1. For the circuit of Fig. 1: -

(*a*) Count the number of circuit elements.

(*b*) If we move from *B* to *C* to *D*, have we formed a path? Have we formed a loop?

(*c*) If we move from *E* to *D* to *C* to *B*, have we formed a path? Have we formed a loop?

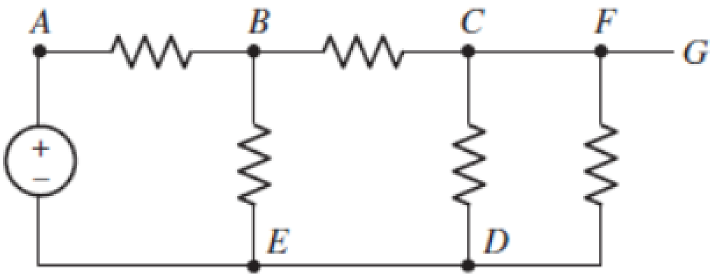


Fig. 1

(a) 4 nodes

(b) path, yes; loop, no

(c) path, yes; loop, no

2. Refer to the circuit of Fig. 2, and answer the following:

(*a*) How many distinct nodes are contained in the circuit?

(*b*) How many elements are contained in the circuit?

(*c*) How many branches does the circuit have?

(*d*) Determine if each of the following represents a path, a loop, both, or neither:

(*i*) *A* to *B*

(*ii*) *B* to *D* to *C* to *E*

(*iii*) *C* to *E* to *D* to *B* to *A* to *C*

(*iv*) *C* to *D* to *B* to *A* to *C* to *E*

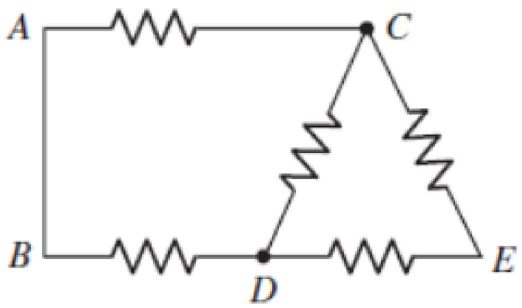


Fig. 2

(a) 4 nodes

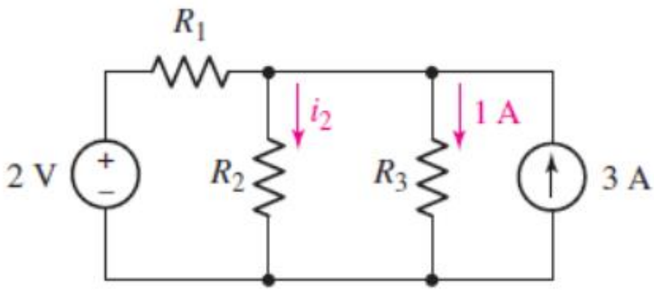
(b) 5 elements

(c) 5 branches

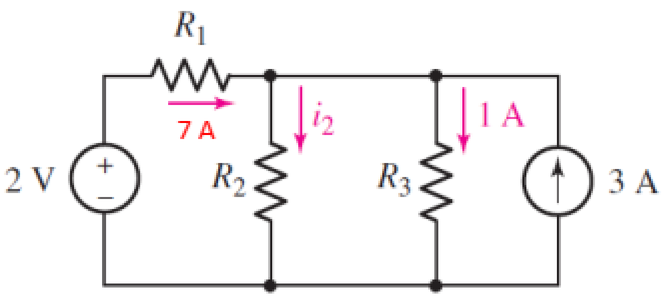
(d) i) neither (only one node) ; ii) path only;

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

3. In the circuit shown, the resistor values are unknown, but the 2 V source is known to be supplying a current of 7 A to the rest of the circuit. Calculate the current labelled i_2.



