The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. What value is $V_o$ at 20 ms? What value is $V_o$ at 32 ms?

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

- Sketch the output, $V_o$.
  At $t = 15$, $V_o = 29$. From 15 – 27, $V$ decreases exponentially toward 93. After 27, $V_o$ increases towards 29.

- What value is $V_o$ at 20 ms?
  $\tau = RC = 446 \times 21.4 = 9544.4 \mu s = 9.54$ ms
  At $t = 20$, $\Delta t = 5$.
  $V_o = 29 + (93 - 29)e^{-t/\tau} = 29 + 64e^{-5/9.54} = 66.89$

- What value is $V_o$ at 32 ms?
  First, figure out $V_o$ at $t = 27$.
  $\Delta t = 27 - 15 = 12$
  $V_o = 29 + (93 - 29)e^{-\Delta t/\tau} = 29 + 64e^{-12/9.54} = 47.19$
  Now, $V_o$ increases from 47.19 (not 29).
  At $t = 32$, $\Delta t = 5$.
  $V_o = 93 + (47.19 - 93)e^{-t/\tau} = 93 - 45.81e^{-5/9.54} = 65.88$
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