1. (a) 5 nodes

   (b) 6 elements

   (c) 6 branches

2. (a) 4 nodes;

(b) 7 elements;

(c) 7 branches (we omit the 2 Ω resistor as it is not associated with a path in our definition)

3. (a) 4 nodes

(b) path, yes; loop, no

(c) path, no; loop, no

4. (a) 6 elements;

(b) path, yes; loop, no.

(c) path, yes; loop, no.

5. (a) 4 nodes

(b) 4 elements

(c) 4 branches

(d) i) neither; ii) path only;

iii) both path and loop; iv) neither ('c' encountered twice).

6. The parallel-connected option would allow most of the sign to still light even if one or more individual bulbs burn out. For that reason, it would be more useful to the owner.

7. By KCL, $iA - iB + iC + iD - iE = 0$. Thus,

(a) $1 - iB + 3 - 2 - 0 = 0$ so $iB =$ 2 A.

(b) $-1 - (-1) - 1 - 1 - iE = 0$ so $iE =$ -2 A

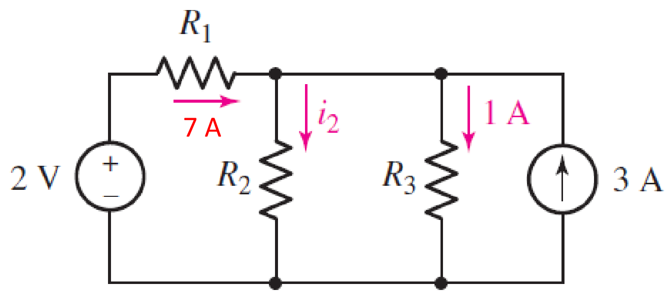
8. (a) By KCL, $7 = 6 + I$ so $I = \boxed{1\text{ A}}$

(b) By KCL, $2 = 3 + I + 3$ so $I = \boxed{-4\text{ A}}$.

(c) No *net* current can flow through the resistor or KCL would be violated.

Hence, $\boxed{I = 0.}$

9. We note that KCL requires that if 7 A flows out of the "+" terminal of the 2 V source, it flows left to right through R1. Equating the currents into the top node of R2 with the currents flowing out of the same node, we may write



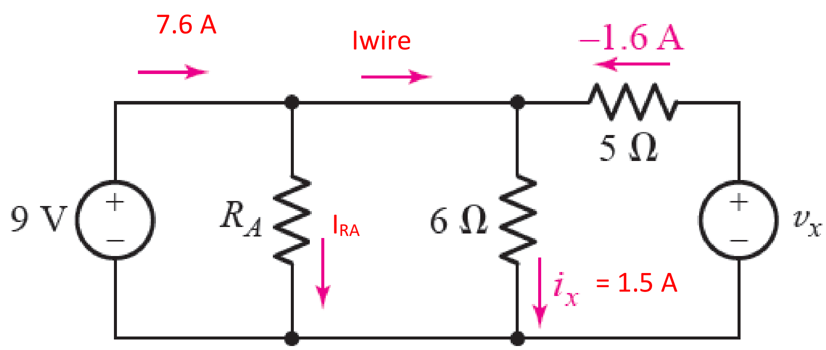
7 + 3 = i2 + 1

or

i2 = 10 – 1 = **9 A**

10. By KCL, $iA + iB + iC = i_{battery} + i_{sign}$. Hence, $i_{battery} = iA + iB + iC - i_{sign} =$ 8.3 A.

11. We can determine RA from Ohm's law if either the voltage across, or the current through the element is known. The problem statement allows us to add labels to the circuit diagram:



Applying KCL to the common connection at the top of the 6 Ω resistor,
Iwire = 1.5 – (-1.6) = 3.1 A

Applying KCL to the top of RA then results in

I_{RA} = 7.6 – Iwire = 7.6 – 3.1 = 4.5 A.

Since the voltage across RA = 9 V, we find that RA = 9/4.5 = **2 Ω**

12. By KCL,

$$IB + IC = IE \quad [1].$$

Given that IC = 1.5 mA, we are left with one equation in two unknowns.

Noting that IC = 50 IB, we may rewrite Eq. [1] as

IC/50 + IC = IE. Solving, IE = 1.53 mA, and IB = IC/50 = 0.03 mA.

