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 $t = 3.3\, \text{ms}$?

All voltages in V

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  Waveform at $V_+$ is a decreasing exponential, starting at $V_+ = 0.80 - 0.24 = 0.56$
  $\Delta t = 3.3 - 1.2 = 2.1$
  $\tau = RC = 20.2 \times 35.7 = 721.14\, \mu\text{s} = 0.72\, \text{ms}$
  $V_+(3.3) = 0.56e^{-\Delta t/\tau} = 0.0303$

- 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, $G = 1 + 42/39 = 2.08$
  Waveform at $V_o$ is a decreasing exponential, starting at $V_+ = 2.08 \times 0.56 = 1.16$
- What is $V_o$ at $t = 3.3\, \text{ms}$?
  $V_+(3.3) = 1.16e^{-\Delta t/\tau} = 0.063$
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 $t = 3.6 \, \text{ms}$?

All voltages in mV

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  $V_+$ is the voltage-divider output from $V_i$.
  $V_+ = \left[\frac{3.2}{3.2 + 20.2}\right] V_o = 0.137V_o$
  Thus, output goes from $V_+ = 0.137 \times 22.95 = 3.14$ to $V_+ = 0.137 \times 60.73 = 8.32$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  Gain, $G = G = 1 + \frac{(2000 || 2000)}{32} = 32.25$
  Thus, output goes from $V_o = 0.137 \times 22.95 \times G = 101.4$ to $V_o = 0.137 \times 60.73 \times G = 268.3$

- What is $V_o$ at $t = 3.6 \, \text{ms}$?
  $V_o = 0.137 \times 60.73 \times G = 268.3$
The op-amp is ideal, with $V_{CC} = 15\, \text{V}$ and $V_{EE} = -15\, \text{V}$.
Input $V_A = -4\, \text{mV}$ (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 $t = 3.6\, \text{ms}$?

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

$$V_o = - \left( \frac{1100}{3.0} V_A + \frac{1100}{39} V_B \right) = - \left( 366.7V_A + 28.2V_B \right)$$

Thus, the output goes from $V_o = -[366.7(-4) + 28.2(26)] = 734 = 0.73\, \text{V}$ to $V_o = -[366.7(-4) + 28.2(42)] = 282 = 0.28\, \text{V}$

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

- What is $V_o$ at $t = 3.6\, \text{ms}$?

$$V_o = -(366.7(-4) + 28.2(42)) = 282 = 0.28\, \text{V}$$