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

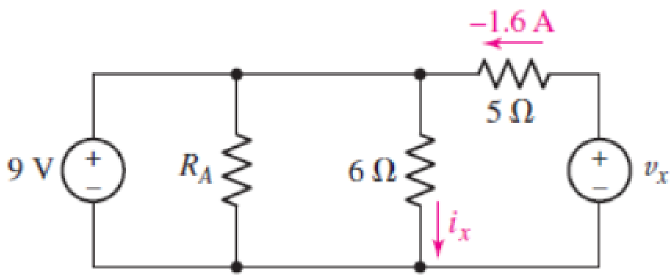


7 + 3 = i2 + 1

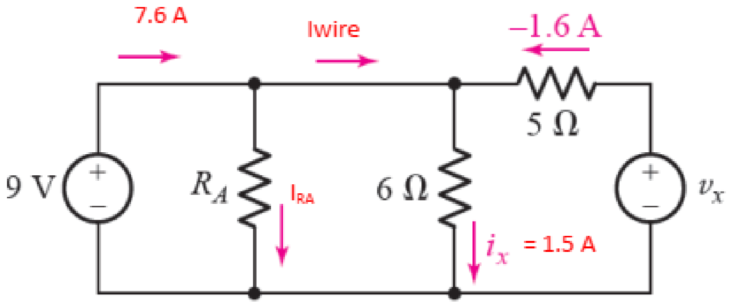
or

i2 = 10 – 1 = 9 A

4. In the circuit depicted below, i_x is determined to be 1.5 A, and the 9 V source supplies a current of 7.6 A (that is, a current of 7.6 A leaves the positive reference terminal of the 9 V source). Determine the value of resistor R_A.



. 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:



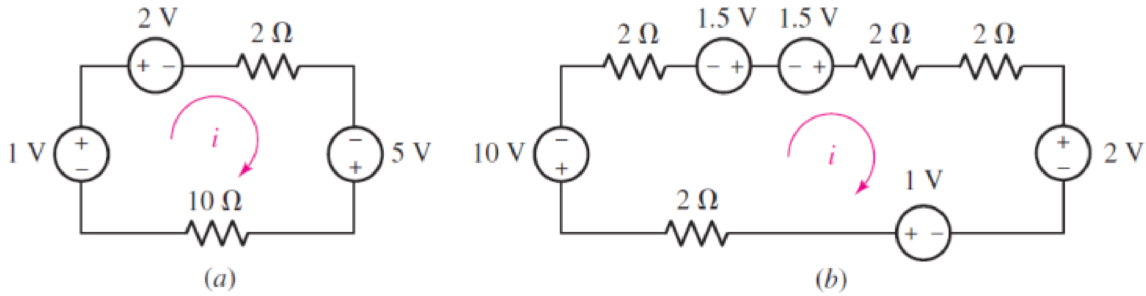
Applying KCL to the common connection at the top of the 6 Ω resistor,
Iwire = 1.5 – (-1.6) = 3.1 A

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 = $\boxed{2\ \Omega}$

5. Use KVL to obtain a numerical value for the current labelled *i* in each circuit depicted



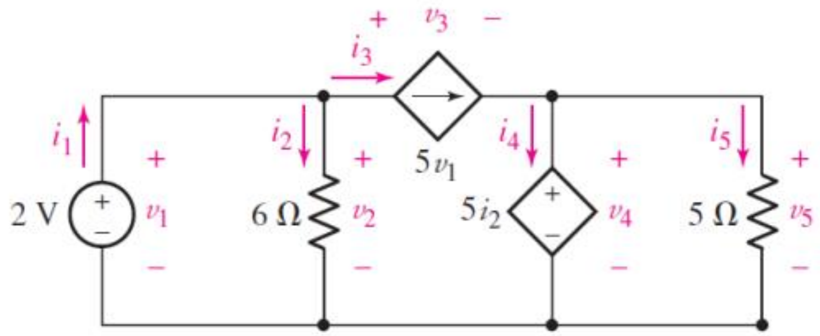
(a) -1 + 2 + 2i – 5 + 10i = 0

Hence, 12i = 4 so i = $\boxed{333\text{ mA}}$

(b) 10 + 2i – 1.5 + 2i + 2i + 2 – 1 + 2i = 0

Hence, 8i = 8 so i = $\boxed{1\text{ A}}$

6. (*a*) Determine a numerical value for each current and voltage (i_1, v_1, etc.) in the below circuit.
(*b*) Calculate the power absorbed by each element and verify that they sum to zero.



