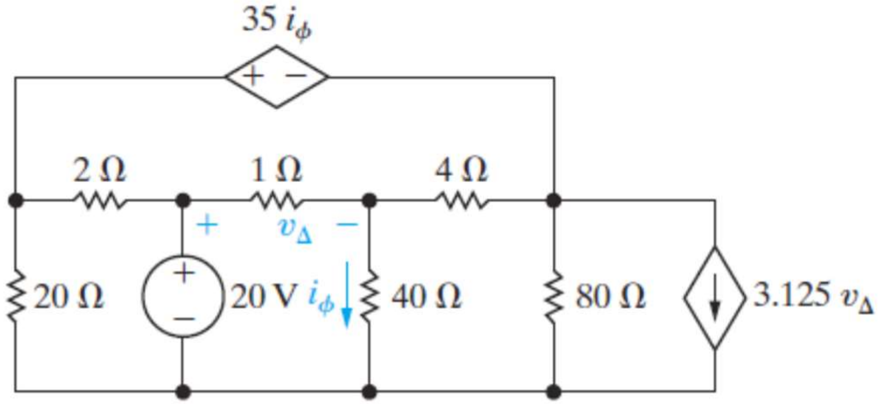
4.30 Use the node-voltage method to find the power developed by the 20 V source in the circuit in Fig. P4.30.

PSPICE
MULTISIM

Figure P4.30



Node equations:

$$\frac{v_1}{20} + \frac{v_1 - 20}{2} + \frac{v_3 - v_2}{4} + \frac{v_3}{80} + 3.125 v_\Delta = 0$$

$$\frac{v_2}{40} + \frac{v_2 - v_3}{4} + \frac{v_2 - 20}{1} = 0$$

Constraint equations:

$$v_\Delta = 20 - v_2$$

$$v_1 - 35 i_\phi = v_3$$

$$i_\phi = v_2/40$$

Solving, $v_1 = -20.25\,\text{V}; \quad v_2 = 10\,\text{V}; \quad v_3 = -29\,\text{V}$

Let i_g be the current delivered by the 20 V source, then

$$i_g = \frac{20 - (20.25)}{2} + \frac{20 - 10}{1} = 30.125\ \text{A}$$

$$p_g\ (\text{delivered}) = 20(30.125) = 602.5\,\text{W}$$

4.42 Use the mesh-current method to find the power developed in the dependent voltage source in the circuit in Fig. P4.42.

PSPICE
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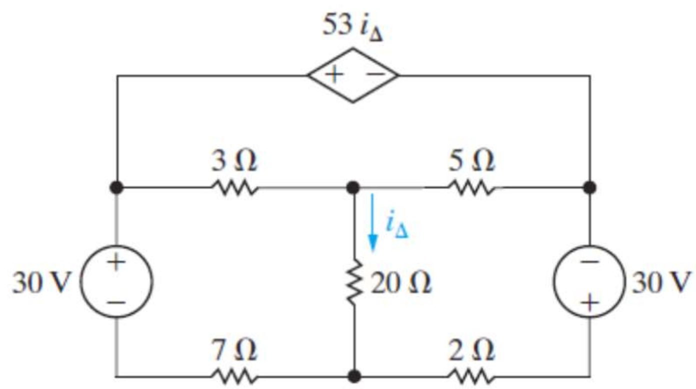
Figure P4.42



Mesh equations:

$53i_\Delta + 8i_1 - 3i_2 - 5i_3 = 0$

$i_\Delta - 3i_1 + 30i_2 - 20i_3 = 30$

$i_\Delta - 5i_1 - 20i_2 + 27i_3 = 30$

Constraint equations:

$i_\Delta = i_2 - i_3$

Solving, $i_1 = 110$ A; $i_2 = 52$ A; $i_3 = 60$ A; $i_\Delta = -8$ A

$p_{depsource} = 53\, i_\Delta\, i_1 = (53)(-8)(110) = -46{,}640$W

4.74 Determine the Thévenin equivalent with respect to the terminals a,b for the circuit shown in Fig. P4.74.

PSPICE
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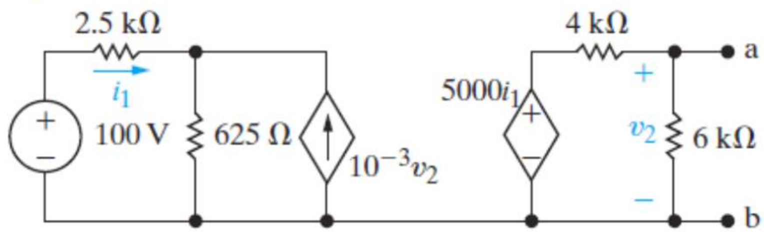
Figure P4.74



