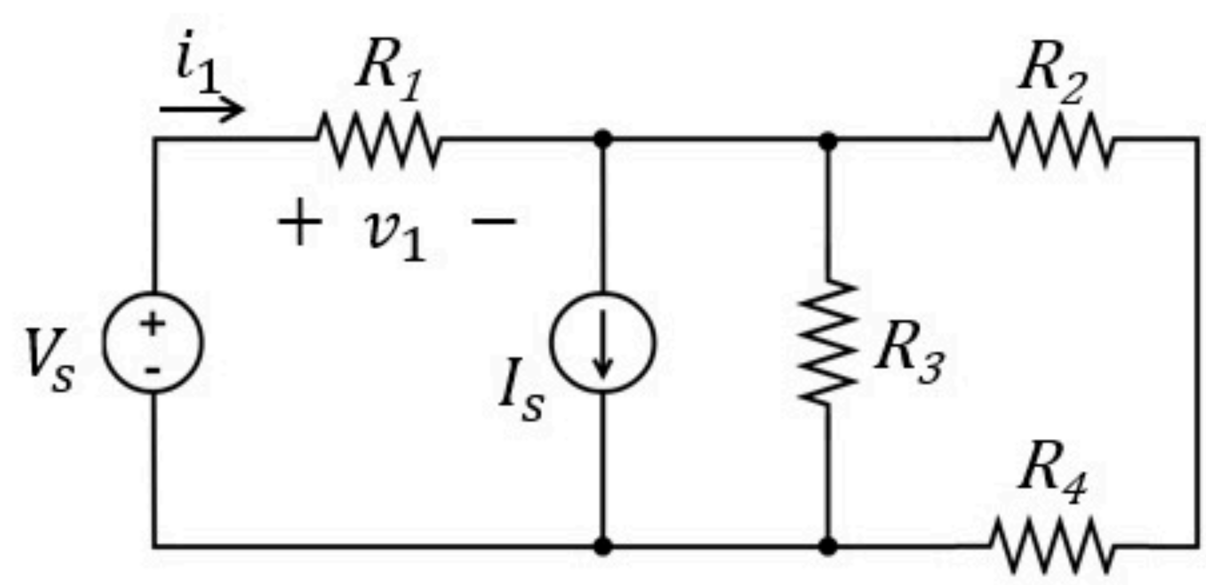
P_{MAX} WHEN $\boxed{R_1 = 0\,\Omega}$

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_l is a variable resistor that can take on values in the range $0 \le R_l \le 24\Omega$.

Vs = 12 V

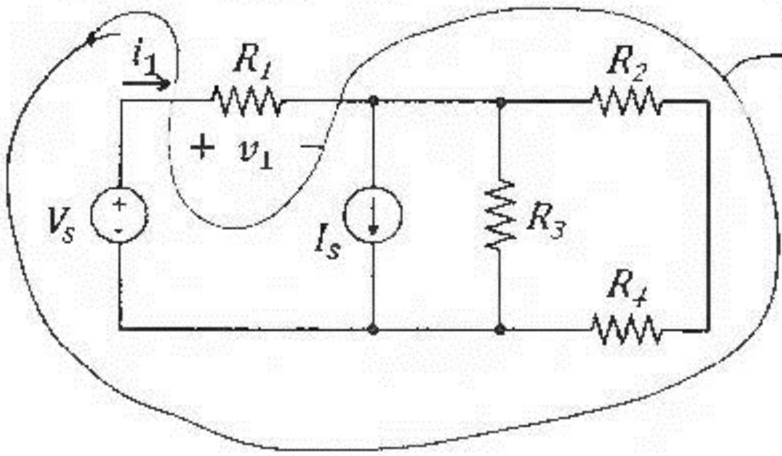
Is = 3 A

R2 = 12 ohm

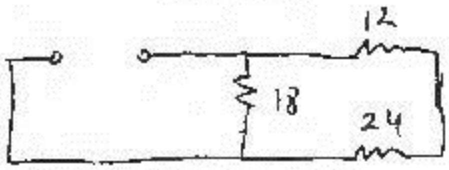
R3 = 18 ohm

R4 = 24 ohm

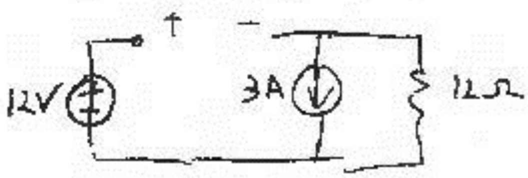
1. Find the value of $R_1 = R_{1a}$ that maximizes current i_1 and the resulting current $i_1 = i_{1a}$.
2. Find the value of $R_1 = R_{1b}$ that maximizes voltage v_1 and the resulting current $v_1 = v_{1b}$.
3. Find the value of $R_1 = R_{1c}$ that maximizes the power received by R_1 and the resulting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



