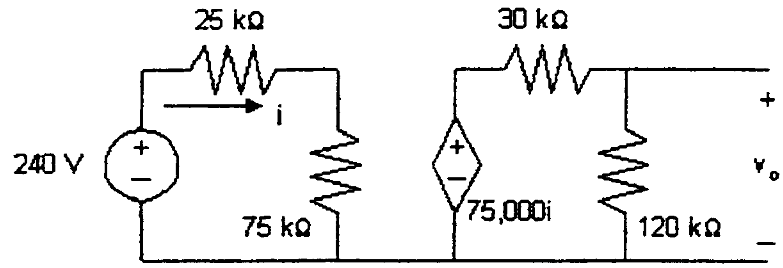
$$75\|150 = 50\ \text{k}\Omega$$

$$v_{o1} = \frac{240}{(25+50)}(50) = 160\ \text{V}$$

$$v_o = \frac{v_{o1}}{(150)}(120) = 128\ \text{V}, \qquad v_o = 128\ \text{V}$$

[b]



$$i = \frac{240}{100} = 2.4\ \text{mA}$$

$$75{,}000i = 180\ \text{V}$$

$$v_o = \frac{180}{150}(120) = 144\ \text{V}; \qquad v_o = 144\ \text{V}$$

[c] It removes loading effect of second voltage divider on the first voltage divider. Observe that the open circuit voltage of the first divider is

$$v'_{o1} = \frac{240}{(100)}(75) = 180\ \text{V}$$

Now note this is the input voltage to the second voltage divider when the current controlled voltage source is used.

P 3.18 [a] $$v_o = \frac{200R_2}{(R_1+R_2)} = \overset{150}{\cancel{40}}; \quad \text{Therefore } R_2 = 3R_1$$

$$\text{Let } R_e = R_2\|R_L = \frac{R_2R_L}{R_2+R_L}$$

$$v_o = \frac{200R_e}{R_1+R_e} = 100; \qquad \text{Therefore } R_1 = R_e$$

$$\text{Thus, } R_2/3 = \frac{60R_2}{60+R_2}$$

$$R_2 = 120\ \text{k}\Omega; \qquad R_1 = 40\ \text{k}\Omega$$

[b] Power dissipated in R_1 will be maximum when the voltage across R_1 is maximum. This will occur under load conditions.

$$v_{R_1} = 200 - 100 = 100 \text{ V}; \qquad P_{R_1} = \frac{(100)^2}{40 \times 10^3} = 250 \text{ mW}$$

So specify a 1/4 W power rating for the resistor.

P 3.19 Refer to the solution of Problem 3.18. The divider will reach its dissipation limit when the power dissipated in R_1 equals 1 W

$$\text{So } (v_{R_1}^2/40) = 1000; \quad v_{R_1} = 200 \text{ V} \quad v_o = 200 - 200 = 0 \text{ V}$$

$$\text{Therefore, } \frac{200R_e}{40 + R_e} = 0, \quad \text{and} \quad R_e = 0 \text{ k}\Omega$$

Thus, $R_L = 0$ kΩ (short circuit)

P 3.20 [a] $$v_o = \frac{16(3.3)}{(4.7 + 3.3)} = 66 \text{ V}$$

[b] $$i = 160/8 = 20 \text{ mA}$$

$$P_{R_1} = (400 \times 10^{-6})(4.7 \times 10^3) = 1.88 \text{ W}$$

$$P_{R_2} = (400 \times 10^{-6})(3.3 \times 10^3) = 1.32 \text{ W}$$

[c] Since R_1 and R_2 carry the same current and $R_1 > R_2$ to satisfy the voltage requirement, first pick R_1 to meet the 0.5 W specification

$$i_{R_1} = \frac{160 - 66}{R_1}, \qquad \text{Therefore, } \left(\frac{94}{R_1}\right)^2 R_1 \le 0.5$$

$$\text{Thus, } R_1 \ge \frac{94^2}{0.5} \quad \text{or} \quad R_1 \ge 17{,}672\,\Omega$$

Now use the voltage specification:

$$\frac{R_2}{R_2 + 17{,}672}(160) = 66$$

Thus, $R_2 = 12{,}408\,\Omega$

P 3.21 $$\frac{(24)^2}{R_1 + R_2 + R_3} = 36, \qquad \text{Therefore, } R_1 + R_2 + R_3 = 16\,\Omega$$

$$\frac{(R_1 + R_2)24}{(R_1 + R_2 + R_3)} = 12$$