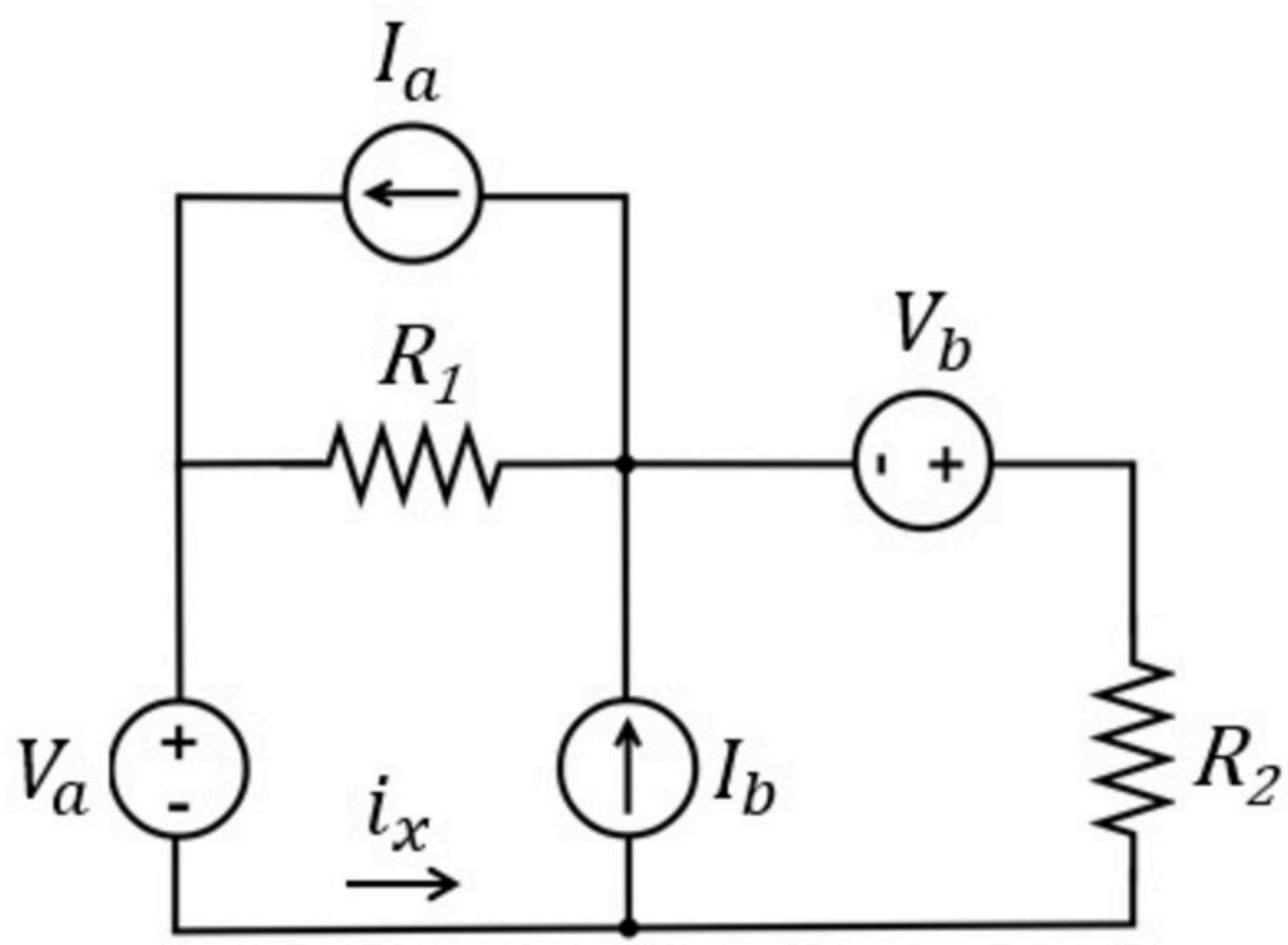
Circuit theorems 006

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

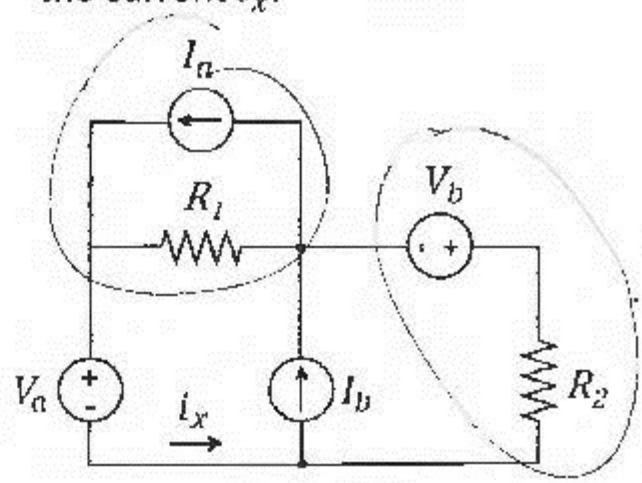
Vb = 6 V

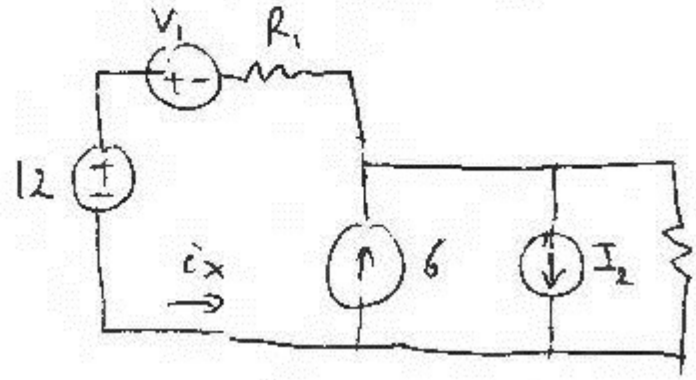
Ia = 4 A

Ib = 6 A

R1 = 3 ohm