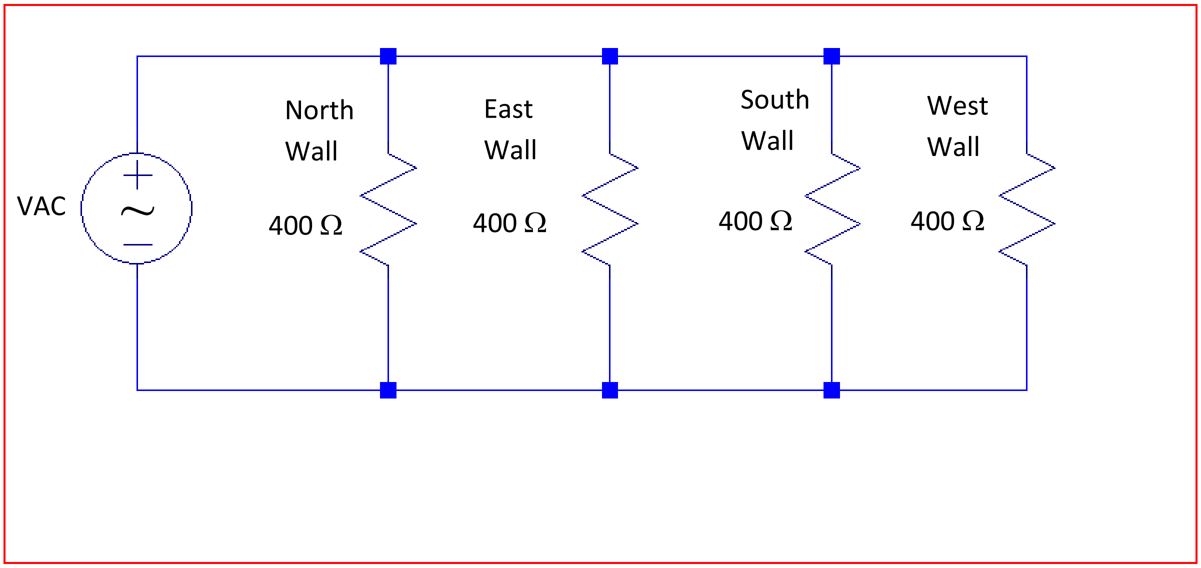
13. By inspection, I3 = –5Vx due to the action of the dependent source.

$Vx = (2\times10^{-3})(4.7\times10^{3}) = 9.4$ V

Hence, I3 = –47 A

14. With finite values of R1 some value of current I will flow out of the source and through the left-most resistor. If we allow some small fraction of that current kI (k < 1) to flow through the resistor connected by a single node, to where does the current continue? With nowhere for the current to go, KCL is violated. At best we must imagine an equal current flowing the opposite direction, yielding a **net** current of zero. Consequently, Vx must be zero.

15. The order of the resistors in the schematic below is unimportant.



16. (a) -v1 + v2 – v3 = 0

Hence, v1 = v2 – v3 = 0 + 17 = **17 V**

(d) v1 = v2 – v3 = -2 – 2 = **-4 V**

(e) v2 = v1 + v3 = 7 + 9 = **16 V**

(f) v3 = -v1 + v2 = 2.33 – 1.70 = **0.63 V**

17. (a) By KVL, $+9 + 4 + vx = 0$

Therefore $vx = -13$ V

From Ohm's law, $ix = vx/7 = -13/7 = -1.86$ A

(b) By KVL, $+2 + (-7) + vx = 0$. Thus, $vx = 5$ V.

Using Ohm's law, $ix = vx/8 = 625$ mA.

