The circuit above is exposed to the input voltage \( V_i \) as shown. Sketch the output, \( V_o \). At what times does \( V_o = 190 \text{ mV} \)?

(Resistances in k\( \Omega \). Voltages in V. Current in mA)

Output is a rising exponential

Time constant: \( \tau = 75.7 \text{ ms} \)

At time \( \Delta t \) after \( t = 49 \).

\[
190 = 525(1 - \exp(-\Delta t/\tau)) \\
\frac{190}{525} = 1 - \exp(-\Delta t/\tau) \\
1 - \frac{190}{525} = \exp(-\Delta t/\tau) \\
\Delta t = -\tau \log \left(1 - \frac{190}{525}\right) \\
t = 49 + 34.0 = 83 \text{ ms}
\]
$V_i$ 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)?

- Calculate a (simplified) expression for $H(\omega) = \frac{V_o}{V_i}$

  $H(\omega) = \frac{2.2 + \frac{1}{j\omega34.4}}{1.4 + \frac{1}{j\omega51.3} + 2.2 + \frac{1}{j\omega34.4}}$

  $H(\omega) = \frac{2.2 + 0.0291}{3.6 + 0.0486}$

  $H(\omega) = 0.6111 \frac{1 + \frac{1}{j\omega5.72}}{1 + \frac{1}{j\omega15.62}}$

- What is $H(\omega)$ when $\omega = 0$ (DC)? Answer = 0.6111

- What is $H(\omega)$ when $\omega \to \infty$ (HF)? Answer = 0.22
In the circuit above, $V_1$ is 4.0 V, and $V_2$ is 3.8 V.

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

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

Loop 1:
- $4.0 - i_1 1.4 + 3.8 - (i_1 + i_2) 2.2 = 0$.
- $7.8 = i_1 3.6 + i_2 2.2$
- $i_1 = \frac{7.8 - i_2 2.2}{3.6} = 2.17 - i_2 0.61$

Loop 2:
- $3.8 - (i_1 + i_2) 2.2 - i_2 39.6 - i_2 51.3 = 0$.
- $3.8 = i_1 2.2 + i_2 93.1$
- $3.8 = 4.77 - i_2 1.34 + i_2 93.10 = 4.77 + i_2 91.76$
- $-0.97 = i_2 91.76$
- $i_2 = -0.0106$
- $V_o = -i_2 39.6 = 0.41976$ (What is the value of $V_o$?)
- $i_1 = 2.17 - i_2 0.61 = 2.176466$  
- $i_1 + i_2 = 2.165866$ (How much current flows out of $V_1$?)