The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. At what times does $V_o = 92$ mV?

Output is a falling exponential

Time constant: $\tau = 163.9$ ms

At time $\Delta t$ after $t = 104$.

$$92 = 174 \exp(-\Delta t/\tau)$$

$$\frac{92}{174} = \exp(-\Delta t/\tau)$$

$$\Delta t = -\tau \log \left( \frac{92}{174} \right)$$

$$t = 104 + 104.4 = 208.4$$ 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 $H(\omega) = \frac{V_o}{V_i}$

$$H(\omega) = \frac{3.7 + \frac{1}{j\omega 44.3}}{2.4 + \frac{1}{j\omega 33.7} + 3.7 + \frac{1}{j\omega 44.3}}$$

$$H(\omega) = \frac{3.7 + \frac{0.0226}{j\omega}}{6.1 + \frac{0.0622}{j\omega}}$$

$$H(\omega) = \frac{0.6066 + \frac{1}{j\omega 11.96}}{1 + \frac{1}{j\omega 3.14}}$$

- What is $H(\omega)$ when $\omega = 0$ (DC)? Answer = 0.6066
- What is $H(\omega)$ when $\omega \to \infty$ (HF)? Answer = 0.16
In the circuit above, $V_1$ is 1.2 V, and $V_2$ is 1.5 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:

• $1.2 - i_1 2.4 + 1.5 - (i_1 + i_2) 3.7 = 0$.

• $2.7 = i_1 6.1 + i_2 3.7$

• $i_1 = \frac{2.7 - i_2 3.7}{6.1} = 0.44 - i_2 0.61$

Loop 2:

• $1.5 - (i_1 + i_2) 3.7 - i_2 53.4 - i_2 33.7 = 0$.

• $1.5 = i_1 3.7 + i_2 90.8$

• $1.5 = 1.63 - i_2 2.26 + i_2 90.80 = 1.63 + i_2 88.54$

• $-0.13 = i_2 88.54$

• $i_2 = -0.0015$

• $V_o = -i_2 53.4 = 0.0801$ (What is the value of $V_o$?)

• $i_1 = 0.44 - i_2 0.61 = 0.440915$

• $i_1 + i_2 = 0.439415$ (How much current flows out of $V_1$?)