OPEN CIRCUIT

$100 = 2500i_1 + 625(i_1 + 10^{-3}v_2)$

$$v_2 = \frac{6000}{10{,}000}(5000i_2)$$

Solving,

$I_1 = 0.02A$; $V_2 = V_{oc} = 60V$

SHORT CIRCUIT

$V_2 = 0$;

$$i_{sc} = \frac{5000}{4000}(i_1)$$

$$i_1 = \frac{100}{2500+625} = 0.032A$$

Thus, $i_{sc} = 0.04A$ $R_{Th} = 1.5$ k

4.81 Find the Norton equivalent with respect to the terminals a,b for the circuit seen in Fig. P4.81.

Figure P4.81

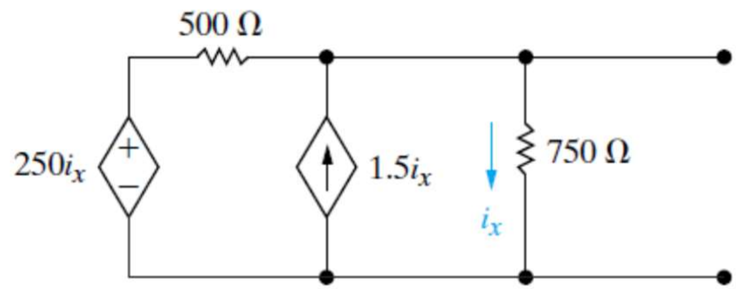
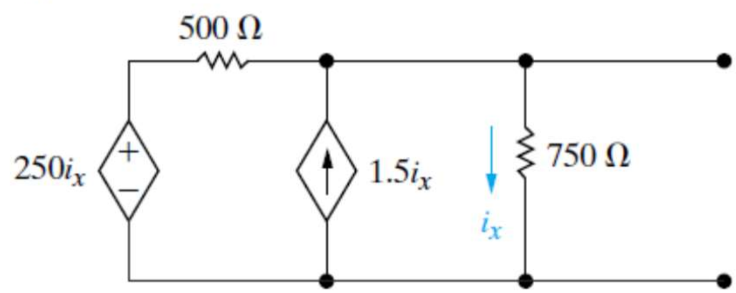


Figure P4.81



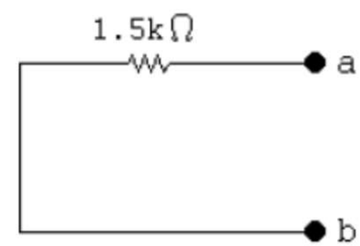
$$\frac{v - 250i_x}{500} - 1.5i_x + \frac{v}{750} - 1 = 0$$

$$i_x = \frac{v}{750}$$

Solving,

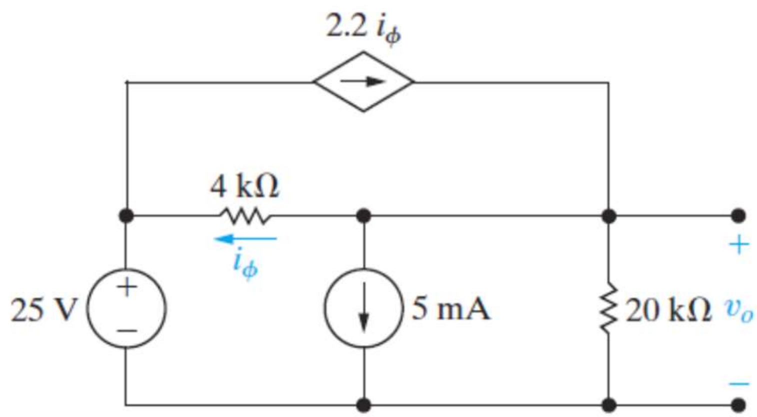
$$v = 1500\,\text{V}; \qquad i_x = 2\,\text{A}$$

$$R_{\text{Th}} = \frac{v}{1\,\text{A}} = 1500 = 1.5\,\text{k}\Omega$$

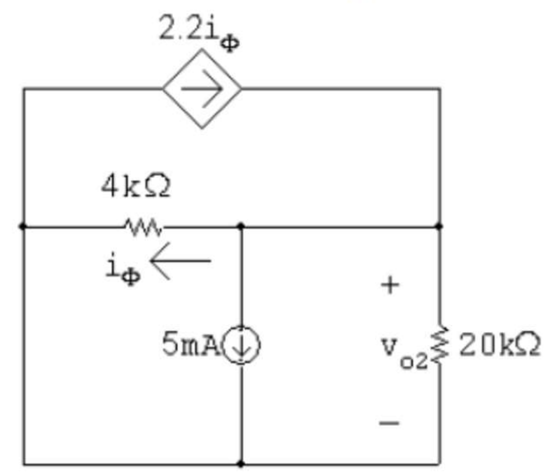


4.97 Use the principle of superposition to find v_o in the circuit in Fig. P4.97.

Figure P4.97



Current source acting alone:

