LAB REPORT: 2

PART A: LOGIC GATES

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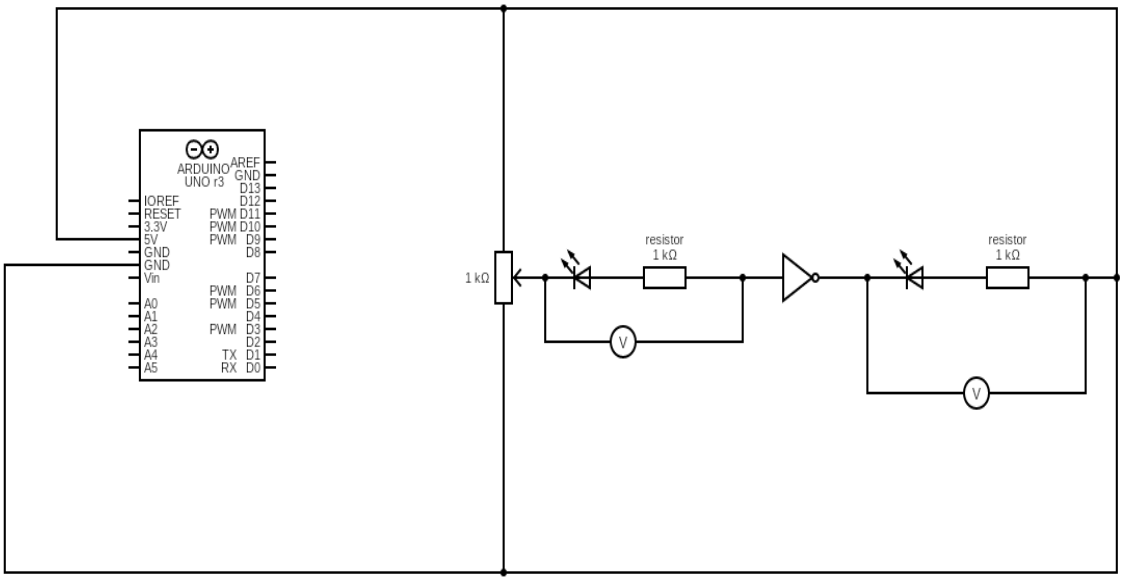
Aim/Objective of the Experiment:

To find out the tipping voltage of the IC which it considers to be HIGH or LOW in both INPUT and OUTPUT pins.

Electronic Components used:

1. Small Breadboard
2. Arduino UNO
3. Resistor (1000 ohm)
4. Potentiometer
5. 2 Multimeters
6. Connecting wires
7. 74HC04 NOT gate IC
8. 2 LED lights

Reference Circuit:



Procedure:

1. Drag all the components to the working area of Tinkercad Simulation Software.

2. Attach 74HC04 HEX Invertor (NOT Gate) to the breadboard.

3. Connect one LED to a resistor and a multimeter which in turn is connected to Ground (GND) pin, and another LED to a resistor and a multimeter which in turn is connected to 5V pin.

4. Connect both multimeters to either end of a potentiometer.

5. Start simulation and note the value of voltage at which both LEDs are glowing. This is the tipping voltage.

6. Note the voltage readings at which both the LEDs start and stop glowing.

Observations:

Tipping voltage is 2.28 V.

V_{IL}	V_{OH}	LED 1	LED 2
0.5 V	4.87 V	OFF	ON
0.7 V	4.87 V	OFF	ON
V_{IH}	V_{OL}	LED 1	LED 2
2.8	0 V	ON	OFF
3.4	0 V	ON	OFF

Conclusion:

1. $V_{OH} = 4.87$ V

2. $V_{OL} = 0.00$ V

3. $0V < V_{IL} < 2.44$ V

4. $2.52V < V_{IH} < 5.00$ V

Hence, $0 \leq V_{OL} \leq 0.4$, $0 \leq V_{IL} \leq 0.8$, $2.0 \leq V_{IH} \leq 5.0$, $2.4 \leq V_{OH} \leq 5.0$

