ECE 321 - Homework #1

Op Amp Amplifiers & Mixers. Due Wednesday, April 7th

Please make the subject "ECE 321 HW#1" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

For all problems, assume you are using

- MCP602 Op Amps (2.7V - 6.0V, max current = 22mA)
- 2SC6144 transistors
- β = 200, 10A max, |Vbe| = 0.7V

555 Timer

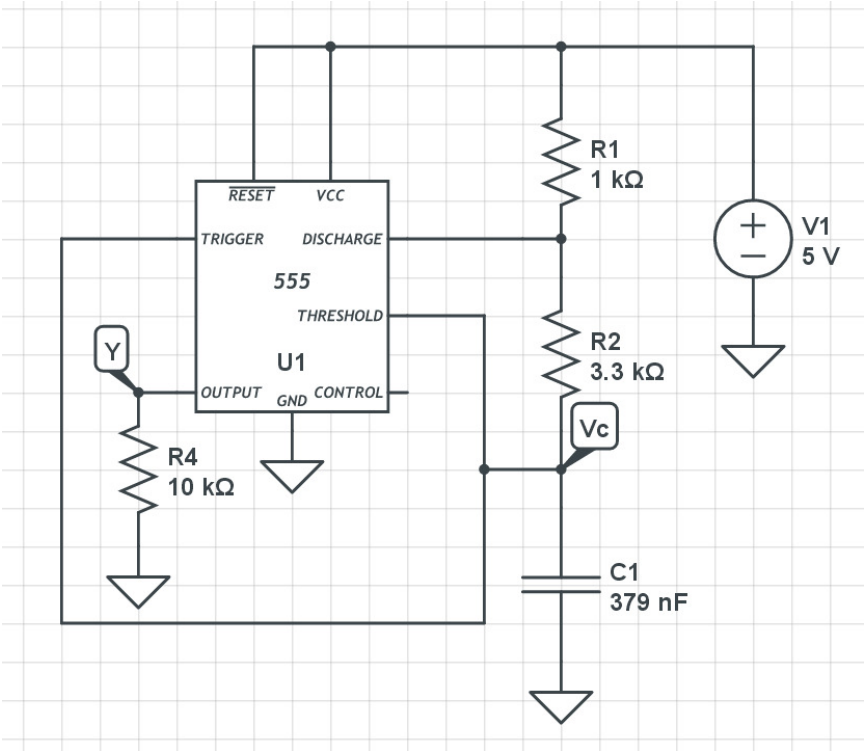
Problem 1) Design a circuit using a 555 timer so that it outputs a 500hz triangle wave

The period is

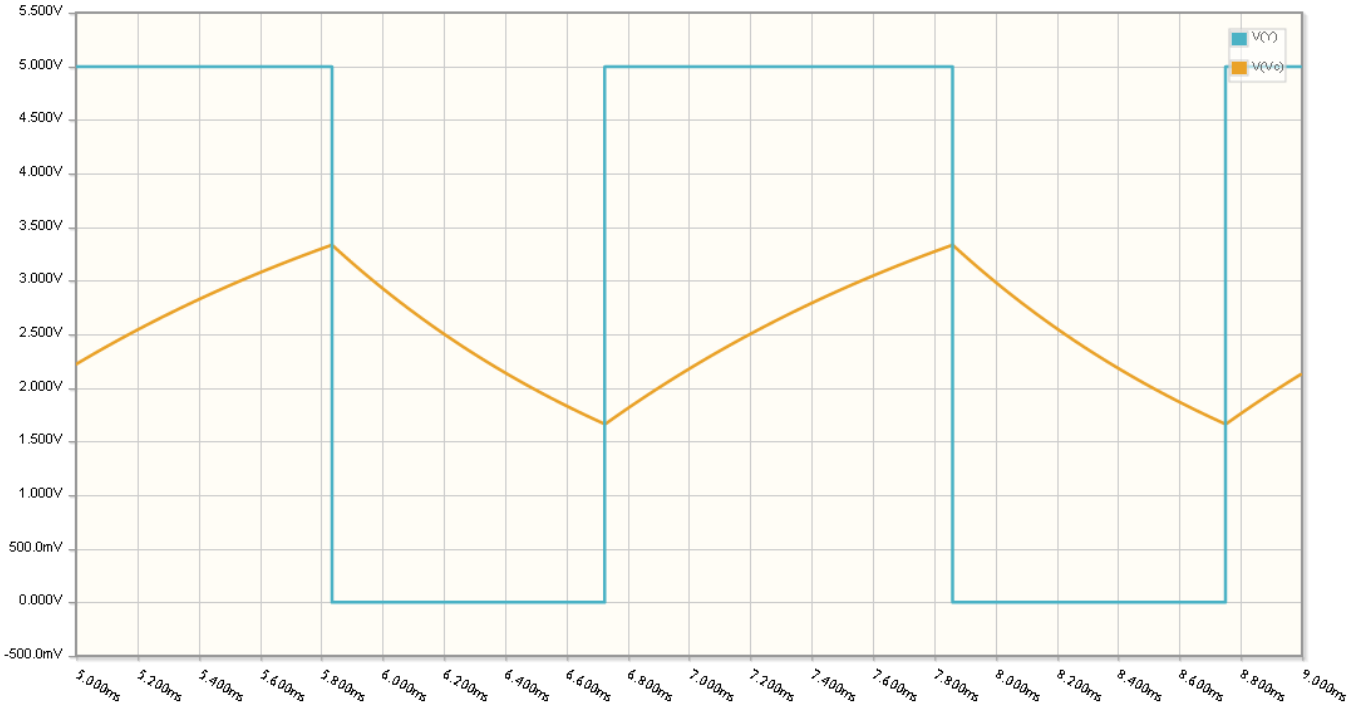
$$T = (R_1 + 2R_2) \cdot C \cdot \ln(2) = 2ms$$

