CHAPTER 2

P.P.2.1 $i = V/R = 110/15 =$ **7.333 A**

P.P.2.2 (a) $v = iR = 3$ mA[10 kohms] = **30 V**

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

(c) $p = vi = 30$ volts[3 mA] = **90 mW**

P.P.2.3 $p = vi$ which leads to $i = p/v = [30\cos^2(t)$ mW$]/[15\cos(t)$ mA$]$

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

$R = v/i = 15\cos(t)\text{V}/2\cos(t)\text{mA} =$ **7.5 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:

$-32 + 4i - (-8) + 2i = 0$ which leads to $i = 24/6 = 4\text{A}$

$v_1 = 4i =$ **16 V** and $v_2 = -2i =$ **–8 V**

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

$-70 + 10i + 2v_x + 5i = 0$

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

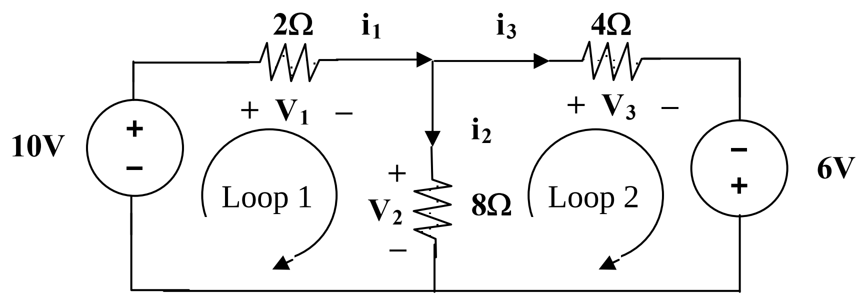
$-70 + 10i + 20i + 5i = 0$ which leads to $i = 2$ A.

Thus, $v_x =$ **20V** and $v_0 =$ **–10 V**

P.P.2.7 Applying KCL, $0 = -9 + i_0 + [i_0/4] + [v_0/8]$, but $i_0 = v_0/2$

Which leads to: $9 = (v_0/2) + (v_0/8) + (v_0/8)$ thus, $v_0 =$ **<u>12 V</u>** and $i_0 =$ **<u>6 A</u>**

P.P.2.8



At the top node, $0 = -i_1 + i_2 + i_3$ or $i_1 = i_2 + i_3$ (1)

For loop 1 $-10 + V_1 + V_2 = 0$
or $V_1 = 10 - V_2$ (2)

For loop 2 $-V_2 + V_3 - 6 = 0$
or $V_3 = V_2 + 6$ (3)

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

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

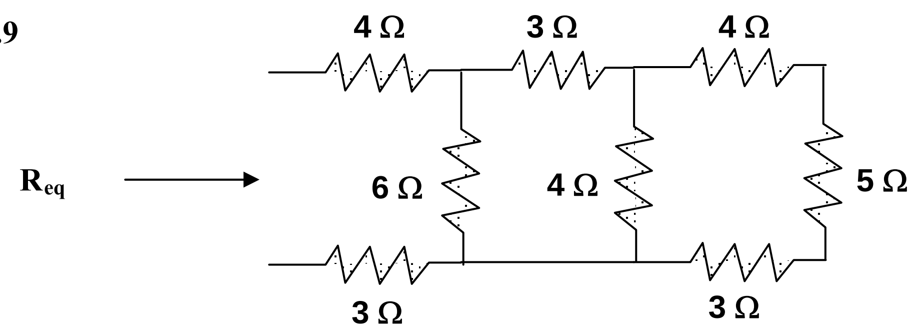
and now using (2) and (3) in the above yields

$$[(10 - V_2)/2] = (V_2/8) + (V_2 + 6)/4$$

or $[7/8]V_2 = 14/4$ or $V_2 =$ **<u>4 V</u>**

$V_1 = 10 - V_2 =$ **<u>6 V</u>**, $V_3 = 4+6 =$ **<u>10 V</u>**, $i_1 = (10-4)/2 =$ **<u>3 A</u>**,
$i_2 = 4/8 =$ **<u>500 mA</u>**, $i_3 =$ **<u>2.5 A</u>**