18. (a) Combining KVL and Ohm's law,

-1 + 2 + 2i – 5 + 10i = 0

Hence, 12i = 4 so i = **333 mA**

(b) Again combining KVL and Ohm's law,

10 + 2i – 1.5 + 1.5 + 2i + 2i + 2 + 2i – 1 + 2i = 0

Hence, i = -11/10 so i = **–1.1 A**

19. From KVL, $+4 - 23 + vR = 0$ so $vR = 23 - 4 = 19$ V

Also, $-vR + 12 + 1.5 - v2 - v3 + v1 = 0$
or $-19 + 12 + 1.5 - v2 - 1.5 + 3 = 0$

Solving, $v2 = -4$ V

20. Vdep = V2 – 1000IC – 1000IC.

With V2 = 15 V, IC = 50IB = $50(20\times10^{-6})$ = 0.001 A

Therefore,

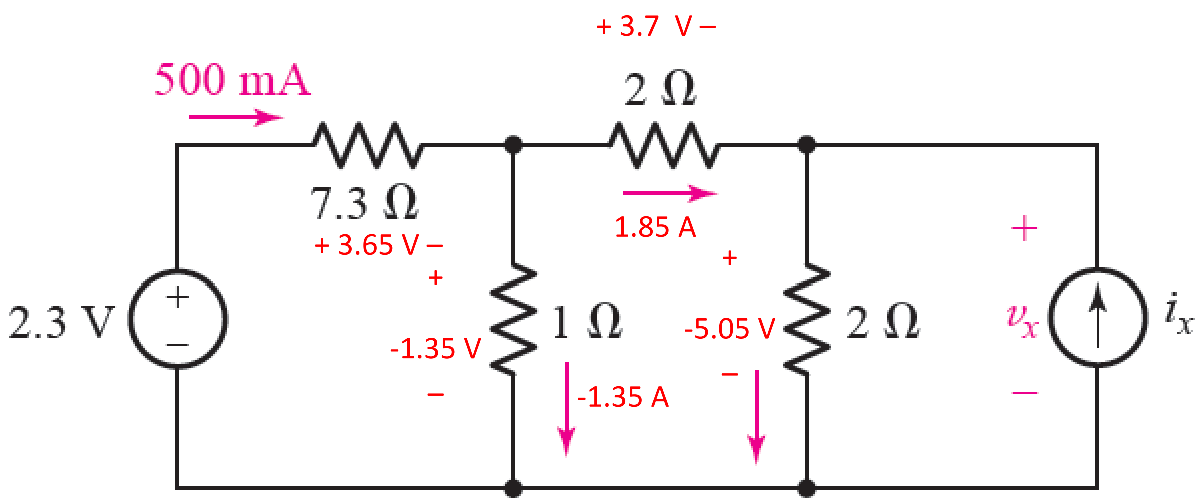
$$\text{Vdep} = 15 - 2000(0.001) = \boxed{13\text{ V.}}$$

21. We apply KCL/KVL and Ohm's law alternately, beginning with the far left. Knowing that 500 mA flows through the 7.3 Ω resistor, we calculate 3.65 V as labelled below. Then application of KVL yields 2.3 – 7.3 = –1.35 V across the 1 Ω resistor.

This tells us that -1.35/1 = -1.35 A flows downward through the 1 Ω resistor. KCL now tells us that 0.5 – (–1.35) = 1.85 flows through the top 2 Ω resistor. Ohm's law dictates a voltage of 3.7 V across this resistor in this case.

Application of KVL determines that –(–1.35) + 3.7 + v2 = 0 or -5.05 V appears across the right-most 2 Ω resistor, as labelled below. Since this voltage also appears across the current source, we know that

$$V_x = -5.05 \text{ V}$$



22. (a) By KVL, $-vs + v1 + v2 = 0$ [1]
Define a clockwise current I. Then $v1 = IR1$ and $v2 = IR2$.

Hence, Eq. [1] becomes

$$-vs + IR1 + IR2 = 0$$

Thus, $vs = (R1 + R2)I$ and $I = v1/R1$
so $vs = (R1 + R2)v1/R1$ or $v1 = vsR1/(R1 + R2)$. QED

Similarly, $v2 = IR2$ so we may also write,

$vs = (R1 + R2)v2/R1$ or $v2 = vsR2/(R1 + R2)$. QED

(Proof, so final answer was given to begin with.)

(b) $R1 > 0$.

23. (a) By inspection:

$v_1 = 2$ V; $v_2 = 2$ V;

i2 = 2/6 = 333 mA

i3 = 5v1 = 10 A

i1 = i2 + i3 = 10.33 A

v4 = v5 = 5i2 = 5(1/3) = 5/3 V

i5 = (5/3)/5 = 333 mA

i3 = i4 + i5 therefore i4 = i3 – i5 = 10 – 1/3 = 9.67 A

-v2 + v3 + v4 = 0 therefore v3 = v4 + v2 = 6/3 = 333 mV

(b) Using the passive sign convention (assuming all elements absorb power):

v1(-i1) + v2(i2) + v3(i3) + v4(i4) + v5(i5) = 0 (should be true, within rounding error).

= -62/3 + 2/3 + 10/3 + 145/9 + 5/9 = 0, so true.

24. Define the current I flowing out of the "+" reference terminal of the 5 V source. This current also flows through the 100 Ω and 470 Ω resistors since no current can flow into the input terminals of the op amp.

