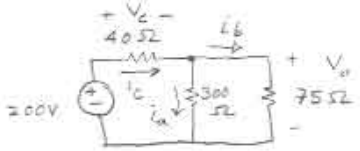
2.14



a) KCL $\Rightarrow$ $i_c = i_a + i_b$ (1)

$V_o = 75 i_b = 300 i_a$

$\therefore i_b = \frac{300}{75} i_a = 4 i_a$ (2)

Substitute (2) into (1) $\Rightarrow$ $i_c = i_a + 4 i_a = 5 i_a$ (3)

KVL $\Rightarrow$ $-200 + V_c + V_o = 0$

$-200 + 40 i_c + 300 i_a = 0$ (4)

substitute (3) into (4) $\Rightarrow$ $-200 + 40(5 i_a) + 300 i_a = 0$

$500 i_a = 200 \Rightarrow \therefore i_a = \frac{200}{500} = 0.4\ A$

b) $i_b = 4 i_a = 4(0.4) = 1.6\ A$

c) $V_o = 300 i_a = 300\ (0.4) = 120\ V$

d) $i_c = 5 i_a = 5(0.4) = 2\ A$

$\therefore P_{40\Omega} = i_c^2 R = (2)^2 \times 40 = 160\ W$

$P_{300\Omega} = i_a^2 R = (0.4)^2 \times 300 = 48\ W$

$P_{75\Omega} = i_b^2 R = (1.6)^2 \times 75 = 192\ W$

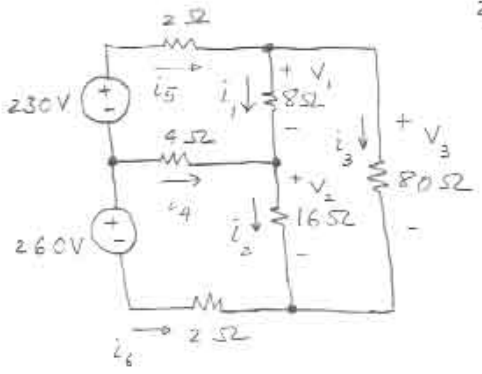
e) $P_{200V} = -iV = -i_c \times 200 = -2 \times 200 = -400\ W$

$\therefore$ Power delived by the 200V source is 400W.

[Notice: $\sum P_{disp} = 160 + 48 + 192 = 400\ W$

$= \sum P_{gen} = 400\ W$]

2.18



a) KVL $\Rightarrow -V_1 + V_3 - V_2 = 0$

$\therefore -8i_1 + V_3 - 16i_2 = 0$

$-8(20) + V_3 - 16(15) = 0$

$\therefore V_3 = 400\,V$

$\therefore i_3 = \frac{400}{80} = 5\,A$

KCL $\Rightarrow i_5 = i_1 + i_3 = 20 + 5 = 25\,A$

KCL $\Rightarrow i_6 + i_2 + i_3 = 0 \Rightarrow i_6 + 15 + 5 = 0 \Rightarrow i_6 = -20\,A$

$\therefore P_{230V} = -iV = -(25)(230) = -5750\,W$

$P_{260V} = iV = (-20)(260) = -5200\,W$

b) Total power supplied $= 5750 + 5200 = 10950\,W$

$i_4 + i_1 = i_2 \Rightarrow i_4 + 20 = 15 \Rightarrow i_4 = -5\,A$

$\therefore P_{4\Omega} = (-5)^2(4) = 100\,W$

$P_{2\Omega} = (25)^2(2) = 1250\,W$ (for upper 2 Ω)

$P_{2\Omega} = (-20)^2 \times 2 = 800\,W$ (for the lower 2 Ω)

$P_{8\Omega} = (20)^2 \times 8 = 3200\,W$

$P_{16\Omega} = (15)^2 \times 16 = 3600\,W$

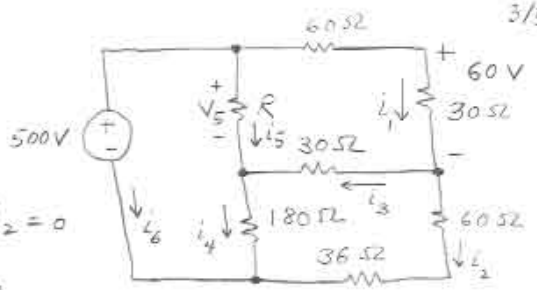
$P_{80\Omega} = (5)^2 \times 80 = 2000\,W$

$\sum P_{diss} = 100 + 1250 + 800 + 3200 + 3600 + 2000 = 10950\,W$

$\therefore$ Total power supplied = total power dissipated by the resistors.

2.25

a)



$i_1 = \frac{60}{30} = 2\ A$

KVL around outer circuit:

$-500 + 60i_1 + 60 + 60i_2 + 36i_2 = 0$

$-500 + 60(2) + 60 + 96i_2 = 0$

$96i_2 = 320 \Rightarrow i_2 = \frac{10}{3}\ A$

KCL $\Rightarrow i_1 = i_2 + i_3 \Rightarrow i_3 = i_1 - i_2 = 2 - \frac{10}{3} = -\frac{4}{3}\ A$

KVL around upper right circuit $\Rightarrow$

$-V_5 + 60i_1 + 60 + 30i_3 = 0$

$-V_5 + 60(2) + 60 + 30\left(-\frac{4}{3}\right) = 0 \Rightarrow V_5 = 140\ V$

KVL around left circuit $\Rightarrow -500 + V_5 + 180i_4 = 0$

$\therefore\ -500 + 140 + 180i_4 = 0 \Rightarrow i_4 = 2\ A$

KCL $\Rightarrow i_5 + i_3 = i_4 \Rightarrow i_5 + \left(-\frac{4}{3}\right) = 2$