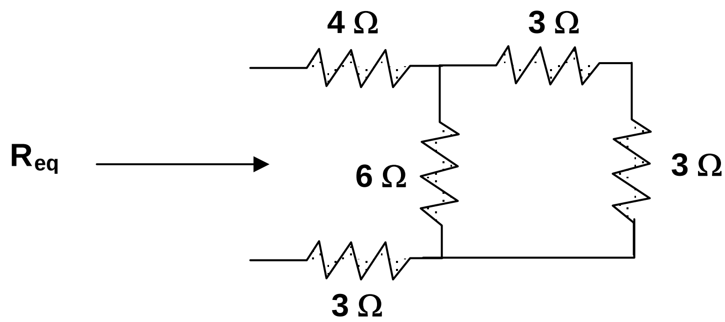
P.P.2.9



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

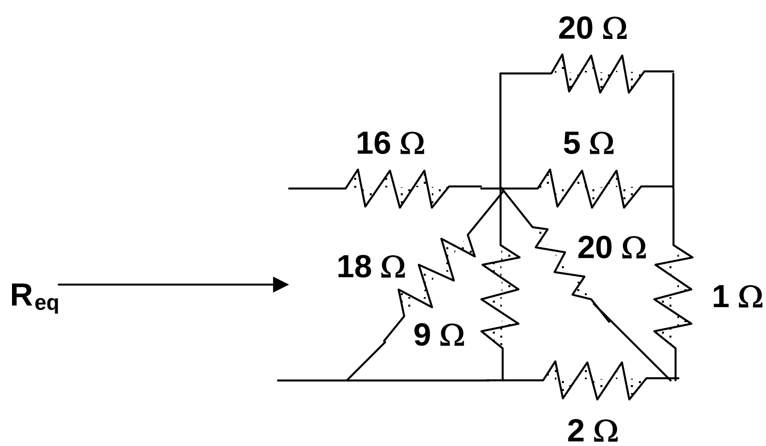
But, 4 in parallel with 12 produces [4x12]/[4+12] = 48/16 = 3ohm.

So that the equivalent circuit is shown below.



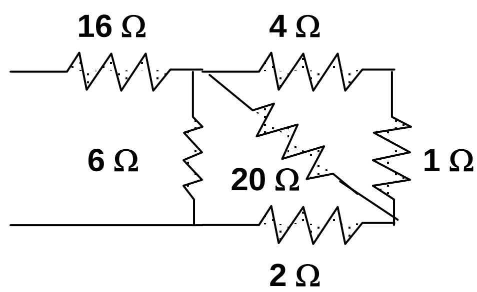
Thus, $\mathbf{R_{eq}}$ = 4 + 3 + [6x6]/[6+6] = <u>**10 Ω**</u>

P.P.2.10

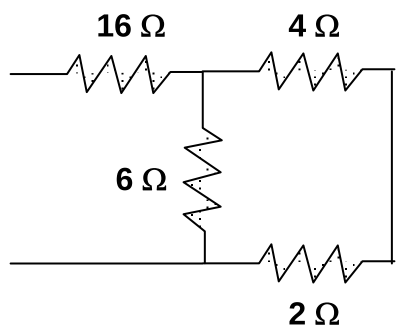


Combining the 9 ohm resistor and the 18 ohm resistor yields [9x18]/[9+18] = 6 ohms.

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



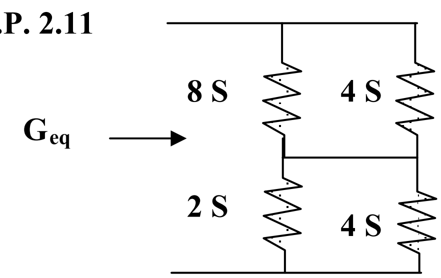
The 4 ohm and 1 ohm resistors can be combined into a 5 ohm resistor in parallel with a 20 ohm resistor. This will result in [5x20/(5+20)] = 4 ohms and the circuit shown below:



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 a 16 ohm resistor or 3 + 16 = 19 ohms. Therefore:

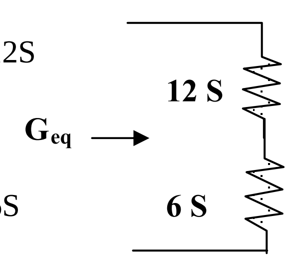
$$R_{eq} = \underline{\textbf{19 ohms}}$$

P.P. 2.11



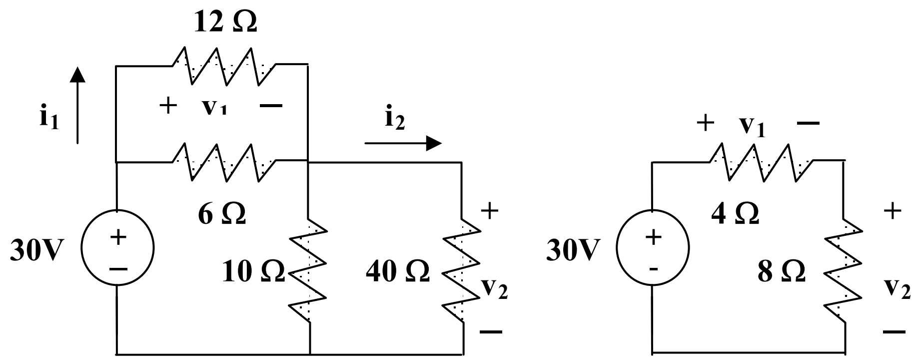
8||4 = 8+4 = 12S

2||4 = 2+4 = 6S



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

P.P.2.12



$6||12 = [6\text{x}12/(6+12)] = 4$ ohm and $10||40 = [10\text{x}40/(10+40)] = 8$ ohm.

