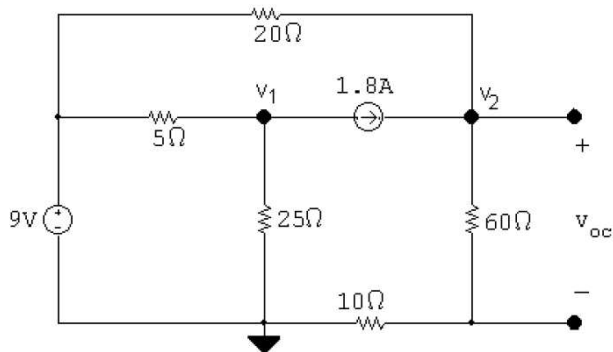


EE 202-131-HW4 Solution

Problem 1 4.65

[a] Open circuit:

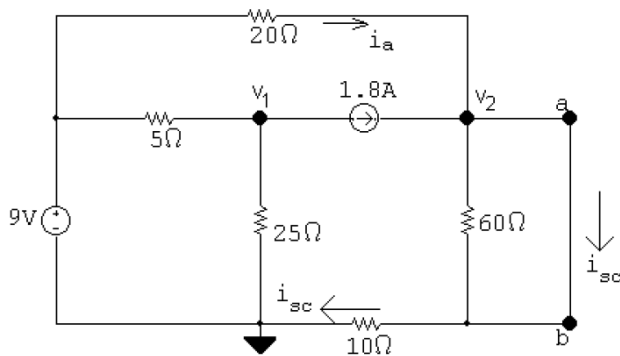


$$\frac{v_2 - 9}{20} + \frac{v_2}{70} - 1.8 = 0$$

$$v_2 = 35 \text{ V}$$

$$v_{\text{Th}} = \frac{60}{70}v_2 = 30 \text{ V}$$

Short circuit:



$$\frac{v_2 - 9}{20} + \frac{v_2}{10} - 1.8 = 0$$

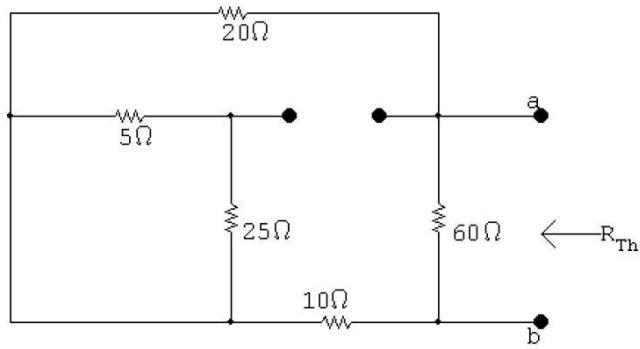
$$\therefore v_2 = 15 \text{ V}$$

$$i_a = \frac{9 - 15}{20} = -0.3 \text{ A}$$

$$i_{\text{sc}} = 1.8 - 0.3 = 1.5 \text{ A}$$

$$R_{\text{Th}} = \frac{30}{1.5} = 20 \Omega$$

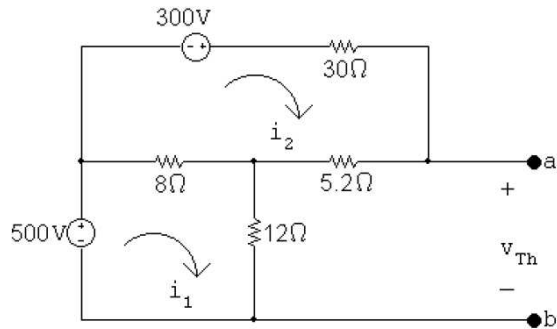
[b]



$$R_{Th} = (20 + 10 \parallel 60) = 20\ \Omega \text{ (CHECKS)}$$

Problem 2 4.66

After making a source transformation the circuit becomes



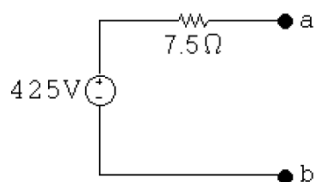
$$500 = 20i_1 - 8i_2$$

$$300 = -8i_1 + 43.2i_2$$

$$\therefore i_1 = 30 \text{ A and } i_2 = 12.5 \text{ A}$$

$$v_{\text{Th}} = 12i_1 + 5.2i_2 = 425 \text{ V}$$

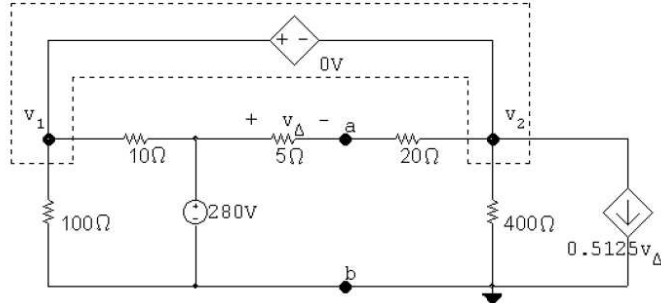
$$R_{\text{Th}} = (8 \parallel 12 + 5.2) \parallel 30 = 7.5 \Omega$$



Problem 3 4.88

[a] First find the Thévenin equivalent with respect to R_o .

