NOTE: Answer any 2 of the following 3 questions.

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

\[ I = I_2 + I_d + I_3 \]

\[ I = 1 + 1.5 + 0.5 = 3\, \text{A} \]

\[ I = 3\, \text{A} \]
Problem #2
Find the output voltage $V$ in the circuit illustrated below:

**Large signal:** $V_s = 20V$

$\sqrt{V} = I_d(5.5\Omega)$, $\sqrt{V} + V_d = 20$

$I_d(5.5\Omega) + V_d = 20$

$I_d = 4A - \frac{V_d}{5.5\Omega}$ => see graph

Cross at $I_d = 2A$, $V_d = 10V$

So $V = 20 - 10 = 10V$

**Small signal:** Nonlinear has slope $\frac{4A}{2V} = \frac{1}{0.5\Omega} = \frac{1}{R_{NL}}$

$\frac{V}{0.5\Omega + 5.5\Omega} = 0.5Vs(\omega t)$

$V = \sqrt{V} + \tilde{V} = 10V + 0.5V\sin(\omega t)$

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:

Use Norton / Thevenin Equivalents

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

$R_{TH} = 8V / 8\Omega = 1\Omega$

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

$V = 2V + I(6.5\Omega)$