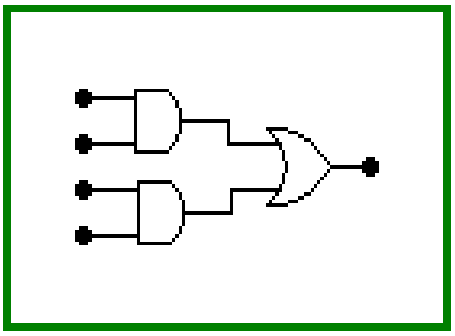
Lab – Boolean Expressions

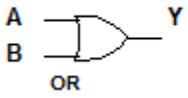
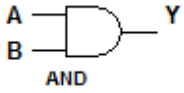
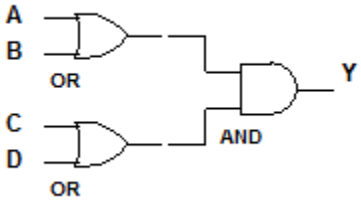


VERY IMPORTANT : DISCONNECT THE POWER SUPPLY FROM YOUR CIRCUIT WHEN WIRING YOUR CIRCUITS.

Purpose: To study the use of logic gates to create boolean expressions.

Part A – Boolean Expressions

- The following boolean expressions can be wired using logic gates as follows:

A+B = Y	
A•B = Y	
(A+B)•(C+D) = Y	

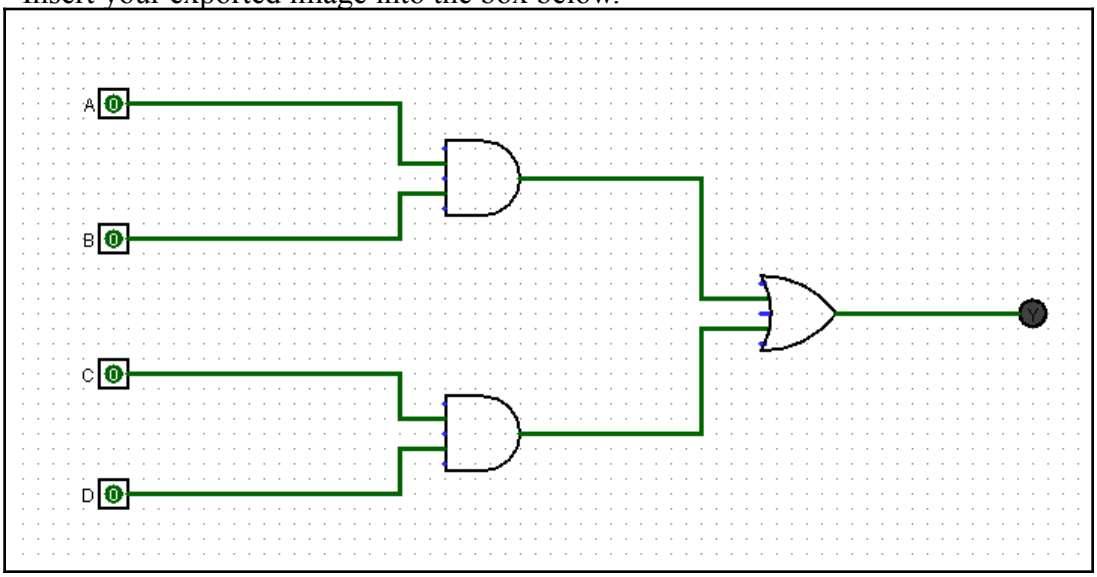
1. Creating a circuit using AND and OR gates from a Boolean Expression

a. Consider the following expression:

$$A \bullet B + C \bullet D = Y$$

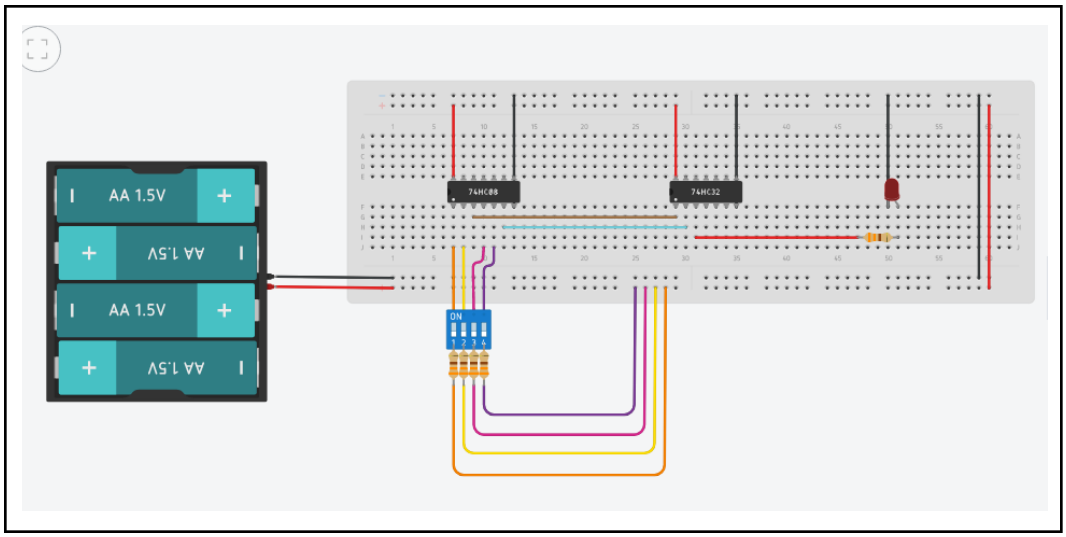
b. Use *Logisim* to create the schematic for the expression above using the necessary gates: (Remember to use pins for the inputs A, B, C, and D). Y will be represented by an LED (ON = 1 OFF = 0)

Insert your exported image into the box below.



c. Use the necessary logic gates to create your circuit on a breadboard. Use the pull down resistors and push button switches to create active high inputs. Use a resistor and LED at the output to show your circuit operation visually.

Paste a screenshot of your Tinkercad circuit in the box below:



d. Complete the truth table:

D	C	B	A	A•B	C•D	Y
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	0	1	1	1	0	1
0	1	0	0	0	0	0
0	1	0	1	0	0	0
0	1	1	0	0	0	0
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	0	1	0	0	1
1	0	1	0	0	0	1
1	0	1	1	1	0	0
1	1	0	0	0	1	1
1	1	0	1	0	1	1
1	1	1	0	0	1	1
1	1	1	1	1	1	1

Part B – DeMorgan's Law

Purpose: To verify DeMorgan's Laws

- DeMorgan's second law states:

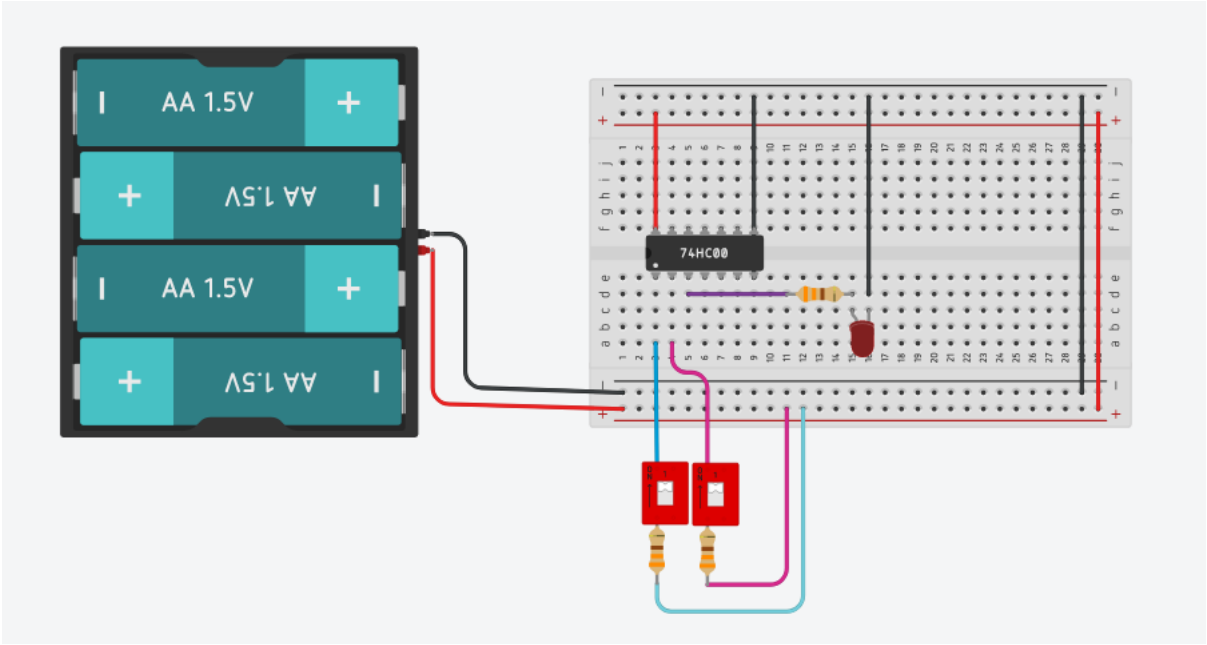
$$\overline{A\ B} = \overline{A} + \overline{B}$$

