ECE 320 - Homework #8

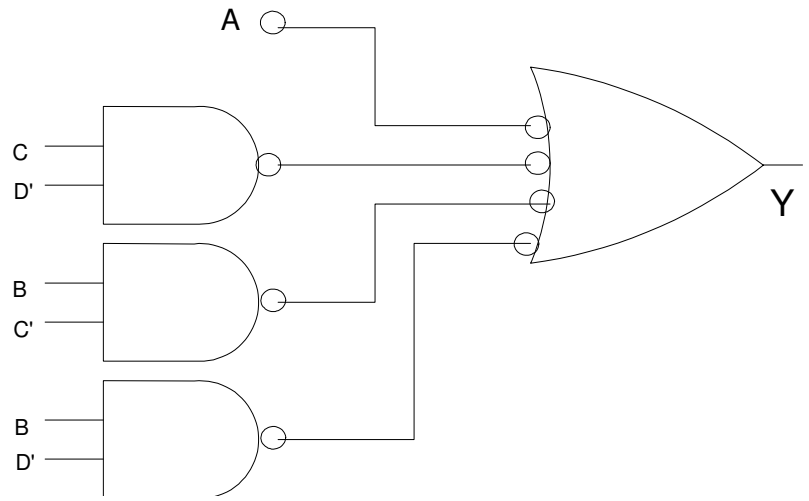
Boolean Logic, DTL, TTL Logic. Due Monday, Marth 8th

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'

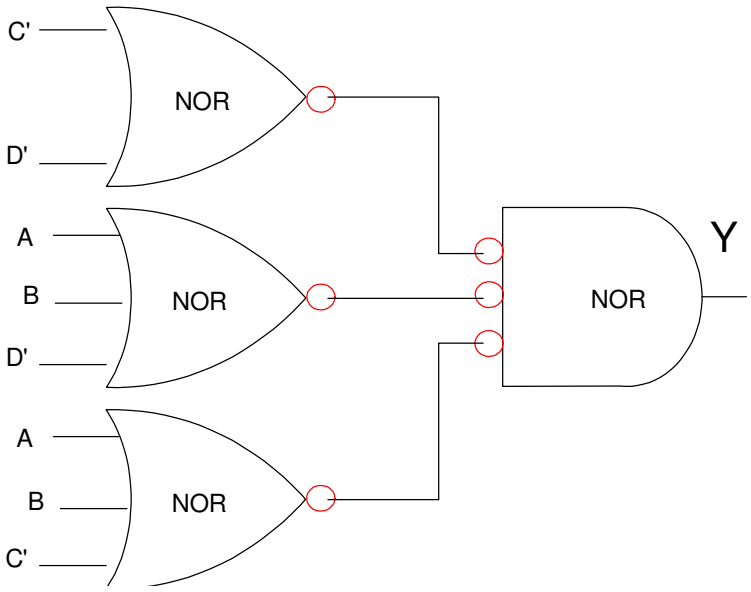


2) Implement the following function using NOR gates (i.e. circle the zeros)

