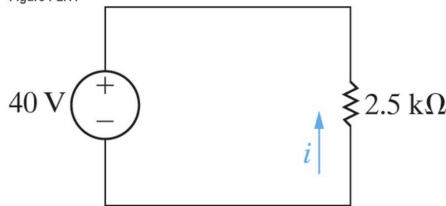


2.11 For the circuit shown in Fig. P2.11
Figure P2.11



- a. Find i .
b. Find the power supplied by the voltage source.
c. Reverse the polarity of the voltage source and repeat parts (a) and (b).

$$V = 40V \quad R = 2.5 \text{ k}\Omega$$

$$\text{Ohm's Law: } V = iR$$

$$i = \frac{V}{R} = \frac{40V}{2500\Omega}$$

$$a) \quad \boxed{i = 16 \text{ mA}}$$

$$P = Vi \Rightarrow P = (40V)(16 \text{ mA}) \quad b) \quad \boxed{P = 640 \text{ mW}}$$

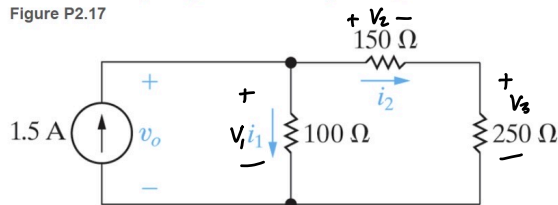
$$i = -\frac{V}{R} = -\frac{40V}{2500\Omega} = -0.016$$

$$P = Vi \Rightarrow P = (40V)(-16 \text{ mA})$$

$$c) \quad \boxed{\begin{array}{l} i = -16 \text{ mA} \\ P = +640 \text{ mW} \end{array}}$$

2.17 PSPICE
MULTISIM

- a. Find the currents i_1 and i_2 in the circuit in Fig. P2.17.
Figure P2.17



- b. Find the voltage v_o .
c. Verify that the total power developed equals the total power dissipated.

$$-1.5A + i_1 + i_2 = 0 \quad \text{KCL}$$

$$i_1 + i_2 = 1.5A$$

$$v_1 = i_1(100\Omega)$$

$$v_2 = i_2(150\Omega)$$

$$v_3 = i_2(250\Omega)$$

$$-v_1 + v_2 + v_3 = 0 \quad \text{KVL}$$

$$-100i_1 + 150i_2 = 0 \quad i_1 = 1.5 - i_2$$

$$-100(1.5 - i_2) + 400i_2 = 0$$

$$500i_2 = 150$$

$$a) \quad \boxed{i_2 = 0.3A \quad i_1 = 1.2A}$$

$$V_o - V_1 = 0$$

$$V_1 = (100\Omega)(1.2A) = 120V$$

$$V_o = V_1$$

$$b) \quad \boxed{V_o = 120V}$$

$$P_D = -V_o(1.5A) = -180W$$

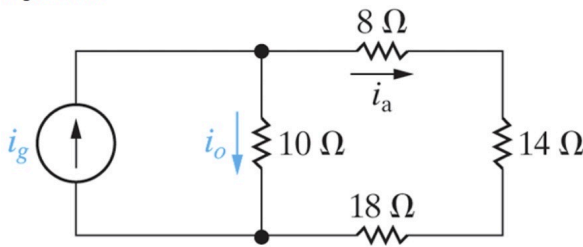
$$P_1 = (100\Omega)(1.2A)^2 = 144W$$

$$P_2 = (150\Omega)(0.3A)^2 = 13.5W$$

$$- P_3 = 250\Omega(0.3A)^2 = 22.5W$$

$$c) \quad \boxed{\begin{array}{l} P_{\text{developed}} = -180W \\ P_{\text{diss}} = 144 + 13.5 + 22.5 = 180W \\ P_{\text{developed}} = P_{\text{diss}} = 180W \end{array}}$$

2.19 PSPICE MULTISIM The current i_a in the circuit shown in Fig. P2.19 is 20 A. Find (a) i_o ; (b) i_g ; and (c) the power delivered by the independent current source.
Figure P2.19



KVL $V = 8i_a + 14i_a + 18i_a = 40(20)$
 $V = 800V$

$V = 10\Omega i_o$
 $i_o = \frac{800V}{10\Omega} = 80A$

a) $i_o = 80A$

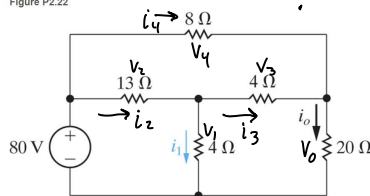
KCL $i_g + i_o + i_a = 0$
KVL $i_g = -20A - i_o$

b) $i_g = 100A$

$P = iV = (100)(800)$

c) $P = 80kW$

2.22 PSPICE MULTISIM The current i_o in the circuit in Fig. P2.22 is 2 A.
Figure P2.22



- a. Find i_1 .
 b. Find the power dissipated in each resistor.
 c. Verify that the total power dissipated in the circuit equals the power developed by the 80 V source.

