The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. At what times does $V_o = 113 \text{ mV}$?

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

Output is a rising exponential

Time constant: $\tau = 124.5 \text{ ms}$

At time $\Delta t$ after $t = 92$.

$113 = 271(1 - e^{\frac{-t}{\tau}})$

$\frac{113}{271} = 1 - e^{\frac{-92}{\tau}}$

$1 - \frac{113}{271} = e^{\frac{-92}{\tau}}$

$\Delta t = -\tau \log \left(1 - \frac{113}{271}\right)$

$t = 92 + 67.2 = 159.2 \text{ ms}$
$V_i$ 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 $H(\omega) = \frac{V_o}{V_i}$

$$H(\omega) = \frac{3.0 + \frac{1}{j\omega 41.5}}{1.7 + \frac{1}{j\omega 38.6} + 3.0 + \frac{1}{j\omega 41.5}}$$

$$H(\omega) = \frac{3.0 + 0.0241}{4.7 + 0.0500}$$

$$H(\omega) = 0.6383 \frac{1 + \frac{1}{j\omega 13.83}}{1 + \frac{1}{j\omega 4.26}}$$

- What is $H(\omega)$ when $\omega = 0$ (DC)? Answer = 0.6383
- What is $H(\omega)$ when $\omega \to \infty$ (HF)? Answer = 0.20
In the circuit above, $V_1$ is 6.4 V, and $V_2$ is 3.2 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:
- $6.4 - i_1 \cdot 2.2 + 3.2 - (i_1 + i_2) \cdot 3.0 = 0$.
- $9.6 = i_1 \cdot 5.2 + i_2 \cdot 3.0$
- $i_1 = \frac{9.6 - i_2 \cdot 3.0}{5.2} = 1.85 - i_2 \cdot 0.58$

Loop 2:
- $3.2 - (i_1 + i_2) \cdot 3.0 - i_2 \cdot 50.6 - i_2 \cdot 38.6 = 0$.
- $3.2 = i_1 \cdot 3.0 + i_2 \cdot 92.2$
- $3.2 = 5.55 - i_2 \cdot 1.74 + i_2 \cdot 92.20 = 5.55 + i_2 \cdot 90.46$
- $-2.35 = i_2 \cdot 90.46$
- $i_2 = -0.0260$
- $V_o = -i_2 \cdot 50.6 = 1.3156$ (What is the value of $V_o$?)
- $i_1 = 1.85 - i_2 \cdot 0.58 = 1.86508$
- $i_1 + i_2 = 1.83908$ (How much current flows out of $V_1$?)