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 $t = 4.2\, ms$?

**All voltages in V**

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  
  Waveform at $V_+$ is a decreasing exponential, starting at $V_+ = 0.64 - 0.26 = 0.38$  
  $\Delta t = 4.2 - 1.9 = 2.3$  
  $\tau = RC = 20.1 \times 34.4 = 691.44\, \mu s = 0.69\, ms$  
  $V_+(4.2) = 0.38e^{-\Delta t/\tau} = 0.0136$

- 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, $G = 1 + 42/34 = 2.24$  
  Waveform at $V_o$ is a decreasing exponential, starting at $V_+ = 2.24 \times 0.38 = 0.85$

- What is $V_o$ at $t = 4.2\, ms$?  
  $V_+(4.2) = 0.85e^{-\Delta t/\tau} = 0.030$
The op-amp is ideal, with $V_{CC} = 10\, \text{V}$ and $V_{EE} = -10\, \text{V}$.

![Op-amp circuit diagram]

- 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 $t = 3.9\, \text{ms}$?

All voltages in mV

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  $V_+$ is the voltage-divider output from $V_i$.
  \[ V_+ = \left[\frac{3.2}{3.2 + 20.1}\right] V_o = 0.137 V_o \]
  Thus, output goes from $V_+ = 0.137 \times 21.42 = 2.93$ to $V_+ = 0.137 \times 63.49 = 8.70$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  Gain, $G = G = 1 + (1700||170) / 33 = 26.76$
  Thus, output goes from $V_o = 0.137 \times 21.42 \times G = 78.5$ to $V_o = 0.137 \times 63.49 \times G = 232.8$

- What is $V_o$ at $t = 3.9\, \text{ms}$?
  $V_o = 0.137 \times 63.49 \times G = 232.8$
The op-amp is ideal, with \( V_{CC} = 15 \text{ V} \) and \( V_{EE} = -15 \text{ V} \).
Input \( V_A = -11 \text{ mV} \) (constant over time).

\[ V_B (\text{mV}) \]

\[ \begin{array}{c|c}
1.3 & 28 \\
4.1 & 26 \\
\end{array} \]

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

- What is \( V_o \) at \( t = 3.9 \text{ ms} \)?

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

\[
V_o = - \left( \frac{1100}{3.0} V_A + \frac{1100}{34} V_B \right) = -(366.7V_A + 32.4V_B)
\]

Thus, the output goes from
\[
V_o = -[366.7(-11) + 32.4(28)] = 3126 = 3.13 \text{ V}
\]
\[
V_o = -[366.7(-11) + 32.4(26)] = 3191 = 3.19 \text{ V}
\]

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

- What is \( V_o \) at \( t = 3.9 \text{ ms} \)?

\[
V_o = -(366.7(-11) + 32.4(26)) = 3191 = 3.19 \text{ V}
\]