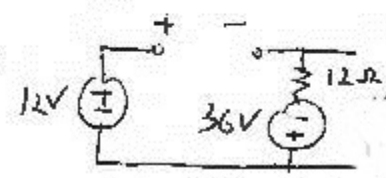
→ FIND THEVENIN MODEL



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

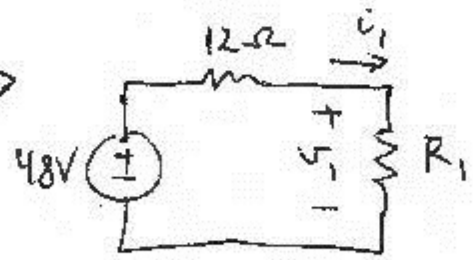


SOURCE TRANSFORM ⇝



$v_{oc} = 48V$

⇒



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

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

$\boxed{v_1 = 32V}$

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

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

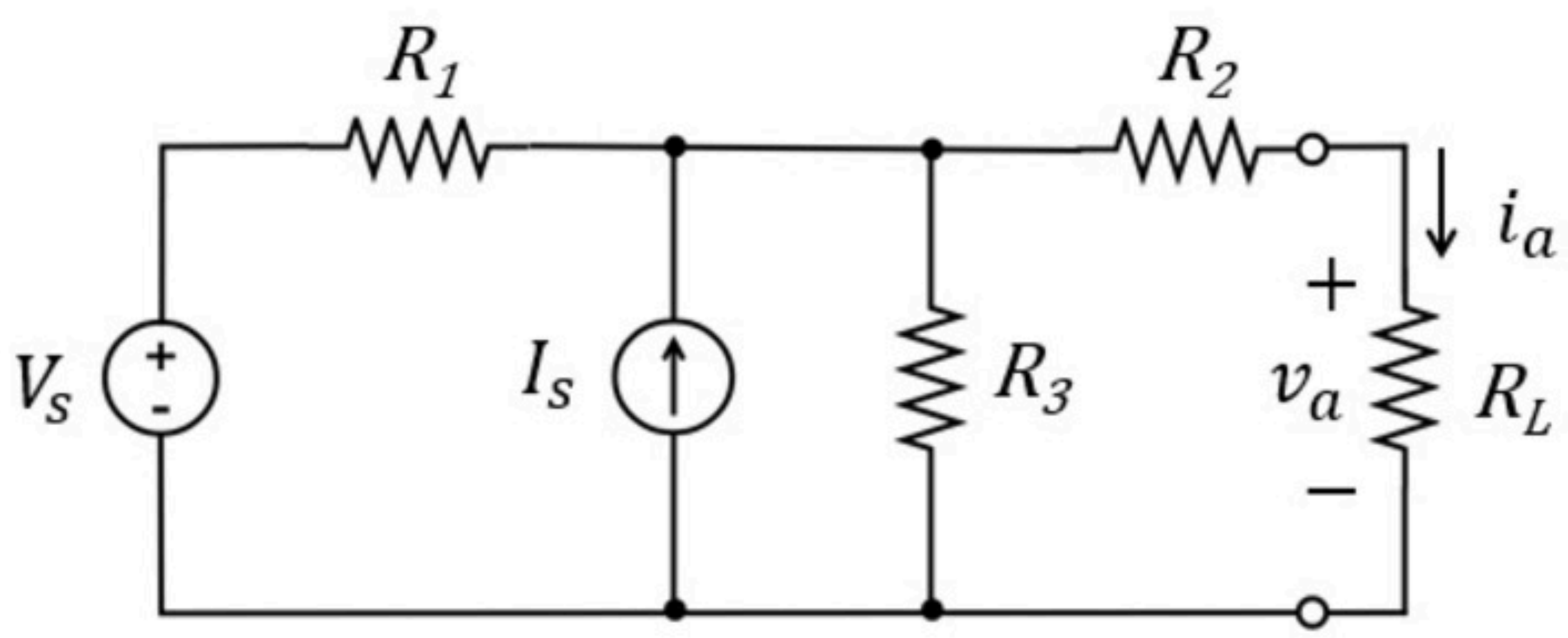
$\boxed{P = 48W}$

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

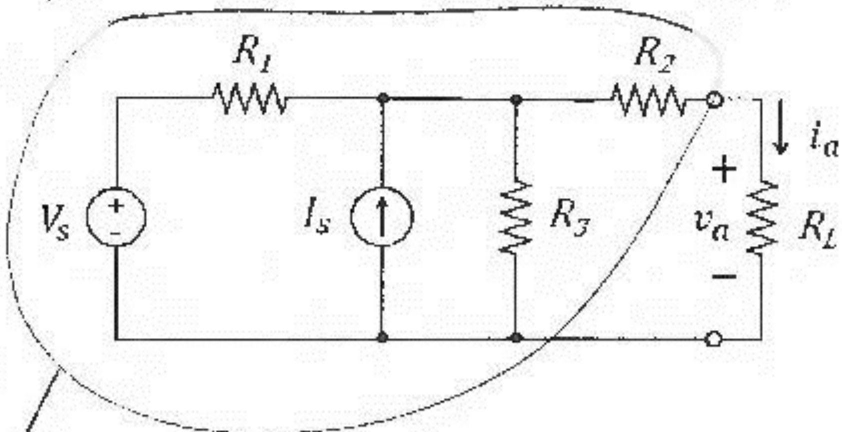
Vs = 12 V

Is = 2 A

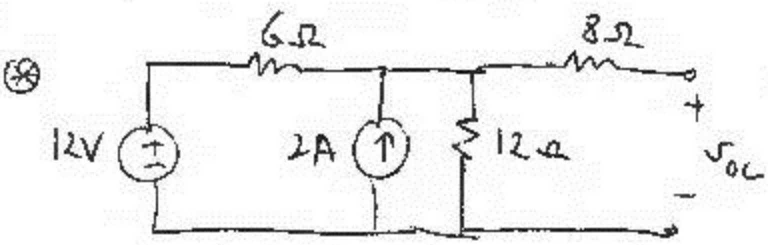
R1 = 6 ohm

R2 = 8 ohm

