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

![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 $t = 4.7\, \text{ms}$?

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 $V_+ = 0.58 - 0.36 = 0.22$
  
  $\Delta t = 4.7 - 1.9 = 2.8$
  
  $\tau = RC = 38.7 \times 39.0 = 1509.3\, \mu\text{s} = 1.51\, \text{ms}$
  
  $V_+(4.7) = 0.22e^{-\Delta t/\tau} = 0.0345$

- 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, $G = 1 + 61/22 = 3.77$
  
  Waveform at $V_o$ is an decreasing exponential, starting at $V_+ = 3.77 \times 0.22 = 0.83$

- What is $V_o$ at $t = 4.7\, \text{ms}$?
  
  $V_+(4.7) = 0.83e^{-\Delta t/\tau} = 0.130$
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 $t = 3.7\, ms$?

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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 $V_i$.
  $V_+ = [4.6/(4.6 + 38.7)] V_o = 0.106 V_o$
  Thus, output goes from $V_+ = 0.106 \times 20.77 = 2.20$ to $V_+ = 0.106 \times 63.53 = 6.73$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  Gain, $G = G = 1 + (1100||1100)/38 = 15.47$
  Thus, output goes from $V_o = 0.106 \times 20.77 \times G = 34.1$ to $V_o = 0.106 \times 63.53 \times G = 104.2$

- What is $V_o$ at $t = 3.7\, ms$?
  $V_o = 0.106 \times 63.53 \times G = 104.2$
The op-amp is ideal, with $V_{CC} = 15\, \text{V}$ and $V_{EE} = -15\, \text{V}$.
Input $V_A = -11\, \text{mV}$ (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 $t = 3.7\, \text{ms}$?

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

$$V_o = -\left(\frac{1500}{5.8} V_A + \frac{1500}{22} V_B\right) = -(258.6V_A + 68.2V_B)$$

Thus, the output goes from
$$V_o = -[258.6(-11) + 68.2(38)] = 253 = 0.25\, \text{V}$$
$$V_o = -[258.6(-11) + 68.2(20)] = 1481 = 1.48\, \text{V}$$

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

- What is $V_o$ at $t = 3.7\, \text{ms}$?
  $$V_o = -(258.6(-11) + 68.2(20)) = 1481 = 1.48\, \text{V}$$