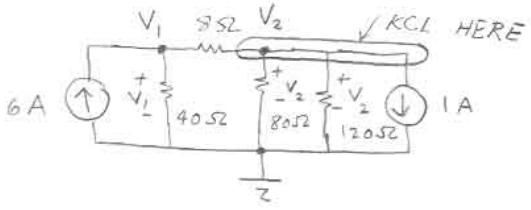
HW #4

4.9



Node 1 ⇒

$$-6 + \frac{V_1}{40} + \frac{V_1 - V_2}{8} = 0$$

$$-240 + V_1 + 5V_1 - 5V_2 = 0 \Rightarrow 6V_1 - 5V_2 = 240 \quad (1)$$

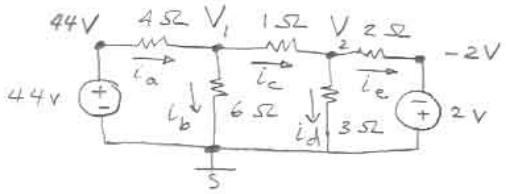
Node 2 ⇒

$$\frac{V_2 - V_1}{8} + \frac{V_2}{80} + \frac{V_2}{120} + 1 = 0$$

$$30V_2 - 30V_1 + 3V_2 + 2V_2 + 240 = 0 \Rightarrow -30V_1 + 35V_2 = -240 \quad (2)$$

Solving. $\Rightarrow V_1 = 120\,V$ & $V_2 = 96\,V$

4.10



a)
Node 1 ⇒

$$\frac{V_1 - 44}{4} + \frac{V_1}{6} + \frac{V_1 - V_2}{1} = 0$$

$$3V_1 - 132 + 2V_1 + 12V_1 - 12V_2 = 0$$

$$17V_1 - 12V_2 = 132 \quad (1)$$

Node 2 $\Rightarrow$ $V_2 - V_1 + \frac{V_2}{3} + \frac{V_2 - (-2)}{2} = 0$

$$6V_2 - 6V_1 + 2V_2 + 3V_2 + 6 = 0$$

$$-6V_1 + 11V_2 = -6 \quad (2)$$

Solving $\Rightarrow V_1 = 12\,V$ & $V_2 = 6\,V$

$i_a = \frac{44 - V_1}{4} = \frac{44 - 12}{4} = 8A$, $i_b = \frac{12}{6} = 2A$, $i_c = \frac{12 - 6}{1} = 6A$

$i_d = \frac{6}{3} = 2A$, $i_e = \frac{6 - (-2)}{2} = 4A$

4.10 b)

$P_{44V} = -8 \times 44 = -352\,W$, $P_{2V} = -4 \times 2 = -8\,W$

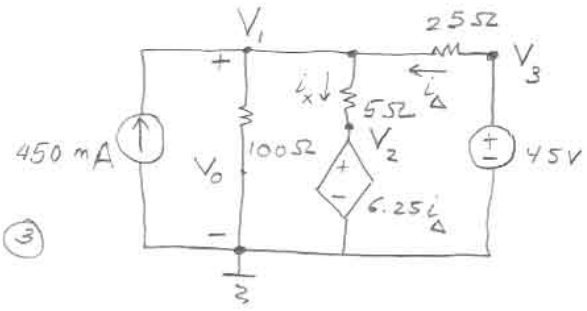
$\therefore P_{developed} = 352 + 8 = 360\,W$

4.17

a) $V_3 = 45V$ (1)

$V_2 = 6.25 i_\Delta$ (2)

$i_\Delta = \frac{V_3 - V_1}{25} = \frac{45 - V_1}{25}$ (3)



Substitute (3) into (2) $\Rightarrow$

$V_2 = 6.25 \left(\frac{45 - V_1}{25} \right) = \frac{1}{4}(45 - V_1) \Rightarrow$

$4V_2 = 45 - V_1 \Rightarrow V_1 + 4V_2 = 45$ (4)

Node 1 $\Rightarrow -450 \times 10^{-3} + \frac{V_1}{100} + \frac{V_1 - V_2}{5} + \frac{V_1 - V_3}{25} = 0$

$-45 + V_1 + 20V_1 - 20V_2 + 4V_1 - 4V_3 = 0$

$25V_1 - 20V_2 - 45 - 4(45) = 0$

$25V_1 - 20V_2 = 225$ (5)

Solving (4) & (5) $\Rightarrow V_1 = V_o = 15V$

b) $i_\Delta = \frac{V_3 - V_1}{25} = \frac{45 - 15}{25} = \frac{30}{25} = 1.2A$

$6.25 i_\Delta = 6.25(1.2) = 7.5\,V = V_2$ & $i_x = \frac{V_1 - V_2}{5} = \frac{15 - 7.5}{5}$

