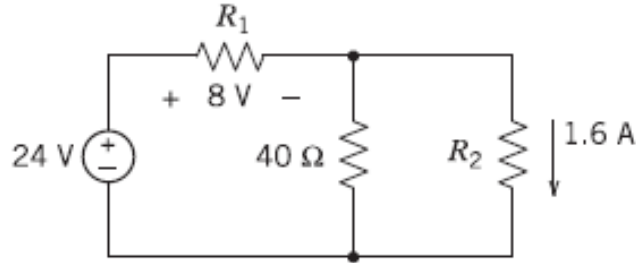


Name:

Student ID #:

1. (10 pts) Determine the values of the resistances  $R_1$  for the circuit shown in Figure P 1.

Figure P 1



**Solution:**

Using voltage division

$$8 = \frac{R_1}{R_1 + \frac{40R_2}{R_2 + 40}} \times 24 \Rightarrow \frac{1}{3} = \frac{R_1(R_2 + 40)}{R_1R_2 + 40(R_1 + R_2)}$$

$$\Rightarrow R_1R_2 + 40(R_1 + R_2) = 3R_1R_2 + 120R_1 \Rightarrow R_1 = \frac{40R_2}{2R_2 + 80}$$

Using KVL

$$24 = 8 + R_2(1.6) \Rightarrow R_2 = 10 \Omega$$

Then

$$R_1 = \frac{40(10)}{2(10) + 80} = 4 \Omega$$

2 (15 pts) Determine the values of the node voltages,  $v_1$ , in the circuit shown Figure P2.

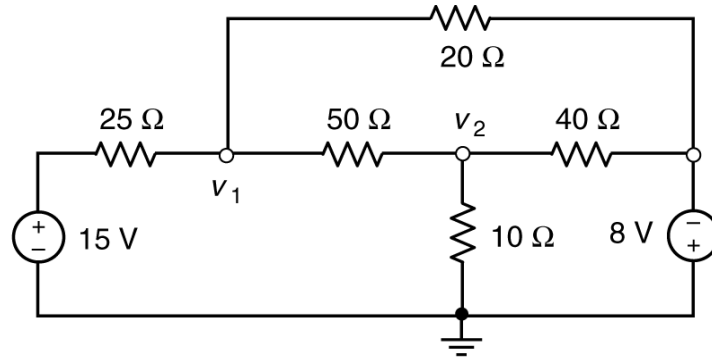
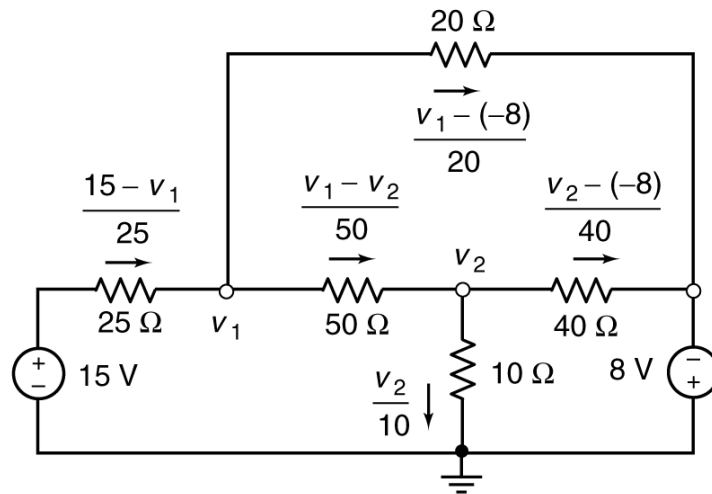


Figure P2

**Solution:** First, express the resistor currents in terms of the node voltages:



Apply KCL at node 1 to get  $\frac{15 - v_1}{25} = \frac{v_1 - v_2}{50} + \frac{v_1 + 8}{20} \Rightarrow 0.11v_1 - 0.02v_2 = 0.2$

Apply KCL at node 2 to get  $\frac{v_1 - v_2}{50} = \frac{v_2}{10} + \frac{v_2 + 8}{40} \Rightarrow -0.02v_1 + 0.145v_2 = -0.2$

In matrix form:

$$\begin{bmatrix} 0.11 & -0.02 \\ -0.02 & 0.145 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 0.2 \\ -0.2 \end{bmatrix}$$

$$v_1 = 1.6077 \text{ V and } v_2 = -1.1576 \text{ V}$$