$i_o = 2A \Rightarrow V_0 = (20\Omega)(2A) = 40V$

$80V - V_4 - V_0 = 0$

$V_4 = 80 - 40 = 40V$

By KCL $i_4 = \frac{V_4}{8\Omega} = 5A$

$i_4 + i_3 - i_o = 0$

$i_3 = 2 - 5 = -3A$

KVL $V_3 = (-3A)(4\Omega) = -12V$

$V_1 - V_3 - V_0 = 0$

$V_1 = (-12V) + (40V) = 28V$

$V_1 = i_1 R_1 \Rightarrow i_1 = \frac{28V}{4\Omega} = 7A$

a) $i_1 = 7A$

KVL $i_2 - i_1 - i_3 = 0$

$i_2 = 4A$

$P = I^2 R$

b) $P_1 = (49)(4) = 196W$
 $P_2 = (16)(13) = 208W$
 $P_3 = (9)(4) = 36W$
 $P_4 = (25)(8) = 200W$
 $P_0 = (4)(20) = 80W$

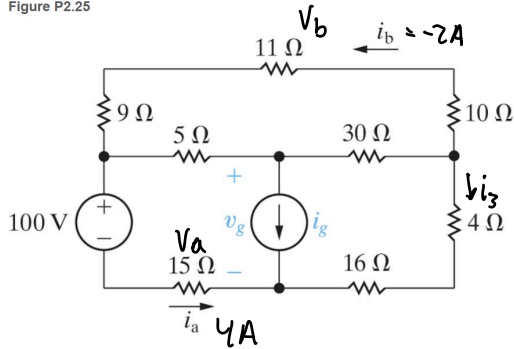
$P_{total} = 196 + 208 + 36 + 200 + 80 = 720W$

$i_{source} = i_2 + i_3 + i_o = 4 + 3 + 2 = 9A$

$P_{dev} = (9)(80) = 720W$

c) $P_{total} = P_{dev} = 720W$

2.25 PSPICE MULTISIM The currents i_a and i_b in the circuit in Fig. P2.25 are 4 A and -2 A, respectively.
Figure P2.25



- Find i_g .
- Find the power dissipated in each resistor.
- Find v_g .
- Show that the power delivered by the current source is equal to the power absorbed by all the other elements.

$$V_a = 15(4) = 60V$$

$$V_b = -22V$$

$$-100 + 5(-i_a + i_b) + 30(i_3 + i_b) + 20i_3 + 15(-i_a) = 0$$

$$-100 - 30 + 30i_3 - 60 + 20i_3 - 60 = 0$$

$$50i_3 - 250 = 0$$

$$i_3 = 5A$$

By KCL

$$i_g = -(i_a + i_3) = -9A$$

$$c) \boxed{i_g = -9A}$$

$$b) \begin{aligned} P_{11} &= (4)(11) = 44W \\ P_9 &= (4)(9) = 36W \\ P_{10} &= 4(10) = 40W \\ P_4 &= 25(4) = 100W \\ P_{16} &= 25(16) = 400W \\ P_{15} &= 16(15) = 240W \\ P_5 &= (4 - (-2))^2(5) = 180W \\ P_{30} &= (5 - 2)^2(30) = 270W \end{aligned}$$

Sub circuit 1

$$\begin{aligned} -100 + 5(-i_a + i_b) + V_g + 15(-i_a) &= 0 \\ -100 + 5(-6) + V_g + 15(-4) &= 0 \end{aligned}$$

$$c) \boxed{V_g = 190V}$$

$$P_g = V_g i_g = (190)(9) = -1710W$$

$$P_{total} = 1310W$$

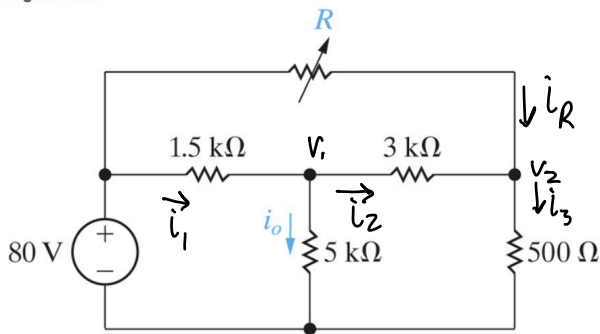
$$P_{source} = (100)(4) = 400W$$

$$P_{source} + P_{total} + P_g = 0$$

$$1310 + 400 - 1710 = 0$$

$$d) \boxed{1710W = 1710W \text{ in the power balances}}$$

2.27 PSPICE MULTISIM The variable resistor R in the circuit in Fig. P2.27 is adjusted until i_o equals 10 mA. Find the value of R .
Figure P2.27



