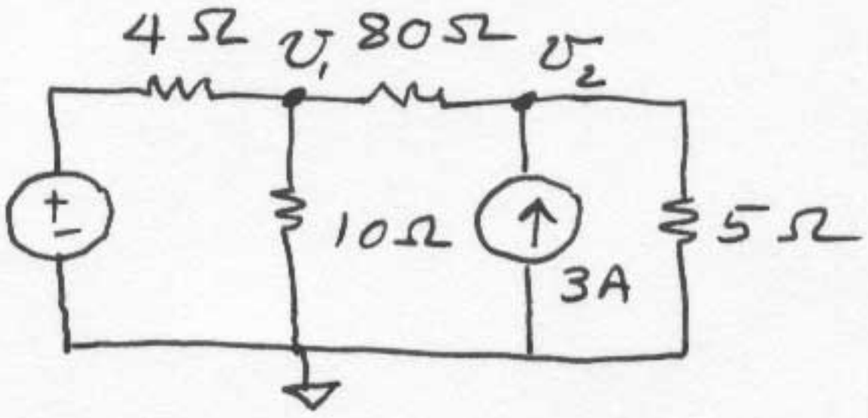
P 4.5 Use the lower terminal of the 80Ω resistor as a reference.

$$\frac{v_o - 60}{10} + \frac{v_o}{5} + 3 = 0 \Longrightarrow v_o = 10\,V$$

P 4.9



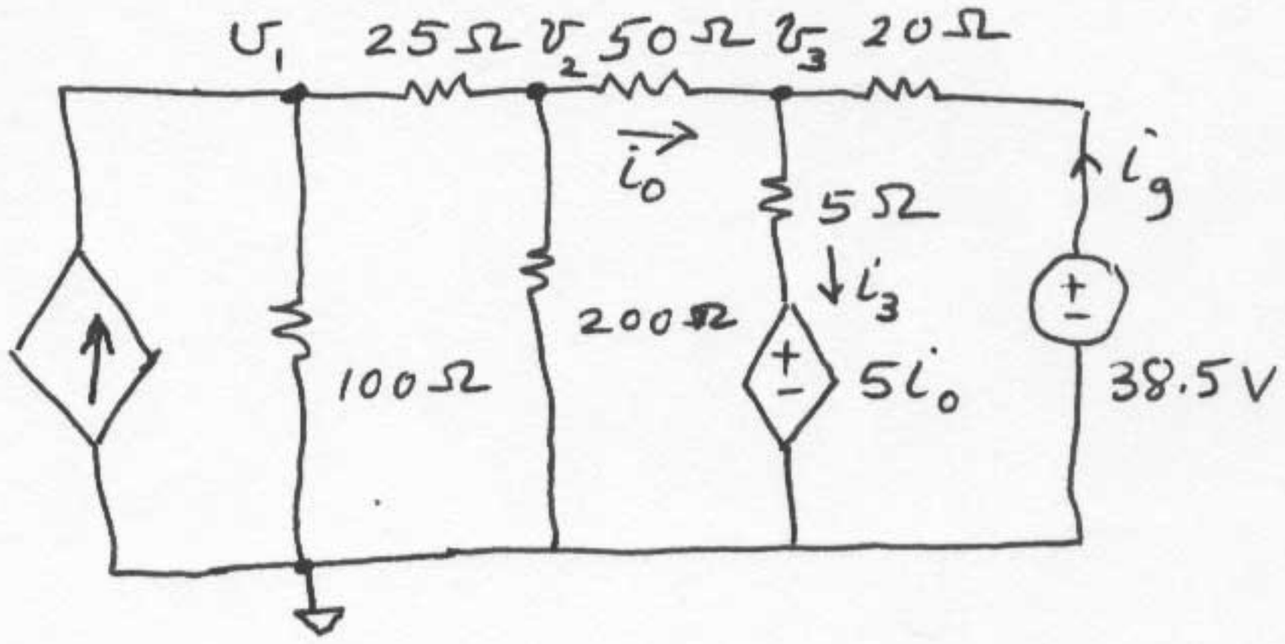
$$\frac{v_1 - 144}{4} + \frac{v_1}{10} + \frac{v_1 - v_2}{80} = 0$$

So $29v_1 - v_2 = 2880$ ①

$$-3 + \frac{v_2 - v_1}{80} + \frac{v_2}{5} = 0 \quad \text{, so} \quad -v_1 + 17v_2 = 240 \text{ ②}$$

$\therefore v_1 = 100\,V$ and $v_2 = 20\,V$

P 4.23 a)



$$i_o = \frac{v_2 - v_3}{50}$$

$$-2i_o + \frac{v_1}{100} + \frac{v_1 - v_2}{25} = 0$$

$\therefore 5v_1 - 8v_2 + 4v_3 = 0$ ①

$$\frac{v_2 - v_1}{25} + \frac{v_2}{200} + \frac{v_2 - v_3}{50} = 0 \Longrightarrow -8v_1 + 13v_2 - 4v_3 = 0 \text{ ②}$$

$$\frac{v_3 - v_2}{50} + \frac{v_3 - 5i_o}{5} + \frac{v_3 - 38.5}{20} = 0 \Longrightarrow -4v_2 + 29v_3 = 192.5 \text{ ③}$$

