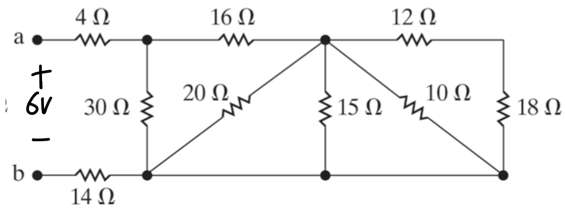
3.25 Attach a 6 V voltage source between the terminals a–b in **Fig. P3.6**(b), with the positive terminal at the top.

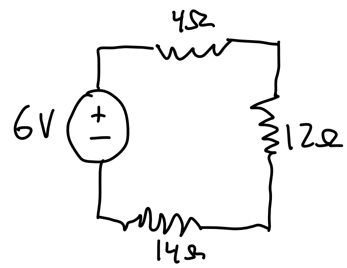
a) Use voltage division to find the voltage across the 4 Ω resistor, positive at the top.
b) Use the result from part (a) to find the current in the 4 Ω resistor from left to right.
c) Use the result from part (b) and current division to find the current in the 16 Ω resistor from left to right.
d) Use the result from part (c) and current division to find the current in the 10 Ω resistor from top to bottom.
e) Use the result from part (d) to find the voltage across the 10 Ω resistor, positive at the top.
f) Use the result from part (e) and voltage division to find the voltage across the 18 Ω resistor, positive at the top.



(b)

$$\frac{1}{R_{eq}} = \frac{1}{(12+18)} + \frac{1}{10} + \frac{1}{15} + \frac{1}{20} = \frac{1}{4}$$

$$\frac{1}{R_{eq}} = \frac{1}{30} + \frac{1}{20} = \frac{1}{12} \quad R_{eq} = 12\Omega$$



a) $\frac{4}{4+12+14}(6V) = 0.8V$

$\boxed{V_{4\Omega} = 0.8V}$

b) $V = IR \Rightarrow I = \frac{V}{R}$

$I = \frac{0.8V}{4\Omega} = 0.2A \quad \boxed{I = 0.2A}$

c) $R = 20\Omega$

$i = \frac{12}{20}(0.2) = 120mA$

$\boxed{i = 120mA}$

d) $\frac{1}{R_{eq}} = \frac{1}{20} + \frac{1}{15} + \frac{1}{10} + \frac{1}{30} = \frac{1}{4}$

$i = \frac{4}{10}(0.12) = 48mA \quad \boxed{i = 48mA}$

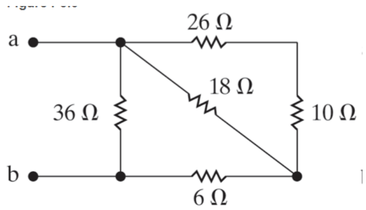
e) $V = iR \Rightarrow V = (48mA)(10\Omega)$

$V = 480mV$

f) $V = \frac{18}{30}(480mV) \quad \boxed{V = 288mV}$

3.27 Attach a 450 mA current source between the terminals a–b in **Fig. P3.6**(a), with the current arrow pointing up.

a) Use current division to find the current in the 36 Ω resistor from top to bottom.
b) Use the result from part (a) to find the voltage across the 36 Ω resistor, positive at the top.
c) Use the result from part (b) and voltage division to find the voltage across the 18 Ω resistor, positive at the top.
d) Use the result from part (c) and voltage division to find the voltage across the 10 Ω resistor, positive at the top.



(a)

$\frac{1}{R} = \frac{1}{18} + \frac{1}{36} = \frac{1}{12}$

$R_{eq} = 18\Omega$

a) $\frac{1}{R} = \frac{1}{36} + \frac{1}{18} = \frac{1}{12} \quad R = 12\Omega$

$i = \frac{12\Omega}{36\Omega}(450mA) = 0.15A$

$\boxed{i = 150mA}$

b) $V = iR \quad V = (150mA)(36)$

$\boxed{V = 5.4V}$

c) $\frac{1}{R_{eq}} = \frac{1}{18} + \frac{1}{36} = \frac{1}{12}$

$V = \frac{12}{12+6}(5.4V) = 3.6V$

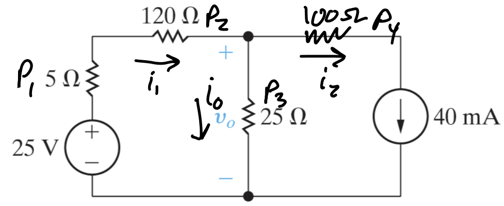
$\boxed{V = 3.6V}$

(d) $V = \frac{10}{26+10}(3.6V) = 1V$

$\boxed{V = 1V}$

4.8 PSPICE MULTISIM A $100\ \Omega$ resistor is connected in series with the 40 mA current source in the circuit in Fig. P4.6.

a) Find v_o.
b) Find the power developed by the 40 mA current source.
c) Find the power developed by the 25 V voltage source.
d) Verify that the total power developed equals the total power dissipated.
e) What effect will any finite resistance connected in series with the 40 mA current source have on the value of v_o?



