ELEC1100 - Tutorial 5

Introduction to Lab Homework

Arrangement

❖ Weeks 7-8

- Go to your Canvas lab page (LA1/LA2/LA3)
- Find "homework questions" & "Homework summary sheet"
- There are 3 questions in this lab homework
- Follow the given steps in "homework questions"
- Complete the "summary sheet" and submit to your Canvas lab page (LA1/LA2/LA3) before the deadline.

Submission Deadline: 11:50am (in the morning) on Apr 09 (Thu)

Policies

❑ Penalty mark on late submission

- 50% penalty mark will be given to a late submission within 3 hours.
- Zero mark will be given to more than 3-hour late submission.

❑ Submit as a single **Word document**

- Follow the scheme given in the summary sheet, type in your answers.
  (or draw diagrams, or paste the screenshot of your Tinkercad simulation results)
- Pasting photos of handwritten steps are acceptable.
- It is your responsibility to ensure that the handwritten parts are readable.

Those in cursive handwriting will NOT be graded.

Policies

- About Discussion
  - It is allowed to discuss with others regarding the general approaches.
  - It is **NOT acceptable** to work together on a detailed solution, to copy a solution, or give away a solution.

- This lab homework accounts for 15% of your overall grade

Copying from each other will result in zero mark

Topics & Skills

❖ Hot Topics

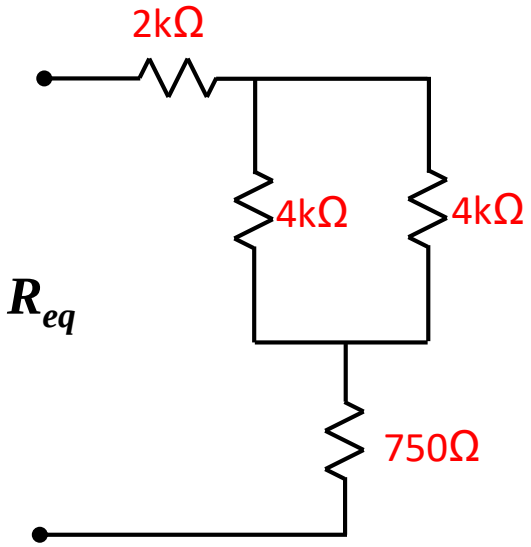
- Resistance, Resistor
- Transistor
- Basic logic gates
- Truth table & K-map (you need to use what you learn in Lecture 11 & 12 for **Q3**)

