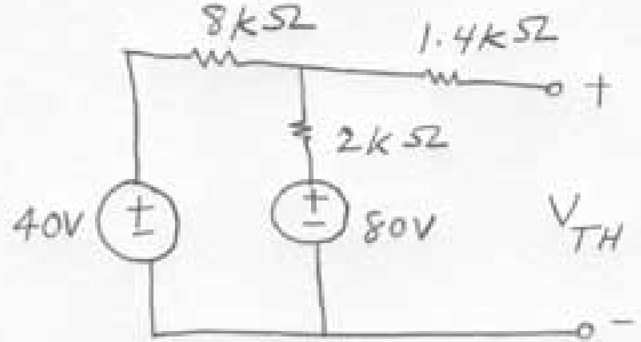
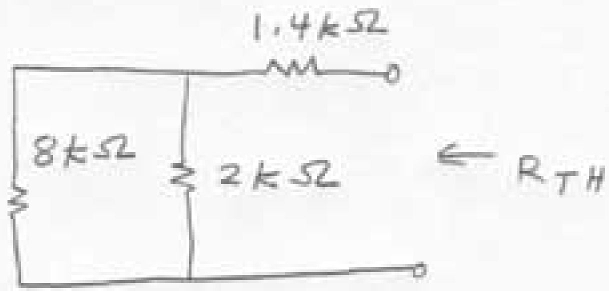
P4.75 a)



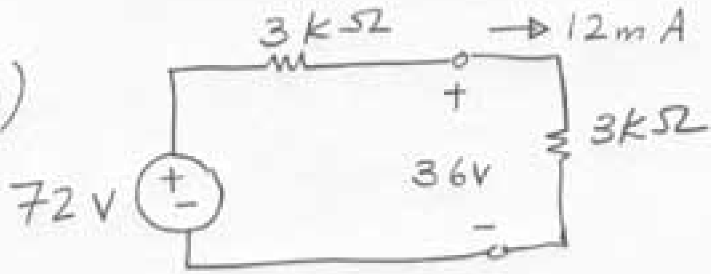
$$\frac{V_{TH}-40}{80}+\frac{V_{TH}-80}{2}=0$$

$$\therefore V_{TH}=72V$$



$$R_{TH}=8//2+1.4=3k\Omega$$

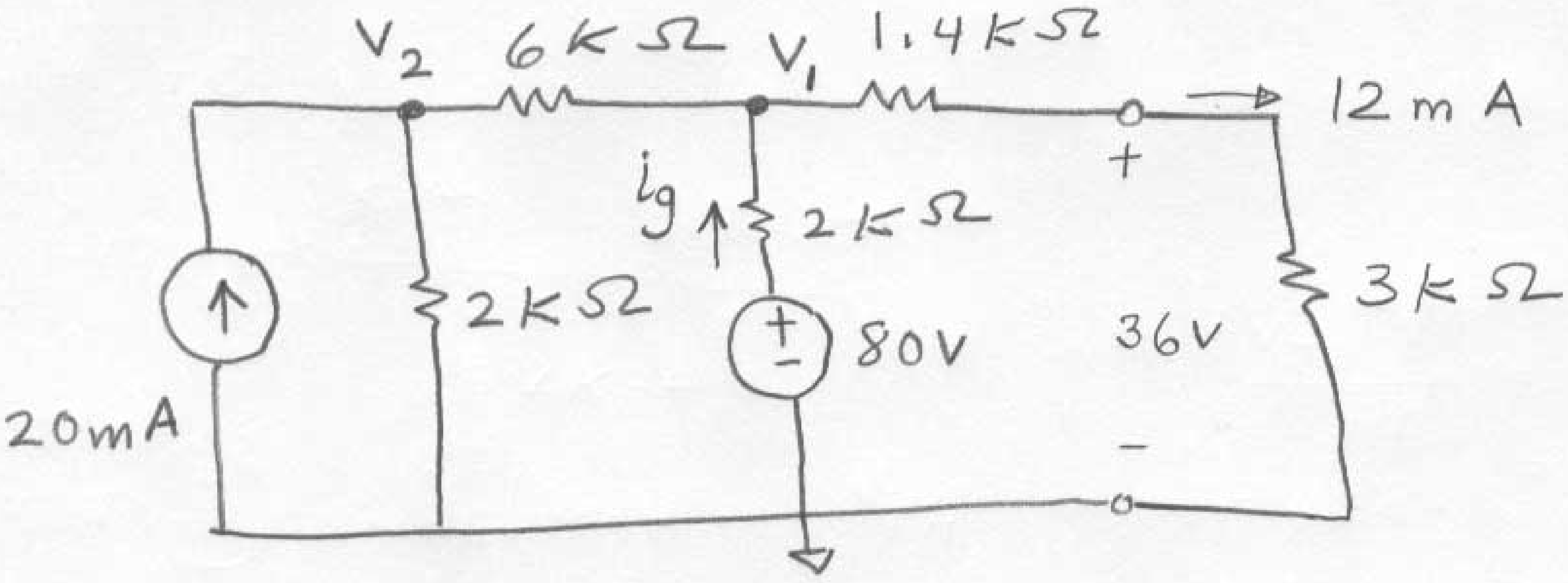
b)