$\boxed{v_1 = 2\text{ V}}$; $\boxed{v_2 = 2\text{ V}}$; i2 = 2/6 = $\boxed{333\text{ mA}}$

i3 = 5v1 = $\boxed{10\text{ A}}$

i1 = i2 + i3 = $\boxed{10.33\text{ A}}$

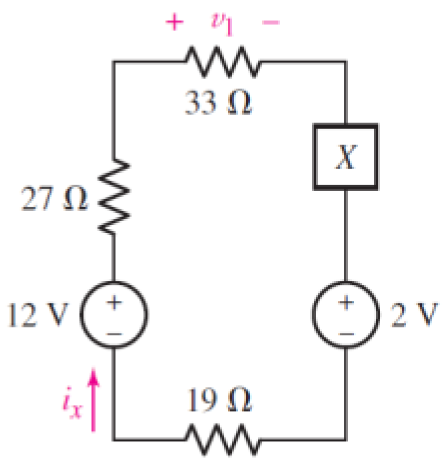
v4 = v5 = 5i2 = 5(1/3) = $\boxed{5/3\text{ V}}$

i5 = (5/3)/5 = $\boxed{333\text{ mA}}$

i3 = i4 + i5 therefore i3 – i5 = 10 – 1/3 = $\boxed{9.67\text{ A}}$

-v2 + v3 + v4 = 0 thefore v3 = v4 + v2 = 6/3 = $\boxed{2\text{ V}}$

7. Compute the power absorbed by each element in the below circuit if the mysterious element *X* is
(*a*) a 13 Ω resistor;
(*b*) a dependent voltage source labelled $4v_1$, "+" reference on top;
(*c*) a dependent voltage source labelled $4i_x$, "+" reference on top.



(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

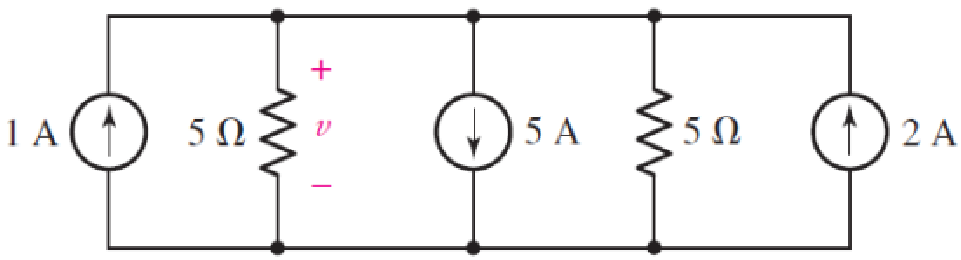
(b) By KVL, -12 + 27ix + 33ix + 4v1 + 2 + 19ix = 0
and v1 = 33ix. Solving together, ix = 10/211 = 47.39 mA

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

8. Referring to the circuit depicted below, determine the value of the voltage *v*.



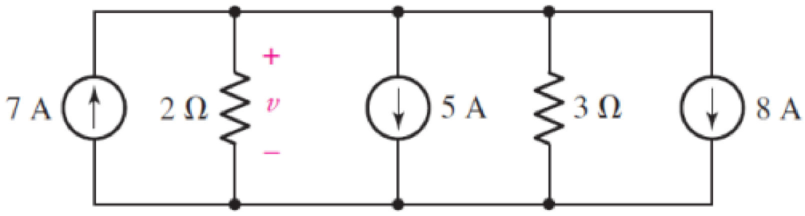
Combining KCL and Ohm's law in a single step results in

1 + 2 = v/5 + 5 + v/5

Solving, v = $\boxed{-5\text{ V}}$

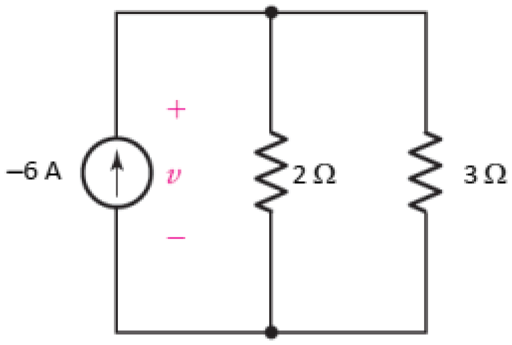
9. (*a*) For the below circuit, determine the value for the voltage labelled *v*, after first simplifying the circuit to a single current source in parallel with two resistors.