Then, $-5 + 100I + 470I + vout = 0$ [1]

Further, since Vd = 0, we may also write

$-5 + 100I = 0$ [2]

Solving, $Vout = 5 - 570I = 5 - 570(5/100) = \boxed{-23.5 \text{ V}}$

25. With a clockwise current i, KVL yields

$-(-8) + (1)i + 16 + 4.7i = 0$

Therefore, $i = -(16 - 8)/5.7 =$ **-4.21 A**

Absorbed power:

Source vs1: $+(-8)(+4.21) =$ **-33.68 W**

Source vs2: $(16)(-4.21) =$ **-67.36 W**

R1: $(4.21)^2(1) =$ **17.21 W**

R2: $(4.21)^2(4.7) =$ **83.30 W**

Check: The sum of the above 'absorbed' powers = -0.02, which is within rounding error of zero, as expected.

26. Define a clockwise current I. Then, KVL yields

$-12 + 2i + 3i + 5i + 2 + I - 4 = 0$

Hence, I = 14/11 = 1.27 A.

Using the passive sign convention to compute power absorbed:

P12V = (12)(-1.27)	= -15.24 W
$P2\Omega = 2i^2$	= 3.23 W
$P3\Omega = 3i^2$	= 4.84 W
$P5\Omega = 5i^2$	= 8.06 W
P2V = 2(i)	= 2.54 W
P4V = 4(-i)	= -5.8 W
$P1\Omega = (1)i^2$	= 1.61 W

Summing these yields -0.04 W, which is within rounding error of zero, as expected.

27. Define a clockwise current I

Then invoking KVL and Ohm's law we may write

$500I - 2 + 1000I + 3vx + 2200I = 0$

Since vx = -500I, the above equation can be recast as

$500I - 2 + 1000I - 1500I + 2200I = 0$

Solving, I = 2/2200 = 909.1 μA

ABSORBED POWER

500 Ω:	$500(I^2)$	= 413.2 μW
2 V source:	(2)(-I)	= -1.818 mW
1 kΩ:	$(1000)(I^2)$	= 826.5 μW
Dep source:	[(3)(-500I)](I)	= -1.240 mW
2.2 kΩ:	$(2200)(I^2)$	= 1.818 mW

28. (a) By KVL, -12 + 27ix + 33ix + 13ix + 2 + 19ix = 0
Hence, ix = 10/92 = 108.7 mA

Element	$P_{absorbed}$	(W)
12 V	(12)(-0.1087) =	-1.304
27 Ω	$(27)(0.1087)^2$ =	0.3190
33 Ω	$(33)(0.1087)^2$ =	0.3899
13 Ω	$(13)(0.1087)^2$ =	0.1536
19 Ω	$(19)(0.1087)^2$ =	0.2245
2 V	(2)(0.1087) =	0.2174

(b) By KVL, -12 + 27ix + 33ix + 4v1 + 2 + 19ix = 0
and v1 = 33ix. Solving together, ix = 10/211 = 47.39 mA

Element	$P_{absorbed}$ (W)
12 V	-0.5687
27 Ω	0.06064
33 Ω	0.07411
Dep source	0.2964
19 Ω	0.04267
2 V	0.09478

(c) By KVL, -12 + 27ix + 33ix + 4ix + 2 + 19ix + 2= 0
Solving, ix = 10/83 = 120.5 mA

Element	$P_{absorbed}$ (W)
12 V	-1.446
27 Ω	0.3920
33 Ω	0.4792
Dep source	0.05808
19 Ω	0.2759
2 V	0.2410

29. A simple KVL equation for this circuit is

$$-3 + 100I_D + V_D = 0$$

Substituting in the equation which related the diode current and voltage,

$$-3 + (100)(45\times10^{-9})\left(e^{V_D/27\times10^{-3}} - 1\right)$$

Solving either by trial and error or using a scientific calculator's equation solver,

$$V_D = \boxed{359 \text{ mV}}$$

which then allows us to use the diode equation to compute $I_D = \boxed{26.38 \text{ mA}}$.

30. (a) KCL yields $3 - 7 = i1 + i2$

or, $-4 = v/4 + v/2$

Solving, $v = -5.333$ V

Thus, $i1 = v/4 =$ **–1.333 A** and $i2 = v/2 =$ **–2.667 A**

(b)

Element	**Absorbed Power**		
3 A	(-5.333)(-3)	=	16.00 W
7 A	(-5.333)(7)	=	-37.33 W
4 Ω	$(4)(-1.333)^2$	=	7.108 W
2 Ω	$(2)(-2.667)^2$	=	14.23 W

31. Consider the currents flowing INTO the top node. KCL requires

$-2 - i1 - 3 - i2 = 0$

Or $i1 + i2 = -5$ [1]

Also, $i1 = v/10$ and $i2 = v/6$ so Eq. [1] becomes

$v/10 + v/6 = -5$

Solving, $v = \boxed{-18.75 \text{ V}}$

Thus the power supplied by the –2 A source is $(-2)(-18.75) = \boxed{37.5 \text{ W}}$

and the power supplied by the 3 A source is $-(3)(-18.75) = \boxed{56.25 \text{ W}}$

32. Define ix as the current through X, pointing downward.
By KCL,

$1 – v/5 – ix – v/5 + 2 = 0$
or
$3 – (2/5)v – ix = 0$

(a) The current source sets ix = 2 A.
Thus, $v = (3 – ix)(5/2) =$ **2.5 V**

(b) v = **2 V**, by inspection.

