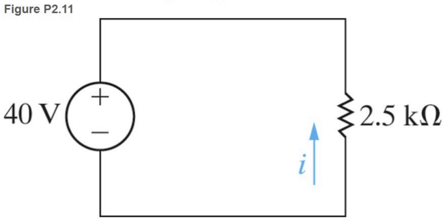
2.11 For the circuit shown in **Fig. P2.11**

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).

$V = 40\,V \quad R = 2.5\ k\Omega$

Ohms Law : $V = ir$

$i = \frac{V}{r} = \frac{40V}{2500\,\Omega}$

a) $\boxed{i = 16\,mA}$

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

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

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

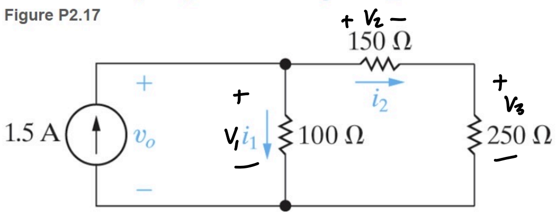
c) $\boxed{\begin{array}{l} i = -16\,mA \\ P = +640mW \end{array}}$

2.17 PSPICE MULTISIM

a)

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.

$-1.5A + i_1 + i_2 = 0$ KCL

$i_1 + i_2 = 1.5A$

$V_1 = i_1(100\Omega)$

$V_2 = i_2(150\Omega)$

$V_3 = i_2(250\Omega)$

$-V_1 + V_2 + V_3 = 0$ KVL

$-100i_1 + 400i_2 = 0 \qquad i_1 = 1.5 - i_2$

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

$500i_2 = 150$

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

$V_o - V_1 = 0$

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

$V_o = V_1$

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

$P_o = -V_o(1.5A) = -180\ W$

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

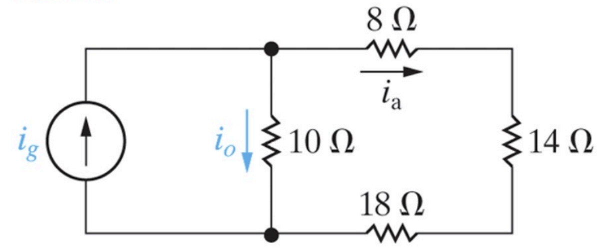
$P_2 = (150\Omega)(0.3A)^2 = 13.5W$

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

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

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

$V = 800V$

$V = 10\Omega\, i_o$

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

a) $\boxed{i_o = 80A}$

KCL

$i_g + i_o + i_a = 0$

KVL $i_g = -20A - i_o$

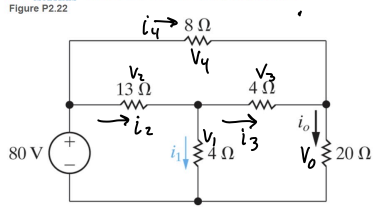
b $\boxed{i_g = 100A}$

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

c) $\boxed{P = 80\,kW}$

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.

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

$80V - V_4 - V_o = 0$

$V_4 = 80 - 40 = 40V$

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

$i_4 + i_3 - i_o = 0$

$i_3 = 2 - 5 = -3A$

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

$V_1 - V_3 - V_o = 0$

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

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

a) $\boxed{i_1 = 7A}$

KVL

$i_2 - i_1 - i_3 = 0$

$i_2 = 4A$

$P = I^2R$

b)
$$\boxed{\begin{aligned} P_1 &= (49)(4) = 196W \\ P_2 &= (16)(13) = 208W \\ P_3 &= (9)(4) = 36W \\ P_4 &= (25)(8) = 200W \\ P_o &= (4)(20) = 80W \end{aligned}}$$

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

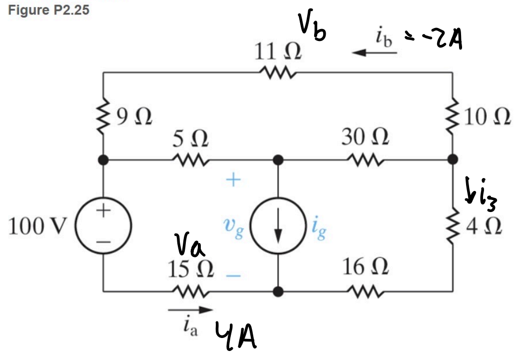
$i_{source} = i_2 + i_3 + i_o = 4 + 3 + 2 = 9A$

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

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

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



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

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

$V_b = -22\,V$

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

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

$50 i_3 - 250 = 0$

$i_3 = 5A$

By KCL

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

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

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

Sub circuit 1

$-100 + 5(-i_a + i_b) + V_g + 15(-i_a) = 0$

$-100 + 5(-6) + V_g + 15(-4) = 0$

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

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

$P_{total} = 1310W$

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

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

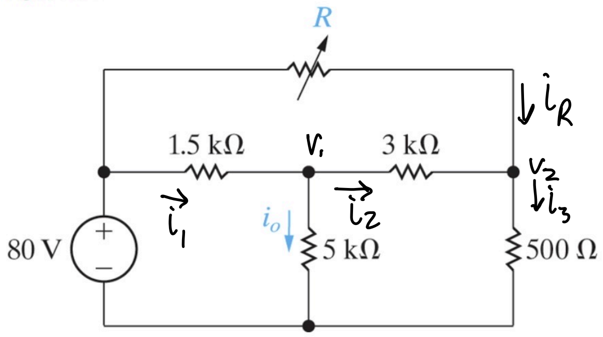
$1310 + 400 - 1710 = 0$

d) $\boxed{1710 = 1710}$

∴ 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



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

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

$i_2 = i_1 - i_o = 10mA$

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

$V_2 = 20V$

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

KCL $i_3 = i_R + i_2$

$i_R = (40mA) - (10mA) = 30mA$

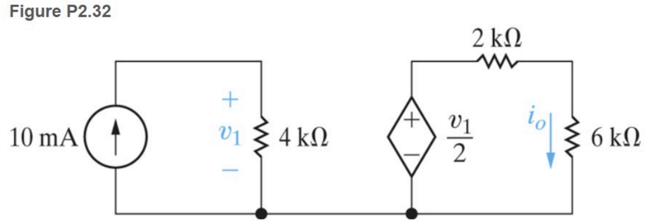
$R = \frac{80-20}{30mA} = 2k\Omega$

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

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

a. Find i_o.
b. 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



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

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

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

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

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

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

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

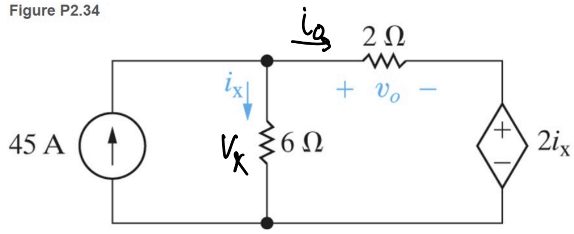
$P_{source2} = -\left(\frac{40}{2}\right)(2.5mA) = -0.05W$

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

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

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

$45 - i_x - i_o = 0$

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

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

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

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

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

Total power supplied to the circuit is 4050watts