

ECE 320 - Homework #8

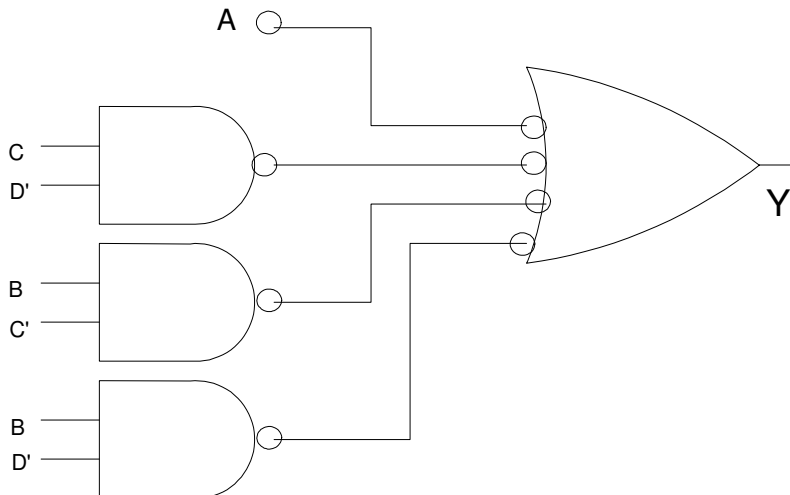
Boolean Logic, DTL, TTL Logic. Due Monday, Marth 8th

Boolean Logic

1) Implement the following funciton using NAND gates (i.e. circle the ones)

f(A,B,C,D)		CD			
		00	01	11	10
AB	00	1	0	0	0
	01	1	1	0	1
	11	x	x	x	x
	10	1	1	x	x

$$Y = A + C'D' + BC' + BD'$$

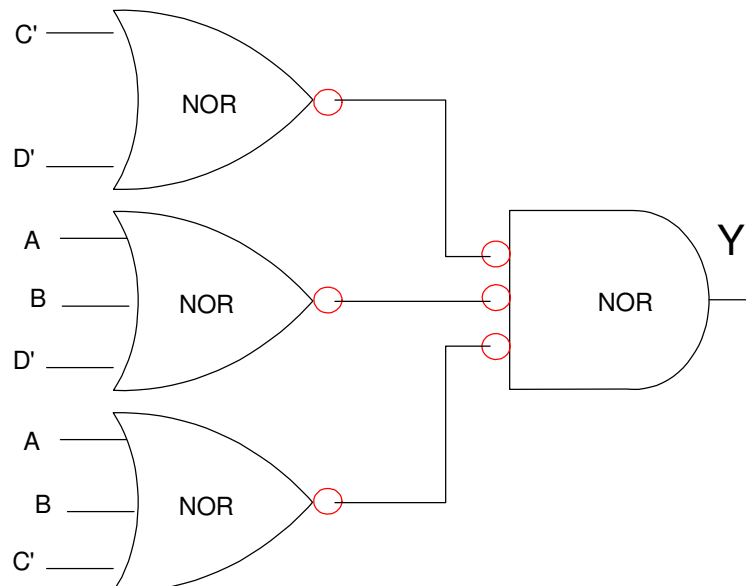


2) Implement the following function using NOR gates (i.e. circle the zeros)

f(A,B,C,D)		CD			
		00	01	11	10
AB	00	1	0	0	0
	01	1	1	0	1
	11	x	x	x	x
	10	1	1	x	x

