$V_0 = 4 \text{ V}$ before $R_L$ is attached.
when $R_L$ is attached, $V_0 = 3 \text{ V}$

Find $R_L$

Before $R_L$ is attached, using Voltage Divider Law,

$$4 = \frac{20(L_0)}{40+R_L}$$

$$R_2 = 10 \Omega$$

Now the circuit becomes:

To find $R_L$:

$$3 = \frac{20(10||R_L)}{40+(10||R_L)}$$

$$\frac{10}{10||R_L} = \frac{120}{17}$$

$$\frac{10(R_L)}{10+R_L} = \frac{120}{17} \Rightarrow \boxed{R_L = 24 \Omega}$$
a) Calculate $V_0$

\[ V_0 = \frac{75(500)}{500+200} \]

\[ V_0 = 15\,\text{V} \]

b) Calculate power in the resistor

\[ P_{500} = \frac{V^2}{R} = \frac{(15)^2}{500} = 0.45\,\text{W} = P_{500} \]

\[ P_{200} = \frac{V^2}{R} = \frac{(75-15)^2}{2000} = 1.8\,\text{W} = P_{200} \]

c) For $V_0 = 15\,\text{V}$ and $1\,\text{W}$ maximum resistor, find the smallest $R_1 + R_2$ can be.

The ratio of $R_1 : R_2$ has to remain the same.

\[ P_{R_1} = \frac{V^2}{R_1} \quad \text{or} \quad \frac{(60)^2}{R_1} \leq 1\,\text{W} \]

\[ R_1 \geq 3600\,\Omega \]

For $R_1 = 3600$, $R_2 = \frac{3600}{4} = 900\,\Omega = R_2$
The voltage divider in (c) is loaded with (b). Find $V_o$.

First find $V_i$ then use a voltage divider to find $V_o$.

\[ 30K + 120K = 150K \]
\[ 75K || 150K = \frac{(75)(150)}{75+150} = 50K \]

The circuit now becomes:

using a voltage divider,

\[ V_i = \frac{240(50K)}{25K + 50K} = 160V \]

Now calculate $V_o$:

\[ V_o = \frac{160(120K)}{30K + 120K} \]
\[ V_o = 128V \]
a) Find $i_s + i_o$

The $90\Omega + 10\Omega$ in parallel $= \frac{10(90)}{10+90} = 9\Omega$

Using a current divider,

$$i_2 = \frac{2.4(20+10)}{20+10} = 1.6A$$

Again, using a current divider,

$$i_1 = \frac{2.4(6+9)}{6+9(20+10)}$$

Find $i_0$ using a current divider from $i_2$:

$$i_0 = \frac{i_2 (10)}{10+90} = \frac{16}{100} = 0.16A$$

$V_o = i_0 (20) = 16V = V_o$

b) Find power dissipated in the $6\Omega$ resistor

$$P_{6\Omega} = i_2^2 R = (1.6)^2 \times 6 = 15.36W$$

c) Find the power developed by the source

$$V_{source} = i_1 (20+10) = (0.8)(30) = 24V$$

$$P_{source} = 24(2.4) = 57.6W$$
a) Find $V_0$

Assume reference at bottom of circuit

Using voltage divider,

$$V_0 = \frac{160V \cdot R_2}{R_1 + R_2}$$

$$V_0 = 66V$$

b) $P_{R_2} = \frac{V^2}{R} = \frac{(160 - 66)^2}{4.7k} = 1.88W$

$$P_{R_2} = \frac{66^2}{3.3k} = 1.32W$$

c) Assume only .5W resistor available & $V_0$ is the same as part a. Find the smallest value of $R_1$ & $R_2$

For $R_2$, $P_{R_2} = \frac{V^2}{R_2}$

$$0.5 = \frac{66^2}{R_2} \Rightarrow R_2 = 3.71k\Omega$$

For $R_1$, $P_{R_1} = \frac{(160 - 66)^2}{R_1}$

$$0.5 = \frac{94^2}{R_1} \Rightarrow R_1 = 17.67k\Omega$$
a) find $V_X$

For left branch:

\[ V_{X+} = \frac{18(6K)}{6K+2K} = 13.5V \]
\[ V_{X-} = \frac{18(3K)}{9K+5K} = 4.5V \]
\[ V_X = V_{X+} - V_{X-} = 9.0V \]

b) Replace the 18V source with a general source $V_S$.

Find $V_X$ in terms of $V_S$.

\[ V_{X+} = \frac{V_S(6K)}{6K+2K} = \frac{3}{4} V_S \]
\[ V_{X-} = \frac{V_S(3K)}{9K+5K} = \frac{1}{2} V_S \]
\[ V_X = V_{X+} - V_{X-} = \frac{1}{2} V_S \]