February 5, 2006

CHAPTER 2

P.P.2.1 $i = V/R = 110/12 =$ **9.167 A**

P.P.2.2 (a) $v = iR = 2$ mA[10 kohms] = **20 V**

(b) $G = 1/R = 1/10$ kohms = **100 µS**

(c) $p = vi = 20$ volts[2 mA] = **40 mW**

P.P.2.3 $p = vi$ which leads to $i = p/v = [20 \cos^2(t)$ mW]/[10cos(t) mA]

or $i =$ **2cos(t) mA**

$R = v/i = 10\cos(t)\text{V}/2\cos(t)\text{mA} =$ **5 kΩ**

P.P.2.4 5 branches and 3 nodes. The 1 ohm and 2 ohm resistors are in parallel. The 4 ohm resistor and the 10 volt source are also in parallel.

P.P.2.5 Applying KVL to the loop we get:

$-10 + 4i - 8 + 2i = 0$ which leads to $i = 3\text{A}$

$v_1 = 4i =$ **12V** and $v_2 = -2i =$ **–6V**

P.P.2.6 Applying KVL to the loop we get:

$-35 + 10i + 2v_x + 5i = 0$

But, $v_x = 10i$ and $v_0 = -5i$. Hence,

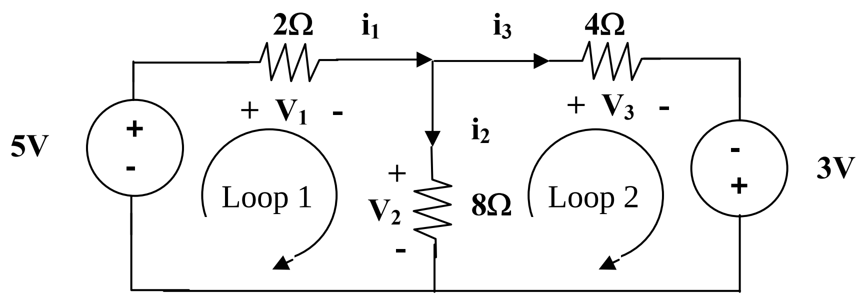
$-35 + 10i + 20i + 5i = 0$ which leads to $i = 1\text{A}$.

Thus, $v_x =$ **10V** and $v_0 =$ **–5V**

P.P.2.7 Applying KCL, $6 = i_0 + [i_0/4] + [v_0/8]$, but $i_0 = v_0/2$

Which leads to: $6 = (v_0/2) + (v_0/8) + (v_0/8)$ thus, $v_0 =$ **8V** and $i_0 =$ **4A**

P.P.2.8



At the top node, $i_1 = i_2 + i_3$ (1)

For loop 1 $-5 + V_1 + V_2 = 0$
or $V_1 = 5 - V_2$ (2)

For loop 2 $-V_2 + V_3 - 3 = 0$
or $V_3 = V_2 + 3$ (3)

Using (1) and Ohm's law, we get

$$(V_1/2) = (V_2/8) + (V_3/4)$$

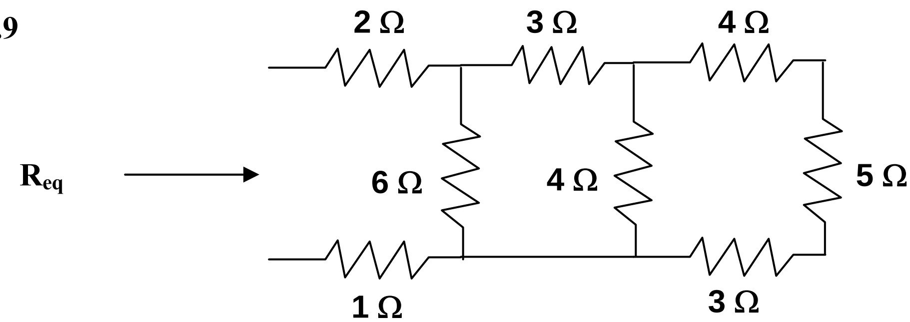
and now using (2) and (3) in the above yields

$$[(5 - V_2)/2] = (V_2/8) + (V_2+3)/4$$

or $V_2 =$ **2 V**

$V_1 = 5 - V_2 =$ **3V**, $V_3 = 2+3 =$ **5V**, $i_1 = (5-2)/2 =$ **1.5A**,
$i_2 =$ **250 mA**, $i_3 =$ **1.25A**