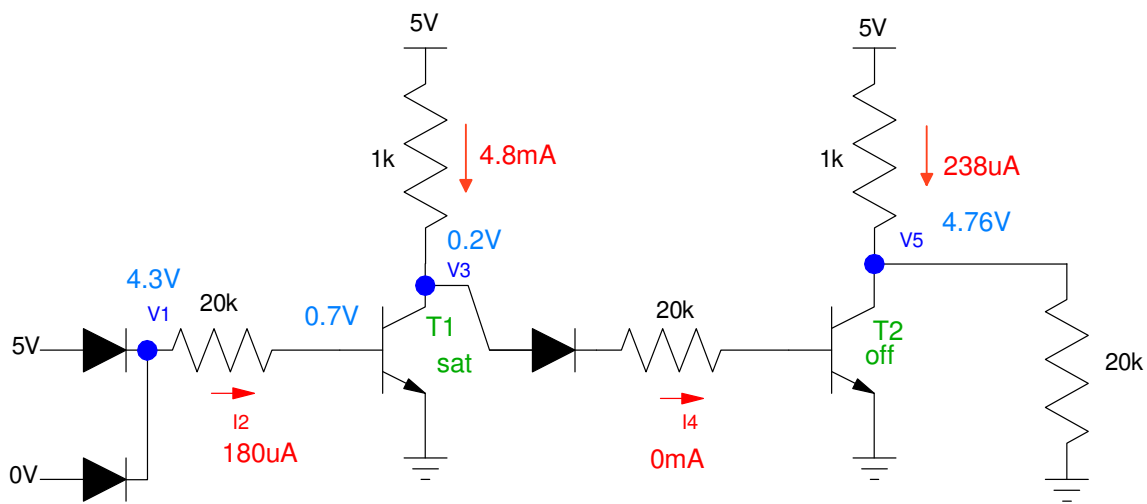
$$Y' = CD + A'B'D + A'BC$$

$$Y = (C' + D')(A + B + D')(A + B + C')$$



DTL Logic

3) Determine the voltages and currents for the following DTL OR gate



The 5V source turns on transistor T1 (saturated)

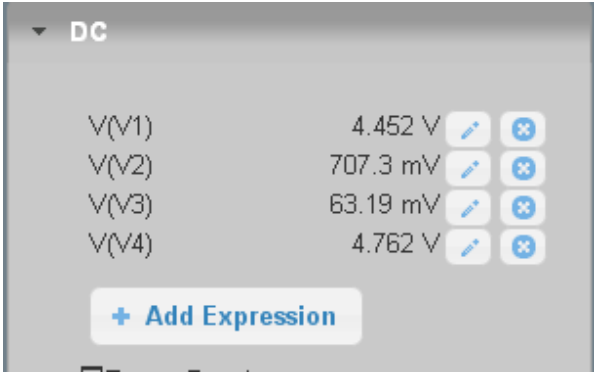
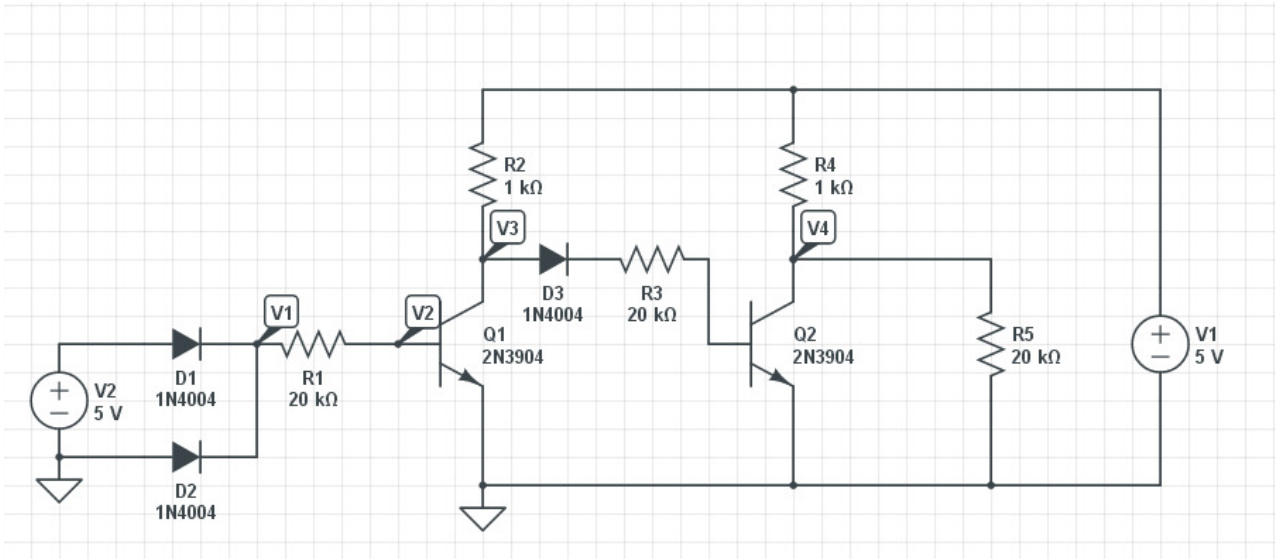
$$I_2 = \left(\frac{5V - 0.7V - 0.7V}{20k} \right) = 180\mu A$$

