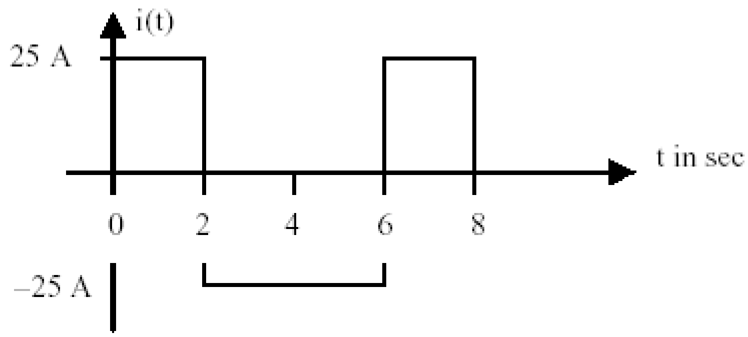
Chapter 1, Solution 7

$$i = \frac{dq}{dt} = \begin{cases} 25A, & 0 < t < 2 \\ -25A, & 2 < t < 6 \\ 25A, & 6 < t < 8 \end{cases}$$

which is sketched below:



Chapter 1, Solution 14

(a) $q = \int i dt = \int_0^1 0.02\left(1 - e^{-0.5t}\right)dt = 0.02\left(t + 2e^{-0.5t}\right)\Big|_0^1 = 0.02\left(1 + 2e^{-0.5} - 2\right) =$ **4.261 mC**

(b) $p(t) = v(t)i(t)$

$p(1) = 10\cos(2) \times 0.02(1 - e^{-0.5}) = (-4.161)(0.007869)$

= **–32.74 mW**

Chapter 2, Solution 3

For silicon, $\rho = 6.4x10^2$ Ω-m. $A = \pi r^2$. Hence,

$$R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2} \longrightarrow r^2 = \frac{\rho L}{\pi R} = \frac{6.4x10^2 x4x10^{-2}}{\pi x240} = 0.033953$$

r = **184.3 mm**

Chapter 2, Solution 7

6 branches and 4 nodes

Chapter 2, Solution 15

Calculate v and i_x in the circuit of Fig. 2.79.

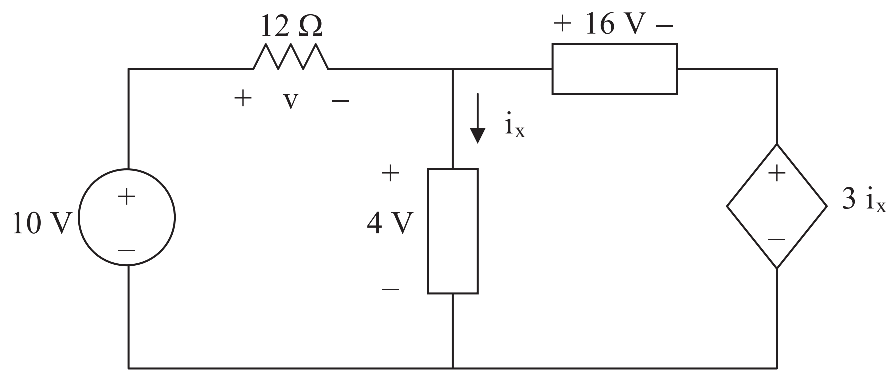


Figure 2.79
For Prob. 2.15.

Solution

For loop 1, $-10 + v + 4 = 0$, $v =$ **6 V**

For loop 2, $-4 + 16 + 3i_x = 0$, $i_x =$ **–4 A**

Chapter 2, Solution 22

Find $\boldsymbol{V_o}$ in the circuit in Fig. 2.86 and the power absorbed by the dependent source.

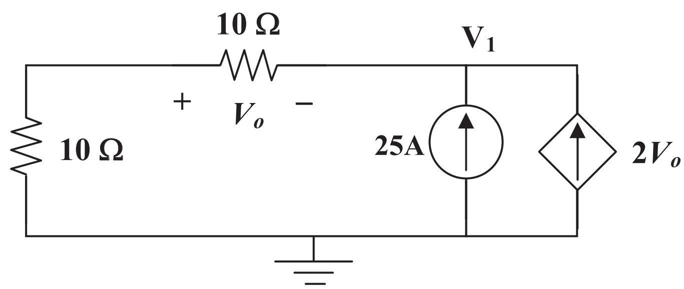


Figure 2.86
For Prob. 2.22

Solution

At the node, KCL requires that $[-V_o/10]+[-25]+[-2V_o] = 0$ or $2.1V_o = -25$

or $V_o = \mathbf{-11.905\ V}$

The current through the controlled source is $i = 2V_0 = -23.81$ A
and the voltage across it is $V_1 = (10+10)\ i_0$ (where $i_0 = -V_0/10$) $= 20(11.905/10)$ $= 23.81$ V.

