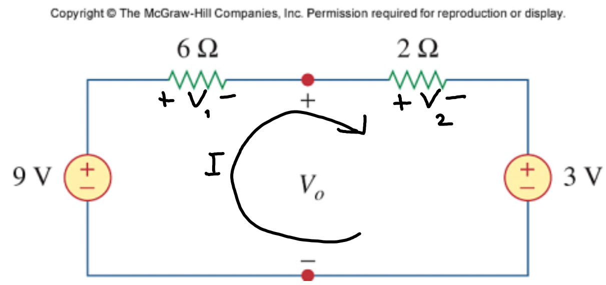
HW2, Chapter 2

Sunday, November 15, 2009
1:21 PM

2.16



KCL says that we can use one current I throughout the whole loop.

By KVL,

$-9 + V_1 + V_2 + 3 = 0$

By Ohm's law,

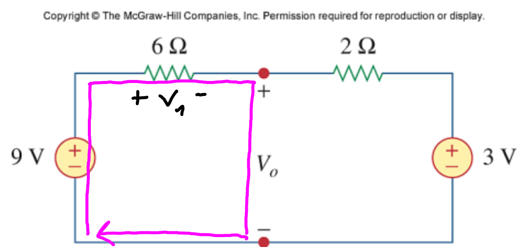
$V_1 = I \times 6$

$V_2 = I \times 2$

Therefore, $-9 + I\times 6 + I \times 2 + 3 = 0$

$I = \frac{6}{8}$

Now, we will use KVL on another "loop" shown below



In which case, we have

$-9 + V_1 + V_o = 0$

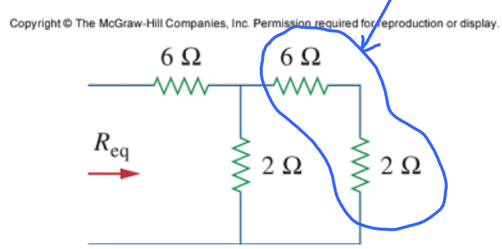
$V_o = 9 - V_1$

$= 9 - \frac{6}{8} \times 6$

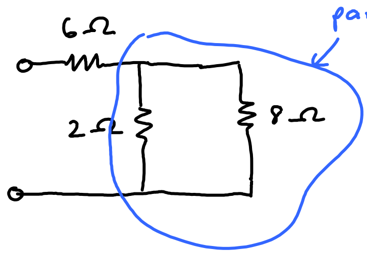
$= \frac{9}{2} = \boxed{4.5\ V}$

2.30

Series : $6 + 2 = 8\,\Omega$

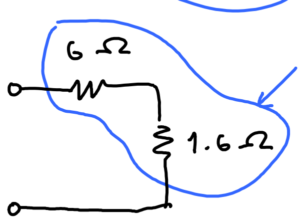


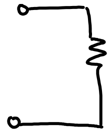
parallel : $\frac{8 \times 2}{8 + 2} = 1.6\ \Omega$



$\frac{1}{\frac{1}{8} + \frac{1}{2}}$

Series : $6 + 1.6 = 7.6\ \Omega$

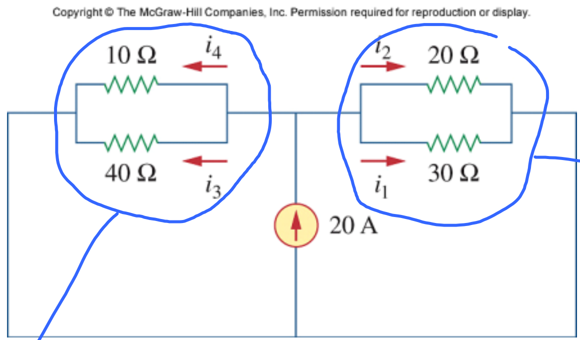




$R_{eq} = \boxed{7.6\ \Omega}$

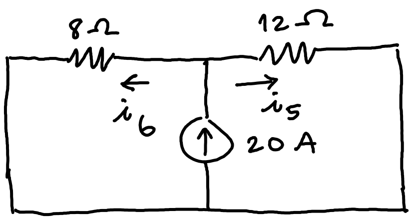
(CDF)

2.32 We will use the current divider formula.



parallel : $\frac{20 \times 30}{20+30} = \frac{600}{50} = 12\ \Omega$

parallel : $\frac{10 \times 40}{10+40} = \frac{400}{50} = 8\ \Omega$



So, 20 A is split into the 8Ω and 12Ω resistors.

