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 $t = 4.2\,\text{ms}$?

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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 $V_+ = 0.55 - 0.00 = 0.55$
  
  $\Delta t = 4.2 - 1.3 = 2.9$
  
  $\tau = RC = 25.3 \times 29.4 = 743.82\,\mu\text{s} = 0.74\,\text{ms}$
  
  $V_+(4.2) = 0.55 e^{-\Delta t/\tau} = 0.0109$

- 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, $G = 1 + 72/26 = 3.77$
  
  Waveform at $V_o$ is an decreasing exponential, starting at $V_+ = 3.77 \times 0.55 = 2.07$

- What is $V_o$ at $t = 4.2\,\text{ms}$?
  
  $V_+(4.2) = 2.07 e^{-\Delta t/\tau} = 0.041$
The op-amp is ideal, with $V_{CC} = 10\, V$ and $V_{EE} = -10\, V$.

![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 $t = 3.9\, ms$?

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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 $V_i$.  
  $V_+ = \left[\frac{5.4}{5.4 + 25.3}\right] V_o = 0.176 V_o$  
  Thus, output goes from $V_+ = 0.176 \times 20.54 = 3.62$ to $V_+ = 0.176 \times 61.33 = 10.79$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  Gain, $G = G = 1 + (1300||1300)/20 = 33.50$  
  Thus, output goes from $V_o = 0.176 \times 20.54 \times G = 121.1$ to $V_o = 0.176 \times 61.33 \times G = 361.6$

- What is $V_o$ at $t = 3.9\, ms$?  
  $V_o = 0.176 \times 61.33 \times G = 361.6$
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 $t = 3.9\, \text{ms}$?

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

$$V_o = -\left(\frac{1800}{3.8}V_A + \frac{1800}{26}V_B\right) = -(473.7V_A + 69.2V_B)$$

Thus, the output goes from

- $V_o = -[473.7(-5) + 69.2(2)] = 2230 = 2.23\, \text{V}$ to
- $V_o = -[473.7(-5) + 69.2(17)] = 1192 = 1.19\, \text{V}$

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

- What is $V_o$ at $t = 3.9\, \text{ms}$?

$V_o = -(473.7(-5) + 69.2(17) = 1192 = 1.19\, \text{V}$