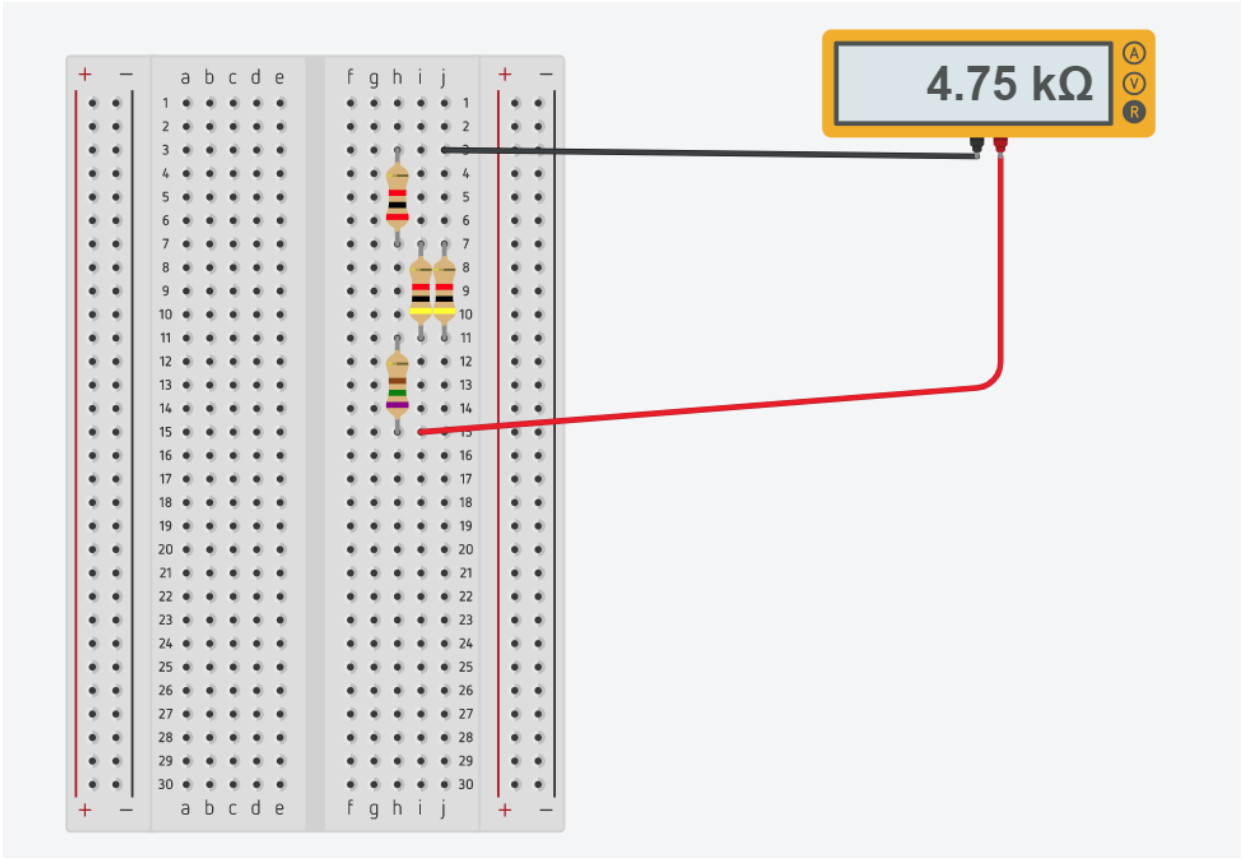
❖ Skills required

- Do simple math & deduction
- Circuit building & debugging
- Logic system design & verification

Example Question [1]

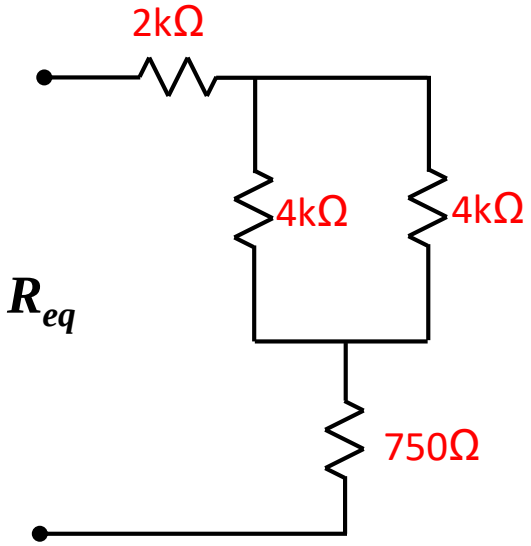
- Measure the equivalent resistance R_{eq} in Tinkercad





Example Question [1]