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

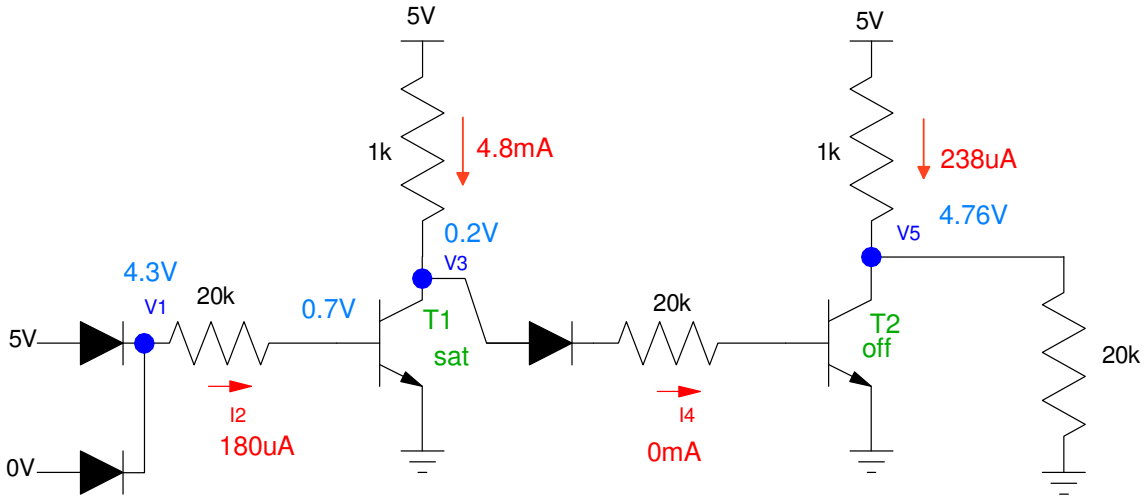
Y' = CD + A'B'D + A'B'C

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)

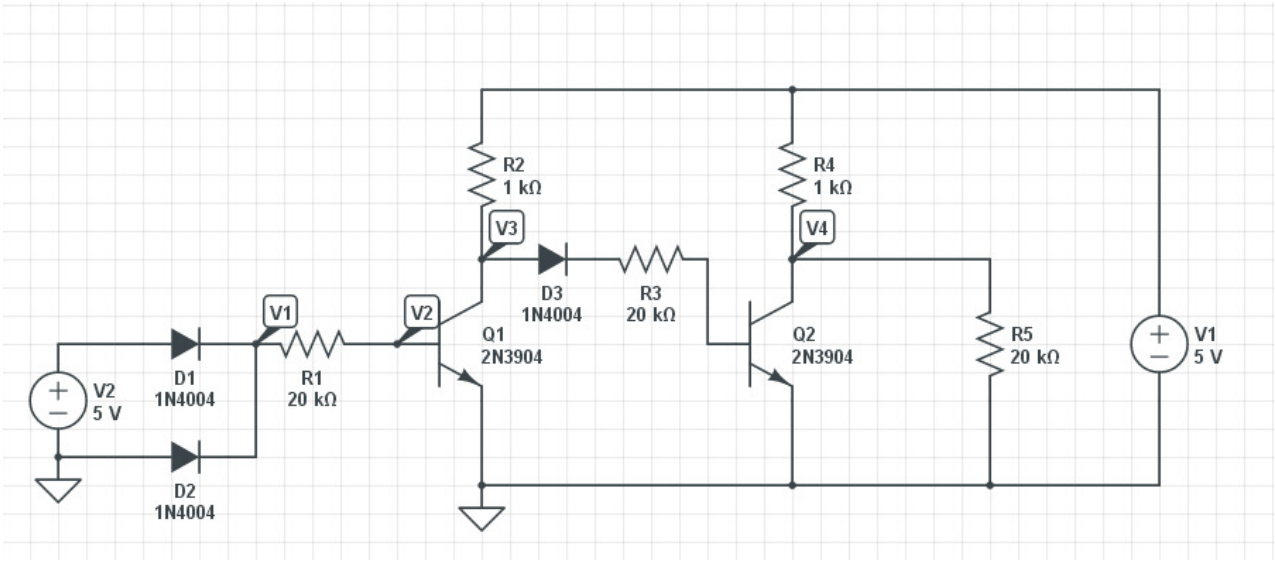
$$I_2 = \left(\frac{5V-0.7V-0.7V}{20k}\right) = 180\mu A$$

