The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. At what times does $V_o = 147$ mV?

(Resistances in kΩ. Voltages in V. Current in mA)

Output is a falling exponential

Time constant: $\tau = 140.2$ ms

At time $\Delta t$ after $t = 49$.

$147 = 443 e^{-\Delta t / \tau}$

$\frac{147}{443} = e^{-\Delta t / \tau}$

$\Delta t = -\tau \log \left( \frac{147}{443} \right)$

$t = 49 + 154.7 = 203.7$ ms
\( V_i \) is a sinusoidal waveform with frequency \( \omega = 2\pi f \).

- Calculate a (simplified) expression for \( H(\omega) = \frac{V_o}{V_i} \)
- What is \( H(\omega) \) when \( \omega \to 0 \) (very low frequency)?
- What is \( H(\omega) \) when \( \omega \to \infty \) (HF)?

\[
\begin{align*}
\frac{H(\omega)}{V_i} &= \frac{2.5 + \frac{1}{j\omega 56.1}}{1.2 + \frac{1}{j\omega 47.1} + 2.5 + \frac{1}{j\omega 56.1}} \\
H(\omega) &= 2.5 + \frac{0.0178}{3.7 + \frac{0.0391}{j\omega}} \\
H(\omega) &= 0.6757 \frac{1 + \frac{1}{j\omega 22.47}}{1 + \frac{1}{j\omega 6.91}}
\end{align*}
\]

- What is \( H(\omega) \) when \( \omega = 0 \) (DC)? Answer = 0.6757
- What is \( H(\omega) \) when \( \omega \to \infty \) (HF)? Answer = 0.21
In the circuit above, $V_1$ is 4.6 V, and $V_2$ is 2.9 V.

- What is the value of $V_0$?
- How much current flows out of $V_1$?

(Resistances in kΩ. Voltages in V. Current in mA)

**Loop 1:**

- $4.6 - i_1 3.6 + 2.9 - (i_1 + i_2) 2.5 = 0$.
- $7.5 = i_1 6.1 + i_2 2.5$
- $i_1 = \frac{7.5 - i_2 2.5}{6.1} = 1.23 - i_2 0.41$

**Loop 2:**

- $2.9 - (i_1 + i_2) 2.5 - i_2 39.7 - i_2 47.1 = 0$.
- $2.9 = i_1 2.5 + i_2 89.3$
- $2.9 = 3.08 - i_2 1.02 + i_2 89.30 = 3.08 + i_2 88.28$
- $-0.18 = i_2 88.28$
- $i_2 = -0.0020$
- $V_o = -i_2 39.7 = 0.0794$ (What is the value of $V_o$?)
- $i_1 = 1.23 - i_2 0.41 = 1.23082$
- $i_1 + i_2 = 1.22882$ (How much current flows out of $V_1$?)