2.1 Determine the current and power dissipated in the resistors in Fig. P2.1.

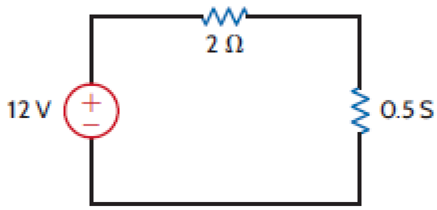


Figure P2.1

SOLUTION:

$$R_2 = \frac{1}{0.5} = 2\,\Omega$$

$$I = \frac{12}{2+2}$$

$$I = 3\text{A}$$

$$P_{R_1} = I^2 R_1 = (3)^2(2)$$

$$P_{R_1} = 18\text{ W}$$

$$P_{R_2} = I^2 R_2 = (3)^2(2)$$

$$P_{R_2} = 18\text{ W}$$

2.2 For the circuit given in Fig. P2.2.

(a) Determine resistance R that will result in the 25 kΩ resistor absorbing 2mW.

(b) Determine resistor R that will result 12 V source delivering 3.6mW to the circuit.

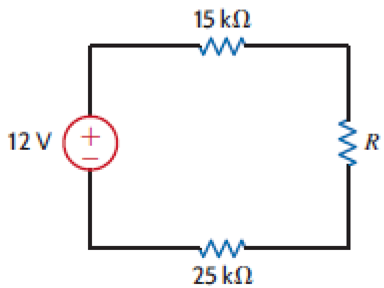


Figure P2.2

SOLUTION:

Let us define a clockwise current i.

a. i= 12/(40 + R) mA, with R expressed in kΩ.
We want $i^2 \cdot 25 = 2$
Or $(12/40+R)^2.25 = 2$
On rearranging we get,
$R^2 + 80R - 200 = 0$
which has the solutions R = -82.43 kΩ and R = 2.426 kΩ. Only the latter is a physical solution, so
R = 2.426 kΩ.

b. We require i· 12 = 3.6 or i= 0.3 mA
From the circuit, we also see that i= 12/(15 + R + 25) mA
Substituting the desired value for i, we find that the required value of R is R = 0

2.3 Given the circuit in Fig. P2.3, find the voltage across each resistor and the power dissipated in each.

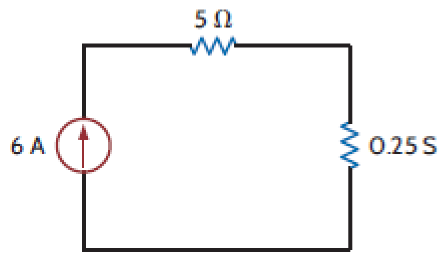


Figure P2.3

SOLUTION:

$$R_2 = \frac{1}{0.25} = 4\,\Omega$$

$$V_{R_1} = I R_1$$

$$V_{R_1} = 6(5) = 30\,V$$

$$V_{R_2} = I R_2 = 6(4) = 24\,V$$

$$P_{R_1} = \frac{V_{R_1}^2}{R_1} = \frac{(30)^2}{5}$$

$$P_{R_1} = 180\,W$$

$$P_{R_2} = \frac{V_{R_2}^2}{R_2} = \frac{(24)^2}{4}$$

$$P_{R_2} = 144\,W$$

2.4 In the network in Fig. P2.4, the power absorbed by R_x is 20 mW. Find R_x.

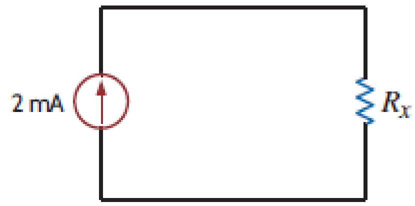


Figure P2.4

SOLUTION:

$$P_{Rx} = 20mW$$

$$P_{Rx} = I^2 R_x$$

$$R_x = \frac{P_{Rx}}{I^2} = \frac{20m}{(2m)^2} = \frac{20 \times 10^{-3}}{(2 \times 10^{-3})^2} = \frac{20 \times 10^{-3}}{4 \times 10^{-6}}$$

$$R_x = 5K\Omega$$

2.5 A model for a standard two D-cell flashlight is shown in Fig. P2.5. Find the power dissipated in the lamp.

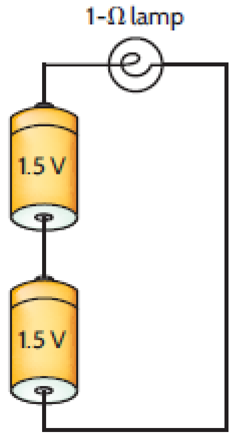


Figure P2.5

SOLUTION:

$$I = \frac{V}{R}$$

$$I = \frac{1.5 + 1.5}{1}$$

$$I = 3A$$

$$P_{lamp} = I^2 R = 3^2(1)$$

$$P_{lamp} = 9\,W$$

2.6 An automobile uses two halogen headlights connected as shown in Fig. P2.6. Determine the power supplied by the battery if each headlight draws 3 A of current.

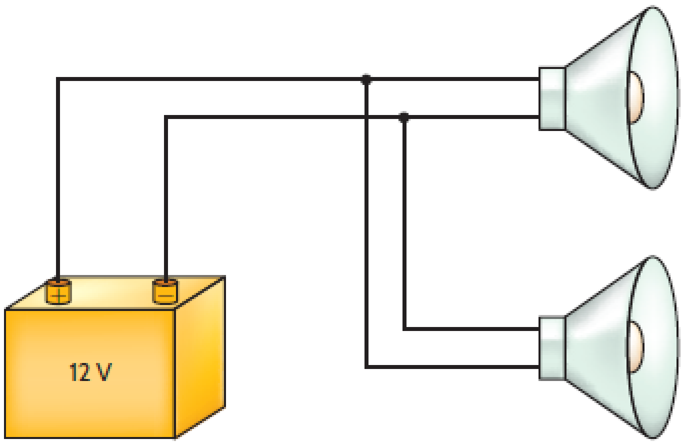


Figure P2.6

SOLUTION:

$I_1 = I_2 = 3A$

$I = I_1 + I_2 = 6A$

$P_{12V} = VI = 12(6)$

$P_{12V} = 72\ W$

2.7 Many years ago a string of Christmas tree lights was manufactured in the form shown in Fig. P2.7a. Today the lights are manufactured as shown in Fig. P2.7b. Is there a good reason for this change?

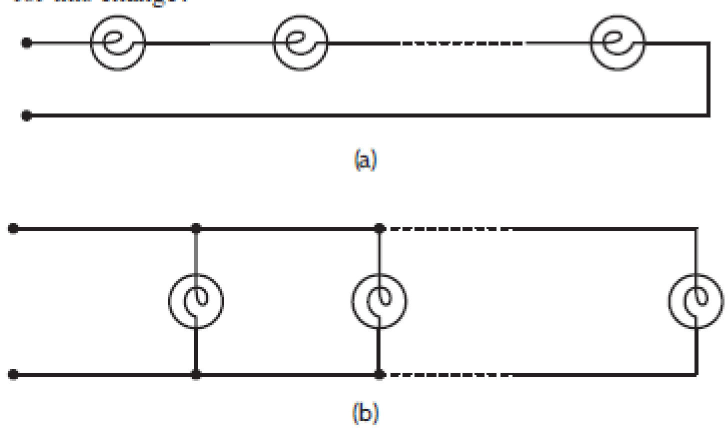


Figure P2.7

SOLUTION:

When Christmas tree lights are connected in series as shown in Figure 2.9a, an open circuit bulb failure will cause all bulbs to turn off (no current flows.)
If the bulbs are connected in parallel as shown in Figure 2.9b, an open circuit bulb failure will only cause one bulb to turn off. The other bulbs will still function when connected in parallel.

2.8 Find I_1 in the network in Fig. P2.8.

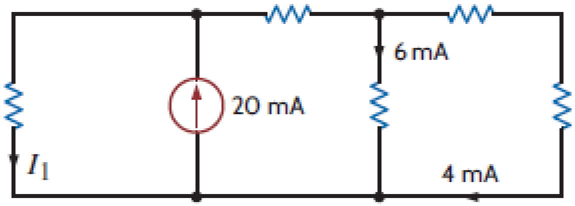


Figure P2.8

SOLUTION:

KCL at node B: $I_2 = 6m + 4m$

$I_2 = 10mA$

KCL at node A: $I_1 + I_2 = 20m$

$I_1 = 20m - 10m$

$I_1 = 10mA$

2.9 In the following circuit in Fig. P2.9, determine *I*.

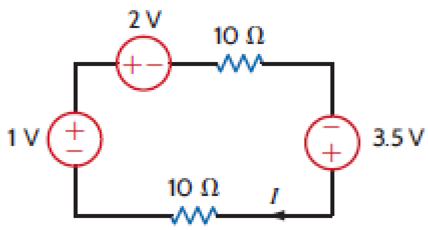


Figure P2.9

SOLUTION:

-1 + 2 + 10*I* – 3.5 + 10i= 0

Solving, *I* = 125 mA

2.10 Find I_1 and I_2 in the network in Fig. P2.10.

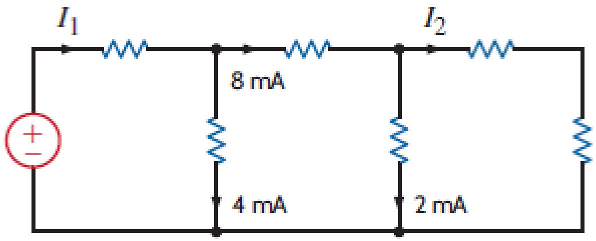
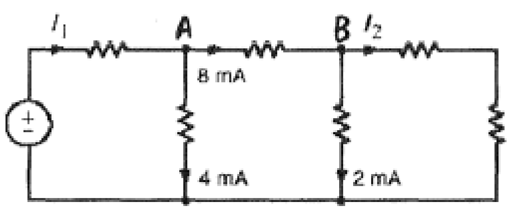


Figure P2.10

SOLUTION:



KCL at node A: $I_1 = 4m + 8m$

$I_1 = 12mA$

KCL at node B: $8m = 2m + I_2$

$I_2 = 6mA$

2.11 Find I_1 in the circuit in Fig. P2.11.

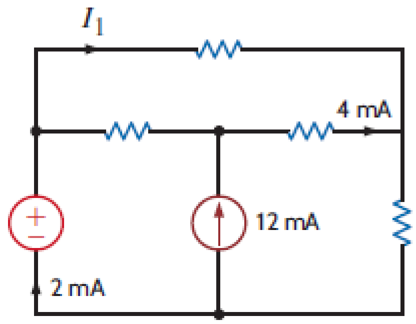
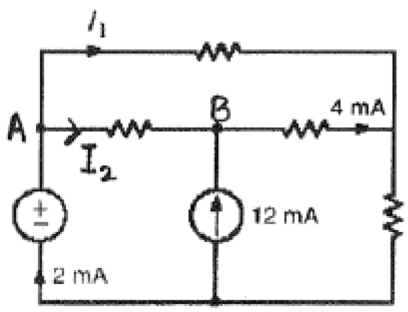


Figure P2.11

SOLUTION:



KCL at node B : $I_2 + 12m = 4m$

$I_2 = -8mA$

KCL at node A : $2m = I_1 + I_2$

$I_1 = 10mA$

2.12 In given circuit in Fig. P2.12.

(a) Let $V_x = 10\text{V}$ and find I_s

(b) Let $I_s = 50\text{A}$ and find V_x

(c) Calculate the ratio $\frac{V_x}{I_s}$

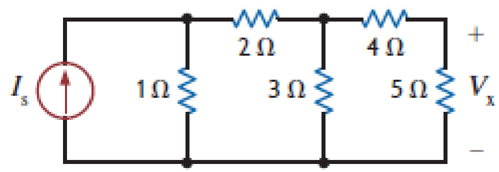


Figure P2.12

SOLUTION:

a. The current through the 5-Ω resistor is 10/5 = 2 A. Define R as 3 || (4 + 5) = 2.25 Ω. The current through the 2-Ω resistor then is given by
$I_s(1/1+(2+R)) = I_s/5.25$
The current through the 5-Ω resistor is
$I_S = 42$ A

b. Given that I_S is now 50 A, the current through the 5-Ω resistor becomes
$I_s/5.25(3/3+9) = 2.381\text{A}$
Thus, $V_x = 5(2.381) = 11.90$ V

c. $V_x/I_s = 0.2381$

2.13 Determine I_L in the circuit in Fig. P2.13.

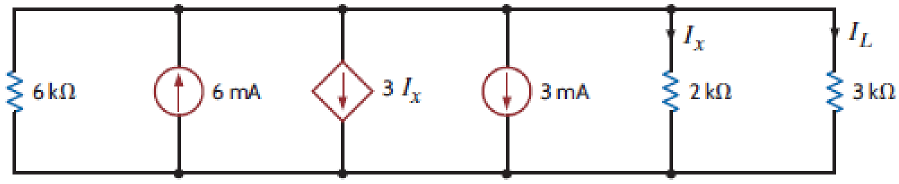


Figure P2.13

SOLUTION:

$$6m = \frac{V}{6k} + 3I_x + 3m + I_x + I_L$$

$$\frac{V}{6k} + 4I_x + I_L = 3m$$

$$I_x = \frac{V}{2k} \text{ and } I_L = \frac{V}{3k}$$

$$\frac{V}{6k} + 4\left(\frac{V}{2k}\right) + \frac{V}{3k} = 3m$$

$$V + 12V + 2V = 18$$

$$15V = 18$$

$$V = \frac{18}{15} V$$

$$I_L = \frac{18}{15(3k)}$$

$$I_L = 0.4 mA$$

2.14 Calculate the value of I in the circuit in Fig. P2.14.

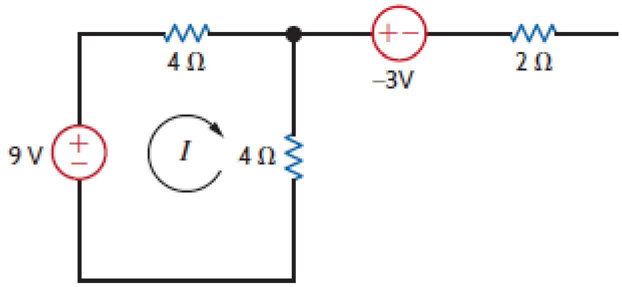


Figure P2.14

SOLUTION:

Starting with the bottom node and proceeding in a clockwise direction, we write the KVL equation

$-9 + 4I + 4I = 0$ (no current flows through either the -3 V source or the 2 Ω resistor)

Solving, we find that $I = 9/8$ A = 1.125 A.

2.15 Find I_1 in the network in Fig. P2.15.

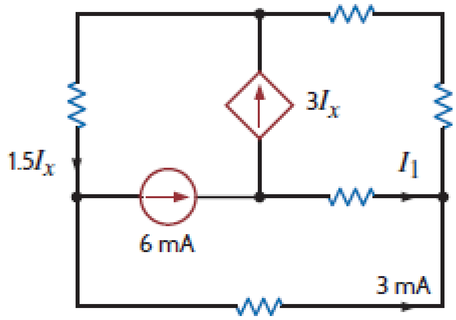


Figure P2.15

SOLUTION:

$$1.5I_X = 6\,mA + 3\,mA = 9\,mA$$

$$I_X = 6\,mA$$

$$6\,mA = 3I_X + I_1$$

$$= 18\,mA + I_1$$

$$I_1 = -12\,mA$$

2.16 Find I_x, I_y, and I_z in the network in Fig. P2.16.

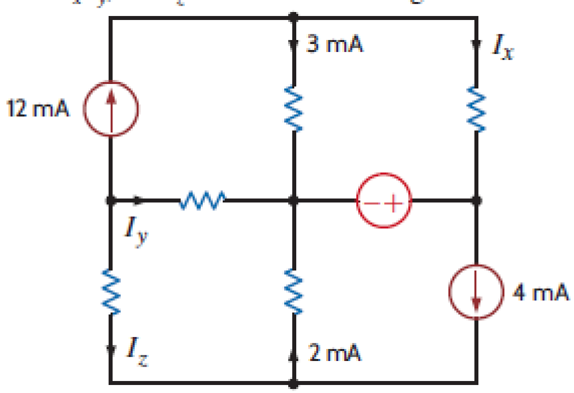


Figure P2.16

SOLUTION:

KCL at A: $12m = 3m + I_x$

$I_x = 9mA$

KCL at B: $I_z + 4m = 2m$

$I_z = -2mA$

KCL at C: $12m + I_y + I_z = 0$

$I_y = 2m - 12m$

$I_y = -10mA$

2.17 In the circuit, in Fig. P2.17, if $V = 6\text{V}$, find I_s.

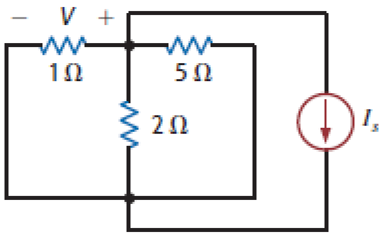


Figure P2.17

SOLUTION:

Since v = 6 V, we know the current through the 1-Ω resistor is 6 A, the current through the 2-Ω resistor is 3 A, and the current through the 5-Ω resistor is 6/5 = 1.2 A, as shown below

By KCL, $6 + 3 + 1.2 + I_S = 0$

$I_S = -10.2$ A

2.18 Find I_1 in the network in Fig. P2.18.

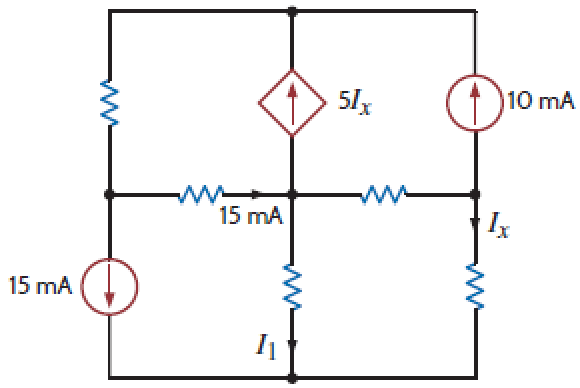


Figure P2.18

SOLUTION:

$$10\,mA + 5I_x = 15\,mA + 15\,mA$$

$$I_x = 4\,mA$$

$$15\,mA + I_1 + I_x = 0$$

$$15\,mA + I_1 + 4\,mA = 0$$

$$I_1 = -19\,mA$$

2.19 Find I_1, I_2, and I_3 in the network in Fig. P2.19.

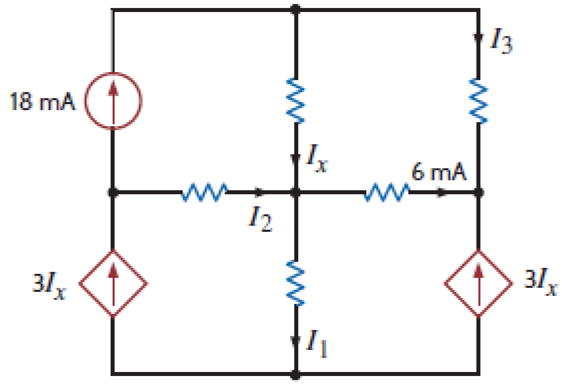


Figure P2.19

SOLUTION:

$$18\,mA + 3I_X + 6\,mA = I_X$$

$$I_X = -12\ mA$$

$$I_1 = 3I_X + 3I_X = 6I_X = -72\ mA$$

$$3I_X = I_2 + 18\,mA$$

$$-36\ mA = I_2 + 18\,mA$$

$$-54\ mA = I_2$$

$$18\,mA = I_X + I_3$$

$$18\,mA = -12\,mA + I_3$$

$$30\,mA = I_3$$

2.20 In the network in Fig. P2.20, Find I_1, I_2 and I_3 and show that KCL is satisfied at the boundary.

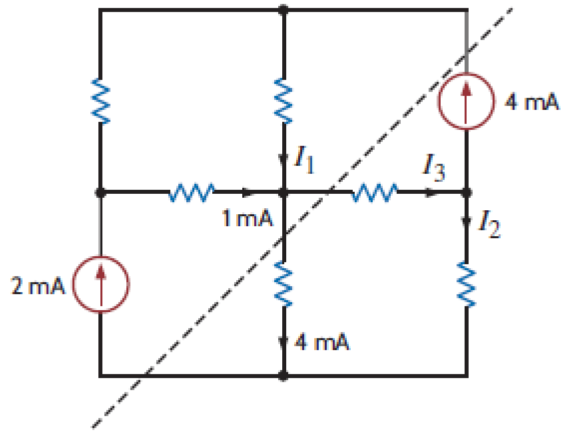


Figure P2.20

SOLUTION:

$$2mA - 1mA + 4mA = I_1$$
$$I_1 = 5mA$$
$$I_2 + 4mA = 2mA$$
$$I_2 = -2mA$$
$$I_3 = I_2 + 4mA$$
$$= 2mA$$

Across the Boundary (left -, Right +)

$$-2mA + 4mA + 2mA - 4mA = 0$$

2.21 Determine V_o and I in the circuit in Fig P2.21.

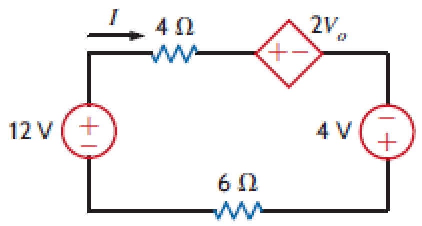


Figure P2.21

SOLUTION:

We apply KVL around the loop. The result is,

$-12 + 4I + 2v_o - 4 + 6I = 0$ (i)

Applying Ohm's law to the 6- Ω resistor gives

$V_0 = -6I$

Substituting in (i), we get,

$-16 + 10I - 12I = 0 \quad \Rightarrow \quad I = -8$ A and $V_o = 48$ V

20.22 Find currents and voltages in the circuit in Fig. P2.22.

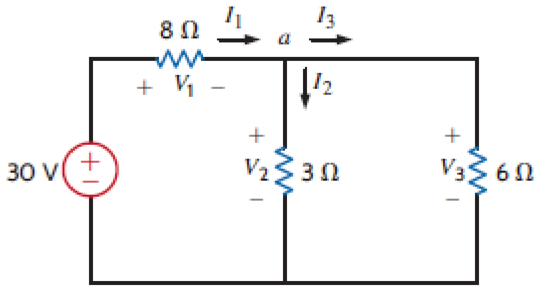


Figure P2.22

SOLUTION:

We apply Ohm's law and Kirchhoff's laws. By Ohm's law,

$V_1 = 8I_1, V_2 = 3I_2, \quad V_3 = 6I_3$ (i)

Since the voltage and current of each resistor are related by Ohm'slaw as shown, we are really looking for three things: (V_1, V_2, V_3) or (I_1, I_2, I_3) At node a, KCL gives

$I_1 - I_2 - I_3 = 0$ (ii)

Applying KVL to loop 1,

$-30 + V_1 + V_2 = 0$

=> $-30 + 8I_1 + 3I_2 = 0$ From (i)

=> $I_1 = (30 – 3I_2) / 8$ (iii)

Applying KVL to loop 2,

$-V_2 + V_3 = 0$ => $V_3 = V_2$ (iv)

We express V_1 and V_2 in terms of I_1 and I_2 as in Eq. (i). Equation (iv) becomes

$6I_3 = 6I_2$ => $I_3 = I_2 / 2$ (v)

Substituting values in eq. (iii) gives,

$((30 – 3I_2) / 8) + I_2 + (I_2/2) = 0$ or $I_2 = 2$ A

Substituting the values of I_2 and using equations (i) to (v) we get,

$I_1 = 3$ A, $I_3 = 1$ A, $V_1 = 24$ V, $V_2 = 6$ V, $V_3 = 6$ V

2.23 Find V_{fb} and V_{ec} in the circuit in Fig. P2.23.

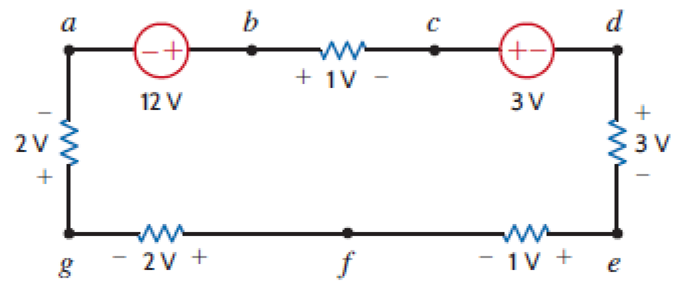


Figure P2.23

SOLUTION:

KVL around fbcdef :

$V_{fb} + 1 + 3 + 3 + 1 = 0$

$V_{fb} = -8V$

KVL around ecde :

$V_{ec} + 3 + 3 = 0$

$V_{ec} = -6V$

2.24 In the simple circuit in Fig. P2.24, using KVL derive the following expressions.

$$V_1 = V_s \frac{R_1}{R_1 + R_2} \text{ and } V_2 = V_s \frac{R_2}{R_1 + R_2}$$

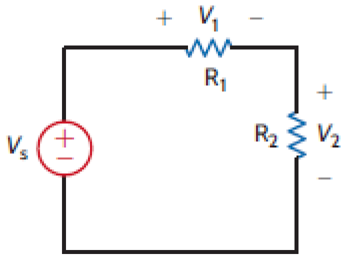


Figure P2.24

SOLUTION:

Begin by defining a clockwise current i

$-V_S + V_1 + V_2 = 0$

So, $V_S = V_1 + V_2 = I(R_1 + R_2)$

and hence $I = V_s/R_1+R_2$

Thus $V_1 = R_1 I = v_s R_1/R_1+R_2$ and $V_2 = R_2 I = V_s R_2/R_1+R_2$

2.25 Given the circuit diagram in Fig. P2.25, find the following voltages: V_{da}, V_{bh}, V_{gc}, V_{di}, V_{fa}, V_{ac}, V_{ai}, V_{hf}, V_{fb}, and V_{dc}.

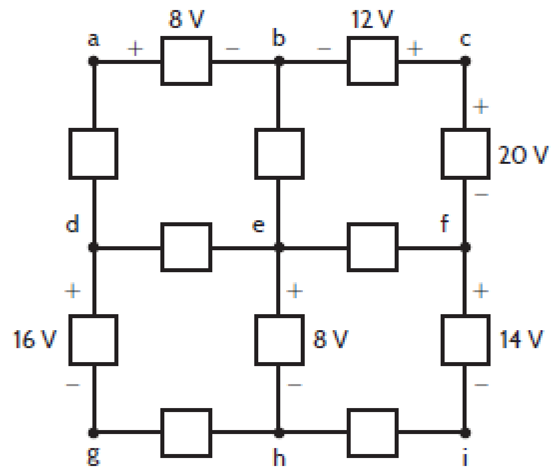


Figure P2.25

SOLUTION:

KVL : $V_{en} = V_{ef} + V_{fi} + V_{ih}$

$V_{ef} = 8 - 14 - 4$

$V_{ef} = -10V$

KVL : $V_{de} + V_{ef} + V_{fi} + V_{ih} = V_{dg} + V_{gh}$

$V_{de} = 16 + 12 - (-10) - 14 - 4$

$V_{de} = 20V$

KVL : $V_{ef} + V_{be} + V_{cb} = V_{cf}$

$V_{be} = 20 - (-10) - 12$

$V_{be} = 18V$

KVL : $V_{de} = V_{da} + V_{ab} + V_{be}$

$V_{da} = 20 - 8 - 18$

$\boxed{V_{da} = -6V}$

$V_{bh} = V_{be} + V_{eh} = 18 + 8$

$\boxed{V_{bh} = 26V}$

KVL : $V_{gh} = V_{gc} + V_{in} + V_{fi} + V_{cf}$

$V_{gc} = 12 - 4 - 14 - 20$

$\boxed{V_{gc} = -26\,V}$

KVL : $V_{di} + V_{in} = V_{dg} + V_{gh}$

$V_{di} = -4 + 16 + 12$

$\boxed{V_{di} = 24\,V}$

KVL : $V_{fa} + V_{ab} + V_{cf} = V_{cb}$

$V_{fa} = 12 - 8 - 20$

$\boxed{V_{fa} = -16\,V}$

KVL : $V_{ac} + V_{cb} = V_{ab}$

$V_{ac} = 8 - 12$

$V_{ac} = -4\,V$

KVL : $V_{cf} + V_{fi} + V_{ia} + V_{ab} = V_{cb}$

$V_{ia} = 12 - 14 - 8 - 20$

$V_{ia} = -30\,V$

KVL : $V_{hf} + V_{fi} + V_{in} = 0$

$V_{hf} = -14 - 4$

$\boxed{V_{hf} = -18\,V}$

KVL : $V_{fb} + V_{cf} = V_{cb}$

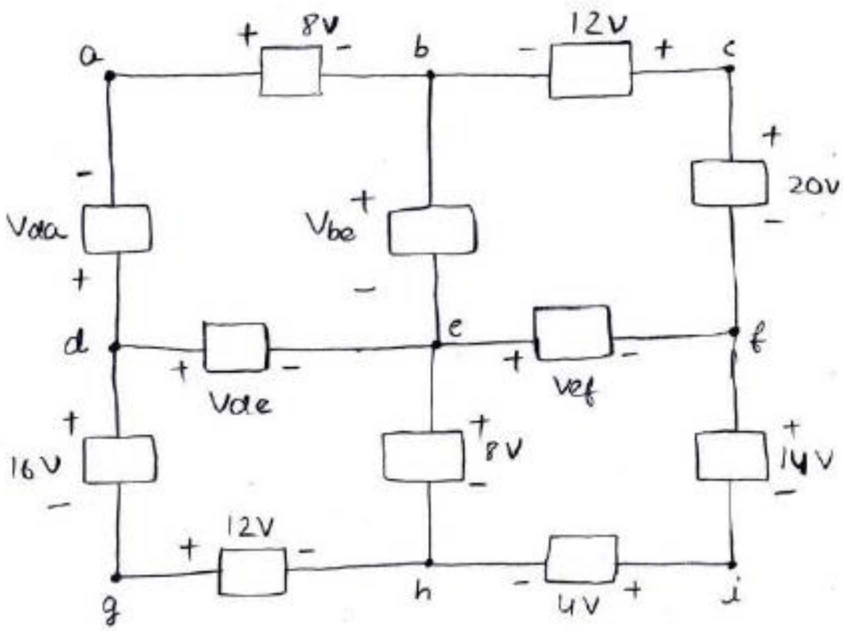
$V_{fb} = 12 - 20$

$V_{fb} = -8\text{V}$

KVL : $V_{dc} + V_{cf} = V_{ef} + V_{de}$

$V_{dc} = -10 + 20 - 20$

$\boxed{V_{dc} = -10\text{V}}$



2.26 Find V_x and V_y in the circuit in Fig. P2.26.

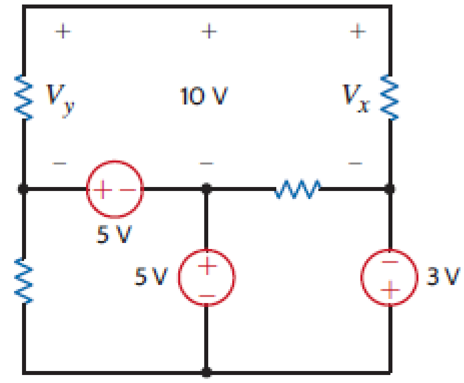


Figure P2.26

SOLUTION:

$$-5-10+V_x-3=0$$

$$V_x=18\text{ V}$$

$$-5-V_y+10=0$$

$$V_y=5\text{ V}$$

2.27 Find V_1, V_2 and V_3 in the network in Fig. P2.27.

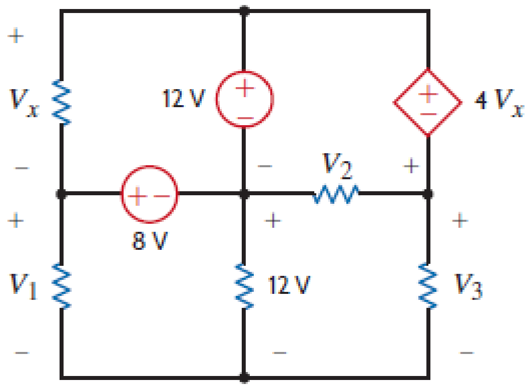


Figure P2.27

SOLUTION:

$$-V_1 + 8 + 12 = 0$$
$$V_1 = 20V$$

$$-V_x + 12 - 8 = 0$$
$$V_x = 4V$$

$$-12 + 4V_x + V_2 = 0$$
$$-12 + 16 + V_2 = 0$$
$$V_2 = -4V$$

$$-12 - V_2 + V_3 = 0$$
$$-12 + 4 + V_3 = 0$$
$$V_3 = 8V$$

2.28 In the Fig. P2.28, find voltage drop across *x*-*y* terminals.

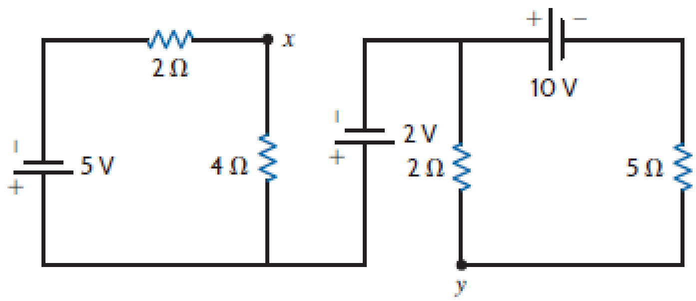
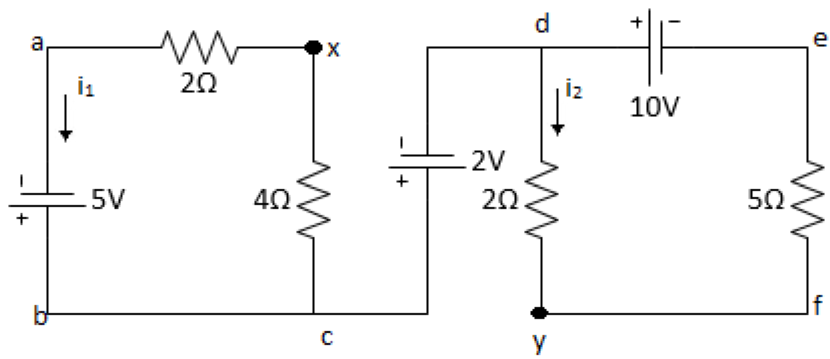


