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

- 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 $t = 3.5\, \text{ms}$?

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 $V_+ = 0.73 - 0.14 = 0.59$
  
  $\Delta t = 3.5 - 1.4 = 2.1$
  
  $\tau = RC = 27.3 \times 22.1 = 603.33\, \mu\text{s} = 0.60\, \text{ms}$
  
  $V_+(3.5) = 0.59e^{-\Delta t/\tau} = 0.0178$

- 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, $G = 1 + 55/27 = 3.04$
  
  Waveform at $V_o$ is an decreasing exponential, starting at $V_+ = 3.04 \times 0.59 = 1.79$

- What is $V_o$ at $t = 3.5\, \text{ms}$?
  
  $V_+(3.5) = 1.79e^{-\Delta t/\tau} = 0.054$
The op-amp is ideal, with \( V_{CC} = 10 \, \text{V} \) and \( V_{EE} = -10 \, \text{V} \).

- 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 \( t = 3.2 \, \text{ms} \)?

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All voltages in mV

- Sketch the input \( V_{+} \) as a function of the voltage input \( V_{i} \).
  
  \( V_{+} \) is the voltage-divider output from \( V_{i} \).
  
  \[ V_{+} = \left[ 4.1 / (4.1 + 27.3) \right] V_{o} = 0.131V_{o} \]
  
  Thus, output goes from \( V_{+} = 0.131 \times 22.27 = 2.92 \) to \( V_{+} = 0.131 \times 61.53 = 8.06 \)

- Sketch the output \( V_{o} \) as a function of the voltage input \( V_{i} \) (label times and voltages).
  
  Gain, \( G = 1 + \frac{1400 \parallel 1400}{27} = 26.93 \)
  
  Thus, output goes from \( V_{o} = 0.131 \times 22.27 \times G = 78.6 \) to \( V_{o} = 0.131 \times 61.53 \times G = 217.1 \)

- What is \( V_{o} \) at \( t = 3.2 \, \text{ms} \)?
  
  \( V_{o} = 0.131 \times 61.53 \times G = 217.1 \)
The op-amp is ideal, with $V_{CC} = 15\,\text{V}$ and $V_{EE} = -15\,\text{V}$.
Input $V_A = -6\,\text{mV}$ (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 $t = 3.2\,\text{ms}$?

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

$$V_o = -\left(\frac{1400}{4.1} V_A + \frac{1400}{27} V_B\right) = -(341.5V_A + 51.9V_B)$$

Thus, the output goes from
$V_o = -[341.5(-6) + 51.9(16)] = 1219 = 1.22\,\text{V}$ to
$V_o = -[341.5(-6) + 51.9(35)] = 232 = 0.23\,\text{V}$

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

- What is $V_o$ at $t = 3.2\,\text{ms}$?
  $V_o = -(341.5(-6) + 51.9(35)) = 232 = 0.23\,\text{V}$