a) Node Voltage Method

$$\frac{V_o-25}{125}+\frac{V_o}{25}+0.04A=0$$

$$V_o-25+5V_o+5=0$$

$$V_o=\frac{20}{6}\Rightarrow \boxed{V_o=3.33V}$$

b) voltage drop: $3.33-(100)(0.04)=-0.667V$

$$P=VI=(-0.667)(0.04)\Rightarrow \boxed{P=26.68mW}$$

c) $$i=\frac{V}{R}=\frac{3.33-25}{125}=-173.36mA$$

$$P=(-173.36mA)(25)\ \boxed{P=4.33W}$$

d) $$P_1=(173.36)^2(5)=150.27mW$$

$$P_2=(173.36)^2(120)=3.61\ W$$

$$P_3=\frac{(3.33)^2}{25}=443.56\ mW$$

$$P_4=(0.04)^2(100)=160mW$$

$$P_{dev}=4.33+0.02668=4.357\ W$$

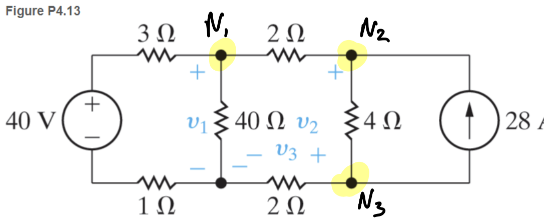
$$P_{dis}=0.15027+3.61+0.443556+0.16\Rightarrow 4.364W$$

$\boxed{\text{They are Equal}}$

e) V_o is independent of any series connected to the 40mA current source so there will not be any effect

4.13 PSPICE MULTISIM
a) Use the node-voltage method to find v_1, v_2, and v_3 in the circuit in Fig. P4.13.
b) ~~How much power does the 40 V voltage source deliver to the circuit?~~

Figure P4.13



N_1 $$\frac{V_1}{40}+\frac{V_1-V_2}{2}+\frac{V_1-40}{4}=0 \quad -(1)$$

N_2 $$\frac{V_2-V_1}{2}+\frac{V_2-V_3}{4}-28=0 \quad -(2)$$

N_3 $$28+\frac{V_3}{2}+\frac{V_3-V_2}{4}=0 \quad -(3)$$

N_1: $$V_1+20V_1-20V_2+10V_1-400=0$$

$$31V_1-20V_2=400 \quad -(1)$$

N_2: $$2V_2-2V_1+V_2-V_3-112=0$$

$$-2V_1+3V_2-V_3=112 \quad -(2)$$

N_3: $$-V_2+3V_3=-112 \quad -(3)$$

$$V_1=\frac{400}{31}+\frac{20}{31}V_2$$

$$V_3=\frac{V_2}{3}-\frac{112}{3}$$

sub eq 2

$$-2\left(\frac{400}{31}+\frac{20}{31}V_2\right)+3V_2-\left(\frac{V_2}{3}-\frac{112}{3}\right)=112$$

$$-\frac{40}{31}V_2+3V_2-\frac{V_2}{3}=112+\frac{800}{31}-\frac{112}{3}$$

$$V_2=73V$$

$\boxed{V_2=73V}$

Eq 1

$$31V_1-20(73)=400$$

$\boxed{V_1=60V}$

Eq 3

$$-73+3V_3=-112$$

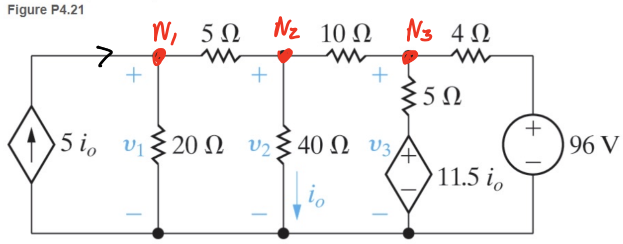
$\boxed{V_3=-13V}$

4.21 PSPICE MULTISIM

a) Find the node voltages v_1, v_2, and v_3 in the circuit in Fig. P4.21.

b) ~~Find the total power dissipated in the circuit.~~

Figure P4.21



N_1: $-\frac{V_2}{8} + \frac{V_1}{20} + \frac{V_1}{5} - \frac{V_2}{5} = 0$

$-5V_2 + 2V_1 + 8V_1 - 8V_2 = 0$

$10V_1 - 13V_2 = 0$ — (1)

N_2: $\frac{V_2}{40} + \frac{V_2}{5} - \frac{V_1}{5} + \frac{V_2}{10} - \frac{V_3}{10} = 0$

$V_2 + 8V_2 - 8V_1 + 4V_2 - 4V_3 = 0$

$-8V_1 + 13V_2 - 4V_3 = 0$ — (2)

N_3: $\frac{V_3}{10} - \frac{V_2}{10} + \frac{V_3}{5} - \frac{11.5}{5}\left(\frac{V_2}{40}\right) + \frac{V_3}{4} - 24 = 0$

