The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. At what times does $V_o = 102$ mV?

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

Output is a rising exponential

Time constant: $\tau = 171.2$ ms

At time $\Delta t$ after $t = 35$.

\[
102 = 142(1 - exp(-\Delta t/\tau))
\]

\[
\frac{102}{142} = 1 - exp(-\Delta t/\tau)
\]

\[
1 - \frac{102}{142} = exp(-\Delta t/\tau)
\]

\[
\Delta t = -\tau \log \left(1 - \frac{102}{142}\right)
\]

\[
t = 35 + 216.9 = 251.9 \text{ ms}
\]
$V_i$ 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)?

\[
H(\omega) = \frac{3.2 + \frac{1}{j\omega53.5}}{3.5 + \frac{1}{j\omega32.1} + 3.2 + \frac{1}{j\omega3.5}}
\]

\[
H(\omega) = 3.2 + 0.0187
\]

\[
H(\omega) = 6.7 + 0.0498
\]

\[
H(\omega) = 0.4776 \frac{1 + \frac{1}{j\omega16.71}}{1 + \frac{1}{j\omega3.00}}
\]

- What is $H(\omega)$ when $\omega = 0$ (DC)? Answer = 0.4776
- What is $H(\omega)$ when $\omega \to \infty$ (HF)? Answer = 0.09
In the circuit above, $V_1$ is 4.3 V, and $V_2$ is 7.0 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:
- $4.3 - i_1 3.3 + 7.0 - (i_1 + i_2) 3.2 = 0$.
- $11.3 = i_1 6.5 + i_2 3.2$
- $i_1 = \frac{11.3 - i_2 3.2}{6.5} = 1.74 - i_2 0.49$

Loop 2:
- $7.0 - (i_1 + i_2) 3.2 - i_2 36.4 - i_2 32.1 = 0$.
- $7.0 = i_1 3.2 + i_2 71.7$
- $7.0 = 5.57 - i_2 1.57 + i_2 71.70 = 5.57 + i_2 70.13$
- $1.43 = i_2 70.13$
- $i_2 = 0.0204$
- $V_o = -i_2 36.4 = -0.74256$ (What is the value of $V_o$?)
- $i_1 = 1.74 - i_2 0.49 = 1.73004$
- $i_1 + i_2 = 1.750404$ (How much current flows out of $V_1$?)