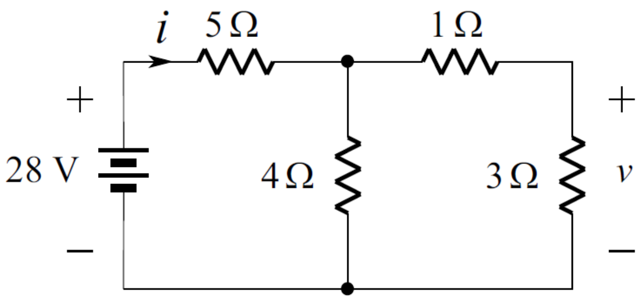
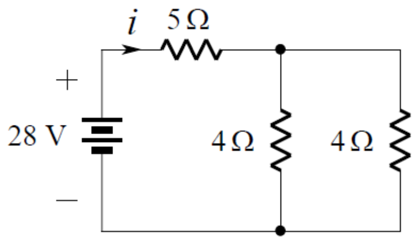
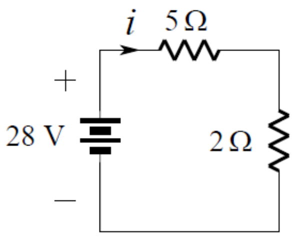
1. Please find the current i in the circuit below:



In order to find i, we can replace series and parallel connections of resistors by their equivalent resistances. We begin by noting that the $1\,\Omega$ and $3\,\Omega$ resistors are in series. Combining them we obtain:



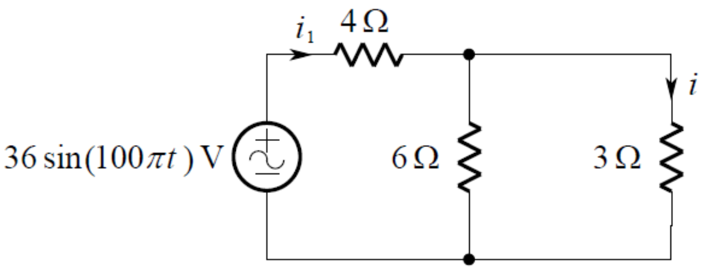
Note that it is not possible to display the original voltage v in this figure. Since the two $4\,\Omega$ resistors are connected in parallel, we can further simplify the circuit as shown below:



Here, the $5\,\Omega$ and $2\,\Omega$ resistors are in series, so we may combine them into one $7\,\Omega$ resistor. Then, from Ohm's Law, we have:

$$i = \frac{28}{7} = 4\,\text{A}$$

2. Please find the current i in the circuit below



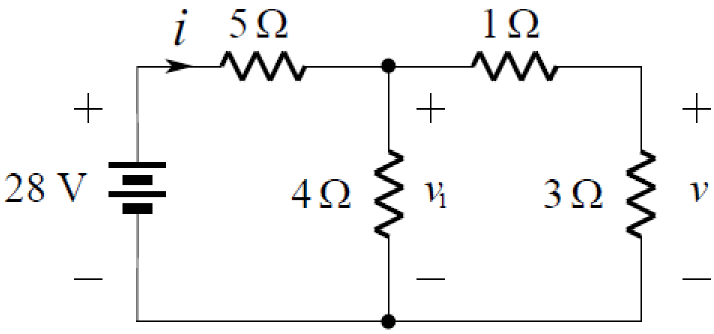
The total current delivered by the source is:

$$i_1 = \frac{36\sin(100\pi t)}{4+(6)(3)/(6+3)}$$
$$= 6\sin(100\pi t)\,\text{A}$$

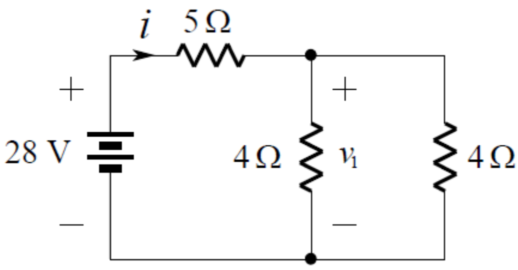
Therefore the desired current is:

$$i = \frac{6}{6+3} i_1 = \frac{2}{3} \times 6\sin(100\pi t) = 4\sin(100\pi t)\,\text{A}$$