$$\beta I_2 = 18mA > 4.8mA \quad T1 \text{ is saturated}$$

0.2V at V3 isn't enough to turn on T2 (off)

$$V_5 = \left(\frac{20k}{20k + 1k} \right) 5V = 4.76V$$

4) Simulate this circuit in CircuitLab to verify your answers for problem #3



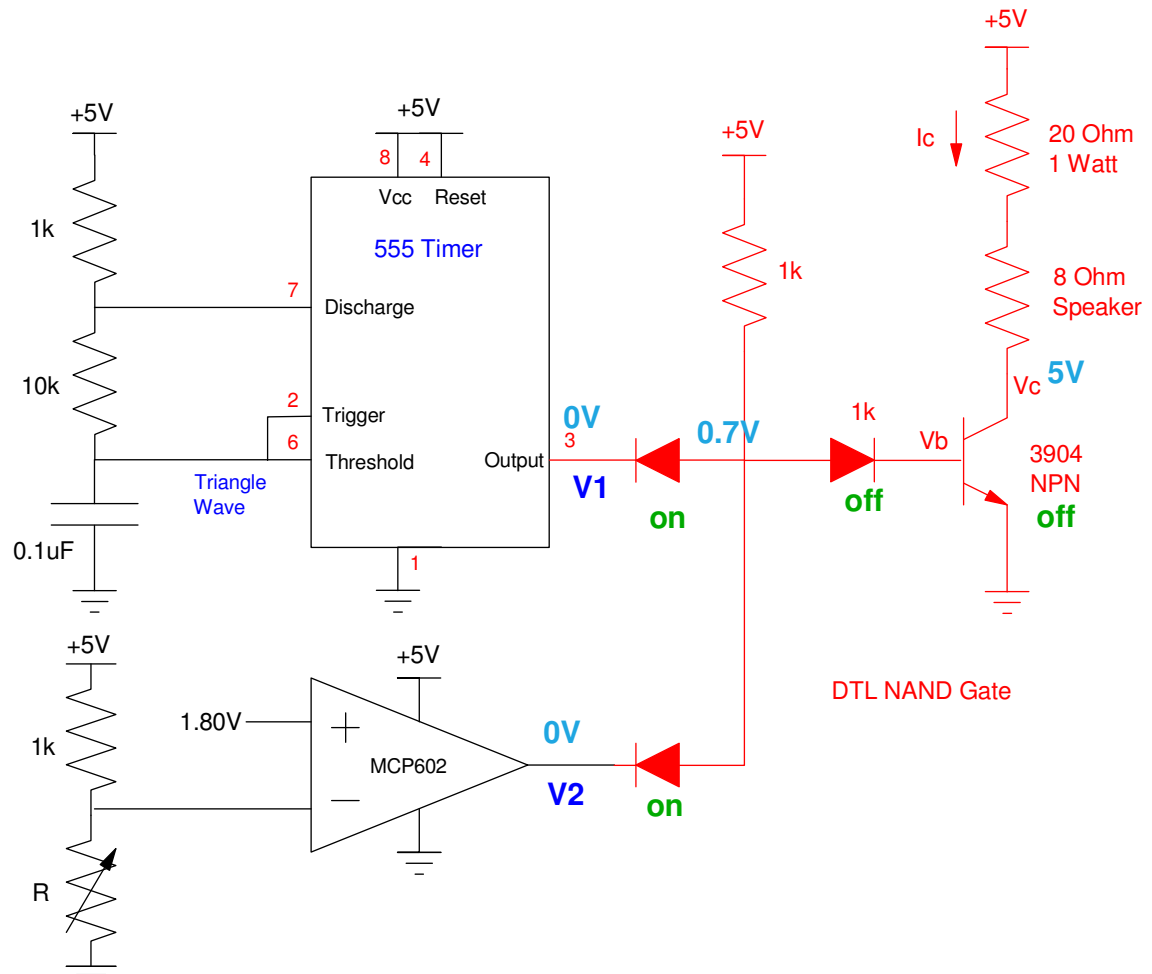
	V1	V2	V3	V4
Calculated	4.3V	0.7V	0.2V	4.76V
Simulated	4.452V	0.707V	0.063V	4.762V

The circuit below uses a DTL NAND gate to drive the speaker when

- The 555 timer outputs 5V, and
- The comparator outputs 5V,.