(c) ix = 2V therefore

$3 – (2/5)v – 2v = 0$
Solving,
$V = 15/12\ V =$ **1.25 V**

33. Summing the currents flowing into the top node, KCL yields

–v/1 + 3ix + 2 – v/3 = 0 [1]

Also, ix = -v/3. Substituting this into Eq. [1] results in

–v –v + 2 – v/3 = 0

Solving, v = 6/7 V (857 mV)

The dependent source supplies power = (3ix)(v)
= (3)(–v/3)(v) = –36/49 W (-735 mW)

The 2 A source supplies power = (2)(v) = 12/7 W = (1.714 W)

34. Define the center node as +v; the other node is then the reference terminal.

KCL yields $3\times10^{-3} - 5\times10^{-3} = \frac{v}{1000} + \frac{v}{4700} + \frac{v}{2800}$

Solving, v = –1.274 V

(a)

R	**Pabsorbed**
1 kΩ	1.623 mW
4.7 kΩ	345.3 μW
2.8 kΩ	579.7 μW

(b)

Source	**P absorbed**	
3 mA	$(v)(3\times10^{-3})$	= –3.833 mW
5 mA	$(v)(-5\times10^{-3})$	= +6.370 mW

(c) $\sum P_{absorbed} = 2.548$ mW

$\sum P_{supplied} = 2.548$ mW

Thus, $\sum P_{supplied} = \sum P_{absorbed}$.

35. By KVL, veq = v1 + v2 – v3

(a) veq = 0 – 3 – 3 = **–6 V;**

(b) veq = 1 + 1 – 1 = **1 V;**

(c) veq = -9 + 4.5 – 1 = **–5.5 V**

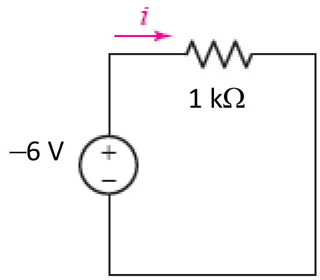
36. KCL requires that ieq = i1 – i2 + i3

(a) ieq = 0 + 3 + 3 = **6A**

(b) ieq = 1 – 1 + 1 = **1 A**

(c) ieq = –9 – 4.5 + 1 = **–12.5 A**

37. The voltage sources are in series, hence they may be replaced with veq = –2 + 2 – 12 + 6 = –6 V. The result is the circuit shown below:



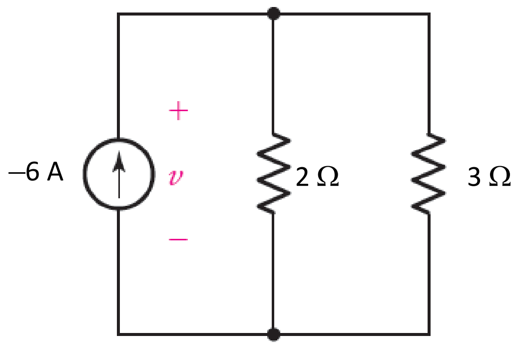
Analyzing the simplifed circuit, i = –6/1000 = **–6 mA**

38. We may first reduce the series connected voltage sources, or simply write a KVL equation around the loop as it is shown:

$+2 + 4 + 7i + v1 + 7i + 1 = 0$

Setting $i = 0$, $v1 =$ $\boxed{-7\text{ V}}$

39. The current sources are combined using KCL to obtain $i_{eq} = 7 - 5 - 8 = -6$ A. The resulting circuit is shown below.



(a) KCL stipulates that $-6 = \frac{v}{2} + \frac{v}{3}$ v.

Solving, $v = -36/5$ V

(b) $P_{supplied}$ by equivalent source = (v)(-6) = 43.2 W

Source	**$P_{supplied}$ (W)**	
7 A source	(7)(-36/5)	= –50.4 W
5 A source	(-5)(-36/5)	= 36 W
8 A source	(-8)(-36/5)	= 57.6 W
		43.2 W so confirmed.

