LAB REPORT : 2

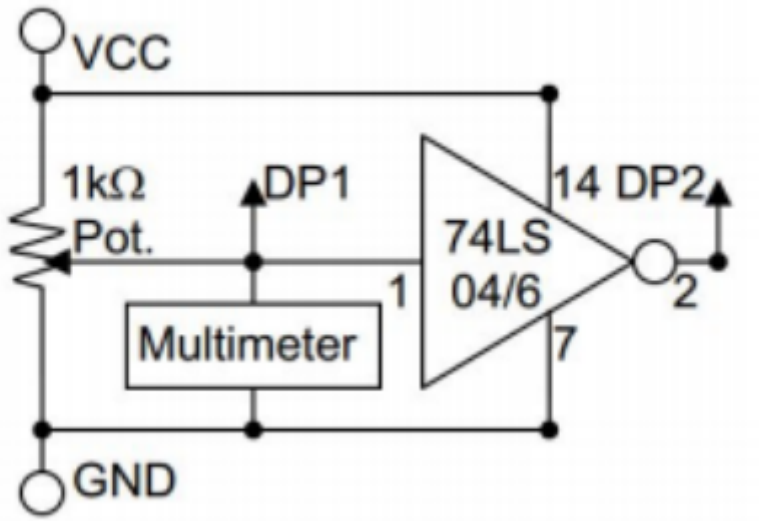
NAME: Arya Marda
ROLL NUMBER : 2021102021
GROUP NUMBER : 3

Part A:

Aim: We are intending to find the tipping point voltage for the IC which it considers to be HIGH or LOW in both INPUT and OUTPUT pins.

Electronic components used : Wires , Not gate IC, Arduino UNO, Breadboard , LED, Resistance , Multimeter.

Reference circuit :



Procedure : 1. Set up the circuit shown in Fig above on the breadboard and turn the potentiometer shaft to one end so that the multimeter reads 0V.
2. DP1 and DP2 are LEDs connected with appropriate resistors. DP2 must be glowing.
3. Now rotate the potentiometer shaft gradually up to the other end and tabulate the transitions in DP1 and DP2.

Conclusion:

$0V \leq V_{OL} \leq 0.1V$,
$2.44V \leq V_{OH} \leq 5.0V$,

$1.2V \leq V_{IL} \leq 2.5Mv$,
$1.3 V \leq V_{IH} \leq 5.0V$.

Link to the tinkercad circuit :
https://www.tinkercad.com/things/bFJBl0nOHhj

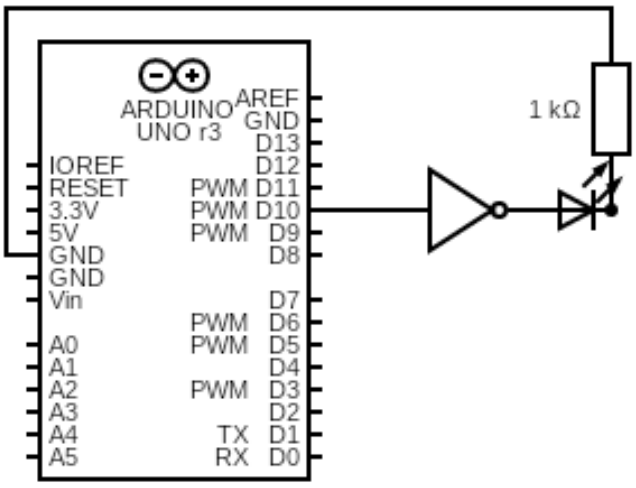
Part B:

Part 1 :

Aim : The goal of this part of the experiment is to take input from the serial monitor and verify the truth table of NOT gates .

Electronic components used : Wires , Not gate , Arduino UNO, Breadboard , LED, Resistance .

Reference circuit :



Procedure : 1. Place the IC on breadboard and give V cc and Gnd connection to it.
2. Take inputs from the Serial Monitor for values of A route them to the input pins of the IC.

3. Connect an LED with appropriate resisitor to the output of the NOT GATE.
4. Note the output of the chosen gate for different values of input in a truth table.