1. **<u>Connecting DeMorgan's second Law.</u>**

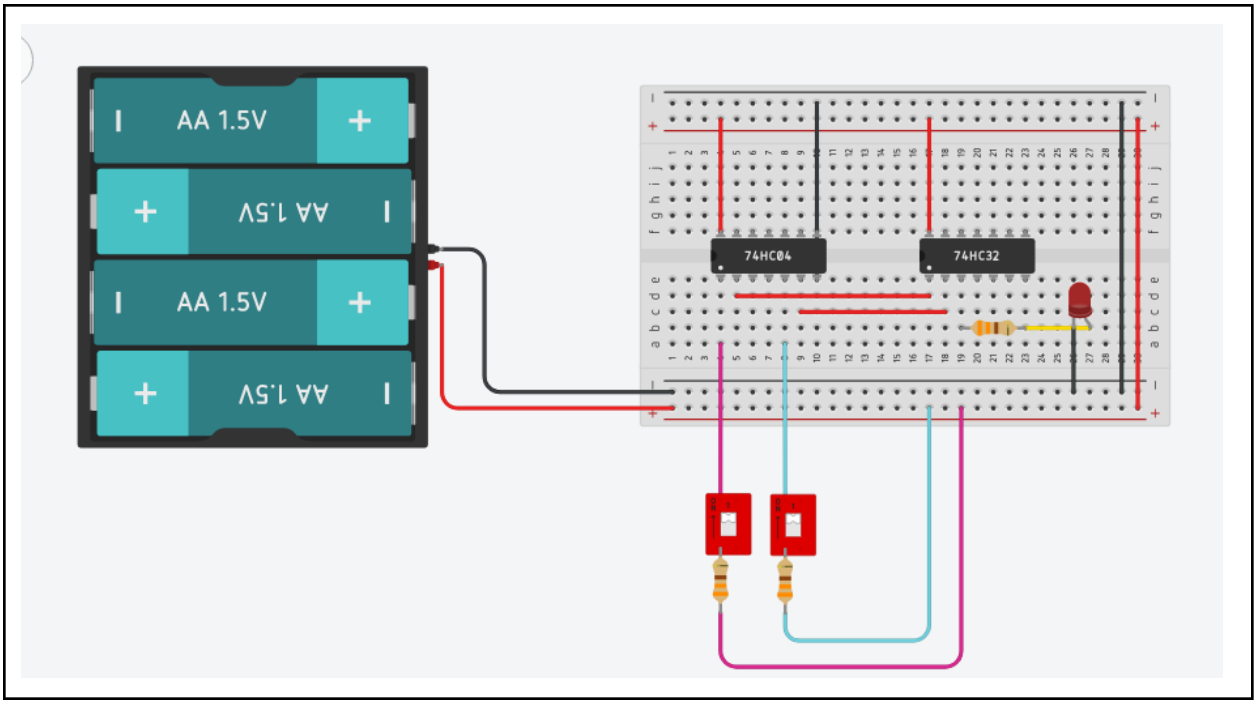
- Use two breadboards side by side or one large breadboard to wire both the left side of the equation (using a NAND gate) and the right side of the equation (using a NOT and an OR gate). Both circuits can share the same power supply.

Circuit: Wire the circuit described above and insert a screenshot of your Tinkercad circuit below.

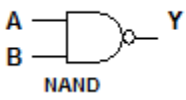
NAND Circuit



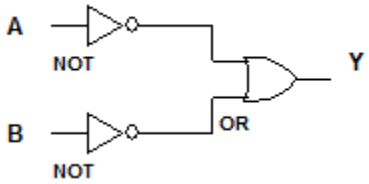
NOT and OR Circuit



- Observe the different outputs as you change the inputs. Use active high inputs and resistor LED combinations at the output. Record your observations in the table below.



A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0



A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0