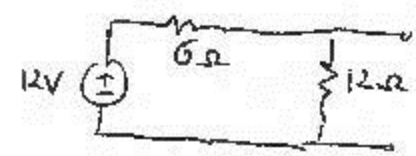
R3 = 12 ohm



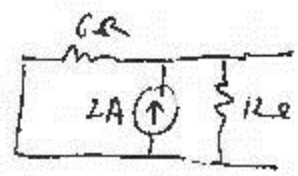
FIND THEVENIN MODEL



⇝ SUPERPOSITION

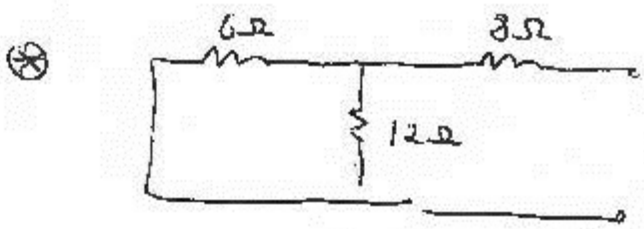


$v_{oc_1} = \frac{12}{18} \cdot 12 = 8V$

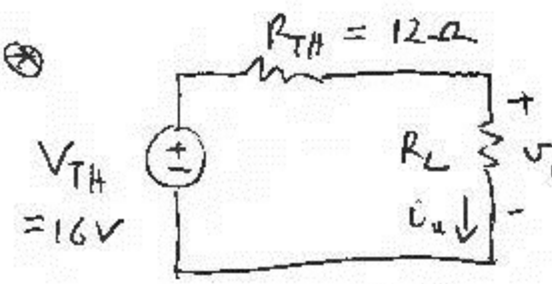


$v_{oc_2} = 2 \cdot (12 /\!/ 6) = 2 \cdot 4 = 8V$

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



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



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

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

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

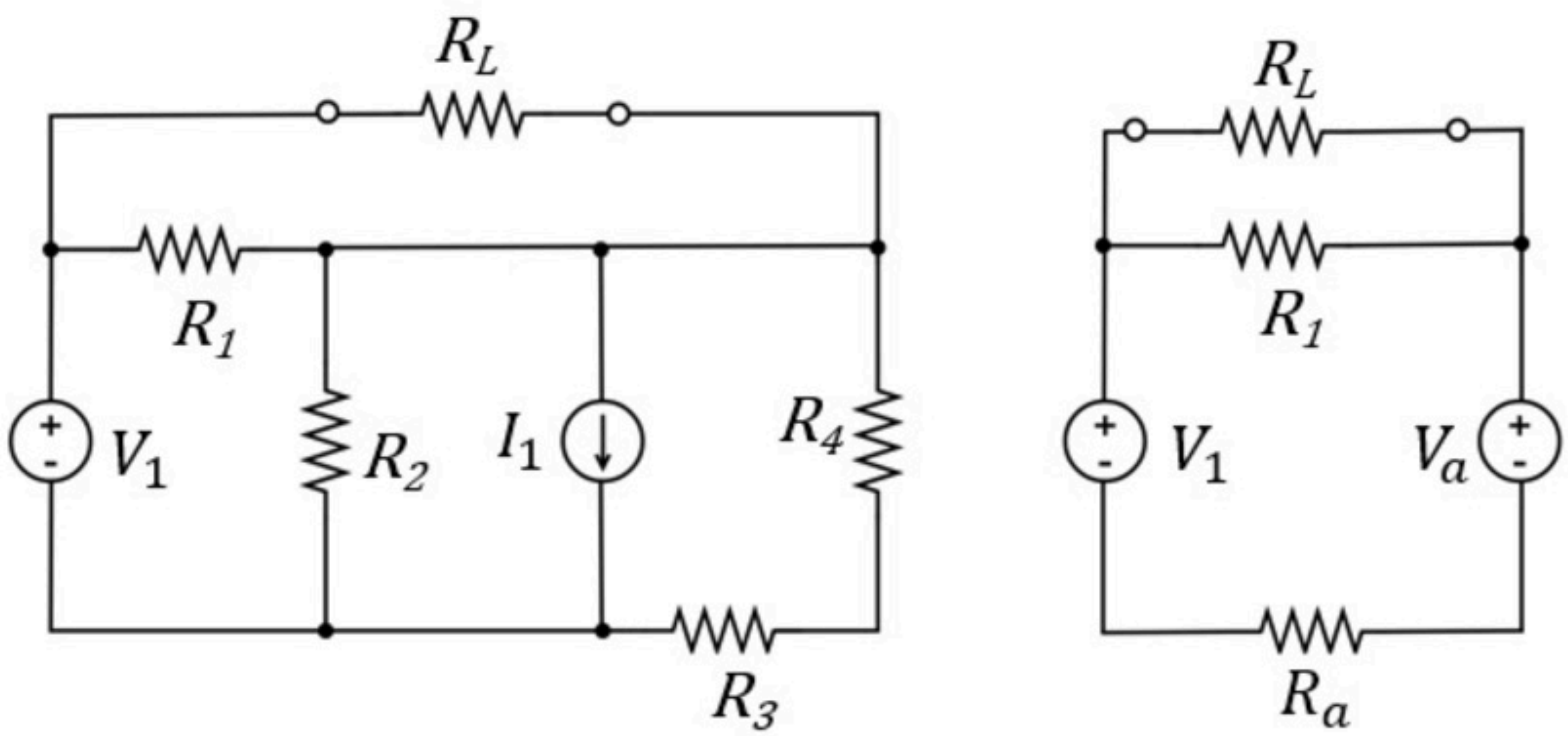
③ $i_a = \frac{16}{R_L + 12} = 1 \Rightarrow \boxed{R_L = 4\ \Omega}$