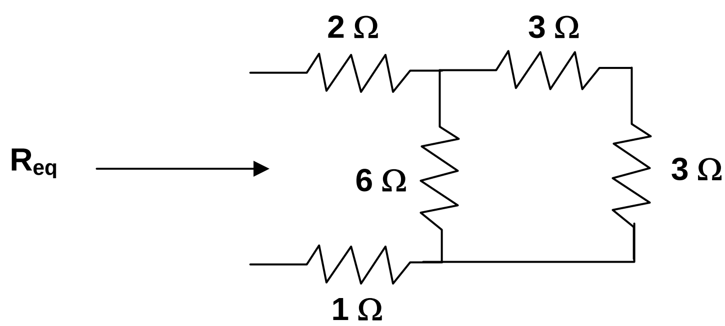
P.P.2.9



Combining the 4 ohm, 5 ohm, and 3ohm resistors in series gives 4+3+5 = 12.

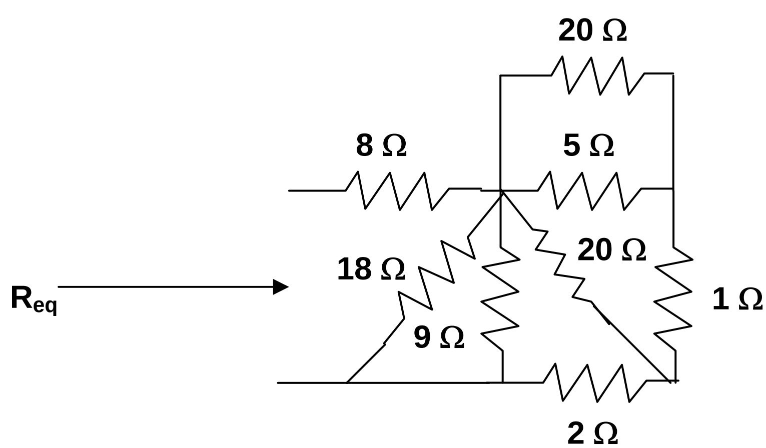
But, 4 in parallel with 12 produces [4x12]/[4+12] = 48/16 = 3ohm.

So that the equivalent circuit is shown below.



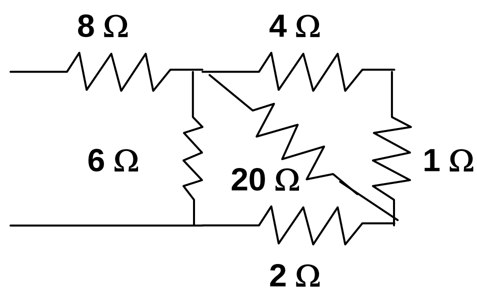
Thus, $\mathbf{R_{eq}}$ = 1 + 2 + [6x6]/[6+6] = **6 Ω**

P.P.2.10

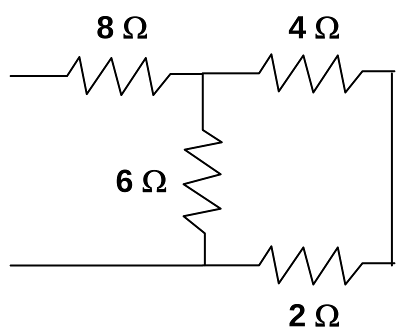


Combining the 9 ohm resistor and the 18 ohm resistor yields [9x18]/[9+18] = 6 ohms.