R2 = 3 ohm

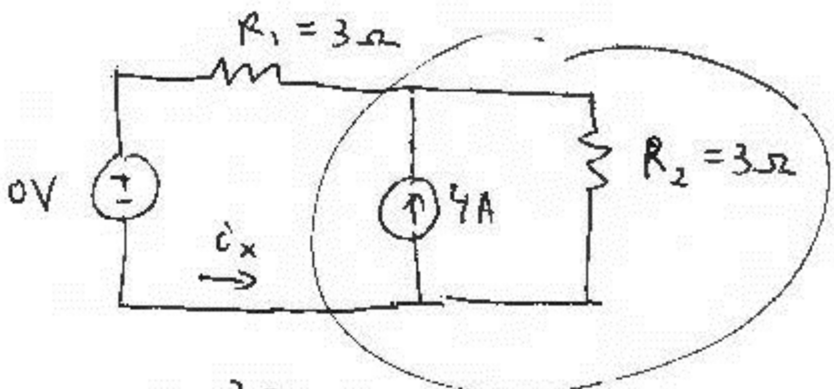


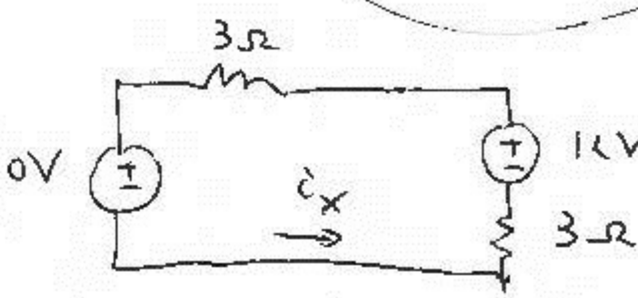


$$V_1 = I_a \cdot R_1 = 4 \cdot 3 = 12V$$

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

R_2





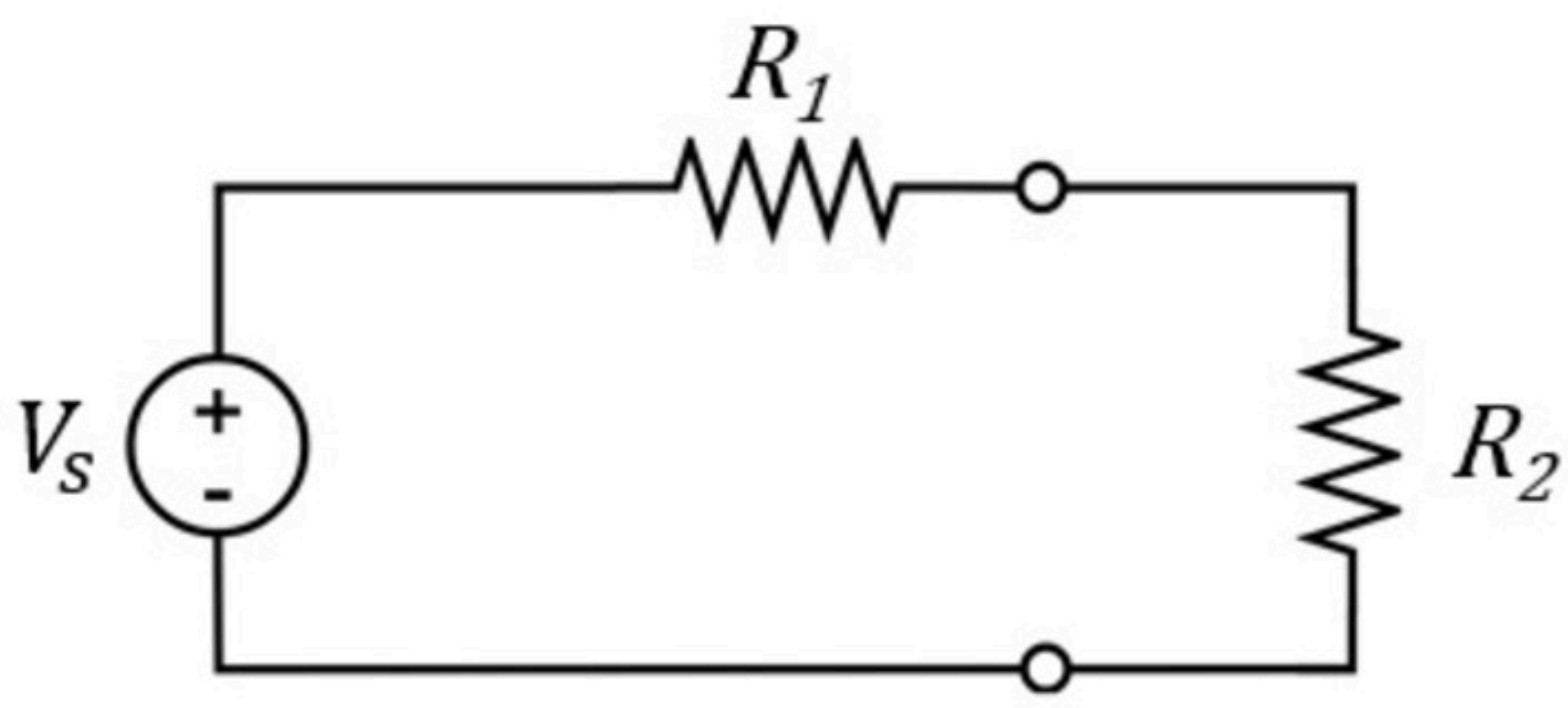
$$i_x = \frac{12V}{6\Omega} = 2A$$

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

Circuit theorems 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

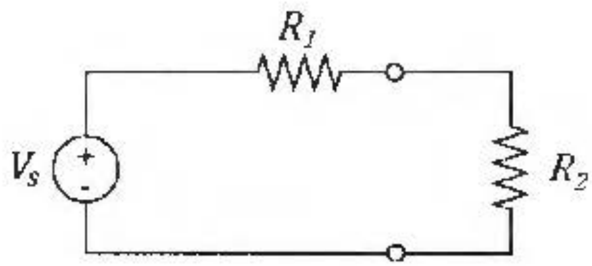
Calculate the following:

R1 (ohm) :