Open circuit voltage: $i_\phi = 0$; $50i_\phi = 0$



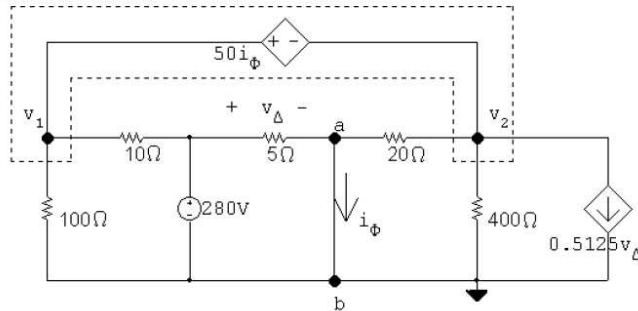
$$\frac{v_1}{100} + \frac{v_1 - 280}{10} + \frac{v_1 - 280}{25} + \frac{v_1}{400} + 0.5125v_\Delta = 0$$

$$v_\Delta = \frac{(280 - v_1)}{25} \cdot 5 = 56 - 0.2v_1$$

$$v_1 = 210 \text{ V}; \quad v_\Delta = 14 \text{ V}$$

$$V_{\text{Th}} = 280 - v_\Delta = 280 - 14 = 266 \text{ V}$$

Short circuit current



$$\frac{v_1}{100} + \frac{v_1 - 280}{10} + \frac{v_2}{20} + \frac{v_2}{400} + 0.5125(280) = 0$$

$$v_\Delta = 280 \text{ V}$$

$$v_2 + 50i_\phi = v_1$$

$$i_\phi = \frac{280}{5} + \frac{v_2}{20} = 56 + 0.05v_2$$

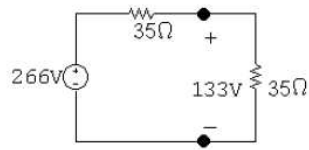
$$v_2 = -968 \text{ V}; \quad v_1 = -588 \text{ V}$$

$$i_\phi = i_{\text{sc}} = 56 + 0.05(-968) = 7.6 \text{ A}$$

$$R_{\text{Th}} = V_{\text{Th}}/i_{\text{sc}} = 266/7.6 = 35 \Omega$$

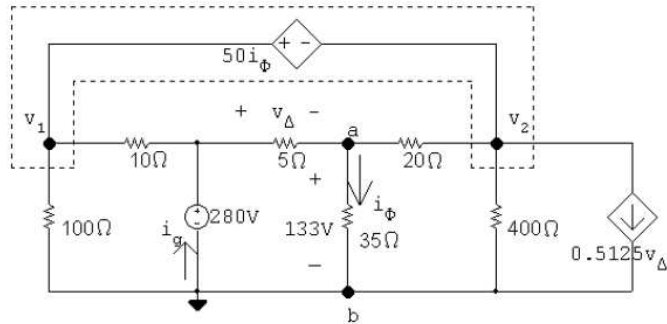
$$\therefore R_o = 35 \Omega$$

[b]



$$p_{\max} = (133)^2/35 = 505.4 \text{ W}$$

[c]



$$\frac{v_1}{100} + \frac{v_1 - 280}{10} + \frac{v_2 - 133}{20} + \frac{v_2}{400} + 0.5125(280 - 133) = 0$$

$$v_2 + 50i_\phi = v_1; \quad i_\phi = 133/35 = 3.8 \text{ A}$$

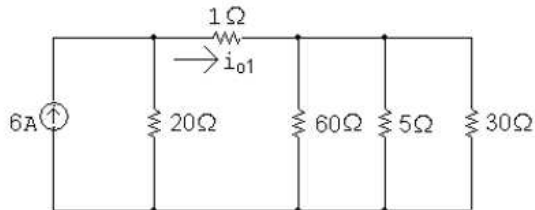
Therefore, $v_1 = -189 \text{ V}$ and $v_2 = -379 \text{ V}$; thus,

$$i_g = \frac{280 - 133}{5} + \frac{280 + 189}{10} = 76.30 \text{ A}$$

$$p_{280\text{V}} (\text{dev}) = (280)(76.3) = 21,364 \text{ W}$$

Problem 4 4.94

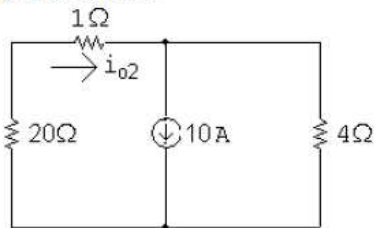
6 A source:



$$30\Omega \parallel 5\Omega \parallel 60\Omega = 4\Omega$$

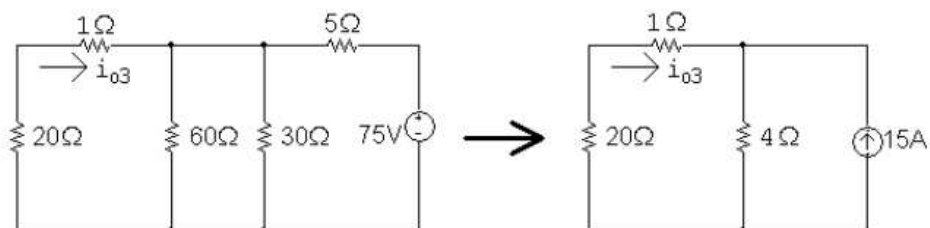
$$\therefore i_{o1} = \frac{20}{20+5}(6) = 4.8\text{ A}$$

10 A source:



$$i_{o2} = \frac{4}{25}(10) = 1.6\text{ A}$$

75 V source:

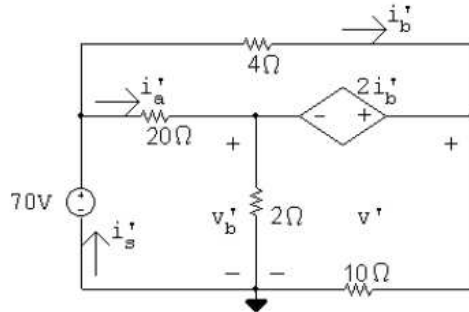


$$i_{o3} = -\frac{4}{25}(15) = -2.4\text{ A}$$

$$i_o = i_{o1} + i_{o2} + i_{o3} = 4.8 + 1.6 - 2.4 = 4\text{ A}$$

Problem 4 4.96

70-V source acting alone:



$$v' = 70 - 4i_b'$$

$$i_s' = \frac{v_b'}{2} + \frac{v'}{10} = i_a' + i_b'$$

$$70 = 20i_a' + v_b'$$

$$i_a' = \frac{70 - v_b'}{20}$$

$$\therefore i_b' = \frac{v_b'}{2} + \frac{v'}{10} - \frac{70 - v_b'}{20} = \frac{11}{20}v_b' + \frac{v'}{10} - 3.5$$

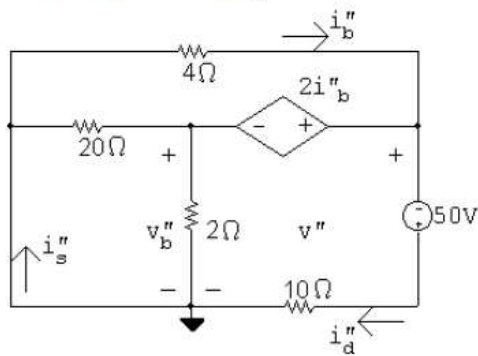
$$v' = v_b' + 2i_b'$$

$$\therefore v_b' = v' - 2i_b'$$

$$\therefore i_b' = \frac{11}{20}(v' - 2i_b') + \frac{v'}{10} - 3.5 \quad \text{or} \quad i_b' = \frac{13}{42}v' - \frac{70}{42}$$

$$\therefore v' = 70 - 4\left(\frac{13}{42}v' - \frac{70}{42}\right) \quad \text{or} \quad v' = \frac{3220}{94} = \frac{1610}{47} \text{ V} = 34.255 \text{ V}$$

50-V source acting alone:



$$v'' = -4i_b''$$

$$v'' = v_b'' + 2i_b''$$

$$v'' = -50 + 10i_d''$$

$$\therefore i_d'' = \frac{v'' + 50}{10}$$

$$i_s'' = \frac{v_b''}{2} + \frac{v'' + 50}{10}$$

$$i_b'' = \frac{v_b''}{20} + i_s'' = \frac{v_b''}{20} + \frac{v_b''}{2} + \frac{v'' + 50}{10} = \frac{11}{20}v_b'' + \frac{v'' + 50}{10}$$

$$v_b'' = v'' - 2i_b''$$

$$\therefore i_b'' = \frac{11}{20}(v'' - 2i_b'') + \frac{v'' + 50}{10} \quad \text{or} \quad i_b'' = \frac{13}{42}v'' + \frac{100}{42}$$

$$\text{Thus, } v'' = -4\left(\frac{13}{42}v'' + \frac{100}{42}\right) \quad \text{or} \quad v'' = -\frac{200}{47} \text{ V} = -4.255 \text{ V}$$

$$\text{Hence, } v = v' + v'' = \frac{1610}{47} - \frac{200}{47} = \frac{1410}{47} = 30 \text{ V}$$