Link for Tinkercad Simulation Circuit Part A

PART B: VERIFYING THE TRUTH TABLE OF LOGIC GATES

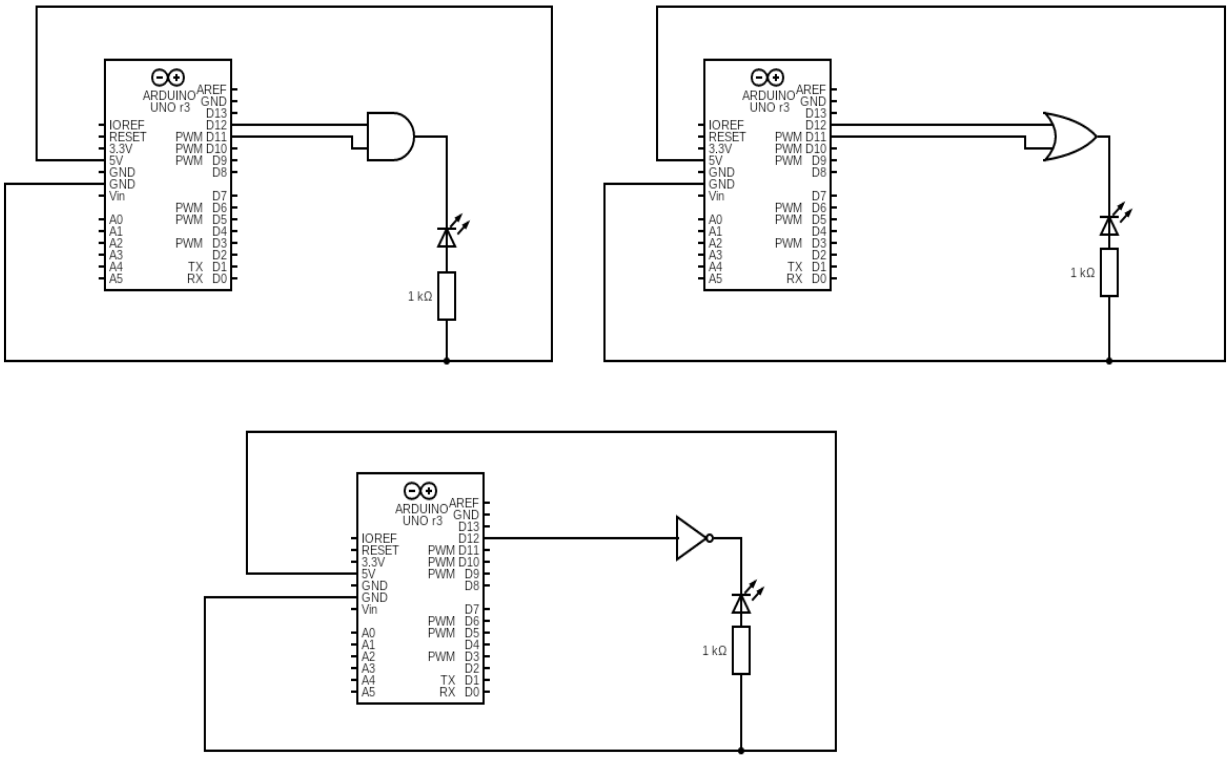
Aim/Objective of the experiment:

To observe the output of LEDs connected to various gates and verify that they match with the values in truth table

Electronic Components used:

1. Small breadboard
2. Arduino UNO
3. Connecting Wires
4. 74HC08 IC AND Gate
5. LED
6. Resistor

Reference Circuit:



Procedure:

1. Drag all the components mentioned above to the Tinkercad working area.

2. Attach the 74HC08 AND Gate to the breadboard.

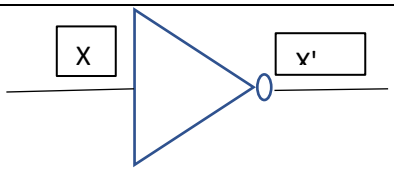
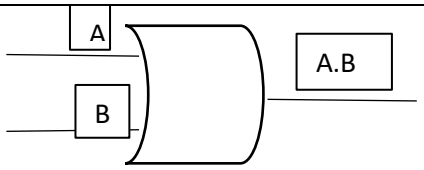
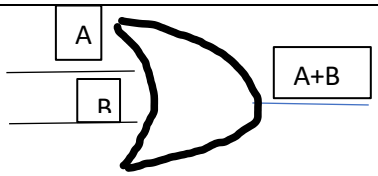
3. Take inputs from the Serial Monitor for values of A and B and direct them to the input pins of the IC.