$= 1.5A$

$\therefore P_{6.25 i_\Delta} = i_x V_2 = 1.5(7.5) = 11.25\,W$

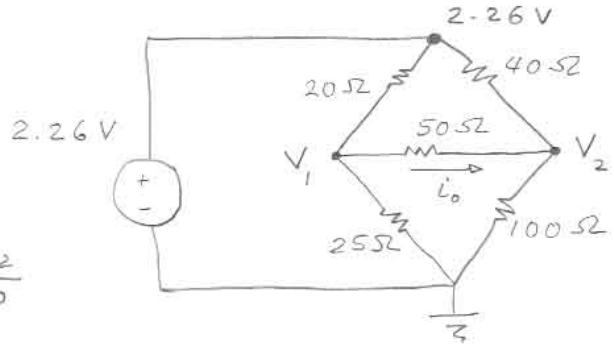
4.17 c)

$P_{450mA} = -450 \times 10^{-3}(15) = -6.75W$ (developed)

$P_{45V} = -1.2 \times 45 = -54W$ (developed).

∴ Total power developed by the independent sources is $6.75 + 54 = 60.75W$

4.22



Node 1:

$$\frac{V_1 - 2.26}{20} + \frac{V_1 - V_2}{50} + \frac{V_1}{25} = 0 \Rightarrow$$

$$5V_1 - 11.3 + 2V_1 - 2V_2 + 4V_1 = 0$$

$$11V_1 - 2V_2 = 11.3 \quad (1)$$

Node 2 $\Rightarrow$ $\frac{V_2 - 2.26}{40} + \frac{V_2 - V_1}{50} + \frac{V_2}{100} = 0$

$$5V_2 - 11.3 + 4V_2 - 4V_1 + 2V_2 = 0$$

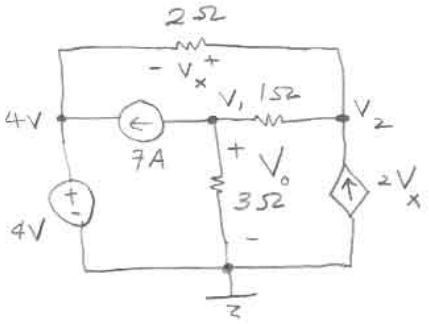
$$-4V_1 + 11V_2 = 11.3 \quad (2)$$

Solving $\Rightarrow$ $V_1 = 1.3V$ & $V_2 = 1.5V$

$$\therefore i_o = \frac{V_1 - V_2}{50} = \frac{1.3 - 1.5}{50} = -4mA$$

4/5

4.25



Node 1 ⇒

$$7 + \frac{V_1}{3} + \frac{V_1 - V_2}{1} = 0$$

$$4V_1 - 3V_2 = -21 \quad (1)$$

Node 2 ⇒

$$\frac{V_2 - 4}{2} + \frac{V_2 - V_1}{1} - 2V_x = 0 \quad \text{and} \quad V_x = V_2 - 4 \Rightarrow$$

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

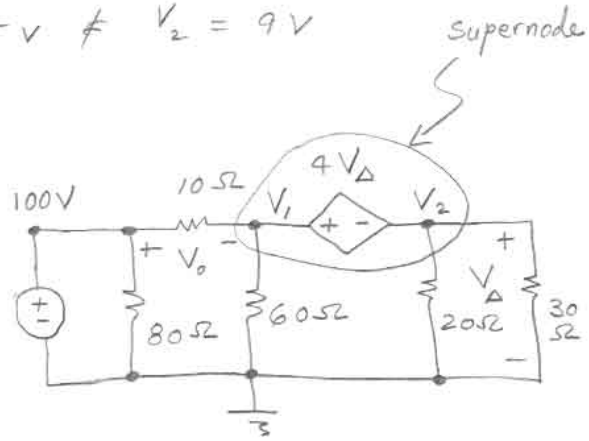
$$V_2 - 4 + 2V_2 - 2V_1 - 4V_2 + 16 = 0$$

$$-2V_1 - V_2 = -12 \quad (2)$$

solving ⇒ $V_1 = 1.5\,V \neq V_2 = 9\,V$

$\therefore V_o = V_1 = 1.5\,V$

4.27



$$V_1 - V_2 = 4V_\Delta \quad (1)$$

$$V_\Delta = V_2 \quad (2)$$

Subtitute (2) into (1) ⇒ $V_1 - V_2 = 4V_2$ ⇒

$$V_1 - 5V_2 = 0 \quad (3)$$

KCL at the supernode →

$$\frac{V_1 - 100}{10} + \frac{V_1}{60} + \frac{V_2}{20} + \frac{V_2}{30} = 0$$

$$6V_1 - 600 + V_1 + 3V_2 + 2V_2 = 0$$

$$7V_1 + 5V_2 = 600 \quad (4)$$

Solving (3) & (4) ⟹

$$V_1 = 75 \quad \& \quad V_2 = 15V$$

$$\therefore V_o = 100 - V_1 = 100 - 75 = 25V$$