Solving ① ② and ③ ⇒

$v_1 = -50\,V$, $v_2 = -30\,V$, $v_3 = 2.5\,V$

P4.23 b) $i_o = \dfrac{v_2 - v_3}{50} = \dfrac{-30 - 2.5}{50} = -0.65\,A$

$$i_3 = \frac{v_3 - 5i_o}{5} = \frac{2.5 - 5(-0.65)}{5} = 1.15\,A$$

$$i_g = \frac{38.5 - 2.5}{20} = 1.8\,A$$

$$\sum P_{dis} = \sum P_{dev}$$

$$P_{2i_o} = -2i_o v_1 = -2(-0.65)(-50) = -65\,W \text{ (developed)}$$

$$P_{5i_o} = 5i_o i_3 = 5(-0.65)(1.15) = -3.7375\,W \text{ (dev.)}$$

$$P_g = -38.5(1.8) = -69.30\,W \text{ (dev.)}$$

$$\sum P_{dev} = 65 + 3.7375 + 69.3 = 138.0375\,W$$

Check:

$$\sum P_{dis} = \frac{2500}{100} + \frac{900}{200} + \frac{400}{25} + (0.65)^2(50) + (1.8)^2(20)$$

$$= 138.0375\ W$$

$$\therefore \sum P_{dev} = \sum P_{dis} = 138.0375\,W$$

P4.24 a)

$$-5 + \frac{v_1}{15} + \frac{v_1 - v_2}{5} = 0 \Rightarrow 4v_1 - 3v_2 = 75 \quad (1)$$

$$\frac{v_2 - v_1}{5} + \frac{v_2}{30} + \frac{v_2}{10} + \frac{v_2 + 5i_\Delta}{30} = 0 \Rightarrow -6v_1 + 11v_2 + 5i_\Delta = 0 \quad (2)$$

but $i_\Delta = \dfrac{v_1 - v_2}{5}$, so $v_1 - v_2 - 5i_\Delta = 0$ (3)

Solving $v_1 = 30\,V$, $v_2 = 15\,V$, $i_\Delta = 3\,A$, $i_o = \dfrac{15+15}{30} = 1A$

