The circuit above is exposed to the an input voltage $V_i$ as shown. Sketch the output, $V_o$. At what times does $V_o = 322$ mV?

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

Output is a rising exponential

Time constant: $\tau = 123.5$ ms

At time $\Delta t$ after $t = 123$.

$$322 = 455(1 - \exp(-\Delta t/\tau))$$

$$\frac{322}{455} = 1 - \exp(-\Delta t/\tau)$$

$$1 - \frac{322}{455} = \exp(-\Delta t/\tau)$$

$$\Delta t = -\tau \log \left(1 - \frac{322}{455}\right)$$

$$t = 123 + 151.9 = 274.9$$ 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 $H(\omega) = \frac{V_o}{V_i}$

$$H(\omega) = \frac{3.2 + \frac{1}{j\omega 38.6}}{3.4 + \frac{1}{j\omega 47.8} + 3.2 + \frac{1}{j\omega 38.6}}$$

$$H(\omega) = \frac{3.2 + 0.0259}{6.6 + 0.0468}$$

$$H(\omega) = 0.4848 \frac{1 + \frac{1}{j\omega 12.07}}{1 + \frac{1}{j\omega 3.24}}$$

- What is $H(\omega)$ when $\omega = 0$ (DC)? Answer = 0.4848
- What is $H(\omega)$ when $\omega \to \infty$ (HF)? Answer = 0.13
In the circuit above, $V_1$ is 5.9 V, and $V_2$ is 4.0 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:
- $5.9 - i_1 1.9 + 4.0 - (i_1 + i_2)3.2 = 0$.
- $9.9 = i_1 5.1 + i_2 3.2$
- $i_1 = \frac{9.9 - 9.32}{5.1} = 1.94 - i_2 0.63$

Loop 2:
- $4.0 - (i_1 + i_2)3.2 - i_2 58.2 - i_2 47.8 = 0$.
- $4.0 = i_1 3.2 + i_2 109.2$
- $4.0 = 6.21 - i_2 2.02 + i_2 109.2 = 6.21 + i_2 107.18$
- $-2.21 = i_2 107.18$
- $i_2 = -0.0206$
- $V_o = -i_2 58.2 = 1.19892$ (What is the value of $V_o$?)
- $i_1 = 1.94 - i_2 0.63 = 1.952978$
- $i_1 + i_2 = 1.932378$ (How much current flows out of $V_1$?)