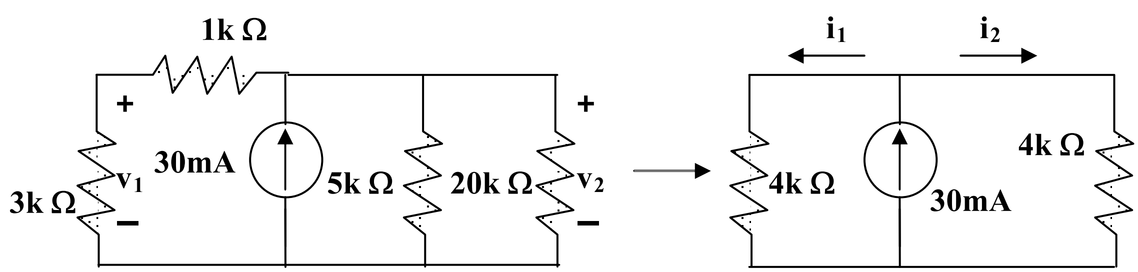
Using voltage division we get:

$\mathbf{v_1} = [4/(4+8)]\,(30) =$ **<u>10 volts</u>**, $\mathbf{v_2} = [8/12]\,(30) =$ **<u>20 volts</u>**

$\mathbf{i_1} = v_1/12 = 10/12 =$ **<u>833.3 mA</u>**, $\mathbf{i_2} = v_2/40 = 20/40 =$ **<u>500 mA</u>**

$\mathbf{P_1} = v_1\, i_1 = 10\text{x}10/12 =$ **<u>8.333 watts</u>**, $\mathbf{P_2} = v_2\, i_2 = 20\text{x}0.5 =$ **<u>10 watts</u>**

P.P.2.13



Using current division, $i_1 = i_2 = (30\text{ mA})(4\text{ kohm}/(4\text{ kohm} + 4\text{ kohm})) = 15\text{mA}$

(a) $\mathbf{v_1} = (3\text{ kohm})(15\text{ mA}) =$ **<u>45 volts</u>**
$\mathbf{v_2} = (4\text{ kohm})(15\text{ mA}) =$ **<u>60 volts</u>**

(b) For the 3k ohm resistor, $\mathbf{P_1} = v_1 \text{ x } i_1 = 45\text{x}15\text{x}10^{-3} =$ **<u>675 mw</u>**
For the 20k ohm resistor, $\mathbf{P_2} = (v_2)^2/20\text{k} =$ **<u>180 mw</u>**

(c) The total power supplied by the current source is equal to:

$\mathbf{P} = v_2 \times 10\text{ mA} = 60 \times 30 \times 10^{-3} = \underline{\mathbf{1.8\ W}}$

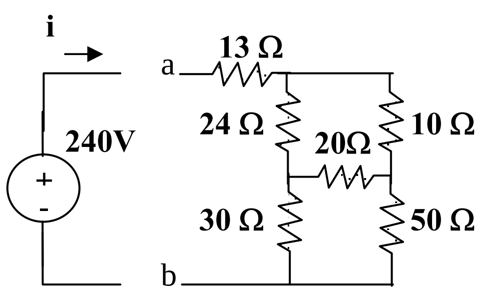
P.P.2.14

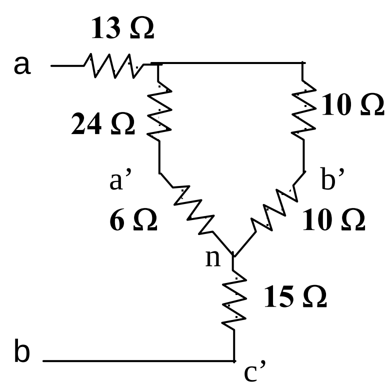
$\mathbf{R_a} = [R_1 R_2 + R_2 R_3 + R_3 R_1]/R_1 = [10 \times 20 + 20 \times 40 + 40 \times 10]/10 = \underline{\mathbf{140\ ohms}}$

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

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

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:





$R_{a'n} = 20 \times 30/[20 + 30 + 50] = 6$ ohms, $R_{b'n} = 20 \times 50/100 = 10$ ohms

$R_{c'n} = 30 \times 50/100 = 15$ ohms.

Thus, $R_{ab} = 13 + [(24 + 6)||(10 + 10)] + 15 = 28 + 30 \times 20/(30 + 20) = \underline{\mathbf{40\ ohms.}}$

$\mathbf{i} = 240/R_{ab} = 240/40 = \underline{\mathbf{6\ amps}}$

P.P.2.16 **For the parallel case, $v = v_0 = 110$volts.**

$\mathbf{p = vi \Longrightarrow i = p/v = 40/110 = \underline{364\ mA}}$

For the series case, $v = v_0/N = 110/10 = 11$ volts

$\mathbf{i} = p/v = 40/11 = \underline{\mathbf{3.64\ amps}}$

P.P.2.17 We use equation (2.61)

(a) $\mathbf{R_1} = 50 \times 10^{-3}/(1-10^{-3}) = 0.05/999 = \underline{\mathbf{50\ m\Omega\ (shunt)}}$

(b) $\mathbf{R_2} = 50 \times 10^{-3}/(100 \times 10^{-3} - 10^{-3}) = 50/99 = \underline{\mathbf{505\ m\Omega\ (shunt)}}$

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