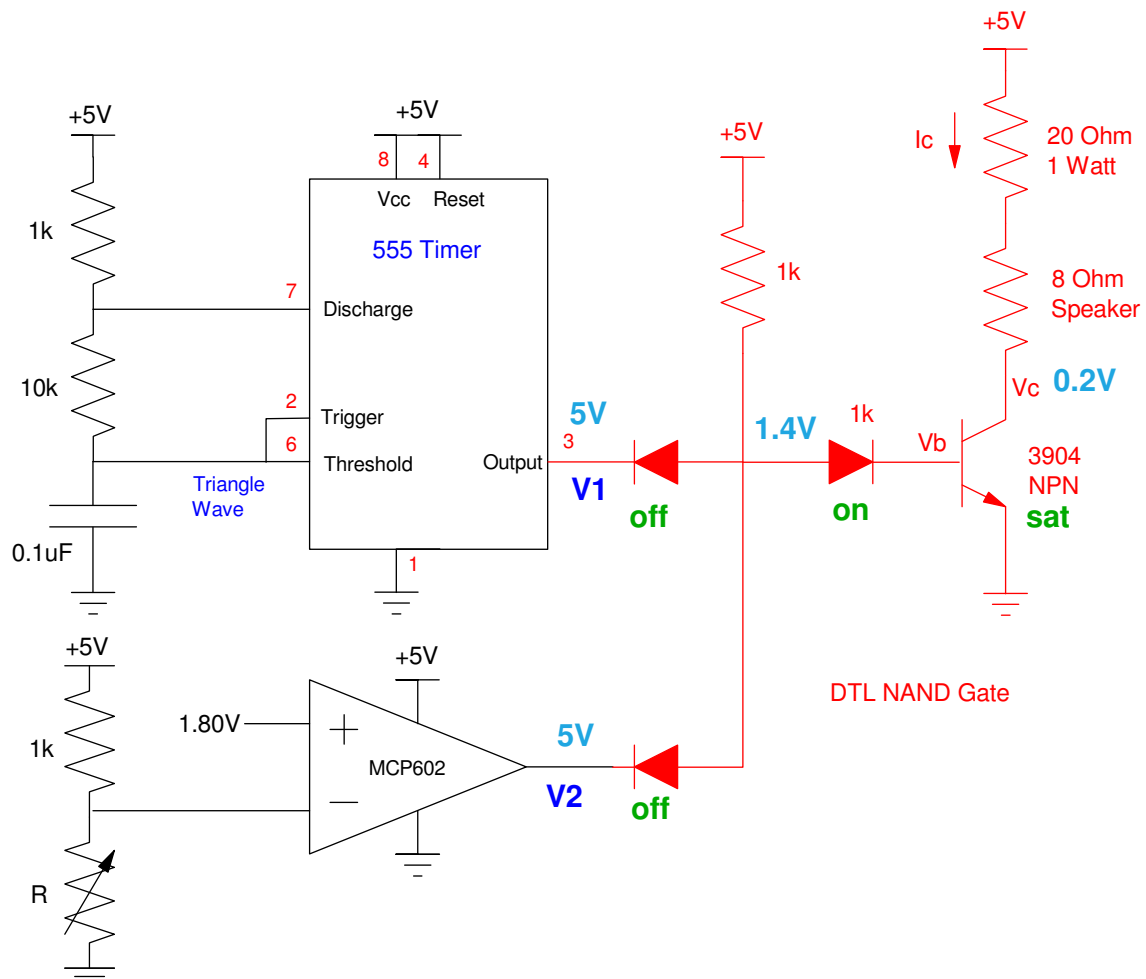
5) Determine the voltages when

- $V_1 = V_2 = 0V$ (red)
- $V_1 = V_2 = 5V$
- $V_1 = 0V, V_2 = 5V$ (blue)