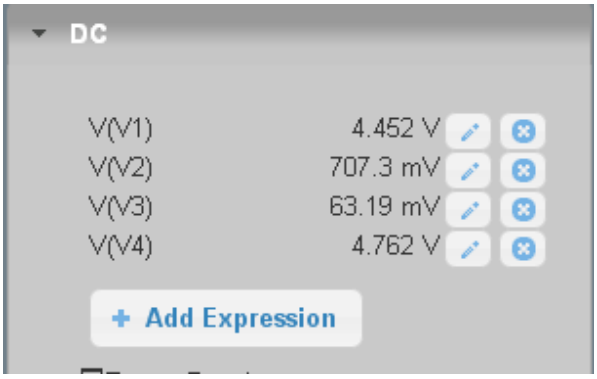
$$\beta I_2 = 18mA > 4.8mA \qquad \textit{T1 is saturated}$$

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





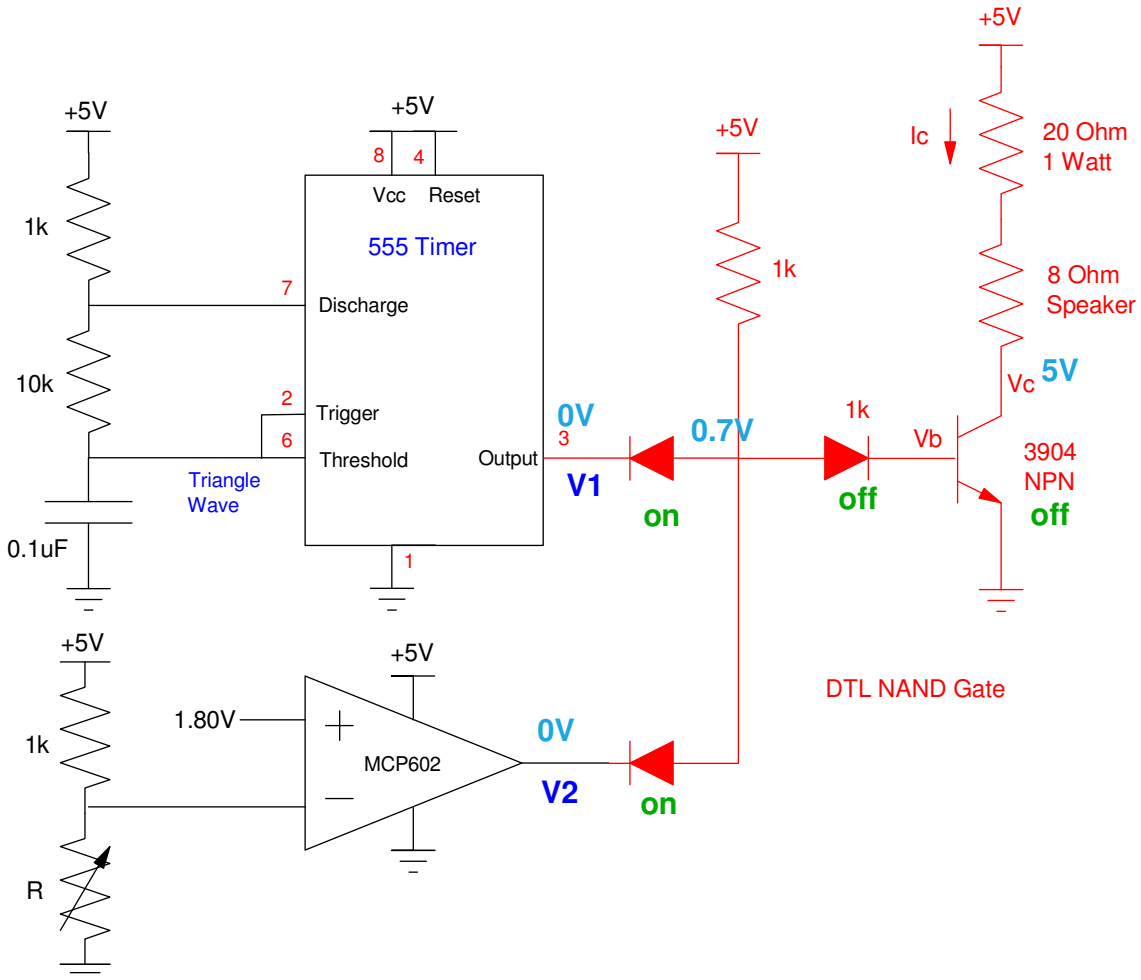
	V1	V2	V3	V4
Calculated	4.3V	0.7V	0.2V	4.76V
Simulated	4.452V	0.707V	0.063V	4.762V