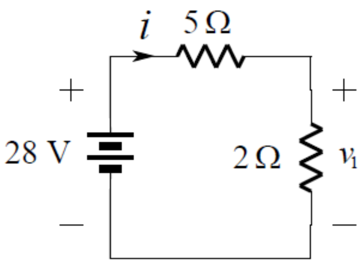
3. Please find the voltage V in the circuit below:



Combining the series connection of the 1Ω and 3Ω resistors, we obtain the circuit below:



Now the pair of 4Ω resistors in parallel can be combined as shown below:



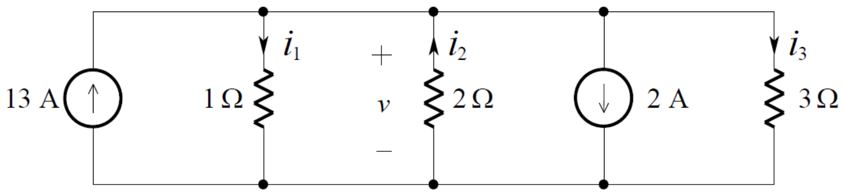
By voltage division:

$$v_1 = \frac{2}{2+5} \times 28 = \frac{56}{7} = 8\,\text{V}$$

Returning to the original circuit and applying voltage division again yields:

$$v = \frac{3}{3+1} v_1 = \frac{3}{4} \times 8 = 6\,\text{V}$$

4. Please find the voltage v in the two-node circuit below



The directions of i_1, i_2, i_3 and the polarity of v were chosen arbitrarily (the directions of the 13 A and 2 A sources are given). By KCL (at either of the two nodes), we have:

$$-13 + i_1 - i_2 + 2 + i_3 = 0$$

From this we can write:

$$i_1 - i_2 + i_3 = 11$$

By Ohm's Law:

$$i_1 = \frac{v}{1} \qquad i_2 = \frac{-v}{2} \qquad i_3 = \frac{v}{3}$$

Substituting these into the previous equation yields:

$$\left(\frac{v}{1}\right) - \left(\frac{-v}{2}\right) + \left(\frac{v}{3}\right) = 11$$

$$v + \frac{v}{2} + \frac{v}{3} = 11$$

$$\frac{6v + 3v + 2v}{6} = 11$$

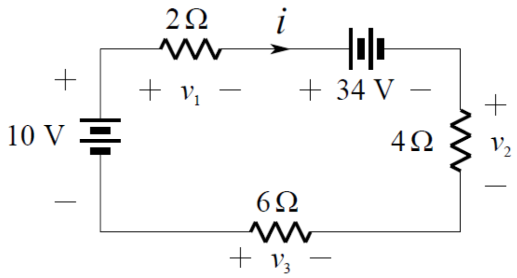
$$\frac{11v}{6} = 11$$

$$v = 6\text{ V}$$

Having solved for v, we can now find that:

$$i_1 = \frac{v}{1} = \frac{6}{1} = 6\text{ A} \qquad \mathrm{i}_2 = -\frac{v}{2} = -\frac{6}{2} = -3\text{ A} \qquad \mathrm{i}_3 = \frac{v}{3} = \frac{6}{3} = 2\text{ A}$$

5. Please find the current in the circuit below:



The polarities of v_1, v_2, v_3 and the direction of i were chosen arbitrarily (the polarities of the 10 V and 34 V sources are given). Applying KVL we get:

$$-10 + v_1 + 34 + v_2 - v_3 = 0$$

Thus:

$$v_1 + v_2 - v_3 = -24$$

From Ohm's Law:

$$v_1 = 2i \qquad v_2 = 4i \qquad v_3 = -6i$$

Substituting these into the previous equation yields:

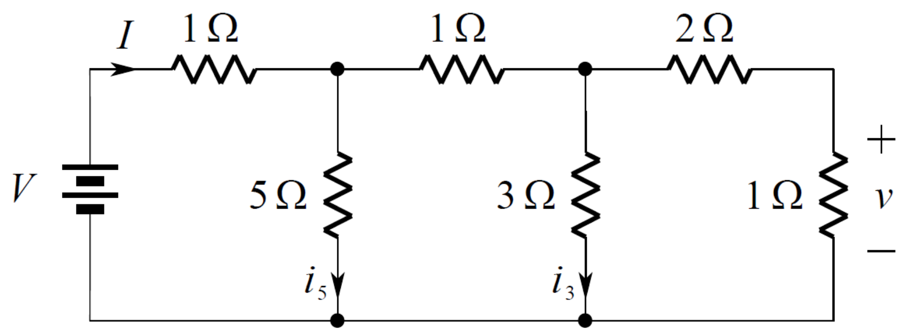
$$\begin{aligned}(2i) + (4i) - (-6i) &= -24\\ 2i + 4i + 6i &= -24\\ 12i &= -24\\ i &= -2\text{ A}\end{aligned}$$

Having solved for i, we now find that:

$$\begin{aligned}v_1 &= 2i = 2(-2) = -4\text{ V}\\ v_2 &= 4i = 4(-2) = -8\text{ V}\\ v_3 &= -6i = (-6)(-2) = 12\text{ V}\end{aligned}$$

6.

Given the series-parallel circuit shown below:



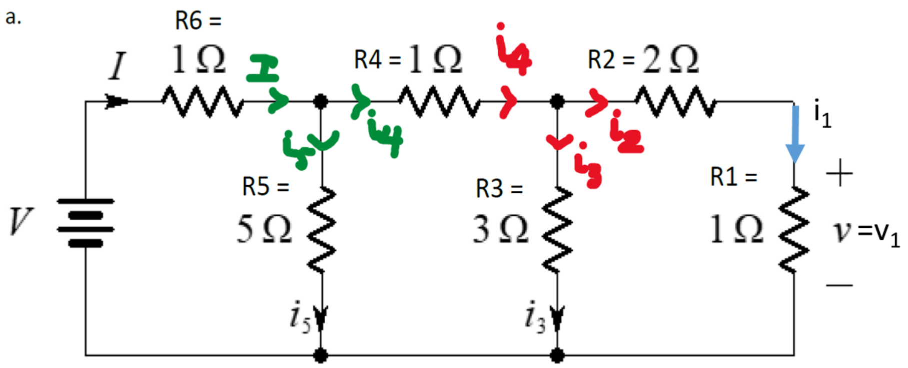
(a) If $v = 2$ volts, what is V?

(b) If $i_3 = 3$ amperes, what is V?

(c) If $i_5 = 4$ amperes, what is V?

(d) what is the equivalent resistance $R_{eq} = V/I$, looking from the battery?

a.



