1. Given that $V_1 = -9\, \text{V}$, $V_3 = 5\, \text{V}$, $V_4 = -6\, \text{V}$ and $I_2 = -2\, \text{A}$, $I_3 = 5\, \text{A}$, $I_4 = -7\, \text{A}$, find the remaining unknown voltages and currents, and power for each component. Be careful of signs!

2. Given that $V_1 = 1\, \text{V}$, $V_2 = -6\, \text{V}$, $V_3 = 7\, \text{V}$, $V_4 = -2\, \text{V}$, and $R = 10\, \Omega$, determine $V_{AB}$, $V_{BC}$, and $I$. $V_{AB}$ is "Voltage from A down to B" = "+" at A, "-" at B.

$V_{AB} = \frac{V_A - V_B}{R}$
3. Consider a PWM waveform with duty cycle = 64%, peak-to-peak voltage = 5V, and frequency = 20kHz.
   a) What is the $V_{\text{rms}}$ of this PWM waveform?
   b) Suppose we know that this PWM can deliver an average power of 0.25W to an unknown resistor. What is the resistance of this unknown resistor?
   c) Suppose we want to generate a sinusoidal waveform that provides the same average power. What should be the amplitude of this sinusoid?
   d) Does the frequency of the sinusoid matter?

\[
\begin{align*}
\text{a)} \quad V_{\text{rms}}^{(\text{PWM})} &= A \sqrt{D \cdot C} \\
V_{\text{rms}} &= (5V) \sqrt{0.64} \\
V_{\text{rms}} &= 4V \\
\text{b)} \quad P_{\text{avg}} &= \frac{V_{\text{rms}}^2}{R} \Rightarrow R = \frac{V_{\text{rms}}^2}{P_{\text{avg}}} = (0.25) \\
R &= 64\,\Omega
\end{align*}
\]

4. Find the $I$-$V$ characteristic of the following circuit. Be careful of the direction of $I$!

\[
\begin{align*}
V_0 &= 40V \\
I_o &= \frac{I_0}{V_0} \\
\text{Slope} &= \frac{V_o}{I_o} \\
V_{\text{intercept}}: \quad V = V_0 \\
I = 0 \\
V_{\text{y-intercept}}: \quad V = 0 \\
I = I_o \\
\text{Current between terminals when shorted with a wire.}
\end{align*}
\]

5. Compute the power of each of the following elements.

\[
\begin{align*}
8V & \quad 4\Omega & \quad 2A \\
8V & \quad -3A & \quad 8V
\end{align*}
\]

\[
\begin{align*}
P_R &= \frac{V^2}{R} = \frac{(8)^2}{4} \\
P_R &= 16W \\
P_I &= -IV = -(3)(8) \\
P_I &= 24W \\
P_V = PV = 8 \times 4 = 32W
\end{align*}
\]

\[
\begin{align*}
P &\text{Method 1:} \\
\text{Source Via KCL} \\
I + 2A &= -3A \\
I &= -5A \\
P &= IV = -5 \times -40 = +200W
\end{align*}
\]

\[
\begin{align*}
P &\text{Method 2:} \\
\Sigma P &= 0 \\
P_V + P_I + P_R &= 0 \\
P_V = -9 - 40 = -49W \\
P_V &= -49W
\end{align*}
\]