$$P_{max}=\frac{(36)^2}{3k}=432mW$$

or $$P_{max}=\frac{(72)^2}{4\times 3K}=432mW$$

P-4.76



$$V_1 = (12 \times 10^{-3})(1.4 + 3) \times 10^3 = 12(4.4) = 52.8\text{ V}$$

$$i_g = \frac{80 - 52.8}{2k} = 13.6\text{ mA}$$

$$P_{80v} = -80(13.6m) = -1088\text{ mW}$$ (actually delivered).

$$-20 + \frac{v_2}{2} + \frac{v_2 - 52.8}{6} = 0$$

$$\therefore \quad v_2 = 43.2\text{ V}$$

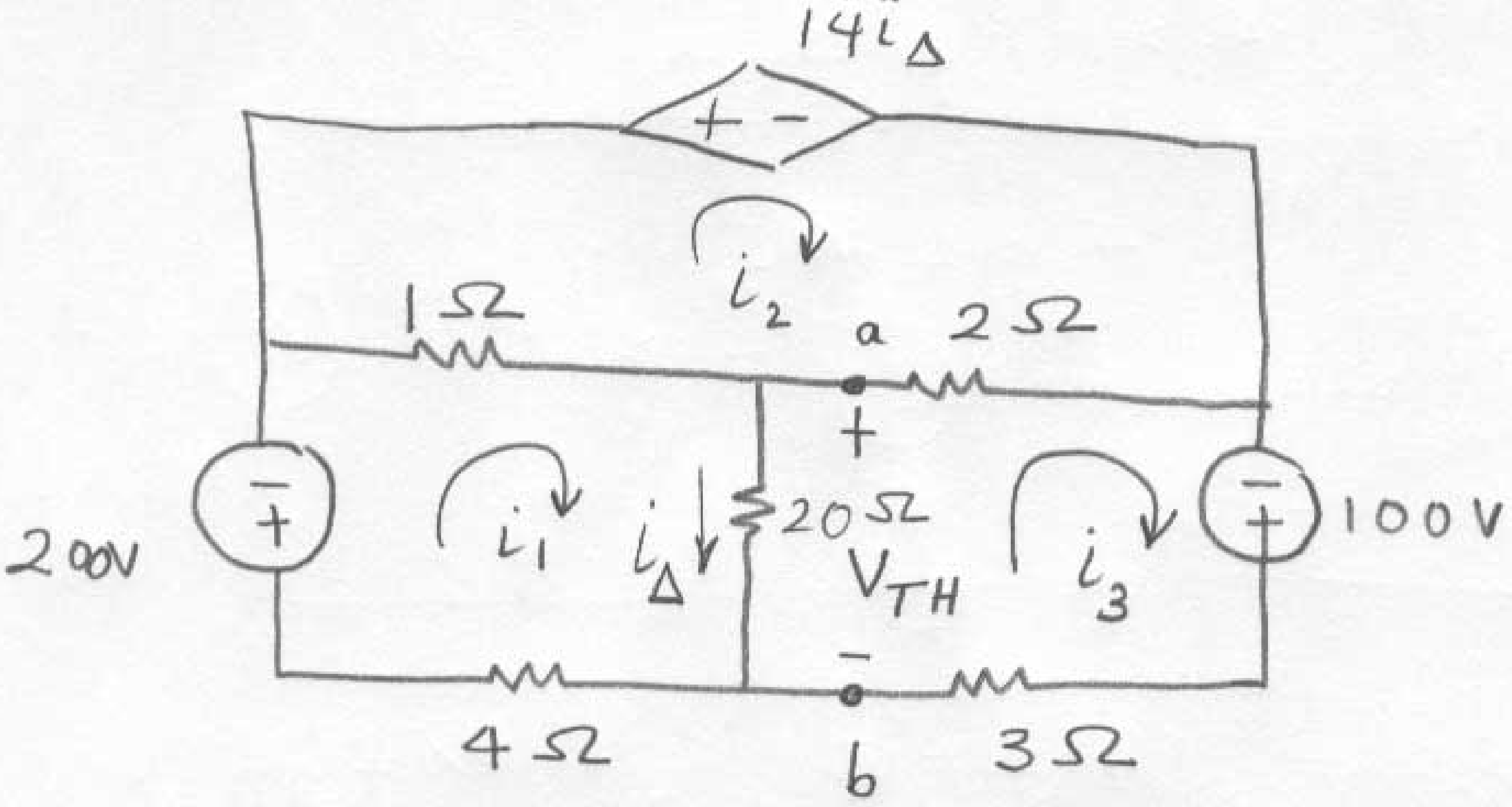
$$P_{20mA} = (-20m)V_2 = -(20m)(43.2) = -864\text{ mW}$$