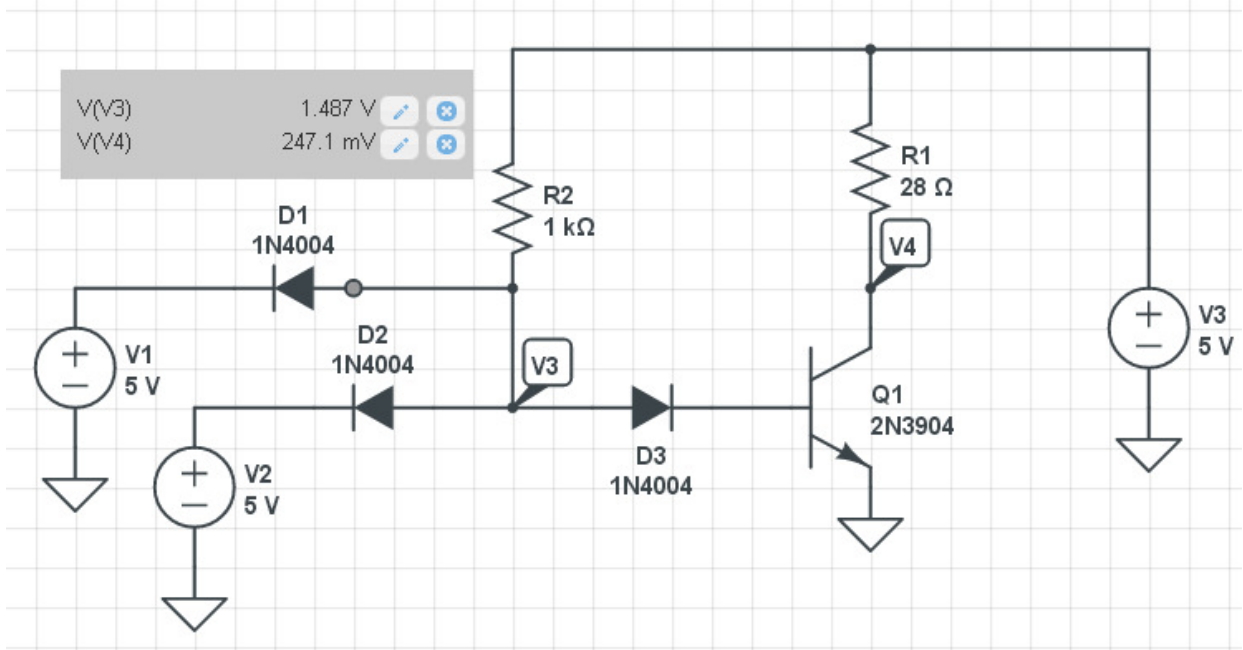
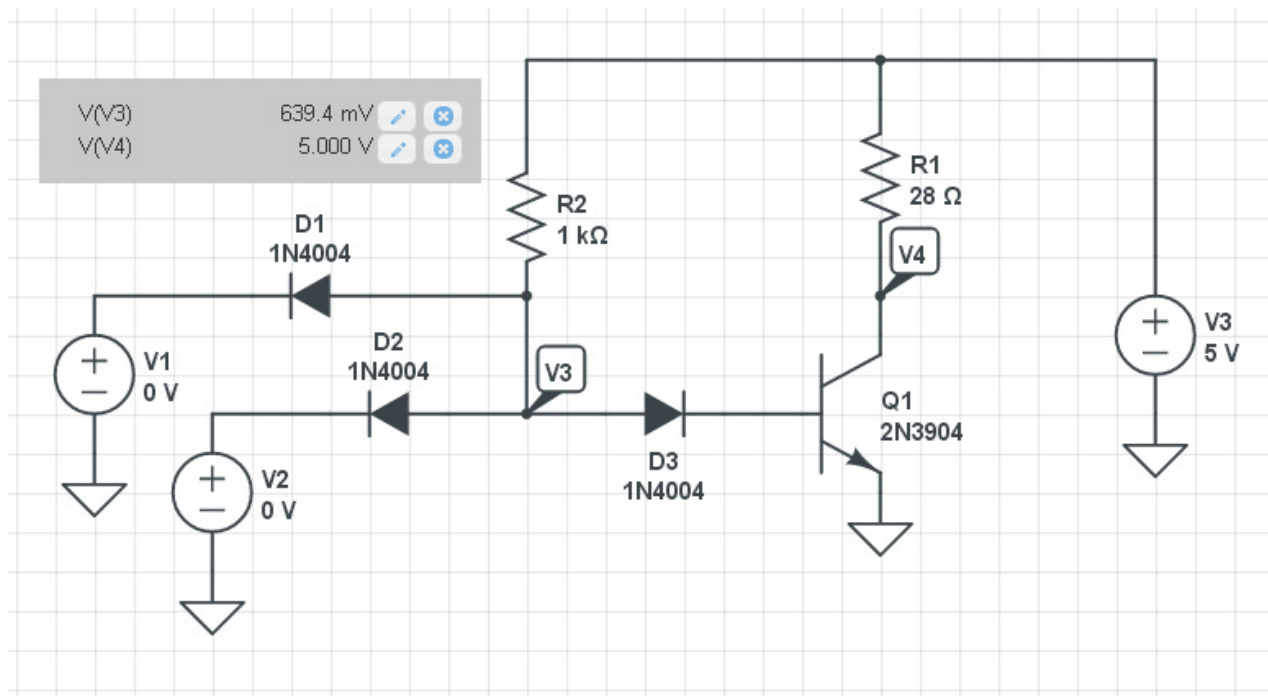


