جواب سوالات Homwork 1

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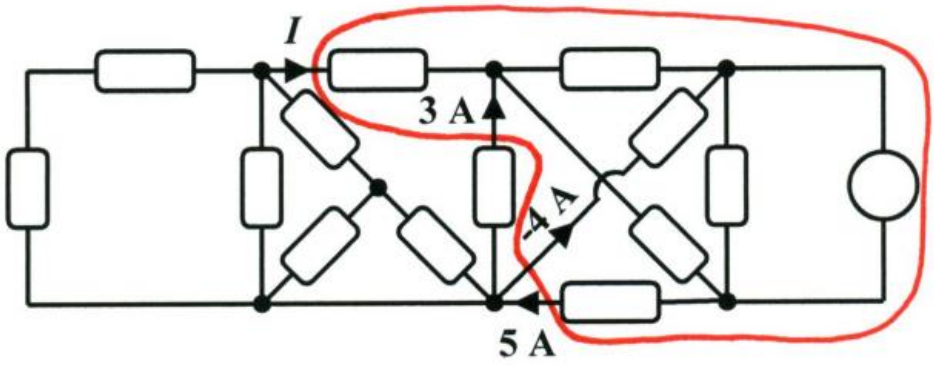
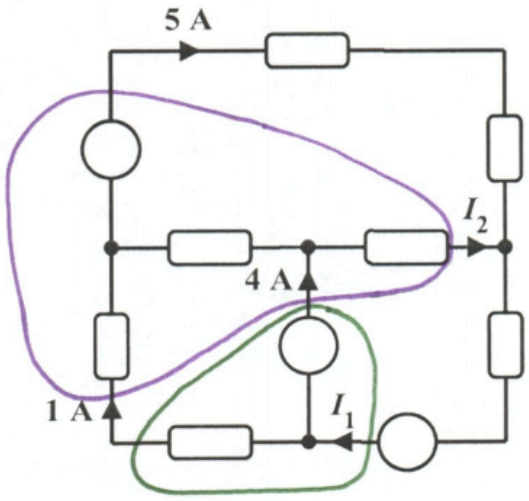
Determine the value of *I*.



$$I + 3A + (-4A) - 5A = 0$$

$$\Rightarrow \quad I = 6\,A$$



a. Determine the value of I_1.

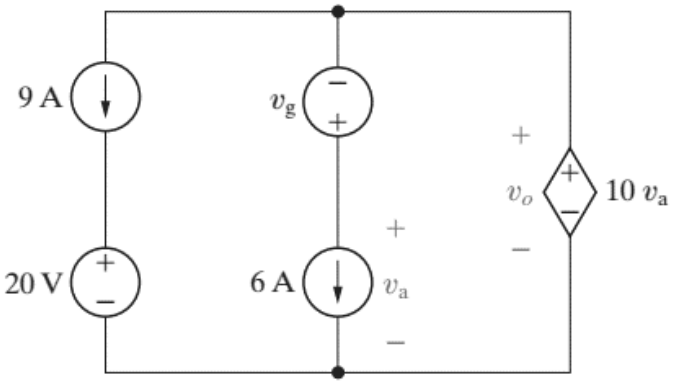
KCL: $I_1 - 1A - 4A = 0$

$\Rightarrow I_1 = 5A$

b. Determine the value of I_2.

KCL: $1A + 4A - I_2 - 5A = 0$

$\Rightarrow I_2 = 0A$



First, $10v_a = 5$ V, so $v_a = 0.5$ V. Then recognize that each of the three branches is connected between the same two nodes, so each of these branches must have the same voltage drop. The voltage drop across the middle branch is 5 V, and since $v_a = 0.5$ V, $v_g = 0.5 - 5 = -4.5$ V. Also, the voltage drop across the left branch is 5 V, so $20 + v_{9A} = 5$ V, and $v_{9A} = -15$ V, where v_{9A} is positive at the top. Note that the current through the 20 V source must be 9 A, flowing from top to bottom, and the current through the v_g is 6 A flowing from top to bottom. Let's find the power associated with the left and middle branches:

$p_{9A} = (9)(-15) = -135\,\text{W}$
$p_{20V} = (9)(20) = 180\,\text{W}$
$p_{v_g} = -(6)(-4.5) = 27\,\text{W}$
$p_{6A} = (6)(0.5) = 3\,\text{W}$

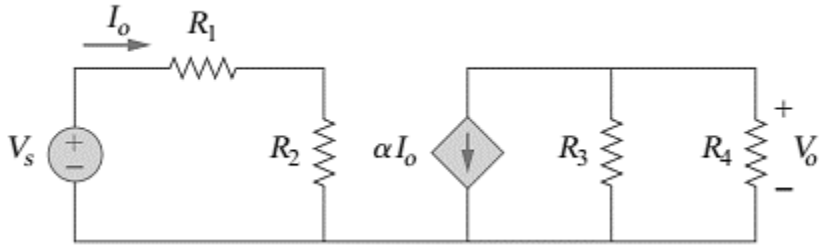
Since there is only one component left, we can find the total power:

$p_{\text{total}} = -135 + 180 + 27 + 3 + p_{\text{ds}} = 75 + p_{\text{ds}} = 0$

so p_{ds} must equal -75 W.

