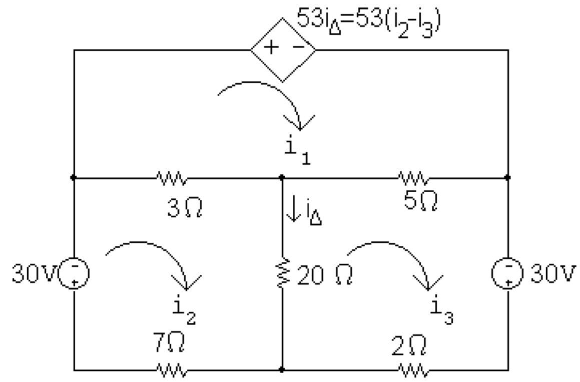
P 4.35



The mesh current equations:

$$53(i_2 - i_3) + 5(i_1 - i_3) + 3(i_1 - i_2) = 0$$
$$30 + 3(i_2 - i_1) + 20(i_2 - i_3) + 7i_2 = 0$$
$$-30 + 2i_3 + 20(i_3 - i_2) + 5(i_3 - i_1) = 0$$

Place these equations in standard form:

$$i_1(5+3) + i_2(53-3) + i_3(-53-5) = 0$$
$$i_1(-3) + i_2(3+20+7) + i_3(-20) = -30$$
$$i_1(-5) + i_2(-20) + i_3(2+20+5) = 30$$

Solving, $i_1 = 186$ A; $i_2 = 81.6$ A; $i_3 = 96$ A

Calculate the power:

$$p_{30\text{V(left)}} = (30)(81.6) = 2448 \text{ W}$$
$$p_{30\text{V(right)}} = -(30)(96) = -2880 \text{ W}$$
$$p_{\text{dep source}} = 53(81.6 - 96)(186) = -141{,}955.2 \text{ W}$$
$$p_{3\Omega} = (3)(186 - 81.6)^2 = 32{,}698.08 \text{ W}$$

$$p_{5\Omega} = (5)(186 - 96)^2 = 40{,}500 \text{ W}$$
$$p_{20\Omega} = (20)(81.6 - 96)^2 = 4147.2 \text{ W}$$
$$p_{7\Omega} = (7)(81.6)^2 = 46{,}609.92 \text{ W}$$
$$p_{2\Omega} = (2)(96)^2 = 18{,}432 \text{ W}$$

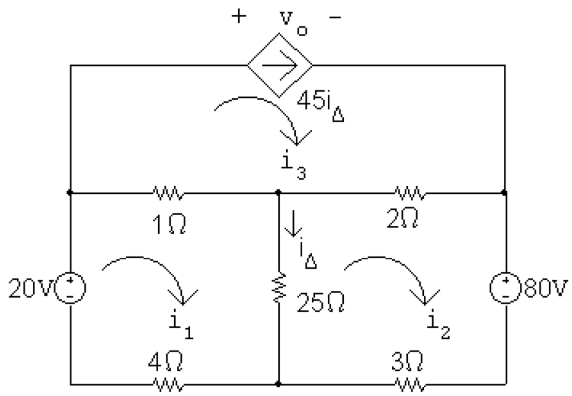
$$\sum p_{\text{dev}} = 2880 + 141{,}955.2 = 144{,}835.2 \text{ W}$$

$$\sum p_{\text{dis}} = 2448 + 32{,}698.08 + 40{,}500 + 4147.2 + 46{,}609.92 + 18{,}432$$

$$= 144{,}835.2 \text{ W(checks)}$$

Thus the dependent source develops $141{,}955.2$ W.

P 4.41 **[a]**



The mesh current equations are:

$$-20 + 1(i_1 - i_3) + 25(i_1 - i_2) + 4i_1 = 0$$

$$80 + 3i_2 + 25(i_2 - i_1) + 2(i_2 - i_3) = 0$$

The constraint equation is:

$i_3 = 45i_\Delta = 45(i_1 - i_2)$

Place these equations in standard form:

$$i_1(1 + 25 + 4) + i_2(-25) + i_3(-1) = 20$$

$$i_1(-25) + i_2(3 + 25 + 2) + i_3(-2) = -80$$

$$i_1(-45) + i_2(45) + i_3(1) = 0$$

Solving, $\quad i_1 = 8$ A; $\quad i_2 = 7$ A; $\quad i_3 = 45$ A

Find the power in the $2\,\Omega$ resistor:

$p_{2\Omega} = 2(i_2 - i_3)^2 = 2(-38)^2 = 2888$ W

The $2\,\Omega$ resistor dissipates 2888 W.

[b] Find the power developed by the sources:

$v_o + 80 + 3(7) + 4(8) - 20 = 0 \quad \therefore \quad v_o = 20 - 80 - 21 - 32 = -113$ V

$$p_{\text{dep source}} = (-113)[45(8 - 7)] = -5085 \text{ W}$$

$$p_{80\text{V}} = (80)(7) = 560 \text{ W}$$

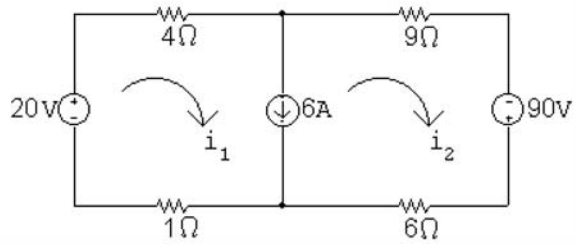
$$p_{20\text{V}} = -(20)(8) = -160 \text{ W}$$

$$\sum p_{\text{dev}} = 5085 + 160 = 5245 \text{ W}$$

The percent of the power developed that is deliverd to the $2\,\Omega$ resistor is:

$$\frac{2888}{5245} \times 100 = 55.06\%$$

P 4.43



The supermesh equation is:
$-20 + 4i_1 + 9i_2 - 90 + 6i_2 + 1i_1 = 0$
The supermesh constraint equation is :
$i_1 - i_2 = 6$
Place these equations in standard form:

$$i_1(4+1) + i_2(9+6) = 20 + 90$$
$$i_1(1) + i_2(-1) = 6$$

Solving, $\quad i_1 = 10$ A; $\quad i_2 = 4$ A
Now find the power:

$$p_{4\Omega} = 10^2(4) = 400 \text{ W}$$
$$p_{1\Omega} = 10^2(1) = 100 \text{ W}$$
$$p_{9\Omega} = 4^2(9) = 144 \text{ W}$$
$$p_{6\Omega} = 4^2(6) = 96 \text{ W}$$
$$p_{20\text{V}} = -(20)(10) = -200 \text{ W}$$
$$v_{6\text{A}} = 9i_2 - 90 + 6i_2 = (9)(4) - 90 + (6)(4) = -30 \text{ V}$$
$$p_{6\text{A}} = (-30)(6) = -180 \text{ W}$$
$$p_{90\text{V}} = -(90)(4) = -360 \text{ W}$$

In summary:
$\sum p_{\text{dev}} = 200 + 180 + 360 = 740$ W
$\sum p_{\text{diss}} = 400 + 100 + 144 + 96 = 740$ W
Thus the power dissipated in the circuit is 740 W