Name: Key
Section:

EE331 Homework PS3 – fall 2012

Problems from Alexander & Sadiku:

CH3

- 3.6 – *Ans:* $V_0 = -2V$
- 3.13
- 3.17
- 3.32 – *Do not think too hard!*

CH4

- 4.38 – *Ans:* $V_{Th} = 19.2V$, $R_{Th} = 5\Omega$, $V_o = 12.8V$
- 4.66 – *Ans:* $P_{max} = 625$ mW

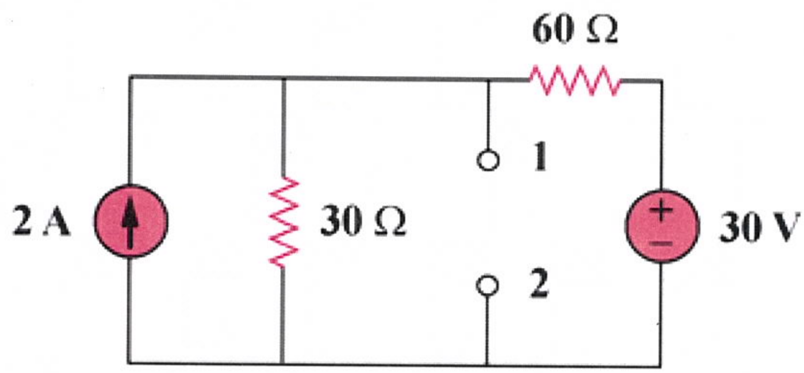
Additional Problems (Instructor Option):

- 2nd page of this assignment
- 4.86 (Hint: consider the blackbox a Thevenin Eq. Circuit, solve for R_{th} and V_{th}) – ans – $i = 1.2857$ A, $P_{max} = 8.1$ W
- Any as assigned by instructor

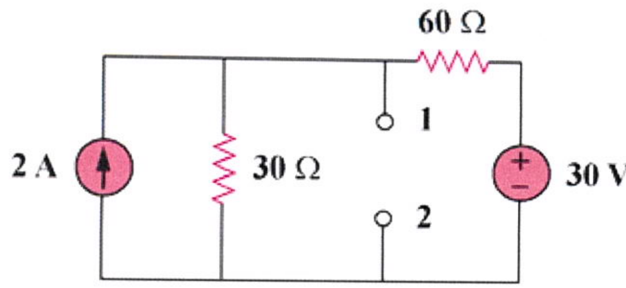
Name: ____________________
Section: ____________________

EE331 Homework PS3 – fall 2012

Determine R_{th} and V_{th} at terminals 1 and 2.



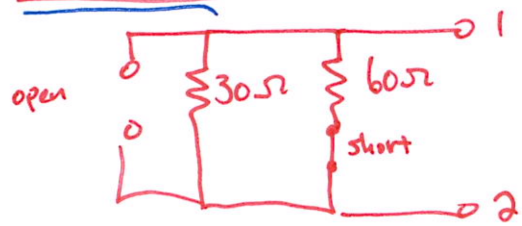
Determine R_{Th} and V_{Th} at terminals 1-2



(b)

Figure 4.101

Steps 1-3

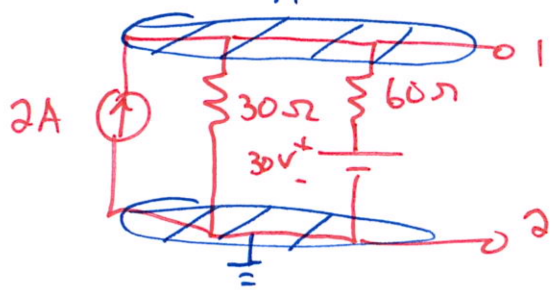


Step 4

$R_{Th} = 30\Omega // 60\Omega$

$= \boxed{20\Omega}$

Step 5

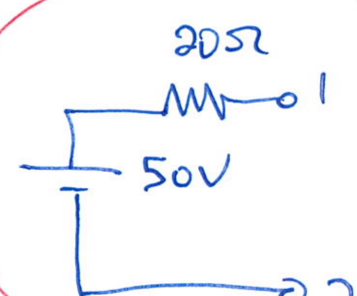


$V_{12} = E_{Th} = V_{TH} = 50V$

solve

$$-2A + \frac{V_A - 0}{30\Omega} + \frac{V_A - 30V}{60\Omega} = 0$$

or Could use Source Transformation on 2A w/ 30Ω



Chapter 3, Solution 6.

Solve for V_1 using nodal analysis.