Hence,

$p_{\text{dependent source}} = V_1(-i) = 23.81\text{x}(-(-23.81)) = \mathbf{566.9\ W}$

Checking, $(25-23.81)^2(10+10) + (23.81)(-25) + 566.9 = 28.322 - 595.2 + 566.9$ $= 0.022$ which is equal zero since we are using four places of accuracy!

Chapter 2, Solution 34

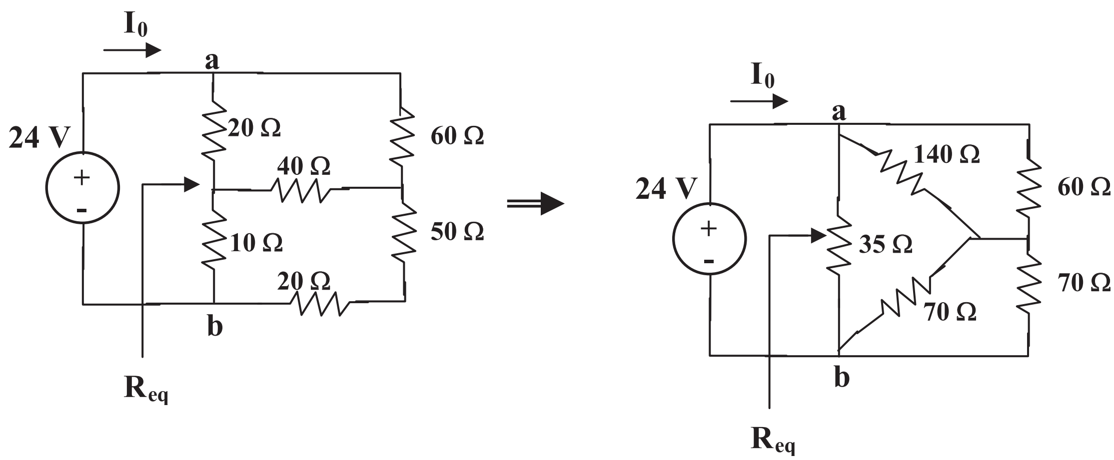
160//(60 + 80 + 20)= 80 Ω,
160//(28+80 + 52) = 80 Ω

$\boldsymbol{R_{eq}}$ = 20+80 = **100 Ω**

I = 200/100 = 2 A or p = VI = 200x2 = **400 W**.

Chapter 2, Solution 55

We convert the T to Δ.



$$R_{ab} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3} = \frac{20x40 + 40x10 + 10x20}{40} = \frac{1400}{40} = 35\Omega$$

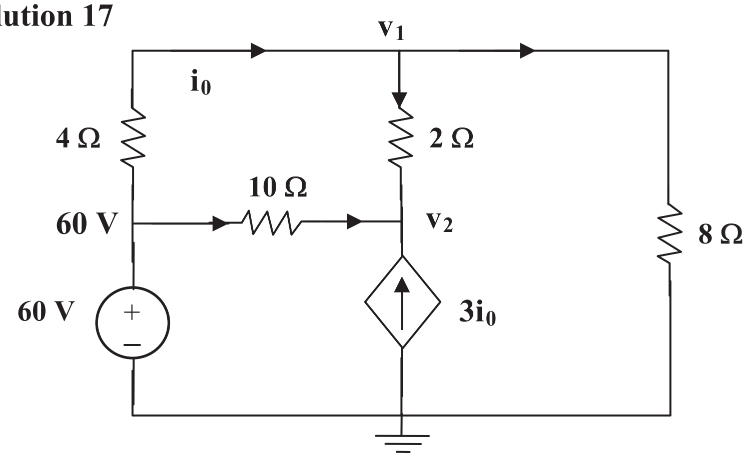
R_{ac} = 1400/(10) = 140Ω, R_{bc} = 1400/(20) = 70Ω

$70 \| 70 = 35$ and $140 \| 160 =$ 140x60/(200) = 42

$R_{eq} = 35 \| (35 + 42) = 24.0625\Omega$

I_0 = 24/(R_{ab}) = **997.4mA**

Chapter 3, Solution 17



At node 1, $\frac{60 - v_1}{4} = \frac{v_1}{8} + \frac{v_1 - v_2}{2}$ $\quad$ $120 = 7v_1 - 4v_2$ $\quad$ (1)

At node 2, $3i_0 + \frac{60 - v_2}{10} + \frac{v_1 - v_2}{2} = 0$

But $i_0 = \frac{60 - v_1}{4}$.

