**Datasheet for Lab 9: First Order Circuits and Oscilloscopes**

Name(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Lab Kit: \_\_\_\_\_\_\_\_ Approximate time to complete:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Watch the [video for Lab 9](https://youtu.be/J82Gzkp5yzE) while completing the lab

**Part 1: Oscilloscope Basics**

1. Copy a screen capture of the display after step 14 in the handout, showing measurements of Peak-to-Peak voltage and Average Period of the test sinewave.

**Part 2: Measuring the Time Constant of a First-Order Circuit**

1. Measure and record the resistance of your three resistors:

100 KΩ (1 of 2) \_\_\_\_\_\_\_\_\_\_\_\_\_

100 KΩ (2 of 2) \_\_\_\_\_\_\_\_\_\_\_\_\_

1. KΩ \_\_\_\_\_\_\_\_\_\_\_\_\_

19. Compute the Thevenin resistance (Req) seen by the Capacitor when the capacitor is charging (switch is closed), using your measured resistor values from 15)

Formula for Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Value for Req (using measured R’s above) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Computed Time constant while capacitor is charging (switch closed)

τ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Copy a screen capture of the increasing capacitor voltage here. Make sure the time constant is being displayed as the difference in time between two vertical X cursor lines that align with the start of the transient response, and the intersection of the charging curve with a Y marker locating 63.2% of the final value (or as close to that as you an get).
2. Copy a screen capture of the decreasing capacitor voltage here. Make sure the time constant is being displayed as the difference in time between two vertical X cursor lines that align with the start of the discharge curve, and the intersection of the charging curve with a Y marker locating 36.8% of the initial value.

Computed Time constant while capacitor is discharging (switch closed, recalculate Req)

Formula for Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Value for Req (using measured R’s above) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

τ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Copy a screen capture of Circuit 2 charging and discharging waveforms here, making sure each shows the rise time/fall time between two X cursors.

Recalculate the theoretical Req and τ for this circuit, in both charging and discharging modes, and enter all of your calculations and measurements in Table I below, with % difference calculations.

Table I: Time constant Measurements vs Theory

|  |  |  |  |
| --- | --- | --- | --- |
|  | Scope Measurement τ | Theoretical τ | % Difference |
| Circuit 1, Charging |  |  |  |
| Circuit 1, Discharging |  |  |  |
| Circuit 2, Charging |  |  |  |
| Circuit 2, Discharging |  |  |  |

**Part 3: Creative Challenge (Optional – 10% Extra Credit)**

Record your investigation of the inductance of the speaker here, including your measurement of RL, a photograph of your circuit, and a screen capture of your scope showing your measurement of the charging time constant for the circuit, followed by the additional calculation to determine the inductance L of the speaker.

**Part 4: Postlab Questions**

1. Comment on the how well the theory predicts the measurements for the time constant of an RC circuit. What are some of the sources of error you can think of in measuring the time constant?

If you found more than 15% error, please consider revisiting your measurements, debugging your wiring, and/or include a close-up photo here of your breadboard for further documentation.

1. Pertaining to Part 1 of the lab, what does triggering do, and why is it important?
2. Which oscilloscope trigger mode “freezes” the display when triggering is not active?
3. Which trigger mode allows you to view the signal dynamics even when triggering is not active?
4. Describe the differences in display behavior when the oscilloscope Run mode is set to “Repeating” as opposed to “Shift.”