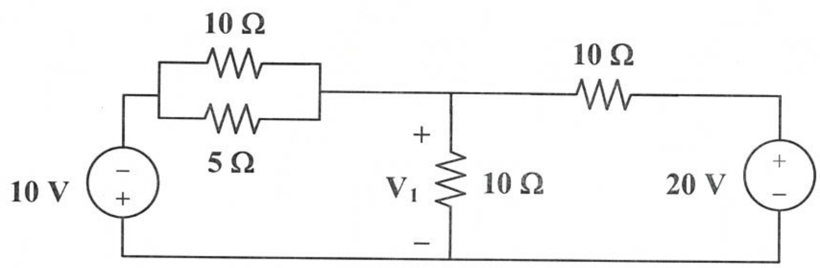


Figure 3.55
For Prob. 3.6.

Step 1. The first thing to do is to select a reference node and to identify all the unknown nodes. We select the bottom of the circuit as the reference node. The only unknown node is the one connecting all the resistors together and we will call that node V_1. The other two nodes are at the top of each source. Relative to the reference, the one at the top of the 10-volt source is –10 V. At the top of the 20-volt source is +20 V.

Step 2. Setup the nodal equation (there is only one since there is only one unknown).

$$\frac{(V_1-(-10))}{5}+\frac{(V_1-(-10))}{10}+\frac{(V_1-0)}{10}+\frac{(V_1-20)}{10}=0$$

Step 3. Simplify and solve.

$$\left(\frac{1}{5}+\frac{1}{10}+\frac{1}{10}+\frac{1}{10}\right)V_1=-\frac{10}{5}-\frac{10}{10}+\frac{20}{10}$$
$$(0.2+0.1+0.1+0.1)V_1=0.5V_1=-2-1+2=-1$$

or

$$V_1 = \mathbf{-2\ V.}$$

The answer can be checked by calculating all the currents and see if they add up to zero. The top two currents on the left flow right to left and are 0.8 A and 1.6 A respectively. The current flowing up through the 10-ohm resistor is 0.2 A. The current flowing right to left through the 10-ohm resistor is 2.2 A. Summing all the currents flowing out of the node, V_1, we get, +0.8+1.6 –0.2–2.2 = 0. The answer checks.

Chapter 3, Solution 13

Calculate v_1 and v_2 in the circuit of Fig. 3.62 using nodal analysis.

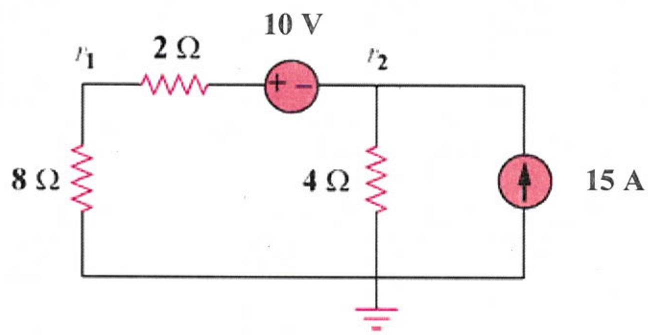


Figure 3.62
For Prob. 3.13.

Solution

At node number 2, $[((v_2 + 10) - 0)/10] + [(v_2 - 0)/4] - 15 = 0$ or $(0.1+0.25)v_2 = 0.35v_2 = -1+15 = 14$ or

$$v_2 = \mathbf{40\ volts}.$$

Next, $I = [(v_2 + 10) - 0]/10 = (40 + 10)/10 = 5$ amps and

$$v_1 = 8x5 = \mathbf{40\ volts}.$$

Chapter 3, Problem 17.

Using nodal analysis, find current i_o in the circuit of Fig. 3.66.

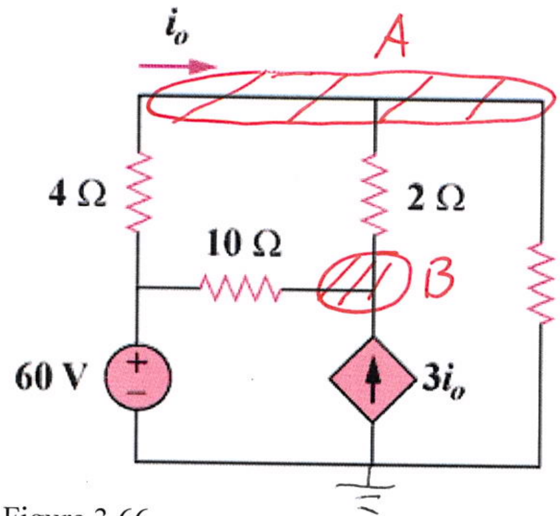


Figure 3.66

- $$\frac{V_A - 60V}{4\Omega} + \frac{V_A - V_B}{2\Omega} + \frac{V_A - 0V}{8\Omega} = 0$$