By CDF,

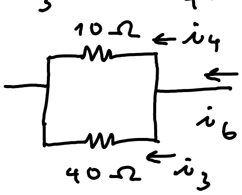
$$i_5 = \frac{\frac{1}{12}}{\frac{1}{12}+\frac{1}{8}} \times 20 = \frac{1}{\cancel{12}} \times \frac{\cancel{12} \times 8}{\cancel{12+8}} \times \cancel{20}$$

$$= 8A.$$

$i_6 = 20A - 8A = 12A.$ ← We can apply CDF to get i_6. However, it is easier to use KCL :

$$i_6 + i_5 - 20 = 0.$$

The current i_6 is split again into i_3 and i_4.



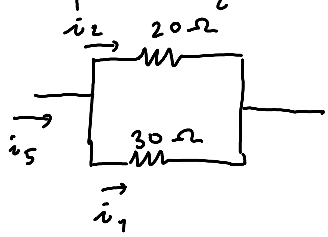
By CDF,

$$i_3 = \frac{\frac{1}{40}}{\frac{1}{10}+\frac{1}{40}} \times 12 = \frac{1}{\cancel{4}} \times \frac{\cancel{4} \times 1}{4+1} \times 12$$

$$= \frac{12}{5} = \frac{24}{10} = 2.4\ A.$$

$$i_4 = i_6 - i_3 = 12 - 2.4 = 9.6\ A$$

The current i_5 is split again into i_1 and i_2.



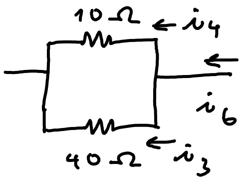
By CDF,

$$i_1 = \frac{\frac{1}{30}}{\frac{1}{30}+\frac{1}{20}} \times 8 = \frac{1}{\cancel{30}} \times \frac{20 \times \cancel{30}}{20+30} \times 8$$

$$= \frac{16}{5} = \frac{32}{10} = 3.2\ A$$

$$i_2 = i_5 - i_1 = 8 - 3.2 = 4.8\ A$$

The current i_6 is split again into i_3 and i_4.



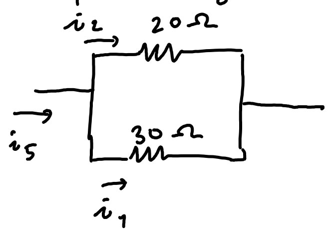
By CDF,

$$i_3 = \frac{\frac{1}{4\cancel{0}}}{\frac{1}{1\cancel{0}}+\frac{1}{4\cancel{0}}} \times 12 = \frac{1}{\cancel{4}} \times \frac{\cancel{4}\times 1}{4+1} \times 12$$

$$= \frac{12}{5} = \frac{24}{10} = 2.4 \text{ A}.$$

$$i_4 \underset{\text{KCL}}{=} i_6 - i_3 = 12 - 2.4 = 9.6 \text{ A}$$

The current i_5 is split again into i_1 and i_2.



By CDF,

$$i_1 = \frac{\frac{1}{30}}{\frac{1}{30}+\frac{1}{20}} \times 8 = \frac{1}{\cancel{30}} \times \frac{2\cancel{0}\times\cancel{30}}{2\cancel{0}+3\cancel{0}} \times 8$$

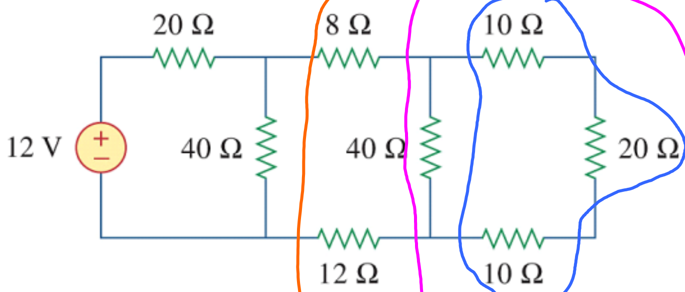
$$= \frac{16}{5} = \frac{32}{10} = 3.2 \text{ A}$$

$$i_2 \underset{\text{KCL}}{=} i_5 - i_1 = 8 - 3.2 = 4.8 \text{ A}$$

So,

$$\boxed{\begin{aligned} i_1 &= 3.2 \text{ A} \\ i_2 &= 4.8 \text{ A} \\ i_3 &= 2.4 \text{ A} \\ i_4 &= 9.6 \text{ A} \end{aligned}}$$

