1 a) Use the node-voltage method to find the total power developed in the circuit.
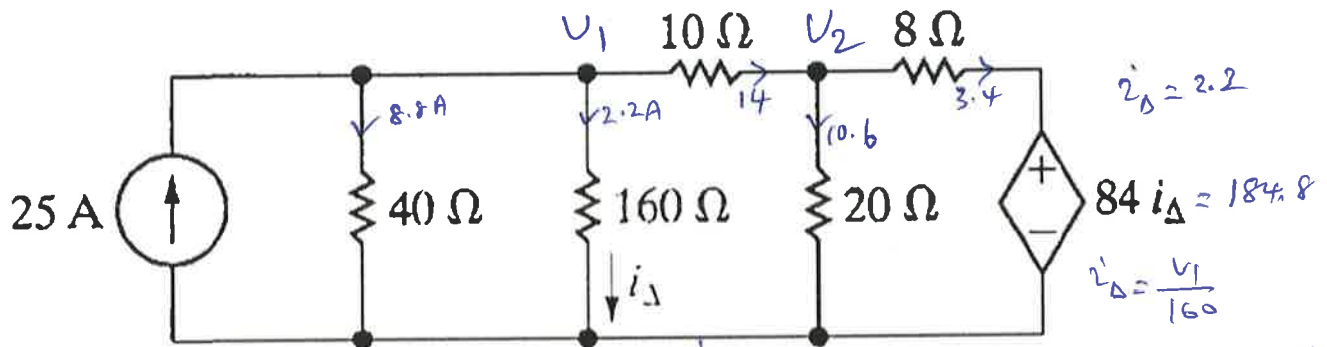
$V_1 = 352$ Volt
$V_2 = 212$ volt

b) Check your answer by finding the total power absorbed in the circuit.

V_1 10 Ω V_2 8 Ω

$i_\Delta = 2.2$

25 A   40 Ω   160 Ω   20 Ω $84 i_\Delta = 184.8$

8.8 A   2.2A   14   10.6   3.4

$i_\Delta = \frac{V_1}{160}$

$$\frac{V_1 - V_2}{10} + \frac{V_1}{160} + \frac{V_1}{40} - 25 = 0$$

$$16(V_1 - V_2) + V_1 + 4V_1 - 4000 = 0$$

$$21 V_1 - 16 V_2 = 4000 \quad —①$$

$$-53 V_1 + 88 V_2 = 0 \quad —②$$

$$V_1 = \frac{88 V_2}{53}$$

$$21 \times \frac{88}{53} V_2 - 16 V_2 = 4000$$

$$21 \times 88 V_2 - 53 \times 16 V_2 = 53 \times 4000$$

$$V_2 = \frac{53 \times 4000}{(21 \times 88 - 53 \times 16)} = \frac{212,000}{1848 - 848} = 212 \text{ volt}$$

$$V_1 = \frac{88}{53} \times V_2 = 352 \text{ volt}$$

$$\frac{V_2 - V_1}{10} + \frac{V_2}{20} + \frac{V_2 - 84 i_\Delta}{8} = 0$$

$$\frac{V_2 - V_1}{10} + \frac{V_2}{20} + \frac{V_2 - 84 \times \frac{V_1}{160}}{8} = 0$$

$$\frac{V_2 - V_1}{10} + \frac{V_2}{20} + \frac{V_2}{8} - \frac{21 V_1}{320} = 0$$