- $$\frac{V_B - 60V}{10\Omega} - 3i_o + \frac{V_B - V_A}{2\Omega} = 0$$

$$i_o = \frac{60V - V_A}{4\Omega}$$

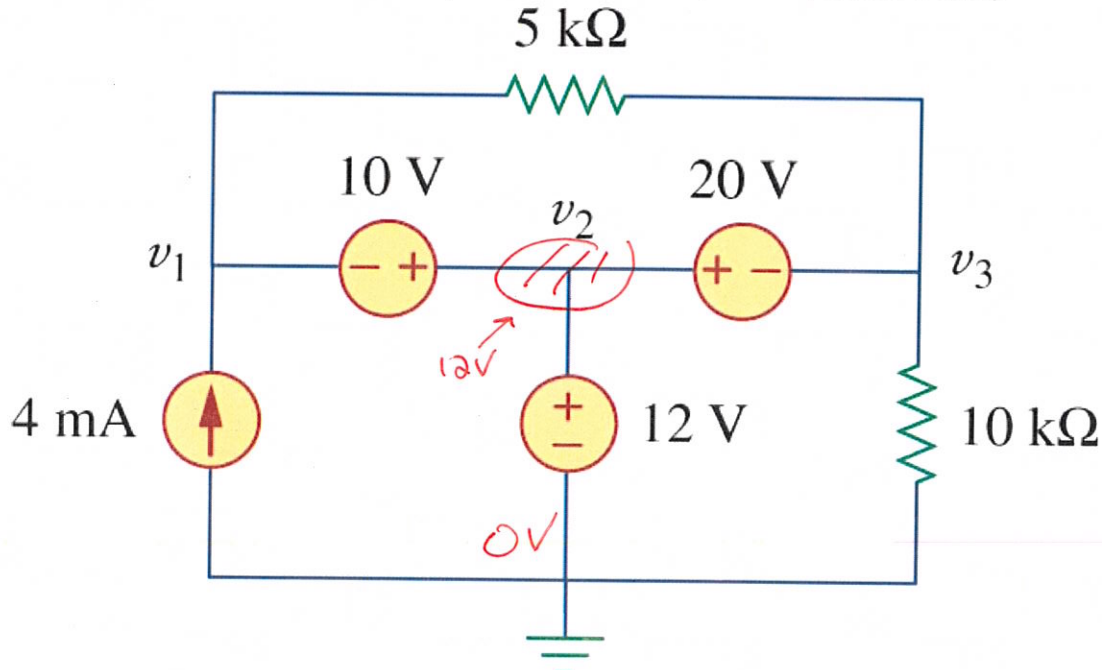
Solve:

$V_A = 53.08V$

$V_B = 62.88V$

$i_o = 1.73A$

Figure 3.81



$V_1 = V_2 - 10V = \boxed{2V}$

$V_2 = \boxed{12V}$

$V_3 = V_2 - 20V = \boxed{-8V}$

Chapter 4, Problem 38.

Apply Thèvenin's theorem to find V_o in the circuit of Fig. 4.105.

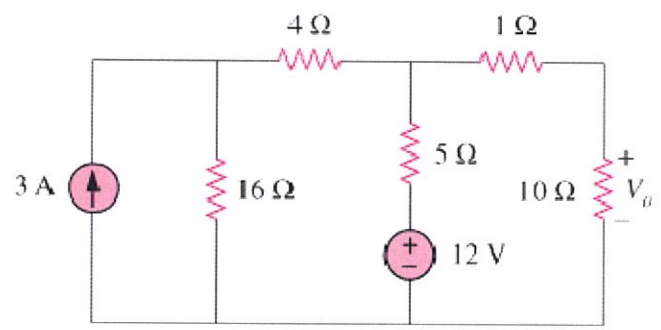
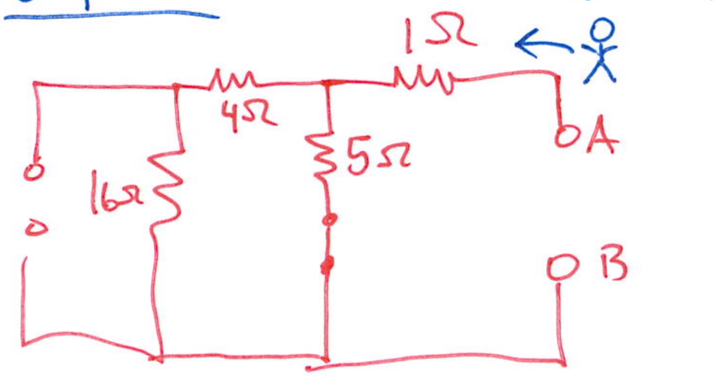


