EGR 260 - Circuit Analysis
File: N260H3BS

Solution to HW #3 – Simple Resistive Circuits

Problem Assignment:

Chapter 3 # 9, 10, 22, 23, 25, 27, 28

P 3.9 **[a]** For circuit (a)

$$R_{ab} = 15\|(18 + 48\|16) = 10\,\Omega$$

For circuit (b)

$$5\|10\|15\|10\|(12 + 18) = 2\,\Omega$$

$$16\|(14 + 2) = 8\,\Omega$$

$$R_{ab} = 4 + 8 + 12 = 24\,\Omega$$

For circuit (c)

$$144\|(4 + 12) = 14.4\,\Omega$$

$$14.4 + 5.6 = 20\,\Omega$$

$$20\|12 = 7.5\,\Omega$$

$$7.5 + 2.5 = 10\,\Omega$$

$$10\|15 = 6\,\Omega$$

$$14 + 6 + 10 = 30\,\Omega$$

$$R_{ab} = 30\|60 = 20\,\Omega$$

[b] $P_a = \dfrac{20^2}{10} = 40\ \text{W}$

$$P_b = \frac{144^2}{27} = 768\ \text{W}$$

$$P_c = 5^2(20) = 500\ \text{W}$$

P 3.10 $R_{eq} = 6\|30\|20 = 4\,\Omega$

$$v_{30\text{A}} = v_{4\Omega} = (30\ \text{A})(4\,\Omega) = 120\ \text{V}$$

Therefore, since the three original resistors are in parallel with the current source:

$$v_{30\Omega} = v_{30\text{A}} = 120\ \text{V}$$

Thus, $p_{30\Omega} = \dfrac{v_{30\Omega}^2}{30} = \dfrac{120^2}{30} = 480\ \text{W}$

P 3.22 [a] The equivalent resistance to the right of the 10 kΩ resistor is $3\text{ k} + 8\text{ k} + [6\text{ k}\|(5\text{ k} + 7\text{ k})] = 15\text{ k}\Omega$. Therefore,

$$i_{10k} = \frac{15\text{ k}\|10\text{ k}}{10\text{ k}}(0.002) = \frac{6\text{ k}}{10\text{ k}}(0.002) = 1.2\text{ mA}$$

[b] The voltage drop across the 10 kΩ resistor can be found using Ohm's law:

$$v_{10k} = (10,000)i_{10k} = (10,000)(0.0012) = 12\text{ V}$$

[c] The voltage v_{10k} drops across the 3 kΩ resistor, the 8 kΩ resistor and the equivalent resistance of the 6 kΩ and the parallel branch containing the 5 kΩ and 7 kΩ resistors. Thus, using voltage division,

$$v_{6k} = \frac{6\text{ k}\|(5\text{ k} + 7\text{ k})}{3\text{ k} + 8\text{ k} + [6\text{ k}\|(5\text{ k} + 7\text{ k})]}(12) = \frac{4}{15}(12) = 3.2\text{ V}$$

[d] The voltage v_{6k} drops across the branch containing the 5 kΩ and 7 kΩ resistors. Thus, using voltage division,

$$v_{5k} = \frac{5\text{ k}}{5\text{ k} + 7\text{ k}}(3.2) = 1.33\text{ V}$$

P 3.23 [a] The voltage drop across the 240 Ω resistor is the same as the voltage drop across the parallel combination of the branch containing the 240 Ω resistor and the branch containing the 180 Ω and 300, Ω resistors. Thus by voltage division,

$$v_{240} = \frac{240\|(180 + 300)}{[240\|(180 + 300)] + 140 + 200}(10) = \frac{160}{500}(10) = 3.2\text{ V}$$

[b] The current in the 240 Ω resistor can be found from its voltage using Ohm's law:

$$i_{240} = \frac{v_{240}}{240} = \frac{3.2}{240} = 13.33\text{ mA}$$

[c] The current in the 140 Ω resistor divides between two branches – one containing the 180 Ω and 300 Ω resistors and the other containing the 240 Ω resistor. Using current division,

$$i_{240} = \frac{240\|(180 + 300)}{240}(i_{140}) = 0.01333 \quad \text{so} \quad i_{140} = \frac{240(0.01333)}{160} = 20\text{ mA}$$

P 3.25 $60\|30 = 20\,\Omega$

$$i_{30\Omega} = \frac{(25)(75)}{125} = 15 \text{ A}$$

$$v_2 = (15)(20) = 300 \text{ V}$$

$$v_2 + 30i_{30} = 750 \text{ V}$$

$$v_1 - 12(25) = 750$$

$$v_1 = 1050 \text{ V}$$

P 3.27 $54\,\Omega\|27\,\Omega = 18\,\Omega;\qquad 18\,\Omega + 2\,\Omega = 20\,\Omega;\qquad 20\|(10+15+35) = 15\,\Omega;$

Therefore, $i_g = \dfrac{675}{30+15} = 15$ A

$$i_{2\Omega} = \frac{20\|60}{20}(15) = 11.25 \text{ A};\quad i_o = \frac{27\|54}{27}(11.25) = 7.5 \text{ A}$$

P 3.28 [a] $40\|10 = 8\,\Omega$ $\qquad i_{120\text{V}} = \dfrac{120}{7.5} = 16$ A

$8 + 2 = 10\,\Omega$ $\qquad i_{4\Omega} = \dfrac{7.5}{4+6}(16) = 12$ A

$15\|10 = 6\,\Omega$ $\qquad i_{2\Omega} = \dfrac{6}{2+8}(12) = 7.2$ A

$6 + 4 = 10\,\Omega$ $\qquad i_o = \dfrac{8}{40}(7.2) = 1.44$ A

$30\|10 = 7.5\,\Omega$

[b] $i_{15\Omega} = i_{4\Omega} - i_{2\Omega} = 12 - 7.2 = 4.8$ A

$P_{15\Omega} = (4.8)^2(15) = 345.6$ W