P 4.24 a) continued

$$P_{5i_\Delta} = (-15)(1) = -15\,W\,(del)$$

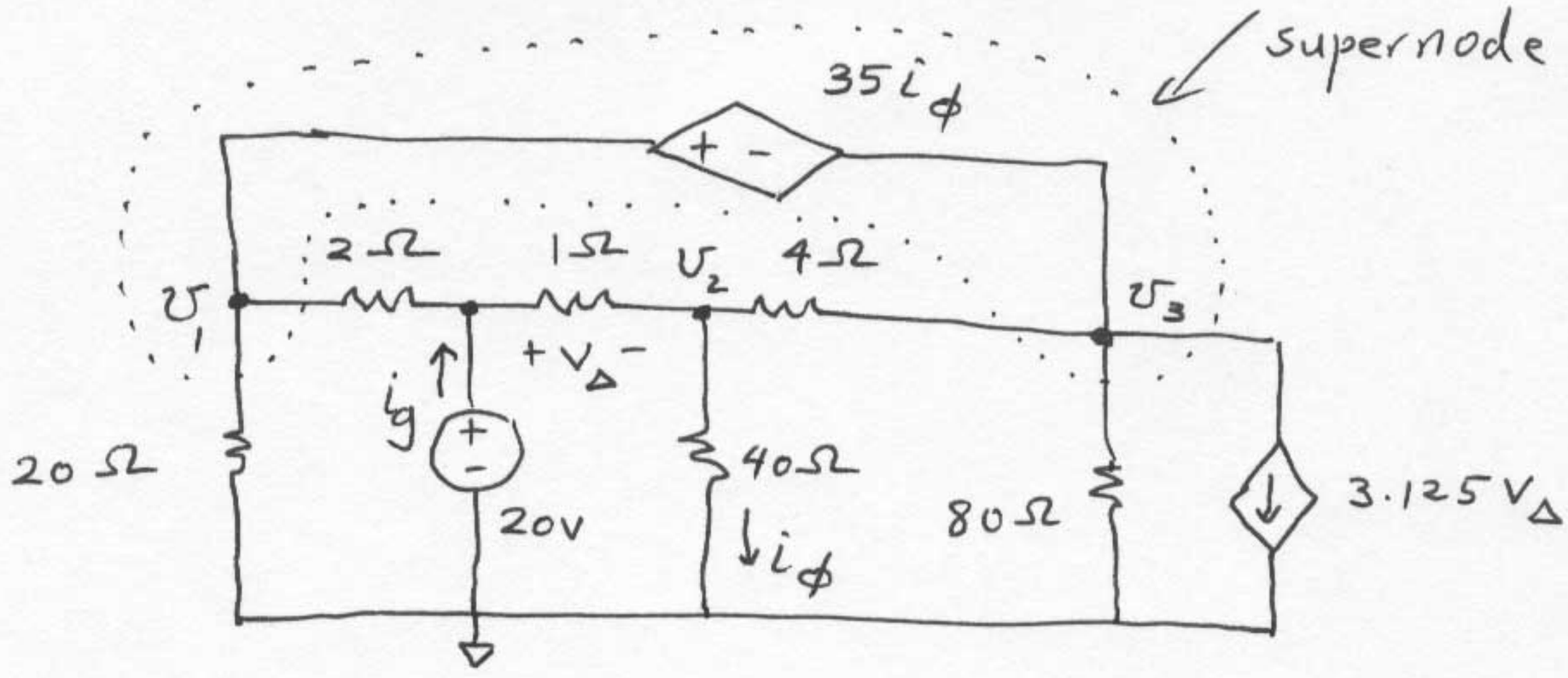
$$P_{5A} = -5(30) = -150\,W\,(del)$$

$$\therefore P_{dev} = 165\,W$$

b) $$\sum P_{abs} = \frac{(30)^2}{15} + \frac{(15)^2}{30} + \frac{(15)^2}{10} + (3)^2(5) + (1)^2(30) = 165\,W$$

$$\therefore \sum P_{abs} = \sum P_{dev} = 165\,W$$

P 4.26



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

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

$$v_\Delta = 20 - v_2$$

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

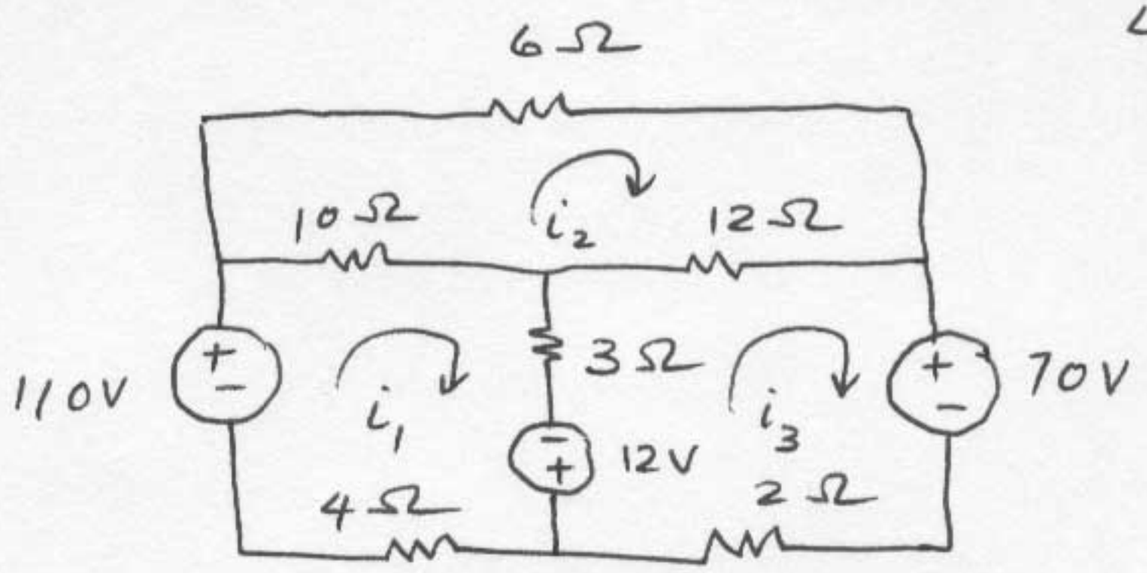
$$i_\phi = v_2/40$$

Solving, $v_1 = -20.25\,V$, $v_2 = 10V$, $v_3 = -29\,V$

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

$$\therefore P_{20V} = -20(30.125) = -602.5\,W \text{ (actually delivered)}.$$

P4.32 a)



$110 + 12 = 17 i_1 - 10 i_2 - 3 i_3$

$0 = -10 i_1 + 28 i_2 - 12 i_3$

$-12 - 70 = -3 i_1 - 12 i_2 + 17 i_3$

Solving: $i_1 = 8\,A$, $i_2 = 2\,A$, $i_3 = -2\,A$

$P_{110V} = -110 i_1 = -880\,W$ (del).

$P_{12V} = -12(i_1 - i_3) = -120\,W$ (del)

$P_{70V} = 70 i_3 = -140\,W$ (del)

$\therefore \quad \sum P_{dev} = 1140\,W$

b) $P_{4\Omega} = (8)^2(4) = 256\,W$, $P_{10\Omega} = (6)^2(10) = 360\,W$

$P_{12\Omega} = (-4)^2(12) = 192\,W$, $P_{2\Omega} = (-2)^2(2) = 8\,W$

$P_{6\Omega} = (2)^2(6) = 24\,W$, $P_{3\Omega} = (10)^2(3) = 300\,W$

$\therefore \quad \sum P_{abs} = 1140\,W$