Figure P2.28

SOLUTION:

First we redraw the circuit with designated loop currents as shown,



In loop *abcx*, KVL gives,

$-5 + 4i_1 + 2i_1 = 0$ or $i_1 = 5/6$ A

=> $v_{bx} = -v_{xb} = 4i_1 = 3.33$ V (x terminal –ve as the current flows from b to x)

Similarly, in loop *defy*,

$-10 + 2i_2 + 5i_2 = 0$ or $i_2 = 10/7$ A

And $v_{dy} = 10/7 \times 2 = 2.857$ A (d terminal +ve)

The voltage between terminals x and y is then

$V_{xb} + v + v_{dy} = (-3.333 + 2 + 2.857)$ V $= 1.524$ V;

$V_{xy} = 1.524$ V

2.29 Find V_o in the circuit in Fig. P2.29.

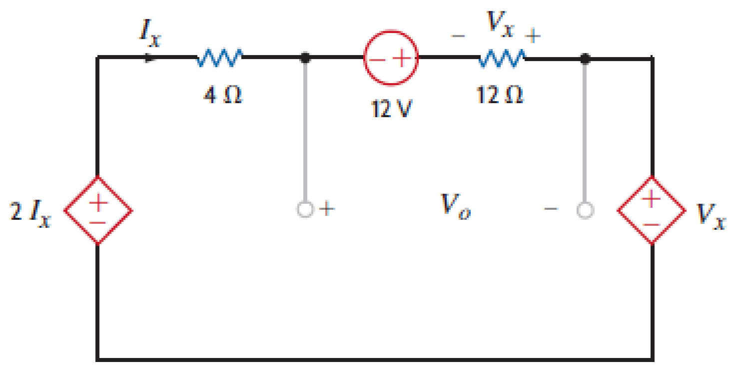


Figure P2.29

SOLUTION:

KVL:

$$V_o + 12 + V_x = 0$$
$$V_o = -V_x - 12$$
$$V_x = -12 I_x$$

KVL around outer loop:

$$2I_x + 12 + V_x = 4I_x + V_x$$
$$2I_x + 12 + 12I_x = 4I_x + 12I_x$$
$$2I_x = 12$$
$$I_x = 6A$$

$$V_x = -12(6) = -72\,V$$
$$V_o = -(-72) - 12$$
$$V_o = 60\,V$$

2.30 The 10-V source absorbs 2.500 mW of power. Calculate (a) V_{ba} and (b) the power absorbed by the dependent voltage source in Fig. P2.30.

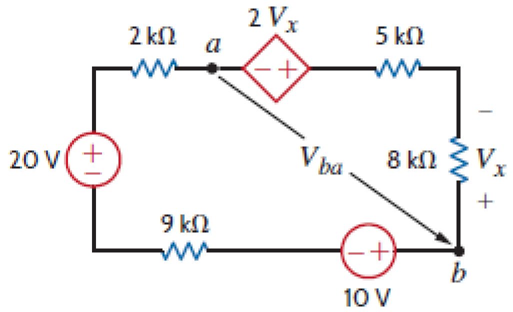
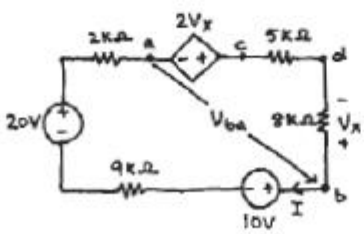


Figure P2.30

SOLUTION:



$P_{10V} = 2.50\ \text{mW}$ absorbed

$P_{10V} = 10I$

$\Rightarrow I = \dfrac{P_{10V}}{10} = 250\ \mu A$

KVL for 'bacdb' : $V_{ba} - V_{ca} - V_{dc} - V_{bd} = 0$

$\Rightarrow V_{ba} = V_{ca} + V_{dc} + V_{bd}$ — (1)

$V_{bd} = -I(8 \times 10^3) = -(250 \times 10^{-6})(8 \times 10^3)$

$\Rightarrow V_{bd} = -2\text{V}$ — (2)

$V_{dc} = -I(5 \times 10^3) \Rightarrow V_{dc} = -1.25\ \text{V}$ — (3)

$V_x = V_{bd} = -2\text{V}$

$V_{ca} = 2V_x = -4\text{V}$ — (4)

Substituting (2), (3), (4) in (1) : $\boxed{V_{ba} = -7.25\ \text{V}}$

$P_{DS} = -2V_x I = -2(-2)(250 \times 10^{-6})$

$\Rightarrow \boxed{P_{DS} = 1\text{mW}}$

2.31 Find V_1, V_2, and V_3 in the network in Fig. P2.31.

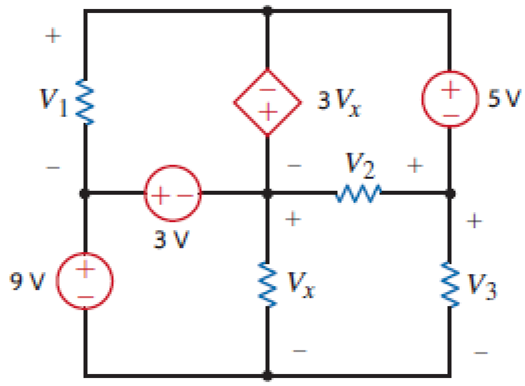


Figure P2.31

SOLUTION:

$-9+3+V_x=0$

$V_x=6\,V$

$-V_1-3V_x-3=0$

$-V_1-18-3=0$

$V_1=-21\,V$

$3V_x+5+V_2=0$

$18+5+V_2=0$

$V_2=-23\,V$

$-V_x-V_2+V_3=0$

$V_3=V_x+V_2$

$=6-23$

$=-17\,V$

2.32 Compute the power absorbed in each element for the circuit shown in Fig. P2.32.

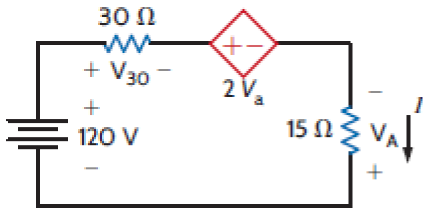


Figure P2.32

SOLUTION:

Applying KVL around the loop:

$-120+v_{30}+2v_A-v_A=0$

Using Ohm's law to introduce the known resistor values:

$v_{30}=30i$ and $v_A=-15I$

Note that the negative sign is required since iflows into the negativeterminal of v_A.

Substituting these into the KVL eq. yields

$-120+30I - 30I + 15I = 0$

And so we find that, $I = 8A$

Computing the power absorbedby each element:

$p_{120v}=(120)(-8)=-960$ W

$p_{30\Omega}=(8)^2(30) =1920$ W

$p_{dep}=(2vA)(8) =2 [(-15)(8)](8) \quad =-1920$ W

$p_{15\Omega}=(8)^2(15) = 960$ W

2.33 Find the voltage, current, and power associated with each element in the circuit in Fig. P2.33.

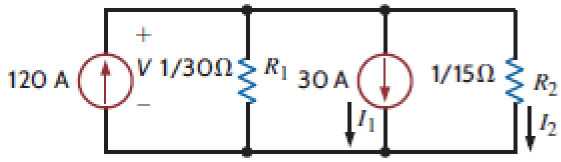


Figure P2.33

SOLUTION:

Determining either current $i_1$or $i_2$will enable us to obtain a value for V. Thus, our next step is to apply KCL to either of the two nodes in the circuit. Equating the algebraic sum of the currents leaving the upper node to zero:

$$-120+I_1+30+I_2=0$$

Writing both currents in terms of the voltage V using Ohm's law,

$I_1=30v$ and $I_2=15v$

We obtain,

$$-120+30V+30+15V=0$$

Solving this equation for v results in,

$$V=2V$$

And invoking Ohm's law then gives,

$I_1=60$ A and $I_2=30$ A

The absorbed power in each element can now be computed. In the two resistors,

$p_{R1}=30(2)^2=120$ W and $p_{R2}=15(2)^2=60$ W

And for the two sources,

$p_{120A}=120(-2)=-240$ W and $p_{30A}=30(2)=60$ W

Since the 120 A source absorbs negative 240 W, it is actually supplying power to the other elements in the circuit. In a similar fashion, we find that the 30 A source is actually absorbing power rather than supplying it.

2.34 Find V_x in the circuit in Fig. P2.34.

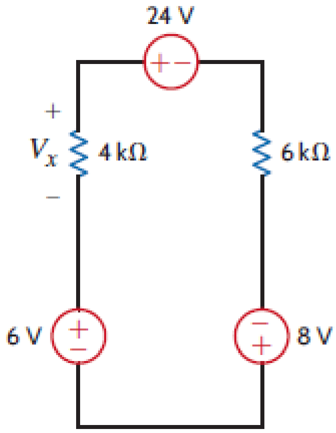


Figure P2.34

SOLUTION:

KVL:

$24 = 4KI + 6 + 8 + 6KI$

$10KI = 10$

$I = 1mA$

$V_x = I(4K) = (1m)(4K)$

$V_x = 4V$

2.35 Determine the value of V and the power supplied by the independent current source shown in Fig. P2.35.

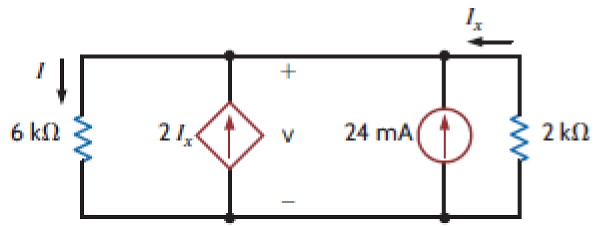


Figure P2.35

SOLUTION:

By KCL, the sum of the currents leaving the upper node must be zero, so that,

$I - 2I_x - 0.024 - I_x = 0$

Again, note that the value of the dependent source ($2I_x$) is treated the same as any other current would be, even though its exact value is not known until the circuit has been analyzed.

We next apply Ohm's law to each resistor:

$I = v/6000$ and $I_x = -v/2000$

Therefore, $\frac{v}{6000} - 2\left(\frac{-v}{2000}\right) - 0.024 - \left(\frac{-v}{2000}\right) = 0$

And so v=(600)(0.024)=14.4V.

The power supplied by the independent source is p_{24}=14.4(0.024)=0.3456 W(345.6mW).

2.36 Find V_x and the power supplied by the 15-V source in the circuit in Fig. P2.36.

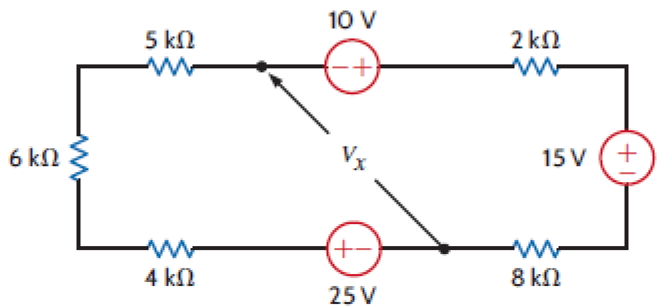


Figure P2.36

SOLUTION:

KVL : $25 + 10 = 4KI + 6KI + 5KI + 2KI + 15 + 8KI$

$25KI = 20$

$I = 0.8mA$

KVL : $V_x + 10 = 2KI + 15 + 8KI$

$V_x = 5 + 10K(0.8m)$

$V_x = 13V$

$P_{15V} = VI = 15(0.8m)$

$P_{15V} = 12\,mW$ (absorbed)

2.37 Find V_1 in the network in Fig. P2.37.

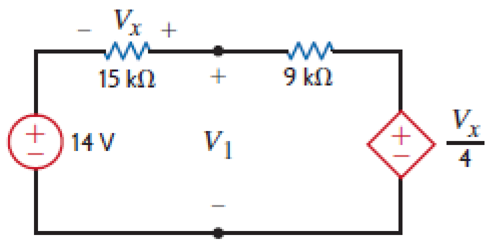
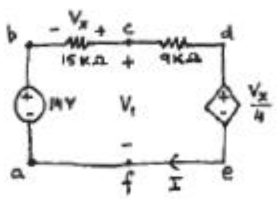


Figure P2.37

SOLUTION:



$$V_x = -I(15\times10^3)$$

KVL for 'abcdefa': $-V_x + I(9\times10^3) + \frac{V_x}{4} - 14 = 0$

$$I(15\times10^3) + I(9\times10^3) - \frac{I}{4}(15\times10^3) = 14$$

$$I(10^3)\left(15 + 9 - \frac{15}{4}\right) = 14$$

$$\Rightarrow I = 691.36\ \mu A$$

KVL for 'cfabc' : $V_1 - 14 - V_x = 0$

$$\Rightarrow V_1 = 14 + V_x$$

$$= 14 + (-I)(15\times10^3)$$

$$= 14 - (691.36\times10^{-6})(15\times10^3)$$

$$\Rightarrow \boxed{V_1 = 3.63\ V}$$

(Value rounded off to 2 significant digits.)

2.38 Find the power supplied by each source, including the dependent source, in Fig. P2.38.

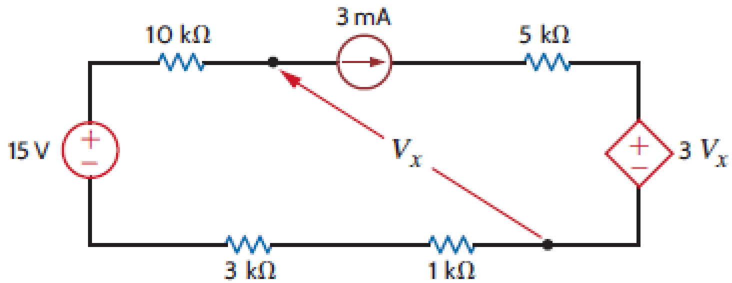
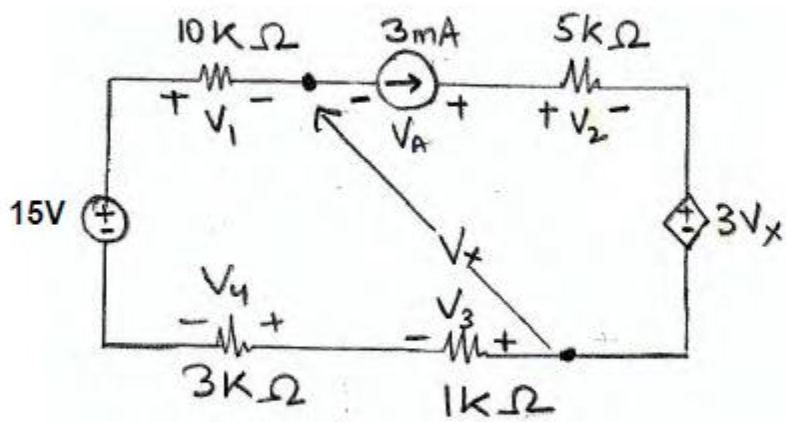


Figure P2.38

SOLUTION:



$$V_1 = (10k)(3m) = 30V$$
$$V_2 = (5K)(3m) = 15V$$
$$V_3 = (1K)(3m) = 3V$$
$$V_4 = (3k)(3m) = 9V$$
$$V_x = -V_1 + 15 - V_4 - V_3$$
$$V_x = -30 + 15 - 9 - 3 = -27V$$

$15V: \; P = (15)(3m) = \underline{45mW}$

$V_A = V_2 + 3V_x - V_x = V_2 + 2V_x$

$V_A = 15 + 2(-27) = -39V$

$3mA: \; P = (-39)(3m) = \underline{-117mW}$

$3V_x: \; P = -(3V_x)(3m) = -(3)(-27)(3m)$

$= \underline{243mW}$

2.39 Find the power absorbed by the dependent source in the circuit in Fig. P2.39.

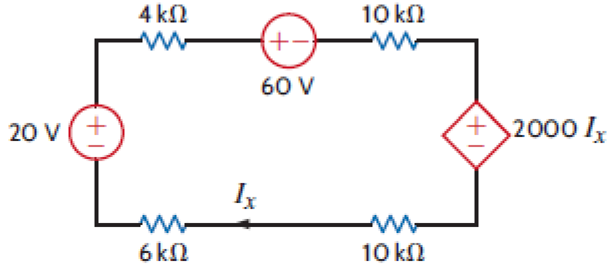


Figure P2.39

SOLUTION:

KVL:

$$20 = 6kI_x + 4kI_x + 60 + 10kI_x + 2kI_x + 10kI_x$$

$$32kI_x = -40$$

$$I_x = 1.25 mA$$

$$P = (2000 I_x)(I_x)$$

$$P = \{200(-1.25m)\}(-1.25m)$$

$$P = 3.125 mW$$

2.40 The 100-V source in the circuit in Fig. P2.40 is supplying 200 W. Solve for V_2.

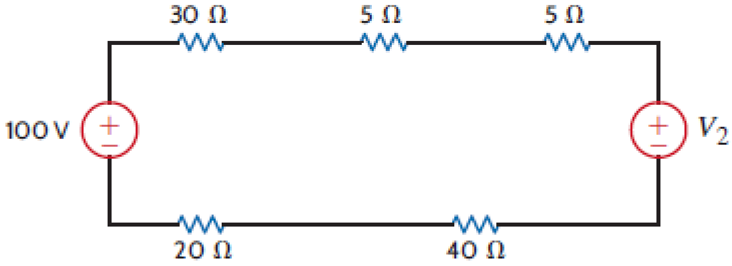
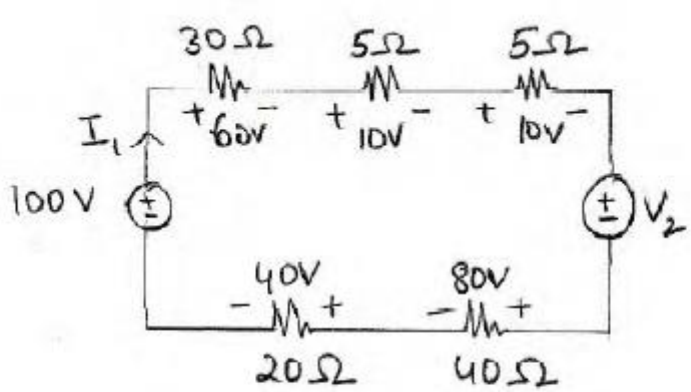


Figure P2.40

SOLUTION:



$$200 = 100\, I_1 \qquad I_1 = 2A$$

$$60 + 10 + 10 + V_2 + 80 + 40 - 100 = 0$$

$$V_2 = -100V$$

2.41 Find the value of V_2 in Fig. P2.41 such that $V_1 = 0$.

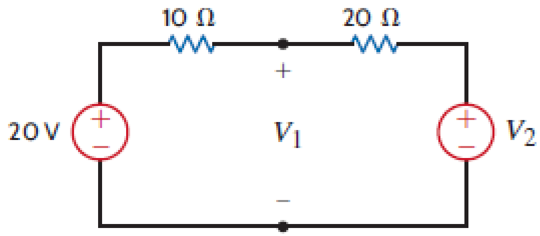
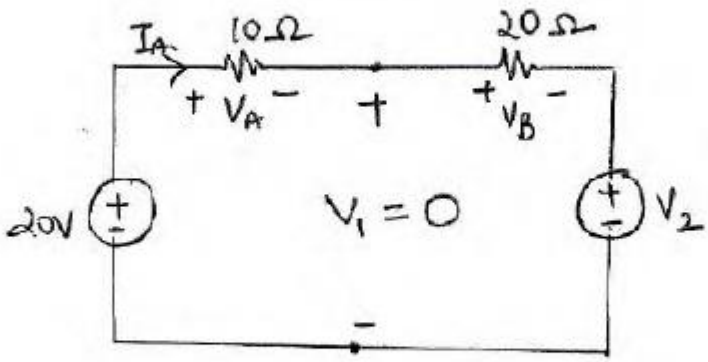


Figure P2.41

SOLUTION:



$$V_A = 20V$$

$$I_A = \frac{20}{10} = 2A$$

$$V_B = (20)(2) = 40V$$

$$V_B + V_2 = V_1 = 0$$

$$V_2 = -V_B$$

$$V_2 = -40V$$

2.42 Find I_x in the circuit in Fig. P2.42.

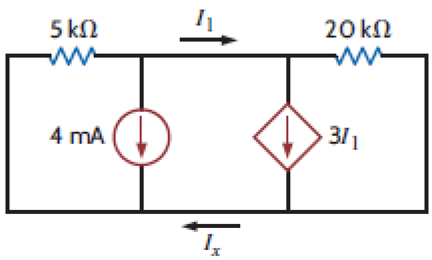


Figure P2.42

SOLUTION:

Let us define a voltage v with the "+" reference at the top node. Applying KCL and summing the currents flowing out of the top node,

$v/5000 + 4\times10^{-3} + 3I_1 + v/20000 = 0$

we observe that

$I_1 = 3\,I_1 + v/2000$

$I_1 = -v/40000$

Upon substituting this equation in the previous one

$v/5000 + 4\times10^{-3} - 3v/40000 + v/20000 = 0$

Solving, we find that

$v = -22.86$ V

$I_1 = 571.4$ µA

Since $I_x = I_1$, we find that $I_x = 571.4$ µA

2.43 Compute the power supplied by each element in the circuit and show that their sum is equal to zero.

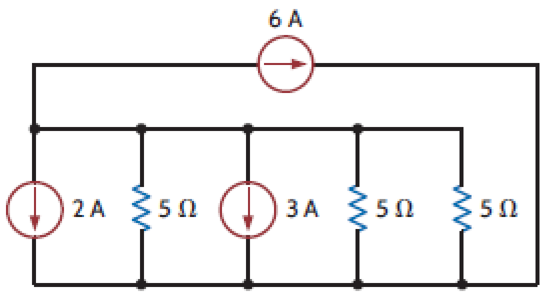


Figure P2.43

SOLUTION:

Let us define a voltage v across the elements, with the "+" reference at the top node
Summing the currents leaving the top node and applying KCL, we find that
$2 + 6 + 3 + v/5 + v/5 + v/5 = 0$
orv = -55/3 = -18.33 V. The power supplied by each source is then computed as:

$p_{2A} = -v(2) = 36.67$ W

$p_{6A} = -v(6) = 110$ W

$p_{3A} = -v(3) = 55$ W

The power absorbed by each resistor is simply $v^2/5 = 67.22$ W for a total of 201.67 W, which is the total power supplied by all sources. If instead we want the "power supplied" by the resistors, we multiply by -1 to obtain -201.67 W. Thus, the sum of the supplied power of each circuit element is zero, as it should be.

2.44 Find the power supplied by each source in the circuit in Fig. P2.44.

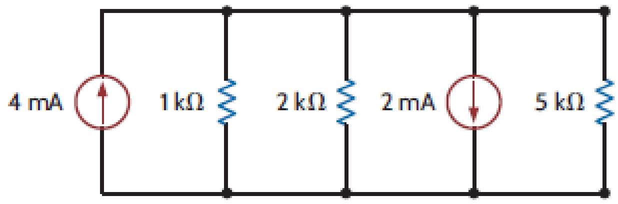
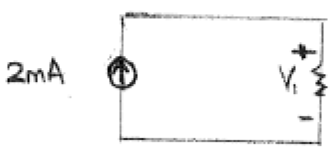


Figure P2.44

SOLUTION:

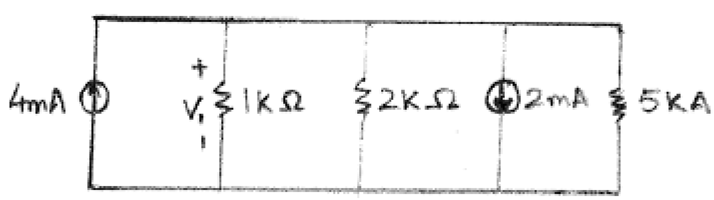


$$R_{eq} = (1k \| 2k) \| 5k$$

$$R_{eq} = 588.24\,\Omega$$

$$V_1 = 2m(588.24)$$

$$V_1 = 1.18\ V$$



$$P_{4mA} = 4m\,(1.18)$$

$$P_{4mA} = 4.72\ mW$$

$$P_{2mA} = (-2m)(1.18)$$

$$P_{2mA} = -2.36\ mW$$

2.45 Find the current I_A in the circuit in Fig. P2.45.

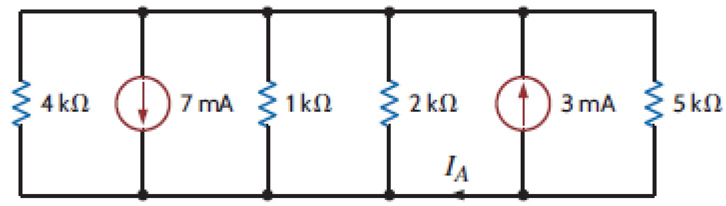
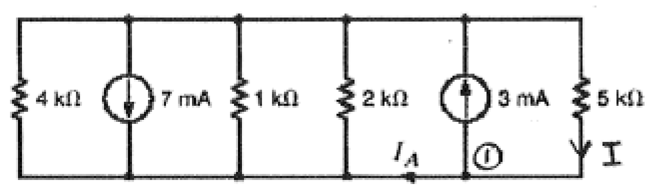
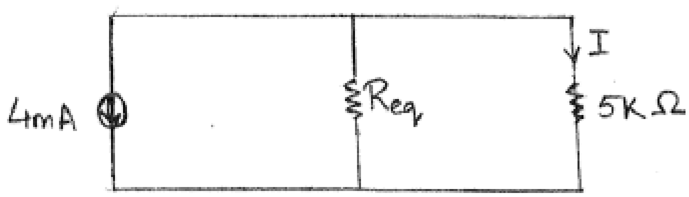


Figure P2.45

SOLUTION:





$$I = \left(\frac{R_{eq}}{R_{eq}+5K}\right)(-4m)$$

$$I = -0.41mA$$

KCL at 1 :

$$I = 3m + I_A$$

$$I_A = -0.41m - 3m$$

$$\boxed{I_A = -3.41mA}$$

2.46 Find I_o in the network in Fig. P2.46.

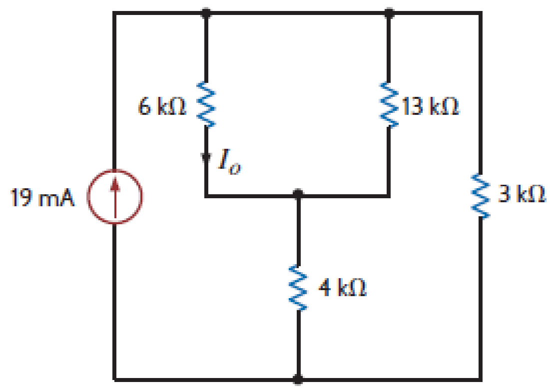
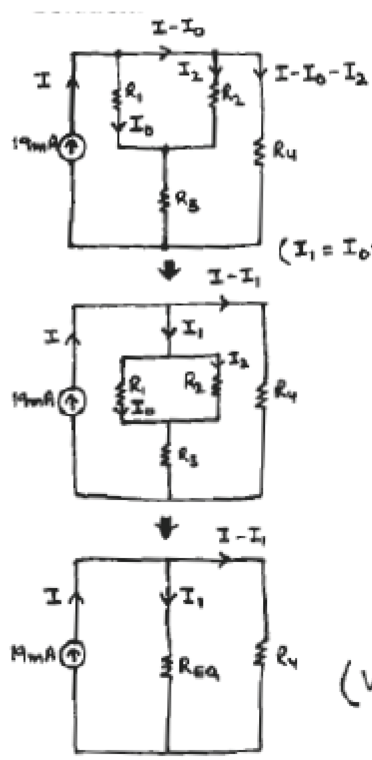


Figure P2.46

SOLUTION:



$R_1 = 6\,k\Omega, R_2 = 13\,k\Omega, R_3 = 4\,k\Omega, R_4 = 3\,k\Omega$

$$R_{EQ} = \frac{R_1 R_2}{R_1 + R_2} + R_3 = \frac{6(13)}{6+13} + 4$$

$$\Rightarrow R_{EQ} = 8.11\ k\Omega$$

$(I_1 = I_o + I_2)$

$$I_1 = 19 \times 10^{-3}\left[\frac{R_4}{R_{EQ} + R_4}\right]$$

$$= 19 \times 10^{-3}\left[\frac{3}{8.11 + 3}\right] = 5.13\,mA$$

$$I_o = I_1\left[\frac{R_2}{R_1 + R_2}\right]$$

$$= 5.13 \times 10^{-3} \times \frac{13}{19}$$

$$\Rightarrow \boxed{I_o = 3.51\ mA}$$

(Value rounded off to two significant digits.)

