2.12: Current source values were applied to the device shown below, and the power absorbed was measured. Current and power values are shown in the table below. Use these values to construct a circuit model of the device consisting of a single resistor.

<table>
<thead>
<tr>
<th>i (in A)</th>
<th>P (in W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>400</td>
</tr>
<tr>
<td>6</td>
<td>900</td>
</tr>
<tr>
<td>8</td>
<td>1600</td>
</tr>
<tr>
<td>10</td>
<td>2500</td>
</tr>
<tr>
<td>12</td>
<td>3600</td>
</tr>
</tbody>
</table>

- \( v = iR \), \( p = iv = i^2R \)
- Use any \( i \) pair to find \( R = \frac{P}{i^2} \) \( \Omega \)
- \( R = \frac{100}{4} = 25 \, \Omega \)
- Try another value to check:
  \[ R = \frac{2500}{(10)^2} = \frac{2500}{100} = 25 \, \Omega \]

2.18: Given the circuit below:
2a. Find $i_a$:
- Apply KCL at node 2: $-i + i_a + i_b = 0$
  \[ i_a + i_b = i \] (Ohm's Law: $V = iR$)
- Apply KVL: $-50V + 4i + 20ia = 0$
  \[ 20ia = 80 - 4i \]
- Apply KVL again: $V_o - 20ia = 0$, $20ia = V_o$
  Ohm's Law: $V_o = i_b R$
  \[ 80i_a = 80i_b \]
  \[ i_b = \frac{20}{80} i_a = \frac{i_a}{4} \]
- Now plug eqns for $i + i_b$ into KCL:
  \[ i_a + i_a/4 = 12.5 - 5i_a \]
  \[ i_a + \frac{i_a}{4} + 5i_a = 12.5 \]
  \[ 6.25i_a = 12.5 \]
  \[ i_a = 2A \]

b. Find $i_b$:
  \[ i_b = i_a/4 = 2/4 = 0.5A \]
  \[ i_b = 0.5A = 500mA \]

c. Find $V_o$:
  \[ V_o = i_b (80) = 0.5(80) = 40V \]
  \[ V_o = 40V \]

d. The power dissipated in each resistor is:
  \[ P_i = i^2 R_i = (i_a + i_b)^2 R_i = (2.5)^2 (4) = 25W \]
  \[ P_i = 25W \]
  \[ P_o = i_a^2 R_o = (2.5)^2 (20) = 80W \]
  \[ P_o = 80W \]
  \[ P_b = i_b^2 R_b = (0.5)^2 (80) = \frac{80}{4} = 20W \]
  \[ P_b = 20W \]

e. Power delivered by 50V source is:
  \[ P = iV = (50)(i_a + i_b) = 50(2.5) = 125W \]
  Note that $P = 0$, $25 + 80 + 20 = 125W$
For the circuit shown below:

a) Find R

• Since we know the current flowing from Node a → b → d = 3A, let's find Vad by Ohm's Law: \( V = iR \) so \( V_{ad} = 3(9 + 6) = 45 \text{ V} \)

• We know \( V_{ae} = 125 \text{ V} \) and we know \( V_{ad} = 45 \text{ V} \) (\( V_{ae} = -125 \text{ V} \)) so use KVL to find \( V_{df} \)

Apply KVL around outer loop:
Node f → a → b → d → e → f
\(-125 \text{ V} + 45 \text{ V} + V_{df} = 0, \ V_{df} = 125 - 45 \text{ V} \)
\( V_{df} = 80 \text{ V} \)

• Since we know \( V_{df} \), we can find current flowing in branch through Nodes d → e → f by Ohm's Law: \( V = iR \)

\[ \begin{align*}
V_{df} &= i_d(10 + 6) = 16i_d \\
i_d &= V_{df}/16 = 80/16 = 5 \text{ A}
\end{align*} \]

• Now we know 2 of the 3 currents flowing into or from node d. Use KCL at node d to find \( I_c \):

\[ \begin{align*}
\frac{3A}{10} + i_d + \frac{i_c}{6} &= 0 \\
-i_c - 3 + i_d &= 0 \\
i_c &= i_d + 3
\end{align*} \]
2.22a cont: \( i_c = i_d + 3 = 2A \)

- By Ohm's Law, \( V_{dc} = i_c (5) = 2(5) = 10V \)
- Now apply KVL around bottom loop (nodes c \( \rightarrow \) d \( \rightarrow \) e \( \rightarrow \) f), going clockwise:
  \[
  V_{cd} + V_{de} - V_{es} = 0 \\
  V_{es} = V_{cd} + V_{de} = 10 + 80 = 90V
  \]
- Apply KVL around left loop (nodes f \( \rightarrow \) a \( \rightarrow \) c \( \rightarrow \) f):
  \[-125 + V_k + V_{es} = 0 \\
  V_k = 125 - V_{es} = 125 - 90 = 35V
  \]
- Apply Ohm's Law at R:
  \( V = iR, R = V/i = V_k/i \)
  Oops, we still need \( i \)
- Apply KCL at node C:
  \[
  -i_r + i_c + i_f = 0, \quad i_r = i_c + i_f \\
  By \text{Ohm's Law}, \quad i_f = V_{es}/30 = 90/30 = 3A \\
  so \quad i_r = 2 + 3 = 5A
  \]
- Now apply Ohm's Law at R:
  \( V_k = i_r R, R = V_k/i_r = 35/5 = 7\ \Omega \)

\[
\text{b) Find the power supplied by the 125 V source:} \quad P_S = -V_S i_S = -125 i_S \quad \text{or} \quad 125 i_S \quad \text{supplied}
\]
- Apply KCL at node a:
  \[
  -i_S + i_r + 3 = 0, \quad i_S = i_r + 3 \\
  i_S = 5 + 3 = 8A
  \]
  \[
  P_S = -125(8) = -1000 \text{ W} \quad \text{or} \quad 1000 \text{ W supplied}
  \]
2.38: Static Electric Shock
Model air space btw your hand + doorknob as 1 MΩ resistance. If current causing shock is 3 mA, what voltage potential exists btw your hand + the doorknob

\[ V = iR = (3 \times 10^{-3})(1 \times 10^6) = 3 \times 10^3 \text{ V} \]

\[ V = 3000 \text{ V} = 3 \text{ kV} \]