The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. What value is $V_o$ at 21 ms? What value is $V_o$ at 36 ms?

Solution (all times in ms, voltages in $\mu V$):

- Sketch the output, $V_o$.
  
  At $t = 16$, $V_o = 11$. From 16 – 31, $V$ decreases exponentially toward 89. After 31, $V_o$ increases towards 11.

- What value is $V_o$ at 21 ms?
  
  $\tau = RC = 496 \times 25.5 = 12648 \mu s = 12.65$ ms

  At $t = 21$, $\Delta t = 5$.

  $V_o = 11 + (89 - 11)e^{-t/\tau} = 11 + 78e^{-5/12.65} = 63.53$

- What value is $V_o$ at 36 ms?

  First, figure out $V_o$ at $t = 31$.

  $\Delta t = 31 - 16 = 15$

  $V_o = 11 + (89 - 11)e^{-\Delta t/\tau} = 11 + 78e^{-15/12.65} = 34.83$

  Now, $V_o$ increases from 34.83 (not 11).

  At $t = 36$, $\Delta t = 5$.

  $V_o = 89 + (34.83 - 89)e^{-t/\tau} = 89 - 54.17e^{-5/12.65} = 52.52$
Briefly (≤50 words) answer the following:

- What is the difference between a microshock and a macroshock?
- When electrodes are placed on the skin are you concerned with macroshock or microshock?
- Define the term “let-go current”.
- Why is the “let-go current” higher (on average) for a subject with higher mass?

For definitions, see in class notes from Sep 13 on “electrical safety”
The optoisolator above has an isolation voltage of 5 kV. Unfortunately, the user spills coffee on the circuit which connects the power line (120 V) to terminal D, while terminal C is at ground. The terminals A and B are connected to a circuit which is connected to the patient. **Sketch where the current does (and doesn’t) flow? Explain what protection the optoisolator offers.**

For definitions, see in class notes from Sep 18 on optoisolators