(actually del.).

$$\sum P_{dev.} = 1088 + 864 = 1952\text{ mW}$$

$$\%\text{ delivered to } R_o = \frac{432}{1952} \times 100 = 22.13\%$$

P-4.77



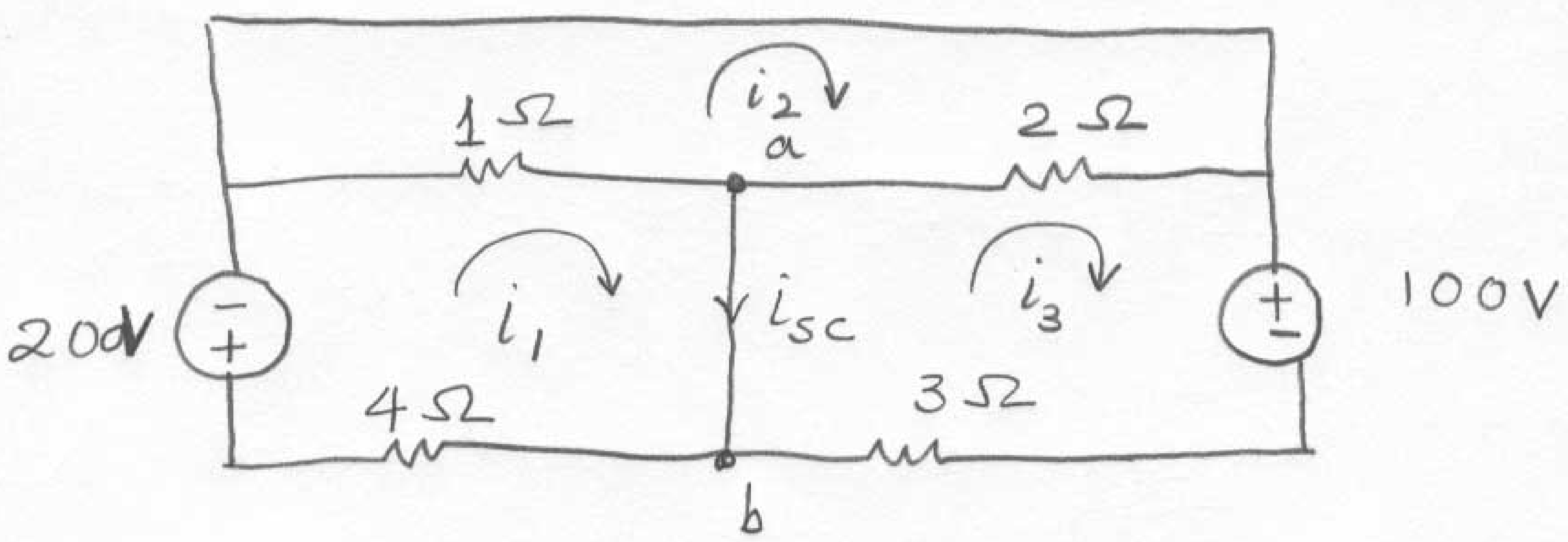
Mesh 1 $\Rightarrow$ $-200 = 25i_1 - i_2 - 20i_3$