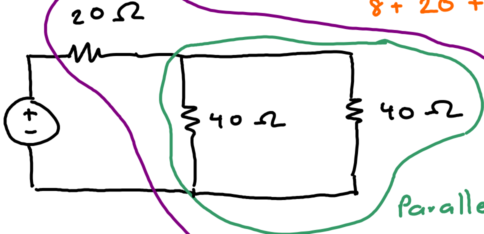
(2.34)



Series:
$10+10+20 = 40\,\Omega$

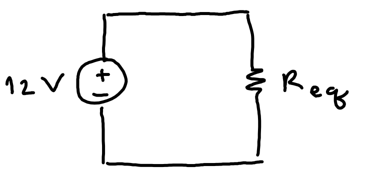
Parallel
$40 // 40 = \frac{40 \times 40}{40+40} = \frac{40}{2} = 20\,\Omega$

Series:
$8 + 20 + 12 = 40\,\Omega$



Parallel
$\frac{40}{2} = 20\,\Omega$

Series:
$20+20 = 40\,\Omega$



$R_{eq} = \boxed{40\,\Omega}$

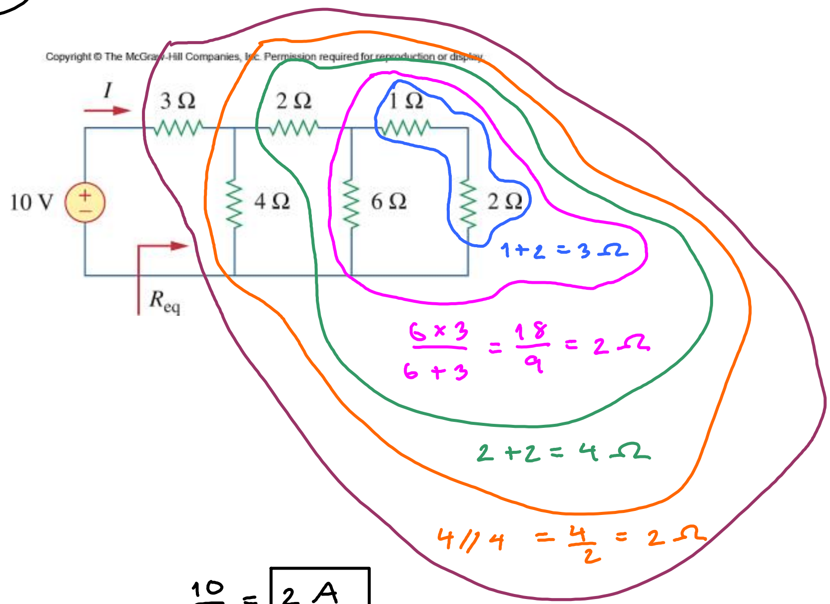
Over all dissipated power $= IV = \frac{V}{R_{eq}} \times V = \frac{V^2}{R_{eq}}$

$$= \frac{12^2}{40} = \frac{12 \times \cancel{12}^{\,3}}{\cancel{40}_{\,10}} = \boxed{3.6\ W}$$

The power of each resistor has positive sign.

We calculate the total power indirectly from the power of the source.

2.40



$1 + 2 = 3\ \Omega$

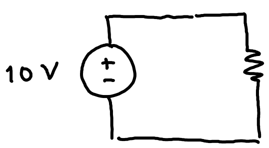
$\frac{6 \times 3}{6+3} = \frac{18}{9} = 2\ \Omega$