$20V_3 - 20V_2 + 40V_3 - 11.5V_2 + 50V_3 - 4800 = 0$

$-31.5V_2 + 110V_3 = 480$ (3)

N1 $-5i + \frac{V_1}{20} + \frac{V_1 - V_2}{5} = 0$

N_2 $\frac{V_2}{40} + \frac{V_2 - V_1}{5} + \frac{V_2 - V_3}{10} = 0$

N_3 $\frac{V_3 - V_2}{10} + \frac{V_3 - 11.5 i_o}{5} + \frac{V_3 - 96}{4} = 0$

$i_o = \frac{V_2}{40}$

Eq1: $V_1 = \frac{13V_2}{10}$

Eq3: $V_3 = \frac{4800}{110} + \frac{31.5}{110} V_2$

Eq2

$-8\left(\frac{13}{10}\right)V_2 + 13V_2 - 4\left(\frac{4800}{110} + \frac{31.5}{110}V_2\right) = 0$

$V_2\left(-\frac{52}{5} + 13 - \frac{63}{55}\right) - \frac{192}{11} = 0$

$\boxed{V_2 = 120V}$

Sub Eq1 $V_1 = \frac{13}{10}(120) = 156V$

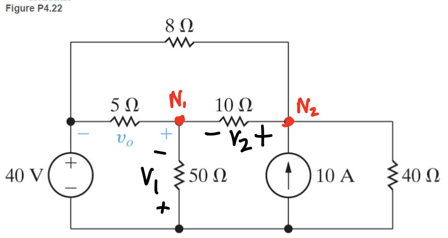
$\boxed{V_1 = 156V}$

Sub Eq3 $V_3 = \frac{4800}{110} + \frac{31.5}{110}(120)$

$\boxed{V_3 = 78V}$

4.22 PSPICE MULTISIM Use the node-voltage method to find the value of v_o in the circuit in Fig. P4.22.

Figure P4.22



N_1: $\frac{V_1 - 40}{5} + \frac{V_1}{50} + \frac{V_1 - V_2}{10} = 0 \Rightarrow 10V_1 - 400 + V_1 + 5V_1 - 5V_2 = 16V_1 - 5V_2 - 400$

N_2: $\frac{V_2 - V_1}{10} + \frac{V_2}{40} - 10 + \frac{V_2 - 40}{8} = 0 \Rightarrow 4V_2 - 4V_1 + V_2 - 400 + 5V_2 - 200 = 0$

$-4V_1 + 10V_2 - 600 = 0$

Eq1 $\Rightarrow V_1 = 25 + \frac{5}{16}V_2$

Eq2 $\Rightarrow -4\left(25 + \frac{5}{16}V_2\right) + 10V_2 - 600 = 0$

$-100 - \frac{5}{4}V_2 + 10V_2 - 600 = 0$

$V_2 = \frac{700}{\left(10 - \frac{5}{4}\right)}$

$V_2 = 80V$

Sub in Eq1

$V_1 = 25 + \frac{5}{16}(80)$

$V_1 = 50V$

$V_o + 40 - V_1 = 0$

$V_o = 50 - 40$

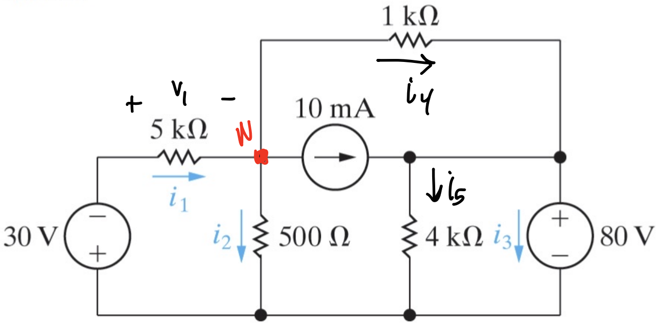
$\boxed{V_o = 10V}$

4.23 PSPICE MULTISIM

a) Use the node-voltage method to find the branch currents i_1, i_2, and i_3 in the circuit in **Fig. P4.23**.

b) ~~Check your solution for i_1, i_2, and i_3 by showing that the power dissipated in the circuit equals the power developed.~~

Figure P4.23



N $\quad \dfrac{V_1-30}{5000} + \dfrac{V_1}{500} + \dfrac{V_1-80}{1000} + 0.01 = 0$

$$V_1 + 30 + 10V_1 + 5V_1 - 400 + 50 = 0$$

$$16V_1 = 320$$

$$V_1 = 20V$$

$$i_1 = \frac{-V_1-30}{5000} \Rightarrow \boxed{i_1 = -0.01A \text{ or } i_1 = -10mA}$$

$$\boxed{i_2 = 0.04A \text{ or } 40mA}$$

$$i_3 = 10mA - i_4 - i_5$$

$$i_4 = \frac{(80-20)}{1000} = 0.06A$$

$$i_5 = \frac{80}{4000} = 0.02A$$

$$i_3 = 0.01 - 0.06 - 0.02$$

$$\boxed{i_3 = -0.07A \text{ or } -70mA}$$