Mesh 2 $\Rightarrow$ $0 = 13i_1 + 3i_2 - 16i_3$

Mesh 3 $\Rightarrow$ $100 = -20i_1 - 2i_2 + 25i_3$

Solving $i_1 = -2.5$, $i_3 = 5\,A$

$$V_{TH} = 20(i_1 - i_3) = 20(-7.5) = -150V$$



Because the short circuit is in // 20Ω,

$\therefore i_\Delta = 0$, $14i_\Delta = 0$

Mesh 1 $\Rightarrow$ $-200 = 5i_1 - i_2 + 0i_3$

Mesh 2 $\Rightarrow$ $0 = -i_1 + 3i_2 - 2i_3$

Mesh 3 $\Rightarrow$ $100 = 0i_1 - 2i_2 + 5i_3$

Solving $i_1 = -40\,A$, $i_3 = 20\,A$

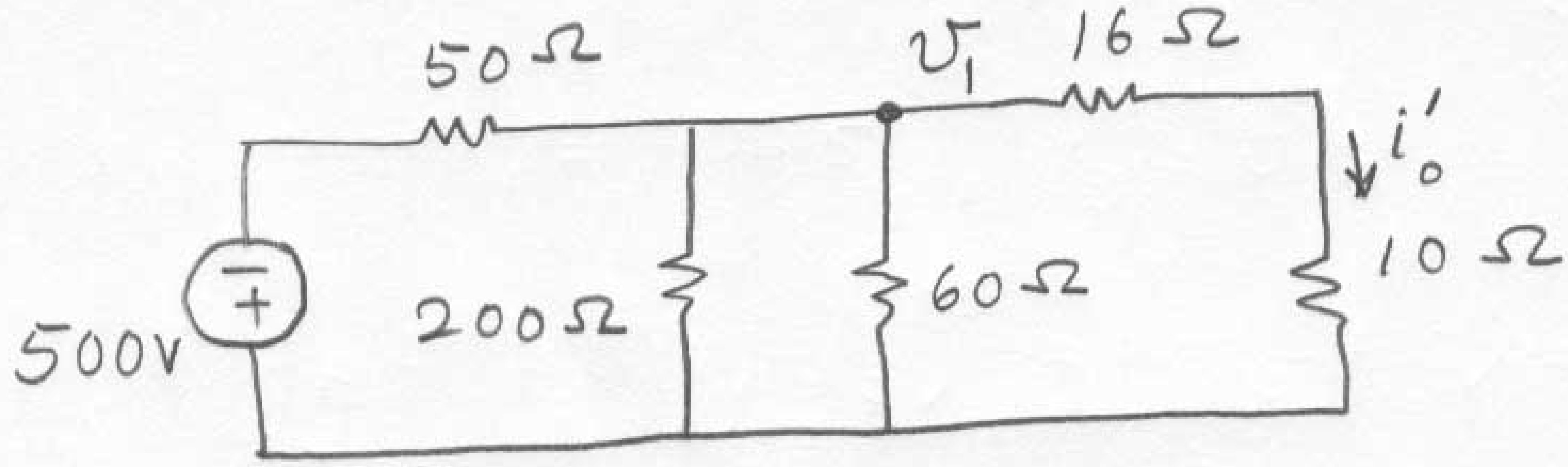
$\therefore\ i_{sc} = i_1 - i_3 = -60\,A$