Code:

```
int pin2 = 3;

int x, k;

void setup()
{
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}

void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);


digitalWrite(pin2,x);
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
k=Serial.read();
}
```

Conclusion :

INPUT THROUGH PIN2	OUTPUT
1	0
0	1

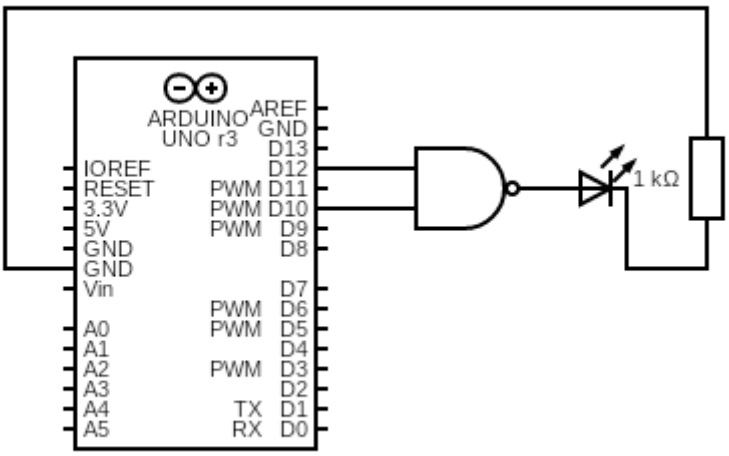
Link of tinkercad circuit : https://www.tinkercad.com/things/k8IRcjlycos

Part 2 :

Aim : The goal of this part of the experiment is to take input from the serial monitor and verify the truth table of NAND gates .

Electronic components used : Wires , NAND gate , Arduino UNO, Breadboard , LED, Resistance .

Reference circuit :



Procedure : 1. Place the IC on breadboard and give V cc and Gnd connection to it.
2. Take inputs from the Serial Monitor for values of A and B and route them to the input pins of the IC.
3. Connect an LED with appropriate resisitor to the output of the NAND GATE.
4. Note the output of the chosen gate for different values of input in a truth table.

Code:

```
int pin1 = 2;
int pin2 = 3;

int x, y, k;

void setup()
{
pinMode(pin1, OUTPUT);
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}
void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);
Serial.print("y=");
while(Serial.available() == 0){}
y=Serial.read();
y=y-'0';
Serial.println(y);
digitalWrite(pin1,x);
digitalWrite(pin2,y);
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
k=Serial.read();
}
```

Conclusion :

Input through pin2	Input through pin3	Output
1	1	0
1	0	1
0	1	1
0	0	1

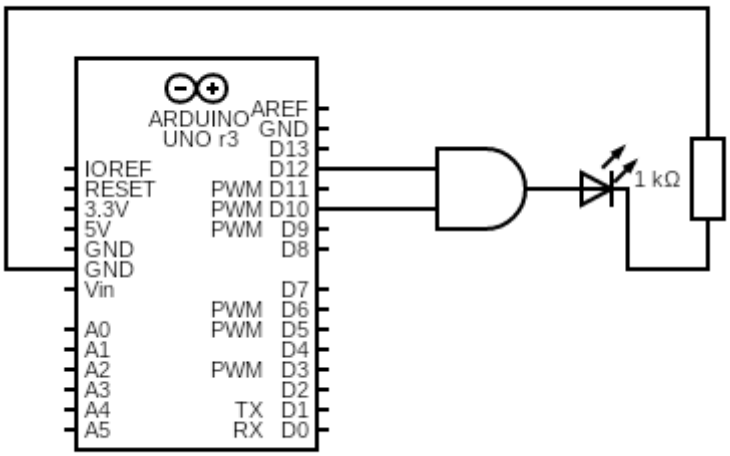
Link:
https://www.tinkercad.com/things/8c7sLocsfb3

Part 3 :

Aim : The goal of this part of the experiment is to take input from the serial monitor and verify the truth table of AND gates .

Electronic components used : Wires , AND gate , Arduino UNO, Breadboard , LED, Resistance .

Reference circuit :



Procedure : 1. Place the IC on breadboard and give V cc and Gnd connection to it.
2. Take inputs from the Serial Monitor for values of A and B and route them to the input pins of the IC.
3. Connect an LED with appropriate resisitor to the output of the AND GATE.
4. Note the output of the chosen gate for different values of input in a truth table.