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

Vs = 12 V

R2 = 3 ohm



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

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

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

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

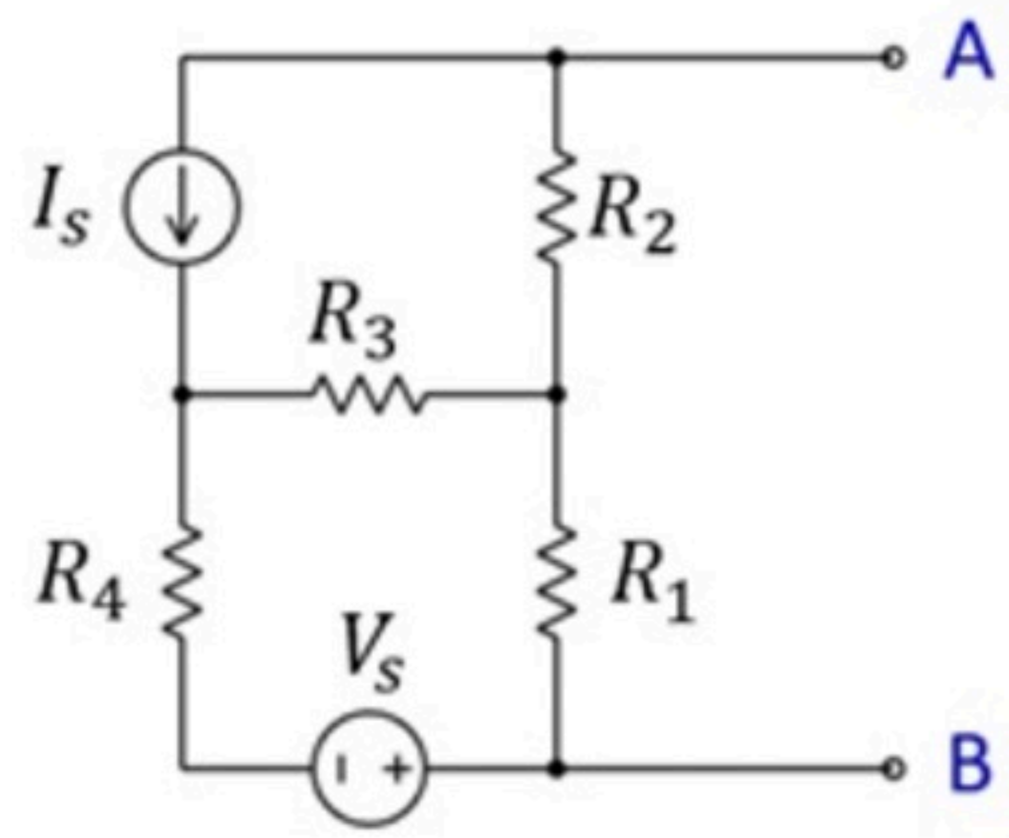
ALWAYS DECREASING

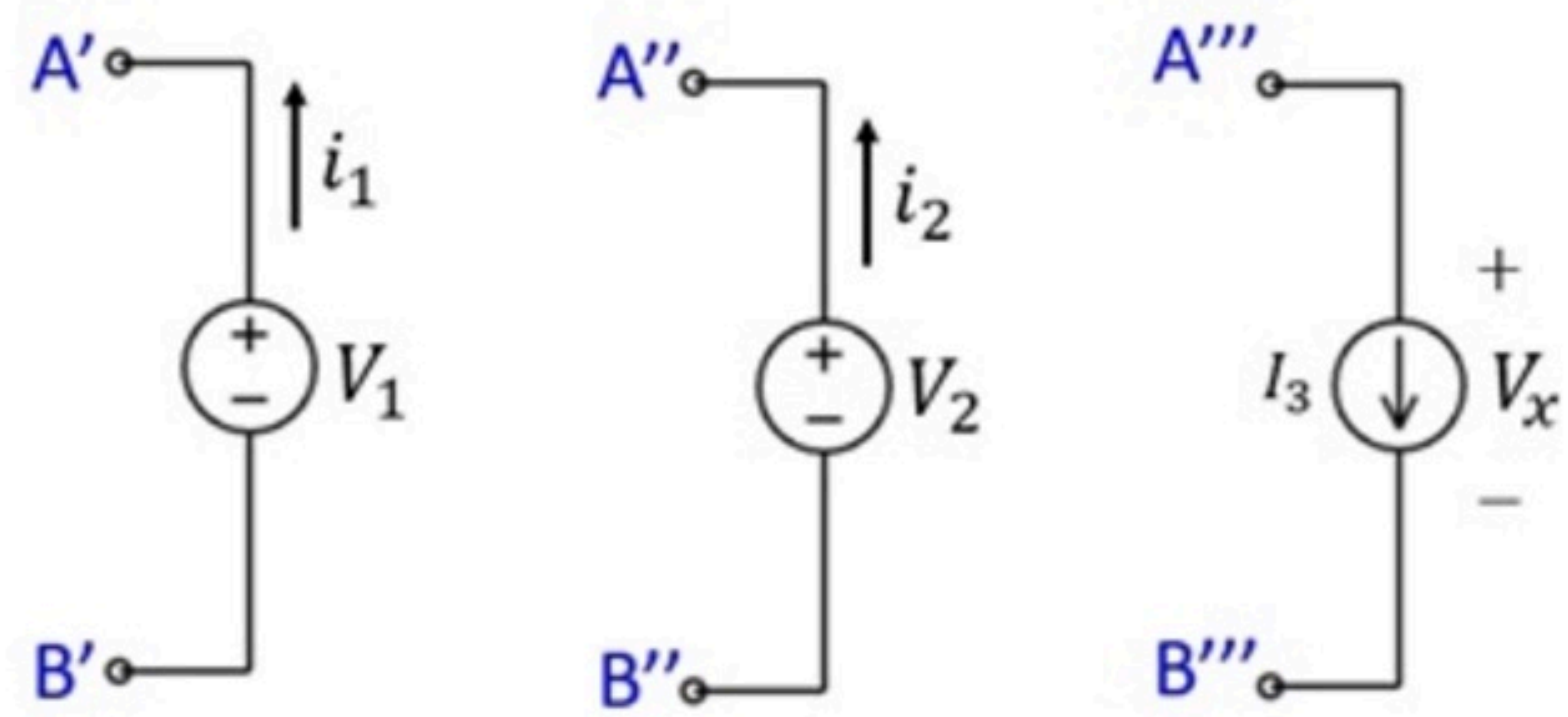
P_{MAX} WHEN $\boxed{R_1 = 0\,\Omega}$

Circuit theorems 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

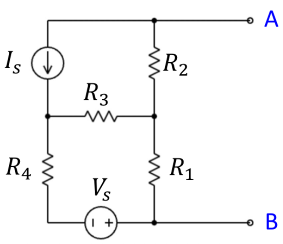
R4 : 2 ohm