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

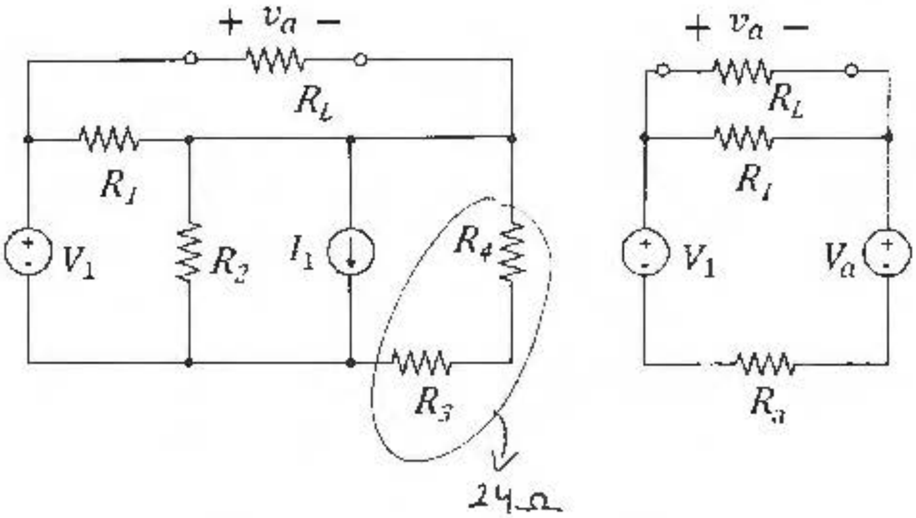
I1 = 2 A

R1 = 22 ohm

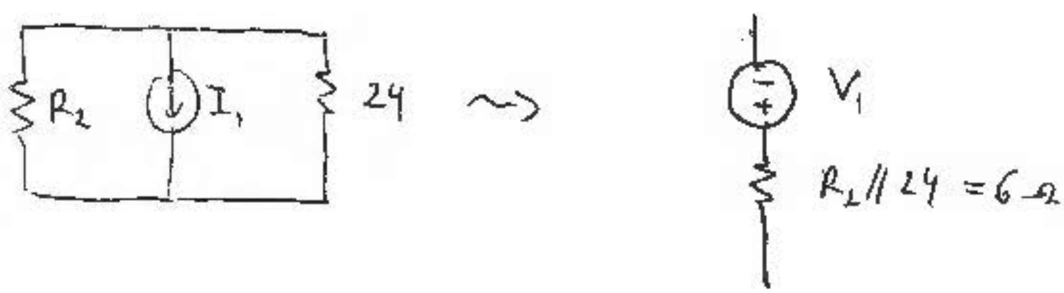
R2 = 8 ohm

R3 = 12 ohm

R4 = 12 ohm



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



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

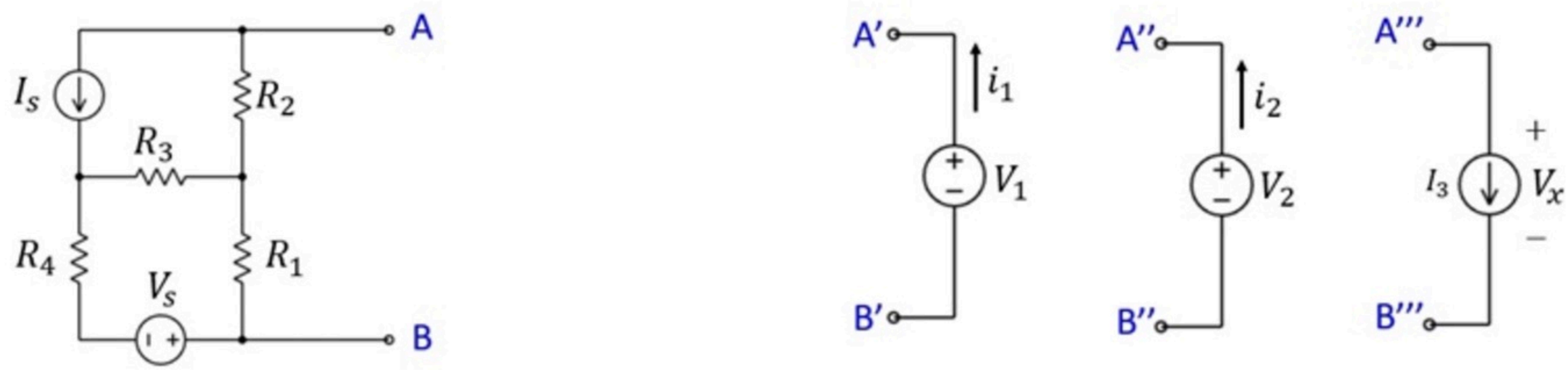
$\boxed{V_a = -12V}$

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

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

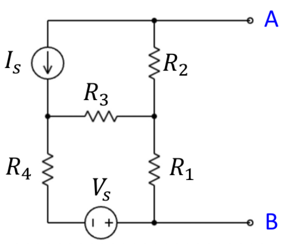
R4 : 2 ohm

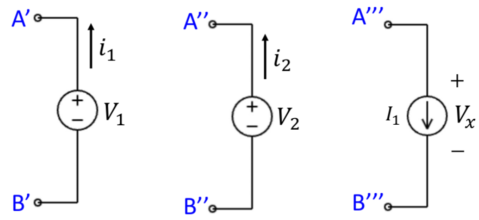
Calculate the following:

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.





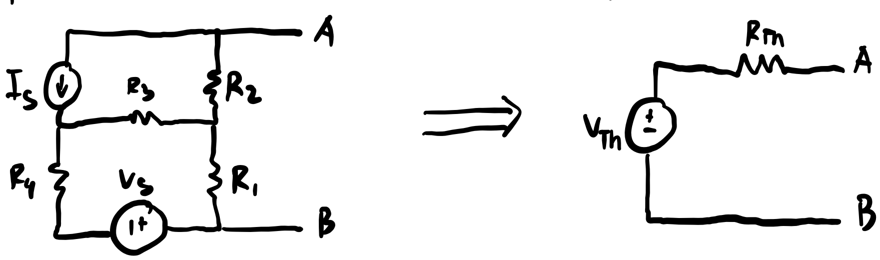
$V_1 = 15$ V
$i_1 = 6$ A
$V_2 = 10$ V
$i_2 = 5$ A
$I_1 = 5$ A
$R_4 = 2\Omega$

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'.

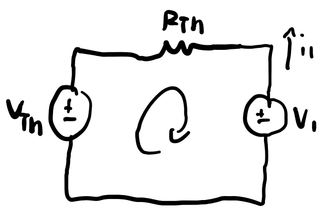
You are also told the value of current i_2 if V_2 is attached, with A connected to A'' and B connected to B''. However, in this case, the independent sources were first turned off (i.e., $V_S = 0$ and $I_S = 0$).