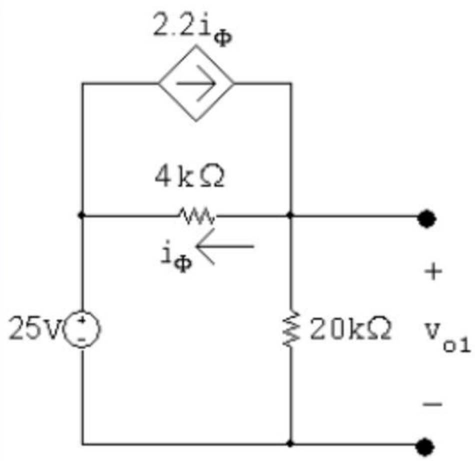


$$\frac{v_{o2}}{4000} + \frac{v_{o2}}{20{,}000} + 0.005 - 2.2\left(\frac{v_{o2}}{4000}\right) = 0$$

Simplifying $\quad 5v_{o2} + v_{o2} + 100 - 11v_{o2} = 0$

$\therefore \quad v_{o2} = 20\,\mathrm{V}$

Voltage source acting alone:

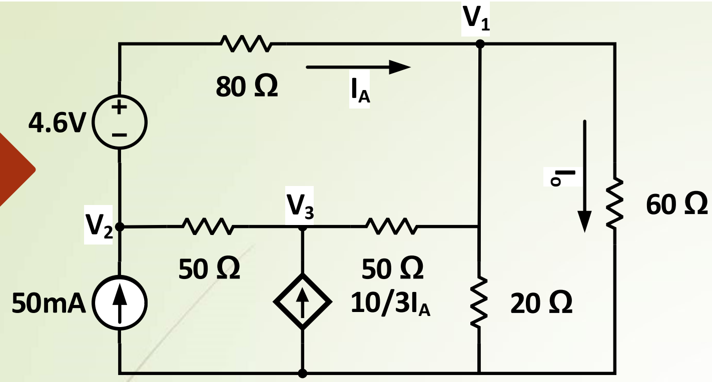


$$\frac{v_{o1} - 25}{4000} + \frac{v_{o1}}{20{,}000} - 2.2\left(\frac{v_{o1} - 25}{4000}\right) = 0$$

Simplifying $\quad 5v_{o1} - 125 + v_{o1} - 11v_{o1} + 275 = 0$

$\therefore \quad v_{o1} = 30\,\mathrm{V}$

$$v_o = v_{o1} + v_{o2} = 30 + 20 = 50\,\mathrm{V}$$



$$\frac{V_1 - 4.6 - V_2}{80} + \frac{V_1}{20} + \frac{V_1}{60} + \frac{V_1 - V_3}{50} = 0$$

$$119V_1 - 15V_2 - 24V_3 = 69$$

$$\frac{V_2 + 4.6 - V_1}{80} + \frac{V_2 - V_3}{50} - 50m = 0$$

$$-5V_1 + 13V_2 - 8V_3 = -3$$

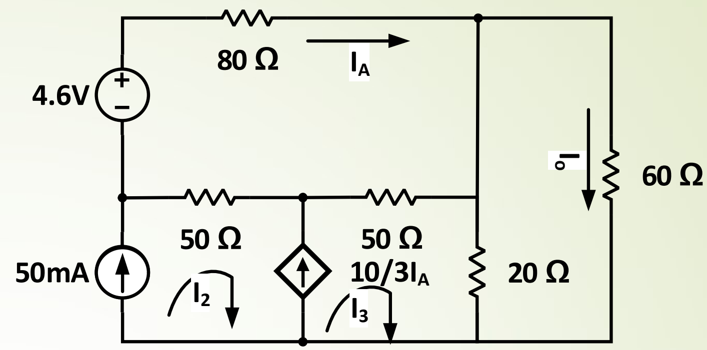
$$\frac{V_3 - V_2}{50} + \frac{V_3 - V_1}{50} - \frac{10}{3} I_A = 0$$