40. We apply KCL to the top node to write

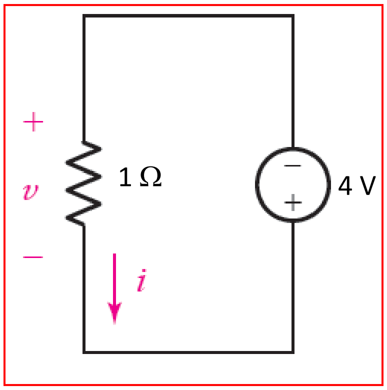
$1.28 - 2.57 = v/1 + Is + vs/1$

Setting v = 0, we may solve our equation to obtain $Is = -1.29$ A

41. (a) Employing KCL, by inspection Ix = 3 A; Vy = 3 V

(b) Yes. Current sources in series must carry the same current. Voltage sources in parallel must have precisely the same voltage.

(c)



(all other sources are irrelevant to determining i and v).

42. Left-hand network: $1 + 2 \parallel 2 = 1 + 1 = \boxed{2\ \Omega}$

Right-hand network: $4 + 1 \parallel 2 + 3 = 4 + 0.6667 + 3 = \boxed{7.667\ \Omega}$

43. For Fig. 3.82(a), Req = 1 + 2 || R = 1 + 2R/(R + 2)

(a) R = 2 Ω so Req = 2 Ω
(b) R = 4 Ω so Req = 2.33 Ω
(c) R = 0 Ω so Req = 1 Ω

For Fig. 3.82(b), 1/Req = 1 + 1/R + 1/3

(a) R = 2 Ω so Req = 0.545 Ω
(b) R = 4 Ω so Req = 0.632 Ω
(c) R = 0 Ω so Req = 0.750 Ω

44. (a) The 4 resistors may be replaced with a single resistor having value

$2 + 7 + 5 + 1 =$ $\boxed{15\ \Omega.}$

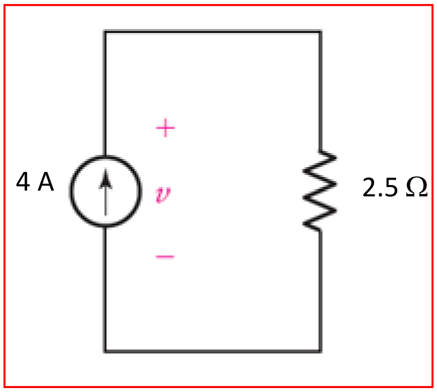
(b) $I = (3 - 1)/ 15 =$ $\boxed{133.3\text{ mA}}$

(c) $\boxed{3\text{ V}}$

(d) $P_{1\Omega} = i^2R =$ $\boxed{17.78\text{ mW}}$

45. KCL yields ieq = -2 + 5 + 1 = 4 A
And Req = 5 || 5 = 2.5 Ω

(a)



(b) Ohm's law yields v = (4)(2.5) = 10 V

(c) Power *supplied* by 2 A source = (–2)(10) = –20 W

46. We can create an effective resistance by making the following combination to appear in parallel with the 1 A source:

6 || 3 1 + 5 + 3 ||6 = 10 Ω.

Noting that 3 || 10 || 5 = 1.579 Ω, we can compute vx = (1)(1.579) = 1.579 V.

Then, i3 = vx/3 = 536.3 mA.

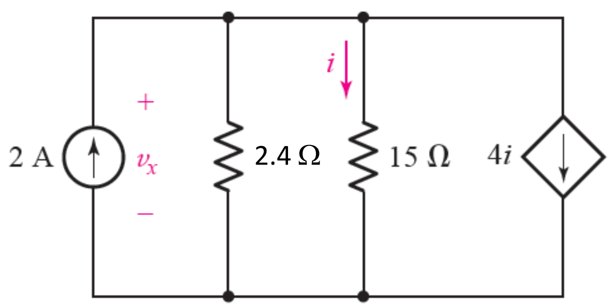
47. At the far right we have the resistor combination 9 + 6 || 6 = 9 + 3 = 12 Ω.
After this, we have three resistors in parallel but should not involve the 15 Ω resistor as it controls the dependent source. Thus, R_{eq}^{-1} = 1/3 + 1/12 and R_{eq} = 2.4 Ω.
The simplified circuit is shown below.
Summing the currents flowing into the top node,

$$2-\frac{v_x}{2.4}-\frac{v_x}{15}-4i=0 \quad [1]$$

Since i = v_x/15, Eq. [1] becomes

$$2-\frac{v_x}{2.4}-\frac{v_x}{15}-\frac{4}{15}v_x=0$$

Solving, v_x = 2.667 V



48. We combine the left-hand set of resistors: $6 + 3 \parallel 15 = 8.5\ \Omega$
The independent sources may be combined into a single 4 + 3 – 9 = -2 A source (arrow pointing up). We leave the 6 Ω resistors; at least one has to remain as it controls the dependent source. A voltage v is defined across the simplified circuit, with the + terminal at the top node.

