David Rafian
Quizzes at 8:45 AM

EL2013
User: MyName
Pass: MyPassword

Monday, Sept 17, 2014

HW assigned
Ch 3: 49, 55, 60, 61, 62
Solutions Friday - not graded
but fair game on test

RH116 exam
3½" x 5" index card
See George's email / extra office hours

- always look at series resistors to combine
- only do 2 resistors in parallel if using $R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$

Check: Great Summary & Review at end of each ch!!

Voltage division: What fraction of total voltage is dropped across one resistor (see EX 3.13)
"Simple ratio of resistors"

Current division: What fraction of total current into a parallel string of resistors flows through any one resistor (see EX 3.14)
"Simple ratio of the "other" resistor to total resistance"
EX 3.13, p. 62

Determine $V_x$.

\[ 12 \sin t \, V \]

\[ \frac{4 \pi}{3} \, \frac{1}{3} \]

\[ + \]

\[ 6 \Omega \]

\[ 3 \Omega \]

\[ - \]

\[ V_x \]

**Note** $V_x$ is same as across $3 \Omega$ as $6 \Omega$.

\[ \frac{M}{4 \pi} \]

\[ V_x \]

\[ 2 \pi \]

\[ \frac{3.16}{3.16} = 2 \Omega \]

\[ 12 \sin t \, V \]

\[ V_x = \left[ \frac{2}{2+4} \right] 12 \sin t \, V = \left[ 4 \sin t \, V \right] \]

EX 3.14, p. 64

Find current through $3 \Omega$ resistor.

The current through both $3 \Omega$ and $6 \Omega$ is

\[ \frac{V}{R} = \frac{12 \sin t}{2+4} = 2 \sin t \, \text{V} \, \text{Amps} \]

This is total current, now how much through the $3 \Omega$ resistor? Hint: Always bigger than through $6 \Omega$, in fact double.

\[ I_3 = \frac{6}{6+3} = \left( \frac{2}{3} \right) 2 \sin t \, \text{A} = \frac{4}{3} \sin t \, \text{Amps} \]
Current Division

\[ i_1 = \frac{V}{R_1} \]

\[ i_2 = \frac{V}{R_2} = i (\frac{R_1 \parallel R_2}{R_2}) = \frac{i}{R_2} \left( \frac{R_1 R_2}{R_1 + R_2} \right) \]

\[ i_2 = i \left( \frac{R_1}{R_1 + R_2} \right) \]

\[ l_2 = l \left( \frac{R_2}{R_1 + R_2} \right) \]
Practice for Exam 1

Most work tons of problems
I will post old tests and solutions
Here are 5 good practice problems:
Practice for Exam 1. 3.52 3.85 3.35 3.1 3.5 3.8 12 11

Practicing Excel 1

Most important to improve:

(Will not do self-evaluation because I need to practice more)

Pep in 2 days please?:


2. (a) 4 nodes;
(b) 7 elements;
(c) 6 branches (we omit the 2 Ω resistor as it is not associated with two distinct nodes)

See the problem in book:
See p. 68, Fig. 3.45

Note the short circuit of 2Ω causes a big node at top.

(not a branch)
34. Define the center node as +v; the other node is then the reference terminal.

KCL yields \(3 \times 10^{-3} - 5 \times 10^{-3} = \frac{v}{1000} + \frac{v}{4700} + \frac{v}{2800}\)

Solving, \(v = -1.274\) V

(a) \(R\) \(P_{\text{absorbed}}\)

<table>
<thead>
<tr>
<th>R (kΩ)</th>
<th>(P_{\text{absorbed}}) (mW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kΩ</td>
<td>1.623 mW</td>
</tr>
<tr>
<td>4.7 kΩ</td>
<td>345.3 μW</td>
</tr>
<tr>
<td>2.8 kΩ</td>
<td>579.7 μW</td>
</tr>
</tbody>
</table>

(b) Source \(P_{\text{absorbed}}\)

<table>
<thead>
<tr>
<th>Source (mA)</th>
<th>(P_{\text{absorbed}}) (mW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 mA</td>
<td>((v)(3 \times 10^{-3}) = -3.833) mW</td>
</tr>
<tr>
<td>5 mA</td>
<td>((v)(-5 \times 10^{-3}) = +6.370) mW</td>
</tr>
</tbody>
</table>

(c) \[\sum P_{\text{absorbed}} = 2.548\) mW \[\sum P_{\text{supplied}} = 2.548\) mW

Thus, \(\sum P_{\text{supplied}} = \sum P_{\text{absorbed}}\)

Note we make ground reference at the bottom and voltage ref at center.

With the voltage ref at center and ground at bottom, we can redraw (you don't have to, but fun to do!!)

\[3 mA\] source \(I_{\text{tot}}\)

\[2 mA\] source

\[5 mA\] source

\[5 mA\] source

\[1 kΩ\]

\[2.8 kΩ\]

\[4.7 kΩ\]

\[1 kΩ\]

Now: \[(3 - 5) mA = I_{\text{tot}} = I_{4.7} + J_{2.8} + I_{1}\]

\[-2 mA = \frac{v}{47 kΩ} + \frac{v}{28 kΩ} + \frac{v}{1 kΩ}\]

\[\text{Solve for} v\]

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38. We may first reduce the series connected voltage sources, or simply write a KVL equation around the loop as it is shown:

\[ +2 + 4 + 7i + v_1 + 7i + 1 = 0 \]

Setting \( i = 0, v_1 = -7 \text{ V} \)

Here, we can ignore the resistors, and just find when voltages in loop sum to zero, since \( v = 0 \) means \( i = 0 \)!!