Let

- T = 2ms
- R1 = 1k
- R2 = 3.3k
- C = 0.379uF



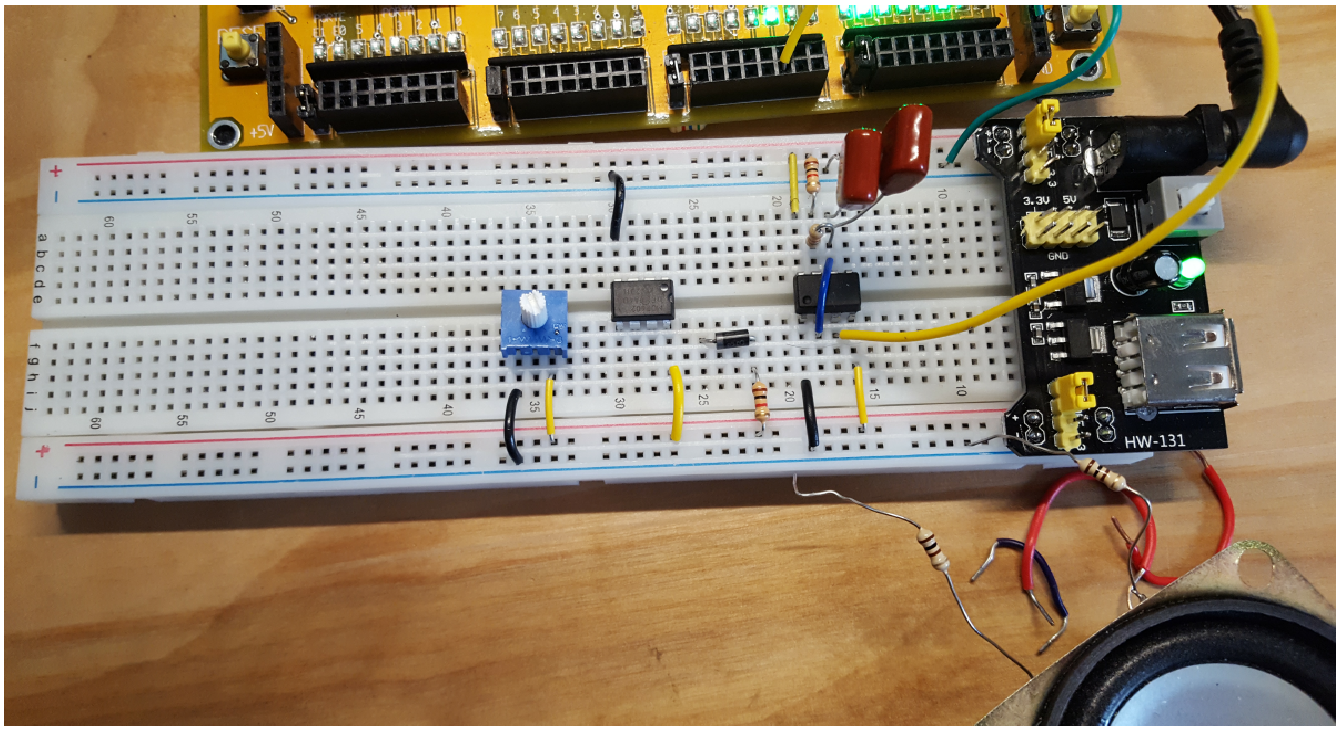
Problem 2) Verify your design in CircuitLab