- Calculate for the equivalent resistance $\boldsymbol{R_{eq}}$



$$\boldsymbol{R_{eq}} = 2k + \frac{1}{\frac{1}{4k} + \frac{1}{4k}} + 0.75k$$

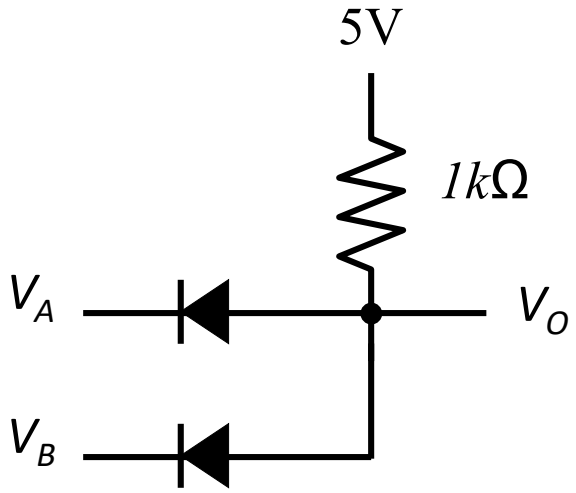
$$= 4.75k$$

****The calculated $\boldsymbol{R_{eq}}$ should match with the reading on Multimeter**

Note: Use your own ***student ID*** number for Homework Question 1

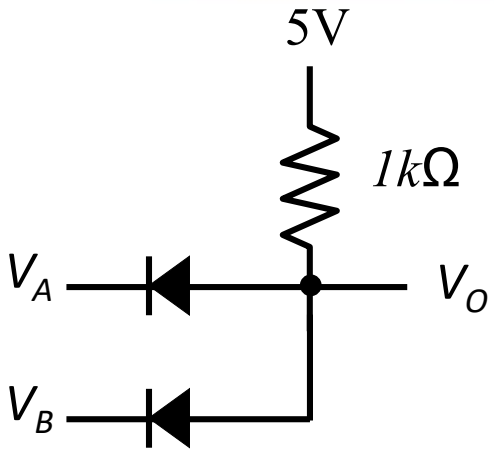
Example Question [2]

- **Construct** the circuit in Tinkercad, and measure the output voltage V_O to fill in the table with given values of V_A and V_B

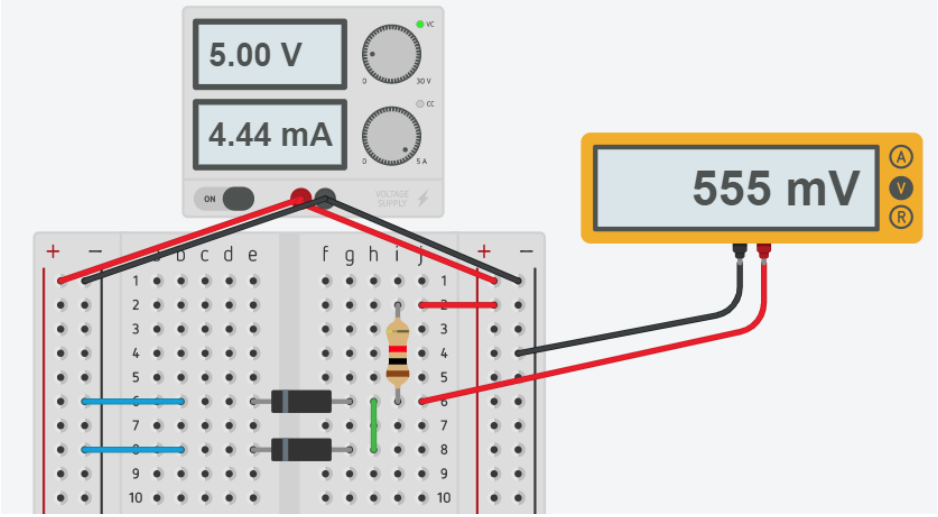


V_A	V_B	V_O
0V	0V	
0V	5V	
5V	0V	
5V	5V	

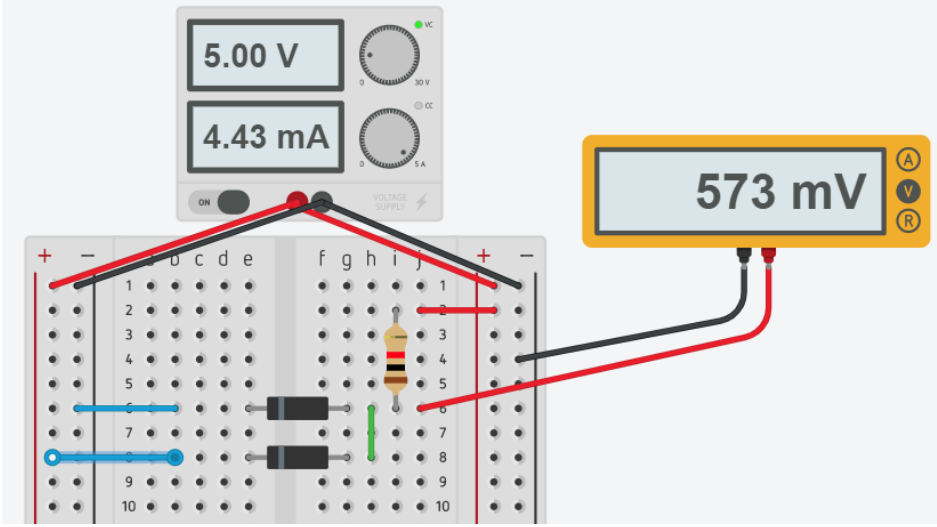
Example Question [2]



