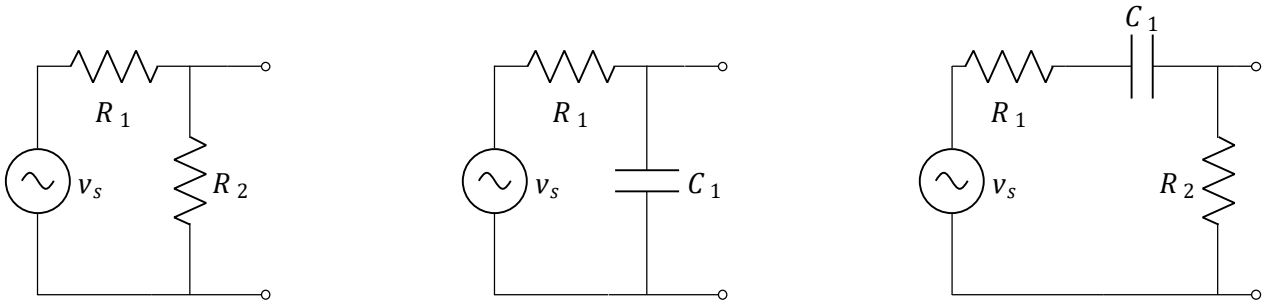
Laboratory 0: Linear circuit analysis and measurement

Part 1: Linear circuit analysis

For each of the circuits shown in Figure 1, apply each of the input signals shown in Figure 2.

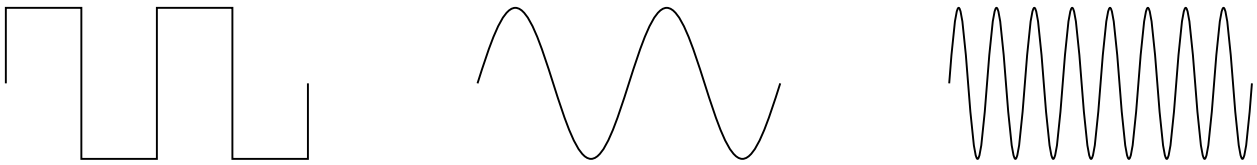


(a) Circuit A (b) Circuit B (c) Circuit C

Figure 1: Circuits for analysis.

Circuit	R_1	R_2	C_1
A	20 kΩ	39 kΩ	-
B	39 kΩ	-	2.2 nF
C	20 kΩ	39 kΩ	2.2 nF

Table 1: Component values for the circuits.



(a) Square 1kHz 2Vp-p (b) Sine 1kHz 2Vp-p (c) Sine 10kHz 2Vp-p

Figure 2: Stimulus waveforms.

1 a) Find the transfer function for Circuit A:

b) What type of circuit is Circuit A?

c) Calculate the peak-to-peak voltage at the output of Circuit A for each of the input waveforms in Figure 2. Complete the table.

V_{p-p} Waveform A (mV)	V_{p-p} Waveform B (mV)	V_{p-p} Waveform C (mV)

Table 2: Calculated voltage outputs for Circuit A.

d) Construct Circuit A using the solderless breadboard provided. Using the picoscope at your workstation, apply each of the input waveforms in Figure 2 to the circuit. Measure and record the peak-to-peak output voltage.

V_{p-p} Waveform A (mV)	V_{p-p} Waveform B (mV)	V_{p-p} Waveform C (mV)

Table 3: Measured voltage outputs for Circuit A.

TA Initials: _____

2 a) Find the transfer function for Circuit B:

b) What type of circuit is Circuit B?

c) Calculate the peak-to-peak voltage at the output of Circuit B for each of the input waveforms in Figure 2.

V_{p-p} Waveform A (mV)	V_{p-p} Waveform B (mV)	V_{p-p} Waveform C (mV)

Table 4: Calculated voltage outputs for Circuit B.

d) Construct Circuit B. Using the picoscope, apply each of the input waveforms in Figure 2 to the circuit. Measure and record the peak-to-peak output voltage.

V_{p-p} Waveform A (mV)	V_{p-p} Waveform B (mV)	V_{p-p} Waveform C (mV)

Table 5: Measured voltage outputs for Circuit B.

TA Initials: _____

3 a) Find the transfer function for Circuit C:

b) What type of circuit is Circuit C?

c) Calculate the peak-to-peak voltage at the output of Circuit C for each of the input waveforms in Figure 2.

V_{p-p} Waveform A (mV)	V_{p-p} Waveform B (mV)	V_{p-p} Waveform C (mV)
Not required		

Table 6: Calculated voltage outputs for Circuit C.

d) Construct Circuit C. Using the Picoscope, apply each of the input waveforms in Figure 2 to the circuit. Measure and record the peak-to-peak output voltage.