2.47 Find I_o in the network in Fig. P2.47.

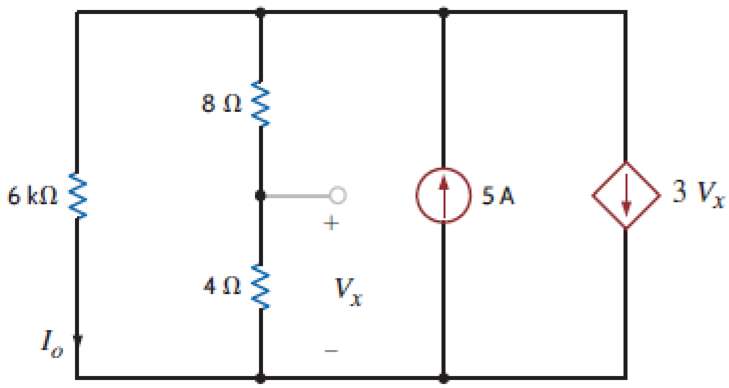


Figure P2.47

SOLUTION:

KCL: $5 = \frac{V_1}{6} + \frac{V_1}{8+4} + 3V_x$

$V_x = \left(\frac{4}{4+8}\right)(V_1)$

$V_x = \frac{V_1}{3}$

$5 = \frac{V_1}{6} + \frac{V_1}{12} + 3\left(\frac{V_1}{3}\right)$

$60 = 2V_1 + V_1 + 12V_1$

$15V_1 = 60$

$V_1 = 4\text{V}$

$V_1 = 6I_o$

$I_o = \frac{V_1}{6}$

$$I_o = \frac{4}{6}$$

$$I_o = \frac{2}{3}\,A$$

2.48 Determine I_L in the circuit in Fig. P2.48.

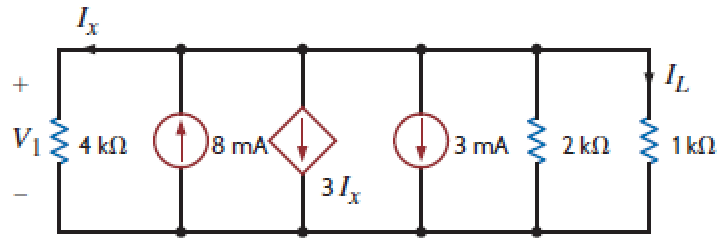


Figure P2.48

SOLUTION:

$$I_x = \frac{V_1}{4000}$$

$$\text{KCL}: \quad I_x - 8 \times 10^{-3} + 3I_x + 3 \times 10^{-3} + \frac{V_1}{2000} + \frac{V_1}{1000} = 0$$

$$\frac{V_1}{4000} - 8 \times 10^{-3} + \frac{3V_1}{4000} + 3 \times 10^{-3} + \frac{V_1}{2000} + \frac{V_1}{1000} = 0$$

$$\frac{V_1}{1000}\left[\frac{1}{4} + \frac{3}{4} + \frac{1}{2} + 1\right] = 5 \times 10^{-3}$$

$$\Rightarrow \quad V_1 = 2\text{V}$$

$$I_L = \frac{V_1}{1000} \quad \Rightarrow \quad I_L = 2\text{mA}$$

2.49 Find the power absorbed by the dependent source in the network in Fig. P2.49.

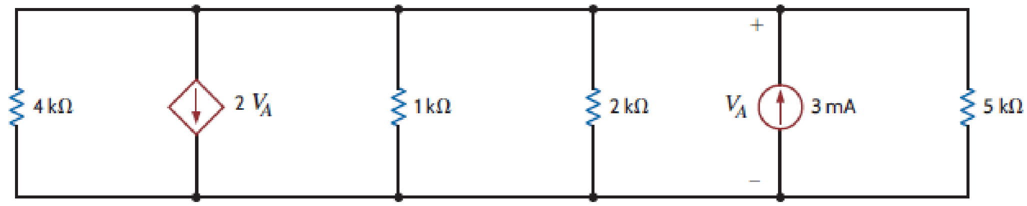
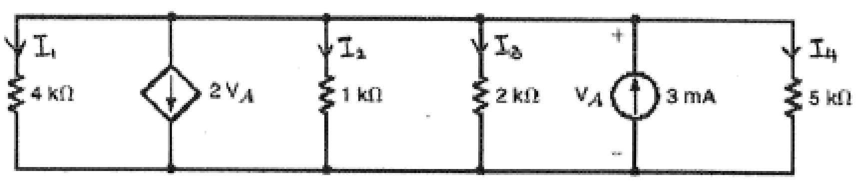


Figure P2.49

SOLUTION:



$$\text{KCL: } 3m = I_1 + 2V_A + I_2 + I_3 + I_4$$

$$I_1 = \frac{V_A}{4K},\ I_2 = \frac{V_A}{1K},\ I_3 = \frac{V_A}{2K},\ \text{and } I_4 = \frac{V_A}{5K}$$

$$3m = \frac{V_A}{4K} + 2V_A + \frac{V_A}{1K} + \frac{V_A}{2K} + \frac{V_A}{5K}$$

$$60 = 5V_A + 40K\,V_A + 20V_A + 10V_A + 4V_A$$

$$V_A = 1.5\,mV$$

$$P_{2VA} = V_A I = V_A(2V_A)$$

$$P_{2VA} = 1.5m(2)(1.5m)$$

$$P_{2VA} = 4.5\,\mu W$$

2.50 Find R_{AB} in the circuit in Fig. P2.50.

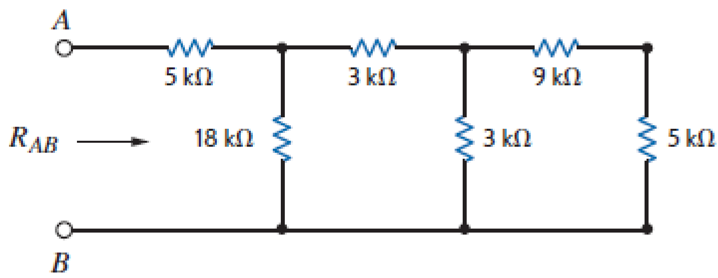
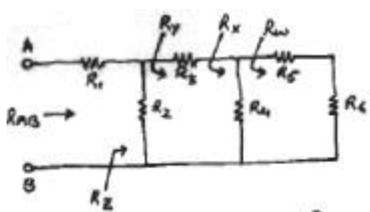


Figure P2.50

SOLUTION:



$R_1 = 5\,k\Omega$, $R_2 = 18\,k\Omega$, $R_3 = 3\,k\Omega$,
$R_4 = 3\,k\Omega$, $R_5 = 9\,k\Omega$, $R_6 = 5\,k\Omega$

$$R_w = R_5 + R_6 = 14\,k\Omega$$

$$R_x = R_4 \parallel R_w = \frac{3(14)}{3+14} = 2.47\,k\Omega$$

$$R_y = R_3 + R_x = 5.47\,k\Omega$$

$$R_z = R_2 \parallel R_y = \frac{18(5.47)}{18+5.47} = 4.20\,k\Omega$$

$$R_{AB} = R_1 + R_z = 9.20\,k\Omega$$

$$\Rightarrow \boxed{R_{AB} = 9.20\,k\Omega}$$

(Value rounded off to 2 significant digits)

2.51 Find the equivalent resistance between terminals *x*-*y* in the resistance network of given fig. P2.51.

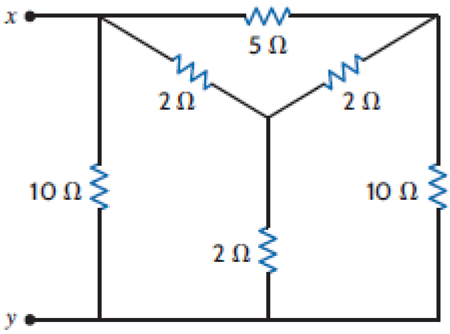


Figure P2.51

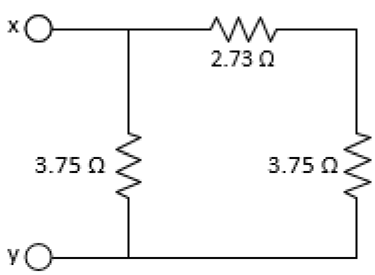
SOLUTION:

Here for the given network, first the inside Y resistances is first converted to equivalent Δ.

$R_1 = 2 + 2 + (2 \times 2)\ /\ 2 = 6\ \Omega$

Due to the symmetry of the inside star network of $R_1 = R_2 = R_3 = 6\ \Omega$

Thus, after simplifying the parallel circuits, the resistance reduces to :



Here, $R_{x\text{-}y} = 3.75\ \Omega\ ||\ (2.73\ \Omega + 3.75\ \Omega)$
$= 2.375\ \Omega$

2.52 Obtain the equivalent resistance for the circuit shown in Fig. P2.52, and use it to find current I.

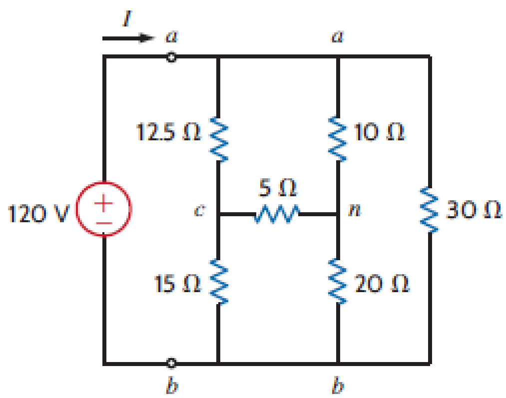


Figure P2.52

SOLUTION:

When we remove the voltage source, we end up with a purely resistive circuit. We use the wye-delta transformation to solve the following circuit.

In this circuit, there are two Y networks and three networks. Transforming just one of these will simplify the circuit. If we convert the Y network comprising the 5-Ω 10-Ω and 20-Ω resistors, we may select

$R_1 = 10\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 5\ \Omega$

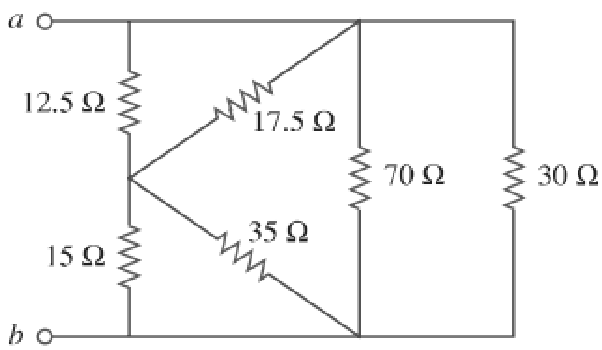
Thus, we have

$$R_a = \frac{R1R2+R2R3+R3R1}{R1} = \frac{10 \times 20 + 20 \times 5 + 5 \times 10}{10} = 35\ \Omega$$

$$R_b = \frac{R1R2+R2R3+R3R1}{R2} = 350 / 20 = 17.5\ \Omega$$

$$R_c = \frac{R1R2+R2R3+R3R1}{R3} = 350 / 5 = 20\ \Omega$$

Now, the circuit looks like,



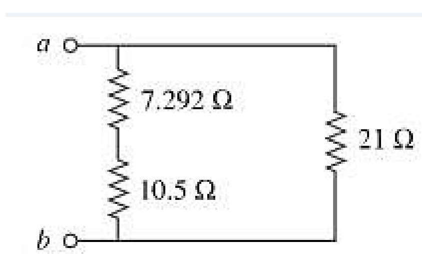
Clearly, (70 Ω|| 30 Ω) , (12.5 Ω || 17.5 Ω) and (15 Ω || 35 Ω)

$$70 \mid\mid 30 = \frac{70 \times 30}{70+30} = 21\ \Omega$$

$$12.5 \mid\mid 17.5 = \frac{12.5 \times 17.5}{12.5+17.5} = 7.292\ \Omega$$

$$15 \mid\mid 35 = \frac{15 \times 35}{15+35} = 10.5\ \Omega$$

Thus, circuit reduces to a series circuit as shown in fig. below:



⇨ R_{ab} = (7.292 Ω + 10.5 Ω) || 21 Ω = 9.632 Ω

Then, $I = \frac{Vs}{Rab}$ = 12.458 A

2.53 Find R_{AB} in the network in Fig. P2.53.

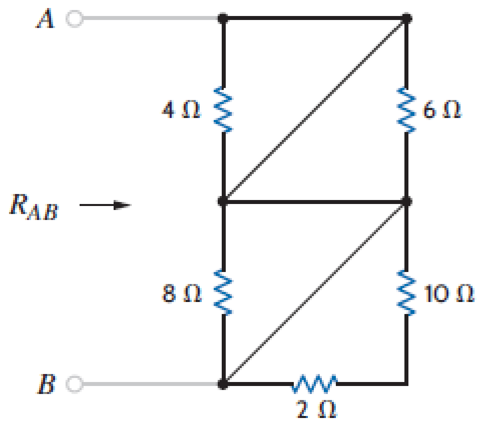


Figure P2.53

SOLUTION:

$R_{AB} = 0$

2.54 Find R_{AB} in the circuit in Fig. P2.54.

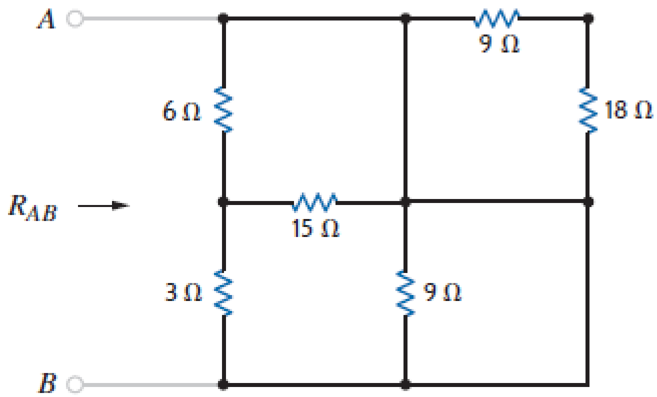


Figure P2.54

SOLUTION:

$R_{AB} = 0$

Since current always flow in Least resistivity path.
The path of current is shown by arrow mark in above fig.

2.55 Find R_{AB} in the network in Fig. P2.55.

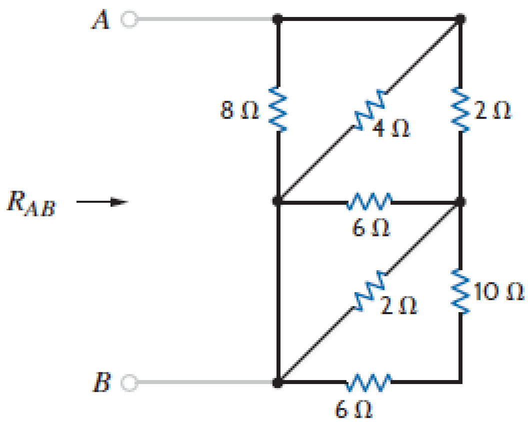
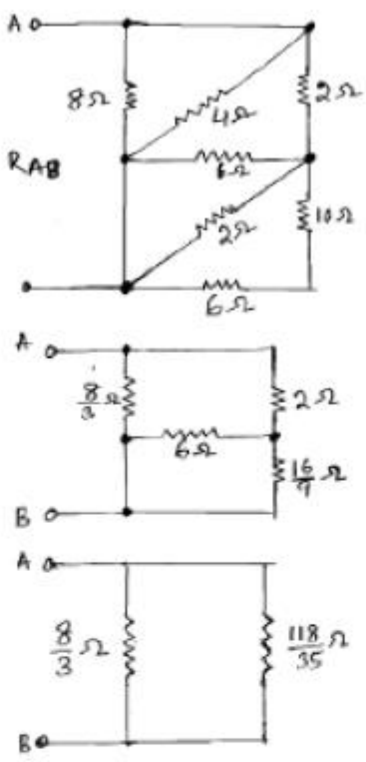


Figure P2.55

SOLUTION:



$R_{AB} = \frac{105}{634}$

2.56 Find R_{AB} in the circuit in Fig. P2.56.

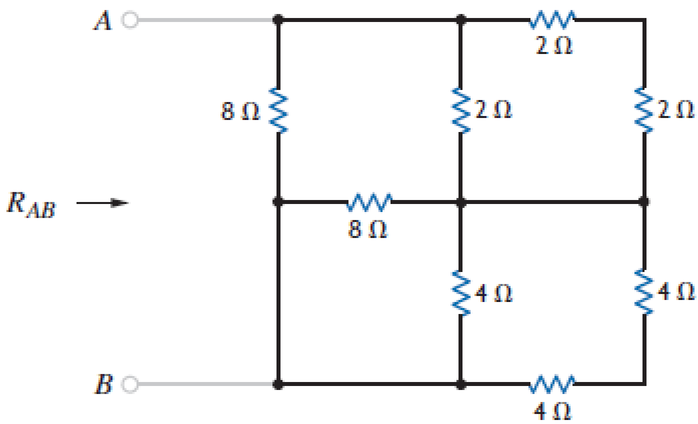
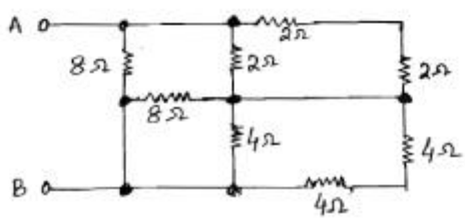
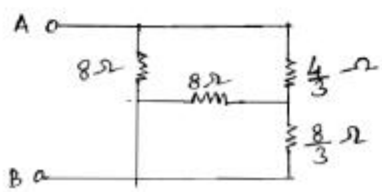
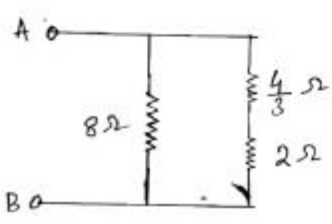


Figure P2.56

SOLUTION:







$$R_{AB} = \frac{40}{17}$$

2.57 Find R_{AB} in the network in Fig. P2.57.

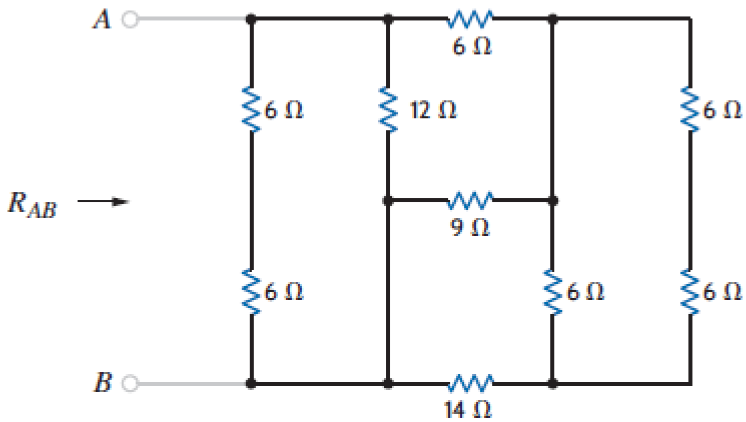
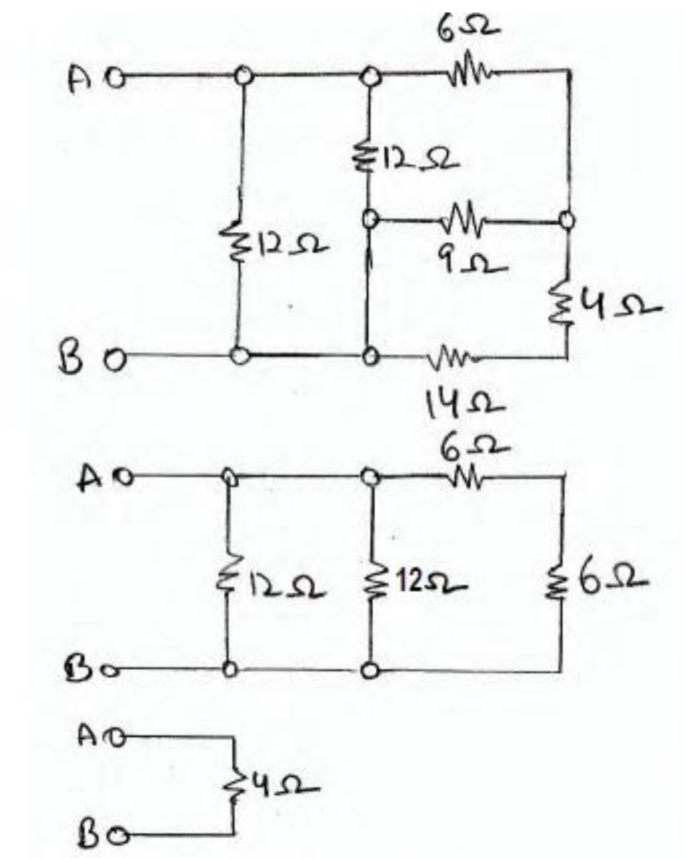


Figure P2.57

SOLUTION:



2.58 Find the equivalent resistance R_{eq} in the network in Fig. P2.58.

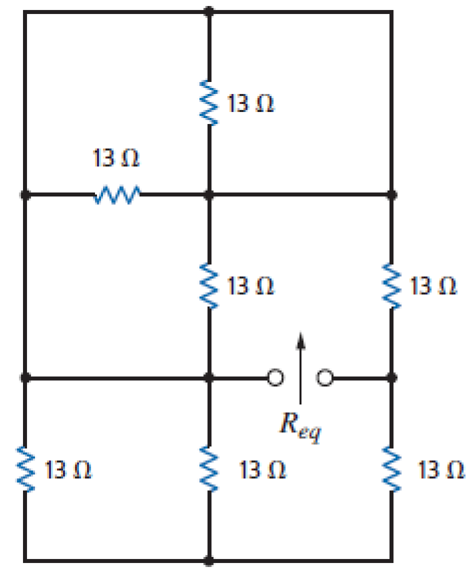
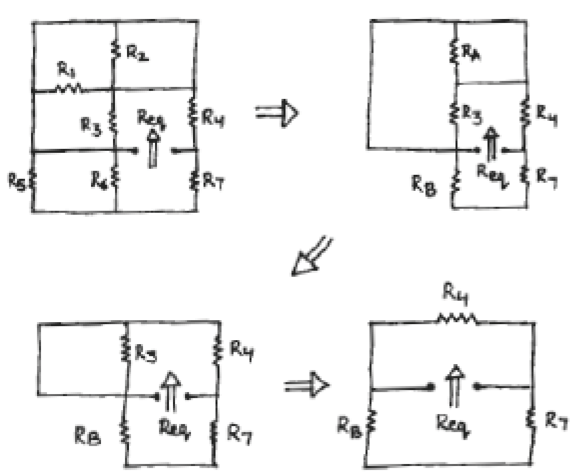


Figure P2.58

SOLUTION:



$R_A = R_1 \| R_2$

$R_B = R_5 \| R_6$

Note: R_A is shorted

$\therefore R_A$ is inactive

$R_B = 6.5$ Ohm

R_3 also shorted

$\therefore R_3$ is inactive

$R_{eq} = R_4 \| (R_B + R_7)$

$\boxed{R_{eq} = 7.8 \text{ Ohm}}$

2.59 Find the equivalent resistance looking in at terminals a-b in the circuit in Fig. P2.59.

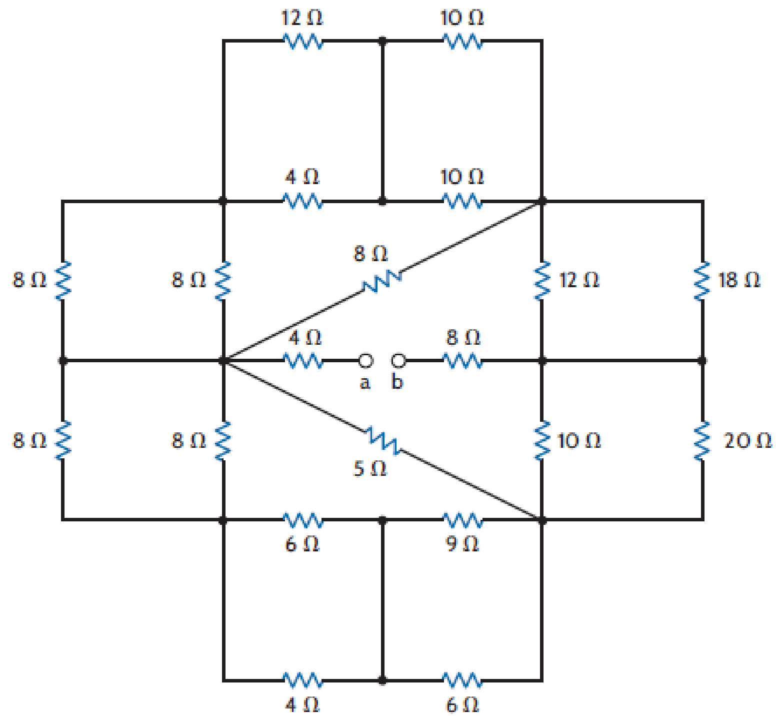
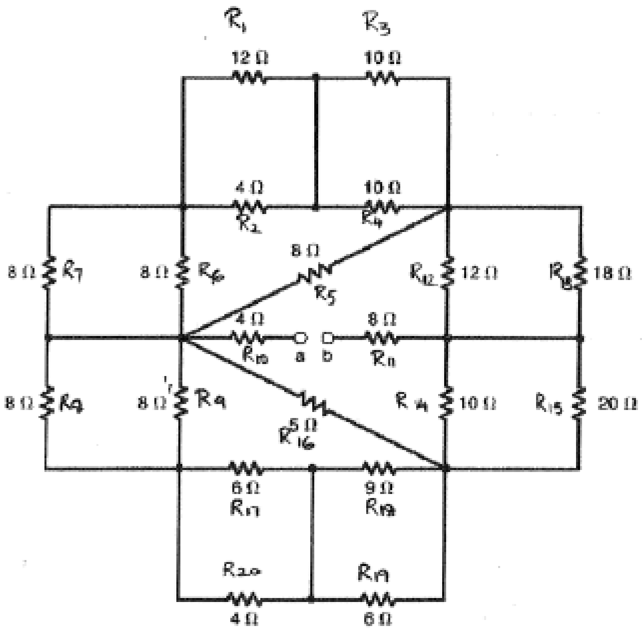


Figure P2.59

SOLUTION:


R1
12 Ω
R3
10 Ω
4 Ω
R2
10 Ω
R4
8 Ω
R5
8 Ω
R7
8 Ω
R6
R12
12 Ω
R13
18 Ω
4 Ω
R10
a
b
8 Ω
R11
8 Ω
R8
8 Ω
R9
R14
10 Ω
R15
20 Ω
5 Ω
R16
6 Ω
R17
9 Ω
R18
R20
R19
4 Ω
6 Ω

$R_a = R_1 || R_2 = 12||4 = 3\Omega$

$R_b = R_3 || R_4 = 10||10 = 5\Omega$

$R_c = R_7 || R_6 = 8||8 = 4\Omega$

$R_d = R_{12} || R_{13} = 12||18 = 7.2\Omega$

$R_e = R_8 || R_9 = 8||8 = 4\Omega$

$R_f = R_{14} || R_{15} = 10||20 = 6.67\Omega$

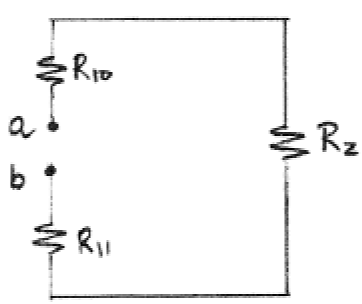
$R_g = R_{17} || R_{20} = 6||4 = 2.4\Omega$

$R_h = R_{18} || R_{19} = 9||6 = 3.6\Omega$

$R_z = (R_x + R_d) || (R_y + R_f)$

$R_z = (4.8 + 7.2) || (3.33 + 6.67)$

$R_z = 12||10 = 5.45\Omega$



$$R_{ab} = R_{10} + R_{11} + R_2 = 4 + 8 + 5.45$$

$$R_{ab} = 17.45\ \Omega$$

2.60 Given the resistor configuration shown in Fig. P2.60, find the equivalent resistance between the following sets of terminals: (1) a and b, (2) b and c, (3) a and c, (4) d and e, (5) a and e, (6) c and d, (7) a and d, (8) c and e, (9) b and d, and (10) b and e.

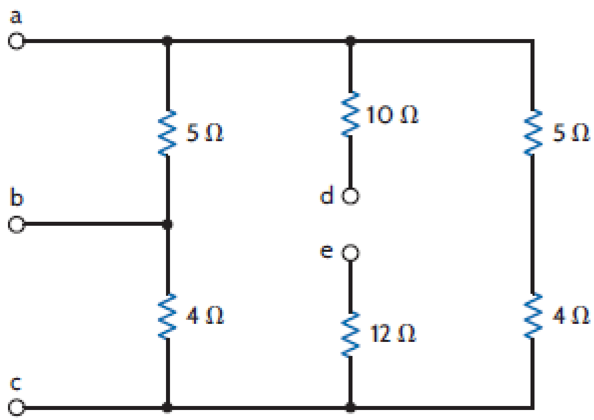
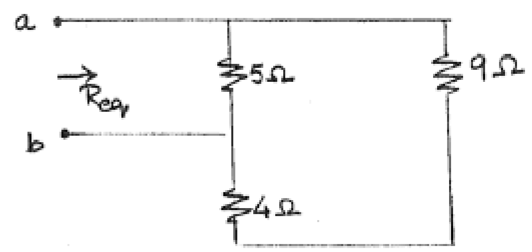


Figure P2.60

SOLUTION:

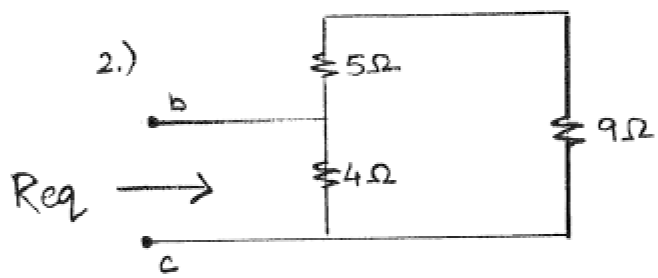
(See Next Page)

1.)



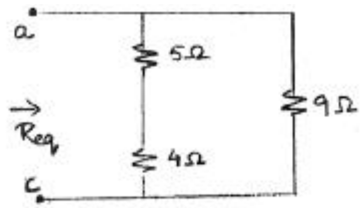
$$R_{eq} = (9+4)\,\|\,5 = 3.61\,\Omega$$

2.)



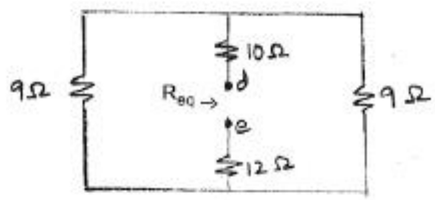
$$R_{eq} = 14\,\|\,14 = 3.11\,\Omega$$

3.)



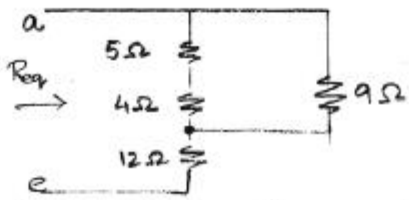
$R_{eq} = 9 \| 9 = 4.5\ \Omega$

4.)