Combining the 5 ohm and the 20 ohm resistors in parallel produces [5x20/(5+20)] = 4 ohms We now have the following circuit:



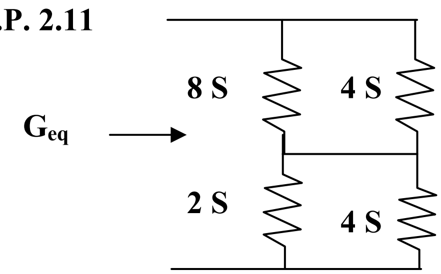
The 4 ohm and 1 ohm resistors can be combined into a 5 ohm resistor in parallel with a 20 ohm resistor. This will result in [5x20/(5+20)] = 4 ohms and the circuit shown below:



The 4 ohm and 2 ohm resistors are in series and can be replaced by a 6 ohm resistor. This gives a 6 ohm resistor in parallel with a 6 ohm resistor, [6x6/(6+6)] = 3 ohms. We now have a 3 ohm resistor in series with an 8 ohm resistor or 3 + 8 = 11ohms. Therefore:

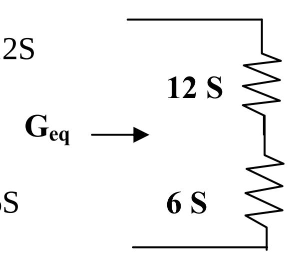
$$R_{eq} = \underline{11 \text{ ohms}}$$

P.P. 2.11



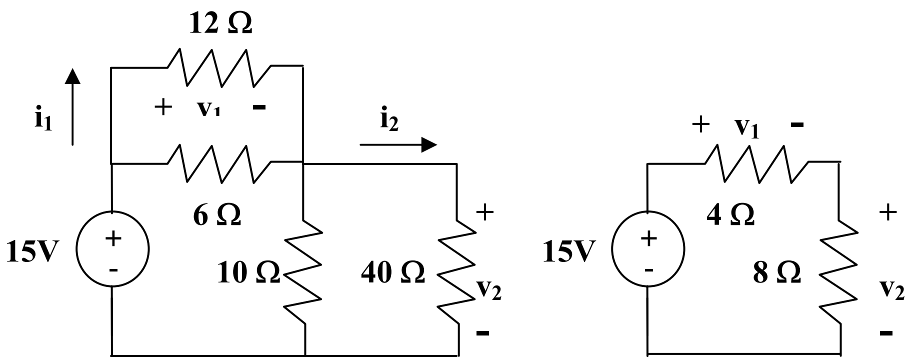
8||4 = 8+4 = 12S

2||4 = 2+4 = 6S



12 S in series with 6 S = {12x6/(12+6)] = 4 or: $G_{eq} = \underline{4 \text{ S}}$

P.P.2.12



6||12 = [6x12/(6+12)] = 4 ohm and 10||40 = [10x40/(10+40)] = 8 ohm.

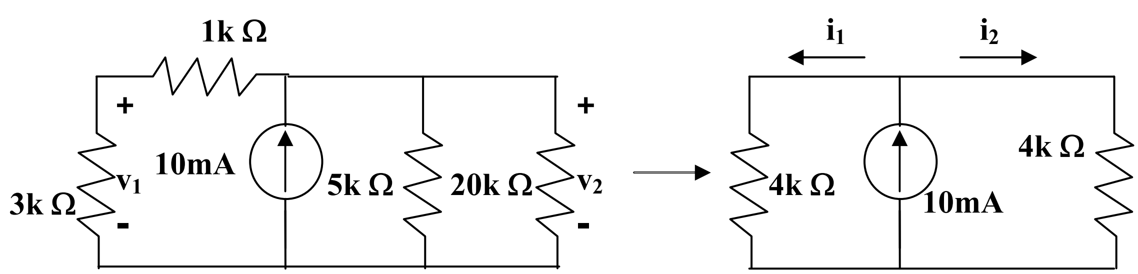
Using voltage division we get:

v_1 = [4/(4+8)] (15) = **<u>5 volts</u>**, **v_2** = [8/12] (15) = **<u>10 volts</u>**

i_1 = v_1/12 = 5/12 = **<u>416.7 mA</u>**, **i_2** = v_2/40 = 10/40 = **<u>250 mA</u>**