Figure 4.105

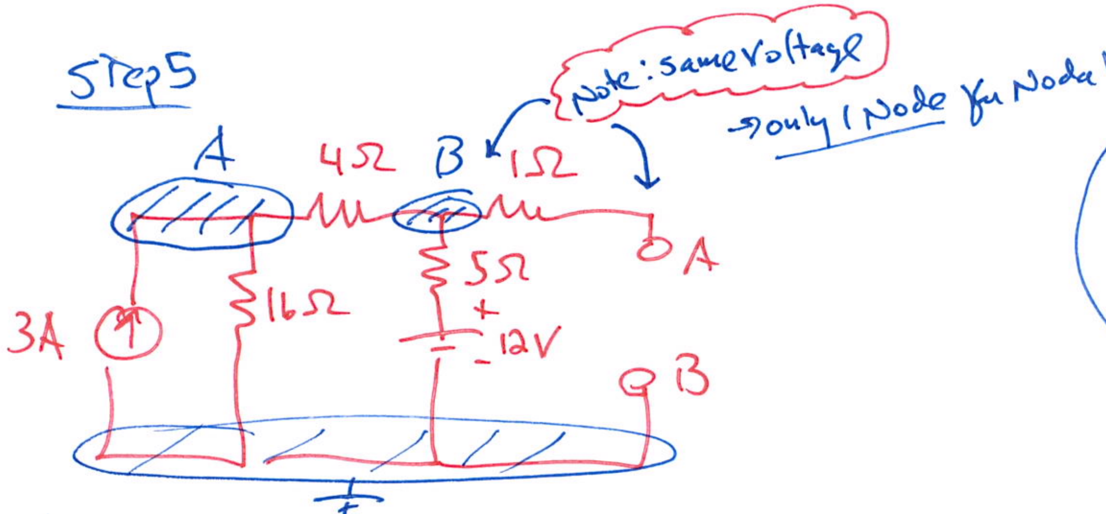
Steps 1–3



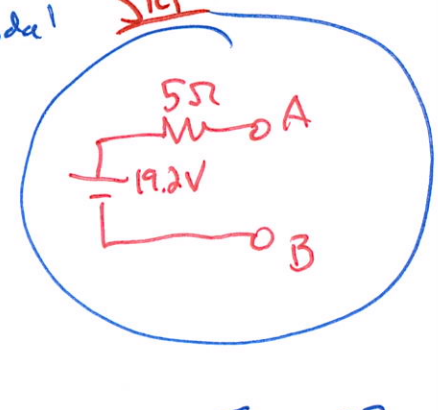
Step 4

$$R_{TH} = 1\Omega + 5\Omega \parallel (4\Omega + 16\Omega)$$
$$= \boxed{5\Omega}$$

Step 5



Step 6



Nodal

$$-3A + \frac{V_A - 0}{16\Omega} + \frac{V_A - 12V}{9\Omega} = 0 \Rightarrow V_A = 24.96V \Rightarrow V_B = V_{TH} = 12V + \left(\frac{24.96 - 12}{9\Omega}\right) \cdot 5\Omega$$

Combine (4Ω+5Ω) (under the 9Ω)

$I_{4\Omega \text{ and } 5\Omega}$ (over the fraction)

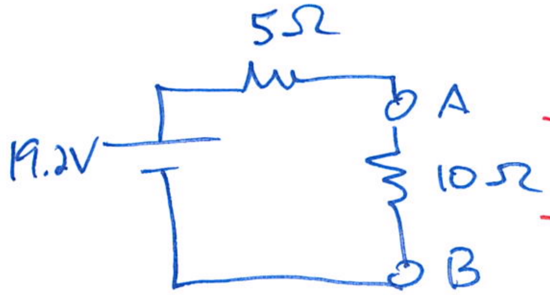
$$= \boxed{19.2V}$$

over ⟹

* or could use Source Transformation on 3A w/16Ω *

#38 Cont.