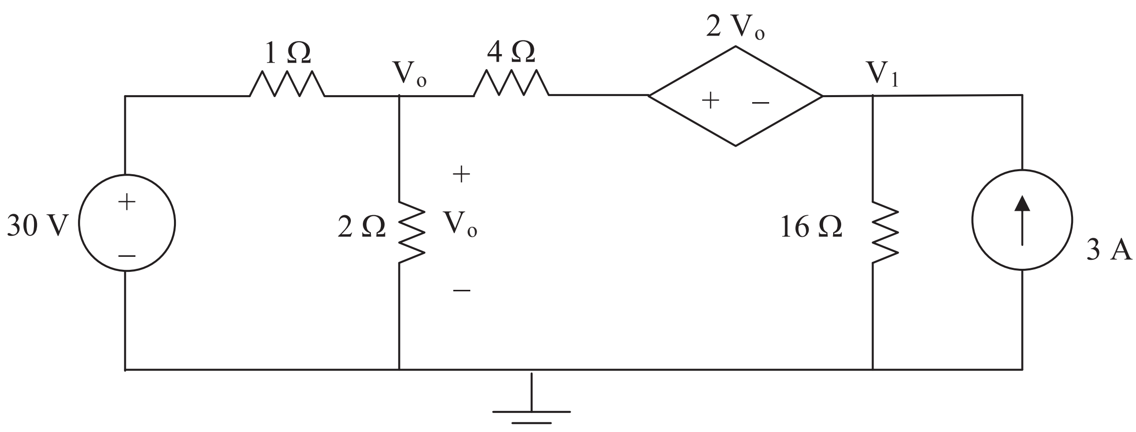
Hence

$$\frac{3(60 - v_1)}{4} + \frac{60 - v_2}{10} + \frac{v_1 - v_2}{2} = 0 \longrightarrow 1020 = 5v_1 + 12v_2 \qquad (2)$$

Solving (1) and (2) gives $v_1 = 53.08$ V. Hence $i_0 = \frac{60 - v_1}{4} =$ **1.73 A**

Chapter 3, Solution 23

We apply nodal analysis to the circuit shown below.



At node o,

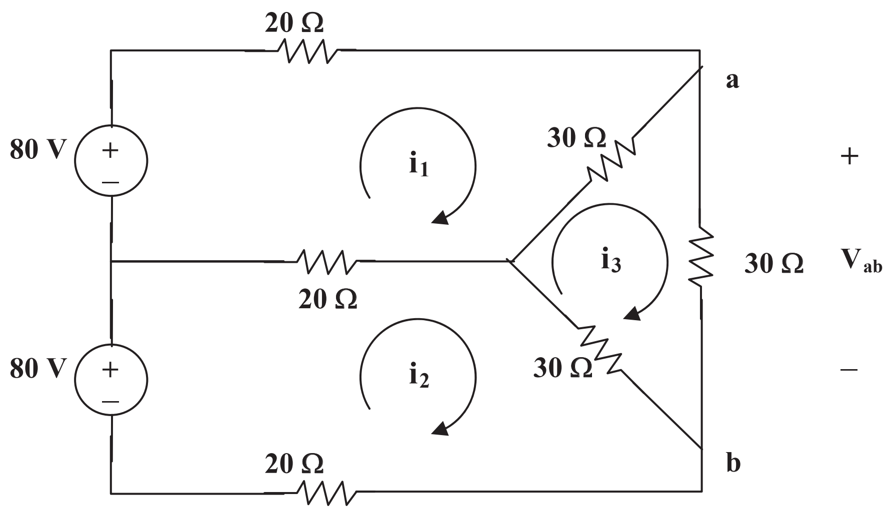
$$\frac{V_o - 30}{1} + \frac{V_o - 0}{2} + \frac{V_o - (2V_o + V_1)}{4} = 0 \rightarrow 1.25V_o - 0.25V_1 = 30 \qquad (1)$$

At node 1,

$$\frac{(2V_o + V_1) - V_o}{4} + \frac{V_1 - 0}{16} - 3 = 0 \rightarrow 5V_1 + 4V_o = 48 \qquad (2)$$

From (1), $V_1 = 5V_o - 120$. Substituting this into (2) yields
$29V_o = 648$ or $V_o =$ **22.34 V**.

