HW #8 Solutions EE301

Ch 6 #29, 30, 37, 41

(6.29) a. $I_1 = \frac{R_2}{R_1+R_2} I_T$ for 2 resistors in parallel

$I_1 = \frac{2\Omega}{8\Omega+2\Omega}(10A) = \boxed{2A}$

$I_2 = \frac{8\Omega}{8\Omega+2\Omega}(10A) = \boxed{8A}$

b. $I_1 = \frac{R_2}{R_1+R_2} I_T = \frac{1k\Omega}{3k\Omega+1k\Omega}(16mA) = \boxed{4mA}$

$I_2 = \frac{R_1}{R_1+R_2} I_T = \frac{3k\Omega}{3k\Omega+1k\Omega}(16mA) = \boxed{12mA}$

(6.30) a. $I_1 = \frac{R_2}{R_1+R_2} I_T = \frac{1M\Omega}{1k\Omega+1M\Omega}(2mA) = \boxed{1.998mA}$

$I_2 = \frac{R_1}{R_1+R_2} I_T = \frac{1k\Omega}{1k\Omega+1M\Omega}(2mA) = \boxed{1.998\mu A}$

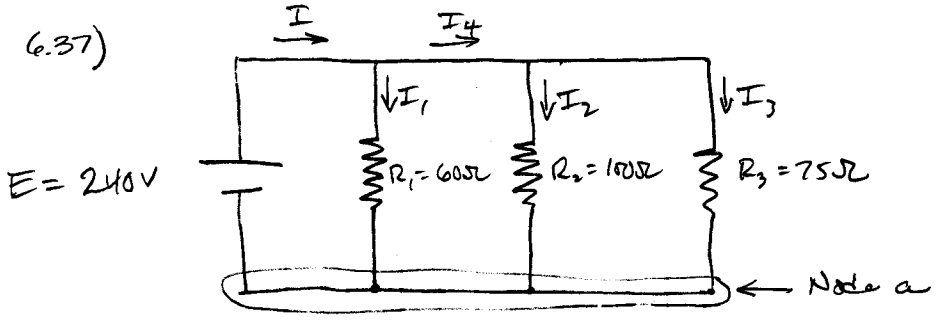
b. Same current divider rule, but variables rearranged.

$I = 4mA = \frac{80\Omega}{16\Omega+80\Omega}(I_1)$

$\boxed{I_1 = 4.8mA}$

$I_2 = \frac{16\Omega}{16\Omega+80\Omega}(4.8mA) = \boxed{0.8mA}$

(6.37)



a) Find R_T

$R_T = \frac{R_1R_2R_3}{R_1R_2+R_2R_3+R_1R_3} = \frac{(60\Omega)(100\Omega)(75\Omega)}{(60\Omega)(100\Omega)+(100\Omega)(75\Omega)+(60\Omega)(75\Omega)}$

$R_T = \frac{450000\Omega^3}{6000\Omega^2+7500\Omega^2+4500\Omega^2} = \boxed{25\Omega}$