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



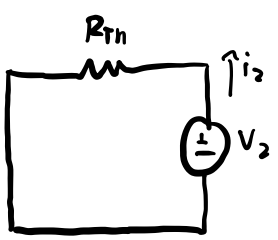
when $A \to A'$, $B \to B'$



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 $V_S = 0$, $I_S = 0$

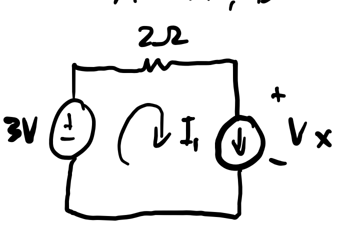


$R_{Th} = \frac{V_2}{i_2} = \frac{10}{5} = 2\Omega$

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

$V_{Th} = 3V$

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



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

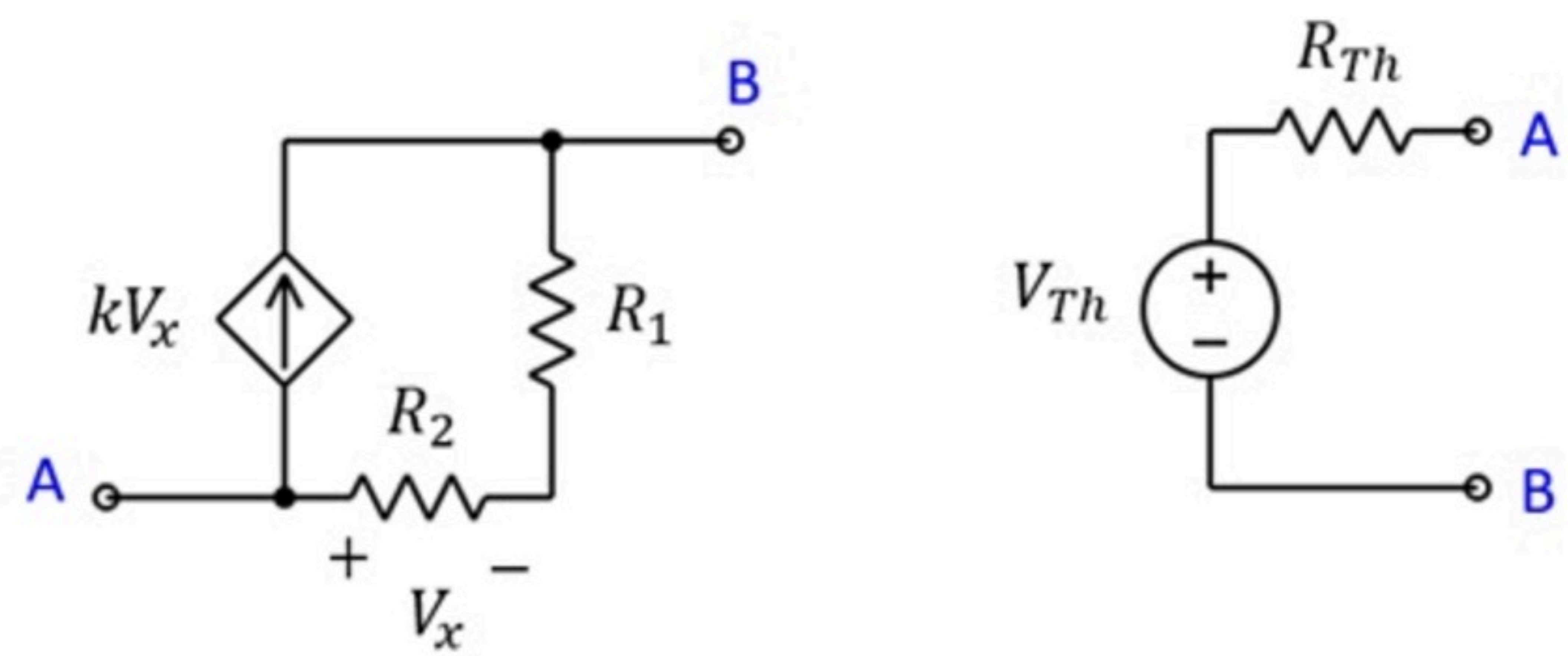
$V_x = 3 - 2(5)$

$\boxed{V_x = -7V}$

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

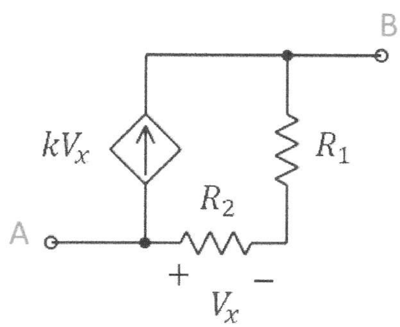
k : -2 A/V

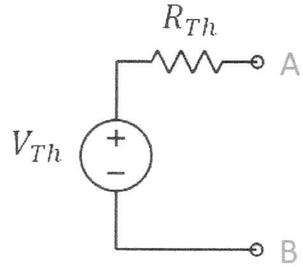
Calculate the following:

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}.