$2 + 2 = 4\ \Omega$

$4 // 4 = \frac{4}{2} = 2\ \Omega$

$3 + 2 = 5\ \Omega$

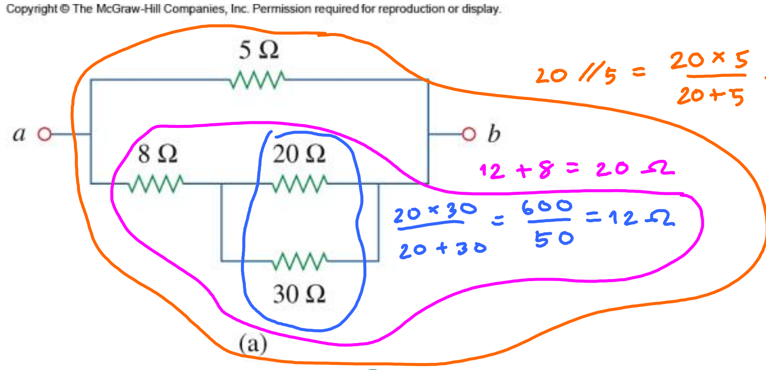
$I = \frac{10}{5} = \boxed{2\ A}$



$R_{eq} = \boxed{5\ \Omega}$

2.42

(a)



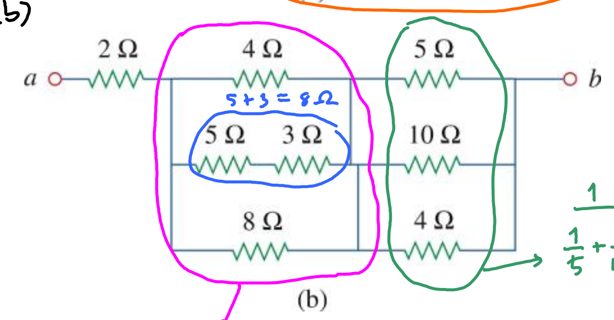
(a)

$20 // 5 = \frac{20 \times 5}{20+5} = \frac{100}{25} = \boxed{4\ \Omega}$

$12 + 8 = 20\ \Omega$

$\frac{20 \times 30}{20+30} = \frac{600}{50} = 12\ \Omega$

(b)



(b)

$5 + 3 = 8\ \Omega$

$\frac{1}{\frac{1}{5}+\frac{1}{10}+\frac{1}{4}} = \frac{20}{11}\ \Omega$

$4 // 8 // 8 = \frac{1}{\frac{1}{4}+\frac{1}{8}+\frac{1}{8}} = \frac{1}{\frac{1}{2}} = 2\ \Omega$

$R_{eq} = 2\ \Omega + 2\ \Omega + \frac{20}{11}\ \Omega = \frac{64}{11}\ \Omega \approx \boxed{5.818\ \Omega}$

HW2, Chapter 3

Sunday, November 15, 2009
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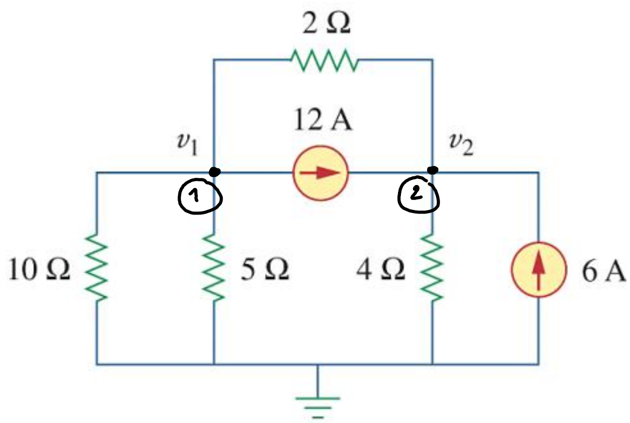
3.2



KCL at 1

$$\frac{v_1 - 0}{10} + \frac{v_1 - 0}{5} + \frac{v_1 - v_2}{2} + 12 = 0$$

KCL at 2

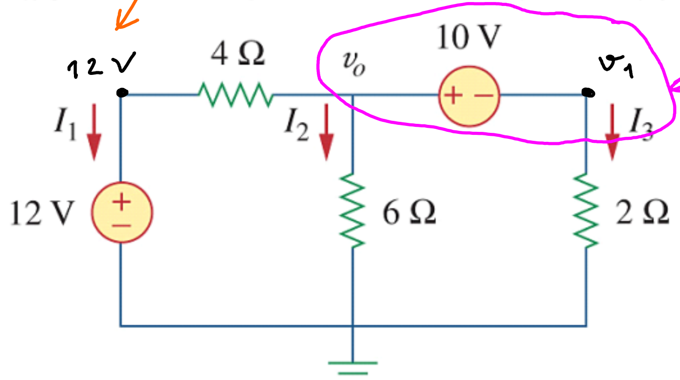
$$-12 + \frac{v_2 - v_1}{2} + \frac{v_2}{4} - 6 = 0$$