Chapter 3, Solution 43



For loop 1,

$$80 = 70i_1 - 20i_2 - 30i_3 \longrightarrow 8 = 7i_1 - 2i_2 - 3i_3 \qquad (1)$$

For loop 2,

$$80 = 70i_2 - 20i_1 - 30i_3 \longrightarrow 8 = -2i_1 + 7i_2 - 3i_3 \qquad (2)$$

For loop 3,

$$0 = -30i_1 - 30i_2 + 90i_3 \longrightarrow 0 = i_1 + i_2 - 3i_3$$

(3)

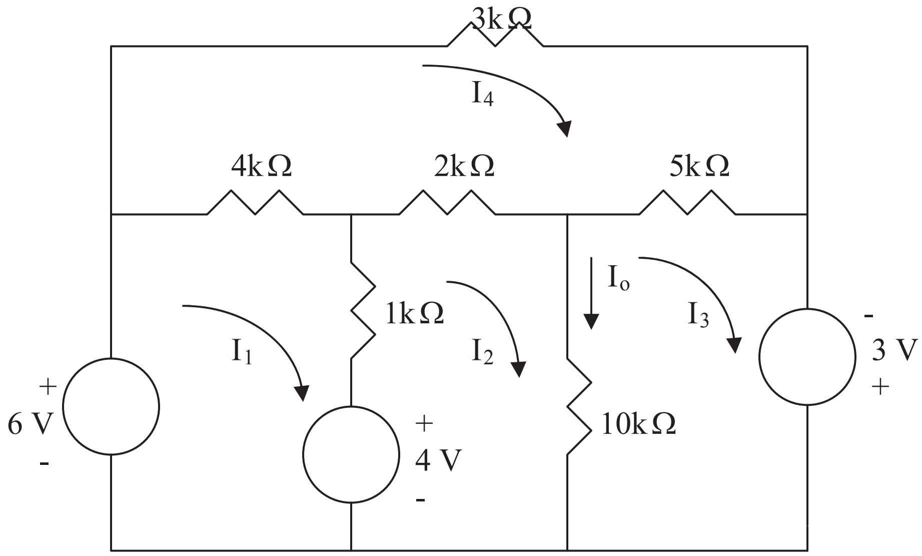
Solving (1) to (3), we obtain $i_3 = 16/9$

$$I_o = i_3 = 16/9 = \mathbf{1.7778\ A}$$

$$V_{ab} = 30i_3 = \mathbf{53.33\ V}.$$

Chapter 3, Solution 48

We apply mesh analysis and let the mesh currents be in mA.



For mesh 1,

$$-6+8+5I_1 - I_2 - 4I_4 = 0 \longrightarrow 2 = 5I_1 - I_2 - 4I_4 \qquad (1)$$

For mesh 2,

$$-4+13I_2 - I_1 - 10I_3 - 2I_4 = 0 \longrightarrow 4 = -I_1 + 13I_2 - 10I_3 - 2I_4 \qquad (2)$$

For mesh 3,

$$-3+15I_3 - 10I_2 - 5I_4 = 0 \longrightarrow 3 = -10I_2 + 15I_3 - 5I_4 \qquad (3)$$

