Assignment 2

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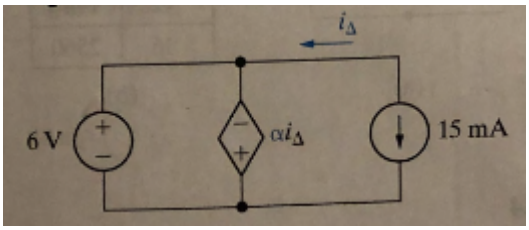
Chapter 2

6 Consider the interconnection shown in the figure below.



a) What value of α is required to make this a valid interconnection?

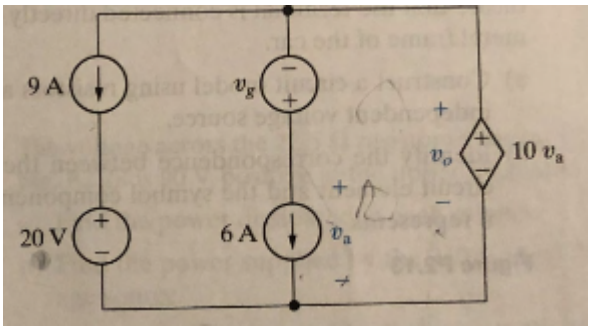
$$\begin{aligned} a &= \frac{-6\,\text{V}}{-15\,\text{mA}} \\ &= 400 \end{aligned}$$

b) For this value of α, find the power associated with the current source.

$$\begin{aligned} p &= \text{V} * i \\ &= 6\,\text{V} * 15\,\text{mA} \\ &= 90\,\text{mW} \end{aligned}$$

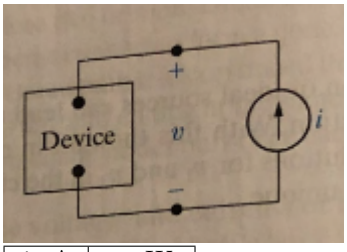
c) Is the current source supplying or absorbing power?
absorbing

9 Find the total power developed in the circuit in the figure below if $v_o = 5\,\text{V}$



$$
\begin{aligned}
10v_a &= v_o \\
v_a &= 0.5\,\text{V} \\
i_{v_a} &= 15\,\text{A} \\
v_g &= v_a - v_o \\
&= 0.5\,\text{V} - 5\,\text{V} \\
&= -4.5\,\text{V} \\
P_{v_g} &= v_g * 6 \\
&= (-4.5) * 6 \\
&= -27\,\text{W} \\
v_{9_a} &= -15\,\text{V} \\
P_{9\text{A}} &= -15 * 5 \\
&= -75\,\text{W} \\
P_{20\text{V}} &= 20 * 9 \\
&= 180\,\text{W} \\
P_{v_o} &= -(9\,\text{V}) * (15\,\text{A}) \\
&= -135\,\text{W} \\
P_{total} &= 210\,\text{W}
\end{aligned}
$$

15 A variety of current source values were applied to the device shown in the figure below

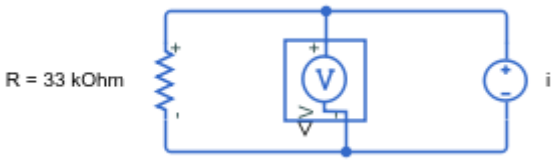


imA	pmW
0.5	8.25
1.0	33.00
1.5	74.25
2.0	132.00
2.5	206.25
3.0	297.00

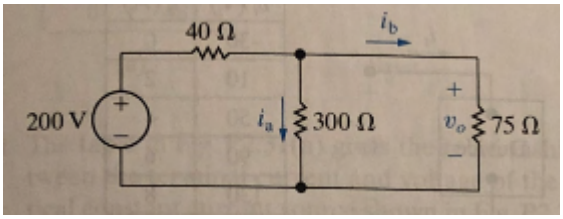
a) The power absorbed by the device for each value of current is recorded in the table given in the table above.

imA	pmW	$R = \frac{p}{i^2}$kΩ
0.5	8.25	33
1.0	33.00	33
1.5	74.25	33
2.0	132.00	33
2.5	206.25	33
3.0	297.00	33

b) Use the values in the table to construct a circuit model for the device consisting of a single resistor.