Code:

```
int pin1 = 2;
int pin2 = 3;

int x, y, k;

void setup()
{
pinMode(pin1, OUTPUT);
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}

void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);
Serial.print("y=");
while(Serial.available() == 0){}
y=Serial.read();
y=y-'0';
Serial.println(y);
digitalWrite(pin1,x);
digitalWrite(pin2,y);
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
k=Serial.read();
}
```

Conclusion :

Input through pin2	Input through pin3	Output
1	1	1
1	0	0
0	1	0
0	0	0

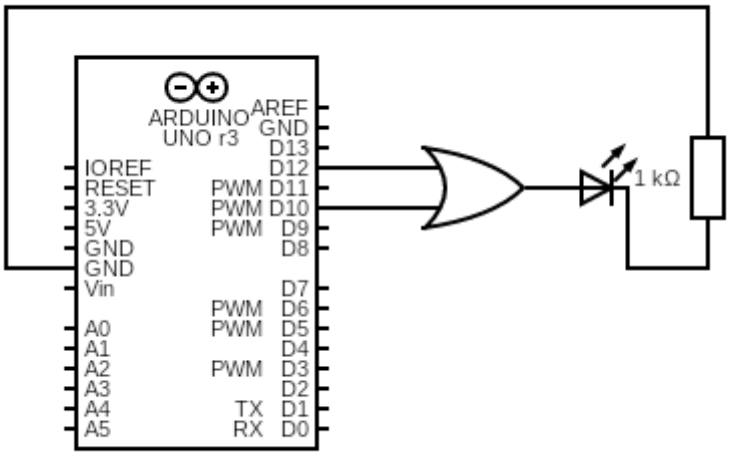
Link of tinkercad circuit :
https://www.tinkercad.com/things/bS5xUSFKepr

Part 4 :

Aim : The goal of this part of the experiment is to take input from the serial monitor and verify the truth table of OR gates .

Electronic components used : Wires , OR gate , Arduino UNO, Breadboard , LED, Resistance .

Reference circuit :



Procedure : 1. Place the IC on breadboard and give V cc and Gnd connection to it.
2. Take inputs from the Serial Monitor for values of A and B and route them to the input pins of the IC.
3. Connect an LED with appropriate resisitor to the output of the OR GATE.

4. Note the output of the chosen gate for different values of input in a truth table.

Code:

```
int pin1 = 2;
int pin2 = 3;

int x, y, k;

void setup()
{
pinMode(pin1, OUTPUT);
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}

void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);
Serial.print("y=");
while(Serial.available() == 0){}
y=Serial.read();
y=y-'0';
Serial.println(y);
digitalWrite(pin1,x);
digitalWrite(pin2,y);
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
k=Serial.read();


}
```

Conclusion :

Input through pin2	Input through pin3	Output
1	1	1
1	0	1
0	1	1
0	0	0

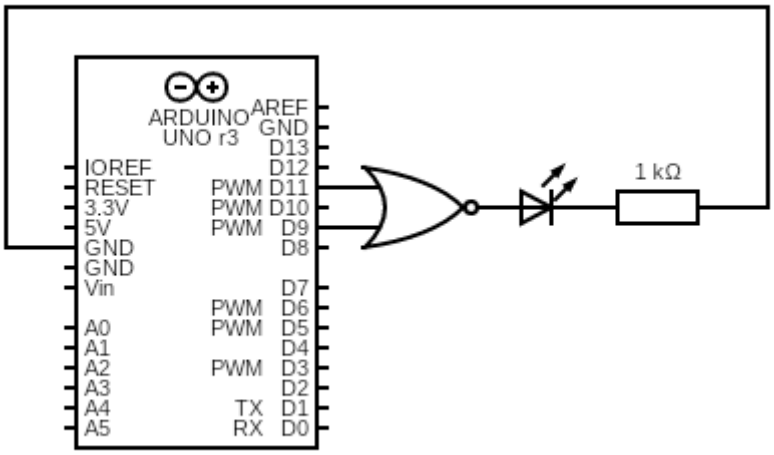
Link of tinkercad circuit :
https://www.tinkercad.com/things/8wGmP53KBUm

Part 5 :

Aim : The goal of this part of the experiment is to take input from the serial monitor and verify the truth table of NOR gates .