P_1 = v_1 i_1 = 5x5/12 = **<u>2.083 watts</u>**, **P_2** = v_2 i_2 = 10x0.25 = **<u>2.5 watts</u>**

P.P.2.13



Using current division, i_1 = i_2 = (10 mA)(4 kohm/(4 kohm + 4 kohm)) = 5mA

(a) **v_1** = (3 kohm)(5 mA) = **<u>15 volts</u>**
v_2 = (4 kohm)(5 mA) = **<u>20 volts</u>**

(b) For the 3k ohm resistor, **P_1** = v_1 x i_1 = 15x5 = **<u>75 mw</u>**
For the 20k ohm resistor, **P_2** = $(v_2)^2$ /20k = **<u>20 mw</u>**

(c) The total power supplied by the current source is equal to:
P = v_2 x 10 mA = 20x10 = **<u>200 mw</u>**

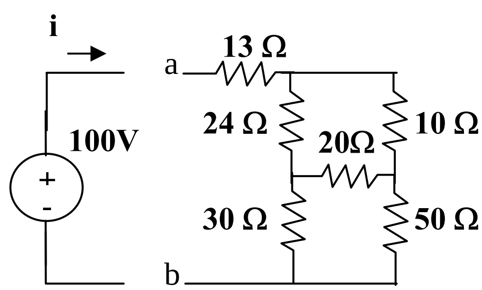
P.P.2.14

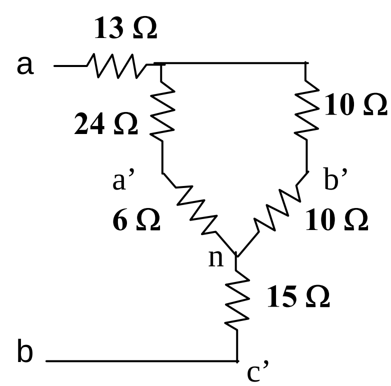
$\mathbf{R_a}$ = $[R_1 R_2 + R_2 R_3 + R_3 R_1]/ R_1$ = $[10x20 + 20x40 + 40x10]/10$ = **140 ohms**

$\mathbf{R_b}$ = $[R_1 R_2 + R_2 R_3 + R_3 R_1]/ R_2$ = 1400/20 = **70 ohms**

$\mathbf{R_c}$ = $[R_1 R_2 + R_2 R_3 + R_3 R_1]/ R_3$ = 1400/40 = **35 ohms**

P.P.2.15 We first find the equivalent resistance, R. We convert the delta sub-network to a wye connected form as shown below:





$R_{a'n}$ = 20x30/[20 + 30 + 50] = 6 ohms, $R_{b'n}$ = 20x50/100 = 10 ohms
$R_{c'n}$ = 30x50/100 = 15 ohms.

Thus, R_{ab} = 13 + (24 + 6)||(10 + 10) + 15 = 28 + 30x20/(30 + 20) = **40 ohms.**

i = 100/ R_{ab} = 100/40 = **2.5 amps**

P.P.2.16

For the parallel case, v = v_0 = 110volts.
p = vi $\Longrightarrow$ i = p/v = 40/110 = **364 mA**

For the series case, v = v_0/N = 110/10 = 11 volts
i = p/v = 40/11 = **3.64 amps**

P.P.2.17 We use equation (2.61)

(a) $\mathbf{R_1}$ = $50x10^{-3}/ (1-10^{-3})$ = 0.05/999 = **50 mΩ (shunt)**

(b) $\mathbf{R_2}$ = $50x10^{-3}/(100x10^{-3} – 10^{-3})$ = 50/99 = **505 mΩ (shunt)**

(c) $\mathbf{R_3}$ = $50x10^{-3}/(10x10^{-3}-10^{-3})$ = 50/9 = **5.556 Ω (shunt)**