18 Given the circuit shown in the figure below, find



a) the value of i_a

$$\begin{aligned} i_a &= \frac{v_o}{R_a} \\ &= 0.4\,\text{A} \end{aligned}$$

b) the value of i_b

$$\begin{aligned} i_b &= \frac{v_o}{R_b} \\ &= 1.6\,\text{A} \end{aligned}$$

c) the value of v_o

$$\begin{aligned} \frac{v_o - v_g}{R_g} + \frac{v_o}{R_a} + \frac{v_o}{R_b} &= 0 \\ \frac{v_o - 200}{40} + \frac{v_o}{300} + \frac{v_o}{75} &= 0 \\ v_o &= 120\,\text{V} \end{aligned}$$

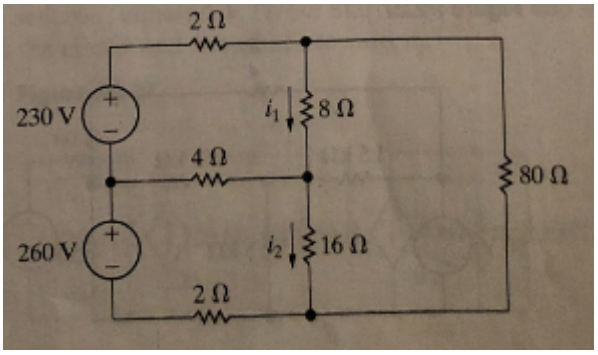
d) the power dissipated in each resistor

$$\begin{aligned} P_g &= (\frac{v_g - v_o}{R_g})^2 * R_g \\ &= 160\,\text{W} \\ P_{R_a} &= i_a^2 * R_a \\ &= 48\,\text{W} \\ P_{R_b} &= i_b^2 * R_b \\ &= 192\,\text{W} \end{aligned}$$

e) the power delivered by the 200 V source

$$\begin{aligned} P_g &= V_g * I_g \\ &= 200 * \frac{200-120}{40} \\ &= 400\,\text{W} \end{aligned}$$

24 The currents i_1 and i_2 in the circuit in the figure below are 20 A and 15 A, respectively



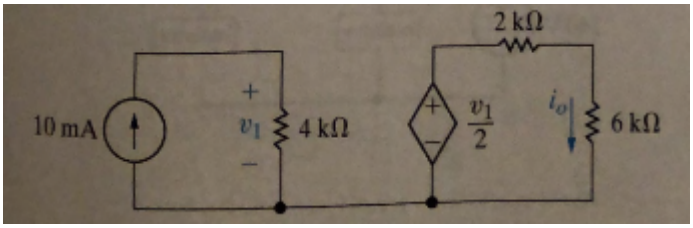
a) Find the power supplied by each voltage source.

$$
\begin{aligned}
-230 + 2i_1 + 8(i_1 - i_3) + 4(i_1 - i_2) &= 0 \\
-260 + 2i_2 + 4(i_2 - i_1) + 16(i_2 - i_3) &= 0 \\
8(i_3 - i_1) + 16(i_3 - i_2) + 80i_3 &= 0 \\
i_1 &= 25\,\text{A} \\
i_2 &= 20\,\text{A} \\
i_3 &= 5\,\text{A} \\
P_{230} &= 230i_1 \\
&= 5750\,\text{W} \\
P_{260} &= 260i_2 \\
&= 5200\,\text{W}
\end{aligned}
$$

b) Show that the total power supplied equals the total power dissipated in the resistors.

$$
\begin{aligned}
P_T &= P_{230} + P_{260} \\
&= 10.950\,\text{W} \\
P_d &= 2i_a + 8i_1 + 4(i_a - i_b) + 2i_b + 16i_2 + 80i_c \\
&= 1250 + 3200 + 100 + 800 + 3600 + 2000 \\
&= 10.590\,\text{W}
\end{aligned}
$$

32 Consider the circuit shown in the figure below.



a) Find i_o

$$
\begin{aligned}
\text{V}_1 &= 10\,\text{mA} * 4\,\text{k}\Omega \\
&= 40\,\text{V} \\
i_o &= \frac{\frac{\text{V}_1}{2}}{2\,\text{k}\Omega + 6\,\text{k}\Omega} \\
&= 2.5\,\text{mA}
\end{aligned}
$$

b) Verify the value of i_o by showing that the power generated in the circuit equals the power absorbed in the circuit.

$$
\begin{aligned}
P_{generated} &= \frac{\text{V}_1}{2} * 2.5\,\text{mA} \\
&= 50\,\text{mW} \\
P_{absorbed} &= (2\,\text{k}\Omega + 6\,\text{k}\Omega) * i_o^2 \\
&= 50\,\text{mW}
\end{aligned}
$$