4. Connect the LED to the output of AND Gate by means of resistor.

5. Note the output of the Gate for different values on input in the truth table.

6. Repeat the process for other Gates.

Observation:

Gate	Symbol	Input		Output
		A	B	C
74HC04 (NOT)		0 1		1 0
74HC08 (AND)		0 0 1 1	0 1 0 1	0 0 0 1
74HC32 (OR)		0 0 1 1	0 1 0 1	0 1 1 1

Link for Tinkercad simulation circuit Part B AND Gate

Link for Tinkercad simulation circuit Part B OR Gate

PART C: DE MORGAN'S LAW

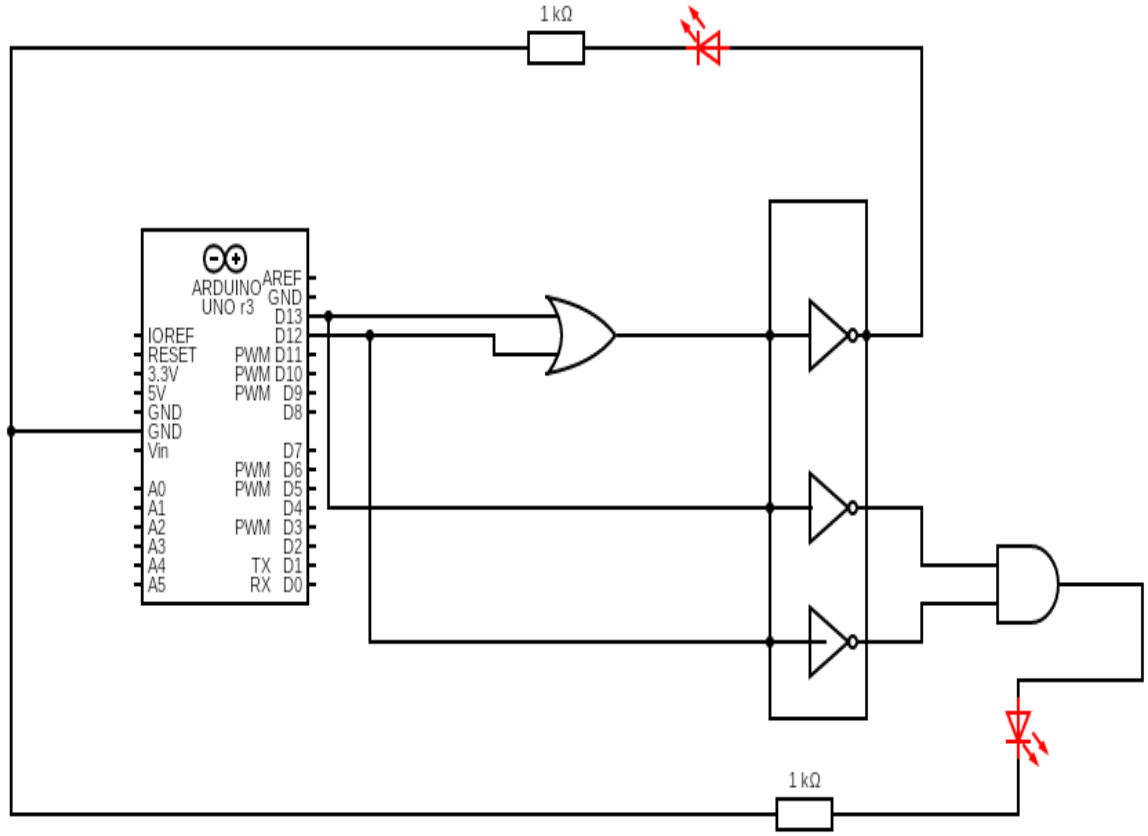
Aim/Objective of the experiment:

To verify De Morgan's theorems which state that (A+B)' = A'B' and (A.B)' = A' + B'.

Electronic Components used:

1. Arduino UNO
2. Small Breadboard
3. Connecting wires
4. 2 LEDs
5. 2 Resistors
6. 74HC04 IC (NOT Gate)
7. 74HC08 IC (AND Gate)
8. 74HC32 IC (OR Gate)

Reference Circuit:



Procedure:

1. Drag all the electronic components mentioned above to the Tinkercad working area.

2. Attach the NOT, AND and OR gates to the breadboard as shown.

3. Connect both the LEDs to one resistor each and then to any two pins on the Arduino UNO (12 and 13 in this case).

4. Connect both the outputs of the NOT Gate to the input of the AND Gate.

5. Connect the ICs to the Ground (GND) and 5V pins.

6. Pass pins 12 and 13 through OR Gate and individually through NOT gates, and the output of OR Gate through NOT Gate.

Observation:

A	B	OUTPUT
0	0	1
0	1	0
1	0	0
1	1	0

Link for Tinkercad Simulation Circuit Part C

PART D: BINARY FULL ADDER

Aim/Objective of the experiment:

To verify the truth table output of a full adder with the values obtained in the experiment, hence generating the final CARRY output using XOR and AND Gates without a third IC.