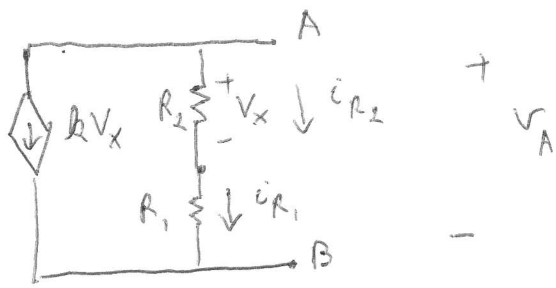


$R_1 = 4\,\Omega$

$R_2 = 2\,\Omega$

$k = -2\ A/V$

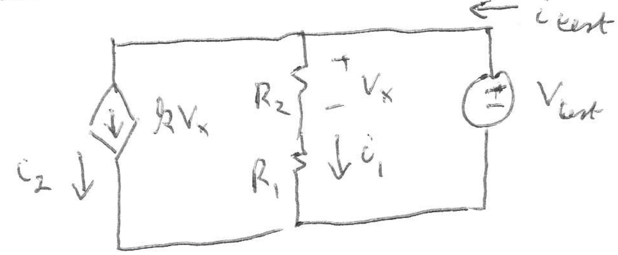
REDRAW:



(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

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

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

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

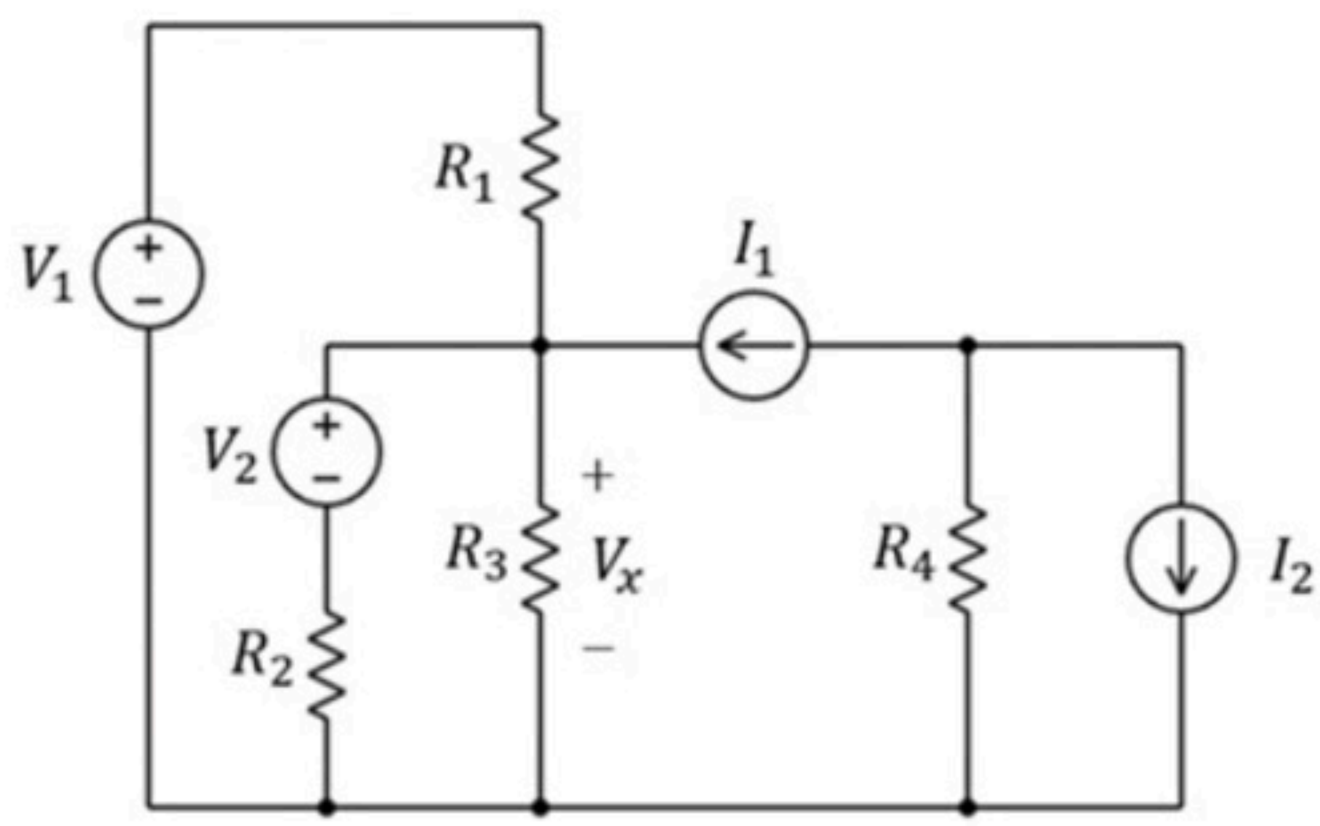
Circuit theorems 015

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}.

$R_1 = 15\Omega$

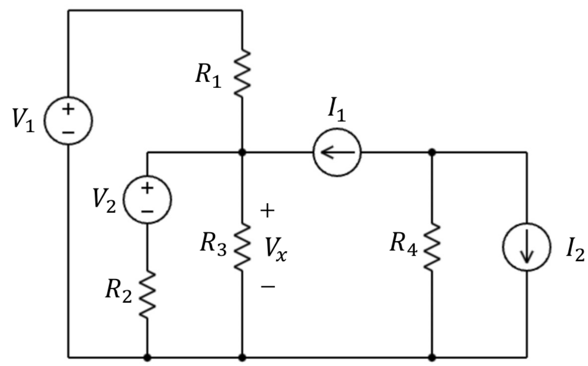
$R_2 = 5\Omega$

$R_3 = 15\Omega$

$R_4 = 7\Omega$

$I_1 = 2A$

$V_x = 15$



a. Generally,

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

If all sources are doubled,

$$V_{x1} = a(2V_1) + b(2V_2) + c(2I_1) + d(2I_2) = 2(aV_1 + bV_2 + cI_1 + dI_2)$$