$$R_{TH} = \frac{V_{TH}}{i_{sc}} = \frac{-150}{-60} = 2.5\,\Omega$$

For maximum power transfer $R_o = R_{TH} = 2.5\Omega$

$$b)\ P_{max} = \frac{V_{TH}^2}{4R_{TH}} = \frac{(-150)^2}{4(2.5)} = 2250\,W.$$

P-4.90 a) $i_o' = i_o\big|_{500V}$

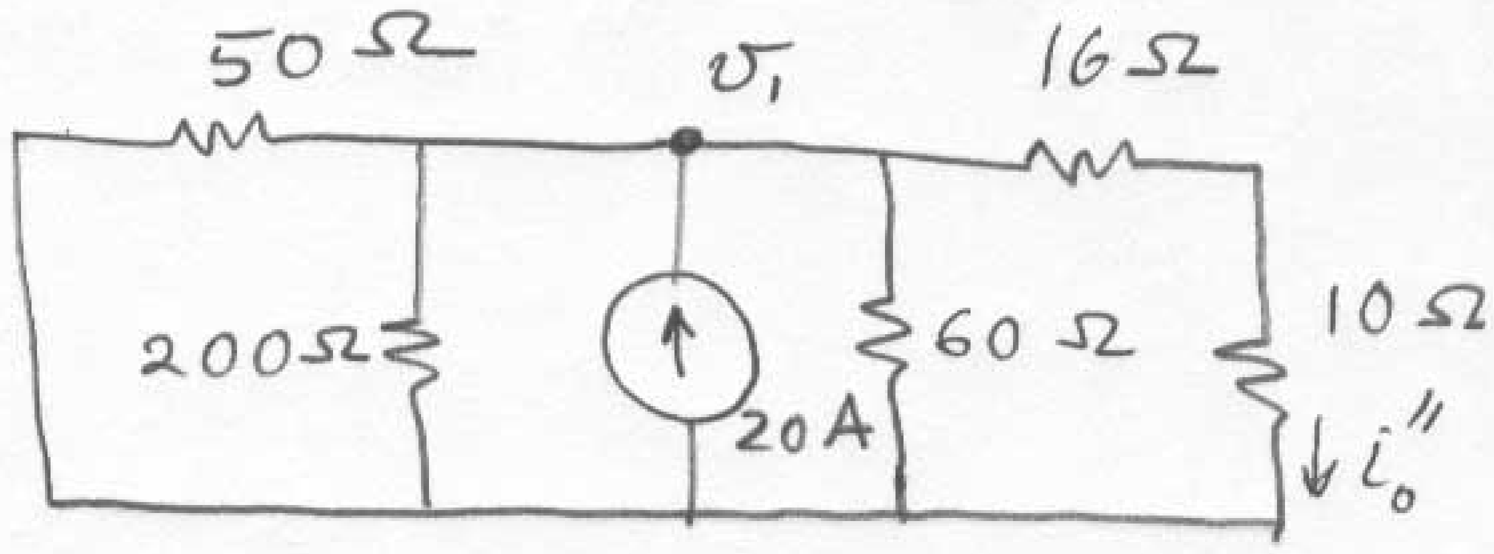


