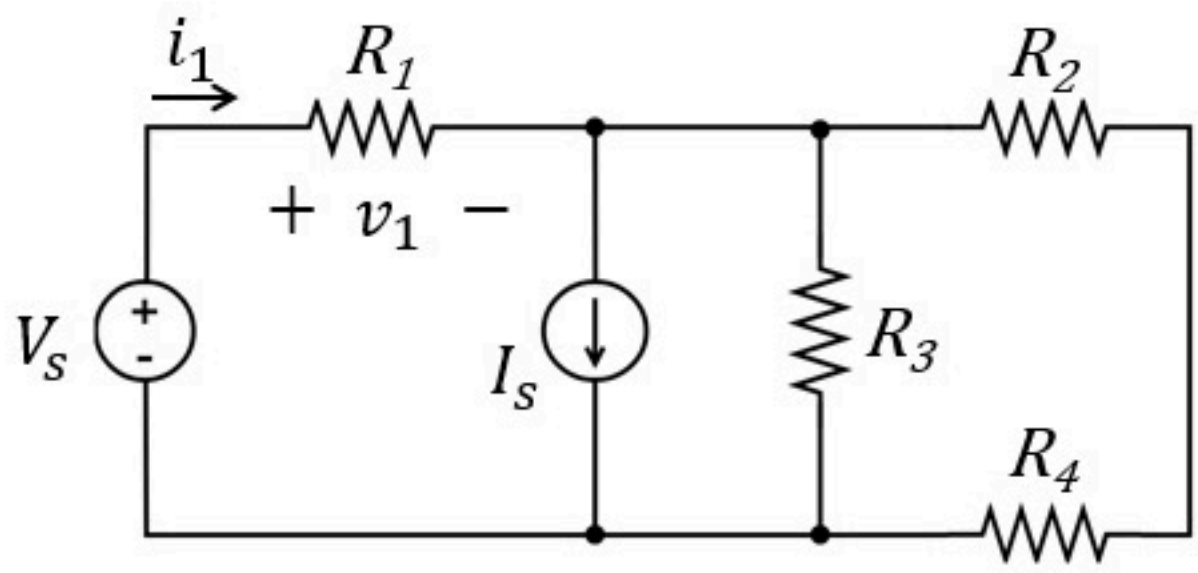
Circuit theorems 009

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) :

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v1b (V) :

R1b (ohm) :

P1c (W) :

R1c (ohm) :

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

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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}.

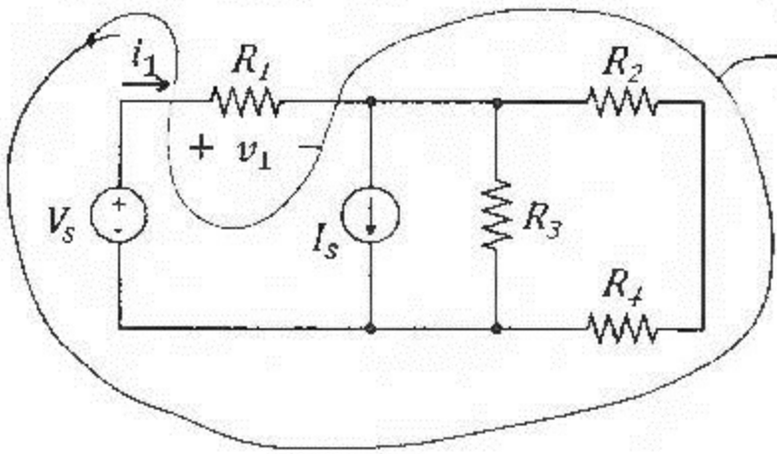
Vs = 12 V

Is = 3 A

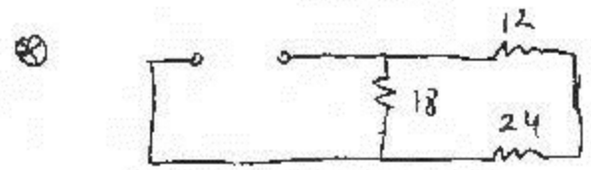
R2 = 12 ohm

R3 = 18 ohm

R4 = 24 ohm

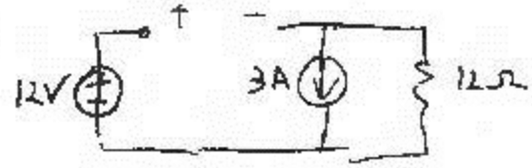


FIND THEVENIN MODEL

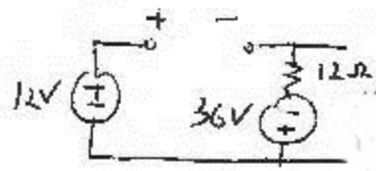


$\Rightarrow R_{TH} = 18 \,//\, (12+24) = \left(\frac{1}{18} + \frac{1}{36}\right)^{-1}$

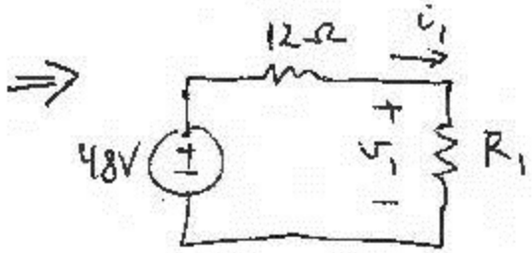
$= \left(\frac{3}{36}\right)^{-1} = 12\,\Omega$



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

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

$\boxed{P = 48W}$