(1) You are given the circuit of Figure 1. Find the value of E that will make \( V_x = 0 \) volts.

Using Nodal Analysis

At \( V_x \)

\[
\frac{V_x - 6V_x}{20} + \frac{V_x - 40}{40} + \frac{V_x + E}{20} = 0
\]

\[
2V_x - 12V_x + V_x - 40 + 2V_x + 2E = 0
\]

\[
-7V_x - 40 + 2E = 0
\]

If \( V_x = 0 \),

\[
2E = 40
\]

\[
E = 20 \text{ V}
\]
(2) You are given the circuit of Figure 2. Solve for $R_{eq}$, resistance looking into terminals a-b.

Redraw the circuit:

\[ R_{eq} = R_{ab} = \frac{90 \Omega}{15} = \frac{90 \times 5}{90 + 15} = 12 \Omega \]

$R_{eq} = 12 \Omega$
(3) You are given the circuit of Figure 3.
(a) Find the power supplied by the 40 V source.
(b) Find the power absorbed by the 25 Ω resistor.

Resistance to the right of a-b

\[ R_{ab} = \frac{12}{10+40} = \frac{400}{50} \]

\[ R_{ab} = 8 \Omega \]

Resistance seen by the source = 12 + 8 = 20 Ω

\[ I = \frac{40}{20} = 2 \text{ A} \]

Using current division

\[ I_{25} = \frac{I \times 10}{10+40} = \frac{2 \times 10}{50} = 0.4 \text{ A} \]

\[ P_{abs} = I_{25}^2 \times 25 = (0.4)^2 \times 25 = 4 \text{ W} \]

\[ P_{abs} = 4 \text{ W} \]

\[ P_{40} = 40 \times I = 40 \times 2 = 80 \text{ W} \]

\[ P_{40} = 80 \text{ W} \]
(4) You are given the circuit of Figure 4. Use mesh analysis to solve for $I_1$ and $I_2$.

\[10I_1 + 25I_1 + 30I_1 + 15I_2 = 40 - 40I_2 = 0\]

\[65I_1 + 55I_2 = 40\]

Constraint:
\[I_1 - I_2 = -6\]

\[
\begin{bmatrix}
105 & 55 \\
1 & -1
\end{bmatrix}
\begin{bmatrix}
I_1 \\
I_2
\end{bmatrix} =
\begin{bmatrix}
40 \\
-6
\end{bmatrix}
\]

$I_1 = -2.417 \text{ A}$

$I_2 = 3.56 \text{ A}$
(5) You are given the circuit of Figure 5. Use nodal analysis to find the current $I$ as indicated.

\[ \frac{V_2 - 40}{30} + \frac{V_2}{40} + \frac{V_1}{20} = 5 \]

\[ 4V_2 - 160 + 3V_2 + 6V_1 = 60 \]

\[ 6V_1 + 7V_2 = 760 \]

**Super Mesh**

\[ \frac{V_2 - 40}{30} + \frac{V_2}{40} + \frac{V_1}{20} = 5 \]

Constraint:

\[ V_2 - 10 - V_1 = 0 \]

\[ -V_1 + V_2 = 10 \]

\[ \begin{bmatrix} 6 & 7 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 760 \\ 10 \end{bmatrix} \]

\[ V_1 = 53.08 \text{V} \]

\[ V_2 = 63.08 \text{V} \]

\[ I = \frac{V_1}{20} = \frac{53.08}{20} = 2.654 \text{A} \]