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 $t = 4.4 \, \text{ms}$?

All voltages in $\text{V}$

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  Waveform at $V_+$ is an decreasing exponential, starting at $V_+ = 0.52 - 0.16 = 0.36$
  $\Delta t = 4.4 - 1.8 = 2.6$
  $\tau = RC = 25.0 \times 37.8 = 945 \, \mu\text{s} = 0.94 \, \text{ms}$
  $V_+(4.4) = 0.36e^{-\Delta t/\tau} = 0.0226$

- 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, $G = 1 + \frac{74}{23} = 4.22$
  Waveform at $V_o$ is an decreasing exponential, starting at $V_+ = 4.22 \times 0.36 = 1.52$

- What is $V_o$ at $t = 4.4 \, \text{ms}$?
  $V_+(4.4) = 1.52e^{-\Delta t/\tau} = 0.096$
The op-amp is ideal, with $V_{CC} = 10\, \text{V}$ and $V_{EE} = -10\, \text{V}$.

![Image of 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 $t = 4.3\, \text{ms}$?

All voltages in mV

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  $V_+$ is the voltage-divider output from $V_i$.
  
  $V_+ = \left[\frac{5.6}{(5.6 + 25.0)}\right] V_o = 0.183 V_o$
  
  Thus, output goes from $V_+ = 0.183 \times 20.20 = 3.70$ to $V_+ = 0.183 \times 63.22 = 11.57$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  Gain, $G = G = 1 + \frac{(1200||1200)}{28} = 22.43$
  
  Thus, output goes from $V_o = 0.183 \times 20.20 \times G = 82.9$ to $V_o = 0.183 \times 63.22 \times G = 259.5$

- What is $V_o$ at $t = 4.3\, \text{ms}$?
  
  $V_o = 0.183 \times 63.22 \times G = 259.5$
The op-amp is ideal, with $V_{CC} = 15 \text{ V}$ and $V_{EE} = -15 \text{ V}$.
Input $V_A = -10 \text{ mV}$ (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 $t = 4.3 \text{ ms}$?

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
  
  $$V_o = -\left(\frac{1900}{3.7}V_A + \frac{1900}{23}V_B\right) = -(513.5V_A + 82.6V_B)$$

  Thus, the output goes from
  
  $V_o = -[513.5(-10) + 82.6(18)] = 3648 = 3.65 \text{ V}$ to
  
  $V_o = -[513.5(-10) + 82.6(14)] = 3979 = 3.98 \text{ V}$

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

- What is $V_o$ at $t = 4.3 \text{ ms}$?
  
  $V_o = -(513.5(-10) + 82.6(14) = 3979 = 3.98 \text{ V}$