$$v_1 = 2V \Rightarrow i_1 = \frac{v_1}{R1} = \frac{2V}{1\Omega} = 2A$$

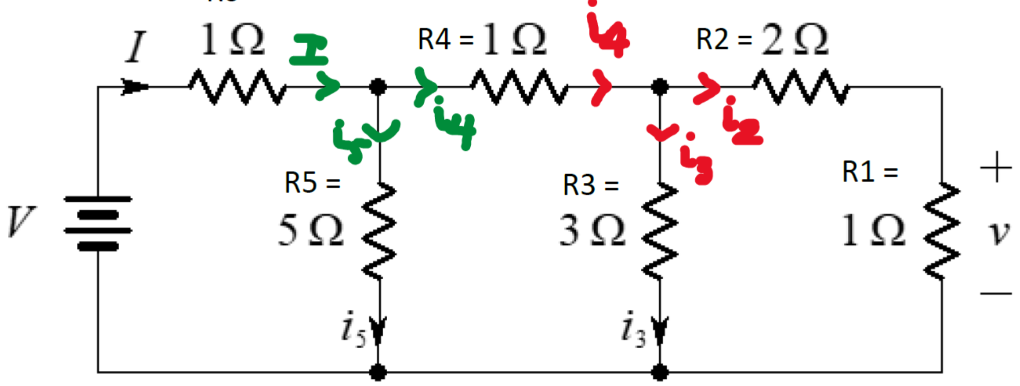
- ⇨ $i_2 = 2A$ ($R1$ is in series with $R2$)
- ⇨ $v_2 = i_2 * R2 = 2A * 2\Omega = 4V$
- ⇨ $v_3 = v_2 + v_1 = 4V + 2V = 6V$ ($R3$ is in parallel with $R1, R2$)
- ⇨ $i_3 = \frac{v_3}{R3} = \frac{6V}{3\Omega} = 2A$
- ⇨ $i_4 = i_3 + i_2 = 2A + 2A = 4A$ (red arrows on the circuit)
- ⇨ $v_4 = i_4 * R4 = 4A * 1\Omega = 4V$
- ⇨ $v_5 = v_4 + v_3 = 4V + 6V = 10V$ ($R5$ is in parallel with $R4, R3$)

- ⇨ $i_5 = \frac{v_5}{R5} = \frac{10V}{5\Omega} = 2A$
- ⇨ $I = i_5 + i_4 = 2A + 4A = 6A$ (green arrows on the circuit)

V_6= I*R6=6V

V=v6+v5=16V

b.



Given: $i_3 = 3A$

- ⇨ $v_3 = i_3 * R3 = 3A * 3\Omega = 9V$
- ⇨ $v_3 = v_{1,2} = 9V$
- ⇨ $i_1 = i_2 = i_{1,2} = \frac{v_{1,2}}{R_{eq1,2}} = \frac{9V}{1\Omega + 2\Omega} = 3A$
- ⇨ $i_4 = i_3 + i_1 = 3A + 3A = 6A$
- ⇨ $v_4 = i_4 * R4 = 6A * 1\Omega = 6V$
- ⇨ $v_5 = v_4 + v_3 = 6V + 9V = 15V$
- ⇨ $i_5 = \frac{v_5}{R5} = \frac{15V}{5\Omega} = 3A$
- ⇨ $I = i_5 + i_4 = 3A + 6A = 9A$

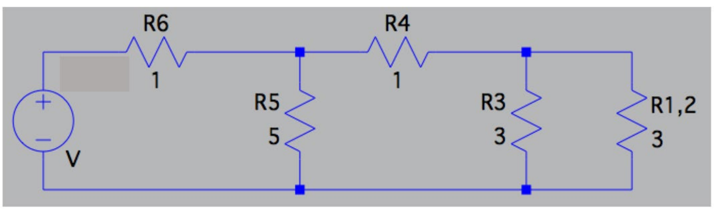
V_6= I*R6=9V

V=v6+v5=9V+15V=24V

C.

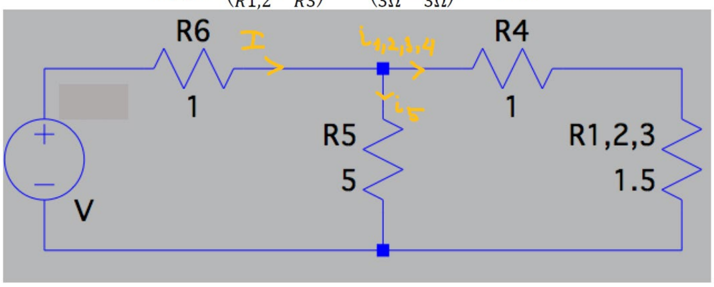
R1,2 is the equivalent resistance of R1 is in series with R2.