Electronic components used : Wires , NOR gate , Arduino UNO, Breadboard , LED, Resistance .

Reference circuit :



Procedure : 1. Place the IC on breadboard and give V cc and Gnd connection to it.

2. Take inputs from the Serial Monitor for values of A and B and route them to the input pins of the IC.
3. Connect an LED with appropriate resisitor to the output of the NOR GATE.
4. Note the output of the chosen gate for different values of input in a truth table.

Code:

```
int pin1 = 2;
int pin2 = 3;

int x, y, k;

void setup()
{
pinMode(pin1, OUTPUT);
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}

void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);
Serial.print("y=");
while(Serial.available() == 0){}
y=Serial.read();
y=y-'0';
Serial.println(y);
digitalWrite(pin1,x);
digitalWrite(pin2,y);
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
```

```
k=Serial.read();
}
```

Conclusion :

Input through pin2	Input through pin3	Output
1	1	0
1	0	0
0	1	0
0	0	1

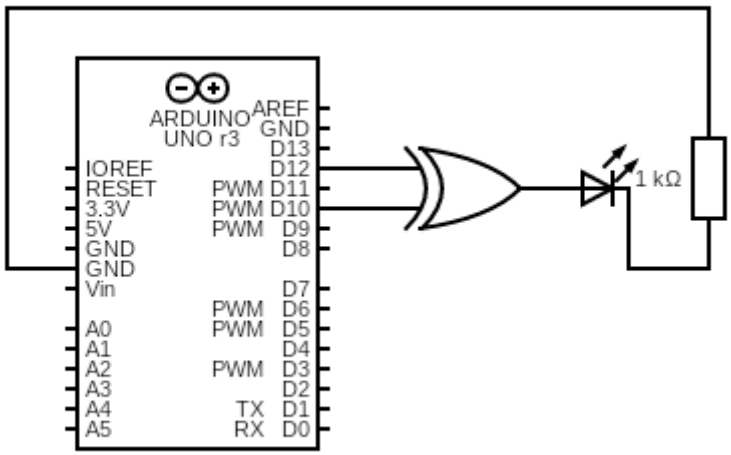
Link of tinkercad circuit :
https://www.tinkercad.com/things/4M7GVp8WeVr

Part 6 :

Aim : The goal of this part of the experiment is to take input from the serial monitor and verify the truth table of XOR gates .

Electronic components used : Wires , XOR gate , Arduino UNO, Breadboard , LED, Resistance .

Reference circuit :



Procedure : 1. Place the IC on breadboard and give V cc and Gnd connection to it.

2. Take inputs from the Serial Monitor for values of A and B and route them to the input pins of the IC.
3. Connect an LED with appropriate resisitor to the output of the XOR GATE.
4. Note the output of the chosen gate for different values of input in a truth table.

Code:

```
int pin1 = 2;
int pin2 = 3;

int x, y, k;

void setup()
{
pinMode(pin1, OUTPUT);
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}

void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);
Serial.print("y=");
while(Serial.available() == 0){}
y=Serial.read();
y=y-'0';
Serial.println(y);
digitalWrite(pin1,x);
digitalWrite(pin2,y);
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
```

k=Serial.read();
}

Conclusion :