$\therefore\ i_5 = \frac{10}{3}\ A \Rightarrow R = \frac{V_5}{i_5} = \frac{140}{10/3} = 42\ \Omega$

b) KCL $\Rightarrow i_6 + i_4 + i_2 = 0 \Rightarrow i_6 + (2) + \frac{10}{3} = 0$

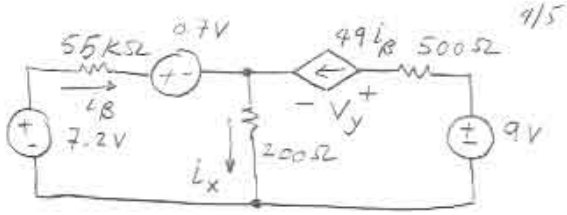
$\therefore\ i_6 = -\frac{16}{3}\ A$

$p_{500V} = +iV = \left(-\frac{16}{3}\right)(500) = -2666.7\ W$

$= -2.667\ kW$

(Actually supplied)

2.29



a) KCL $\Rightarrow i_\beta + 49 i_\beta = i_x$

$\therefore i_x = 50 i_\beta$

KVL around left circuit $\Rightarrow$

$-7.2 + 55000 i_\beta + 0.7 + 200 i_x = 0$

$-7.2 + 55000 i_\beta + 0.7 + 200(50 i_\beta) = 0$

$65000 i_\beta = 6.5 \Rightarrow i_\beta = 0.1 \text{ m A}$

KVL around right circuit $\Rightarrow$

$-200 i_x - V_y - (49 i_\beta)(500) + 9 = 0$

$-200(50 i_\beta) - V_y - 24500 i_\beta + 9 = 0$

$V_y = -10000 i_\beta - 24500 i_\beta + 9 = -34500 i_\beta + 9 = -34500 \times 10^{-4} + 9$

$= -3.45 + 9 = +5.55 \text{ V}$

b) $P_{7.2V} = -iV = -i_\beta(7.2) = -10^{-4} \times 7.2 = -0.72 \text{ m W}$

$P_{55k\Omega} = i_\beta^2 \times 55k = (10^{-4})^2 (55 \times 10^3) = 55 \times 10^{-5} = 0.55 \text{ m W}$

$P_{0.7V} = +iV = i_\beta(0.7) = 10^{-4}(0.7) = 0.07 \text{ m W}$

$P_{200\Omega} = i_x^2(200) = (50 i_\beta)^2 \times 200 = (50 \times 10^{-4})^2 \times 200 = 5 \text{ m W}$

$P_{49 i_\beta} = +iV = (49 i_\beta)(V_y) = (49 \times 10^{-4})(+5.55) = +27.195 \text{ m W}$

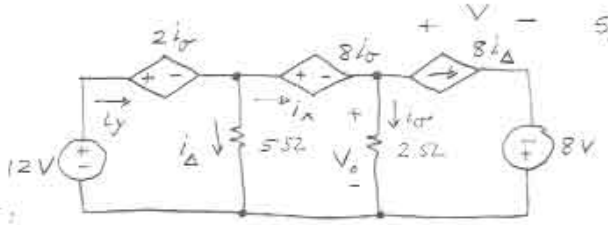
$P_{9V} = -iV = -(49 i_\beta)(9) = -(49 \times 10^{-4})9 = -44.1 \text{ m W}$

$P_{500\Omega} = i^2 R = (49 \times 10^{-4})^2 \times 500 = 12.005 \text{ m W}$

$\Sigma P_{dis} = 0.55 + 0.07 + 5 + 27.195 + 12.005 = 44.82 \text{ m W}$, $\Sigma P_{gen} = 0.72 + 44.1 = 44.82 \text{ m W}$

2.30

a)



KVL around left circuit:

$-12 + 2i_\sigma + 5i_\Delta = 0$ (1)

KVL around middle circuit:

$-5i_\Delta + 8i_\sigma + 2i_\sigma = 0 \Rightarrow 10i_\sigma = 5i_\Delta \Rightarrow i_\Delta = 2i_\sigma$ (2)

Substitute (2) into (1) $\Rightarrow -12 + 2i_\sigma + 10i_\sigma = 0$

$12i_\sigma = 12 \Rightarrow i_\sigma = 1\ A$

$\therefore i_\Delta = 2i_\sigma = 2\ A$

$V_o = 2i_\sigma = 2(1) = 2\ V$

b) KCL $\Rightarrow i_x = i_\sigma + 8i_\Delta = 1 + 8(2) = 17\ A$

KCL $\Rightarrow i_y = i_\Delta + i_x = 2 + 17 = 19\ A$

$P_{12V} = -(12)(19) = -228\ W$, $P_{8i_\sigma} = i_x(8i_\sigma)$
$= 17(8 \times 1) = 136\ W$

$P_{2i_\sigma} = +(19)(2) = 38\ W$

$P_{5\Omega} = (2)^2(5) = 20\ W$

$P_{2\Omega} = (1)^2 2 = 2\ W$

$P_{8V} = -(8i_\Delta)(8) = -(8 \times 2)(8) = -128\ W$

KVL around right circuit $\Rightarrow -V_o + V - 8 = 0$

$-2 + V - 8 = 0 \Rightarrow V = 10\ V$

$\therefore P_{8i_\Delta} = iV = (8i_\Delta)(10) = (8 \times 2)(10) = 160\ W$

$\sum P_{gen} = 228 + 128 = 356\ W$

$\sum P_{dis} = 38 + 20 + 2 + 160 + 136 = 356\ W$

$\therefore \sum P_{gen} = \sum P_{dis} = 356\ W$