Therefore,

$$\sum P_{\text{dev}} = \sum P_{\text{abs}} = 210\,\text{W}$$



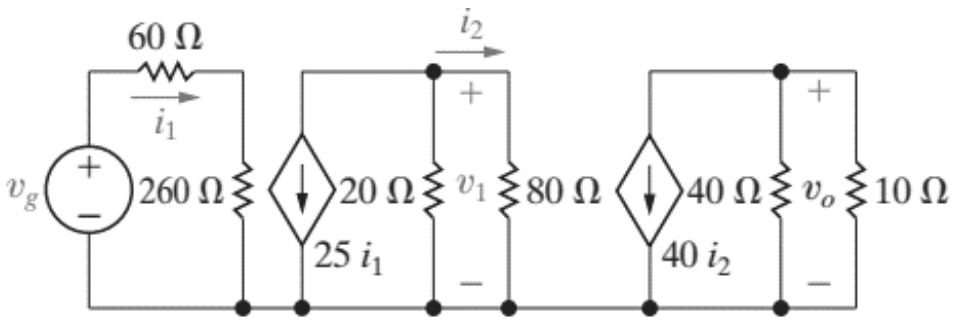
$$I_0 = \frac{V_s}{R_1 + R_2}$$

$$V_0 = -\alpha I_0 \left(R_3 \| R_4\right) = -\frac{\alpha V_s}{R_1 + R_2} \cdot \frac{R_3 R_4}{R_3 + R_4}$$

$$\frac{V_0}{Vs} = \frac{-\alpha R_3 R_4}{(R_1 + R_2)(R_3 + R_4)}$$

If $R_1 = R_2 = R_3 = R_4 = R$,

$$\left|\frac{V_0}{V_S}\right| = \frac{\alpha}{2R} \cdot \frac{R}{2} = \frac{\alpha}{4} = 10 \longrightarrow \alpha = \underline{\mathbf{40}}$$



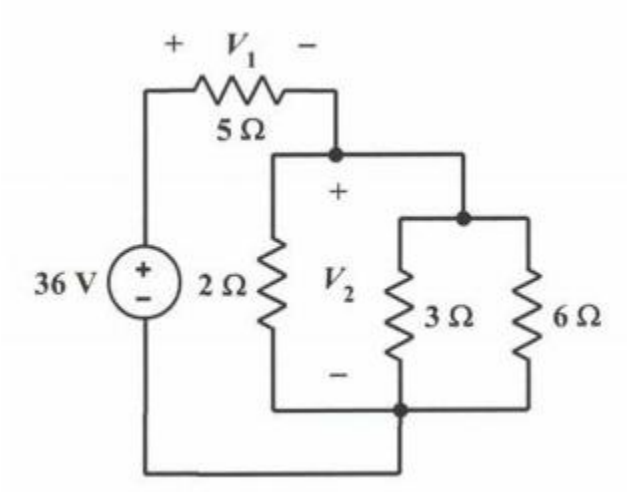
$$40i_2 + \frac{5}{40} + \frac{5}{10} = 0; \quad i_2 = -15.625 \text{ mA}$$

$$v_1 = 80i_2 = -1.25 \text{ V}$$

$$25i_1 + \frac{(-1.25)}{20} + (-0.015625) = 0; \quad i_1 = 3.125 \text{ mA}$$

$$v_g = 60i_1 + 260i_1 = 320i_1$$

Therefore, $v_g = 1$ V.



a. Determine the value of V_1.