Input through pin2	Input through pin3	Output
1	1	0
1	0	1
0	1	1
0	0	0

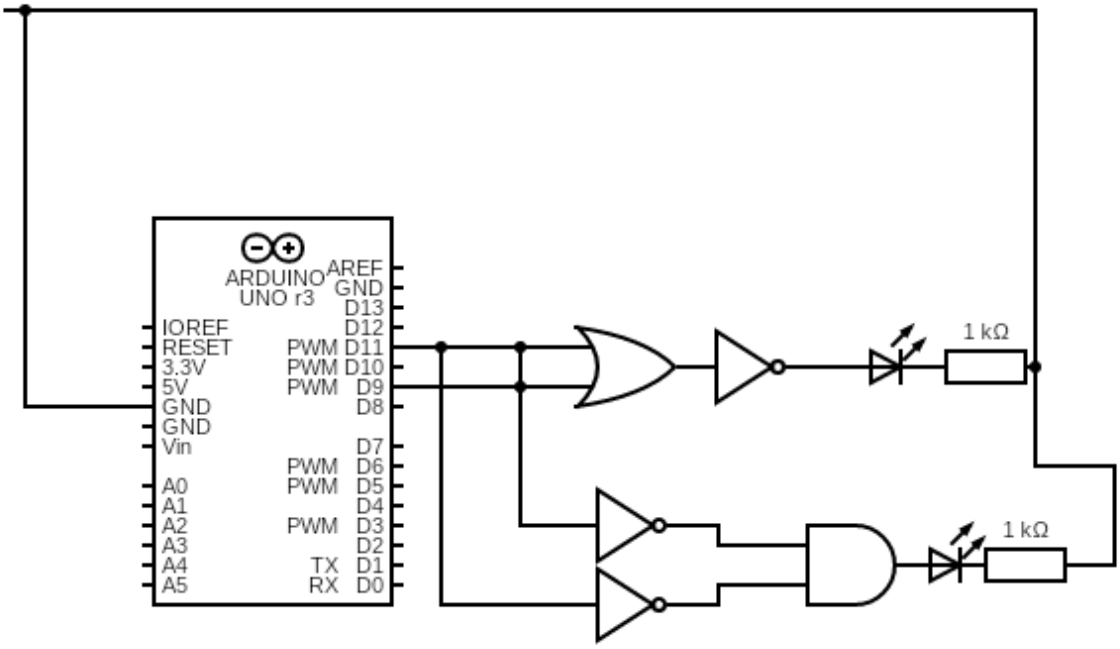
Link of tinkercad circuit :
https://www.tinkercad.com/things/3eZbnpxB34y

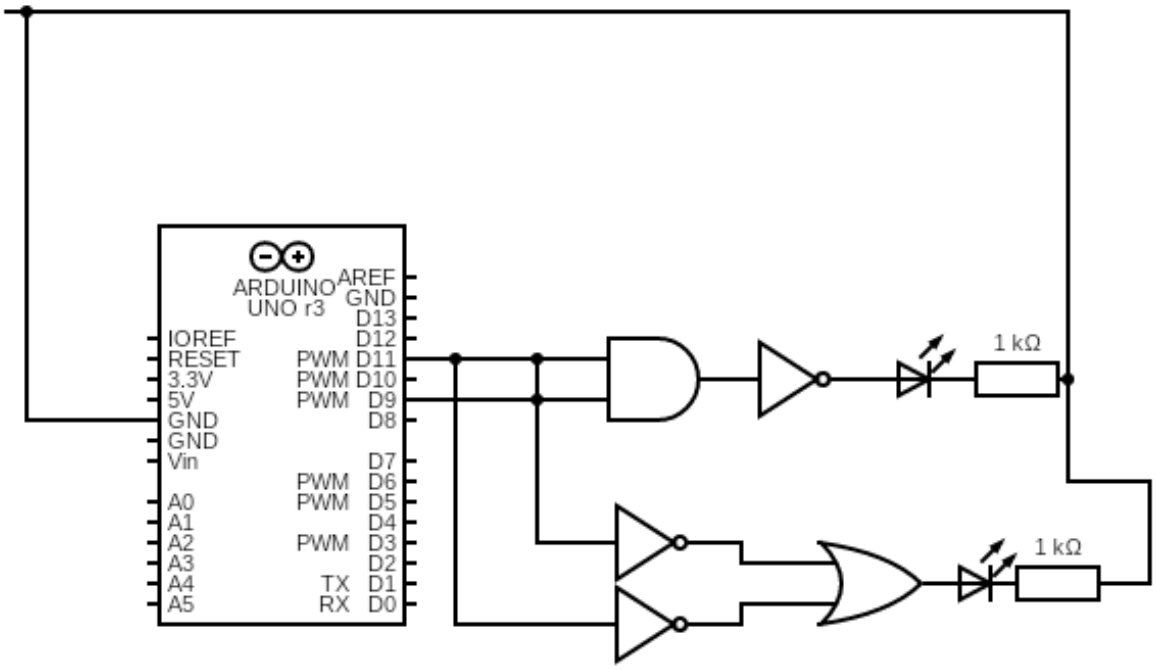
PART C:

Aim : Verifing De Morgan's theorems that state's that $(A + B)' = A' \cdot B'$ and $(A \cdot B)' = A' + B'$.