Applying KCL to the top node,

$$-2 - 2i = v/8.5 + v/6 + v/6 \qquad [1]$$

where i = v/6. Thus, Eq. [1] becomes $-2 - 2v/6 = v/8.5 + 2v/6$ or v = -2.55 V.

We have lost the 15 Ω resistor temporarily, however. Fortunately, the voltage we just found appears across the original resistor combination we replaced. Hence, a current -2.55/8.5 = -0.3 A flows downward through the combination.

Hence, the voltage across the 3 Ω || 15 Ω combination is

$$v - 6(-0.3) = -0.75 \text{ V}$$

Thus, $P_{15\Omega} = (-0.75)^2/15$ = **37.5 mW**

49. Starting from the far right, we define $R_A = R_7 \parallel [R_8 + R_{10} \parallel R_{11} + R_9]$

$$= 10 \parallel [10 + 10\parallel 10 + 10] = 10 \parallel 25 = 7.143\ \Omega.$$

Next, $R_4 \parallel [R_5 + R_A + R_6] = 10 \parallel [10 + 7.143 + 10] = 7.308\ \Omega$

Finally, $R_{eq} = R_1 \parallel [R_2 + 7.308 + R3] = \boxed{7.32\ \Omega}$

50. Four 100 Ω resistors may be combined as:

(a) 25 Ω = 100 Ω || 100 Ω || 100 Ω || 100 Ω

(b) 60 Ω = [(100 Ω || 100 Ω) + 100 Ω] || 100 Ω

(c) 40 Ω = (100 Ω + 100 Ω) || 100 Ω || 100 Ω

51. (a) v2 = v1 – v2 = 9.2 – 3 = **6.2 V**

(b) v1 = v – v2 = 2 – 1 = **1 V**

(c) v = v1 + v2 = 3 + 6 = **9 V**

(d) v1 = vR1/(R1 + R2) = v2R2/(R1 + R2).

Thus, setting v1 = v2 and R1 = R2, R1/R2 = **1**

(e) v2 = vR2/(R1 + R2) = vR2/(2R2 + R2) = v/3 = **1.167 V**

(f) v1 = vR1/(R1 + R2) = (1.8)(1)/(1 + 4.7) = **315.8 mV**

52. (a) $i1 = i - i2 = 8 - 1 = \boxed{7A}$

(b) $v = i(R1 \parallel R2) = i(50\times10^3) = \boxed{50\ V}$

(c) $i2 = iR1/(R1 + R2) = (20\times10^{-3})(1/5) = \boxed{4\ mA}$

(d) $i1 = iR2/(R1 + R2) = (10)(9)/18 = \boxed{5A}$

(e) $i2 = iR1/(R1 + R2) = (10)(10\times10^6)/(10\times10^6 + 1) = \boxed{10\ A}$

53. **One** possible solution: Choose v = 2 V. Then

R1 = v/i1 = 2 Ω

R2 = v/i2 = 1.67 Ω

R3 = v/i3 = 250 mΩ

R4 = v/i4 = 645 mΩ

54. First, replace the 2 Ω || 10 Ω combination with 1.66 Ω. Then

$$v_x = 3\frac{2}{2+3+1.667} = \boxed{900\text{ mV}}$$

55. Employing voltage division,

$V_{3\Omega} = (9)(3)/(1 + 3 + 5 + 7 + 9) = \boxed{1.08 \text{ V}}$

$V_{7\Omega} = (9)(7)/(1 + 3 + 5 + 7 + 9) = \boxed{2.52 \text{ V}}$

56. We begin by simplifying the circuit to determine i1 and i2.
We note the resistor combination (4 + 4) || 4 + 5 = 8 || 4 + 5 = 7.667 Ω.
This appears in parallel with the 1 Ω and 2 Ω resistors, and experiences current i2.

