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 $t = 4.4$ 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 $V_+ = 0.88 - 0.14 = 0.74$
  
  $\Delta t = 4.4 - 1.7 = 2.7$
  
  $\tau = RC = 23.1 \times 26.4 = 609.84 \mu s = 0.61$ ms
  
  $V_+(4.4) = 0.74e^{-\Delta t/\tau} = 0.0089$

- 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, $G = 1 + 52/36 = 2.44$
  
  Waveform at $V_o$ is an decreasing exponential, starting at $V_+ = 2.44 \times 0.74 = 1.81$

- What is $V_o$ at $t = 4.4$ ms?
  
  $V_+(4.4) = 1.81e^{-\Delta t/\tau} = 0.022$
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 $t = 4\,\text{ms}$?

All voltages in mV

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  $V_+$ is the voltage-divider output from $V_i$.
  
  $V_+ = [3.9/(3.9 + 23.1)] V_o = 0.144 V_o$
  
  Thus, output goes from $V_+ = 0.144 \times 23.76 = 3.42$ to $V_+ = 0.144 \times 62.89 = 9.06$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  Gain, $G = G = 1 + (1800\|1800)/27 = 34.33$
  
  Thus, output goes from $V_o = 0.144 \times 23.76 \times G = 117.5$ to $V_o = 0.144 \times 62.89 \times G = 310.9$

- What is $V_o$ at $t = 4\,\text{ms}$?
  
  $V_o = 0.144 \times 62.89 \times G = 310.9$
The op-amp is ideal, with $V_{CC} = 15\,\text{V}$ and $V_{EE} = -15\,\text{V}$.

Input $V_A = -9\,\text{mV}$ (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 $t = 4\,\text{ms}$?

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

$$V_o = -\left(\frac{1300}{3.5} V_A + \frac{1300}{36} V_B\right) = -(371.4 V_A + 36.1 V_B)$$

Thus, the output goes from $V_o = -[371.4(-9) + 36.1(16)] = 2765 = 2.77\,\text{V}$ to $V_o = -[371.4(-9) + 36.1(50)] = 1538 = 1.54\,\text{V}$

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

- What is $V_o$ at $t = 4\,\text{ms}$?

$$V_o = -(371.4(-9) + 36.1(50)) = 1538 = 1.54\,\text{V}$$