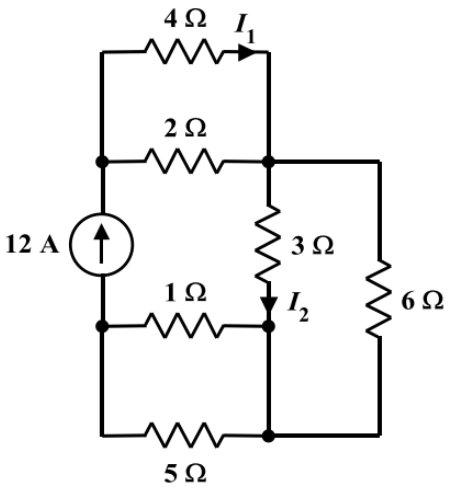
$$2\Omega \| 3\Omega \| 6\Omega = 1\Omega$$

$$V_1 = \frac{5\Omega}{5\Omega + 1\Omega} \cdot 36V = 30V$$

b. Determine the value of V_2.

$$V_2 = \frac{1\Omega}{5\Omega + 1\Omega} \cdot 36V = 6V$$

or $V_2 = 36V - V_1 = 6V$



Determine the value of I_1.

The 2Ω and 4Ω resistors are in parallel with 12A delivered to the pair.

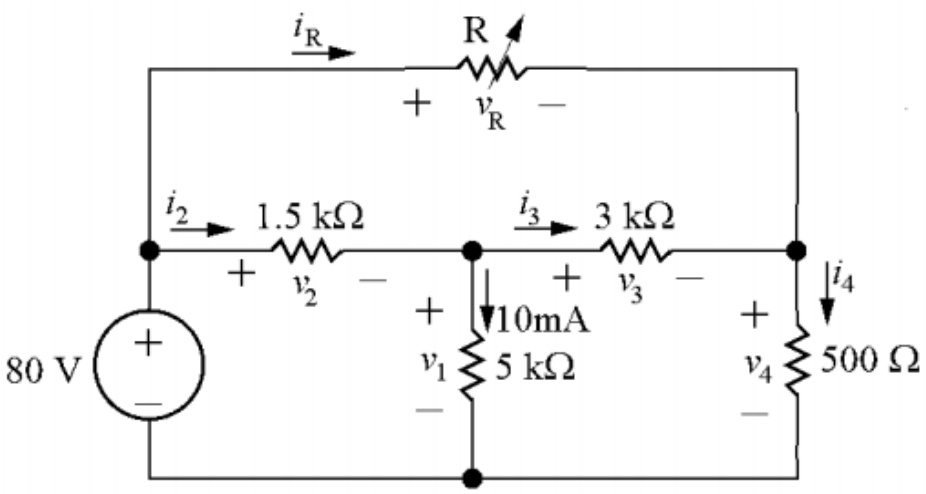
$$I_1 = \frac{\frac{1}{4\Omega}}{\frac{1}{4\Omega}+\frac{1}{2\Omega}} \cdot 12A = 4A \quad \text{or} \quad I_1 = \frac{2\Omega}{4\Omega+2\Omega} \cdot 12A = 4A$$

Determine the value of I_2.

The 3Ω and 6Ω resistors are in parallel with 12A delivered to the pair.

$$I_2 = \frac{\frac{1}{3\Omega}}{\frac{1}{3\Omega}+\frac{1}{6\Omega}} \cdot 12A = 8A \quad \text{or} \quad I_2 = \frac{6\Omega}{3\Omega+6\Omega} \cdot 12A = 8A$$

Label all unknown resistor voltages and currents:



Ohms' law for 5 kΩ resistor: $v_1 = (0.01)(5000) = 50$ V

KVL for lower left loop: $-80 + v_2 + 50 = 0 \quad \rightarrow \quad v_2 = 80 - 50 = 30$ V

Ohm's law for 1.5 kΩ resistor: $i_2 = v_2/1500 = 30/1500 = 20$ mA

KCL at center node:

$i_2 = i_3 + 0.01 \quad \rightarrow \quad i_3 = i_2 - 0.01 = 0.02 - 0.01 = 0.01 = 10$ mA

Ohm's law for 3 kΩ resistor $v_3 = 3000 i_3 = 3000(0.01) = 30$ V

KVL for lower right loop:

$-v_1 + v_3 + v_4 = 0 \quad \rightarrow \quad v_4 = v_1 - v_3 = 50 - 30 = 20$ V

Ohm's law for 500 Ω resistor: $i_4 = v_4/500 = 20/500 = 0.04 = 40$ mA

KCL for right node:

$i_3 + i_R = i_4 \quad \rightarrow \quad i_R = i_4 - i_3 = 0.04 - 0.01 = 0.03 = 30$ mA

KVL for outer loop:

$-80 + v_R + v_4 = 0 \quad \rightarrow \quad v_R = 80 - v_4 = 80 - 20 = 60$ V

Therefore,

$$R = \frac{v_R}{i_R} = \frac{60}{0.03} = 2000 = 2 \text{ k}\Omega$$