(*b*) Verify that the power supplied by your equivalent source is equal to the sum of the supplied powers of the individual sources in the original circuit.



Engineering Circuit Analysis 8th Edition Chapter Three Exercise Solutions

The current sources are combined using KCL to obtain ieq = 7 – 5 – 8 = –6 A.
The resulting circuit is shown below.



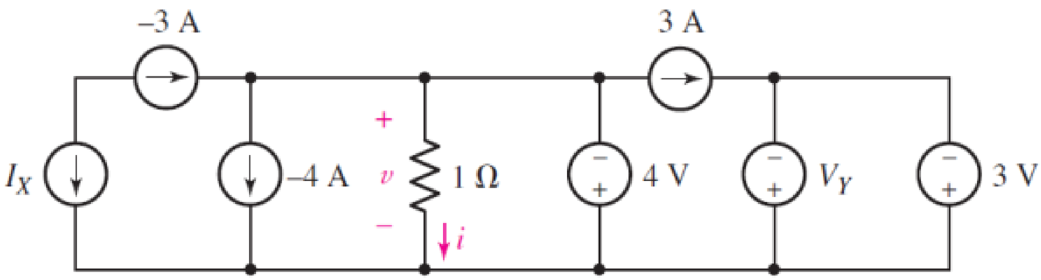
(a) KCL stipulates that $-6 = \frac{v}{2} + \frac{v}{3}$ v.

Solving, $\boxed{v = -36/5 \text{ V}}$

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

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
		$\boxed{43.2 \text{ W}}$ so confirmed.

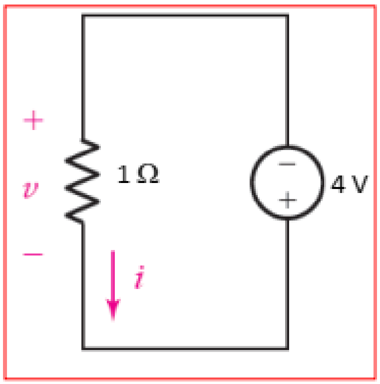
10. (*a*) Determine the values for I_X *and* V_Y in the circuit shown below.
(*b*) Are those values necessarily unique for that circuit? Explain.
(*c*) Simplify the circuit as much as possible and still maintain the values for *v* and *i*. (Your circuit must contain the 1 Ω resistor.)



(a) Employing KCL, by inspection $\boxed{Ix = 3\ A;\ Vy = 3\ V}$

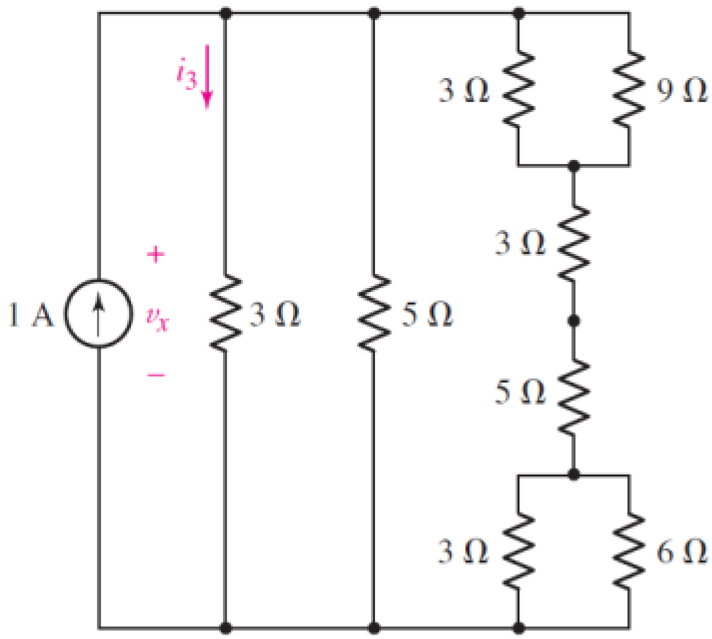
(b) $\boxed{\text{Yes.}}$ Current sources in series must carry the same current. Voltage sources in parallel must have precisely the same voltage.