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

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

5) Determine the voltages when

- V1 = V2 = 0V (red)
- V1 = V2 = 5V
- V1 = 0V, V2 = 5V (blue)



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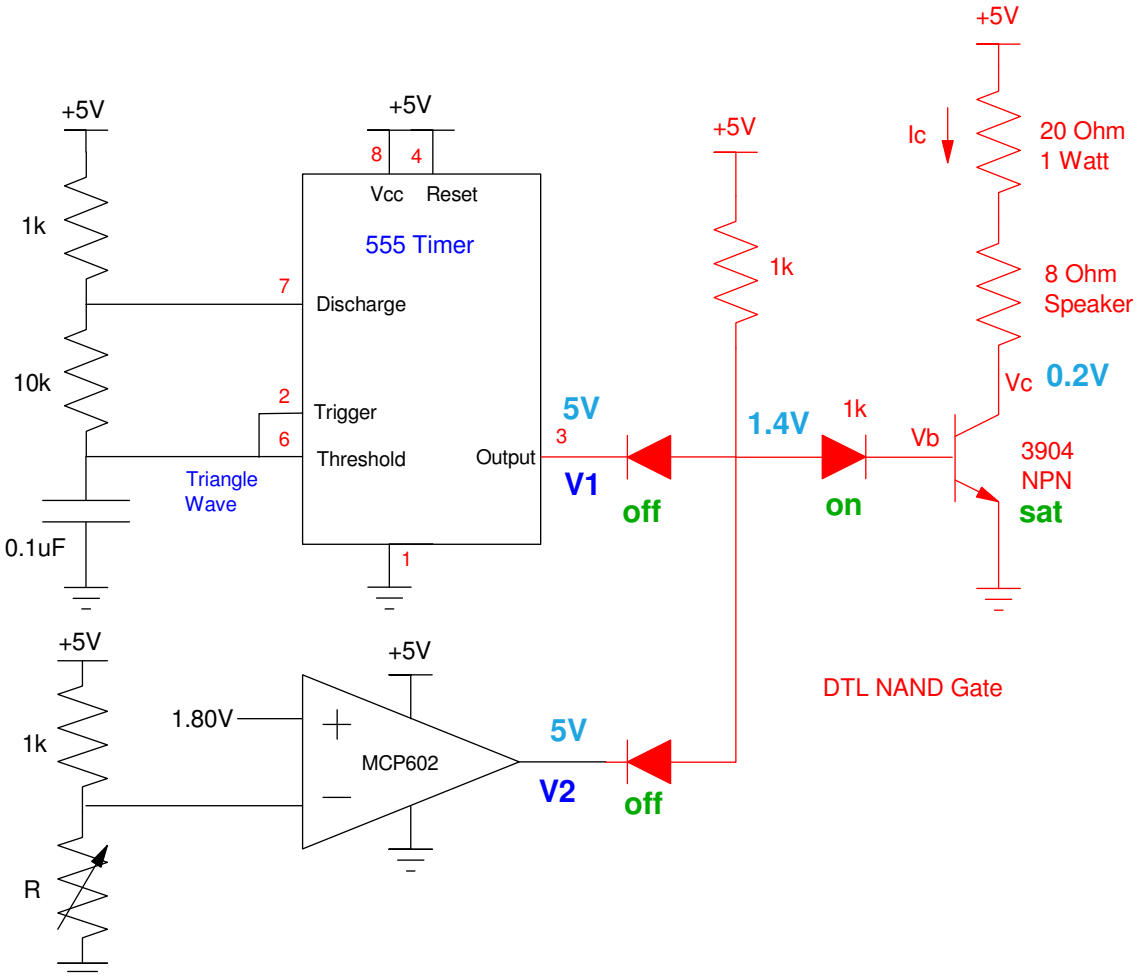
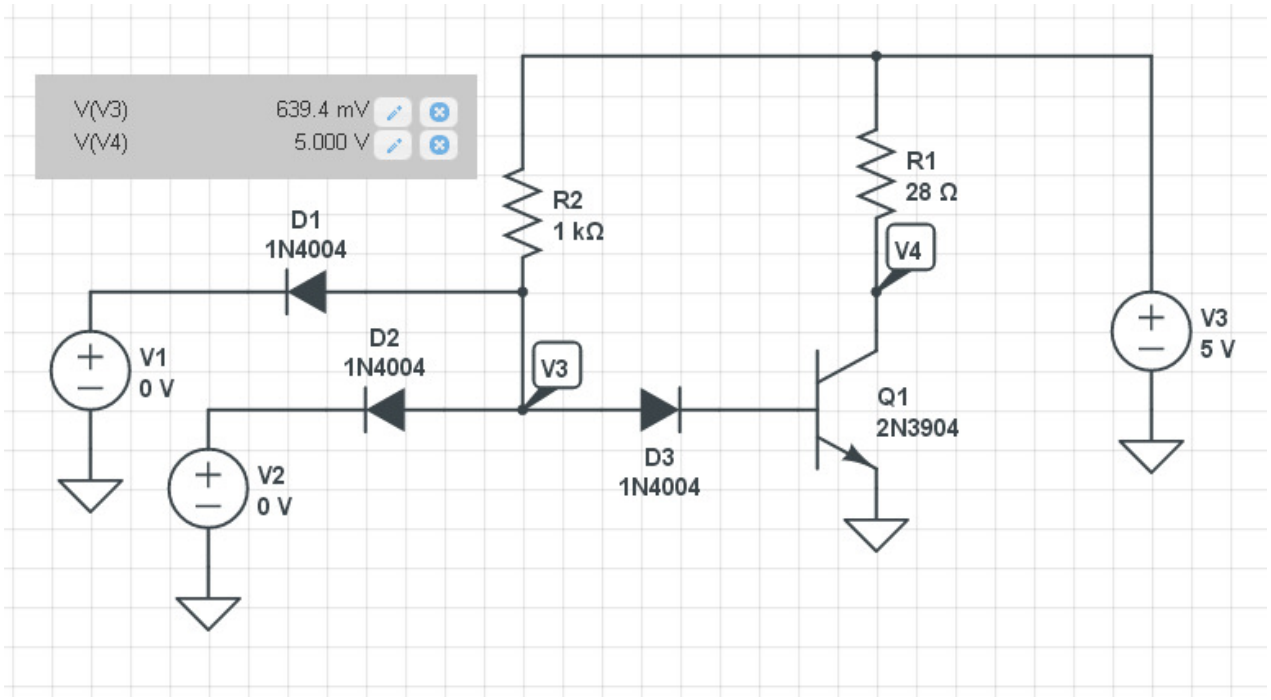
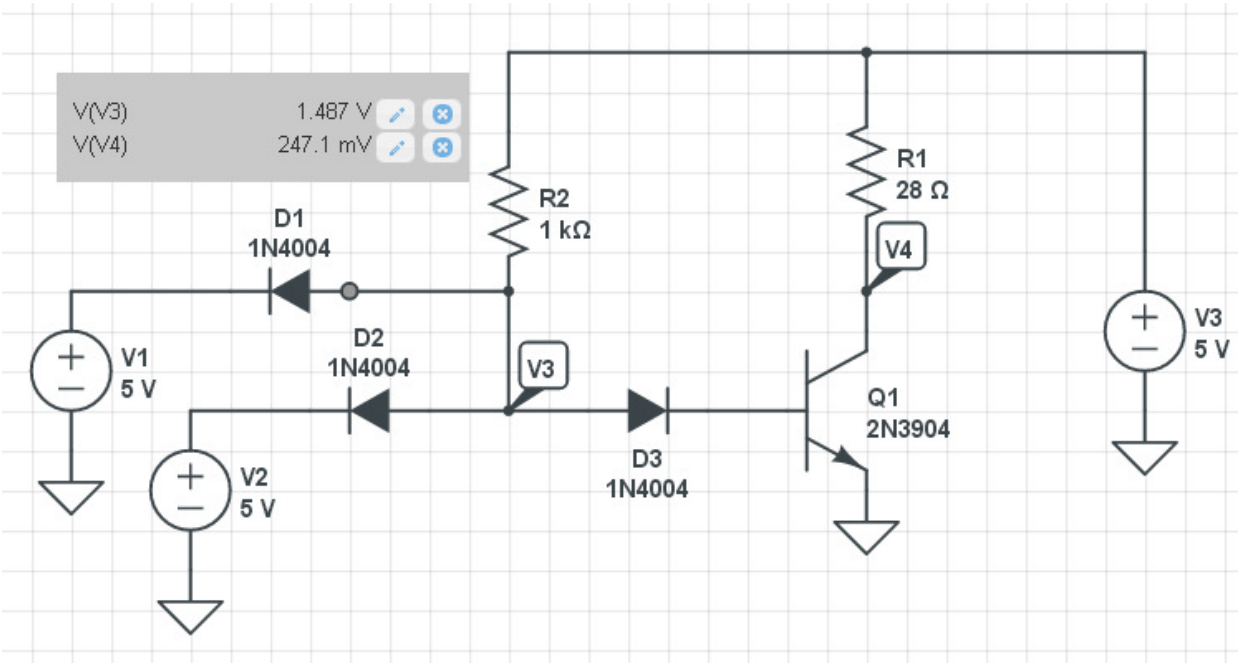

