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 $\text{V}$

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  Waveform at $V_+$ is an decreasing exponential, starting at $V_+ = 0.84 - 0.38 = 0.46$
  $\Delta t = 4.2 - 1.5 = 2.7$
  $\tau = RC = 32.7 \times 39.6 = 1294.92 \, \mu\text{s} = 1.29 \, \text{ms}$
  $V_+(4.2) = 0.46e^{-\Delta t/\tau} = 0.0567$

- 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, $G = 1 + 73/31 = 3.35$
  Waveform at $V_o$ is an decreasing exponential, starting at $V_+ = 3.35 \times 0.46 = 1.54$

- What is $V_o$ at $t = 4.2 \, \text{ms}$?
  $V_+(4.2) = 1.54e^{-\Delta t/\tau} = 0.190$
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 $t = 3.9\, \text{ms}$?

All voltages in mV

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  
  $V_+$ is the voltage-divider output from $V_i$.
  
  $V_+ = \left[\frac{5.5}{(5.5 + 32.7)}\right] V_o = 0.144V_o$
  
  Thus, output goes from $V_+ = 0.144 \times 23.42 = 3.37$ to $V_+ = 0.144 \times 62.12 = 8.95$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  
  Gain, $G = G = 1 + \frac{(1600||1600)}{39} = 21.51$
  
  Thus, output goes from $V_o = 0.144 \times 23.42 \times G = 72.5$ to $V_o = 0.144 \times 62.12 \times G = 192.4$

- What is $V_o$ at $t = 3.9\, \text{ms}$?
  
  $V_o = 0.144 \times 62.12 \times G = 192.4$
The op-amp is ideal, with $V_{CC} = 15$ V and $V_{EE} = -15$ V. 
Input $V_A = -7$ 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 $t = 3.9$ 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
  
  $$V_o = - \left( \frac{1800}{4.9} V_A + \frac{1800}{31} V_B \right) = -(367.3 V_A + 58.1 V_B)$$

  Thus, the output goes from
  
  $V_o = -[367.3(-7) + 58.1(40)] = 247 = 0.25$ V to
  
  $V_o = -[367.3(-7) + 58.1(46)] = -102 = -0.10$ V

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

- What is $V_o$ at $t = 3.9$ ms?
  
  $V_o = -(367.3(-7) + 58.1(46)) = -102 = -0.10$ V