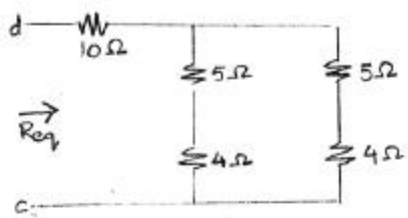
$R_{eq} = (9 \| 9) + 10 + 12 = 26.5\ \Omega$

5.)



$R_{eq} = [9 \| (5+4)] + 12 = (9 \| 9) + 12 = 16.5\ \Omega$

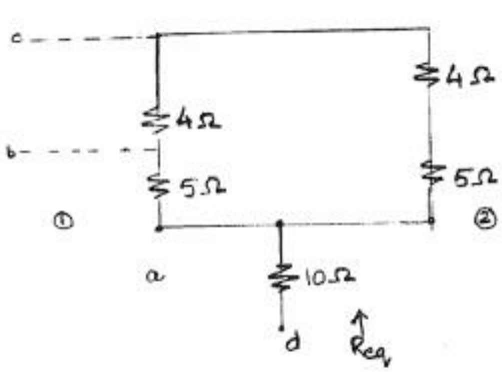
6.)

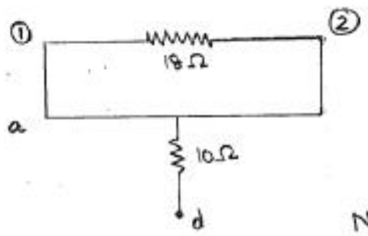


$R_{eq} = (9 \| 9) + 10$

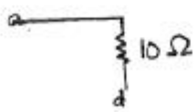
$R_{eq} = 14.5\ \Omega$

7)



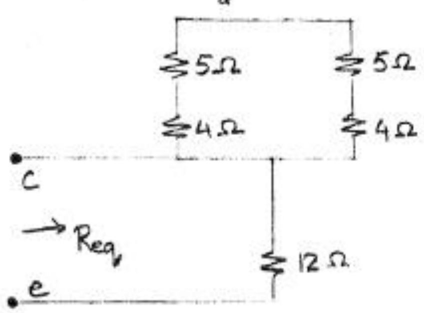


Node ① and ② are shorted.



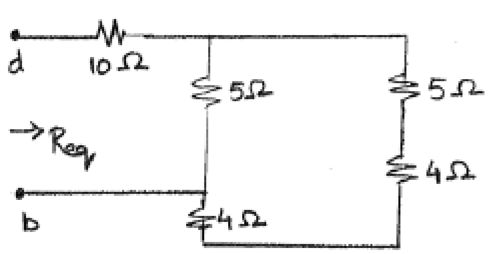
$= R_{eq} = 10\Omega$

8.)



$R_{eq} = 12\ \Omega$

9.)



$R_{eq} = (13 \| 5) + 10 = 13.61\ \Omega$

10.)

$$R_{eq} = (14 \| 4) + 12$$

$$R_{eq} = \frac{4(14)}{4+14} + 12$$

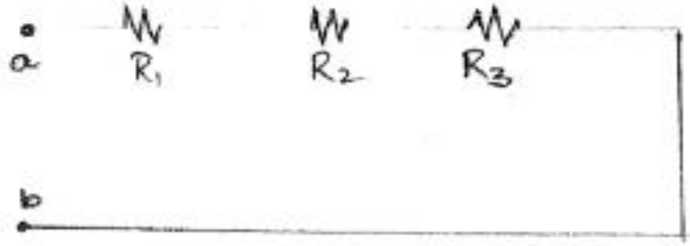
$$R_{eq} = 15.11\,\Omega$$

2.61 Seventeen possible equivalent resistance values may be obtained using three resistors. Determine the seventeen different values if you are given resistors with standard values: 47Ω, 33Ω, and 15Ω.

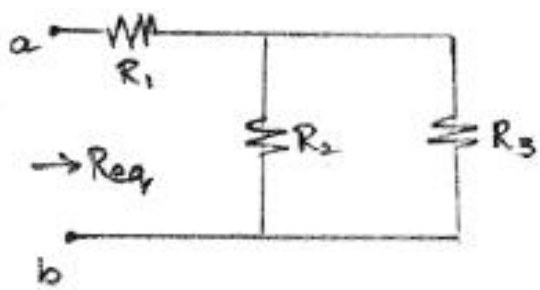
SOLUTION:

(See Next Page)

$R_1 = 47\,\Omega$, $R_2 = 33\,\Omega$, and $R_3 = 15\,\Omega$

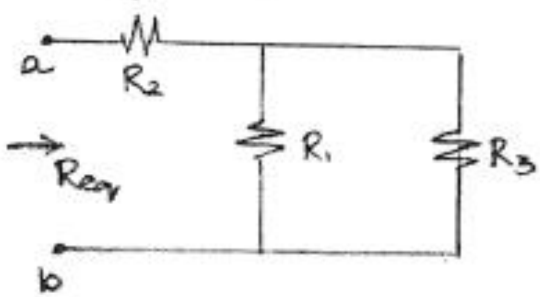


$$R_{eq} = R_1 + R_2 + R_3 = 95\,\Omega$$



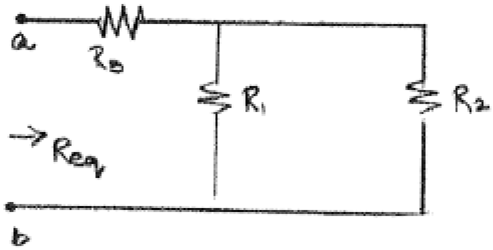
$$R_{eq} = R_1 + (R_2 \| R_3) = 47 + \frac{33(15)}{33+15}$$

$$R_{eq} = 57.31\,\Omega$$



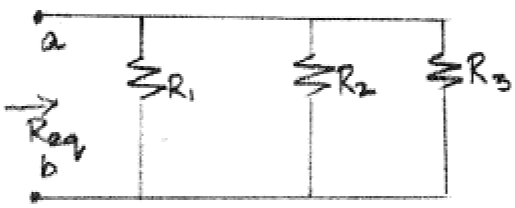
$$R_{eq} = R_2 + (R_1 \| R_3) = 33 + \frac{47(15)}{47+15}$$

$$R_{eq} = 44.37\,\Omega$$



$$R_{eq} = R_3 + (R_1 \| R_2) = 15 + \frac{47(33)}{47+33}$$

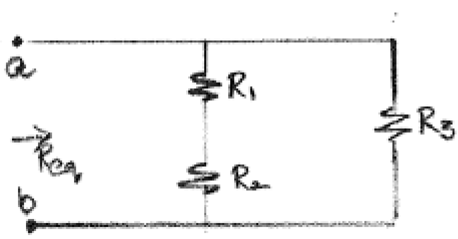
$$R_{eq} = 34.39\ \Omega$$



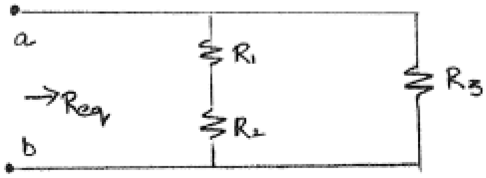
$$R_{eq} = R_1 \| R_2 \| R_3 = 47 \| 33 \| 15$$

$$R_{eq} = \frac{47(33)}{47+33} \| 15$$

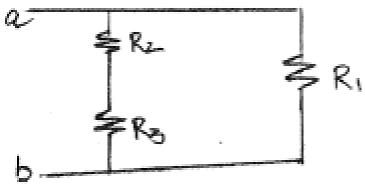
$$R_{eq} = 19.39 \| 15 = 8.46\ \Omega$$



$$R_{eq} = (R_1 + R_2) \| R_3 = 80 \| 15 = 12.63\ \Omega$$

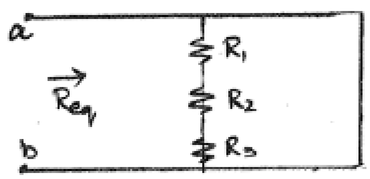


$$R_{eq} = (R_1 + R_3) \| R_2 = 62 \| 33 = 21.54\,\Omega$$



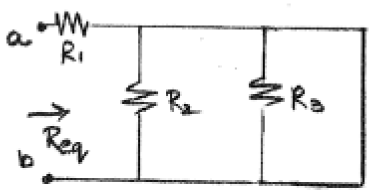
$$R_{eq} = (R_2 + R_3) \| R_1 = 48 \| 47$$

$$R_{eq} = 23.75\ \Omega$$



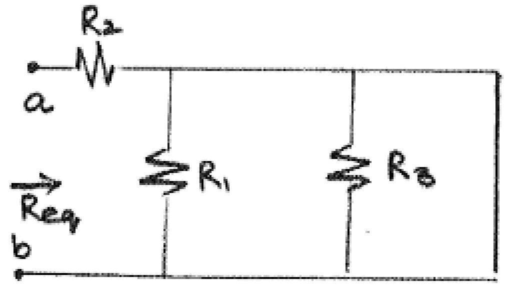
$$R_{eq} = (R_1 + R_2 + R_3) \| 0$$

$$R_{eq} = 0\,\Omega$$



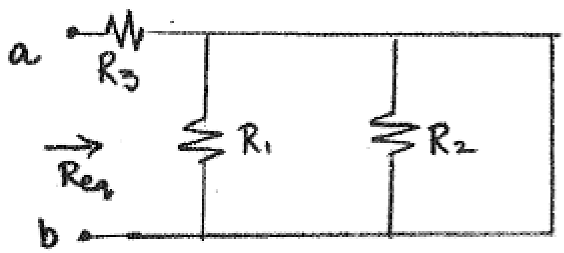
$$R_{eq} = R_1 + (R_2 \| R_3 \| 0)$$

$$R_{eq} = R_1 = 47\,\Omega$$



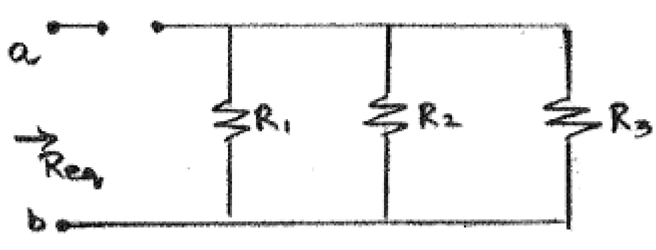
$$R_{eq} = R_2 + (R_1 \| R_3 \| 0)$$

$$R_{eq} = R_2 = 33\ \Omega$$

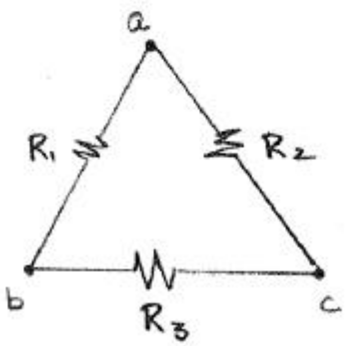


$$R_{eq} = R_3 + (R_1 \| R_2 \| 0)$$

$$R_{eq} = R_3 = 15\ \Omega$$



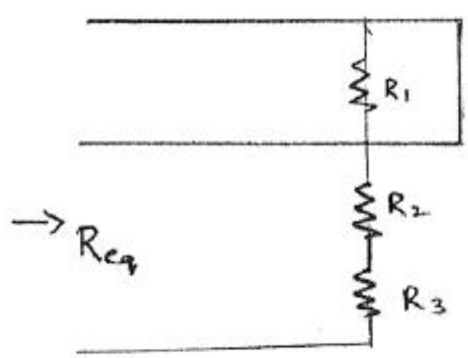
$$R_{eq} = \infty$$



$$R_{ab} = \frac{R_2(R_1+R_3)}{R_2+R_1+R_3} = \frac{33(47+15)}{33+47+15} = 21.53\,\Omega$$

$$R_{bc} = \frac{R_3(R_1+R_2)}{R_3+R_1+R_2} = \frac{15(47+33)}{15+47+33} = 12.63\,\Omega$$

$$R_{ca} = \frac{R_1(R_2+R_3)}{R_1+R_2+R_3} = \frac{47(33+15)}{47+33+15} = 23.75\,\Omega$$



$$(R_1 \| 0) + R_2 + R_3$$

$$= R_2 + R_3$$

2.62 Find I_1 and V_0 in the circuit in Fig. P2.62.

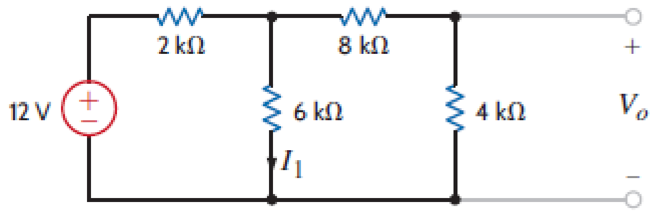
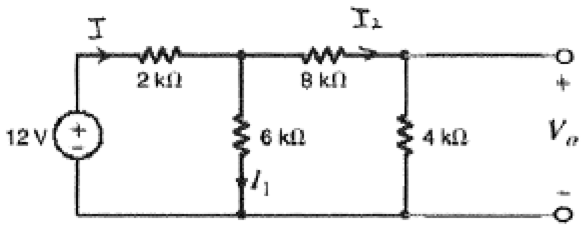


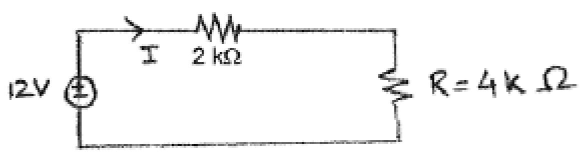
Figure P2.62

SOLUTION:



$R = 12K \| 6K$

$R = 4K\ \Omega$



$I = \frac{12}{2K+4K}$

$I = 2mA$

$I_1 = \left(\frac{8K+4K}{8K+4K+6K}\right)(2m)$

$I_1 = 1.33\ mA$

KCL:

$$I = I_1 + I_2$$

$$I_2 = 2m - 1.33m$$

$$I_2 = 0.667\,mA$$

$$V_o = I_2(4k)$$

$$V_o = 0.667(4k)$$

$$V_o = 2.67V$$

2.63 Find I_1 and V_0 in the circuit in Fig. P2.63.

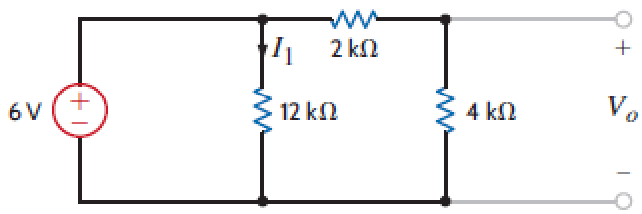
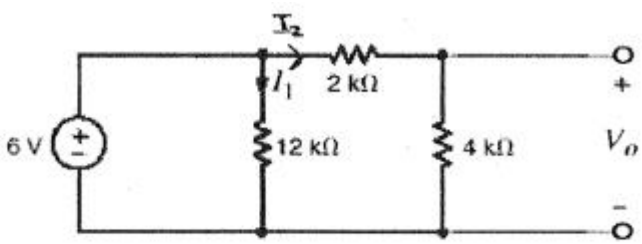


Figure P2.63

SOLUTION:



$$I_1 = \frac{6}{2K} = 0.5\,mA$$

$$I_2 = \frac{6}{2K+4K} = 1mA$$

$$V_o = I_2(4K) = 1m(4k)$$

$$V_o = 4\,V$$

2.64 Find power absorbed by the 5 Ω resistor in Fig. P2.64.

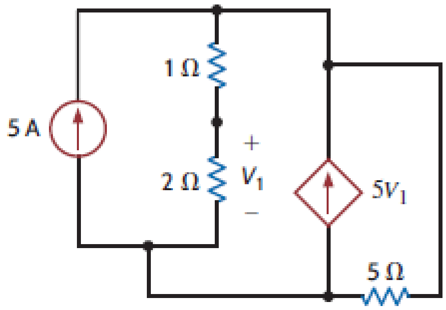


Figure P2.64

SOLUTION:

Lets define a voltage v_x across the 5-A source, with the "+" reference on top

Applying KCL at the top node then yields

$5 + 5v_1 - v_x / (1 + 2) – v_x / 5 = 0$ [1]

where $v_1 = 2[v_x /(1 + 2)] = 2 v_x / 3$

Thus, Eq. [1] becomes

$5 + 5(2 v_x / 3) – v_x / 3 – v_x / 5 = 0$

or $75 + 50 v_x – 5 v_x – 3 v_x = 0$, which, upon solving, yields v_x = -1.786 V

The power absorbed by the 5-Ω resistor is then simply $(v_x)^2/5$ = 638.0 mW.

2.65 For the battery charger modeled by the circuit in Fig P2.65, find the value of the adjustable R so that

(a) A charging current of 4 A flows

(b) A power of 25 W is delivered to battery (0.035 Ω and 10.5 V)

(c) A voltage of 11 V is present at the terminals of battery (0.035 Ω and 10.5 V)

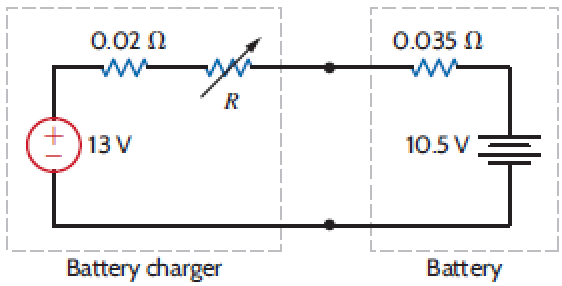


Figure P2.65

SOLUTION:

a. Define the charging current ias flowing clockwise in the circuit provided
By application of KVL,
-13 + 0.02i + Ri+ 0.035i + 10.5 = 0
We know that we need a current i= 4 A, so we may calculate the necessary resistance
R = [13 – 10.5 – 0.055(4)]/ 4 = 570 mΩ

b. The total power delivered to the battery consists of the power absorbed by the 0.035-Ω resistance ($0.035i^2$), and the power absorbed by the 10.5-V ideal battery (10.5i). Thus, we need to solve the quadratic equation
$0.035i^2 + 10.5i = 25$
which has the solutions i= -302.4 A and i= 2.362 A.
In order to determine which of these two values should be used, we must recall that the idea is to charge the battery, implying that it is absorbing power, or that ias defined is positive. Thus, we choose i= 2.362 A, and, making use of the expression developed in part (a), we find that
R = [13 – 10.5 – 0.055(2.362)]/ 2.362 = 1.003 Ω

c. To obtain a voltage of 11 V across the battery, we apply KVL
0.035i + 10.5 = 11 so that i= 14.29 A
From part (a), this means we need
R = [13 – 10.5 – 0.055(14.29)]/ 14.29 = 119.9 mΩ

2.66 Calculate the power and voltage of the dependent source in Fig. P2.66

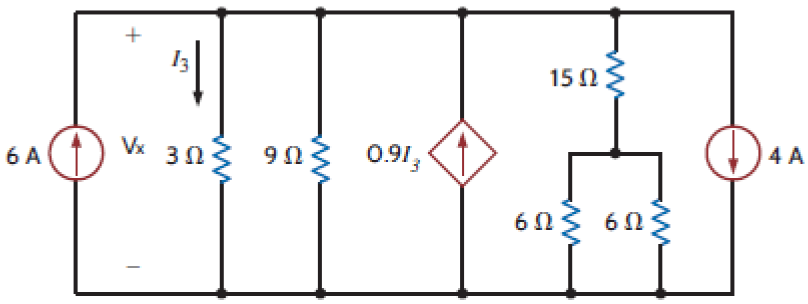


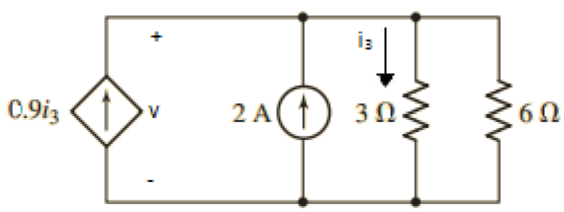
Figure P2.66

SOLUTION:

Despite not being drawn adjacent to one another, the two indepen-dent current sources are in act in parallel, so we replace them witha 2 A source.

The two 6Ω resistors are in parallel and can be replaced with asingle 3Ω resistor in series with the 15Ωresistor. Thus, the two 6Ω resistors and the 15Ωresistor are replaced by an 18 Ω resistor.

No matter how tempting, we should not combine the remaining threeresistors; the controlling variable i_3 depends on the 3 Ω resistor and sothat resistor must remain untouched. The only further simplification, then, is 9 Ω|| 18 Ω = 6 Ω, as shown in the figure below,



Applying KCL at the top node of above figure, we have

$$-0.9i_3 - 2 + i_3 + v/6 = 0$$

Employing Ohm's law,

$$v = 3i_3$$

Which, allows us to compute, $i_3 = 3.333$ A

Thus, the voltage across the dependent source (which is same as the voltage across the 3 Ω resistor) is,

$V=3i_3=10$ V

The dependent source therefore furnishes $v\times0.9i_3=10(0.9)(10/3)=30$ W to the remainder of the circuit.

2.67 Determine I_0 in the circuit in Fig. P2.67.

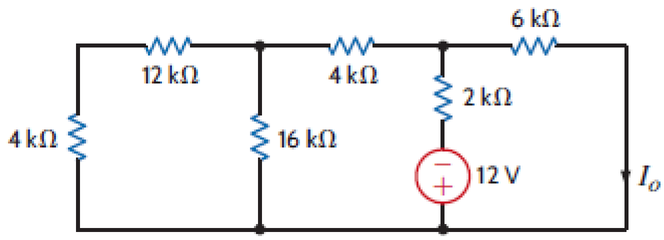
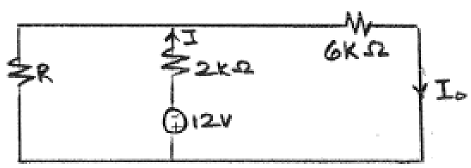


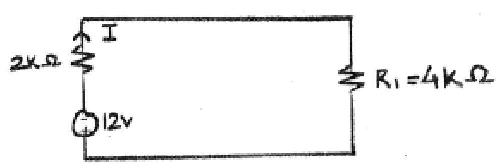
Figure P2.67

SOLUTION:



$$R = \left[(4K + 12K) \parallel 16K\right] + 4K$$

$$R = 8K + 4K = 12K\ \Omega$$



$$R_1 = 12K \parallel 6K$$

$$R_1 = 4K\Omega$$

$$I = \frac{-12}{2K + 4K} = -2mA$$

Current divison:

$$I_o = \left(\frac{12k}{12k + 6k}\right)(-2m)$$

$$I_o = -1.33\,mA$$

2.68 Determine V_0 in the network in Fig. P2.68.

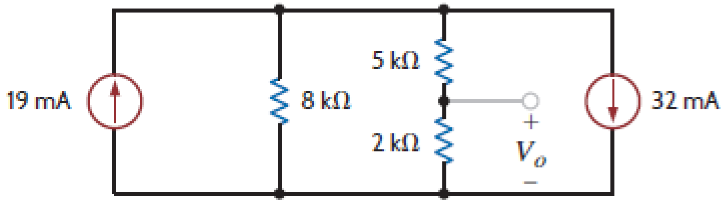
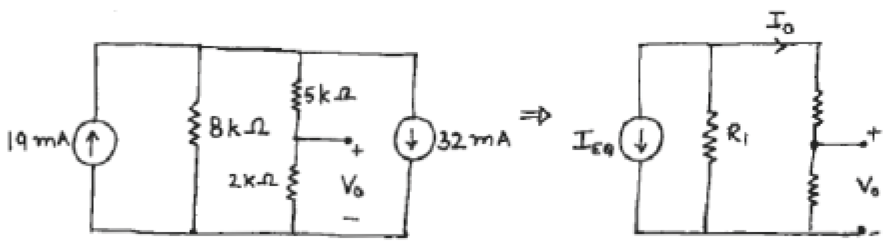


Figure P2.68

SOLUTION:



$R_1 = 8\,k\Omega$, $R_2 = 5\,k\Omega$, $R_3 = 2\,k\Omega$

$$I_{EQ} = (32 - 19) = 13\ mA$$

$$-I_o = I_{EQ}\left[\frac{R_1}{R_1 + (R_2 + R_3)}\right] \Rightarrow I_o = -6.93\ mA$$

$$V_o = I_o R_3$$
$$= -13.86\ V$$

$$\boxed{V_o = -13.9\ V}$$

2.69 Calculate V_{AB} in Fig. P2.69.

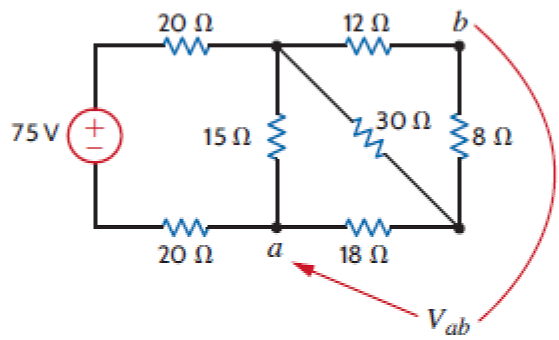
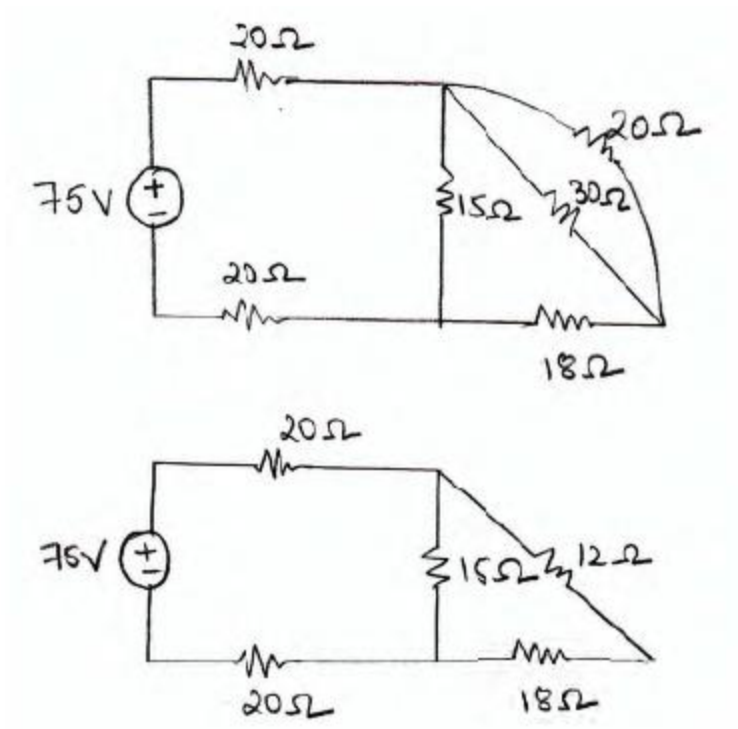
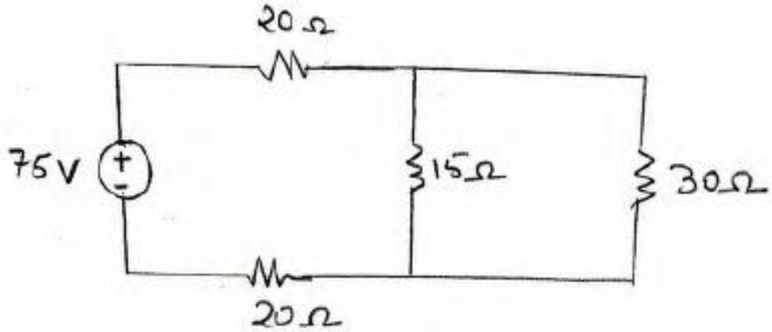
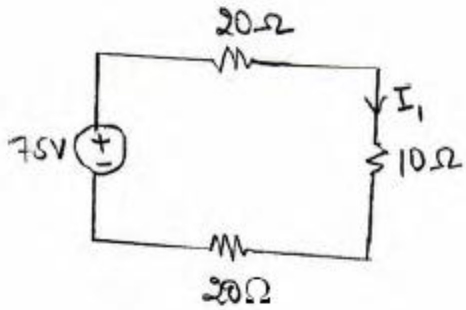


Figure P2.69

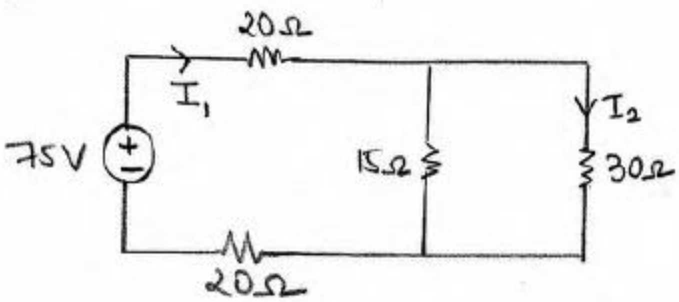
SOLUTION:





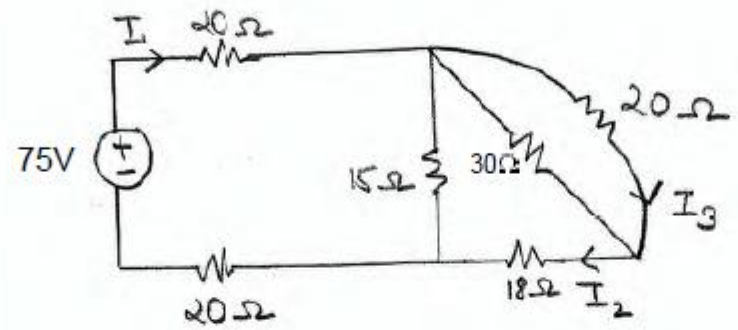


$$I_1 = \frac{75}{20+10+20} = 1.5A$$

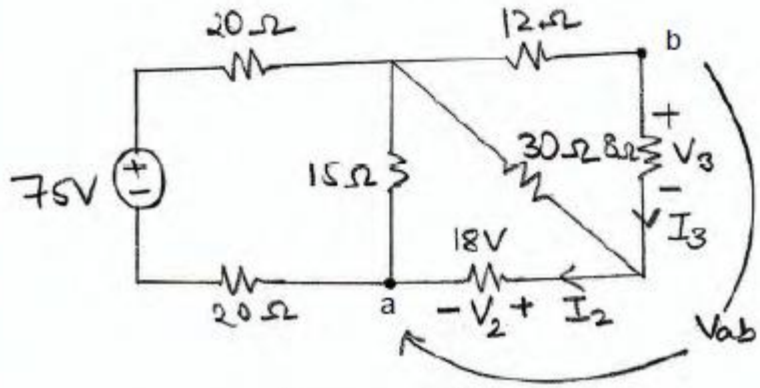


$$I_2 = 1.5\left(\frac{15}{15+30}\right)$$

$$= 0.5A$$



$$I_3 = 0.5\left(\frac{30}{30+20}\right) = 0.3\text{A}$$



$$V_3 = 8I_3 = 8(0.3) = 2.4\text{V}$$

$$V_2 = 18\,I_2 = 18(0.5) = 9\text{V}$$

$$V_{ab} = -V_2 - V_3 = -9 - 2.4 = -11.4\text{V}$$

2.70 The power being by the element X in element if it is

(a) 100 Ω resistor

(b) 40 V independent voltage source, + reference on top

(c) Dependent voltage source labeled $0.25I_x$, +ve reference on top

(d) 2 A independent current source, arrow directed up

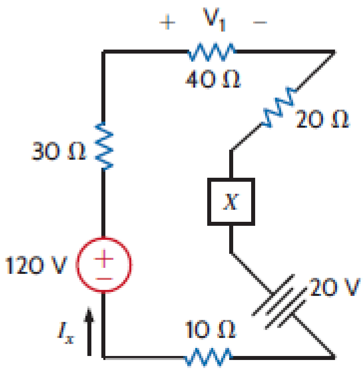


Figure P2.70

SOLUTION:

Applying KVL around this series circuit,

$-120 + 30i_x + 40i_x + 20i_x + v_x + 20 + 10i_x = 0$

where v_x is defined across the unknown element X, with the "+" reference on top.