(c)



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

11. Making appropriate use of resistor combination techniques, calculate i_3 in the circuit below and the power provided to the circuit by the single current source.



Looking at the far right of the circuit, we note the following resistor combination is possible: $3 \parallel 9 + 3 + 5 + 3 \parallel 6 = 2.25 + 8 + 2 = 12.25\ \Omega$

We now have three resistors in parallel: $3 \parallel 5 \parallel 12.25 = 1.626\ \Omega$

Invoking Ohm's law, vx = (1)(1.626) = 1.626 V.

Since this voltage appears across the current source and each of the three resistance (3 Ω, 5 Ω, 12.25 Ω), Ohm's law again applies: i3 = vx/3 = $\boxed{542\text{ mA}}$

Finally, the source supplies $(1.626)^2/3 + (1.626)^2/5 + (1.626)^2/12.25 = \boxed{1.626\text{ W}}$

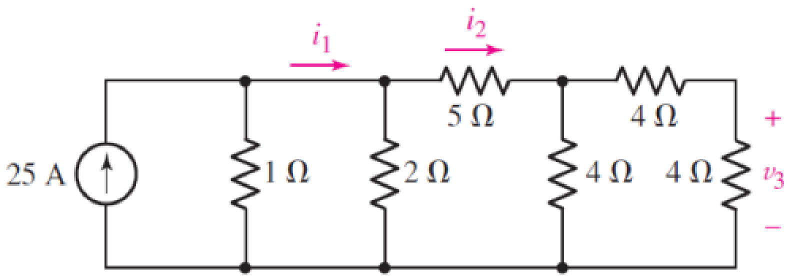
12. A network is constructed from a series connection of five resistors having values 1 Ω, 3 Ω, 5 Ω, 7Ω, and 9 Ω. If 9 V is connected across the terminals of the network, employ voltage division to calculate the voltage across the 3 Ω resistor, and the voltage across the 7 Ω resistor.

Employing voltage division,

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

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

13. Employing resistance combination and current division as appropriate, determine values for i_2, i_2, and v_3 in the circuit below.



We begin by simplifying the circuit to determine i1 and i2.
We note the resistor combination $(4 + 4) \parallel 4 + 5 = 8 \parallel 4 + 5 = 7.667\ \Omega$.
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,

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

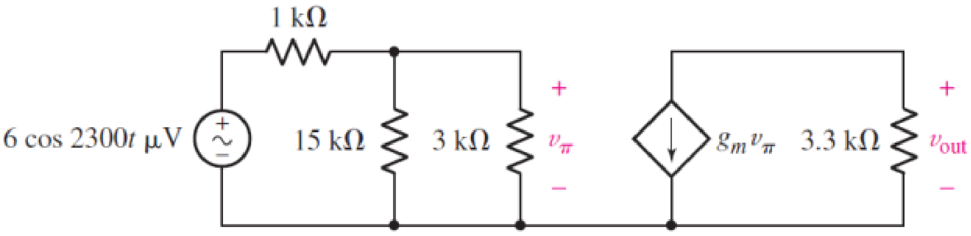
Solving, v = 15.33 V. Thus, i1 = 25 – v/1 = 9.67 A

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

$v3 = 4[4i2/(4 + 8)] = \boxed{2.673\text{ V}}$

14. The circuit depicted below is routinely employed to model the midfrequency operation of a bipolar junction transistor–based amplifier. Calculate the amplifier output v_{out} if the transconductance g_m is equal to 322 mS.



We can apply voltage division to obtain v_π by first combining the 15 kΩ and 3 kΩ resistors: $15\text{ k}\Omega \,\|\, 3\text{ k}\Omega = 2.5\text{ k}\Omega$.

Then by voltage division,

$$v_\pi = 6\times10^{-6}\cos 2300t\left(\frac{2.5}{1+2.5}\right)\text{ V} = 4.28\cos 2300t\ \mu\text{V}$$

By Ohm's law, $v_{out} = -3.3\times103(g_m\, v_p)$

$= -3300(322\times10^{-3})(4.28\times10^{-6})\cos 2300t$

$= \boxed{-4.55\cos 2300t \text{ mV}}$