$$32(V_2 - V_1) + 16 V_2 + 40 V_2 - 21 V_1 = 0$$

$$\boxed{V_1 = 352 \text{ Volt} \\ V_2 = 212 \text{ Volt}}$$

(a) $P_{25A} = V_1 \times 25 = 352 \times 25$
$\boxed{P_{dev} = 8,800 W}$

absorb → $P_{84 i_\Delta} = 184.8 \times \frac{(212 - 184.8)}{8} = 628.32 W$

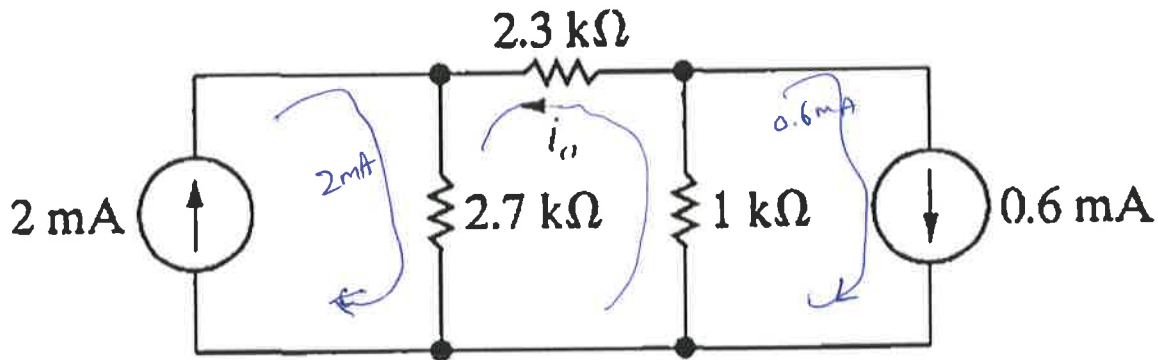**(b)** $\boxed{P_{dev.} = 9,428 W}$

$$P_{abs} = 8.8^2 \times 40 + 2.2^2 \times 160 + 14^2 \times 10 + 10.6^2 \times 20 + 3.4^2 \times 8$$

$$= 3097.6 + 774.4 + 1960 + 2247.2 + 92.48$$

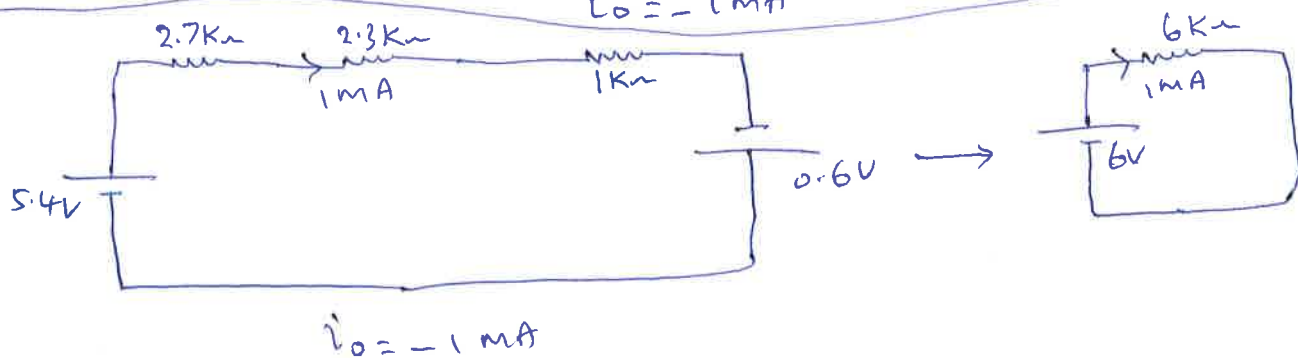$$P_{abs} = 8172 W$$

$$\boxed{P_{abs} = 8172 + 628 = 8800 W}$$

2. Use a series of source transformations to find the current i_o in the circuit. $\quad i_o = -1\,mA$

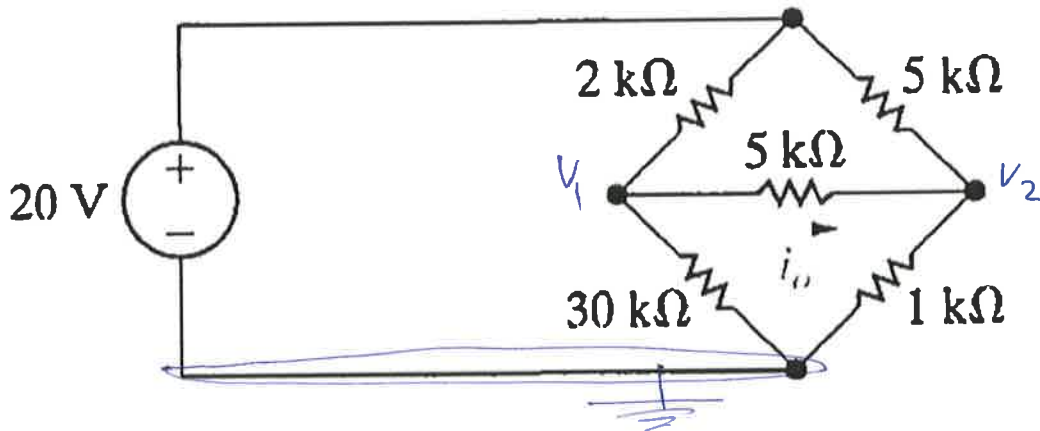$$-(i_o + 0.6) - 2.3\,i_o - 2.7(i_o + 2) = 0$$

$$-6i_o = 6$$

$$i_o = -1\,mA$$

$$i_o = -1\,mA$$

3. Repeat the above problem using the mesh-current method.

4. Use your method of choice to find the current i_o. $\boxed{2mA}$

The circuit shows a 20 V source connected to a bridge network with resistors 2 kΩ, 5 kΩ, 5 kΩ, 30 kΩ, 1 kΩ, node voltages V_1 and V_2, and current i_o.