Period = 2.045ms (489Hz)

Problem 3) Build this circuit in hardware and verify its operation

- Using two 0.18uF capacitors in parallel (what I cound scrounge up - 0.36uF total)



Using a multimeter on the capacitor voltage

- DC voltage = 2.570V (vs. 2.500V expected)
- AC voltage = 0.446Vrms

Peak-to-peak voltage is $2\sqrt{2}$ times larger for sine waves. Multiplying

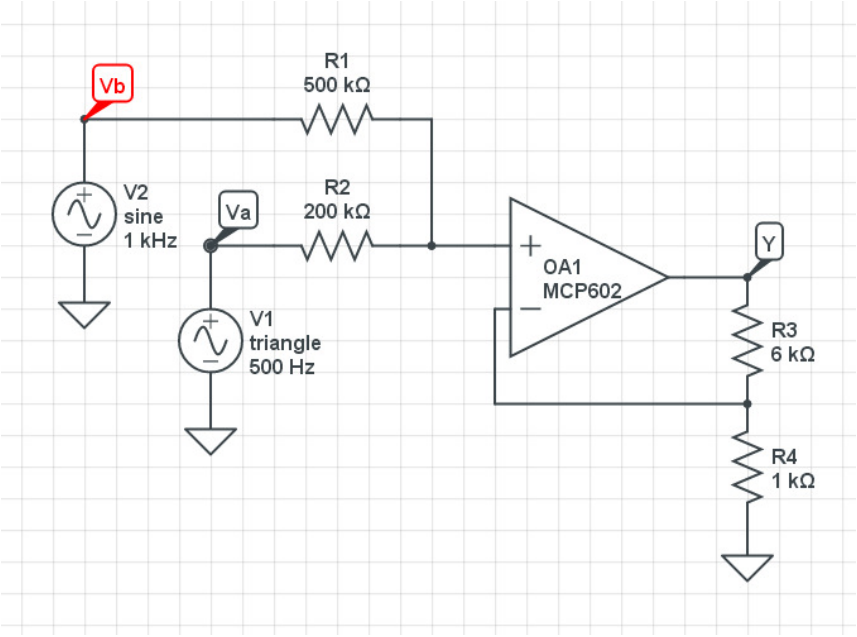
- AC voltage $\approx \left(2\sqrt{2}\right) \cdot 0.446 V_{rms} = 1.261 V_{pp}$ (vs. 1.66Vpp expected)

Voltage Amplfier & Mixer:

Problem 4) Design a circuit to mix two audio signals

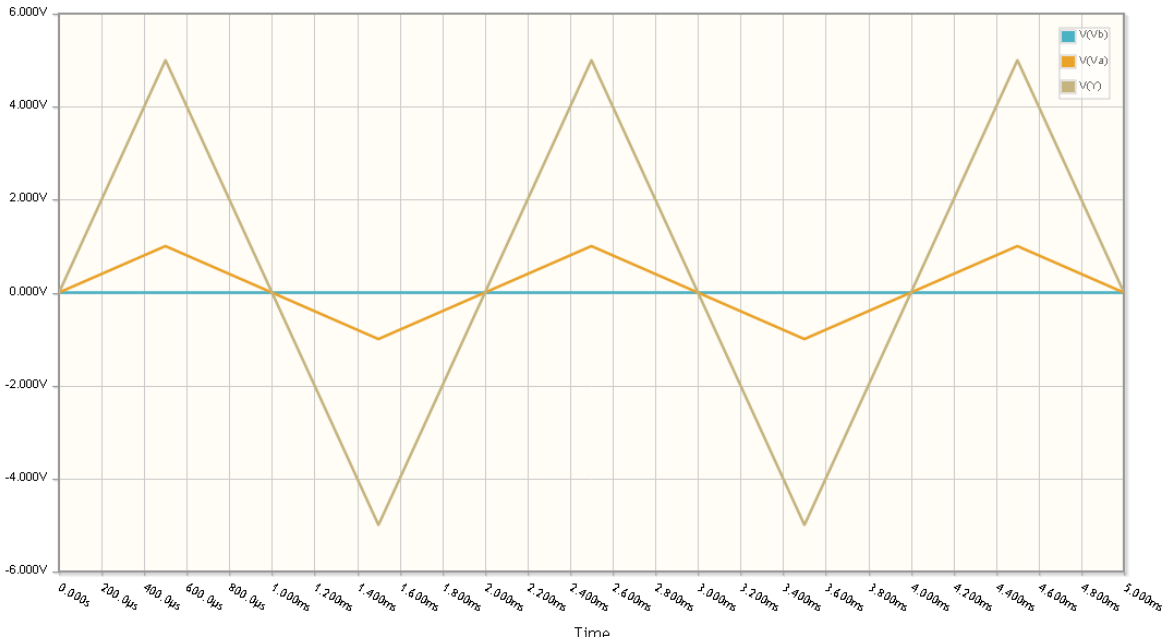
- A = the output of your 555 timer: (1.66Vpp triangle wave, 500Hz)
- B = the output of your cell phone (1Vpp, 20-20kHz sine wave)