For mesh 4,

$$-4I_1 - 2I_2 - 5I_3 + 14I_4 = 0 \qquad (4)$$

Putting (1) to (4) in matrix form gives

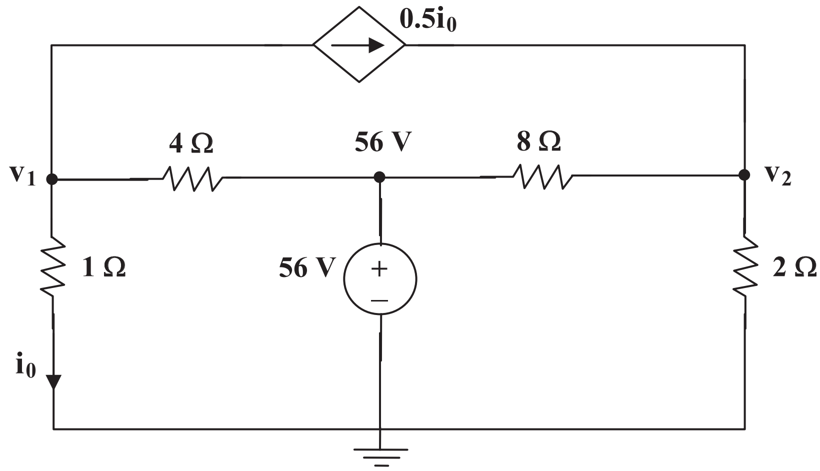
$$\begin{pmatrix} 5 & -1 & 0 & -4 \\ -1 & 13 & -10 & -2 \\ 0 & -10 & 15 & -5 \\ -4 & -2 & -5 & 14 \end{pmatrix}\begin{pmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \end{pmatrix} = \begin{pmatrix} 2 \\ 4 \\ 3 \\ 0 \end{pmatrix} \longrightarrow AI = B$$

Using MATLAB,

$$I = A^{-1}B = \begin{pmatrix} 3.608 \\ 4.044 \\ 3.896 \\ 3 \end{pmatrix} 0.148$$

The current through the 10kΩ resistor is $I_o = I_2 - I_3$ = **148 mA**.

Chapter 3, Solution 60



At node 1, $[(v_1–0)/1] + [(v_1–56)/4] + 0.5[(v_1–0)/1] = 0$ or $1.75v_1 = 14$ or $v_1 = 8$ V

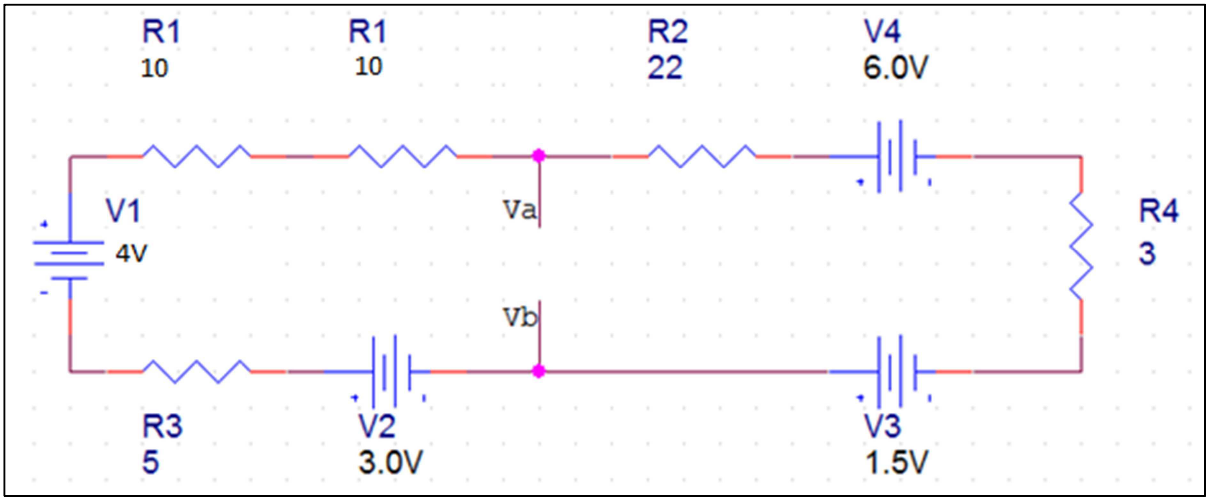
At node 2, $[(v_2–56)/8] – 0.5[8/1] + [(v_2–0)/2] = 0$ or $0.625v_2 = 11$ or $v_2 = 17.6$ V

$P_{1\Omega} = (v_1)^2/1 =$ **64 watts**, $P_{2\Omega} = (v_2)^2/2 =$ **154.88 watts**,

$P_{4\Omega} = (56 – v_1)^2/4 =$ **576 watts**, $P_{8\Omega} = (56 – v_2)^2/8 =$ **1.84.32 watts**.

SUPPLEMENTAL QUESTION:

Solve the circuit below for the Current(s) and Voltage V_{ab}



By KVL with Vb referenced as the ground node:

STEP 1: Find current

-3 + 5I – 4 + 10I + 10I + 22I +6 + 3I – 1.5 = 0
-2.5 + 50I = 0
I = -50mA

STEP 2: Find "Vab"

Vab = 10I + 10I + 4 + 5I + 3
Vab = 25(-0.05) + 7
Vab = 5.75V