$$\frac{V_1}{30} + \frac{V_1 - V_2}{5} + \frac{V_1 - 20}{2} = 0$$

$$V_1 + 6(V_1 - V_2) + 15(V_1 - 20) = 0$$

$$22V_1 - 6V_2 - 300 = 0$$

$$22(7V_2 - 20) - 6V_2 - 300 = 0$$

$$154V_2 - 6V_2 - 440 - 300 = 0$$

$$\frac{V_2}{1} + \frac{V_2 - V_1}{5} + \frac{V_2 - 20}{5} = 0$$

$$5V_2 + V_2 - V_1 + V_2 - 20 = 0$$

$$-V_1 + 7V_2 - 20 = 0$$

$$\longleftarrow V_1 = 7V_2 - 20 \quad \text{——②}$$

$$V_2 = 5 \text{ volt}, \qquad V_1 = 35 - 20 = 15 \text{ volt}$$

$$i_o = \frac{15 - 5}{5} = 2 \text{ mA}$$

$$\boxed{i_o = 2mA}$$

5. Use your method of choice to find the voltage v_o. $\boxed{3.2v}$
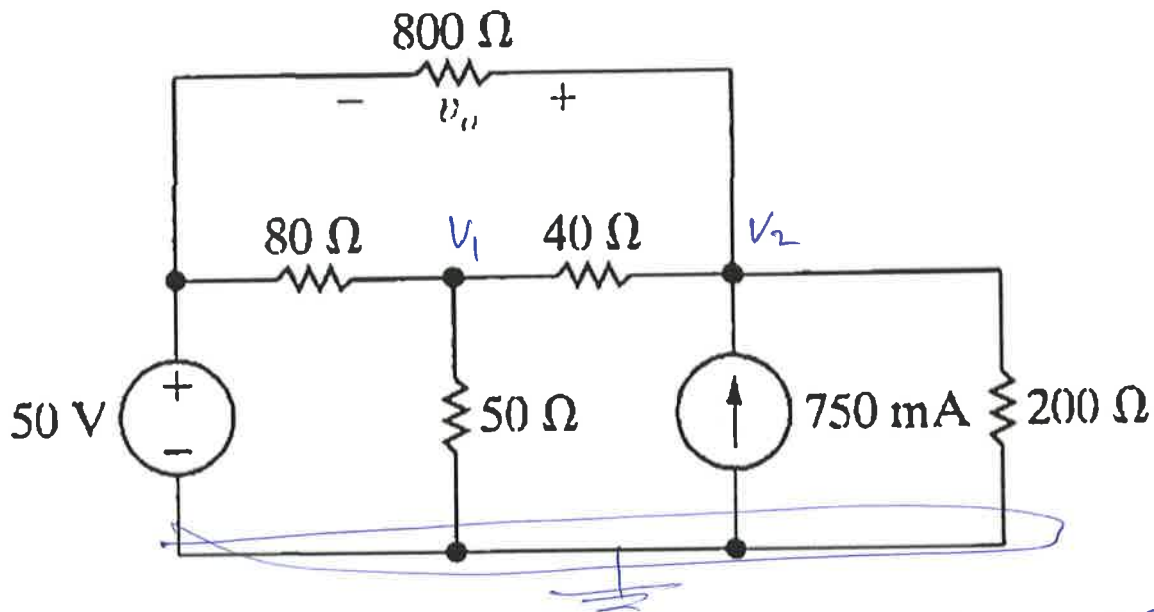
$$\frac{V_1 - 50}{80} + \frac{V_1}{50} + \frac{V_1 - V_2}{40} = 0$$

$$5V_1 - 250 + 8V_1 + 10V_1 - 10V_2 = 0$$

$$23V_1 - 10V_2 - 250 = 0$$

$$23V_1 - 10(0.8V_1 + 26) - 250 = 0$$

$$23V_1 - 8V_1 - 260 - 250 = 0$$

$$15V_1 = 510$$

$$V_1 = 34 \text{ volt}$$

$$\frac{V_2}{200} - 0.75 + \frac{V_2 - V_1}{40} + \frac{V_2 - 50}{800} = 0$$

$$4V_2 - 600 + 20V_2 - 20V_1 + V_2 - 50 = 0$$

$$-20V_1 + 25V_2 - 650 = 0$$

$$25V_2 = 20V_1 + 650$$

$$\longleftarrow V_2 = 0.8V_1 + 26$$

$$V_2 = 53.2 \text{ volt}$$

$$U_0 = V_2 - 50 =$$
$$= 53.2 - 50 = 3.2 \text{ volt}$$

$$\boxed{U_0 = 3.2 \text{ volt}}$$

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