$$\frac{v_1 + 500}{50} + \frac{v_1}{200} + \frac{v_1}{60} + \frac{v_1}{26} = 0$$

$\therefore\ v_1 = -124.8\,V$

$$i_o' = \frac{V_1}{26} = \frac{-124.8}{26} = -4.8\,A$$

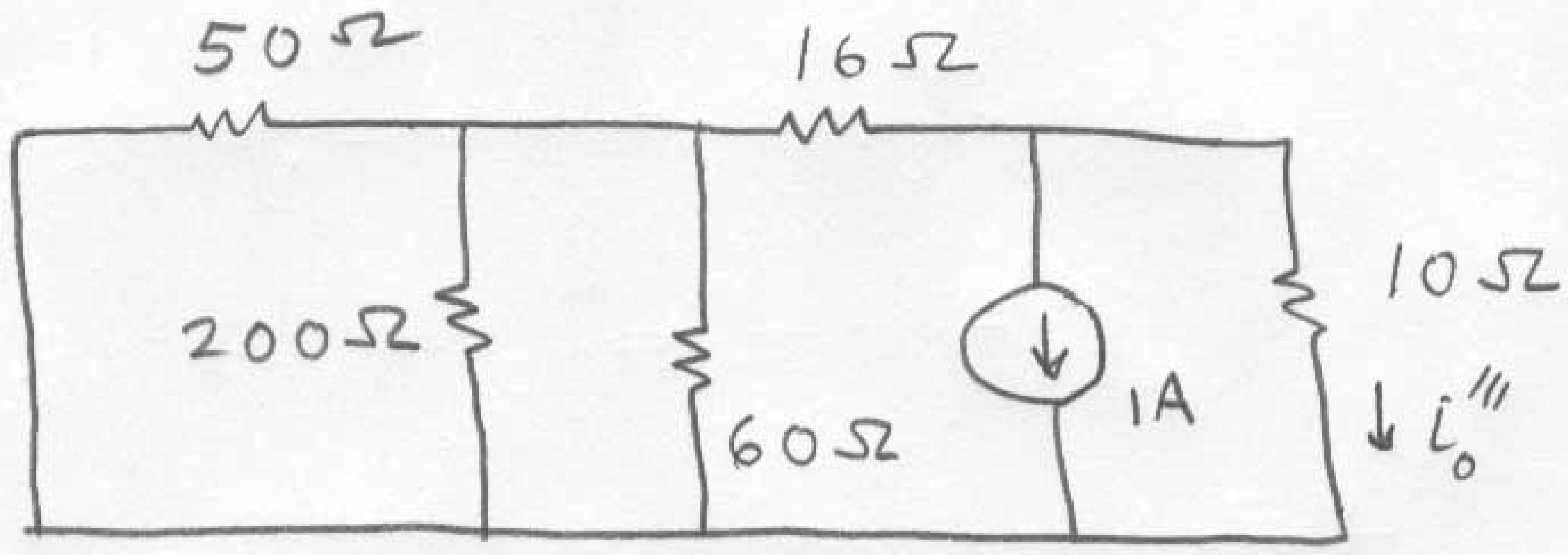
$$i_o'' = i_o\big|_{20A}$$



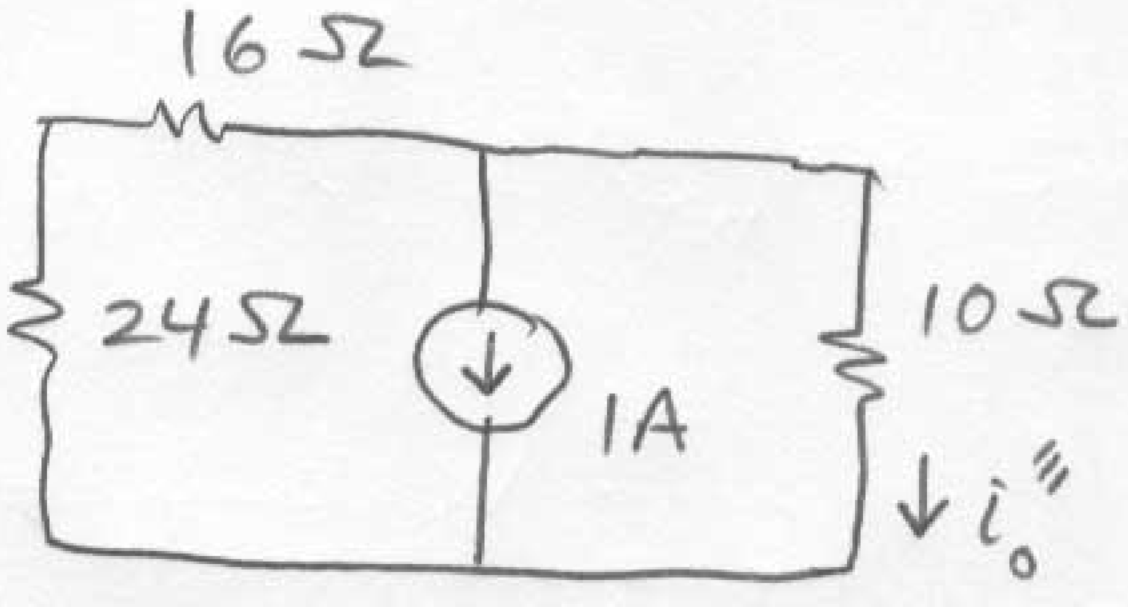
$$\frac{v_1}{50} + \frac{v_1}{200} + \frac{v_1}{60} + \frac{v_1}{26} = 20$$