Simplifying, we find that $100i_x + v_x = 100$

a. If X is a 100-Ω resistor

   $v_x = 100i_x$ so we find that $100\,i_x + 100\,i_x = 100$

   $i_x = 500$ mA and $p_x = v_x i_x = 25$ W

b. If X is a 40-V independent voltage source such that $v_x = 40$ V, we find that

   $i_x = (100 – 40) / 100 = 600$ mA and $p_x = v_x i_x = 24$ W

c. If X is a dependent voltage source such that $v_x = 25ix$

   $i_x = 100/125 = 800$ mA and $p_x = v_x i_x = 16$ W

d. If X is a 2A independent current source, arrow up,

   $100(-2) + v_x = 100$

   so that $v_x = 100 + 200 = 300$ V and $p_x = v_x i_x = -600$ W

2.71 Calculate V_{ab} and V_1 in Fig. P2.71.

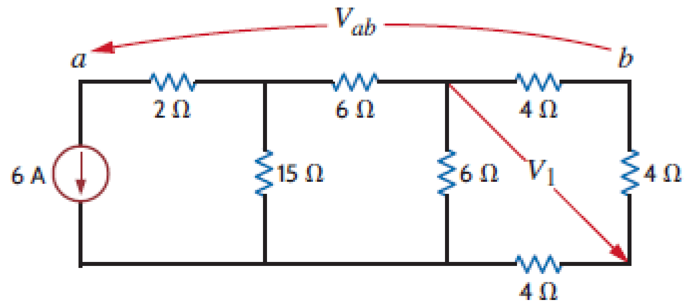
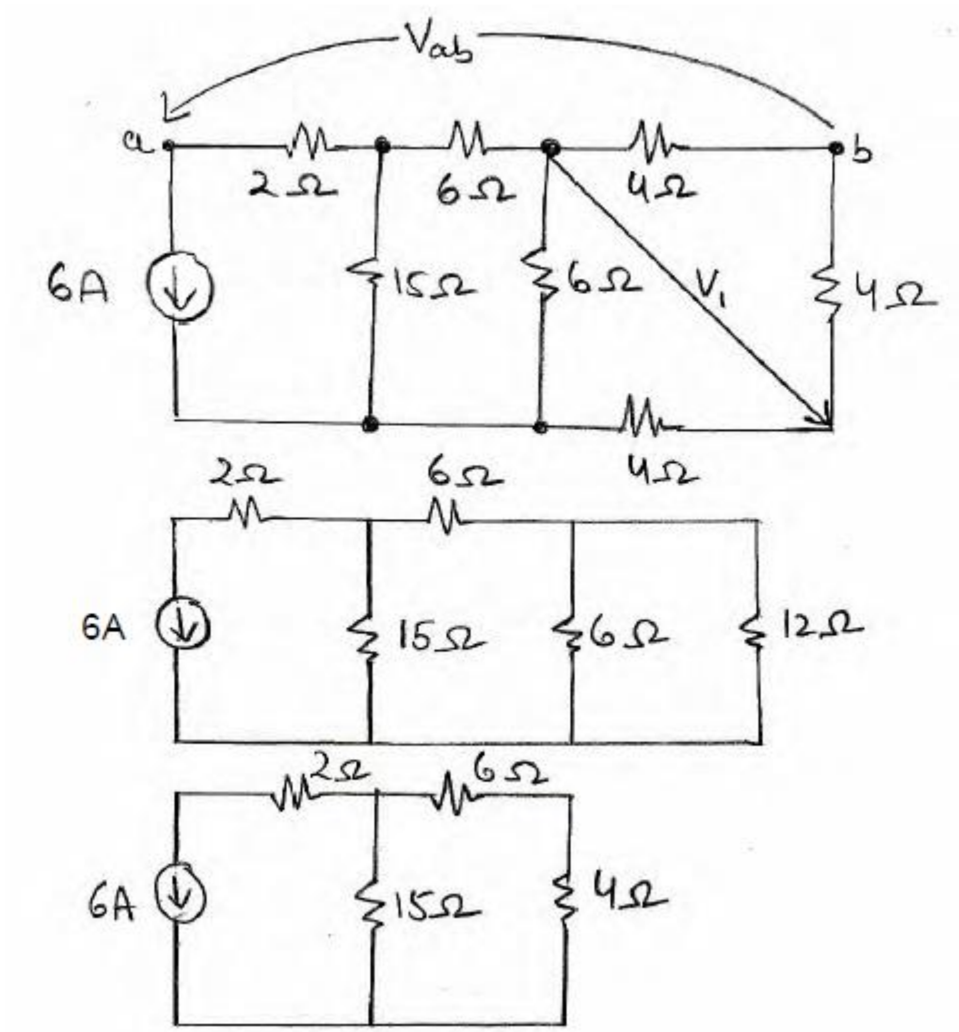
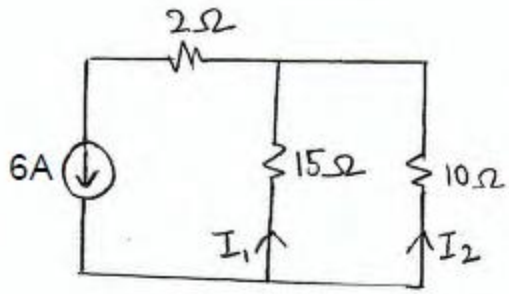


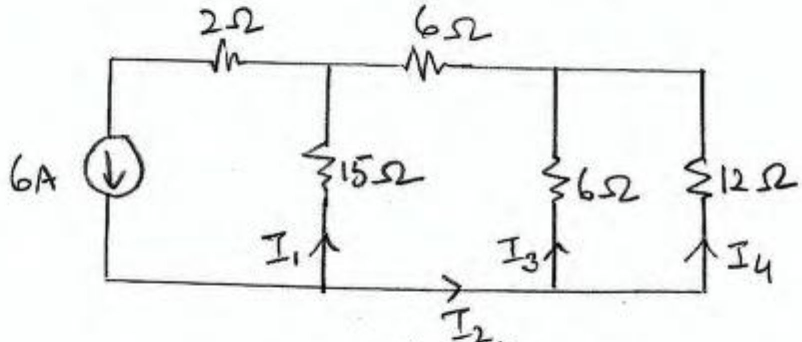
Figure P2.71

SOLUTION:

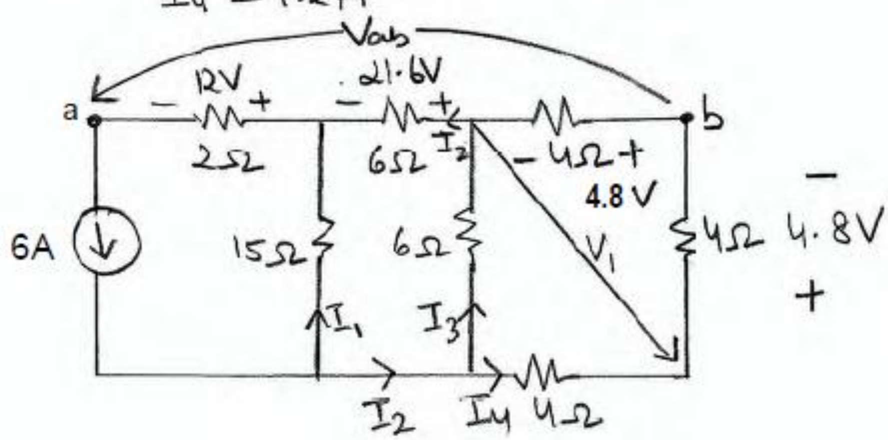




$$I_1 = 6\left(\frac{10}{10+15}\right)$$
$$= 2.4\text{A}$$
$$I_2 = 3.6\text{A}$$



$$I_3 = 3.6\left(\frac{12}{12+6}\right) = 2.4\text{A}$$
$$I_4 = 1.2\text{A}$$



$$V_1 = 4.8 + 4.8 = \underline{9.6\text{V}}$$

$$V_{ab} = -12 - 21.6 - 4.8 = \underline{-38.4\text{V}}$$

2.72 A certain circuit element contains six elements and four nodes numbered 1, 2, 3 and 4. Each circuit element is connected between a different pair of nodes. The voltage V_{12} (+ve reference at the first named node) is 12 V and $V_{34} = -8$ V. Find V_{13}, V_{23} and V_{24} if V_{14} equals

(a) 0 V

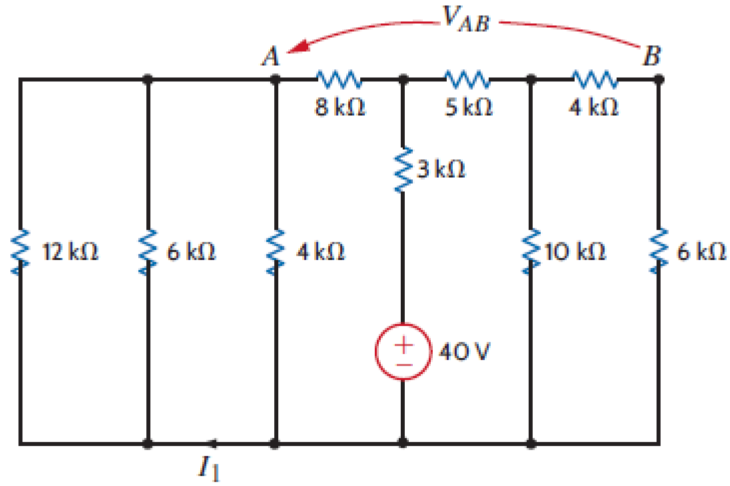
(b) 6 V

(c) −6 V

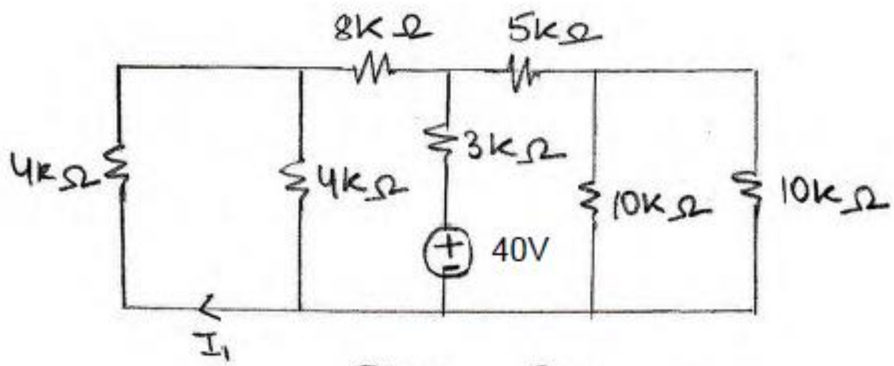
SOLUTION:

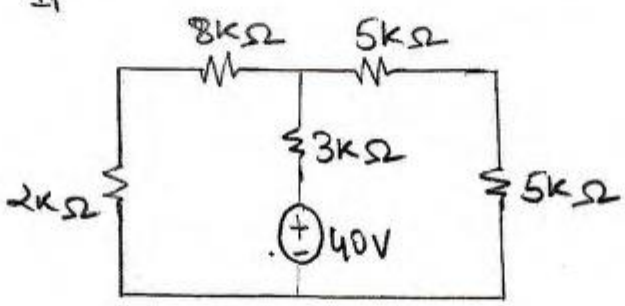
a. $v_{14} = 0$. $v_{13} = v_{43} = 8$ V
   $v_{23} = -v_{12} - v_{34} = -12 + 8 = -4$ V
   $v_{24} = v_{23} + v_{34} = -4 - 8 = -12$ V
b. $v_{14} = 6$ V. $v_{13} = v_{14} + v_{43} = 6 + 8 = 14$ V
   $v_{23} = v_{13} - v_{12} = 14 - 12 = 2$ V
   $v_{24} = v_{23} + v_{34} = 2 - 8 = -6$ V
c. $v_{14} = -6$ V. $v_{13} = v_{14} + v_{43} = -6 + 8 = 2$ V
   $v_{23} = v_{13} - v_{12} = 2 - 12 = -10$ V
   $v_{24} = v_{23} + v_{34} = -10 - 8 = -18$ V

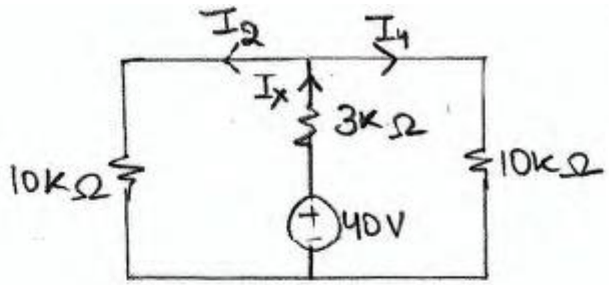
2.73 Calculate V_{AB} and I_1 in Fig. P2.73.



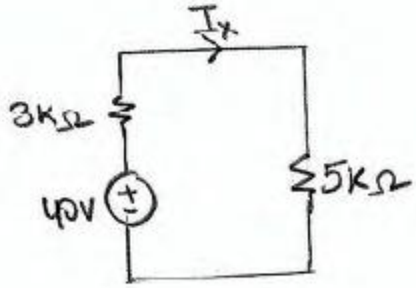
SOLUTION:





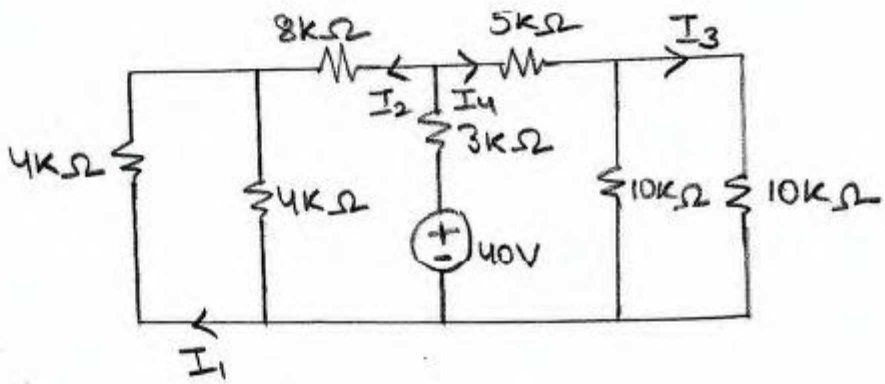


$$I_4 = I_2 = 2.5\,mA$$



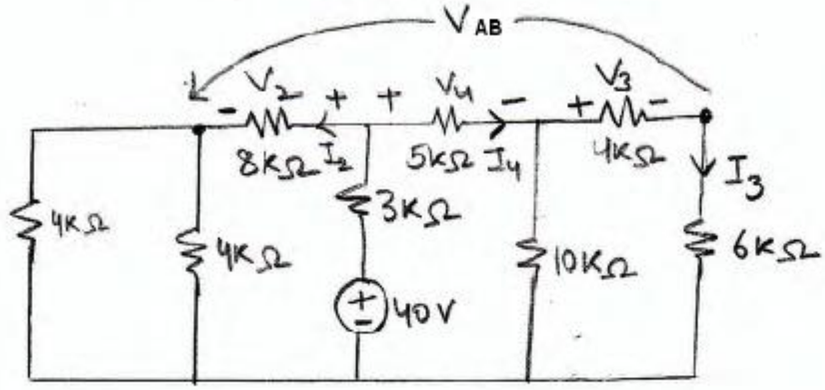
$$I_x = \frac{40}{3k + 5k}$$

$$= 5\,mA$$



$$I_1 = -I_2\left(\frac{4k}{4k+4k}\right) = \underline{-1.25\,mA}$$

$$I_3 = I_4\left(\frac{10k}{10k+10k}\right) = 1.25\text{ mA}$$



$$V_2 = 8k\ I_2 = (8k)(2.5m) = 20V$$

$$V_4 = 5k\ I_4 = (5k)(2.5m) = 12.5V$$

$$V_3 = 4k\ I_3 = (4k)(1.25m) = 5V$$

$$V_{AB} = -V_2 + V_4 + V_3$$

$$= -20 + 12.5 + 5 = \underline{-2.5V}$$

2.74 Calculate V_{AB} and I_1 in Fig. P2.74.

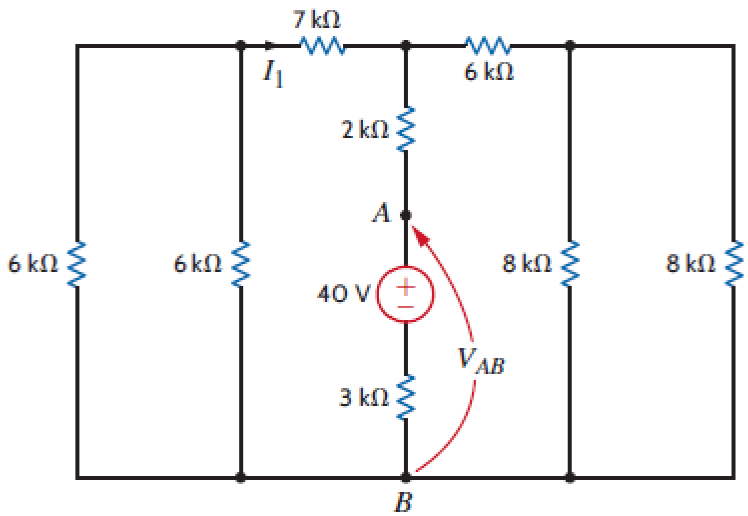
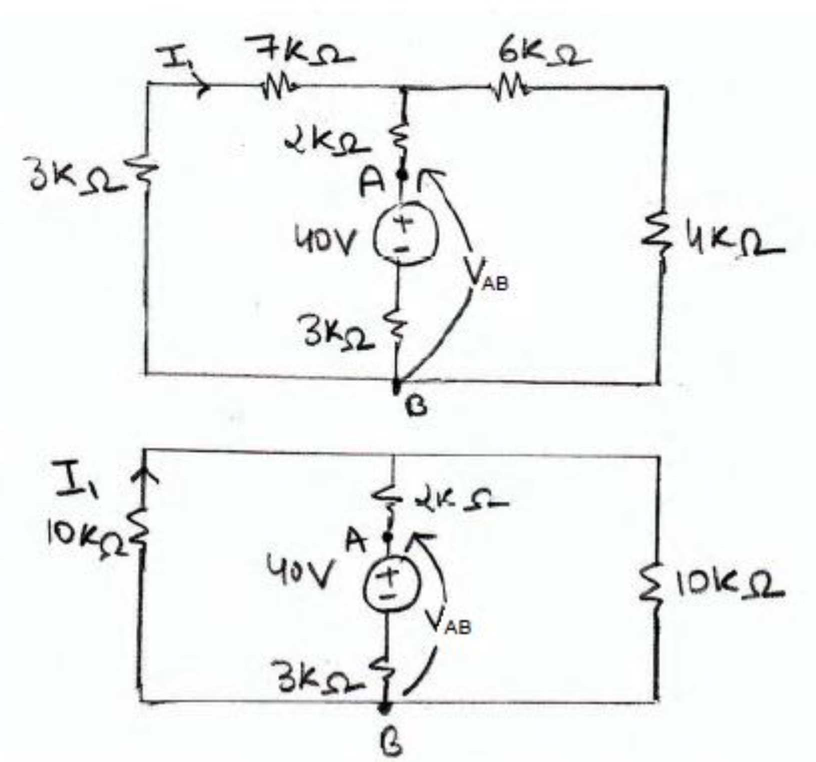
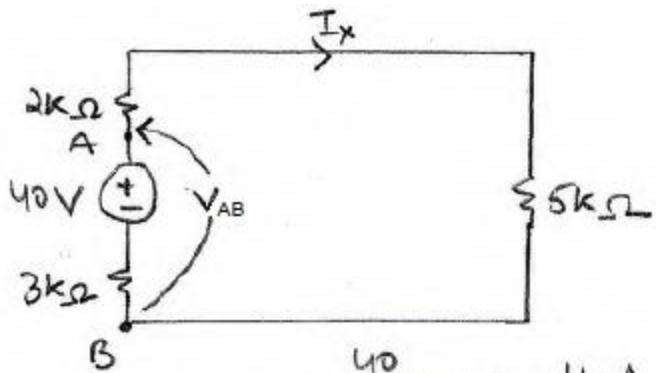


Figure P2.74

SOLUTION:

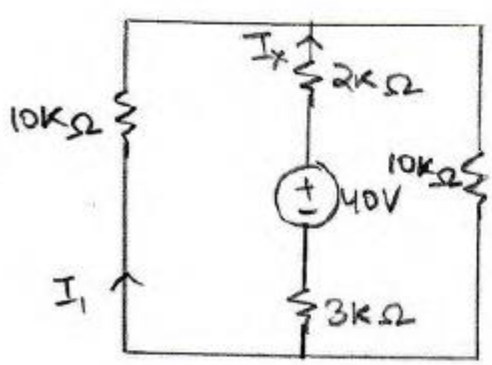




$$I_x = \frac{40}{2k + 3k + 5k} = 4mA$$

$$V_{AB} = 2kI_x + 5kI_x = 7kI_x$$

$$V_{AB} = (7k)(4m) = \underline{28V}$$



$$I_1 = -I_x\left(\frac{10k}{10k + 10k}\right)$$

$$I_1 = \frac{-1}{2} I_x$$

$$I_1 = -\frac{1}{2}(4mA)$$

$$I_1 = -2mA$$

2.75 For the circuit in Fig. P2.75, find I_x, I_y and the power dissipated by 3 Ω resistor.

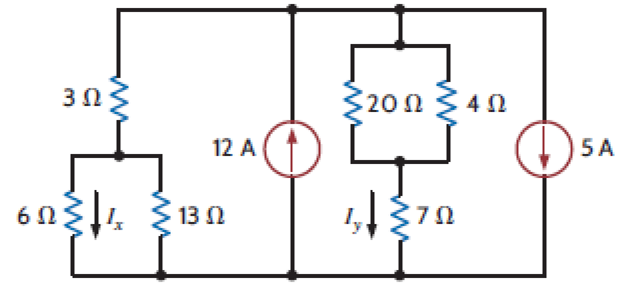


Figure P2.75

SOLUTION:

We may combine the 12-A and 5-A current sources into a single 7-A current source with its arrow oriented upwards. The left three resistors may be replaced by a 3 + 6 || 13 = 7.105 Ω resistor, and the right three resistors may be replaced by a 7 + 20 || 4 = 10.33 Ω resistor.

By current division, i_y = 7 (7.105)/(7.105 + 10.33) = 2.853 A

We must now return to the original circuit. The current into the 6 Ω, 13 Ω parallel combination is 7 – i_y = 4.147 A. By current division

i_x = 4.147 . 13/ (13 + 6) = 2.837 A

and $p_x = (4.147)^2 \cdot 3 = 51.59$ W

2.76 If $V_o = 4\text{V}$ in the network in Fig. P2.76, find V_S.

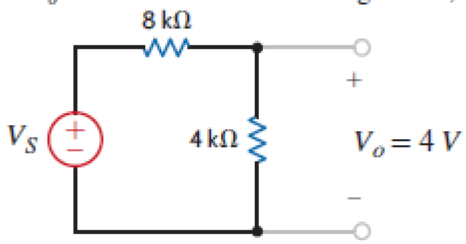


Figure P2.76

SOLUTION:

$$V_o = \left(\frac{4K}{4K+8K}\right) V_S$$

$$V_S = \frac{4}{\left(\frac{4K}{4K+8K}\right)} = 12\text{V}$$

2.77 In the circuit shown in Fig. P2.77

(a) If $I_x = 5$ A, find V_1 and I_y.

(b) If $V_1 = 3$ V, find I_x and I_y.

(c) What value of I_s will lead to $V_1 \neq V_2$?

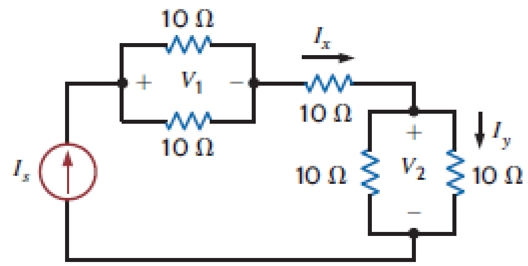


Figure P2.77

SOLUTION:

a. $i_x = v_1/10 + v_1/10 = 5$

$2v_1 = 50$

so $v_1 = 25$ V.

By Ohm's law, we see that $i_y = v_2/10$

also, using Ohm's law in combination with KCL, we may write

$i_x = v_2/10 + v_2/10 = i_y + i_y = 5$ A

Thus $i_y = 2.5$ A

b. From part (a), $i_x = 2\, v_1/\, 10$. Substituting the new value for v_1, we find that

$i_x = 6/10 = 600$ mA

Since we have found that $i_y = 0.5\, i_x$, $i_y = 300$ mA.

c. For any value of i_s this is not possible.

2.78 If $I_o = 2$ mA in the circuit in Fig. P2.78, find V_s.

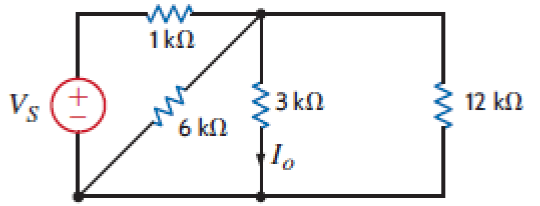
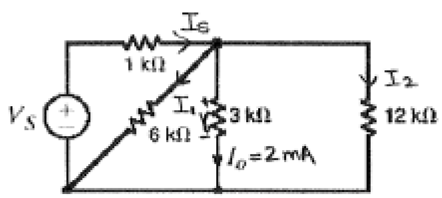


Figure P2.78

SOLUTION:



$V_o = I_o(3K) = 2m(3K) = 6V$

$I_1 = \frac{6}{6K} = 1mA$

$I_2 = \frac{6}{12K} = 0.5mA$

KCL:

$I_s = I_1 + I_o + I_2 = 1m + 2m + 0.5m$

$I_s = 3.5mA$

KVL:

$V_s = 1K I_s + V_o$

$V_s = 1K(3.5) + 6$

$V_s = 9.5\ V$

2.79 Find the value of V_s in the network in Fig. P2.79 such that the power supplied by the current source is 0.

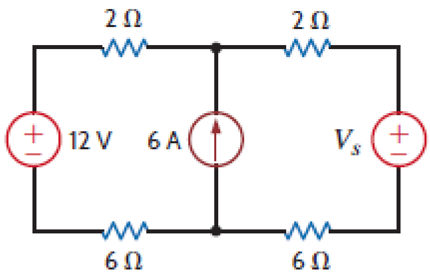
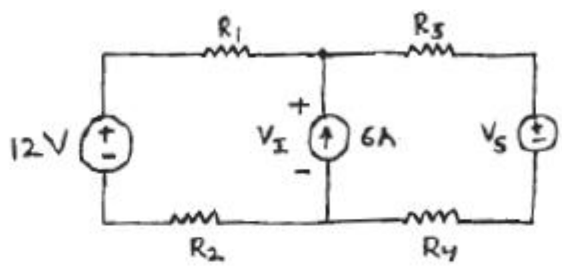


Figure P2.79

SOLUTION:



$R_1 = 2\,\Omega$, $R_2 = 6\,\Omega$, $R_3 = 2\,\Omega$, $R_4 = 6\,\Omega$

$$P_{I_s} = 6\,V_I = 0 \Rightarrow V_I = 0$$

KCL :

$$\frac{12}{R_1+R_2} + \frac{V_s}{R_3+R_4} + 6 = 0$$

$$\frac{12}{8} + \frac{V_s}{8} + 6 = 0$$

$$\boxed{V_s = -60.0 \text{ V}}$$

2.80 In the network in Fig. P2.80, $V_o = 8\text{V}$. Find I_s.

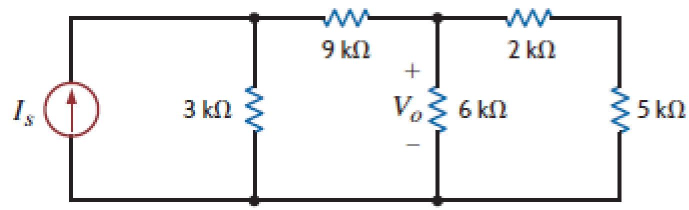
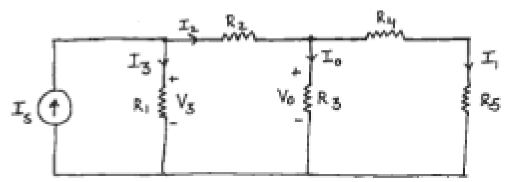


Figure P2.80

SOLUTION:



$R_1 = 3\,k\Omega$, $R_2 = 9\,k\Omega$, $R_3 = 6\,k\Omega$, $R_4 = 2\,k\Omega$, $R_5 = 5\,k\Omega$

$I_o = V_o/R_3 = 8/6 = 1.33\text{ mA}$

$I_1 = \dfrac{V_o}{R_4 + R_5} = \dfrac{8}{7} = 1.143\text{ mA}$

$I_2 = I_o + I_1 = (1.33 + 1.143)\text{mA} = 2.473\text{mA}$

$V_3 = I_2 R_2 + V_o = (2.473 \times 9) + 8 = 30.257\text{ V}$

$I_3 = \dfrac{V_3}{R_1} = 10.087\text{ mA}$

$I_s = I_2 + I_3 = 2.473 + 10.087 = 12.56\text{mA}$

$\boxed{I_s = 12.6\text{ mA}}$

2.81 Find the value of V_1 in the network in Fig. P2.81 such that $V_{a=0}$

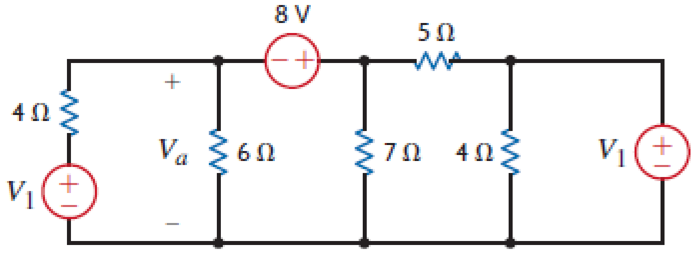
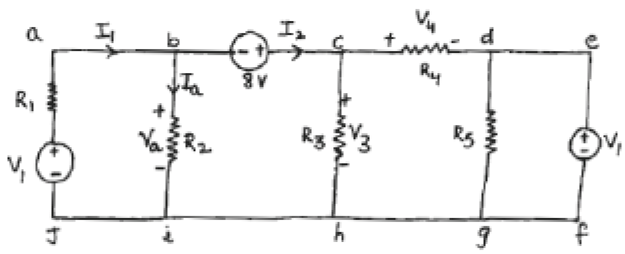


Figure P2.81

SOLUTION:



$R_1 = 4\,\Omega$, $R_2 = 6\,\Omega$, $R_3 = 7\,\Omega$, $R_4 = 5\,\Omega$, $R_5 = 4\,\Omega$

$I_1 = I_a + I_2 \Rightarrow I_1 = I_2$ (By Ohm's law, if $V_a = 0$, $I_a = 0$)

$$I_1 = \frac{V_1}{R_1} = \frac{V_1}{4}$$

$$I_2 = \frac{V_3}{R_3} + \frac{V_4}{R_4} = \frac{V_3}{7} + \frac{V_4}{5}$$

Applying KVL in loop bchib

$$8 + 0 - V_3 = 0$$

$$V_3 = 8\text{ V}$$

Applying KVL in loop cdefghc

$$-V_3 + V_4 + V_1 = 0$$

$$V_4 = 8 - V_1$$

So, $I_2 = \frac{8}{7} + \frac{8 - V_1}{5}$

$I_1 = I_2 = \frac{8}{7} + \frac{8 - V_1}{5}$

So, $\frac{V_1}{4} = \frac{8}{7} + \frac{8 - V_1}{5}$

$V_1 = 6.095\ V$

$\boxed{V_1 = 6.10\ V}$

2.82 Let element X in Fig. P2.82, be an independent current source, arrow directed upward, labeled I_s. What is I_s if none of the four circuit elements absorb any power? Let element X be an independent voltage source, +reference on top, labeled V_s. What is V_s if the voltage source absorbs no power?

