HW #13 (for Quiz 3 on Jan 29)

1. Prob. 3.3
2. Prob. 3.7
3. Prob. 3.11
4. Prob. 3.20
5. Prob. 3.26
6. Prob. 3.32
7. Prob. 3.43

A Diode Circuit

\[
V_i = 5V \\
V_o = 0 \\
I_p = \frac{1}{e^{(V_i/0.7)} - 1} \\
V_{sat} = 0.7V
\]

\[
V_o = 5V \\
V_i = 0.5V \\
I_p = \frac{0.5V}{100} = 0.005A = 5mA
\]

Rectified!

KVL

\[-10 + 2I + 3xI = 0 \]

\[10 = 5I, \quad I = \frac{10}{5} = 2A\]

Prob. 2.22, find Ix

For \( x < 0 \)

\[
V_{x-1} = \frac{15}{2x} \quad \frac{2x}{15} \quad \frac{2x}{3x} = \frac{4V}{6V} = \frac{2}{3}
\]

\[
x = 1, \quad \frac{x}{x+1} = 1
\]

\[
x = 2, \quad \frac{x}{x+1} = \frac{2}{3}
\]

\[
x = 3, \quad \frac{x}{x+1} = \frac{3}{5}
\]

\[
x = 4, \quad \frac{x}{x+1} = \frac{4}{7}
\]

\[
x = 5, \quad \frac{x}{x+1} = \frac{5}{8}
\]

\[
x = 6, \quad \frac{x}{x+1} = \frac{6}{9} = \frac{2}{3}
\]

\[
x = 7, \quad \frac{x}{x+1} = \frac{7}{10} = \frac{7}{10} = 0.469A
\]

For \( x > 0 \)

\[
x = -1, \quad \frac{x}{x+1} = -1
\]

\[
x = 1, \quad \frac{x}{x+1} = \frac{1}{2}
\]

\[
x = 2, \quad \frac{x}{x+1} = \frac{2}{3}
\]
Prob. 2.67

**Right side mesh:**
\[ V_{RL} - 6 + 33I_1 + 0.7 = 0 \]
\[ I_1 = \frac{6 - 0.7}{33} = 0.1 A \]

**Left side mesh:**
\[ V_{RL} = 0 \] (Note: diode is off)
\[ I_1 = 0 \]

⇒ Open circuit with 0 current.

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Prob. 2.70

Continued on Nodal Analysis, Loop/Mesh Analysis (HW3 PP 115-116)

Prob. 2.79

If \( V_{0b} = 9 \), what is \( A^2 \)?

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Prob. 2.94

There can be a few different approaches to finding \( i \).

(Method 1) Throwing again exist for the left side of triode \( a + b \).

Open circuit voltage \( V_{oc} = ? \)

\[ V_{oc} = \frac{V_9}{3} = \frac{6}{3} = 2 \]

Nodal Analysis (\( V_9 = V_{oc} \))
\[ k_1 = 0 \]
\[ 3 + V_9 = 12 \]
\[ k_1 = 3 + V_9 = 12 \ (1) \]
\[ V = 3 + \frac{V_i}{2} + \frac{V_i - V_0}{10} \quad (1) \]

\[ V_{10} = 50 = 30 + 5V_i + V_i - V_0 \Rightarrow 6V_i - V_0 = 20 \quad (2) \]

\[ \frac{V_i - V_0}{10} = \frac{V_0}{12} \]

\[ \Rightarrow \quad V_{10} = 180 + 5V_i - 6V_i = 5V_i - 6V_i + 108 \]

\[ \Rightarrow \quad V_{10} = \frac{20V}{2} \]

Thus far, we have found \[ V_{OC} = 20 = \frac{20}{2} \]

\[ I_{OC} = \frac{10}{3} = \frac{10}{6+4} = 2 \]

Method 2: (By Source Transformation)

\[ I = \frac{20}{2} \]

\[ V = 20 \]

\[ I = 2 \]

\[ I = \frac{20}{2} = 10 \]

By Current Division \[ I = \frac{20}{2} = \frac{10}{2+1} \]

Figure P2.46: Circuit for Problem 2.46.

Let's solve this part by first finding the Norton's equivalent circuit for a-b pair (terminal).

Figure P2.46: Circuit for Problem 2.46.

Analysis:

\[ V_{OC} = 20 \quad (1) \]

\[ I_{OC} = \frac{10}{3} \quad (2) \]

\[ \frac{V_i - V_0}{10} = \frac{V_0}{12} \quad (3) \]
\[
\begin{align*}
C(1) & \quad 2V_1 - V_2 = -4 \\
C(2) & \quad -3V_1 + 2V_2 - 4V_3 = 126 \\
C(3) & \quad V_2 - 2V_3 = 20
\end{align*}
\]

\[3 \times (1) + 2 \times (2) \Rightarrow
\begin{align*}
6V_1 - 3V_2 &= -12 \\
-6V_1 + 18V_2 - 12V_3 &= 312 \\
15V_2 - 12V_3 &= 320
\end{align*}
\]

From (2)', \[V_2 = 20 \text{ V} \]

From (1)', \[V_1 = 8 \text{ V} \]

From (3), \[V_3 = 0 \text{ V} \]