The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. What value is $V_o$ at 23 ms? What value is $V_o$ at 42 ms?

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

- Sketch the output, $V_o$.
  
  At $t = 18$, $V_o = 29$. From $18 - 37$, $V$ decreases exponentially toward 81. After 37, $V_o$ increases towards 29.

- What value is $V_o$ at 23 ms?
  
  $\tau = RC = 306 \times 29.0 = 8874 \mu s = 8.87$ ms
  
  At $t = 23$, $\Delta t = 5$.
  
  $V_o = 29 + (81 - 29)e^{-t/\tau} = 29 + 52e^{-5/8.87} = 58.59$

- What value is $V_o$ at 42 ms?
  
  First, figure out $V_o$ at $t = 37$.
  
  $\Delta t = 37 - 18 = 19$
  
  $V_o = 29 + (81 - 29)e^{-\Delta t/\tau} = 29 + 52e^{-19/8.87} = 35.11$
  
  Now, $V_o$ increases from 35.11 (not 29).
  
  At $t = 42$, $\Delta t = 5$.
  
  $V_o = 81 + (35.11 - 81)e^{-t/\tau} = 81 - 45.89e^{-5/8.87} = 54.88$
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.