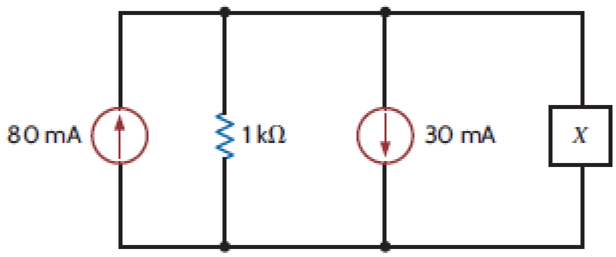


Figure P2.82

SOLUTION:

a. To cancel out the effects of both the 80-mA and 30-mA sources, i_s must be set to i_s = -50mA.

b. Let us define a current is flowing out of the "+" reference terminal of the independent voltage source

Summing the currents flowing into the top node and invoking KCL, we find that

$80\times10^{-3} - 30\times10^{-3} - v_s/1\times10^{3} + i_s = 0$

Simplifying slightly, this becomes

$50 - v_s + 10^{3}\, i_s = 0$ [1]

We are seeking a value for v_s such that $v_s \cdot i_s = 0$. Clearly, setting $v_s = 0$ will achieve this.

From Eq. [1], we also see that setting v_s = 50 V will work as well

2.83 In the circuit in Fig. P2.83.

(a) Calculate V_y if $I_z = -3$ A

(b) What voltage would need to replace the 5 V source to obtain $v_y = -6$ V if $I_z = 0.5$ A.

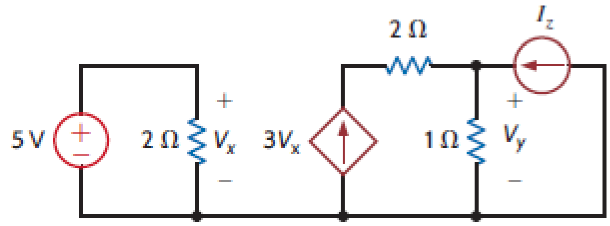


Figure P2.83

SOLUTION:

a. $v_y = 1(3v_x + i_z)$

$v_x = 5$ V and given that $i_z = –3$ A, we find that

$v_y = 3(5) – 3 = 12$ V

b. $v_y = 1(3v_x + i_z) = –6 = 3v_x + 0.5$

Solving, we find that $v_z = (–6 – 0.5)/3 = –2.167$ V.

2.84 Given that $V_o = 4\text{V}$ in the network in Fig. P2.84, find V_S.

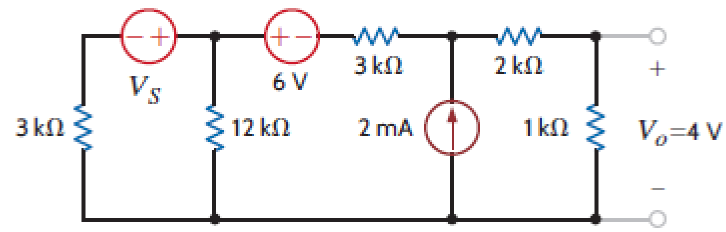
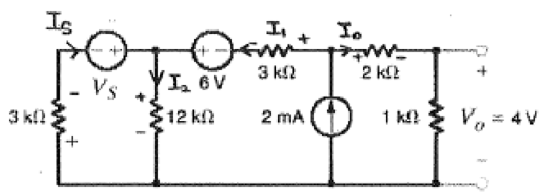


Figure P2.84

SOLUTION:



$$I_o = \frac{V_o}{1K} = \frac{4}{1K} = 4mA$$

$$I_1 + I_o = 2m$$

$$I_1 = 2m - 4m$$

$$I_1 = -2mA$$

KVL:

$$4 + I_o(2K) + 6 = I_1(3K) + I_2(12K)$$

$$(12K)I_2 = 4 + 4m(2K) + 6 - (-2m)(3K)$$

$$I_2 = 2mA$$

KCL:

$$I_s + I_1 = I_2$$

$$I_s = I_2 - I_1$$

$$I_s = 2m - (-2m)$$

$$I_s = 4mA$$

KVL:

$$V_s = 3K I_s + 12K I_2$$

$$V_s = 3K(4m) + 12K(2m)$$

$$V_s = 36V$$

2.85 Determine the current I_z in the circuit in Fig. P2.85. If the resistor carrying 3 A has a value of 1 Ω, what is the value of resistor carrying −5 A.

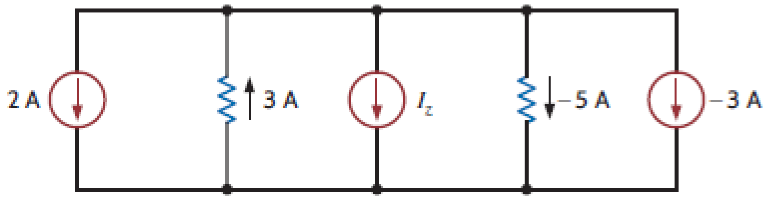


Figure P2.85

SOLUTION:

a. By KCL at the bottom node: $2 - 3 + i_z - 5 - 3 = 0$

So i_z=9A

b. If the left-most resistor has a value of 1 Ω, then 3 V appears across the parallel network. Thus, the value of the other resistor is given by
R = 3/-(-5) = 600mΩ

2.86 If $V_2 = 4$ V in Fig. P2.86, calculate V_x.

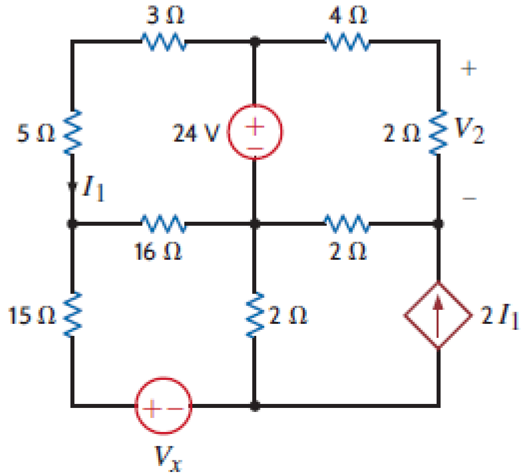
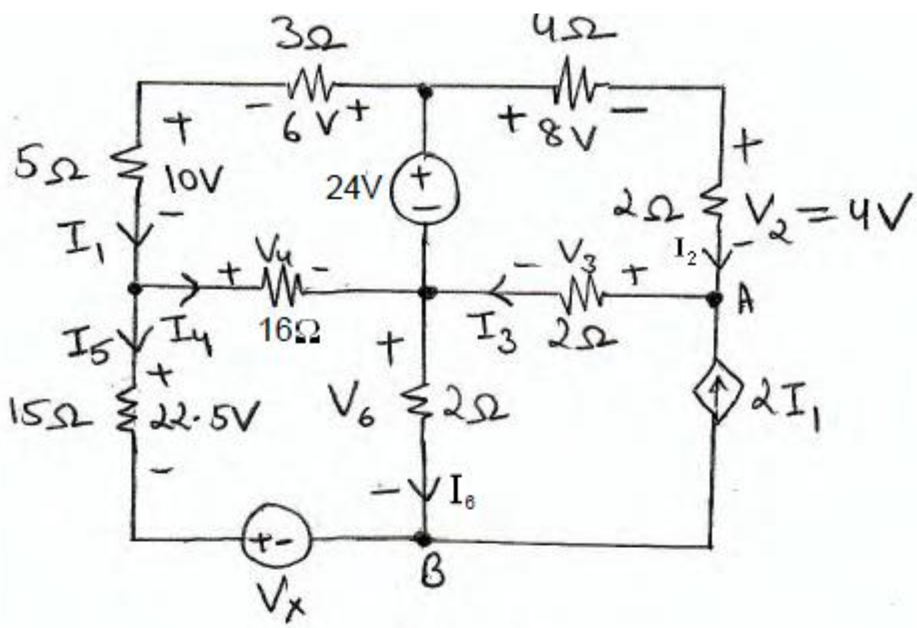


Figure P2.86

SOLUTION:



$$I_2 = \frac{4}{2} = 2A$$

$V_3 = -4 - 8 + 24 = 12V \quad I_3 = \frac{V_3}{2} = 6A$

KCL @ node A: $I_2 + 2I_1 = I_3$

$2 + 2I_1 = 6 \quad 2I_1 = 4 \quad I_1 = 2A$

$V_4 = -10 - 6 + 24 = 8V \quad I_4 = \frac{8}{16} = 0.5A$

$I_5 = I_1 - I_4 = 2 - 0.5 = 1.5A$

KCL @ node B: $I_6 + I_5 = 2I_1 = 4$

$I_6 = 4 - 1.5 = 2.5A \quad V_6 = 2I_6 = 5V$

$V_x = -22.5 + 8 + 5 = \underline{-9.5V}$

2.87 Find the value of I_A in the network in Fig. P2.87.

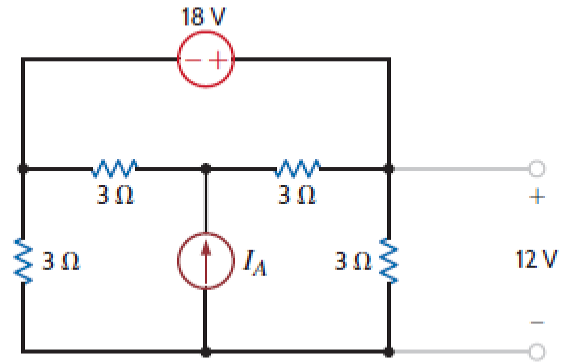
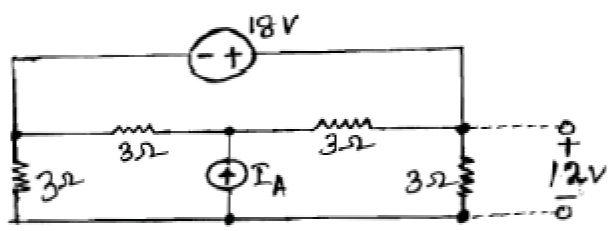
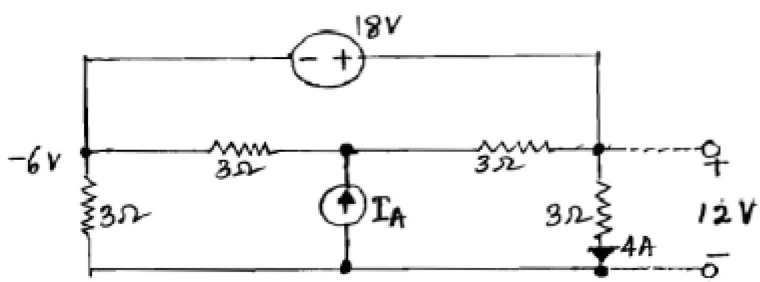


Figure P2.87

SOLUTION:





$$4A + I_A = 0$$

$$I_A = -4A$$

2.88 In the Fig. P2.88.

(a) Find I_x in the circuit if $I_y = 2A$ and $I_z = 0A$.

(b) Find I_y in the circuit if $I_x = 2A$ and $I_z = 2I_y$.

(c) Find I_z in the circuit if $I_x = I_y = I_z$.

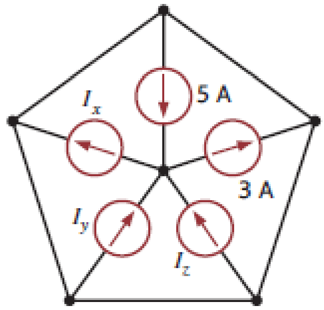


Figure P2.88

SOLUTION:

By KCL we may write;

$5 + i_y + i_z = 3 + i_x$

a. $i_x = 2 + i_y + i_z = 2 + 2 + 0 = 4$ A

b. $i_y = 3 + i_x - 5 - i_z$

$i_y = -2 + 2 - 2\ i_y$

Thus we find that $i_y = 0$

c. $5 + i_y + i_z = 3 + i_x$

$5 + i_x + i_x = 3 + i_z$

$i_x = 3 - 5 = -2A.$

2.89 Find in value of the current source I_A in the network in Fig. P2.89.

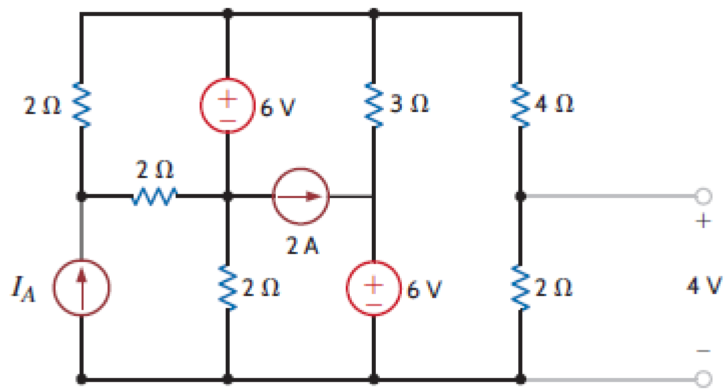
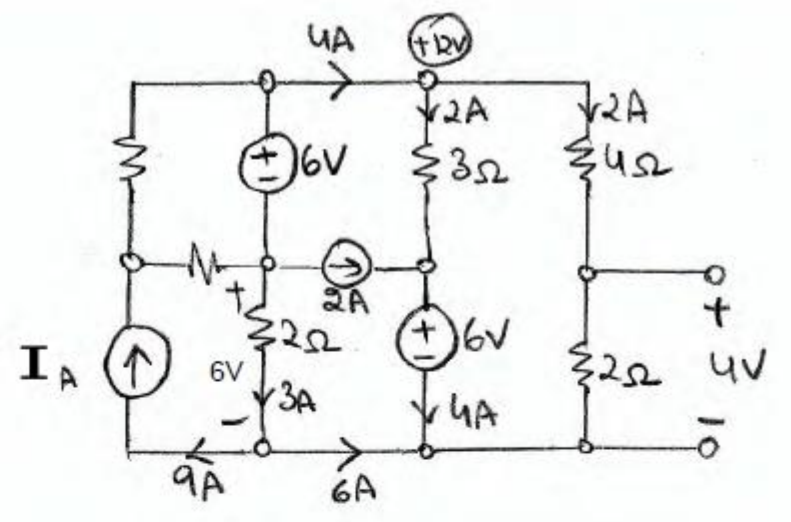


Figure P2.89

SOLUTION:



$I_A = 9A$

2.90 Given $V_o = 12$ V, find the value of I_A in the circuit in Fig. P2.90.

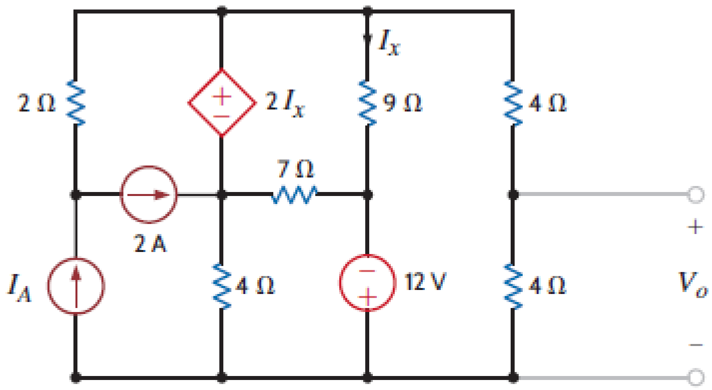
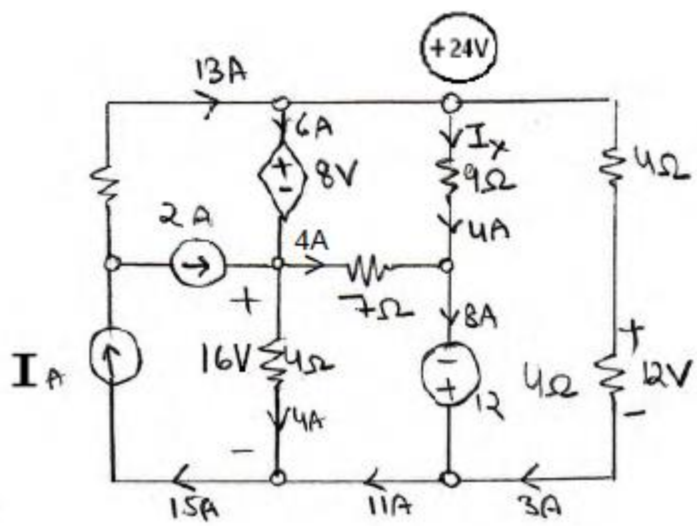


Figure P2.90

SOLUTION:



$\mathrm{I}_A = 15\mathrm{A}$

2.91 Find the value of V_x in the network in Fig. P2.91, such that the 8-A current source supplies 48 W.

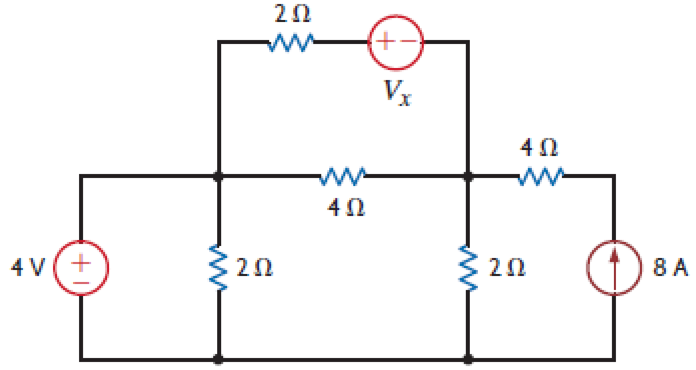
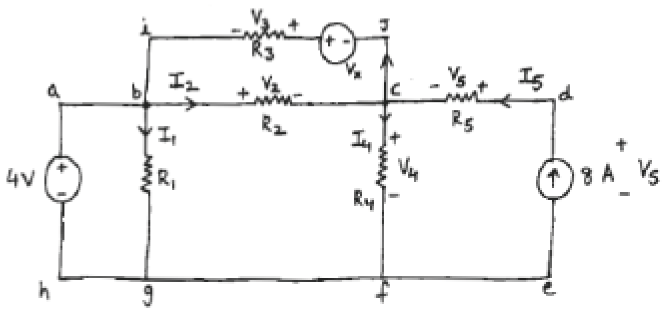


Figure P2.91

SOLUTION:



$R_1 = 2\,\Omega$, $R_2 = 4\,\Omega$, $R_3 = 2\,\Omega$, $R_4 = 2\,\Omega$, $R_5 = 4\,\Omega$

$P_{8A} = (V_S)(8) = 48 \Rightarrow V_S = 6\ \text{V}$

$V_5 = R_5 I_5 = 32\ \text{V}$

$V_S = V_5 + V_4 \Rightarrow V_4 = -V_5 + V_S \Rightarrow V_4 = -26\ \text{V}$

$I_4 = \frac{V_4}{R_4} = -13\ \text{A}$

KVL for loop abcfgha

$-4 + V_2 + V_4 = 0$

$V_2 = 4 - V_4 = 30\ \text{V}$

$I_2 = \frac{V_2}{R_2} = 7.5\ \text{A}$

KCL at node c :

$$I_2 + I_5 = I_3 + I_4$$

$$\therefore I_3 = I_2 + I_5 - I_4$$

$$= 7.5 + 8 + 13$$

$$I_3 = 28.5 \text{ A}$$

$$V_3 = R_3 I_3 = 57 \text{ V}$$

$$V_x = V_3 + V_2$$
$$= 57 + 30$$
$$= 87 \text{ V}$$

$$\boxed{V_x = 87 \text{ V}}$$

2.92 The 5-A current source in Fig. P2.92 supplies 150 W. Calculate V_A.

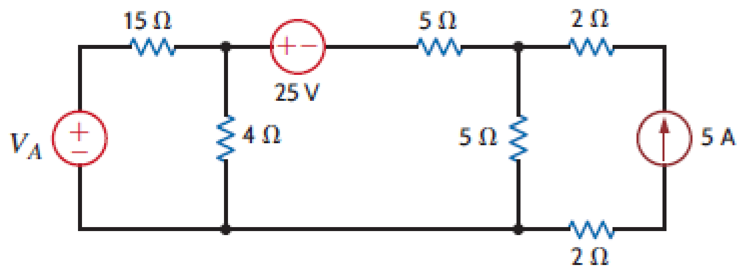
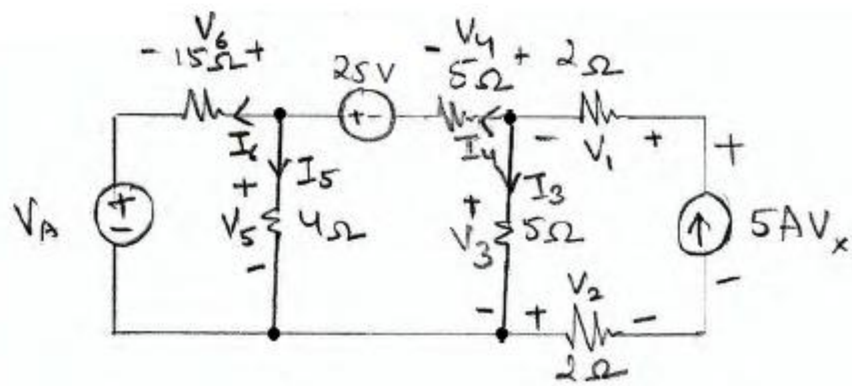


Figure P2.92

SOLUTION:



$$V_1 = (5)(2) = 10V \qquad V_x = \frac{150}{5} = 30V$$

$$V_2 = (5)(2) = 10V$$

$$V_3 = -V_1 + V_x - V_2 = -10 + 30 - 10 = 10V$$

$$I_3 = \frac{V_3}{5} = \frac{10}{5} = 2A$$

$$I_4 = 5 - I_3 = 5 - 2 = 3A$$

$$V_4 = 5I_4 = (5)(3) = 15V$$

$$V_5 = 25 - V_4 + V_3 = 25 - 15 + 10 = 20V$$

$$I_5 = \frac{V_5}{4} = \frac{20}{4} = 5A$$

$$I_6 = I_4 - I_5 = 3-5 = -2A$$

$$V_6 = 15I_6 = 15(-2) = -30V$$

$$V_A = -V_6 + V_5 = -(-30) + 20 = \underline{50V}$$

2.93 Given $I_0 = 8$ mA in the circuit in Fig. P2.93, find I_A.

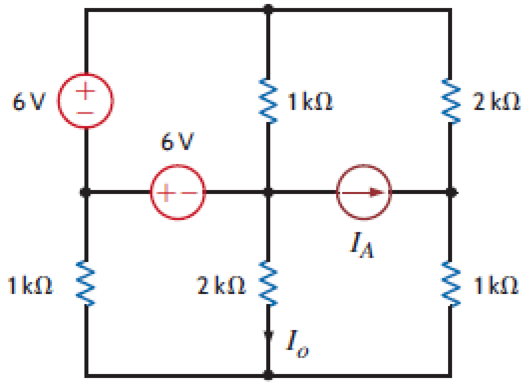
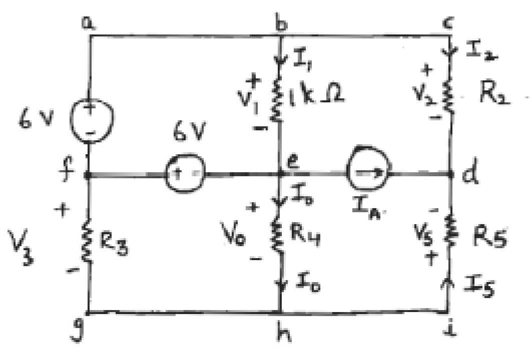


Figure P2.93

SOLUTION:



$R_1 = 1\,k\Omega$, $R_2 = 2\,k\Omega$, $R_3 = 1\,k\Omega$, $R_4 = 2\,k\Omega$, $R_5 = 1\,k\Omega$

$$V_o = R_4 I_o = 16 \text{ V}$$

$$V_3 = 6 + V_o = 22\text{V}$$

$$I_3 = V_3/R_3 = 22 \text{ mA}$$

$$I_5 = I_3 + I_o = 30 \text{ mA}$$

$$V_1 = 6 + 6 = 12\text{ V}$$

$$I_1 = \frac{V_1}{R_1} = 12\text{ mA}$$

KVL for the loop abcdihgfa

$$V_2 = 6 + I_3 R_3 + I_5 R_5$$
$$V_2 = 58\text{ V}$$

$$I_2 = \frac{V_2}{R_2} = 29\text{ mA}$$

$$I_A = -I_2 - I_5$$

$$\Rightarrow \boxed{I_A = -59\text{ mA}}$$

2.94 Given $I_0 = 2$ mA in the network in Fig. P2.94, find V_A.

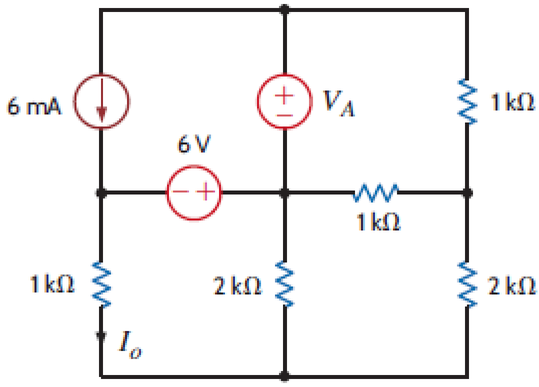
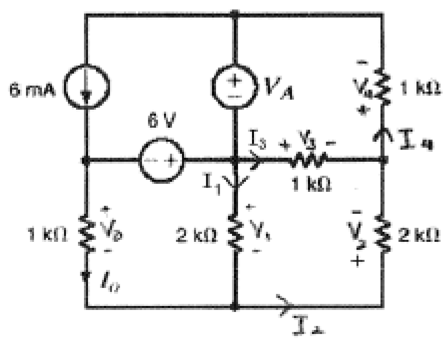


Figure P2.94

SOLUTION:



$V_o = I_o(1K) = 2m(1k) = 2V$

KVL:

$V_1 = V_o + 6 \qquad I_1 = \frac{V_1}{2k}$

$V_1 = 2 + 6 = 8V \qquad I_1 = \frac{8}{2k} = 4mA$

KCL:

$I_o + I_1 = I_2$

$I_2 = 2m + 4m = 6mA$

$V_2 = I_2(2K) = 6m(2k) = 12V$

KVL:

$V_1 + V_2 = V_3$

$V_3 = 8 + 12 = 20V$

$I_3 = \frac{V_3}{1k} = \frac{20}{1K} = 20mA$

KCL:

$I_2 + I_3 = I_4$

$I_4 = 6m + 20m = 26mA$

$V_4 = I_4(1K) = 26m(1K) = 26V$

KVL:

$V_A + V_4 + V_3 = 0$

$V_A = -26 - 20$

$V_A = -46V$

2.95 Given V_o in the network in Fig. P2.95, find I_A.

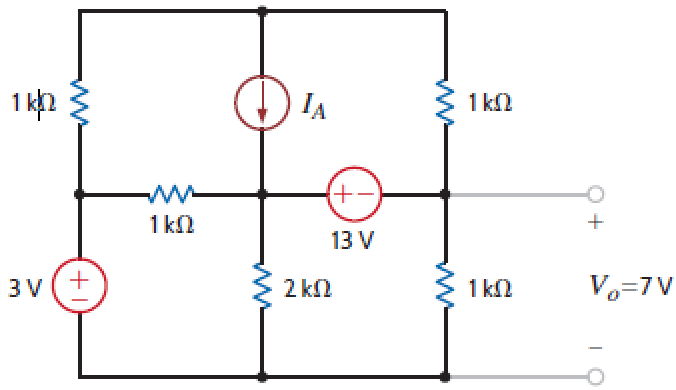
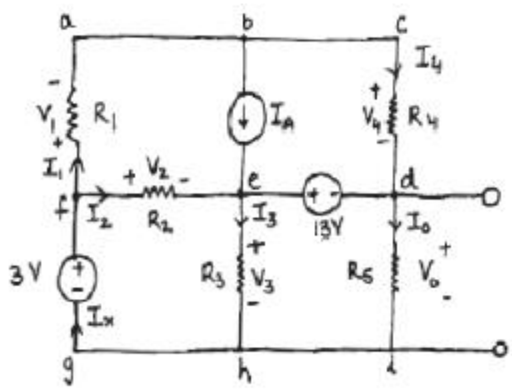


Figure P2.95

SOLUTION:



$R_1 = 1\text{ k}\Omega,\ R_2 = 1\text{ k}\Omega,\ R_3 = 2\text{ k}\Omega,\ R_4 = 1\text{ k}\Omega,\ R_5 = 1\text{ k}\Omega$

$V_o = 7\text{ V}$

$I_o = V_o / R_5 = 7\text{ mA}$

$V_3 = 13 + V_o = 20\text{ V}$

$I_3 = V_3 / R_3 = 10\text{ mA}$

$I_x = I_3 + I_o = 17\text{ mA}$

$V_2 = 3 - V_3 = -17\ V$

$I_2 = V_2/R_2 = -17\ mA$

$I_1 = I_x - I_2 = 34\ mA$

$V_1 = R_1 I_1 = 34\ V$

KVL for the loop abcdihgfa

$\Rightarrow V_4 + V_0 + V_1 = 3$

$V_4 = 3 - V_0 - V_1$

$= -38\ V$

$I_4 = V_4/R_4 = -38\ mA$

$I_A + I_4 = I_1$

So, $I_A = I_1 - I_4$

$= 72\ mA$

$$\boxed{I_A = 72\ mA}$$

2.96 Find the value of V_x in the circuit in Fig. P2.96 such that the power supplied by the 6-A source is 54 W.

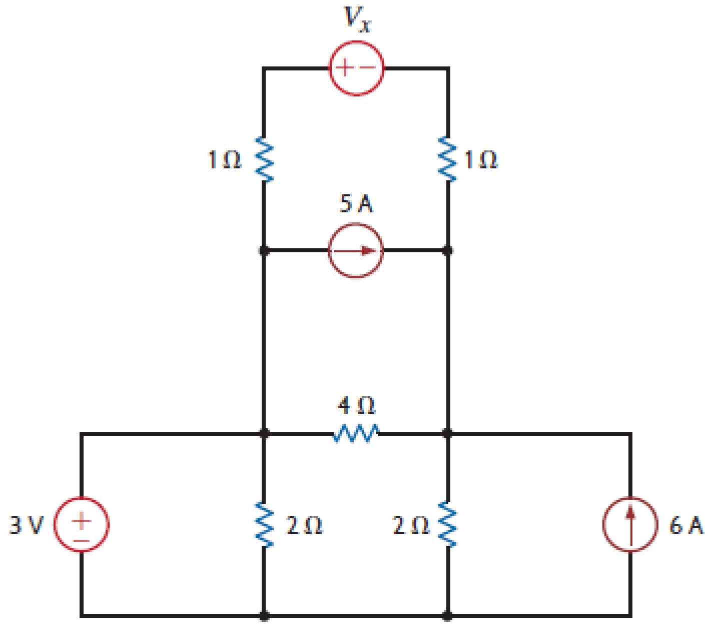
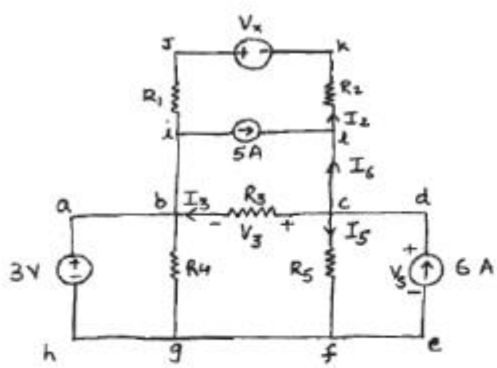


