Solutions HW1

1.18, 1.24, 2.13, 2.16, 2.20, 2.25, 2.26

1.18 device 1)

\[ P_1 = 1V \times (5A)(-24V) = 120W = P_1 \] supplier

1.18 device 2)

\[ P_2 = 1V \times (5A)(6V) = 30W = P_2 \] recipient

1.18 device 3)

\[ P_3 = 1V \times (1A)(8V) = 8W = P_3 \] recipient

1.18 device 4)

\[ P_4 = 1V \times (4A)(12V) = 48W = P_4 \] recipient

1.18 device 5)

\[ P_5 = 1V \times (2A)(-4V) = -8W = P_5 \] supplier

1.18 device 6)

\[ P_6 = 1V \times (3A)(10V) = 30W = P_6 \] recipient

1.18 device 7)

\[ P_7 = 1V \times (2A)(6V) = 12W = P_7 \] recipient

\[ \Sigma P = 0 \]

\[-120W + 30W + 8W + 48W - 8W + 30W + 12W = 0 \]
\( P(x) = I(x) \cdot V(x) \)

\[
\begin{align*}
E &= \int_0^2 p(x) \, dx \\
&= \int_0^1 I(x) \cdot v(x) \, dx + \int_1^2 I(x) \cdot v(x) \, dx \\
&= 2 \int_0^1 I(x) \cdot v(x) \, dx \\
&= 2 \int_0^1 10 \, dx \\
&= 2(50) \int_0^1 x^2 \, dx \\
&= 100 \left. \frac{x^3}{3} \right|_0^1 = 100 \left( \frac{1}{3} - \frac{0}{3} \right) \\
E &= \frac{100}{3} J = 33.33 = E
\end{align*}
\]

\( V_o = I R = (OA)(2 \Omega) = 0 \text{V} \)

1) because \( V_o = 0 \text{V} \), this can be considered one node
or

2) because \( I_o = OA \), this can be considered an open circuit.

\( R_{\text{tot}} = 3 \Omega + \frac{1}{2} \Omega + \frac{1}{2} \Omega \)

\( R_{\text{tot}} = 4 \Omega \)

\( I = \frac{V}{R} = \frac{24 \text{V}}{4 \Omega} \)

\( I = 6 \text{A} \)
Loop 1: \( \Sigma V = 0 = 12V + (4A)(1\Omega) + (I_1)(4.5\Omega) = 0 \)
\[-12 + 4 + 4I_1 = 0 \]
\[I_1 = 2A\]

Loop 2: \( \Sigma V = 0 = (-I_1)(9\Omega) + (I_2)(6\Omega) - 1V_1 = 0 \)
\[I_1 = 2A \quad -8 + 6I_2 - 1 = 0 \]
\[I_2 = \frac{3}{2}A\]

Loop 3: \( \Sigma V = 0 = (-I_2)(6\Omega) + (I_3)(8\Omega) + 5V = 0 \)
\[I_2 = \frac{3}{2}A \quad -9 + 8I_3 + 5 = 0 \]
\[I_3 = \frac{1}{2}A\]

Node 1: \( \Sigma I = 0 = I_4 + I_1 - 4A = 0 \)
\[I_1 = 2A \quad I_4 + 2A - 4A = 0 \]
\[I_4 = 2A\]

Node 2: \( \Sigma I = 0 = I_2 + I_1 - 4A = 0 \)
\[I_2 = \frac{3}{2}A\] so the voltage across each of the resistors in the loop is \( V = I_{\text{resistor}}(\frac{3}{2}A)(2\Omega) = 3V \)
This Req is in series with 1Ω

\[ \text{Req} = 4 \Omega + \text{Req}_1 \]
\[ \text{Req}_1 = 3 \Omega \]

This Req is in parallel with 6Ω

\[ \frac{1}{\text{Req}_1} = \frac{1}{3 \Omega} \quad \frac{1}{\text{Req}_2} = \frac{1}{6 \Omega} \]
\[ \text{Req}_2 = 6 \Omega \]

This Req is in series with 5Ω

\[ \text{Req}_2 = 6 \Omega + \text{Req}_3 \]
\[ \text{Req}_3 = 1 \Omega \]

R is in parallel with 2.5Ω to give Req = 1Ω

\[ \frac{1}{\text{Req}} = \frac{1}{1 \Omega} = \frac{1}{2.5 \Omega} + \frac{1}{R} \]
\[ R = 2.5 \Omega \]

\[ \frac{1}{\text{Req}} = \frac{1}{12 \Omega} + \frac{1}{\text{Req}_2} \]
\[ \text{Req}_2 = 6 \Omega \]
\[ \text{Req}_1 = 2 \Omega \]

\[ \text{Req}_3 = 4 \Omega \]

\[ V = I R = (18 A)(4 \Omega) \]
\[ V = 72 V \]

\[ I_0 = \frac{V}{R} = \frac{72 V}{12 \Omega} = 6 A \]
\[ I_0 = 6 A \]