1. Find the value of the voltage source $V_S$ such that the 9V source neither absorbs nor dissipates power. If the 9V source neither absorbs nor supplies power, $P=0$, and thus its current must be zero! By Ohm's law, we know the 10Ω resistor must then have no voltage drop. Thus, $a = 9V$.

2. Obtain the Thevenin and Norton Equivalents for the following circuit. That is, find $V_T$, $I_N$, and $R_T$.

- **Finding $Voc$**
  - Want to find node voltage b.
  - First, let's find a.
  - KCL @ node a
    \[ I_1 + I_3 = I_2 \]
    \[ \frac{s-a}{25} + \frac{a}{25} = \frac{b-a}{25} \]
    \[ a = 15V \rightarrow I_3 = 1 = \frac{b-a}{10} \]
    \[ I_2 = b = V_{oc} = 25V \]

- **Finding $Isc$**
  - KCL @ node b
    \[ I = 0 \]
    \[ l = I_3 + Isc \]
    \[ I = 1 - I_3 - Isc \]
    \[ Isc = 1 - \frac{l}{I_3} \]
    \[ Isc = 1 - \frac{10}{a} \]
    \[ Isc = \frac{10}{a} \]

- **Finding $Reff$**
  - Source Suppression
    \[ Reff = (25125) \]
    \[ Reff = 22.5\Omega \]

3. Find the labeled current, $I_o$, in the following circuit.

- **Finding node a**
  - will make finding $I_0$ trivial.
  - We will place a supernode around the 2V source because it is a floating source!
  - KCL @ Supernode
    \[ I_0 + I_1 + I_2 + I_3 = 0 \]
    \[ \frac{a + a + 2}{2} + \frac{(a+2) - 6}{4} + \frac{a - 6}{8} = 0 \rightarrow 4a + 4a + 8 + 2a - 8 + a - 6 = 0 \]
    \[ 11a = 6 \rightarrow a = \frac{6}{11} \]
4. In the following circuit, \( V_S = 5 \text{V} \) and the \( V_{ON} \) for the diodes is 2V. Determine how many diodes are on.

Only one right diode is on because the middle branch needs 2 \( V_{ON} = 4 \text{V} \), while the right branch restricts the shared parallel voltage to 2V.

Furthermore, the left branch's diodes cannot be on since they point in opposite directions.

5. In the following circuit, \( V_{clip} = -3 \text{V} \) and the \( V_{ON} \) for the diodes is 1.5V. Determine the minimum and maximum values of the output voltage, \( V_{out} \), and sketch the output waveform.

\[ V_{out} = \begin{cases} 
6 \text{V}, & \text{if left branch ON} \\
-2.1 \text{V}, & \text{if right branch ON} \\
10 \sin(\omega t), & \text{in neither branch ON} 
\end{cases} \]

\[ V_{max} = 6 \text{V}, \quad V_{min} = -4.5 \text{V} \]

6. For the following circuit, \( V_{BE,ON} = 0.4 \text{V} \), \( V_{CE,SAT} = 0.2 \text{V} \), \( R_B = 20 \text{k\Omega} \), \( R_C = 2 \text{k\Omega} \) and \( \beta = 100 \). Find \( V_{CE} \) for the following input voltages.

a. \( V_{in} = 0.3 \text{V} \)
b. \( V_{in} = 1.0 \text{V} \)
c. \( V_{in} = 1.4 \text{V} \)
d. What is the smallest value of \( V_{in} \) that puts the transistor into saturation?

\[ V_{CE} = R_C \cdot I_C \]

\[ I_C = \beta \cdot I_B = \frac{3 \text{mA}}{\beta} = 3 \text{mA} \]

\[ V_{CE} = V_{CC} - I_C \cdot R_C = 4 \text{V} \]

\[ V_{CE} = 4 \text{V} \]

\[ V_{CE} < V_{CE,SAT} \] must be in saturation \( \Rightarrow V_{CE} = 0.2 \text{V} \)

\[ V_{in} = 1.38 \text{V} \]