The op-amp is ideal, with \( V_{CC} = 10 \text{ V} \) and \( V_{EE} = -10 \text{ V} \).

\[
\begin{align*}
V_{i}(V) & \quad 0.63 \\
& \quad 0.17 \\
& \quad 1.3 \quad 3.8 \quad \text{ms}
\end{align*}
\]

- Sketch the input \( V_{+} \) as a function of the voltage input \( V_{i} \).
- Sketch the output \( V_{o} \) as a function of the voltage input \( V_{i} \). (label times and voltages)
- What is \( V_{o} \) at \( t = 3.8 \text{ ms} \)?

All voltages in V

- Sketch the input \( V_{+} \) as a function of the voltage input \( V_{i} \).
  
  Waveform at \( V_{+} \) is an decreasing exponential, starting at \( V_{+} = 0.63 - 0.17 = 0.46 \)
  \( \Delta t = 3.8 - 1.3 = 2.5 \)
  \( \tau = RC = 38.8 \times 29.6 = 1148.48 \mu\text{s} = 1.15 \text{ ms} \)
  \( V_{+}(3.8) = 0.46e^{-\Delta t/\tau} = 0.0523 \)

- Sketch the output \( V_{o} \) as a function of the voltage input \( V_{i} \). (label times and voltages)
  
  From \( V_{+} \) to \( V_{o} \) is a non-inverting amplifier of gain, \( G = 1 + 47/38 = 2.24 \)
  
  Waveform at \( V_{o} \) is an decreasing exponential, starting at \( V_{+} = 2.24 \times 0.46 = 1.03 \)

- What is \( V_{o} \) at \( t = 3.8 \text{ ms} \)?
  
  \( V_{+}(3.8) = 1.03e^{-\Delta t/\tau} = 0.117 \)
The op-amp is ideal, with $V_{CC} = 10$ V and $V_{EE} = -10$ V.

Sketch the input $V_+$ as a function of the voltage input $V_i$.

Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)

What is $V_o$ at $t = 3.5$ ms?

All voltages in mV

Sketch the input $V_+$ as a function of the voltage input $V_i$.

$V_+ = [3.5/(3.5 + 38.8)] V_o = 0.083 V_o$

Thus, output goes from $V_+ = 0.083 \times 21.29 = 1.77$ to $V_+ = 0.083 \times 61.28 = 5.09$

Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)

Gain, $G = G = 1 + (1900 \parallel 1900)/29 = 33.76$

Thus, output goes from $V_o = 0.083 \times 21.29 \times G = 59.7$ to $V_o = 0.083 \times 61.28 \times G = 171.7$

What is $V_o$ at $t = 3.5$ ms?

$V_o = 0.083 \times 61.28 \times G = 171.7$
The op-amp is ideal, with $V_{CC} = 15\, \text{V}$ and $V_{EE} = -15\, \text{V}$.
Input $V_A = -5\, \text{mV}$ (constant over time).

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
- What is $V_o$ at $t = 3.5\, \text{ms}$?

All voltages in mV

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  This is an added circuit

  $$V_o = - \left( \frac{1200}{5.8} V_A + \frac{1200}{38} V_B \right) = -(206.9V_A + 31.6V_B)$$

Thus, the output goes from
$V_o = -[206.9(-5) + 31.6(19)] = 434 = 0.43\, \text{V}$ to $V_o = -[206.9(-5) + 31.6(25)] = 244 = 0.24\, \text{V}$

**Test:** Is $V_o \geq V_{CC}$ or $V_o \leq V_{EE}$?

- What is $V_o$ at $t = 3.5\, \text{ms}$?
  $V_o = -(206.9(-5) + 31.6(25)) = 244 = 0.24\, \text{V}$