Define the voltage v across the 25 A source with the '+' reference on top. Then,

$$25 = \frac{v}{1} + \frac{v}{2} + \frac{v}{7.667}$$

Solving, v = 15.33 V. Thus, i1 = 25 – v/1 = 9.67 A
i2= i1 – v/2 = 2.005 A

Now, from current division we know i2 is split between the 4 Ω and 4 Ω + 4 Ω = 8 Ω branches, so we may write

v3 = 4[4i2/(4 + 8)] = 2.673 V

57. We may do a little resistor combining:

2 kΩ || 4 kΩ = 8/6 kΩ

3 kΩ || 7 kΩ = 21/10 kΩ

The 4 kΩ resistor is in parallel with the series combination of 8/6 + 3 + 21/10 = 6.433 kΩ. That parallel combination is equivalent to 2.466 kΩ.

Thus, voltage division may be applied to yield

$v_{4k\Omega}$ = (3)(2.466)/(1 + 2.466) = 2.134 V

and v_x = (2.134)(21/10)/(8/6 + 3 + 21/10) = **697.0 mV**

58. We *could* use voltage division for determining those voltages if $i_B = 0$. Since it is *nonzero* (presumably – circuit analysis will verify whether this is the case), we do not have equal currents through the two resistors, hence voltage division is not valid.

59. (a) $i_{1k\Omega} = (-g_m v_\pi)(10/11)$ where $v_\pi = 12\times10^{-3}$ (15/18) cos1000t

Thus, $i_{1k\Omega}$ = -10.9cos1000t μV

(b) $v_{out} = (1\times10^3)\ i_{1k\Omega}$ = -10.9 cos1000t mV

(c) $|v_{out}|/|v_s|$ = 10.9/12 < 1, so no, it does not amplify (in terms of voltage magnitude).

(d) $|v_{out}|/|v_\pi|$ = 10.9/10 > 1, so yes.

60. $v_{out} = (3.3\times10^3)(-g_m\, v_\pi) = (3.3\times10^3)(-322\times10^{-3})v_\pi$

where $v_\pi = [6\times10^{-6} \cos 2300t]\,(45/18)/(1 + 45/18) = 4.286\times10^{-6} \cos 2300t$ V.

Thus, $v_{out} = \boxed{4.55 \cos 2300t \text{ mV}}$

61. (a) Looking to the right of the 10 Ω resistors, we see

$40 + 50 \parallel (20 + 47) = 68.63\ \Omega$

Further, the 10 Ω || 10 Ω can be replaced with a 5 Ω resistor without losing the desired voltage. Hence, v appears across 5 || 68.63 = 4.66 Ω

So $v = 20\,(4.66)/(20 + 4.66) = \boxed{3.78\text{ V}}$

(b) The 4 Ω resistor has been "lost" but we can return to the original circuit and note the voltage determined in the previous part. By voltage division, the voltage across the 50 Ω resistor is $v(50 \parallel 67)/(40 + 50 \parallel 67) = 1.57$ V.

$v_{47\Omega} = v_{50\Omega}\,(47)/(20 + 47) = 1.10\text{ V}$

Hence, the power dissipated by the 47 Ω resistor is $(v_{47\Omega})^2/4 = \boxed{25.7\text{ mW}}$

(d) No, the power consumption (26 mW) is far below the maximum rating of 250 mW.

62. (a) Define

$R_{eq} = 40 + 50 \parallel (20 + 47) = 68.63\ \Omega$

$R_{TOTAL} = 20 + 10 \parallel R_{eq} = 28.73\ \Omega$

$i_{total} = 20/R_{TOTAL} = 0.696$ A

By current division, $i_{40} = i_{total}\ (10/(10 + R_{eq}) =$ **8.5 mA**

(b) $P_{20}V = (20)i_{total} = (20)(0.696) =$ **13.92 W**

(d) $I_{50} = i_{40}\ (20 + 47)/[50 + (20 + 47)] = 0.0507$ A

$P_{50} = (i_{50})_2 \times 50 =$ **128 mW**

63. (a) 5 nodes; 6 loops; 7 branches;

(b) Define all currents as flowing either left to right or downward.
Note the combination $R_{eq} = 2/3 + 2 + 5 = 7.667\ \Omega$.

By inspection, $I_{2\Omega left} = -2$ A;

$I5_{\Omega(left)} = (-2)(7.667)/(5 + 7.667) = -1.21$ A;

$I_{2\Omega right} = I_{5\Omega} = (-2)(5)/(5 + 7.667) = -790$ mA;

The remaining currents are found by current division:

$I_{1\Omega} = -0.7895(2)/3 = -526$ mA;
$I_{2\Omega middle} = -0.7895(1)/3 = -263$ mA

(a) $V_{2A} = V_{2\Omega(left)} + V_{5\Omega(left)} = (-2)(2) + (-1.211)(5) = -10.06$ V.