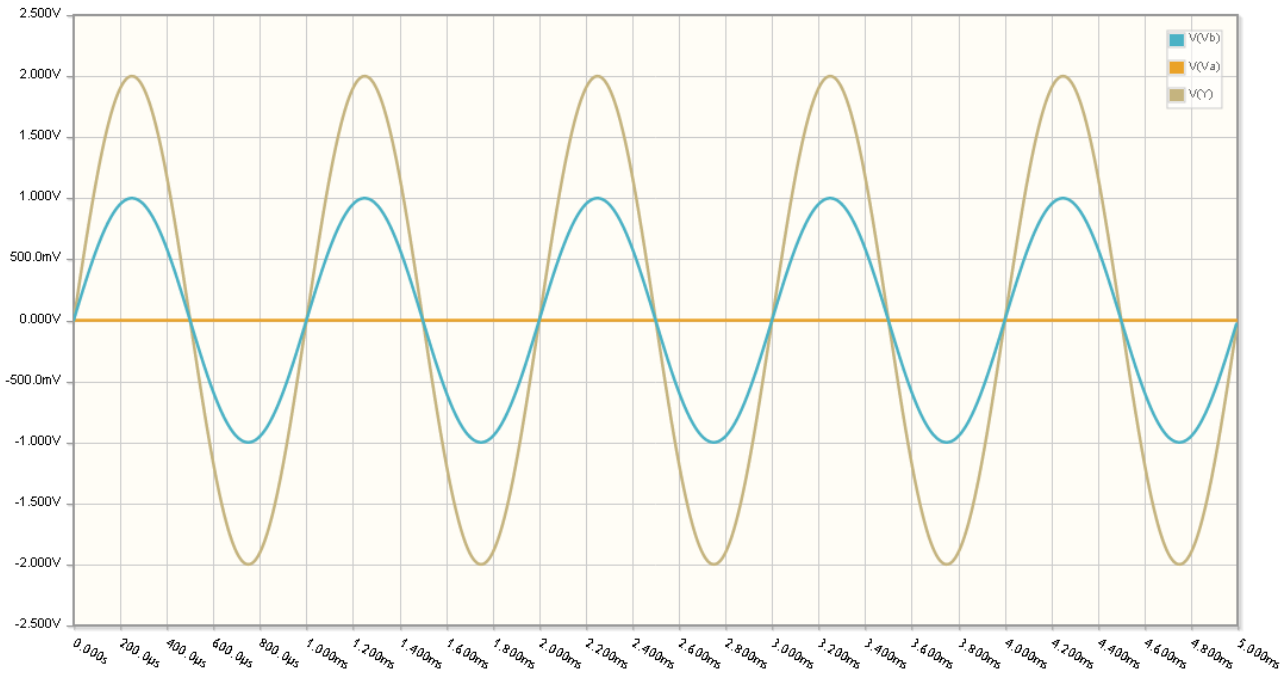
$$Y = 2A + 5B$$



Problem 5) Verify the operation of your mixer in CircuitLab

Use superposition





Problem 6) Verify the operation of your circuit in hardware: Apply a 1kHz sine wave to input A then B

Input A

- Vin = 0.317Vrms
- Vout = 0.649Vrms
- gain = 2.047

Input B

- Vin = 0.317Vrms
- Vout = 1.500Vrms
- gain = 4.73