The circuit above is exposed to the input voltage $V_i$ as shown. Sketch the output, $V_o$. What value is $V_o$ at 16 ms? What value is $V_o$ at 30 ms?

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

- Sketch the output, $V_o$.
  At $t = 11$, $V_o = 18$. From 11 – 25, $V$ decreases exponentially toward 87. After 25, $V_o$ increases towards 18.

- What value is $V_o$ at 16 ms?
  $\tau = RC = 306 \times 25.7 = 7864.2 \mu s = 7.86 ms$
  At $t = 16$, $\Delta t = 5$.
  
  $V_o = 18 + (87 - 18)e^{-t/\tau} = 18 + 69e^{-5/7.86} = 54.52$

- What value is $V_o$ at 30 ms?
  First, figure out $V_o$ at $t = 25$.
  $\Delta t = 25 - 11 = 14$
  $V_o = 18 + (87 - 18)e^{-\Delta t/\tau} = 18 + 69e^{-14/7.86} = 29.62$
  Now, $V_o$ increases from 29.62 (not 18).
  At $t = 30$, $\Delta t = 5$.
  $V_o = 87 + (29.62 - 87)e^{-t/\tau} = 87 - 57.38e^{-5/7.86} = 56.63$
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, while using the circuit outside, lightening strikes, applying 500 kV to terminal C, while terminal D 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