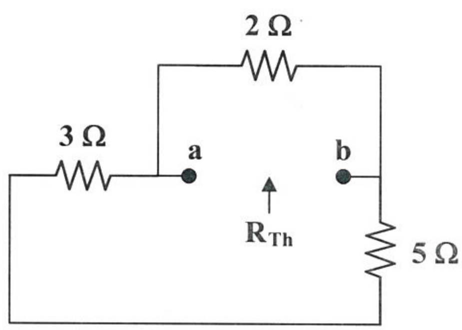
Now find V_o



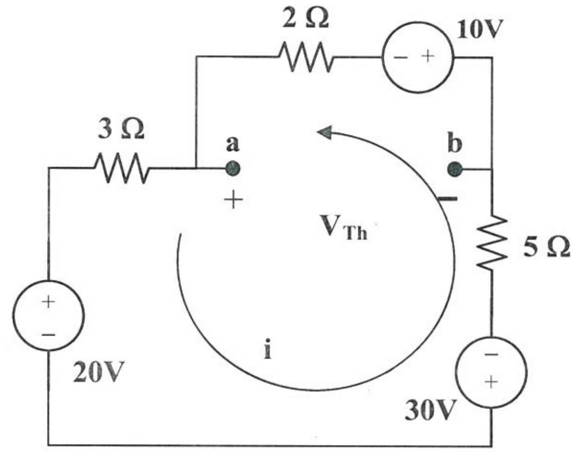
$$+ \quad V_o = \frac{19.2V \cdot 10\Omega}{15\Omega} = 12.8V \quad -$$

Chapter 4, Solution 66.

We first find the Thevenin equivalent at terminals a and b. We find R_{Th} using the circuit in Fig. (a).



(a)



(b)

$$R_{Th} = 2||(3 + 5) = 2||8 = \mathbf{1.6\ ohms}$$

By performing source transformation on the given circuit, we obatin the circuit in (b). We now use this to find V_{Th}.

$$10i + 30 + 20 + 10 = 0, \text{ or } i = -6$$

$$V_{Th} + 10 + 2i = 0, \text{ or } V_{Th} = 2\text{ V}$$

$$p = V_{Th}^2/(4R_{Th}) = (2)^2/[4(1.6)] = \mathbf{625\ m\ watts}$$

Chapter 4, Problem 86.

Note!

A black box with a circuit in it is connected to a variable resistor. An ideal ammeter (with zero resistance) and an ideal voltmeter (with infinite resistance) are used to measure current and voltage as shown in Fig. 4.143. The results are shown in the table below.

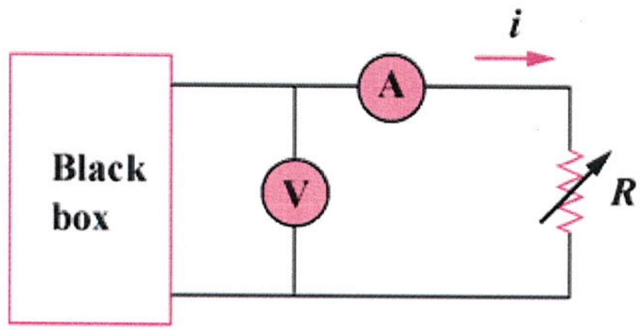
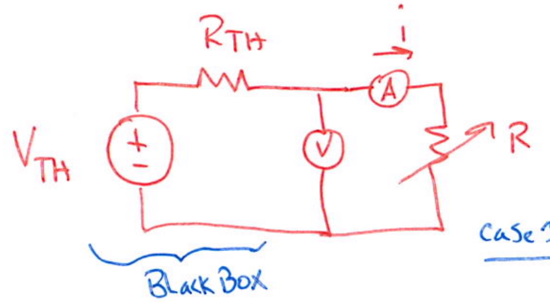


Figure 4.143

(a) Find i when $R = 4\ \Omega$.
(b) Determine the maximum power from the box.

R(Ω)	V(V)	i(A)
2	3	1.5
8	8	1.0
14	10.5	0.75



By KVL

$\Rightarrow V_{TH} = V + i R_{TH}$

Case 1 • $i = 1.5\text{ A}, V = 3\text{ V} \rightarrow V_{TH} = 3 + 1.5 \cdot R_{TH}$

Case 2 • $i = 1\text{ A}, V = 8\text{ V} \rightarrow V_{TH} = 8 + 1 \cdot R_{TH}$

Solve $\rightarrow$ $R_{TH} = 10\Omega,\ V_{TH} = 18\text{V}$

a) for $R = 4\Omega$, $i = V_{TH}/(R + R_{TH}) = \frac{18\text{V}}{(4+10)} = 1.2857\text{A}$

b) $P_{max} = \frac{V_{TH}^2}{4R_{TH}} = \frac{(18\text{V})^2}{(4 \cdot 10\Omega)} = 8.1\text{ W}$