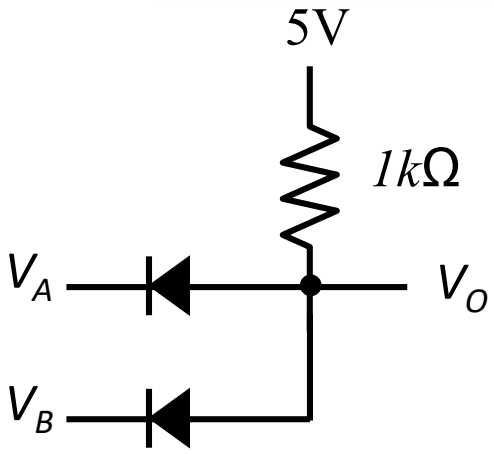
- V_A = 0V
- V_B = 0V



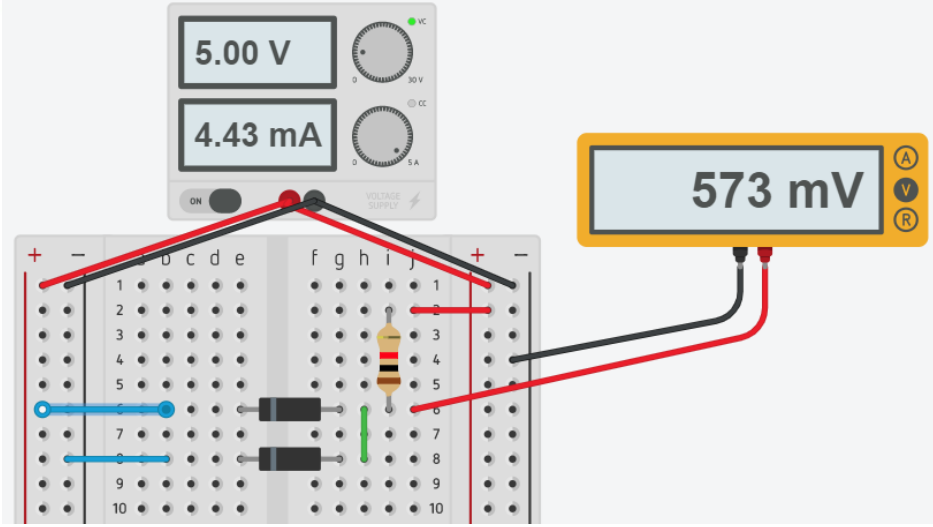
- V_A = 0V
- V_B = 5V



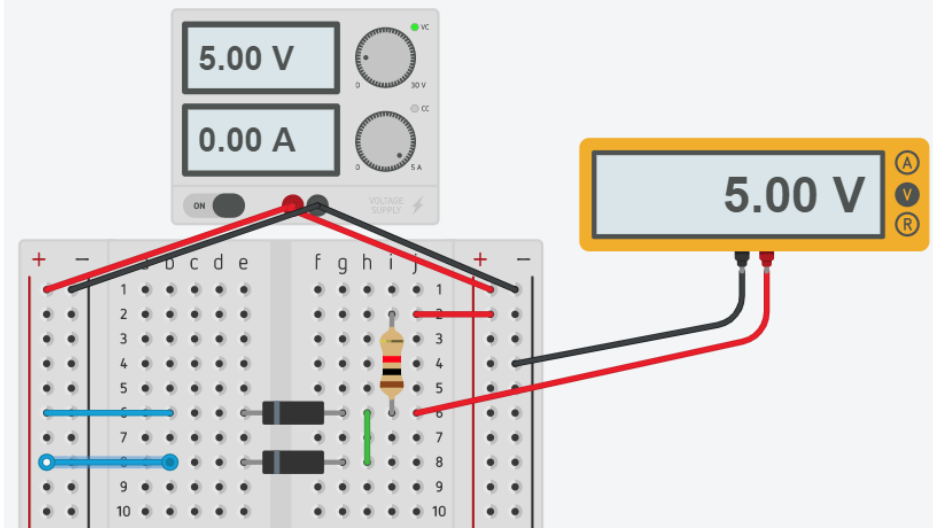
Example Question [2]



