Reading: Sections 3.3 - 3.8 in Hayt/Kemmerly/Durbin

Do all of the Practice problems in the Reading assignment (but do not hand them in).

1. Problem 3.16, parts (b) and (d), p. 70. Writing/solving KVL equations.

2. In the circuit of Figure 3.60, $v_3$ is measured to be -5 V. The values of $v_2$ and $v_1$ are unknown. Determine the values of $v_R$ and $v_x$. Note that $v_x$ is the voltage across a "phantom" branch.

3. Problem 3.18, part (b), p. 71. To do this problem, you will need to define a voltage variable across each of the 2 Ω resistors. Single loop circuit with only independent voltage sources.

4. The figure below is a model for a 2-battery flashlight. As indicated in the figure, the lamp can be modeled as a 1-Ω resistor.

![1-Ω lamp](image)

Using this figure and circuit analysis laws, explain why the lamp will not light if one of the batteries is removed, turned the opposite way, and then reconnected. Your answer must include one or more KCL, KVL, and/or Ohm’s Law equations for the circuit.

5. A 20 Ω load is located 600 feet from a 10 volt source. The load is connected to the source with No. 16 AWG copper wire, creating a complete circuit (a single loop circuit). No. 16 AWG copper wire has a resistance of 4.1 Ω per 1000 ft.

   a. What is the magnitude of the voltage across the load (the 20 Ω resistor)? Hint: model each length of wire as a lumped-parameter resistor (simple 2-terminal resistor) connected to the source and the load with ideal conductors.
6. Design Problem. In the demo I did in the discussion section on Monday 27 August, we connected a nominal 6 V battery to a number of different resistors (we will call these the load resistors) and measured the resulting voltage across the load resistors. Here is the data from that experiment, including the nominal values of the load resistors.

<table>
<thead>
<tr>
<th>Element Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Resistor Value (Ω)</td>
<td>1 M</td>
<td>5.1 k</td>
<td>1 k</td>
<td>510</td>
<td>200</td>
<td>100</td>
<td>51</td>
</tr>
<tr>
<td>Measured Voltage (V)</td>
<td>6.35</td>
<td>6.32</td>
<td>6.27</td>
<td>6.24</td>
<td>6.16</td>
<td>6.07</td>
<td>5.92</td>
</tr>
</tbody>
</table>

Clearly, modeling the battery as an ideal independent voltage source (even with a voltage value of 6.35 V) does not match the data: the predicted voltage across the resistor from such a model would have been 6.35 volts for every resistor. A better model for a battery is an independent voltage source in series with a small resistance known as the source resistance. Using this general type of source model, the circuit for each part of this experiment would be a single loop circuit with three elements in series: the independent voltage source, the source resistance (these two make up the model of the battery), and one of the load resistors. Assuming that all of the load resistor values are accurate, choose one value for the ideal voltage source and one value for the source resistance that will, on the whole, better predict the measured load resistor voltages. Hint: use voltage division. Your model will not perfectly predict the measured values, but it should come much closer. Using the model values that you have chosen (the one source voltage and the one source resistance), compare (in a table) the predicted load voltages (from your model) and the measured voltages. There is no single "right" answer.


10. Problem 3.34, part (a) only, p. 73. Single node-pair circuit with only independent current sources, but it does not appear to be so at first glance.

11. In the current divider network represented in Figure 3.89, calculate both \( i_1 \) and \( i_2 \) if \( i = 12 \) mA, \( R_1 = 1 \) kΩ, and \( R_2 = 4 \) kΩ.

12. Modify Figure 3.85 on p. 76 by removing the 9Ω resistor and both 6Ω resistors. The resulting circuit is a single node-pair circuit with an independent and a dependent current source. Then find the power supplied by the 2A source.