$$= 2V_x$$

$$= 2 \cdot 15$$

$$\boxed{V_{x1} = 30V}$$

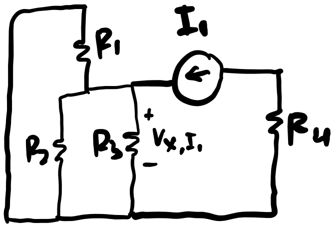
b. If only I_1 is doubled

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

$$= V_x + cI_1$$

find the contribution of I_1 using superposition

when only I_1 is on,



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

$$V_{x,I_1} = 2\left(\frac{\frac{15}{4}}{\frac{15}{4} + 15}\right)15$$

$$= 2\left(\frac{15}{15 + 60}\right)15$$

$$= 2 \cdot \frac{1}{5} \cdot 15$$

$$= 6V \Rightarrow cI_1$$

$$V_{x2} = V_x + cI_1$$

$$= 15 + 6$$

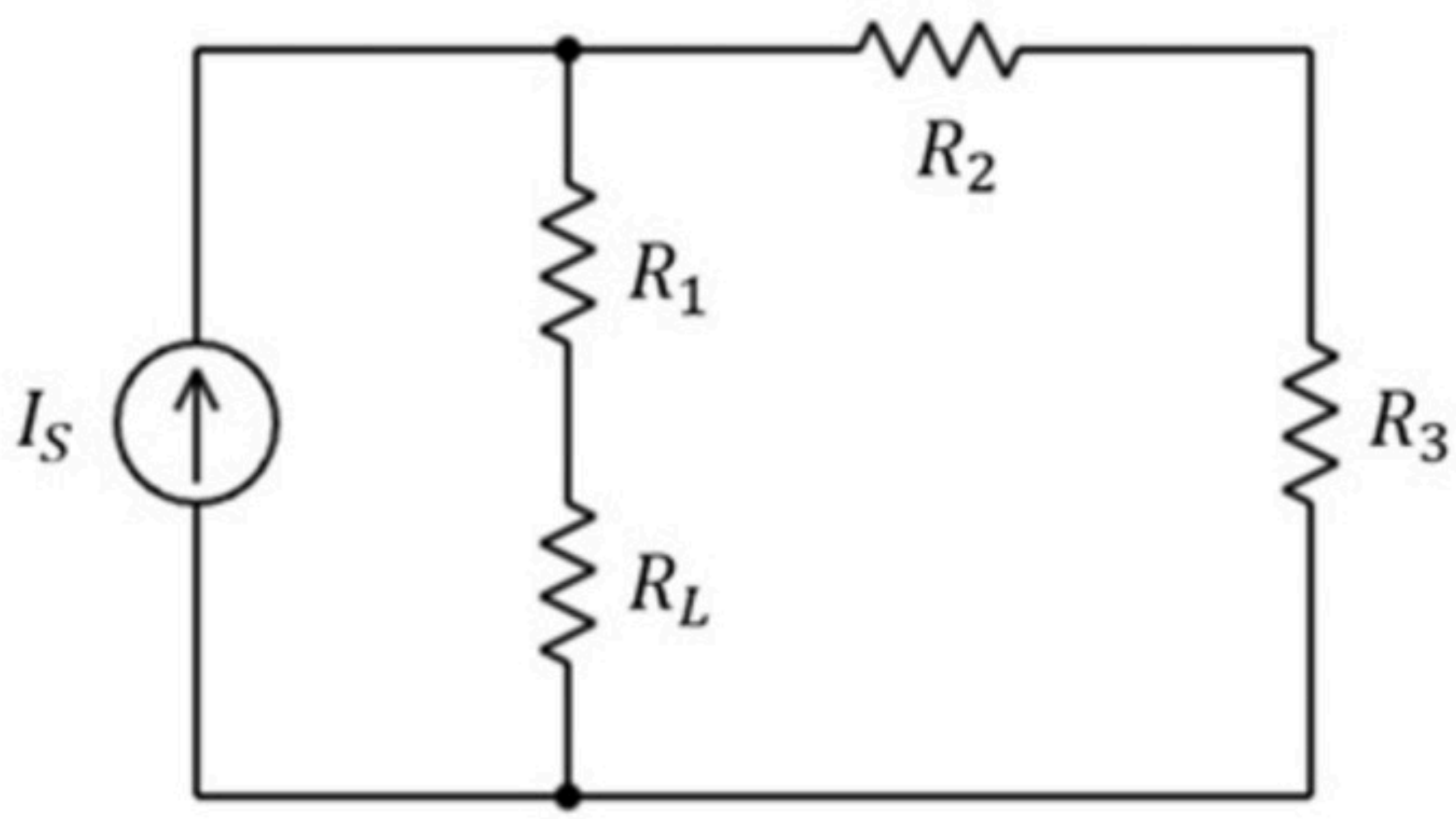
$$\boxed{V_{x2} = 21V}$$

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.

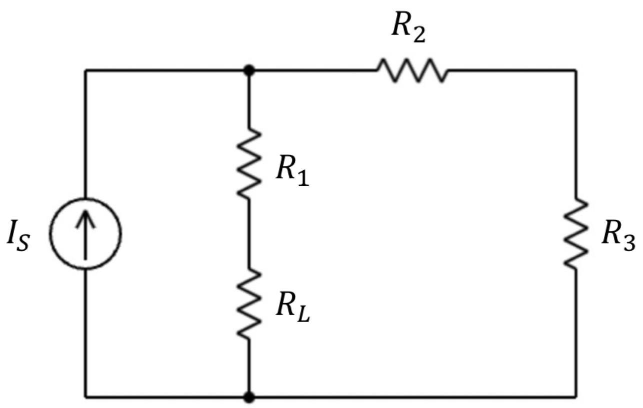
Find the corresponding max power received by R_L.