$$\frac{V_3 - V_2}{50} + \frac{V_3 - V_1}{50} - \frac{10}{3}\left(\frac{V_2 + 4.6 - V_1}{80}\right) = 0$$

$$13V_1 - 37V_2 + 24V_3 = 115$$

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 36.75 \\ 89.75 \\ 123.25 \end{bmatrix}$$

$$I_o = \frac{V_1}{60} = \frac{36.75}{60} = 0.61A$$



$$(I_2 = 0.05)$$

$$(I_3 - 0.05 = \frac{10}{3} I_A) Or (0.3I_3 - 0.015) = I_A$$

$$-4.6 + 80I_A + 50(I_A - I_3) + 50(I_A - 0.05) = 0$$

$$-7.1 + 180I_A - 50I_3 = 0$$

$$-7.1 + 180(0.3I_3 - 0.015) - 50I_3 = 0$$

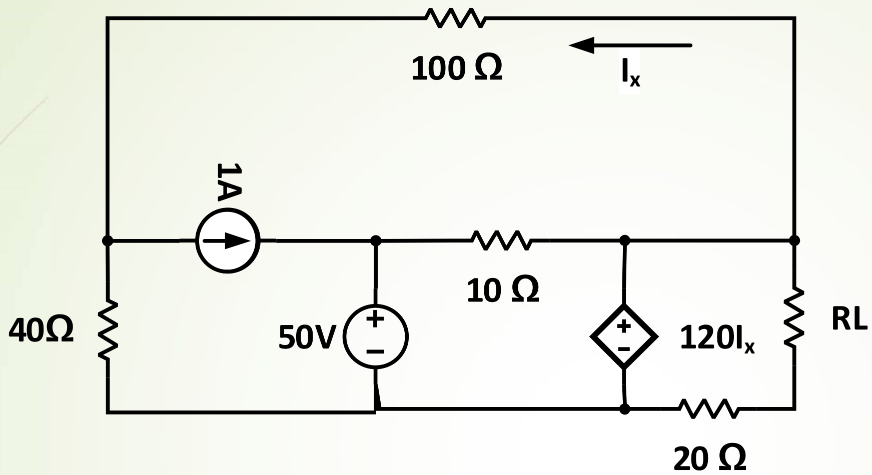
$$I_3 = 2.45A;$$

$$60I_o + 20(I_o - I_3) = 0$$

$$80I_o - 20 * 2.45 = 0$$

$$I_o = 0.61mA$$

Find $\mathbf{R_L}$ that dissipate maximum power**?**



$$V_{oc} = 120I_x$$

$$40(1 - I_x) - 100I_x + 120I_x = 0$$

$$20I_x = 1$$

$$I_x = \frac{1}{20}A$$

$$V_{oc} = \frac{120}{20} = 6A$$

$$I_{sc} = \frac{120I_x}{20} = 6I_x$$

$$40(1 - I_x) - 100I_x + 120I_x = 0$$

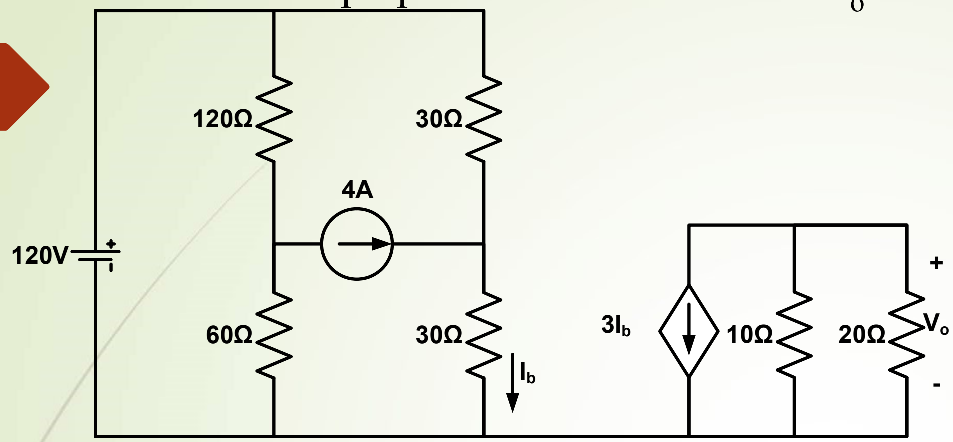