Mathcad

$$\Rightarrow \boxed{\begin{aligned} v_1 &= 0 \\ v_2 &= 24\,V \end{aligned}}$$

3.6

we get the voltage at this non-reference node immediately because a voltage source is between this node and the ground.



supernode

$$v_o - v_1 = 10$$

KCL at supernode :

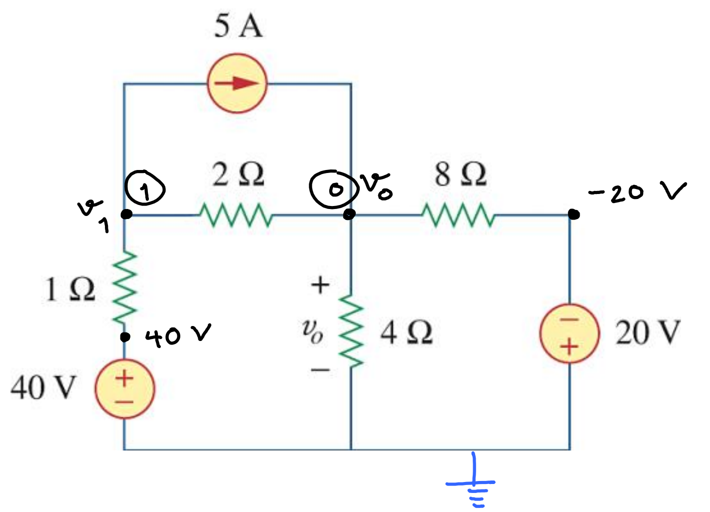
$$\frac{v_o - 12}{4} + \frac{v_o - 0}{6} + \frac{v_1}{2} = 0$$

Mathcad

$$\boxed{v_o \approx 8.727}$$

$$v_1 \approx -1.273$$

3.14



KCL at node 1

$$\frac{v_1 - 40}{1} + \frac{v_1 - v_o}{2} + 5 = 0$$

KCL at node 0

$$\frac{v_0 - v_1}{2} - 5 + \frac{v_0 - 0}{4} + \frac{v_0 - (-20)}{8} = 0$$

Mathcad

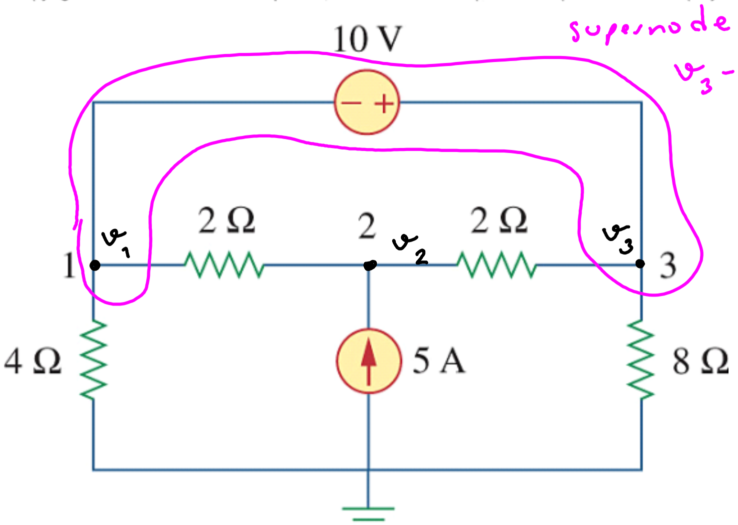
$\Rightarrow$ $\boxed{v_o = 20 \text{ V}}$

$v_1 = 30 \text{ V}$

3.18

supernode:

$v_3 - v_1 = 0$



KCL at supernode

$$\frac{v_1 - 0}{4} + \frac{v_1 - v_2}{2} + \frac{v_3 - v_2}{2} + \frac{v_3 - 0}{8} = 0$$

KCL at node 2

$$\frac{v_2 - v_1}{2} - 5 + \frac{v_2 - v_3}{2} = 0$$

Mathcad

$$\Longrightarrow \boxed{\begin{array}{l} v_1 = 10\ V \\ v_2 = v_3 = 20\ V \end{array}}$$