$\therefore\ v_1 = 249.60\,V$

$$i_o'' = \frac{249.60}{26} = 9.6\,A$$



$i_o''' = i_o\big|_{1A}$



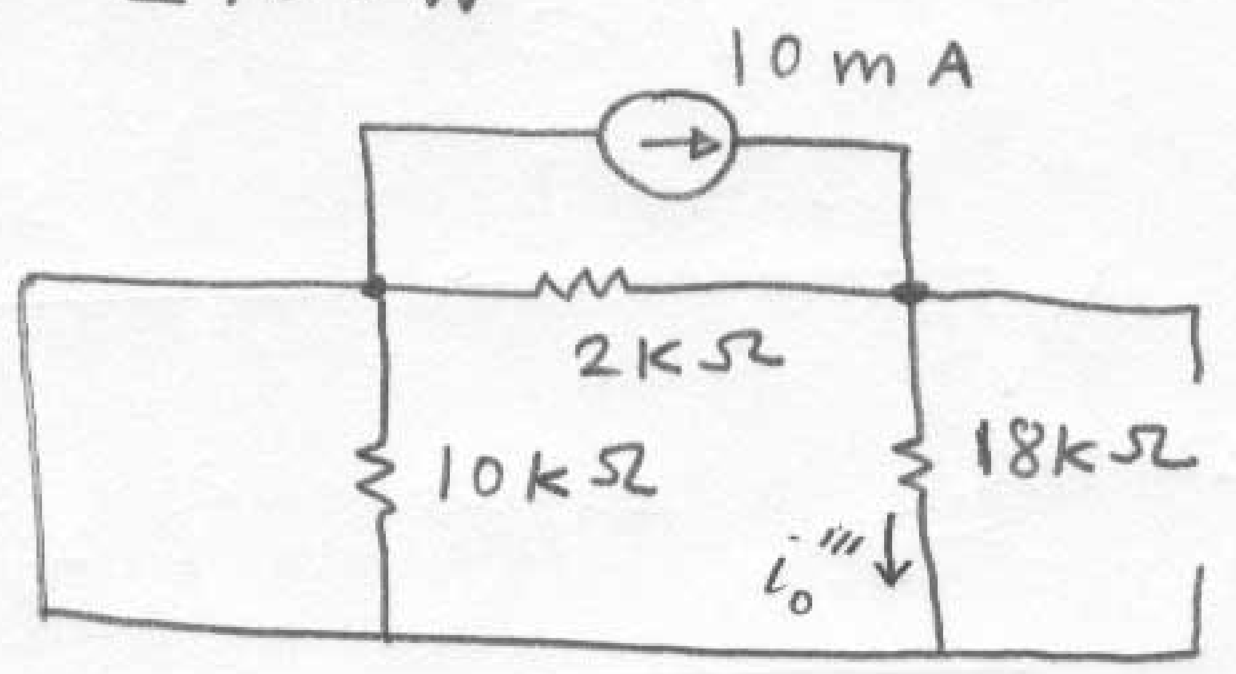
$50 // 200 // 60 = 24\,\Omega$

$i_o''' = -\left(\frac{40}{50}\right) = -0.80\text{ A}$

$i_o = i_o' + i_o'' + i_o''' = -4.8 + 9.6 - 0.8 = 4\text{ A}$

b) $P = 10\, i_o^2 = 160\text{ W}$

P_4.92 a)



By hypothesis $i_o' + i_o'' = 1.5\text{ mA}$

$i_o''' = 10\left(\frac{2}{20}\right) = 1\text{ mA}$, $\therefore i_o = 1.5 + 1 = 2.5\text{ mA}$

b) With all three sources in the circuit, write a single node voltage equation:

$$\frac{v_b}{18} + \frac{v_b - 20}{2} - 5 - 10 = 0$$

$$\therefore \quad v_b = 45\text{ V}$$

$$\therefore \quad i_o = \frac{v_b}{18} = \frac{45}{18} = 2.5\text{ mA}$$