$$R1{,}2 = R1 + R2 = 1\Omega + 2\Omega = 3\Omega$$



R1,2,3 is the equivalent resistance of R1,2 in parallel with R3.

$$R1{,}2{,}3 = \left(\frac{1}{R1{,}2} + \frac{1}{R3}\right)^{-1} = \left(\frac{1}{3\Omega} + \frac{1}{3\Omega}\right)^{-1} = 1.5\Omega$$



Given: $i_5 = 4A$

⇨ $v_5 = i_5 * R5 = 4A * 5\Omega = 20\text{V}$

⇨ $v_5 = v_{1,2,3,4} = 20V$

⇨ $i_{1,2,3,4} = \frac{v_{1,2,3,4}}{R1,2,3,4} = \frac{20}{1\Omega+1.5\Omega} = 8A$

⇨ $I = i_{1,2,3,4} + i_5 = 8A + 4A = 12A$

V_6= I*R6=12

V=v6+v5=12V+20V=32V

(d)

R1,2 is the equivalent resistance of R1 is in series with R2.

$$R1{,}2 = R1 + R2 = 1\Omega + 2\Omega = 3\Omega$$

R1,2,3 is the equivalent resistance of R1,2 is in parallel with R3.

$$R1{,}2{,}3 = \left(\frac{1}{R1{,}2} + \frac{1}{R3}\right)^{-1} = \left(\frac{1}{3\Omega} + \frac{1}{3\Omega}\right)^{-1} = 1.5\Omega$$

R1,2,3,4 is the equivalent resistance of R1,2,3 is in series with R4.

$$R1{,}2{,}3{,}4 = R1{,}2{,}3 + R4 = 1.5\,\Omega + 1\Omega = 2.5\Omega$$

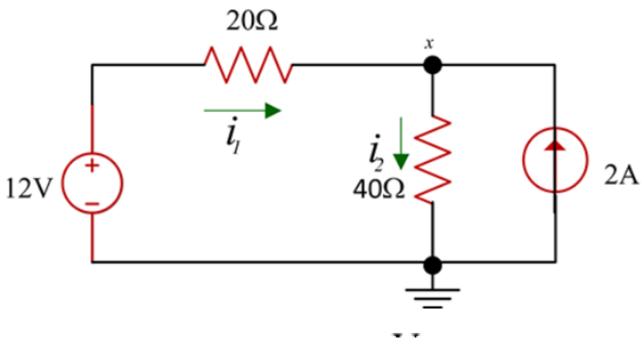
R1,2,3,4,5 is the equivalent resistance of R1,2,3,4 is in parallel with R5.

$$R1{,}2{,}3{,}4{,}5 = \left(\frac{1}{R1{,}2{,}3{,}4} + \frac{1}{R5}\right)^{-1} = \left(\frac{1}{2.5\Omega} + \frac{1}{5\Omega}\right)^{-1} = \frac{5}{3}\Omega$$

R_eq is the equivalent resistance of R1,2,3,4,5 is in series with R6.

$$R_{eq} = R1{,}2{,}3{,}4{,}5 + R6 = \frac{5}{3}\Omega + 1\Omega = \frac{8}{3}\Omega = \frac{\text{V}}{\text{I}}$$

7. Find the current through a 20Ω resistance, and current through a 40Ω resistance



Write KCL at node *x*

$$-i_1 + i_2 - 2A = 0$$

Write v_x in the circuit using Ohm's Law

$$i_1 = \frac{12V - v_x}{20\Omega}, \quad i_2 = \frac{v_x}{40\Omega}$$

Apply last two equation into KCL at node *x*

$$-i_1 + i_2 - 2A = -\frac{12V - v_x}{20\Omega} + \frac{v_x}{40\Omega} - 2A = 0$$