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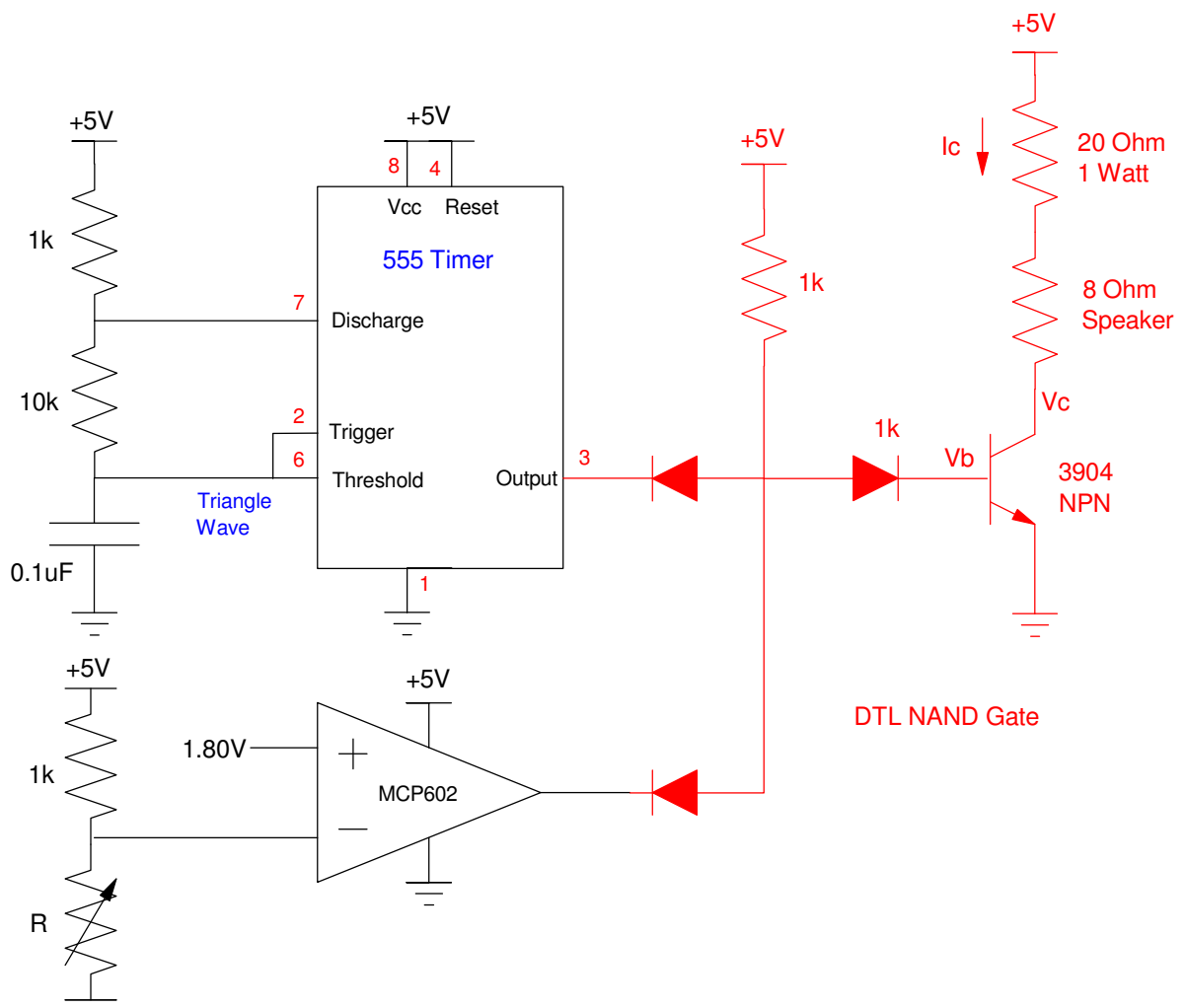
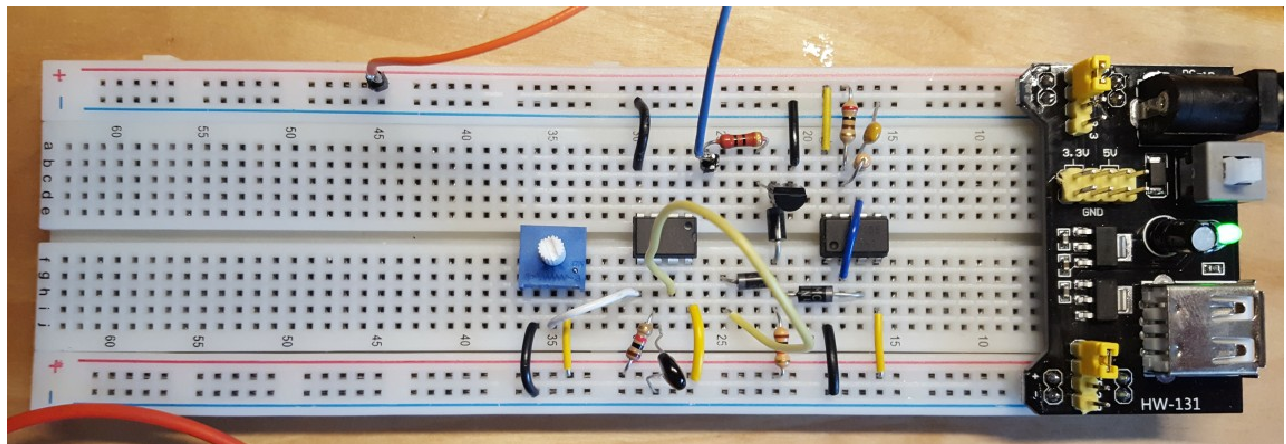
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6) Verify your design using CircuitLab.