Figure P2.96

SOLUTION:



$R_1 = 1\,\Omega$, $R_2 = 1\,\Omega$, $R_3 = 4\,\Omega$, $R_4 = 2\,\Omega$, $R_5 = 2\,\Omega$

$$P_{6A} = 54 = 6\,V_S \Rightarrow V_S = 9\text{ V}$$

$$I_5 = \frac{V_S}{R_5} = 4.5\text{ A}$$

KVL for loop abcdefgha

$V_3 = V_s - 3 = 6\,V$

$I_3 = V_3 / R_3 = 1.5\,A$

KCL at c:

$I_6 + I_3 + I_5 = 6$

$I_6 = 6 - I_3 - I_5 = 0$

KCL at l:

$I_2 = I_6 + 5 = 5\,mA$

KVL for loop bijklcb

$V_3 + V_x = I_2 R_2 + I_2 R_1$

$V_x = I_2 R_2 + I_2 R_1 - V_3$

$\boxed{V_x = 4\,V}$

2.97 The 3-A current source in Fig. P2.97 is absorbing 12 W. Determine R.

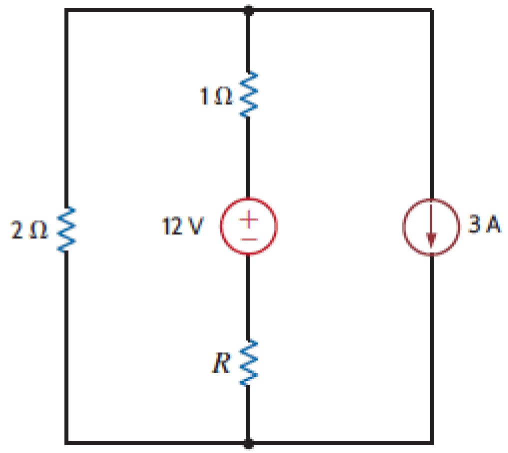
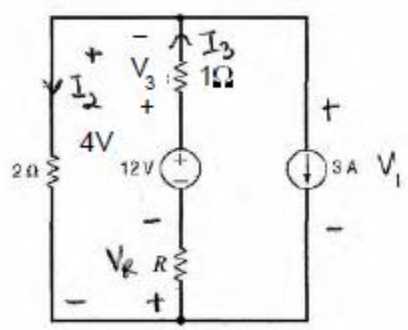


Figure P2.97

SOLUTION:



$$12 = 3V_1 \qquad V_1 = \frac{12}{3} = 4V$$

$$I_2 = \frac{V_1}{2} = \frac{4}{2} = 2A$$

$$I_3 = I_2 + 3 = 5A$$

$$V_3 = 1I_3 = 5V$$

$$V_R = -V_1 - V_3 + 12 = -4 - 5 + 12$$

$$V_R = 3V$$

$$R = \frac{V_R}{I_3} = \frac{3}{5} = \underline{0.6\,\Omega}$$

2.98 If the power supplied by the 50-V source in Fig. P2.98 is 100 W, find R.

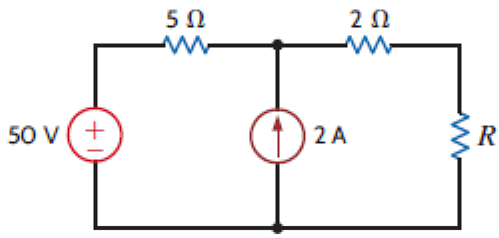
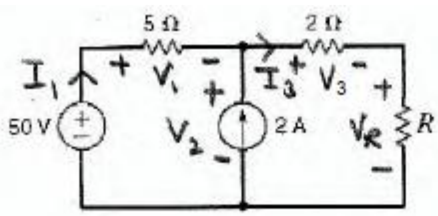


Figure P2.98

SOLUTION:



$$100 = 50 I_1$$

$$I_1 = 2\text{A}$$

$$V_1 = 5I_1 = (5)(2) = 10\text{V}$$

$$V_2 = -V_1 + 50 = -10 + 50 = 40\text{V}$$

$$I_3 = I_1 + 2 = 4\text{A}$$

$$V_3 = 2I_3 = 2(4) = 8\text{V}$$

$$V_R = -V_3 + V_2 = -8 + 40 = 32\text{V}$$

$$R = \frac{V_R}{I_3} = \frac{32}{4} = 8\Omega$$

2.99 Given that $V_1 = 4$ V, find V_A and R_B in the circuit in Fig. P2.99.

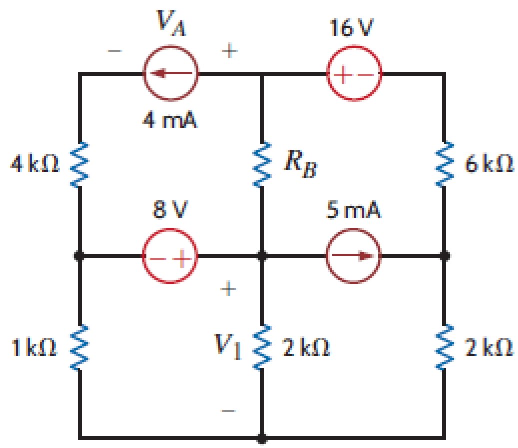
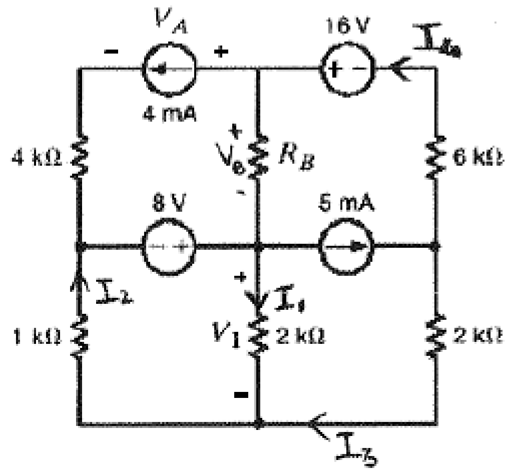


Figure P2.99

SOLUTION:

(See Next Page)



$V_1 = I_1(2K)$

$I_1 = \frac{4}{2K} = 2mA$

KVL:

$V_1 + 1K\,I_2 = 8$

$I_2 = \frac{8-4}{1K} = 4mA$

KCL :

$I_1 + I_3 = I_2$

$I_3 = 4m - 2m$

$I_3 = 2mA$

KCL:

$I_3 + I_4 = 5mA$

$I_4 = 3mA$

KCL:

$I_4 = I_B + 4m$

$I_B = -1mA$

KVL:

$2K I_3 + 16 = 6K\, I_4 + V_B + V_1$

$V_B = 2K(2m) + 16 - 6K(3m) - 4$

$V_B = -2V$

$V_B = I_B R_B$

$R_B = \frac{-2}{-1m} = 2K\Omega$

KVL:

$$8 + V_B = V_A + 4K(4m)$$

$$V_A = 8 - 2 - 4K(4m)$$

$$V_A = -10\text{ V}$$

2.100 Find the power absorbed by the network in Fig. P2.100.

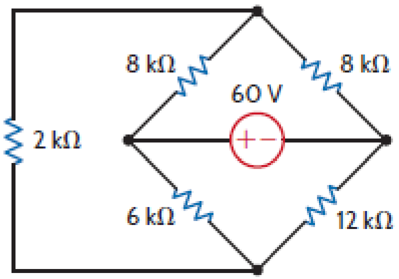
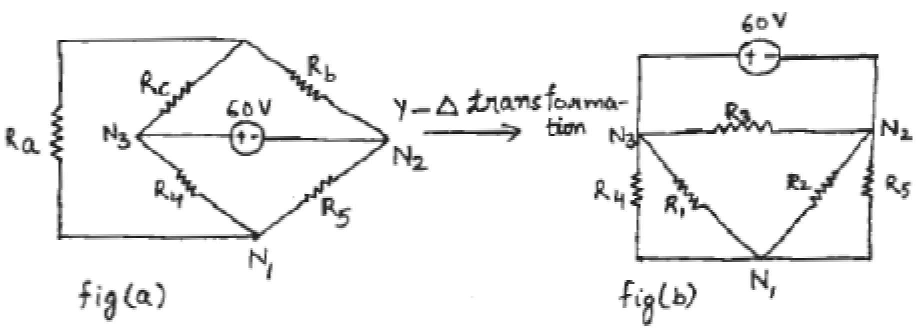


Figure P2.100

SOLUTION:



Ra, Rb, Rc connected in wye configuration

$R_a = 2\,k\Omega$, $R_b = 8\,k\Omega$, $R_c = 8\,k\Omega$, $R_4 = 6\,k\Omega$,

$R_5 = 12\,k\Omega$

$$R_1 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_b} = 12\,k\Omega$$

$$R_2 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_c} = 12\,k\Omega\cdot$$

$$R_3 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_a} = 48\,k\Omega$$

fig (b) $\rightarrow$ fig (c)

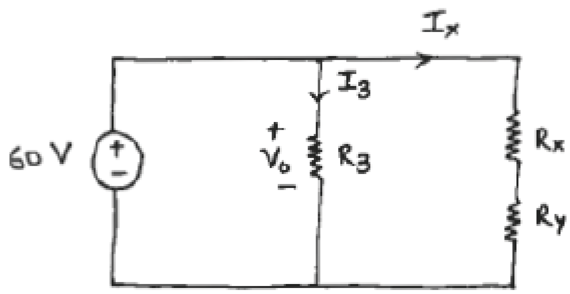


fig (c)

$$R_x = R_1 \parallel R_4 = 4\,k\Omega$$

$$R_y = R_2 \parallel R_5 = 6\,k\Omega$$

$$P = \frac{V_o^2}{R_3} + \frac{V_o^2}{R_x + R_y}$$

$$\boxed{P = 435\ mW}$$

2.101 Find the value of g in the network in Fig. P2.101 such that the power supplied by the 3-A source is 20 W.

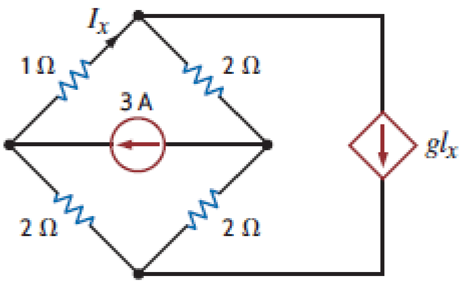
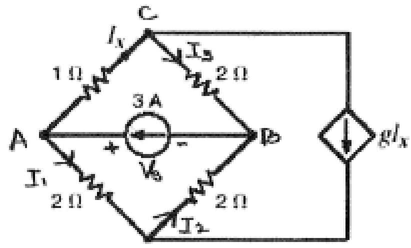


Figure P2.101

SOLUTION:

(See Next Page)



$P = V_s I_s$

$20 = V_s(3)$

$V_s = \frac{20}{3}\,V$

KVL:

$V_s = I_x + 2I_3 \quad — \; (1)$

KCL at A:

$3 = I_1 + I_x$ Putting eq^n (1) for I_x

$I_x = 3 - I_1$

$$V_s = \underbrace{3 - I_1}_{I_2} + 2I_3$$

$$\frac{20}{3} - 3 = -I_1 + 2I_3$$

$$\boxed{11 = -3I_1 + 6I_3}$$

KVL:

$$V_s = 2I_1 + 2I_2$$

KCL at B:

$$3 = I_2 + I_3$$

$$I_2 = 3 - I_3$$

$$\frac{20}{3} = 2I_1 + 2(3 - I_3)$$

$$\boxed{2 = 6I_1 - 6I_3}$$

$$-3I_1 + 6I_3 = 11$$

$$6I - 6I_3 = 2$$

$$I_1 = 4.33\text{A}$$

$$I_3 = 4\text{A}$$

$I_x = 3 - I_1$

$I_x = 3 - 4.33$

$I_x = -1.33A$

KCL at C:

$$I_x = I_3 + gI_x$$

$$-1.33 = 4 + g(-1.33)$$

$$g = 4$$

2.102 Find the power supplied by the 24-V source in the circuit in Fig. P2.102.

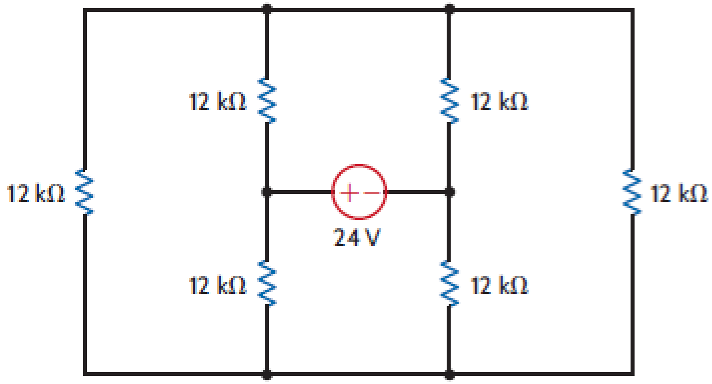
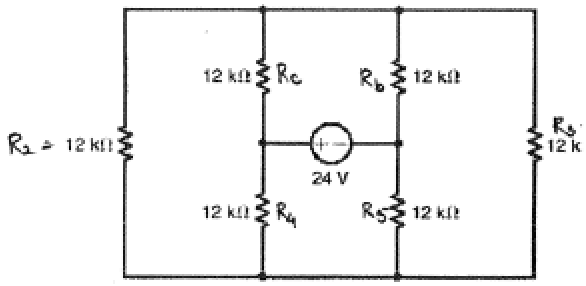


Figure P2.102

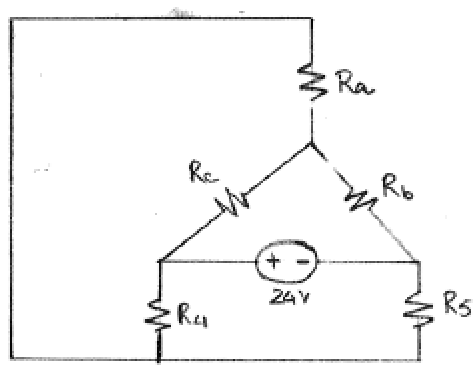
SOLUTION:

(See Next Page)



$R_a = R_2 \| R_3 = 6K\Omega$

$R_a = 6K\Omega$



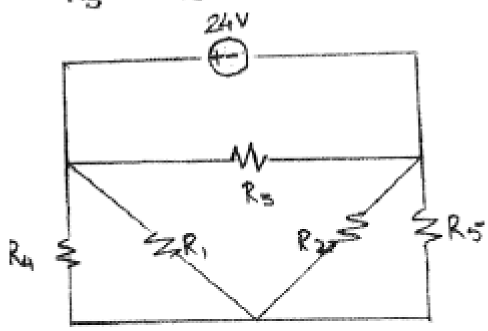
R_a, R_b, and R_c are wye connected

$$R_1 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_b}$$

$$R_1 = \frac{6k(12k) + 12k(12K) + 6K(12K)}{12K} = 24K\Omega$$

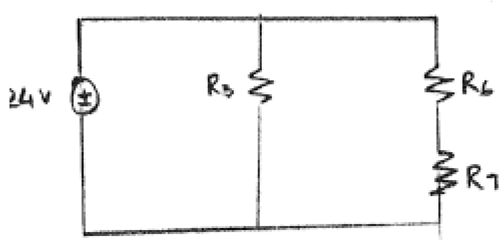
$$R_2 = 24K\Omega$$

$$R_3 = 48K\Omega$$



$$R_6 = R_1 \| R_4 = 24k \| 12k = 8k\Omega$$

$$R_7 = R_2 \| R_5 = 24k \| 12k = 8K\Omega$$



$$P = \frac{(24)^2}{48k} + \frac{(24)^2}{8k + 8K}$$

$$P = 48\,mW$$

2.103 Determine the power loss in the 5 Ω resistor shown in Fig. P2.103.

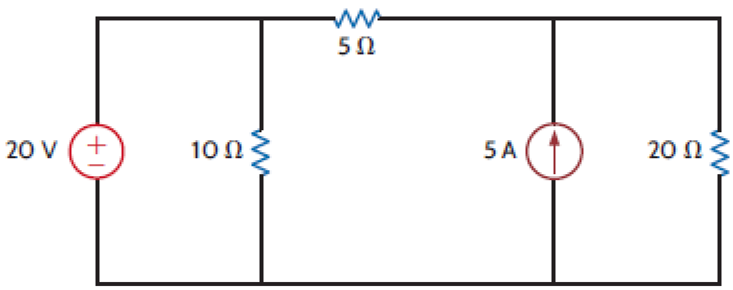
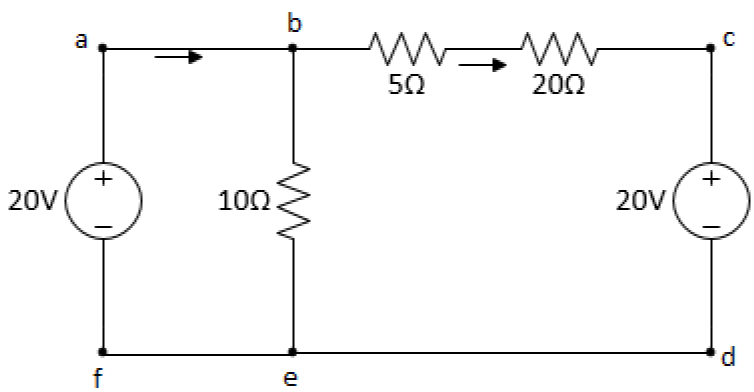


Figure P2.103

SOLUTION:

In the first step, the current source of 5A is converted to equivalent voltage source as shown,



In loop *abef,* using KVL,

$20 = (i_1 - i_2)\ 10$ or, $i_1 - i_2 = 2$ (i)

In loop *bcde,* using KVL,

$25\ i_2 + 100 + (i_1 - i_2)\ 10 = 0$ or, $35\ i_2 - 10\ i_1 = -100$ (ii)

Solving (i) and (ii) for i_2 we get,

$i_2 = -3.2$ A   (*i.e.* actually i_2 flows from terminal c to terminal b)

=>   The power loss in the 5 Ω resistor is $(i_2^2 \times 5)$ W

i.e. $p = (3.2)^2 \times 5$ W

or, $p = 51.2$ W

2.104 Obtain the current I_1 from the circuit in Fig P2.104 using KVL.

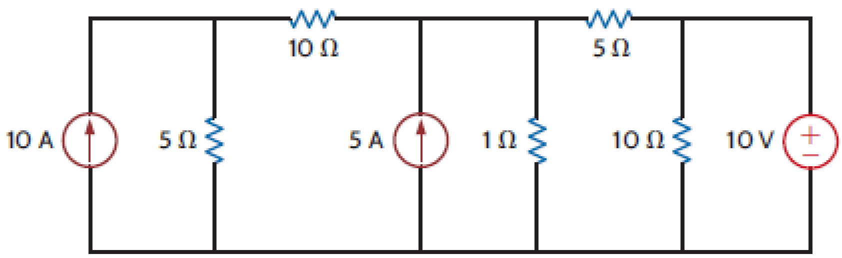
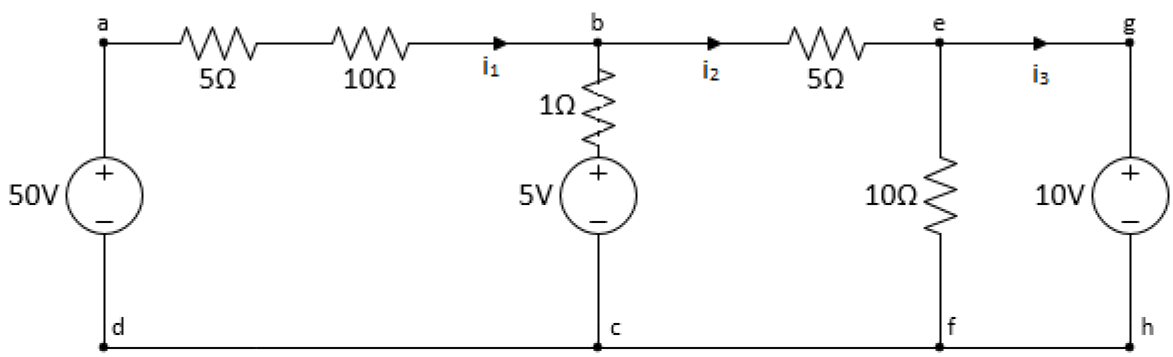


Figure P2.104

SOLUTION:

The current sources are transformed to voltage sources as shown in the figure below,



In loop *abcd,*

$-50 + 15\,i_1 + (i_1 - i_2) + 5 = 0 \quad \Rightarrow \quad 16i_1 - i_2 = 45$ (i)

In loop *befc,*

$-5 + (i_2 - i_1) + 5i_2 + (i_2 - i_3)\,10 = 0$

=> $16i_2 - i_1 - 10\,i_3 = 5$ (iii)

From (iii) , $i_3 = i_2 - 1$ (iv)

Using (iv) in (ii),

$16i_2 - i_1 – 10 (i_2 – 1) = 5$

=> $i_1 – 6 i_2 = 5$ (v)

Solving (i) and (v),

$i_2 = -0.37$ A and $i_1 = 2.79$ A

2.105 Find I_0 in the circuit in Fig. P2.105.

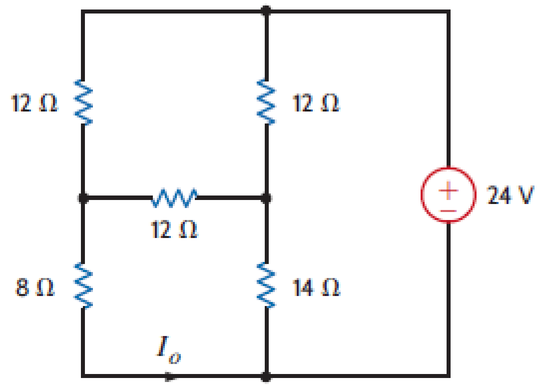
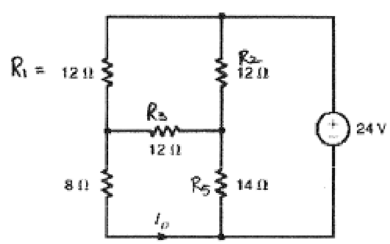
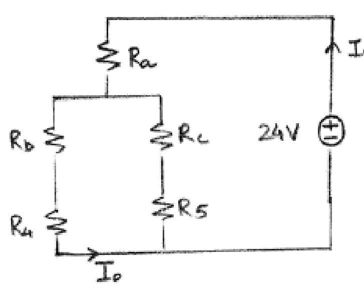


Figure P2.105

SOLUTION:



R_1, R_2, and R_3 are connected in delta.



$R_a = R_b = R_c = 4\ \Omega$

$$R_{eq} = \left[(R_b + R_4) \parallel (R_c + R_5)\right] + R_a$$

$$R_{eq} = (12 \parallel 18) + 4 = \frac{12(18)}{12+18} + 4 = 11.2\ \Omega$$

$$I_s = \frac{24}{R_{eq}} = \frac{24}{11.2} = 2.14A$$

$$I_o = \left(\frac{R_c + R_5}{R_c + R_5 + R_b + R_4}\right) I_s = \left(\frac{4 + 14}{4 + 14 + 4 + 8}\right)(2.14)$$

$$I_o = 1.29A$$

2.106 Find I_0 in the circuit in Fig. P2.106.

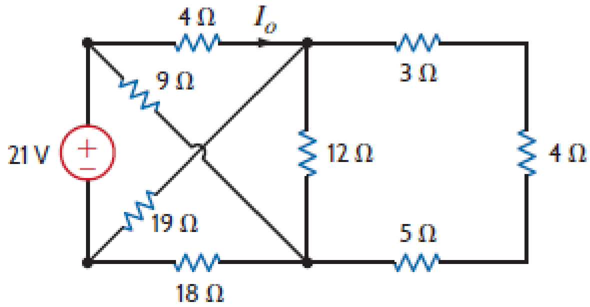


Figure P2.106

SOLUTION:

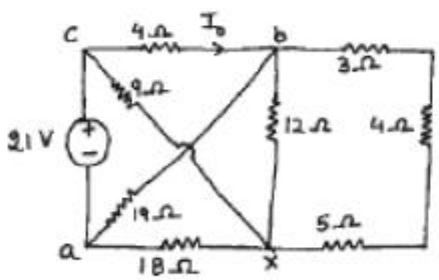


fig (a)

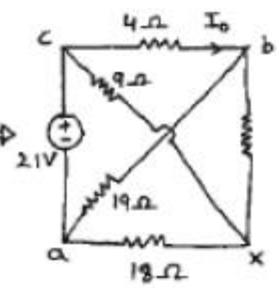


fig (b)

$R_x = 12 \parallel (3+4+5) = 6\ \Omega$

In fig (b) 18 Ω, 9 Ω, R_x are in wye connection
Therefore fig (b) is redrawn as fig (c)

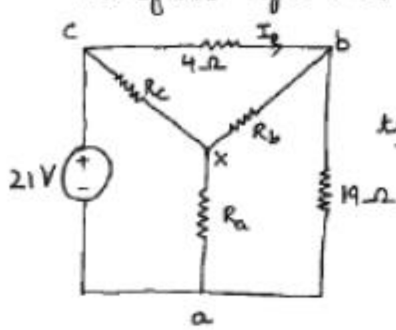


fig (c)

wye-delta transformation →

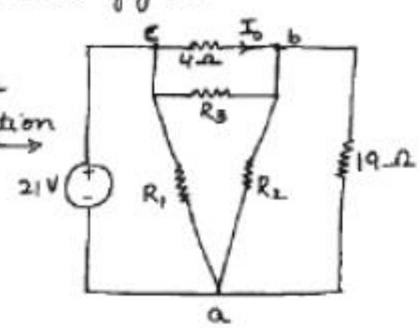


fig (d)

In fig. (c) $R_a = 18\,\Omega$, $R_b = R_x = 6\,\Omega$, $R_c = 9\,\Omega$

From Wye - delta transformation, we have

$$R_1 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_b} = 54\,\Omega$$

$$R_2 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_c} = 36\,\Omega$$

$$R_3 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_a} = 18\,\Omega$$

fig(d) is transformed into fig(e)

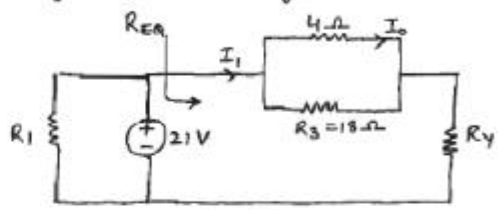


fig (e)

$R_y = R_2 \parallel 19$

$R_y = 12.436\ \Omega$

$R_{EQ} = 4 \parallel R_3 + R_y$

$= 4 \parallel 18 + 12.436$

$R_{EQ} = 15.709\,\Omega$

$$I_1 = \frac{21}{R_{EQ}} = 1.337\text{ A}$$

$$I_o = I_1 \left[\frac{18}{18+4}\right] = 1.09\text{ A}$$

$\boxed{I_o = 1.09\text{ A}}$

2.107 Determine the value of V_0 in the network in Fig. P2.110.

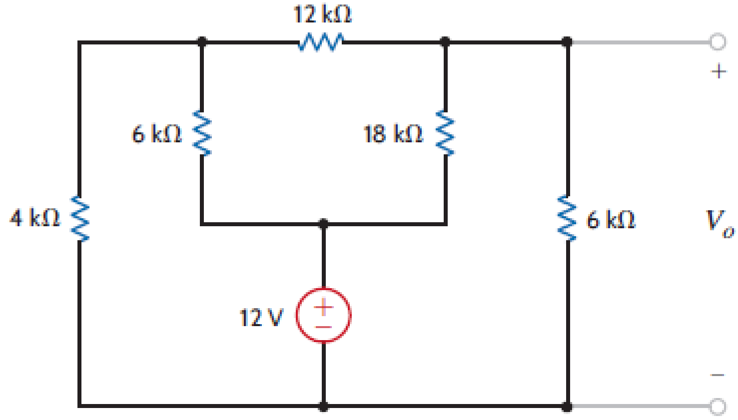
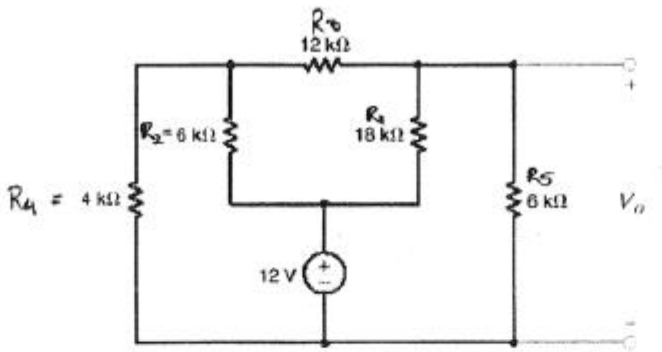


Figure P2.107

SOLUTION:

(See Next Page)

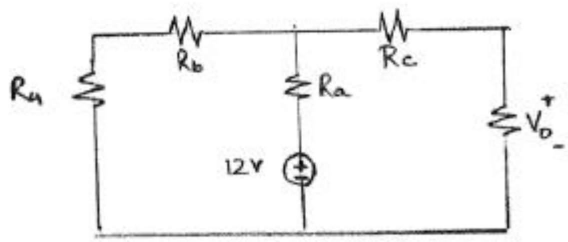


Using a delta to wye transformation:

$$R_a = \frac{R_1 R_2}{R_1 + R_2 + R_3} = \frac{18k(6k)}{18k + 6k + 12k} = 3K\,\Omega$$

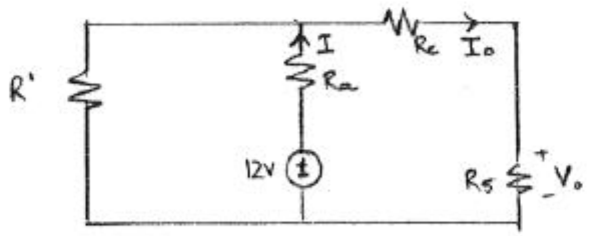
$$R_b = \frac{R_2 R_3}{R_1 + R_2 + R_3} = \frac{6k(12k)}{18k + 6k + 12k} = 2K\,\Omega$$

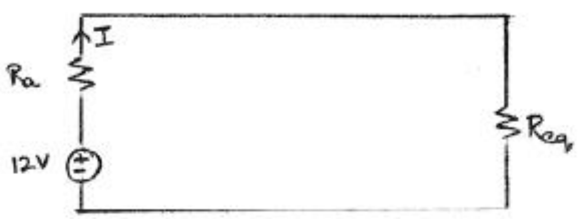
$$R_c = \frac{R_1 R_3}{R_1 + R_2 + R_3} = \frac{18k(12k)}{18k + 6k + 12k} = 6K\,\Omega$$



$R' = R_4 + R_b = 4K + 2K$

$R' = 6K\ \Omega$





$R_{eq} = R' \| (R_c + R_5) = 6K \| (6K + 6K)$

$R_{eq} = 6K \| 12K = \frac{6K(12K)}{6K + 12K} = 4K\ \Omega$

$I = \frac{12}{R_a + R_{eq}} = \frac{12}{3K + 4K}$

$I = 1.714\ mA$

Using current division:

$I_o = \left(\frac{R'}{R' + R_c + R_5}\right)(I)$

$$I_o = \left(\frac{6k}{6k+6k+6k}\right)(1.714m)$$

$$I_o = 0.571\,mA$$

$$V_o = I_o R_5 = (0.571m)(6k)$$

$$V_o = 3.43V$$

2.108 Find V_o in the circuit in Fig. P2.108.

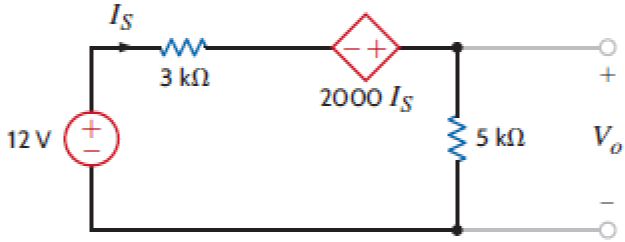


Figure P2.108

SOLUTION:

KVL:

$$12 + 2000 I_s = 3K I_s + 5K I_s$$

$$6K I_s = 12$$

$$I_s = 2mA$$

$$V_o = I_s (5K)$$

$$V_o = 2m(5K)$$

$$V_o = 10V$$

2.109 Use Ohm's and Krichoff's laws on the circuit in Fig. P2.109, to find a. V_x b. I_{in} c. I_s d. The power provided by the dependent source.