Electronic Components used:

1. Arduino UNO
2. Small Breadboard
3. Connecting wires

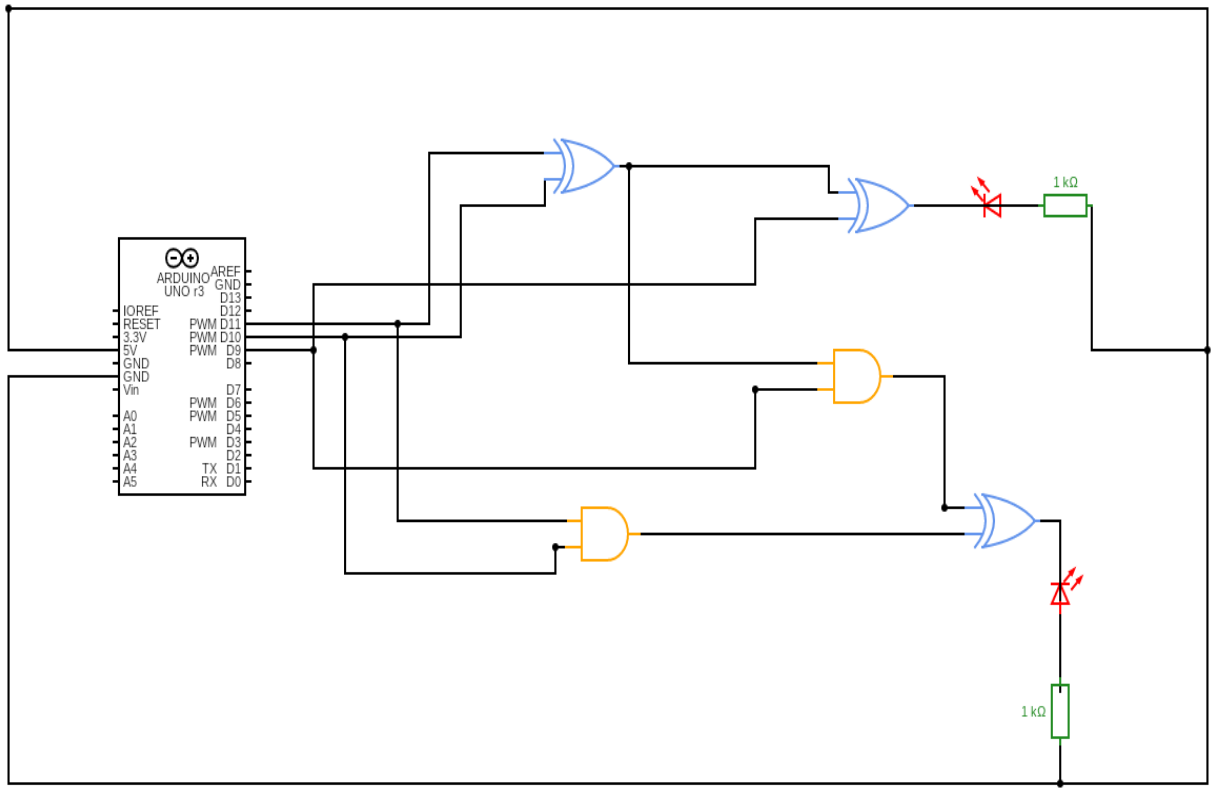
4. 2 Leds

5. 2 Resistors

6. 74HC86 IC

7. 74HC08 IC

Reference Circuit:



Procedure:

1. Drag all the electronic components mentioned above to the Tinkercad working area.

2. Attach the XOR and AND gates to the breadboard as shown to create two half adders.

3. A full adder is constructed by using two half adders which consist of XOR and AND Gates.

4. The partial sum is computed by taking input from and XOR Gate and the sum(S1) and carry (C1) are noted.

5. Set up another half adder using XOR and another AND Gate out of the same ICs.

6. Connect the C input and S1 output generated by first half adder as its inputs to generate the final SUM (S2) and CARRY (C2).

7. Generate the final Carry outputs from the intermediate carry outputs C1 and C2, using the unused Gates in XOR and AND ICs.

8. Connect the output pins to LEDs to note voltage level. Ground the LEDs and Gates.

Observations:

A	B	C	S1	C1	S2	C2
0	0	0	0	0	0	0
0	0	1	1	0	0	1
0	1	0	1	0	1	0
0	1	1	0	1	1	0
1	0	0	1	0	1	0
1	0	1	0	1	1	0
1	1	0	0	1	1	0
1	1	1	1	1	0	1

Link for Tinkercad simulation circuit Part D

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