Lab: 7) (20pt): Verify your design in hardware (build and test the circuit with your lab kit).



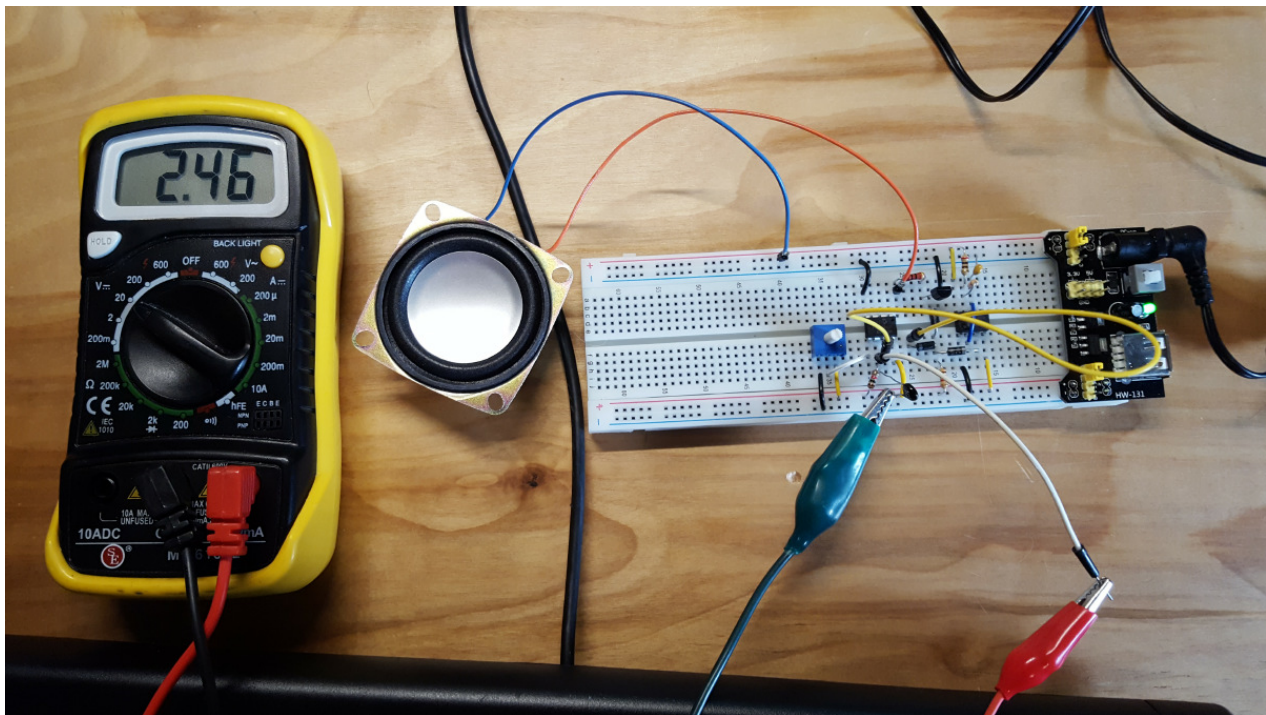
- The 555 timer from homework set #5 for V1, and
- Connecting the comparator from homework set #5 for V2

Verify that

- The speaker turns on when $T > T_{on}$ and
- The speaker turns off when $T < T_{on}$

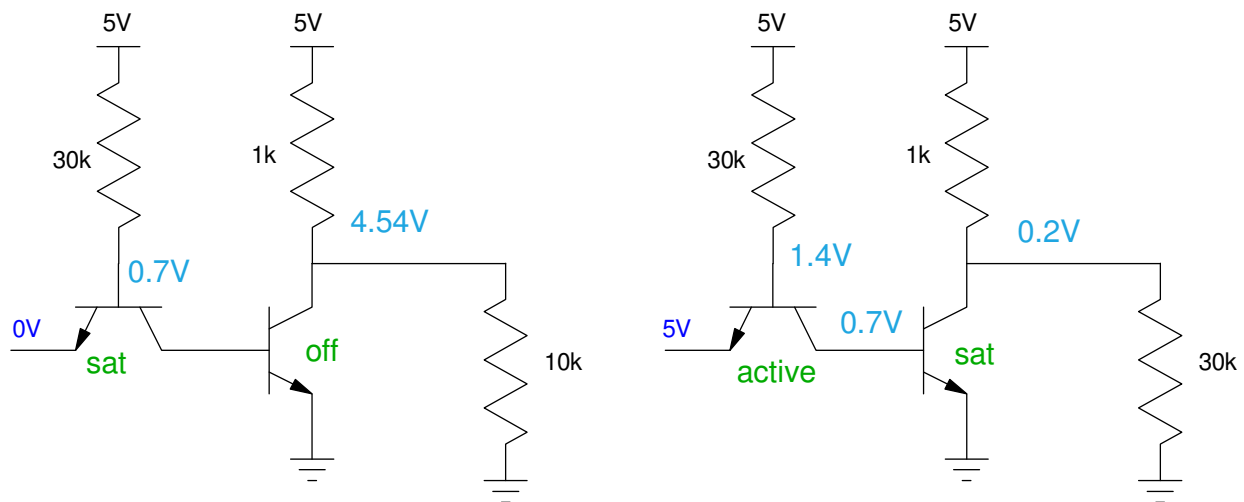
Setting the comparator to turn on at 1.80V

- Speaker turns on when $V_r < 1.80V$
- Speaker turns off when $V_r > 1.83V$



TTL Logic

8) Determine the voltages for the following TTL inverter. Assume 3904 transistors.



9) Simulate these circuits in CircuitLab and determine the voltage and currents