So, just look at voltage sources and combine them.

So, going around the voltage supplies

Solve: \[-2 - 4 - v_1 - 1 = 0 \]

\[ \Rightarrow v_1 = -7 \text{ V} \]

\( v_1 = -7 \text{ V} \) makes total voltage equivalent source = zero, and there is no current as \( V = IR \).
51. (a) \( v_2 = v_1 - v_2 = 9.2 - 3 = 6.2 \text{ V} \)
(b) \( v_1 = v - v_2 = 2 - 1 = 1 \text{ V} \)
(c) \( v = v_1 + v_2 = 3 + 6 = 9 \text{ V} \)
(d) \( v_1 = v R_1 / (R_1 + R_2) = v_2 R_2 / (R_1 + R_2) \).

Thus, setting \( v_1 = v_2 \) and \( R_1 = R_2 \), \( R_1 / R_2 = 1 \)
(e) \( v_2 = v R_2 / (R_1 + R_2) = v R_2 / (2 R_2 + R_2) = v / 3 = 1.167 \text{ V} \)
(f) \( v_1 = v R_1 / (R_1 + R_2) = (1.8)(1) / (1 + 4.7) = 0.3158 \text{ mV} \)

\[(q) \text{ If } V = 9.2 \text{ V}, \ V_1 = 3V, \text{ find } V_2\]

\[V_2 = \left( \frac{R_2}{R_1 + R_2} \right) V \quad \text{and} \quad V_2 = V - V_1 \]

\[i.e., \quad V_2 = 9.2 - 3 = 6.2 \text{ V} \]

(d) \( \text{Find } R_1 / R_2 \text{ if } V_1 = V_2 \). By inspection, if the voltage drops by half across each of two resistors, they must be the same \( \Rightarrow R_1 / R_2 = 1 \)

you can do the rest!

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52. (a) \( i_1 = i - i_2 = 8 - 1 = 7 \text{A} \)

(b) \( v = i(R_1 || R_2) = i(50 \times 10^3) = 50 \text{V} \)

(c) \( i_2 = iR_1/(R_1 + R_2) = (20 \times 10^3)(1/5) = 4 \text{mA} \)

(d) \( i_1 = iR_2/(R_1 + R_2) = (10)(9)/18 = 5 \text{A} \)

(c) \( i_2 = iR_1/(R_1 + R_2) = (10)(10 \times 10^6)/(10 \times 10^6 + 1) = 10 \text{A} \)

\((9) \text{ If } i = 8 \text{Amps, find } i_1 \text{ if } i_2 = 1 \text{A} \)

Simple \(\Rightarrow\) Node analysis: \(KCL:\)

\[ 8 = i_1 + i_2 \]

\[ 8 = i_1 + 1 \Rightarrow i_1 = 7 \text{A} \]

By intuition, this tells you that \( R_1 \) is much smaller than \( R_2 \), 7 times smaller, right?

\((C) \text{ Find } i_2, \text{ if } i = 20 \text{mA}, R_1 = 1 \Omega, R_2 = 4 \Omega \)

Using current division, \( i_2 = i\left(\frac{R_1}{R_1 + R_2}\right) \)

\[ i_2 = 20 \text{mA} \left(\frac{1}{4 + 1}\right) = 4 \text{mA} \]

\((l = l_1 + l_2) \Rightarrow\) Makes sense, since \( i_1 \) must then be \( 20 - 4 = 16 \text{mA} \)

Which is 4 times \( i_2 \). Makes sense since \( R_2 \) is 4 times \( R_1 \), so \( i_1 \) will be 4 times current of \( i_2 \).
54. First, replace the $2 \Omega \parallel 10 \Omega$ combination with $1.66 \Omega$. Then

\[ \mathbf{v_x} = 3 \frac{2}{2+3+1.667} = 900 \text{ mV} \]

Find $V_x$:

Make circuit easier by combining 2 parallel Rs:

Then find voltage drop, simple blathering:

\[ V_x = 3V \left[ \frac{2}{2+3+1 \frac{2}{3}} \right] = 3V \left[ \frac{2}{6 \frac{2}{3}} \right] = 3 \left( \frac{2}{20 \frac{2}{3}} \right) = \frac{18}{20} = 0.9 \text{ V} \]
53. **One possible solution:** Choose $v = 1 \text{ V}$. Then

\[
\begin{align*}
R_1 &= \frac{v}{i_1} = 1 \Omega \\
R_2 &= \frac{v}{i_2} = 833.3 \text{ m}\Omega \\
R_3 &= \frac{v}{i_3} = 125 \text{ m}\Omega \\
R_4 &= \frac{v}{i_4} = 222.6 \text{ m}\Omega
\end{align*}
\]