$$V_1 = (10 \text{ mA})(5 \text{ k}\Omega) = 50 \text{ V}$$

$$i_1 = \frac{80 \text{ V} - 50 \text{ V}}{1.5 \text{ k}\Omega} = 20 \text{ mA}$$

$$i_2 = i_1 - i_o = 10 \text{ mA}$$

$$\text{By KVL } V_2 = -(3 \text{ k}\Omega)(10 \text{ mA}) + 50 \text{ V}$$

$$V_2 = 20 \text{ V}$$

$$i_3 = \frac{20}{500 \Omega} = 40 \text{ mA}$$

$$\text{KCL } i_3 = i_R + i_2$$

$$i_R = (40 \text{ mA}) - (10 \text{ mA}) = 30 \text{ mA}$$

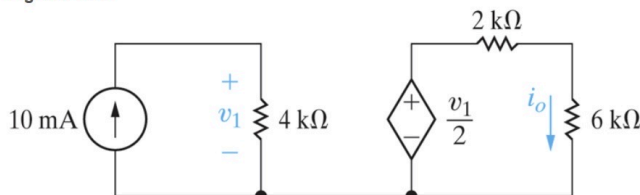
$$R = \frac{80 - 20}{30 \text{ mA}} = 2 \text{ k}\Omega$$

$$\boxed{R = 2 \text{ k}\Omega}$$

2.32 Consider the circuit shown in Fig. P2.32.

- Find i_o .
- Verify the value of i_o by showing that the power generated in the circuit equals the power absorbed in the circuit.

Figure P2.32



$$\rightarrow V_1 = (4 \text{ k}\Omega)(10 \text{ mA}) = 40 \text{ V}$$

$$\rightarrow \frac{40 \text{ V}}{2} = (2 \text{ k}\Omega)i_o + (6 \text{ k}\Omega)i_o$$

$$\text{a) } \boxed{i_o = 2.5 \text{ mA}}$$

$$P_4 = \frac{40^2}{4 \text{ k}\Omega} = 0.4 \text{ W}$$

$$P_2 = 2 \text{ k}\Omega (2.5 \text{ mA})^2 = 12.5 \text{ mW}$$

$$P_6 = 6 \text{ k}\Omega (2.5 \text{ mA})^2 = 37.5 \text{ mW}$$

$$P_{\text{source1}} = -(10 \text{ mA})(40) = -0.4 \text{ W}$$

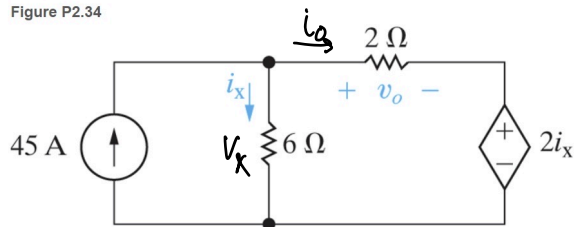
$$P_{\text{source2}} = -\left(\frac{40}{2}\right)(2.5 \text{ mA}) = -0.05 \text{ W}$$

$$P_{\text{total}} = 0.4 + 0.0125 + 0.0375 - 0.4 - 0.05$$

$$\text{b) } \boxed{P_{\text{total}} = 0 \text{ W}}$$

2.34 For the circuit shown in Fig. P2.34, find v_o and the total power supplied in the circuit.

Figure P2.34



$$V_x = (6)(i_x)$$

by KVL:

$$-6i_x + v_o + 2i_x = 0$$

$$v_o = 4i_x$$

$$i_x = \frac{v_o}{4}$$

by KCL

$$45 - i_x - i_o = 0$$

$$45 = \frac{v_o}{4} + \frac{v_o}{2}$$

$$v_o = \left(\frac{4}{3}\right)(45) = 60V$$

$$V_x = 6\left(\frac{60}{4}\right) = 90V$$

$$P_x = -45(90) = -4050W$$

$$P_2 = (2i_x)(i_x) = \left(\frac{60}{2}\right)\left(\frac{60}{2}\right) = 900W$$

Total power supplied to the circuit is 4050 watts