$I_S = 2A$

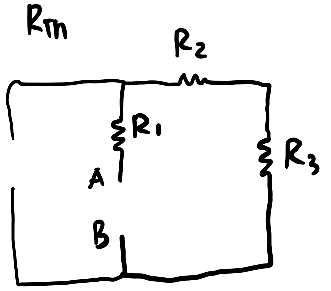
$R_1 = 12\Omega$

$R_2 = 2\Omega$

$R_3 = 2\Omega$



find R_{TH}



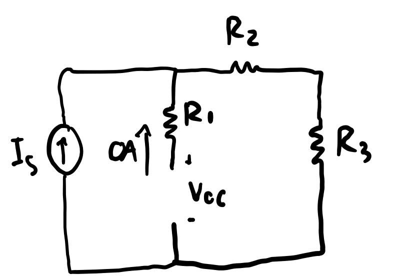
R_1, R_2, R_3 are in series

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

$= 12 + 2 + 2$

$R_{TH} = 16\Omega$

find V_{TH}



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

$= 2 \cdot (2 + 2)$

$V_{OC} = 8V$

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

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

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

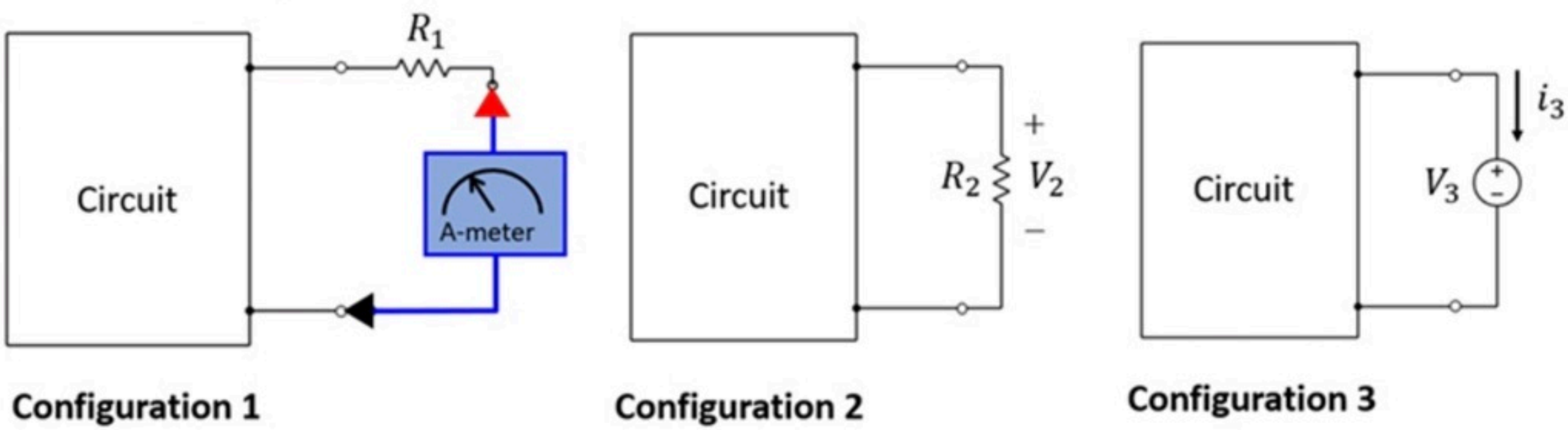
Circuit theorems 017

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.

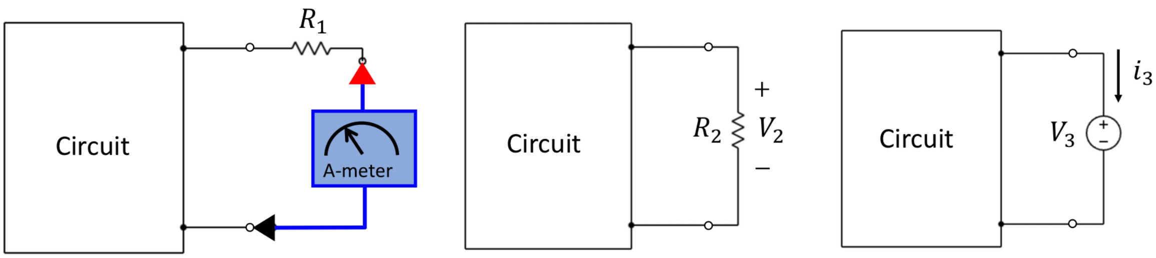
$X = 8A$

$R_1 = 1\Omega$

$V_2 = 16V$

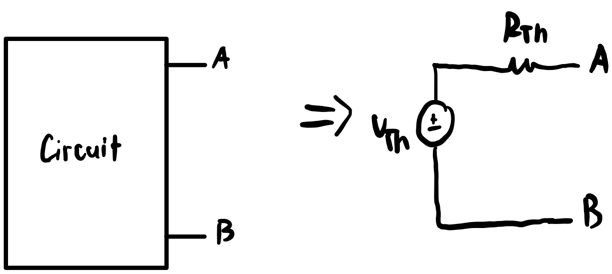
$R_2 = 4\Omega$

$V_3 = 8V$

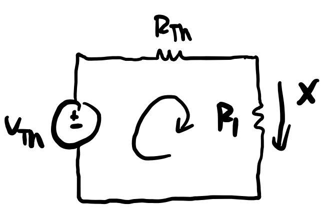


Configuration 1 **Configuration 2** **Configuration 3**

Replace the box by its Thevenin equivalent model



Configuration 1

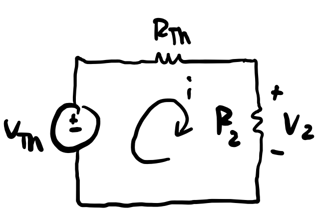


KVL 1: $-V_{Th} + XR_{Th} + XR_1 = 0$

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

$-V_{Th} + 8R_{Th} = -8$ 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: $-(8 + 8R_{Th}) + 4R_{Th} = -16$

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

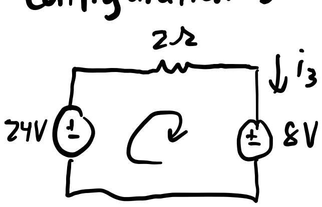
$-4R_{Th} = -8$

$R_{Th} = 2\Omega$

R_{Th} → ①: $V_{Th} = 8 + 8(2)$

$V_{Th} = 24V$

Configuration 3



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

$2i_3 = 16$

$\boxed{i_3 = 8A}$