V_{p-p} Waveform A (mV)	V_{p-p} Waveform B (mV)	V_{p-p} Waveform C (mV)

Table 7: Measured voltage outputs for Circuit C.

TA Initials: _____

Part 2: Rise and Fall Times

Return to Circuit B with the square-wave input (Waveform A).

4 a) Calculate the time constant for Circuit B:

b) Use the time constant to calculate the expected 20-80 % rise and fall times for this circuit:

c) Calculate the 20 % and 80 % voltage levels, given a 2 V p-p input signal:

20 % level (mV)	
80 % level (mV)	

Table 8: 20% and 80% voltage levels for Circuit B.

d) Use the Picoscope's moveable vertical and horizontal markers to estimate the rise time (20-80%) and fall time (80-20%) of the output signal (Figure 3). Repeat your measurement using the Picoscope's automated measurement feature. Record your results in Table 9.

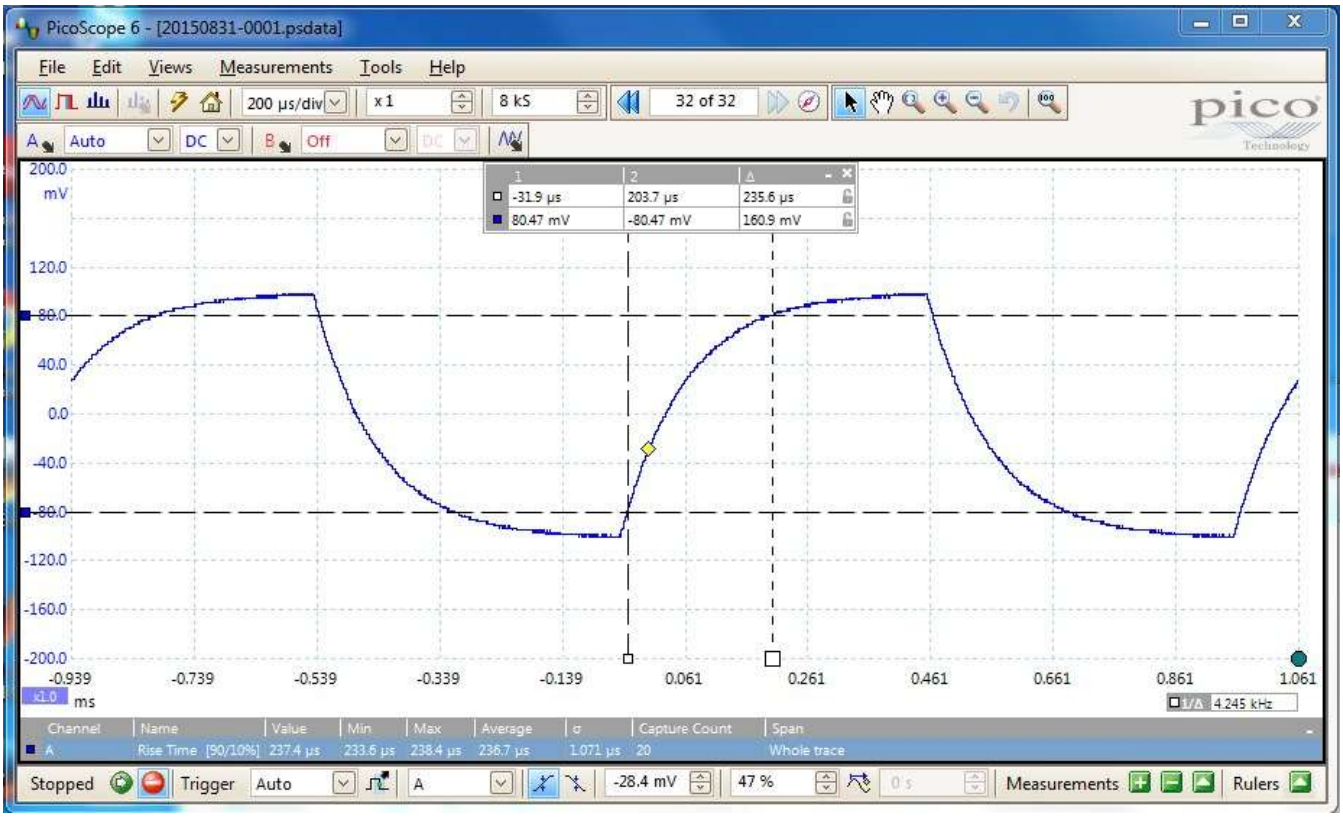


Figure 3: Rise and fall time measurement

	Calculated	Measured	Measured (auto)
20-80 % rise time t_r			
80-20 % fall time t_f			

Table 9: Calculated and measured rise times and fall times for Circuit B.

e) Does the automatic result agree with your manual measurement?

TA Initials: _____