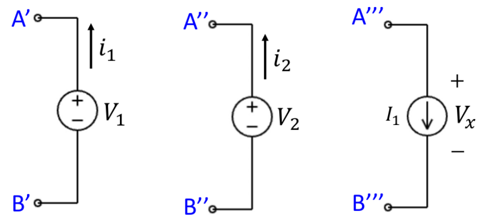
Calculate the following:

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.





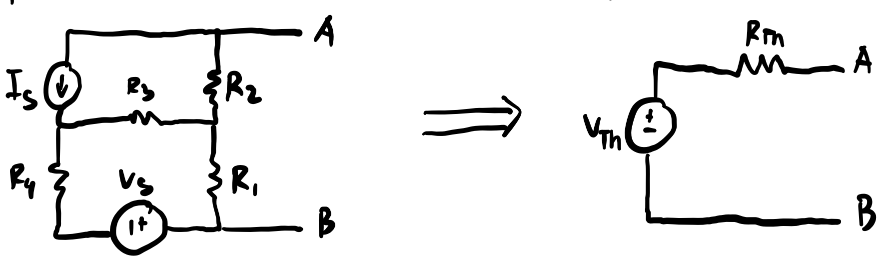
$V_1 = 15\text{ V}$
$i_1 = 6\text{ A}$
$V_2 = 10\text{ V}$
$i_2 = 5\text{ A}$
$I_1 = 5\text{ A}$
$R_4 = 2\Omega$

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'.

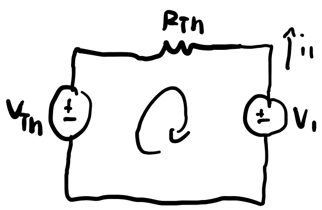
You are also told the value of current i_2 if V_2 is attached, with A connected to A'' and B connected to B''. However, in this case, the independent sources were first turned off (i.e., $V_S = 0$ and $I_S = 0$).