Electronic components used : Arduino UNO, Breadboard , wires, NOT GATE , AND GATE , OR GATE , LED, resistance.

Reference circuits : 1.$(A + B)' = A' \cdot B'$ 2.$(A \cdot B)' = A' + B'$





Procedure : 1. Set up a circuit consisting of two NOT gates and one AND gate to perform function Y = A' · B' and one OR gate to preform (A+B)' .

2. Obtain the truth table of this circuits by noting the output of the function for different values of A and B. Verify that the both funnction give the same output.

3. Repeat steps 1 and 2 using an OR gate instead of an AND gate and AND gate instead of OR gate to verify that the truth table is same for (A · B)' and A'+ B' .

Code :

```
int pin1 = 2;
int pin2 = 3;

int x, y, k;

void setup()
```

```
{
pinMode(pin1, OUTPUT);
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}

void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);
Serial.print("y=");
while(Serial.available() == 0){}
y=Serial.read();
y=y-'0';
Serial.println(y);
digitalWrite(pin1,x);
digitalWrite(pin2,y);
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
k=Serial.read();


}
```

Conclusion :

Input A	Input B	A'·B'	(A+B)'
1	1	0	0
1	0	0	0
0	1	0	0
0	0	1	1

Therfore : (A + B)' = A' · B'

Input A	Input B	(A · B)’	A’+ B’
1	1	0	0
1	0	1	1
0	1	1	1
0	0	1	1

Therfore : (A · B)’ = A’+ B’

Link to tinkercad circuit
https://www.tinkercad.com/things/9dEInNi2mVu

How would you use NAND gates to perform function of NOT gates?

ANS-> NAND gate can act as NOT gate if we keep one input as 1 and take other input from user .

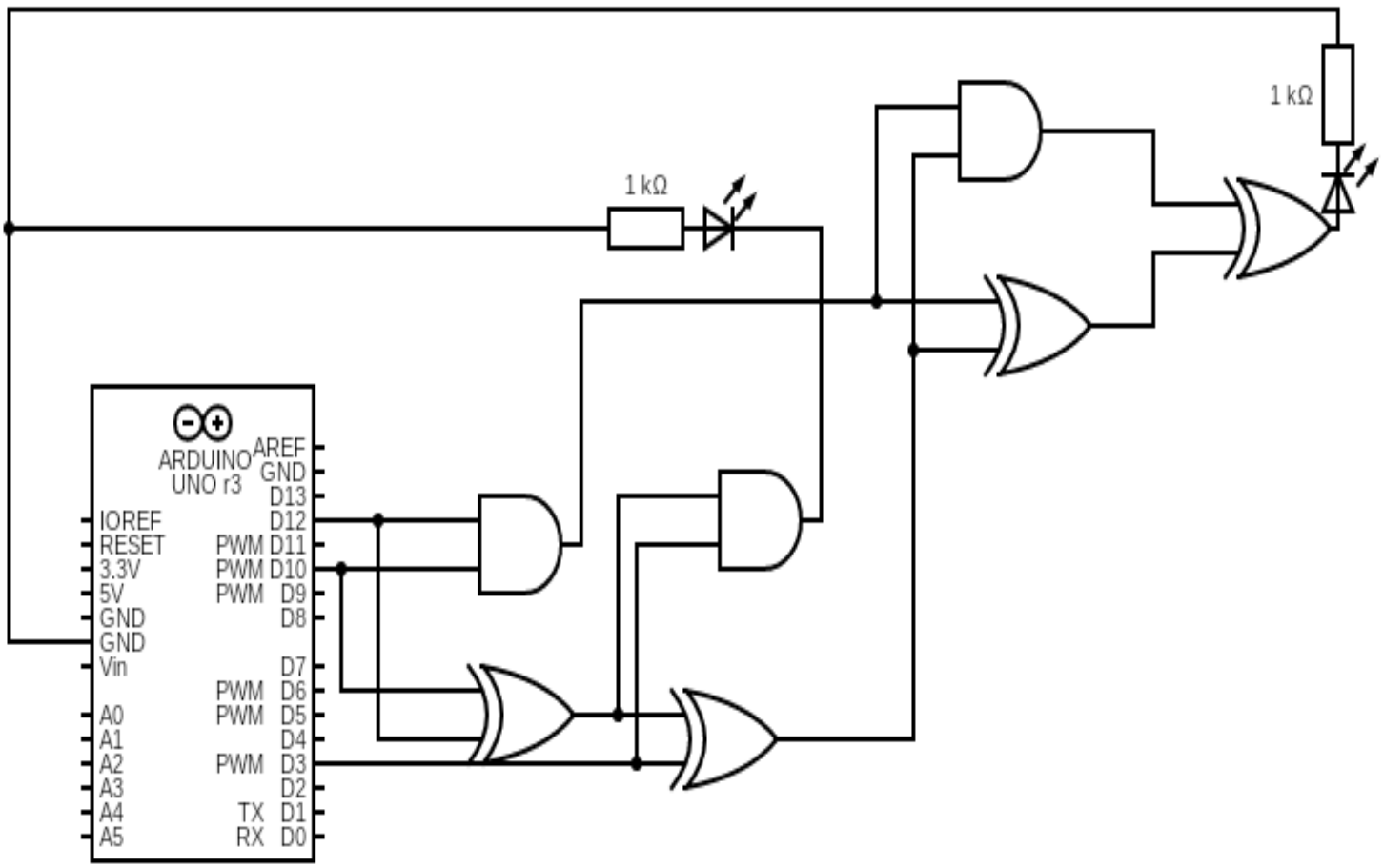
INPUT FROM USER	1 AS DEFAULT	OUTPUT(NAND)
1	1	0
0	1	1