$$-0.6 + 0.05v_x + 0.025v_x - 2 = 0$$

$$v_x = 34.67V$$

The current through a 20Ω resistance

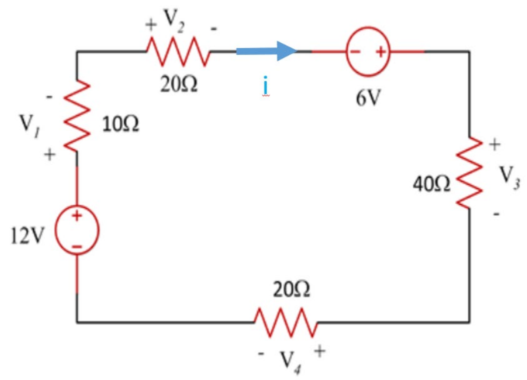
$$i_1 = \frac{12V - 34.67}{20\Omega} = -1.133A$$

The current through a 40Ω resistance

$$i_2 = \frac{v_x}{40\Omega} = \frac{34.67}{40\Omega} = 0.866A$$

8.

Find the current *i* and voltage *v* over the each resistor.



Using KVL for voltages,

V1+V2-6V+V3+V4-12V=0

V1+V2+V3+V4=18V

V1=10 *i; v2=20*i; V3=40*i; V4=20*i

Substituting into KVL equation

$$10i + 20i + 40i + 20i = 18$$

$$(90)i = 18$$

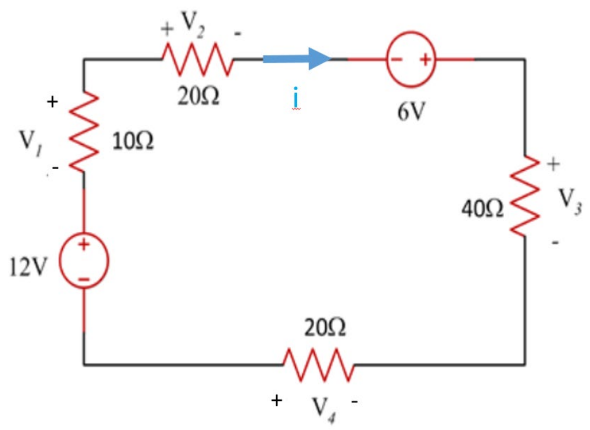
$$i = \frac{18}{90} = 0.2A$$

$$v_1 = R_1 i = 10(0.2) = 2V, \quad v_2 = R_2 i = 20(0.2) = 4V$$

V3=8V, V4=4V

9.

Find the current *i* and voltage *v* over the each resistor.



Using KVL for voltages,

-V1+V2-6V+V3-V4-12V=0

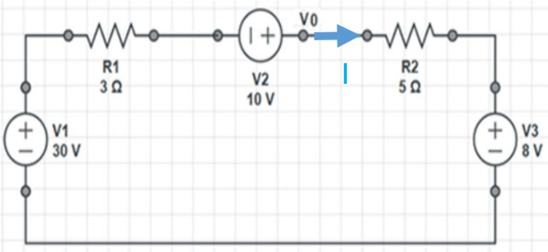
-V1+V2+V3-V4=18V

V1=10 *i; v2=20*i; V3=40*i; V4=20*i

Please finish the rest by yourself

10.

Find V0 in the following circuit.



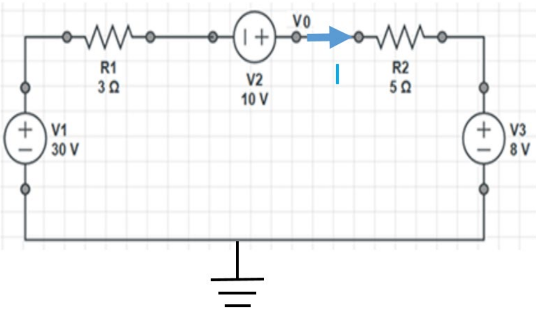
KVL Outher Loop

$$-30 - 10 + 8 + I(3 + 5) = 0$$

$$8I = 32$$

$$I = 4A$$

Then, we assign a ground to the circuit as below:



So, V0=I *5 ohm +8= 28 V