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



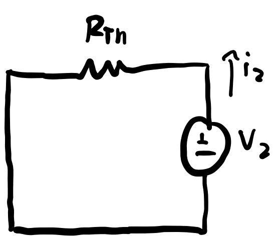
KVL: $-V_{Th} - i_1 R_{Th} + V_1 = 0$

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

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

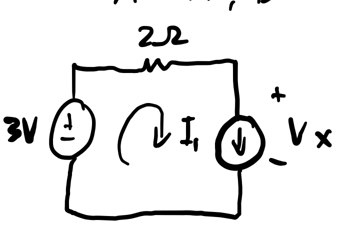
$V_{Th} = 3\text{V}$

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



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

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



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

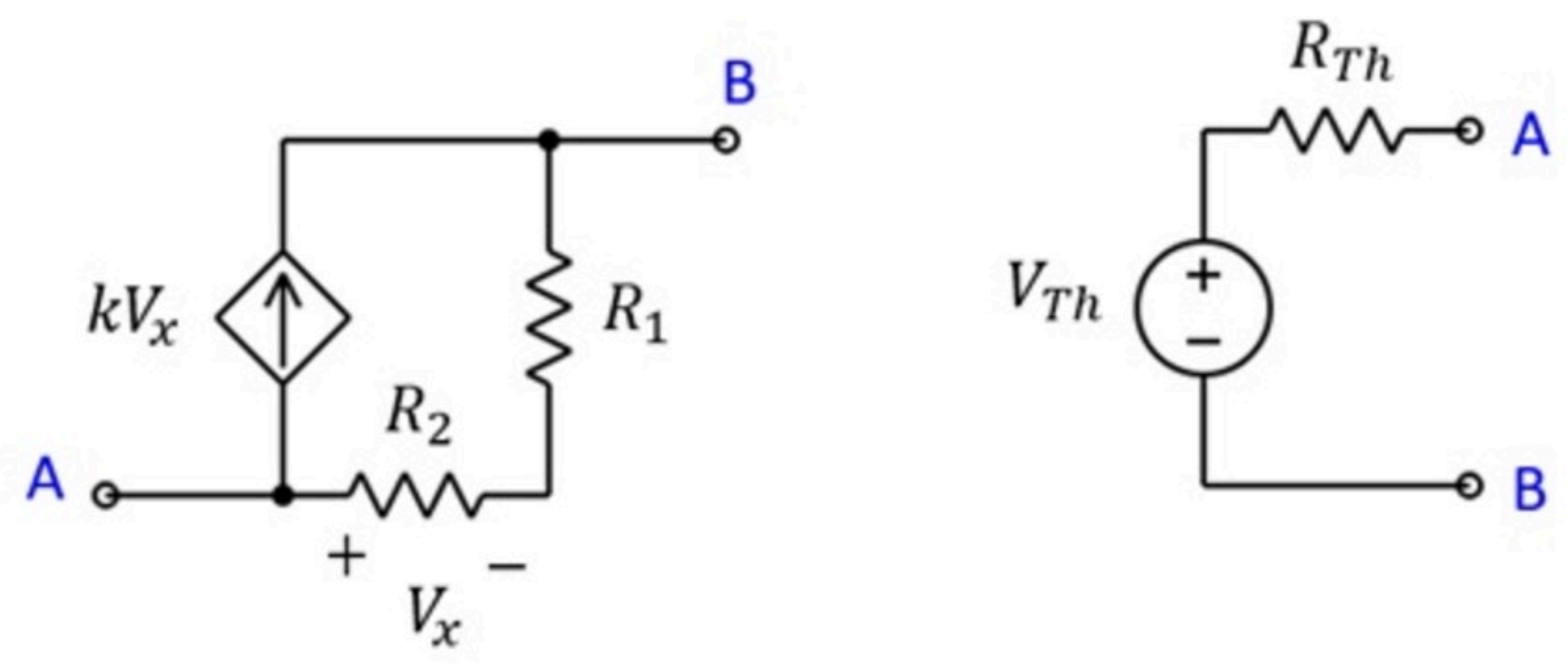
$V_x = 3 - 2(5)$

$\boxed{V_x = -7\text{V}}$

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

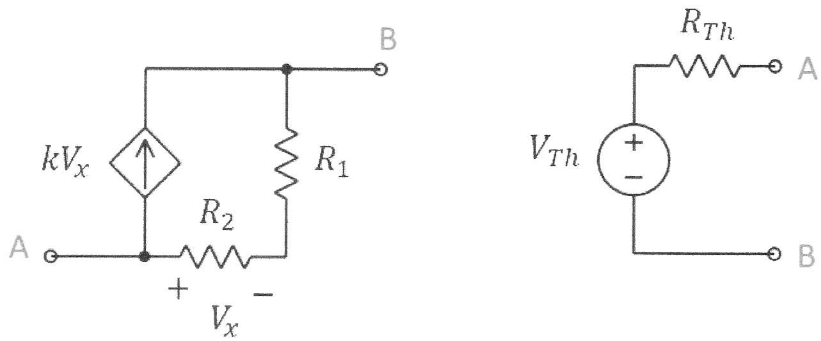
k : -2 A/V

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}.

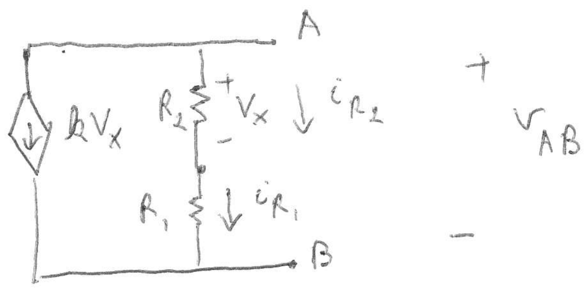


$R_1 = 4\,\Omega$

$R_2 = 2\,\Omega$

$k = -2\ \mathrm{A/V}$

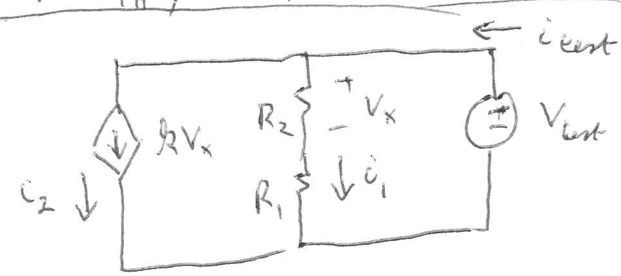
REDRAW:



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

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

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



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

voltage divider

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

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

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

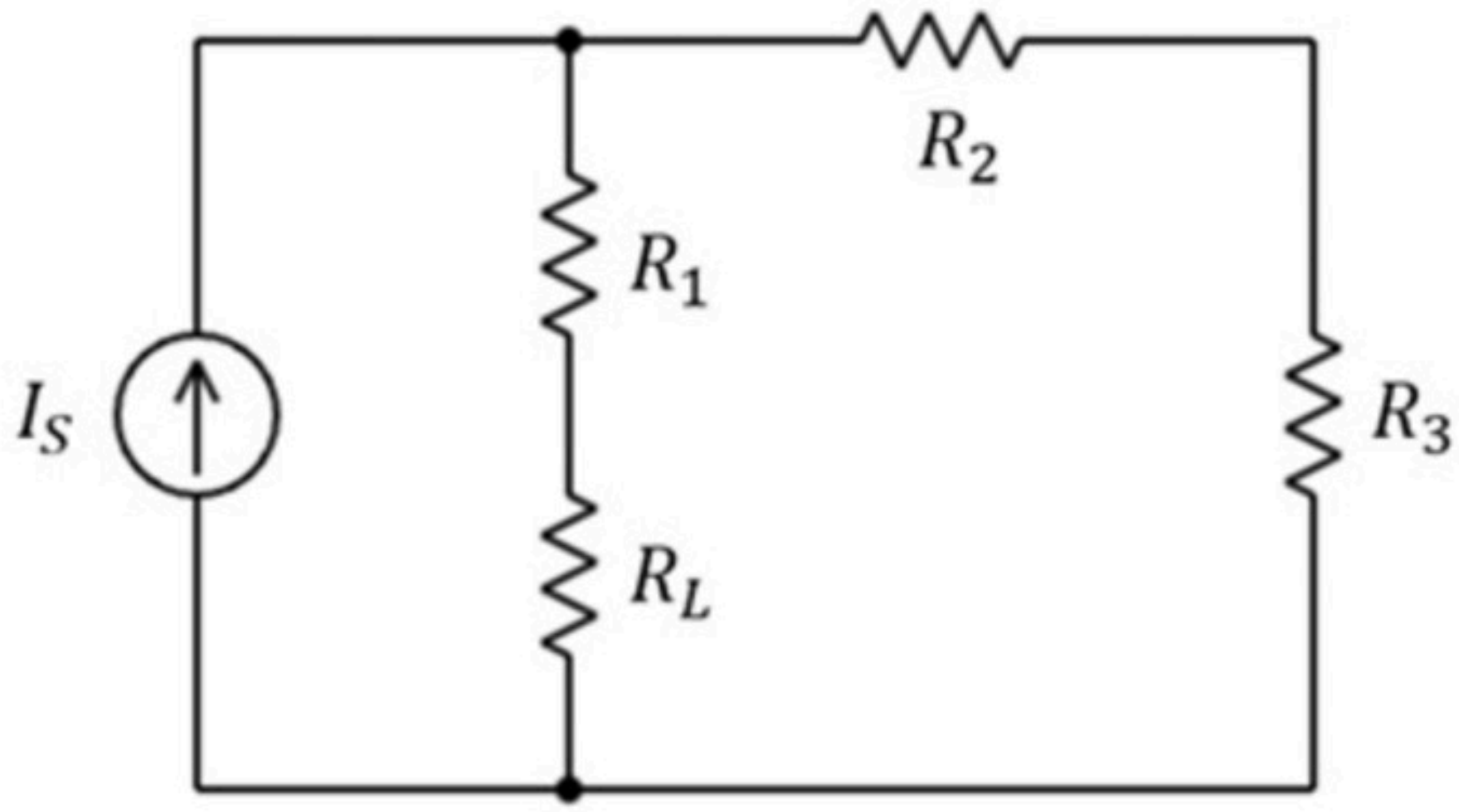
$\boxed{R_{TH} = -2\,\Omega}$

Circuit theorems 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.

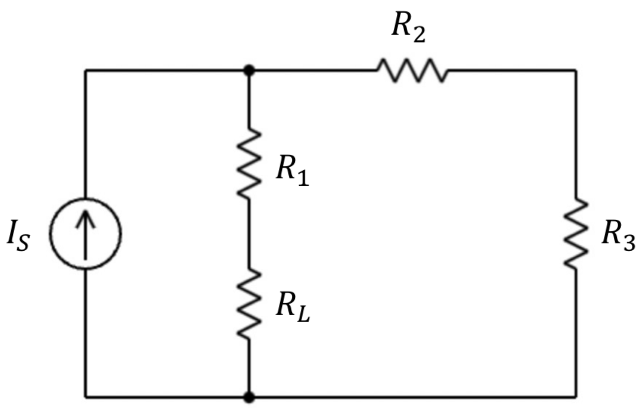
Find the corresponding max power received by R_L.

$I_S = 2A$

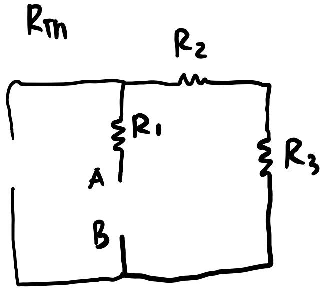
$R_1 = 12\Omega$

$R_2 = 2\Omega$

$R_3 = 2\Omega$



find R_{Th}



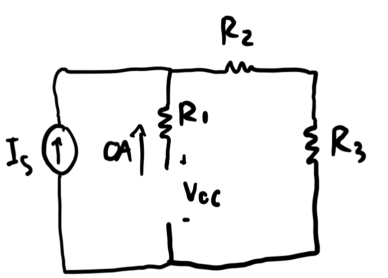
R_1, R_2, R_3 are in series

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

$= 12 + 2 + 2$

$R_{Th} = 16\Omega$

find V_{Th}



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

$= 2 \cdot (2 + 2)$

$V_{oc} = 8V$

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

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

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