NOTE: Answer any 2 of the following 3 questions.

Problem #1
Find the current I in the circuit illustrated below:

\[ I = I_2 + I_d + I_3 \]
\[ I = 1 + 1.5 + 0.5 = 3A \]
Problem #2
Find the output voltage \( V \) in the circuit illustrated below:

Large signal: \( V_s = 20V \)
\[
\begin{align*}
\mathcal{V} &= I_d (5 \Omega), \quad \mathcal{V} + V_d = 20 \\
I_d (5 \Omega) + V_d &= 20 \\
I_d &= 4A - \frac{V_d}{5 \Omega}
\end{align*}
\]

Cross at \( I_d = 2A, \ V_d = 10V \)
so \( \mathcal{V} = 20 - 10 = 10V \)

Small signal: Nonlin has slope \( \frac{1A}{2V} = \frac{1}{0.5 \Omega} = \frac{1}{R_{nl}} \)
\[
\mathcal{V} = \frac{5 \Omega}{0.5 \Omega + 5 \Omega} \left[ 0.55 \sin \omega t \right]
\]
\[
\mathcal{V} = \mathcal{V} + \tilde{\mathcal{V}} = 10V + 0.5V \sin \omega t
\]

Assume that \( V_s = 20V + 0.55V \sin \omega t \) and that the \( I_d-V_d \) characteristic of the nonlinear resistor is as shown below.
Problem #3
Find an analytic expression for the $V-I$ relationship for the circuit illustrated below:

\[ V_{oc} = I_{sc} R_{TH} = (2A)(4.5\Omega) = 8V \]

\[ R_{TH} = 8.5\Omega \]

\[ V_{oc} = 0V \]

\[ R_{TH} = 8.5\Omega / 8.5\Omega = 4.5\Omega \]

\[ V_{oc} = I_{sc} R_{TH} = (1A)(4.5\Omega) = 4V \]

\[ V = 2V + I(6\Omega) \]