+5V
1k
10k
0.1uF
+5V
8
4
Vcc
Reset
555 Timer
7
Discharge
2
Trigger
6
Threshold
Output
3
1
Triangle
Wave
5V
V1
off
+5V
1k
1.4V
1k
on
+5V
Ic
20 Ohm
1 Watt
8 Ohm
Speaker
Vc
0.2V
Vb
3904
NPN
sat
+5V
1k
R
+5V
1.80V
MCP602
5V
V2
off
DTL NAND Gate

6) Verify your design using CircutiLab.





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

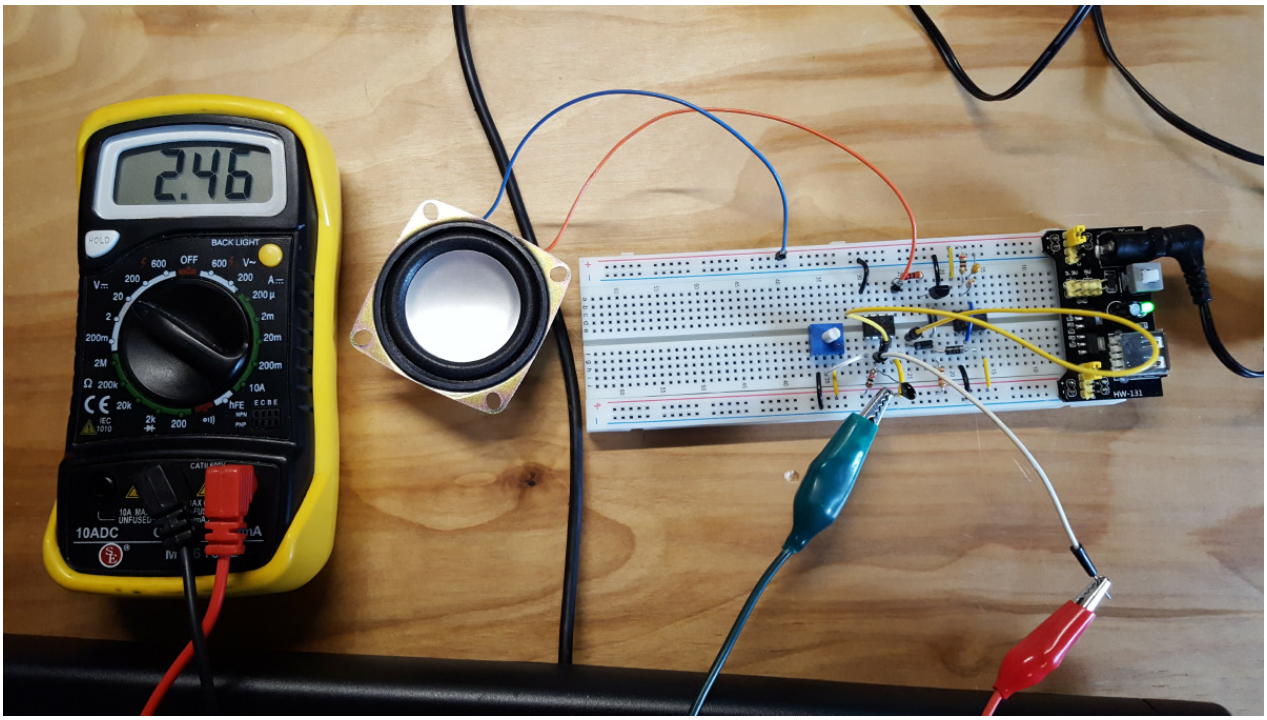
- The 555 timer from homework set #5 for V1, and
- Connecting theThe comparitor from homework set #5 for V2