$$20I_x = 1$$

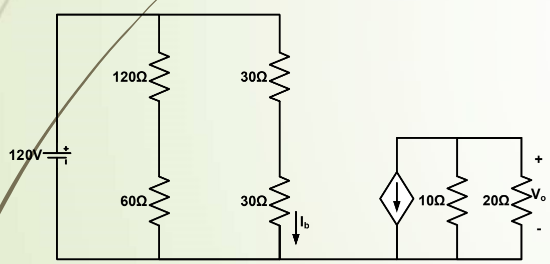
$$I_x = \frac{1}{20}A$$

$$I_{sc} = 6I_x = \frac{3}{10}A$$

$$R_L = R_{th} = \frac{V_{oc}}{I_{sc}} = \frac{120 * 10}{3} = 400\Omega$$

Use Superposition method to find V_o?

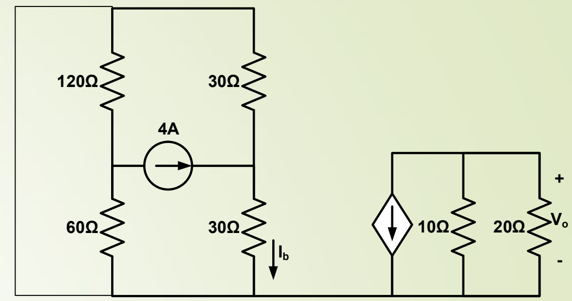


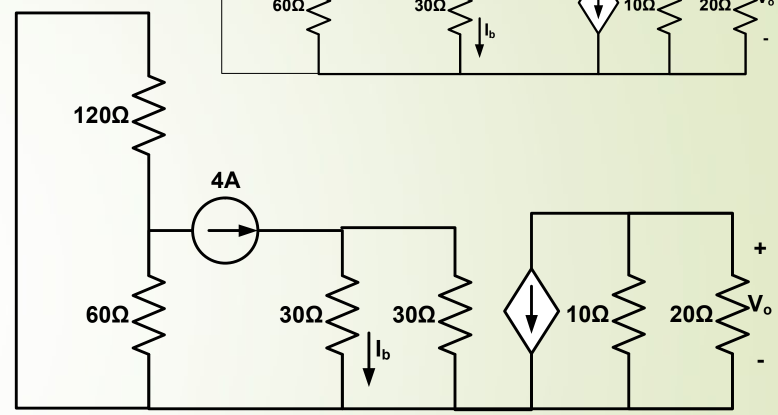


For 120V on

$$I_b = \frac{120}{60} = 2A$$

$$V_{o1} = -\left[\frac{10}{10+20} 3I_b\right] * 20 = -40V$$





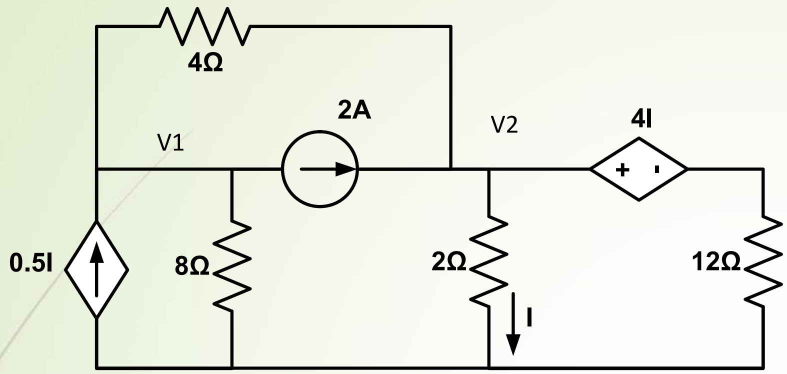
For 4A on

$$I_b = \frac{30}{60} * 4 = 2A$$

$$V_{o2} = -\left[\frac{10}{10+20} 3I_b\right] * 20 = -40V$$

$$V_o = V_{o1} + V_{o2} = -80$$

Use Node Voltage method to find I?



$$I = \frac{V_2}{2}$$

$$-0.5I + 2 + \frac{V_1}{8} + \frac{V_1 - V_2}{4} = 0$$

$$3V_1 - 4V_2 = -16$$

$$\frac{V_2 - 4I}{12} + \frac{V_2}{2} - 2 + \frac{V_2 - V_1}{4} = 0$$

$$10V_2 - 4I - 3V_1 = 24$$

$$8V_2 - 3V_1 = 24$$

1+2---$4V_2 = 8$

$$I = \frac{V_2}{2} = 1A$$