(6.37) b. Find I, I_1, I_2, I_3

$$I = \frac{E}{R_T} = \frac{240V}{25\Omega} = \boxed{9.6A}$$

$$I_1 = \frac{E}{R_1} = \frac{240V}{60\Omega} = \boxed{4A}$$

$$I_2 = \frac{E}{R_2} = \frac{240V}{100\Omega} = \boxed{2.4A}$$

$$I_3 = \frac{E}{R_3} = \frac{240V}{75\Omega} = \boxed{3.2A}$$

Using KCL,

$$I = I_1 + I_4$$

$$I_4 = I - I_1 = 9.6A - 4A = \boxed{5.6A}$$

c. Verify KCL at node a

$$\Sigma I_{entering\ a} = \Sigma I_{exiting\ a}$$

$$I_1 + I_2 + I_3 = I$$

$$4A + 2.4A + 3.2A = 9.6A$$

$$9.6A = 9.6A \checkmark$$

d. $P_1 = I_1^2 R_1 = (4A)^2(60\Omega) = \boxed{960W}$

$P_2 = I_2^2 R_2 = (2.4A)^2(100\Omega) = \boxed{576W}$

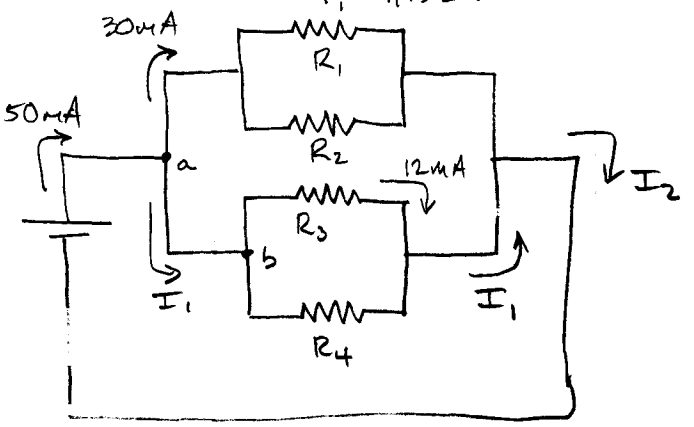
$P_3 = I_3^2 R_3 = (3.2A)^2(75\Omega) = \boxed{768W}$

$P_T = I^2 R_T = (9.6A)^2(25\Omega) = \boxed{2304W}$

$P_1 + P_2 + P_3 = 960W + 576W + 768W = \boxed{2304W} \checkmark$

$P_1 = 1.152W$

6.41)



a. Find resistor values

From P_1 and knowing that $V_1 = E$ (parallel circuit), we can calculate R_1:

$$P_1 = \frac{V_1^2}{R_1} = \frac{E^2}{R_1} \Rightarrow R_1 = \frac{E^2}{P_1} = \frac{(48V)^2}{1.152W} = \boxed{2k\Omega}$$

After determining I_1, we can use KCL to calculate I_2 then R_2.

$$P_1 = I_1^2 R_1 \rightarrow I_1 = \sqrt{\frac{P_1}{R_1}} = \sqrt{\frac{1.152W}{2000\Omega}} = 0.024A$$

$$I_2 = 30mA - I_1 = 30mA - 24mA = 6mA$$

$$R_2 = \frac{V_2}{I_2} = \frac{E}{I_2} = \frac{48V}{6\times10^{-3}A} = \boxed{8k\Omega}$$

Using KCL at node a, we can find the current (I_1) to R_3 and R_4 parallel resistors.

$$50mA = 30mA + I_1$$
$$I_1 = 20mA$$

Then, KCL at node b gives I_4

$$I_1 = 12mA + I_4$$
$$20mA = 12mA + I_4$$
$$I_4 = 8mA$$

$$R_4 = \frac{V_4}{I_4} = \frac{E}{I_4} = \frac{48V}{8\times10^{-3}A} = \boxed{6k\Omega}$$

Use Ohm's Law to find R_3

$$R_3 = \frac{V_3}{I_3} = \frac{E}{I_3} = \frac{48V}{12\times10^{-3}A}$$

$$\boxed{R_3 = 4k\Omega}$$

6.41) b. From part a,

$I_{R_1} = 24mA$

$I_2 = 6mA$

$I_4 = 8mA$

c. $I_1 = 20mA$ from part a using KCL

$I_2 = I_T = 50mA$

d. $P_2 = \frac{V_2^2}{R_2} = \frac{(48V)^2}{8k\Omega} = 0.288W$

$P_3 = \frac{V_3^2}{R_3} = \frac{(48V)^2}{4k\Omega} = 0.576W$

$P_4 = \frac{V_4^2}{R_4} = \frac{(48V)^2}{6k\Omega} = 0.384W$