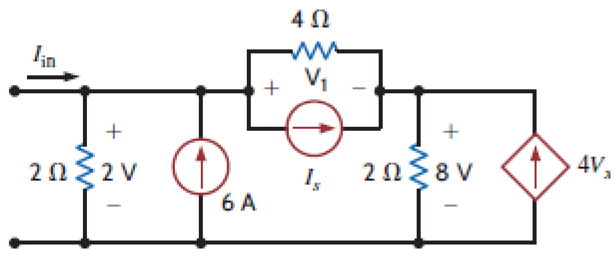


Figure P2.109

SOLUTION:

a. By KVL, $-2 + v_x + 8 = 0$
   So that $v_x = -6$ V.
b. By KCL at the top left node
   $i_{in} = 1 + I_S + v_x/4 - 6$
   $i_{in} = 23$ A
c. By KCL at the top right node,
   $I_S + 4v_x = 4 - v_x/4$
   $I_S = 29.5$ A.
d. The power provided by the dependent source is $8(4v_x) = -192$ W

2.110 Find the power absorbed by each of the seven circuit elements in Fig. P2.110.

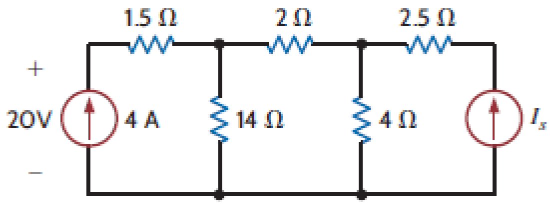


Figure P2.110

SOLUTION:

Beginning from the left, we find

$p_{20V} = -(20)(4) = -80$ W

$v_{1.5} = 4(1.5) = 6$ V therefore $p_{1.5} = (v_{1.5})^2 / 1.5 = 24$ W.

$v_{14} = 20 - v_{1.5} = 20 - 6 = 14$ V therefore $p_{14} = 14^2 / 14 = 14$ W

$i_2 = v_2/2 = v_{1.5}/1.5 - v_{14}/14 = 6/1.5 - 14/14 = 3$ A

Therefore $v_2 = 2(3) = 6$ V and $p_2 = 6^2/2 = 18$ W.

$v_4 = v_{14} - v_2 = 14 - 6 = 8$ V therefore $p_4 = 8^2/4 = 16$ W

$i_{2.5} = v_{2.5} / 2.5 = v_2/2 - v_4/4 = 3 - 2 = 1$ A

Therefore $v_{2.5} = (2.5)(1) = 2.5$ V and so $p_{2.5} = (2.5)^2/2.5 = 2.5$ W.

$I_{2.5} = - I_S$, therefore $I_S = -1$ A.

KVL allows us to write $-v_4 + v_{2.5} + v_{IS} = 0$

so $V_{IS} = v_4 - v_{2.5} = 8 - 2.5 = 5.5$ V and $p_{IS} = -V_{IS} I_S = 5.5$ W

2.111 Find I_o in the circuit in Fig. P2.111.

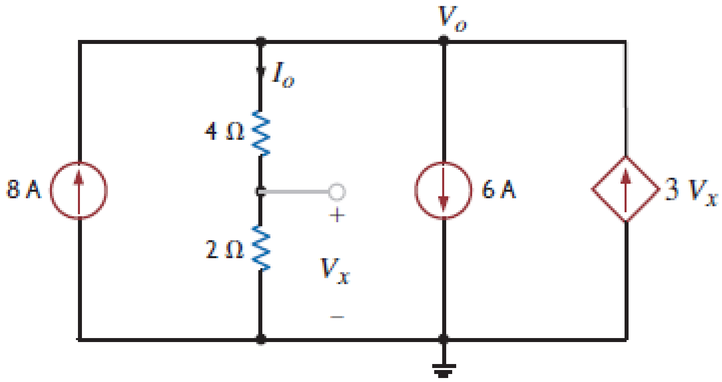
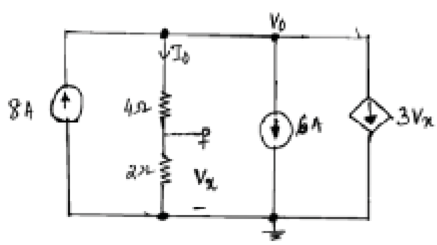


Figure P2.111

SOLUTION:



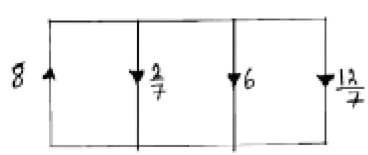
$$-8+\frac{V_0}{6}+6+3V_x=0$$

$$V_x=\frac{1}{3}V_0$$

$$-8+\frac{V_0}{6}+6+3\times\frac{1}{3}V_0=0$$

$$V_0=\frac{12}{7}$$

$$I_0=\frac{V_0}{6}=\frac{2}{7}\text{ A}$$



2.112 Find V_o in the circuit in Fig. P2.112.

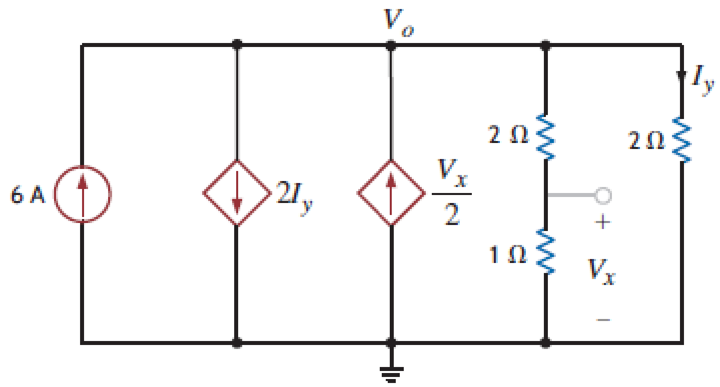


Figure P2.112

SOLUTION:

$$-6 + 2I_y - \frac{V_x}{2} + \frac{V_o}{3} + \frac{V_o}{2} = 0$$

$$V_x = \frac{1}{3} V_o, \quad I_y = \frac{V_o}{2}$$

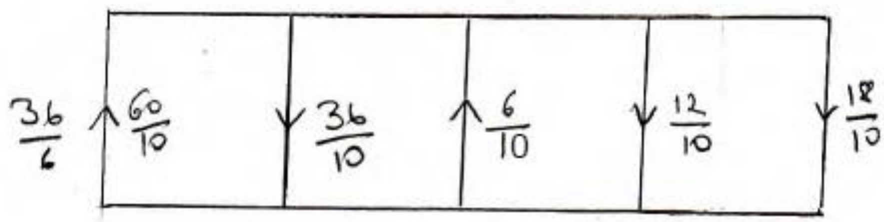
$$-6 + 2\left(\frac{V_o}{2}\right) - \frac{1}{2}\left(\frac{V_o}{3}\right) + \frac{V_o}{3} + \frac{V_o}{2} = 0$$

$$-6 + V_o - \frac{V_o}{6} + \frac{V_o}{3} + \frac{V_o}{2} = 0$$

$$V_o\left(\frac{6}{6} - \frac{1}{6} + \frac{2}{6} + \frac{3}{6}\right) = 6$$

$$V_o\left(\frac{10}{6}\right) = 6$$

$$V_o = \frac{36}{10} = 3.6$$


36/6
60/10
36/10
6/10
12/10
18/10

2.113 Find V_x in the network in Fig. P2.113.

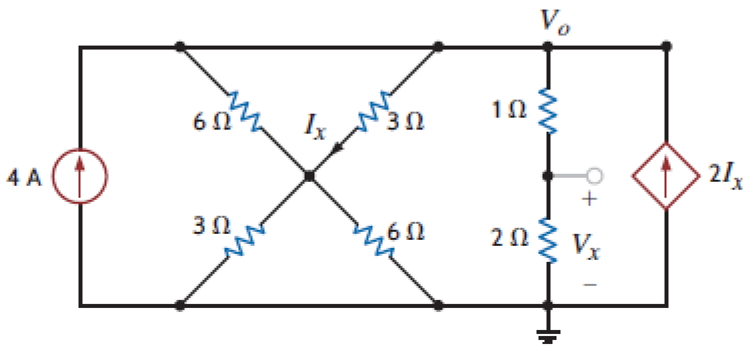
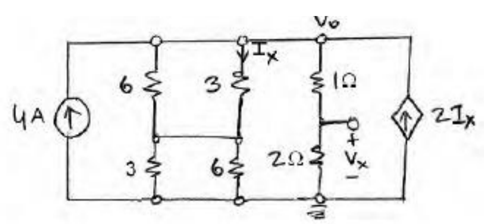
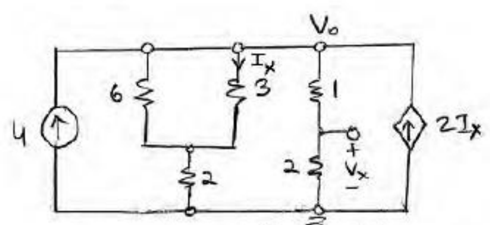


Figure P2.113

SOLUTION:





$$I_x = \left(\frac{1}{2}V_o\right)\left(\frac{1}{3}\right) = \frac{V_o}{6}$$

$$-4 + \frac{V_o}{4} + \frac{V_o}{3} - 2I_x = 0$$

$$-4 + \frac{V_o}{4} + \frac{V_o}{3} - \frac{V_o}{3} = 0$$

$$V_o = 16V$$

$$V_x = 2/3(16) = \frac{32}{3}V$$

2.114 Find V_o in the network in Fig. P2.114.

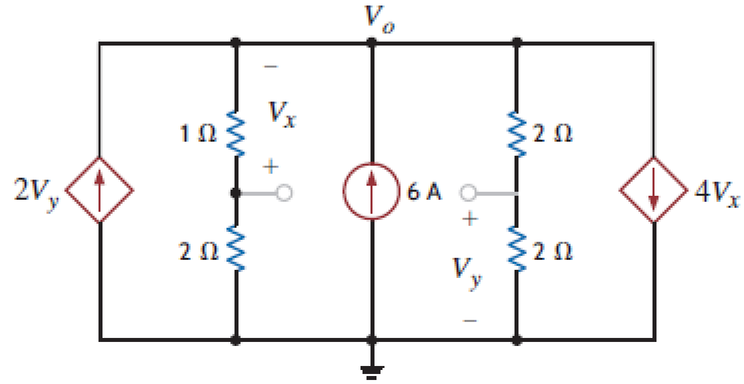


Figure P2.114

SOLUTION:

$$-2V_y + \frac{V_o}{3} - 6 + \frac{V_o}{4} + 4V_x = 0$$

$$V_x = \frac{-V_o}{3} \qquad V_y = \frac{V_o}{2}$$

$$-V_o + \frac{V_o}{3} - 6 + \frac{V_o}{4} - \frac{4}{3}V_o = 0$$

$$\left(-1 + \frac{1}{3} + \frac{1}{4} - \frac{4}{3}\right)V_o = 6$$

$$\left(\frac{-12+4+3-16}{12}\right)V_o = 6$$

$$V_o = \frac{-72}{21}\,V = -\frac{72}{21}\,V$$

2.115 Find R and G in the circuit in Fig. P2.115, if the 5 A source is supplying 100 W and the 40 V source is supplying 500 W.

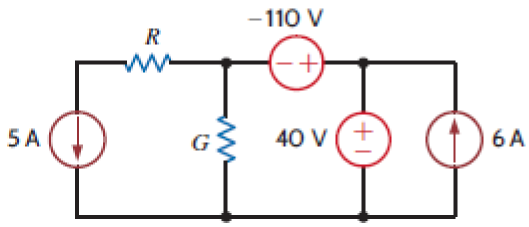


Figure P2.115

SOLUTION:

a. By KVL, –40 + (–110) + R(5) – 20 = 0
   R = 34 Ω
b. By KVL, $-V_G$ - (-110) + 40 = 0
   V_G = 150 V
   Now that we know the voltage across the unknown conductance G, we need only to find the current flowing through it.
   KCL provides us with the means to find this current: The current flowing into the “+” terminal of the –110-V source is 12.5 + 6 = 18.5 A.
   Then, I_x= 18.5 – 5 = 13.5 A
   By Ohm’s law, I_x= G · V_G
   So G = 13.5/ 150 or G = 90 mS

2.116 Find I_0 in the network in Fig. P2.116.

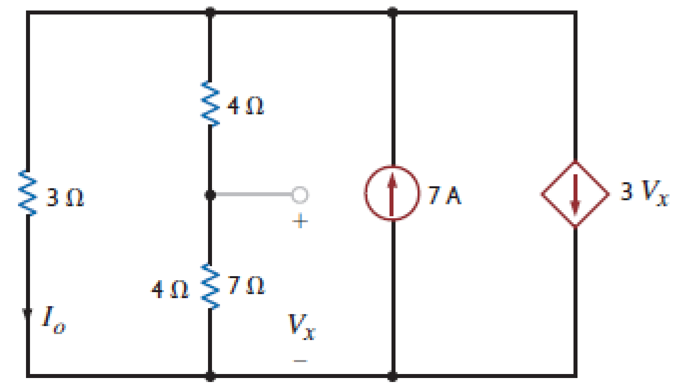
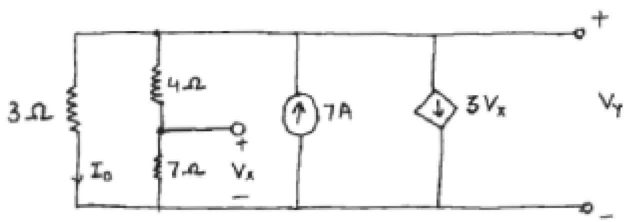


Figure P2.116

SOLUTION:



$$7 = 3V_x + \frac{V_y}{11} + \frac{V_y}{3} \quad \ldots\ldots (1)$$

$$V_x = V_y\left[\frac{7}{7+4}\right] = \frac{7}{11}V_y$$

$$V_x = \frac{7}{11}V_y \quad \ldots\ldots\ldots\ldots (2)$$

Substituting (2) into (1) $\Rightarrow$ $V_y = 3\ V$

$I_0 = \frac{V_y}{3} \Rightarrow \boxed{I_0 = 1\ A}$

2.117 A typical transistor amplifier is shown in Fig. P2.117. Find the amplifier gain G (i.e., the ratio of the output voltage to the input voltage).

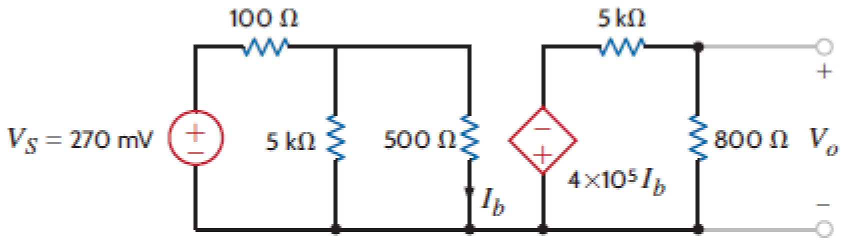
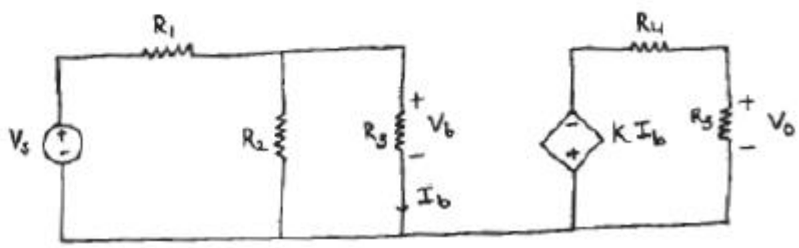


Figure P2.117

SOLUTION:



$V_s = 0.27$ V, $R_1 = 100\,\Omega$, $R_2 = 5\text{k}\Omega$, $R_3 = 500\,\Omega$,

$K = 4\times10^5$, $R_4 = 5\text{k}\Omega$, $R_5 = 800\,\Omega$

$$V_b = V_s \left[\frac{R_2 \| R_3}{R_1 + (R_2 \| R_3)}\right] = 0.221 \text{ V}$$

$$I_b = \frac{V_b}{R_3} = 442\ \mu\text{A}$$

$$V_o = -K I_b \left[\frac{R_5}{R_4 + R_5}\right] \Rightarrow V_o = -24.386 \text{ V}$$

$$G = \frac{V_o}{V_s} = -90.319$$

$$\boxed{G = -90.3}$$

2.118 Find the value of k in the network in Fig. P2.118, such that the power supplied by the 6-A source is 108 W.

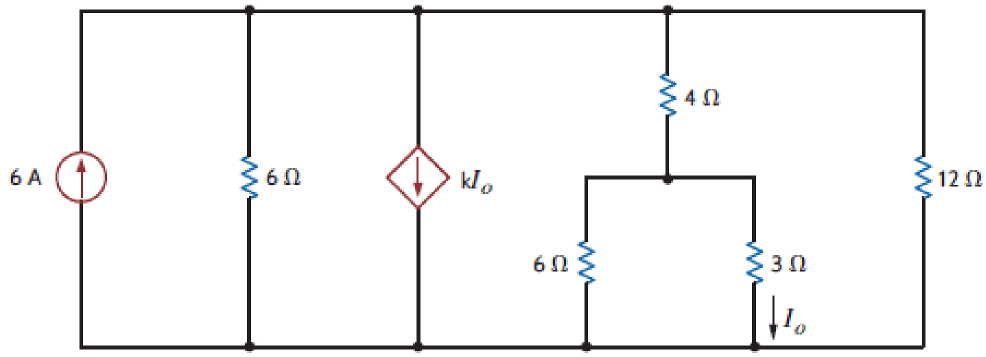
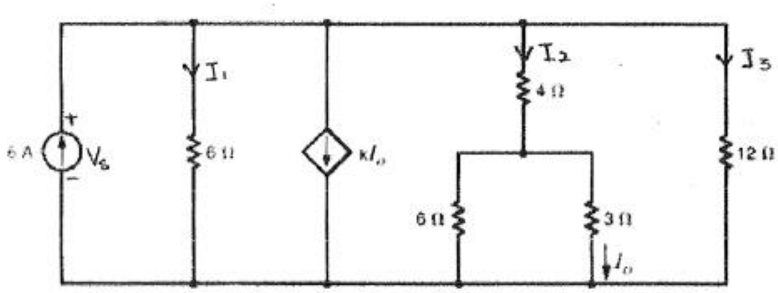


Figure P2.118

SOLUTION:



$$P_{6A} = V_s I_s$$

$$V_s = \frac{108}{6} = 18V$$

KCL:

$$6 = \frac{V_s}{6} + K I_o + \frac{V_s}{4+(6\|3)} + \frac{V_s}{12}$$

$$6 = \frac{18}{6} + K I_o + 36 + 18$$

$$12 K I_o = -18$$

$$K I_o = -1.5V$$

$$I_2 = \frac{V_S}{4+(6\|3)} = \frac{18}{4+2} = 3A$$

$$I_o = \left(\frac{6}{3+6}\right) I_2 = \left(\frac{6}{3+6}\right)(3)$$

$$I_o = 2A$$

$$K = \frac{-1.5}{2}$$

$$K = -0.75$$

2.119 Find the power supplied by the dependent current source in Fig. P2.119.

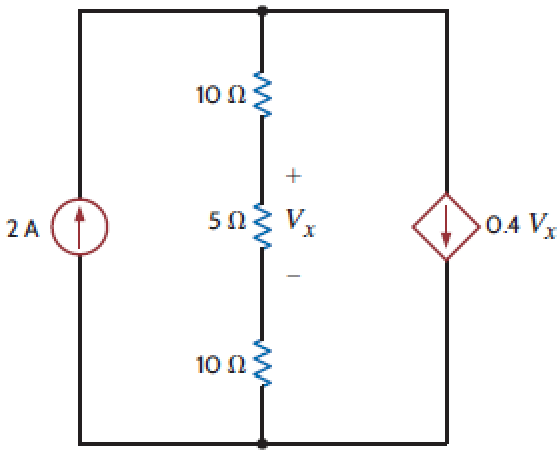
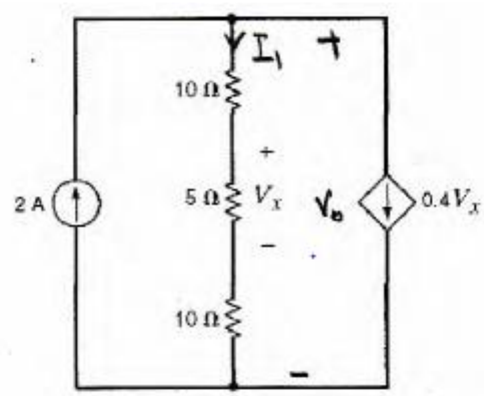


Figure P2.119

SOLUTION:



$2 = I_1 + 0.4 V_x \qquad V_x = 5 I_1$

$2 = I_1 + (0.4)(5I_1) = I_1 + 2I_1$

$2 = 3I_1 \quad I_1 = 2/3 = 0.667\,A$

$0.4 V_x = 2 - I_1 = 2 - 0.667 = 1.333\,A$

$V_0 = 25 I_1 = 25(0.667) = 16.67\,V$

$P_{absorbed}$ by dependent current source:

$$P = (16.67)(1.333) = 22.22\ W$$

$P_{supplied}$ by dependent current source:

$$P_{sup} = -22.22\ W$$

2.120 Find the power absorbed by each circuit element in Fig. P2.120, if the control for dependent source is
a. $0.8I_x$ b. $0.8I_y$

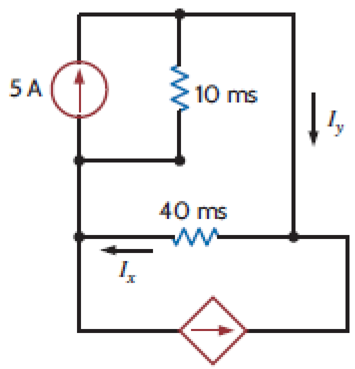


Figure P2.120

SOLUTION:

Define a voltage v_x, "+" reference on the right, across the dependent current source.
Note that in fact v_x appears across each of the four elements. We first convert the 10 mS conductance into a 100–Ω resistor, and the 40–mS conductance into a 25–Ω resistor

a. Applying KCL, we sum the currents flowing into the right–hand node:
$5 – v_x / 100 – v_x / 25 + 0.8\, i_x = 0$
This represents one equation in two unknowns. A second equation to introduce at this point is
$i_x = v_x /25$ so that above becomes
$5 – v_x / 100 – v_x / 25 + 0.8 (v_x / 25) = 0$
Solving for v_x, we find $v_x = 277.8$ V. It is a simple matter now to compute the power absorbed by each element:

P5A	$= –5\, v_x$	= –1.389 kW
P100Ω	$= (v_x)2 / 100$	= 771.7 W
P25Ω	$= (v_x)2 / 25$	= 3.087 kW
Pdep	$= –v_x(0.8\, i_x) = –0.8\, (v_x)^2 / 25$	= –2.470 kW

a. Again summing the currents into the right–hand node
$5 – v_x / 100 – v_x / 25 + 0.8\, i_y = 0$
where$i_y = 5 – v_x /100$

Thus, above becomes

$5 - v_x / 100 - v_x / 25 + 0.8(5) - 0.8 (i_y) / 100 = 0$

Solving, we find that v_x x = 155.2 V and i_y = 3.448 A

P_{5A}	$= -5\ v_x$	= –776.0 W
$P_{100\Omega}$	$= (v_x)^2 / 100$	= 240.9 W
$P_{25\Omega}$	$= (v_x)^2 / 25$	= 963.5 W
P_{dep}	$= -v_x (0.8\ i_y)$	= –428.1 W

$5 - v_x / 100 - v_x / 25 + 0.8(5) - 0.8 (i_y) / 100 = 0$

Solving, we find that v_x x = 155.2 V and i_y = 3.448 A

P_{5A}	$= -5\ v_x$	= –776.0 W
$P_{100\Omega}$	$= (v_x)^2 / 100$	= 240.9 W
$P_{25\Omega}$	$= (v_x)^2 / 25$	= 963.5 W
P_{dep}	$= -v_x (0.8\ i_y)$	= –428.1 W

2.121 The power supplied by the 2-A current source in Fig. P2.121 is 50 W, calculate k.

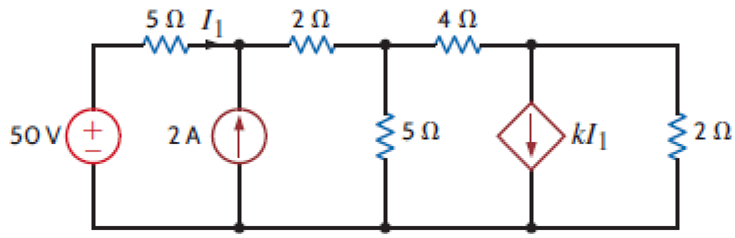
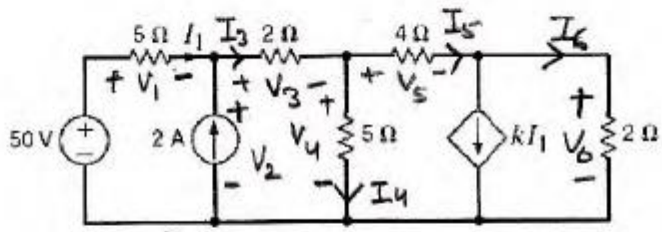


Figure P2.121

SOLUTION:

(See Next Page)



$50 = 2V_2 \qquad V_2 = 25V$

$V_1 = 50 - 25 = 25V \qquad I_1 = \frac{V_1}{5} = 5A$

$I_3 = I_1 + 2 = 7A$

$V_3 = 2I_3 = 14V$

$V_4 = -V_3 + V_2 = -14 + 25 = 11V$

$I_4 = \frac{V_4}{5} = \frac{11}{5} = 2.2A$

$I_5 = I_3 - I_4 = 7 - 2.2 = 4.8A$

$V_5 = 5I_5 = 19.2V$

$V_6 = -V_5 + V_4 = -19.2 + 11 = -8.2V$

$I_6 = \frac{V_6}{2} = \frac{-8.2}{2} = -4.1A$

$kI_1 = I_5 - I_6 = 4.8 - (-4.1) = 8.9A$

$KI_1 = 8.9$

$K = \frac{8.9}{I_1} = \frac{8.9}{5} = \underline{1.78}$

2.122 Given the circuit in Fig. P2.122, solve for the value of k.

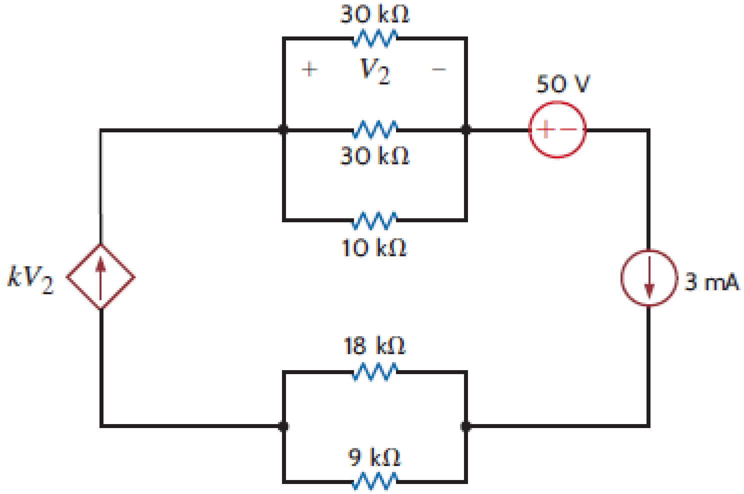
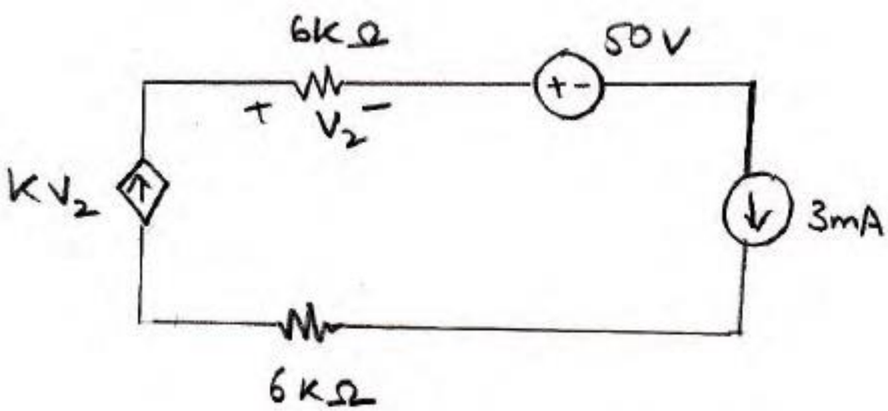


Figure P2.122

SOLUTION:



$$V_2 = (6k)(3m) = 18V$$

$$kV_2 = 3m$$

$$k = \frac{3\times10^{-3}}{18} = \frac{1}{6}\times10^{-3}$$

$$= 1.667\times10^{-4}$$