PART D

Aim : Building a binary Full Adder that adds two bits A and B along with a carry in C to generate SUM and CARRY bits as output.

Electronic components used : Arduino UNO, Breadboard , wires, XOR GATE , AND GATE , LED,resistance.

Reference circuit :



Procedure : 1) Make half Adder circuit which adds two binary inputs A and B to give a sum S1 and a carry C1 according to the following Boolean expressions for the outputs S1 and C1:

$S1 = A' \cdot B + A \cdot B' = A \oplus B$ and $C1 = A \cdot B$

2)Set up a circuit consisting of one XOR gates and one AND gate to perform function $S1 = A \oplus B$ and $C1 = A \cdot B$

3)Finding Final sum and Carry C2 using the same Gates, here 'C' is the third input from the user .

$SUM = S1 \oplus C1$ and $C2 = S1 \cdot C$

4)Final carry is callculated using XOR and AND gate as

Carry = $(C1 \oplus C2) \oplus (C1 \cdot C2)$.

Code:

```
int pin3 = 4;
int pin1 = 2;
int pin2 = 3;

int x, y, z, k;

void setup()
{
pinMode(pin1, OUTPUT);
pinMode(pin2, OUTPUT);
Serial.begin(9600);
}

void loop()
{
Serial.print("\nx=");
while(Serial.available() == 0){}
x=Serial.read();
x=x-'0';
Serial.println(x);

Serial.print("y=");
while(Serial.available() == 0){}
y=Serial.read();
y=y-'0';
Serial.println(y);

Serial.print("z=");
while(Serial.available() == 0){}
z=Serial.read();
z=z-'0';
Serial.println(z);

digitalWrite(pin1,x);
digitalWrite(pin2,y);
digitalWrite(pin3,z);
```

```
Serial.print("Enter anything to go to Read again");
while(Serial.available() == 0){}
k=Serial.read();
}
```

Conclusion :

A	B	C	S1	SUM	C1	C2	CARRY	ANS
0	0	0	0	0	0	0	0	00
0	0	1	0	1	0	0	0	01
0	1	0	1	1	0	0	0	01
0	1	1	1	0	0	1	1	10
1	0	0	1	1	0	0	0	01
1	0	1	1	0	0	1	1	10
1	1	0	0	0	1	0	1	10
1	1	1	0	1	1	0	1	11

Link to tinkercad circuit :
https://www.tinkercad.com/things/hbNuevpWhh9