Verify that

- The speaker turns on when T > Ton and
- The speaker turns off when T < Ton

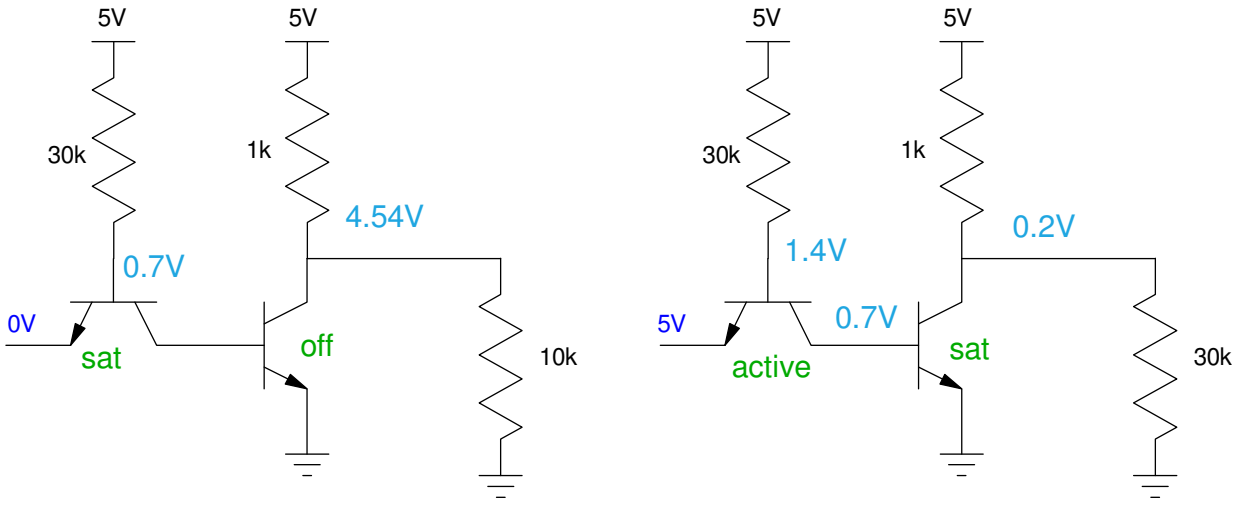
Setting the comparitor to turn on at 1.80V

- Speaker turns on when Vr < 1.80V
- Speaker turns off when Vr > 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