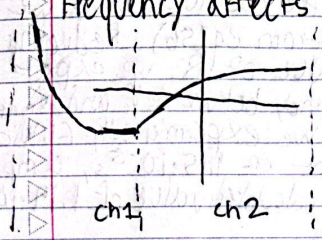
Caden Roberts

Lab Circuits Step Response

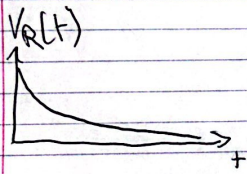
EN-01 11/28

Experiment 1

We are doing this experiment to observe how frequency affects voltage on the oscillope.



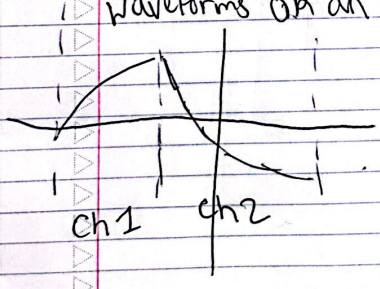
We observe (to the left) on the oscillope. The max val is 2V. At a higher frequency the lines increase in number on the screen to beyond the pixel limit of the oscillope. At a lower frequency the curve stretches to almost a flat line across the screen.



We expect $V_R(t)$ to look like (to the left).

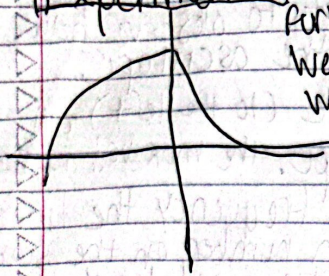
Experiment 2

We are doing this experiment to further investigate waveforms on an oscillope. What we see below matches our previous prediction.



We observe 8μs reading on cursor 1 when channel 1 drops from 2V to 1V, and a 92μs reading on cursor 1 when channel 2 drops from 2V to 1V. We measure a time constant $1.443 \cdot 8 \cdot 10^{-6} = 1.15 \cdot 10^{-5}$ s, compared to our theoretical time constant $12005\Omega \cdot 9.9 \cdot 10^{-9}$ nF $= 1.19 \cdot 10^{-5}$ s. The time constant will decrease as R decreases, and increase as C increases. The circuit will charge/discharge faster as the time constant decreases.

Experiment 3] We are doing this experiment to further investigate circuit step responses. We observe on the oscilloscope what we would expect from eq(56). Reducing the value of R, we expect the discrepancy between V_0 and V_{max} to increase. We experimentally find a time constant of $1.15 \cdot 10^{-5}$ s, compared with our RL calculated value of $1.19 \cdot 10^{-5}$ s



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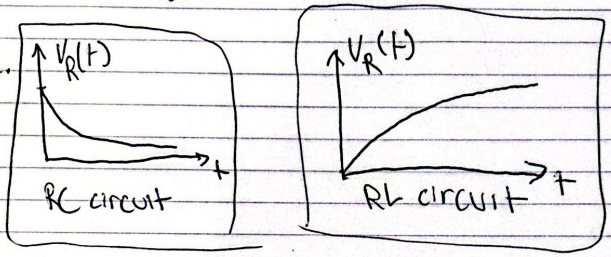
Pre Lab

SN-01 11/28

1. $\tau_{RC} = 1200 \cdot 10 \cdot 10^{-9} = \boxed{1.2 \cdot 10^{-5}\ s}$

$\tau = \frac{15 \cdot 10^{-3}}{1200 + 130} = \boxed{1.13 \cdot 10^{-5}\ s}$

2.



3. $\frac{V_0}{2} = V_0(1 - e^{-t/\tau})$

$\frac{1}{2} = e^{-t/\tau}$

$\ln(2) = \frac{t_{1/2}}{\tau}$ → $\tau = \frac{t_{1/2}}{\ln(2)} = \boxed{1.443\, t_{1/2}}$