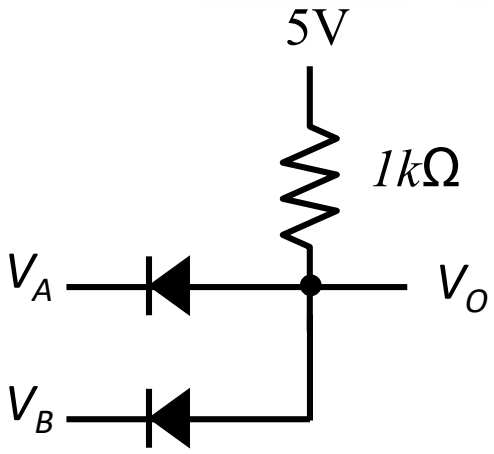
- V_A = 5V
- V_B = 0V



- V_A = 5V
- V_B = 5V



Example Question [2]

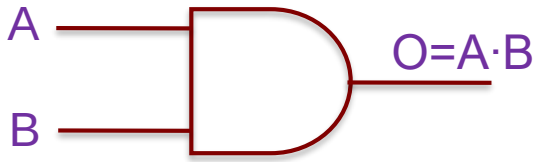


Translate the ***voltages*** into binary ***truth table***

V_A	V_B	V_O
0V	0V	0.555V
0V	5V	0.573V
5V	0V	0.573V
5V	5V	5V

V_A	V_B	V_O
0	0	0
0	1	0
1	0	0
1	1	1

Q: Which logic gate is implemented by this diodes circuit?

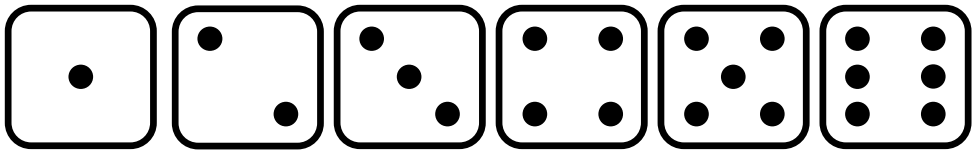


2-inputs AND gate

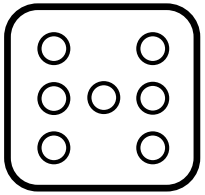
Homework Task 3

❖ Digital Dice Decoder

- On each of its six sides, one of the following patterns appears, representing the numbers 1 to 6.



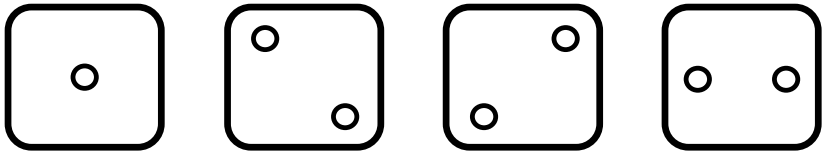
- You can think of them as seven lights to be turned "ON" with a given "High" voltage. By turning on the appropriate lights, you can create any one of the six patterns on the face of a dice.



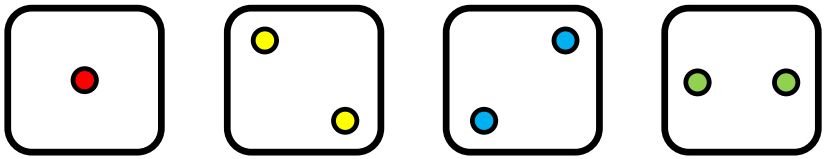
Homework Task 3

❖ Digital Dice Decoder

- On closer inspection, there are only **four unique patterns** from which the pattern for any face can be formed.

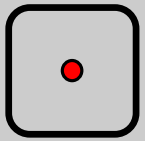
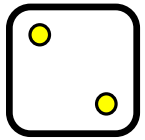
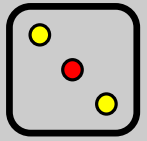
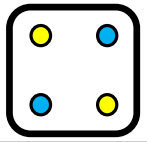
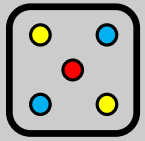
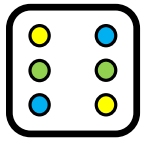


- If we use *different colors* for each of these base patterns, a digital dice display can be made using 4 sets of LEDs: “Red”, “Yellow”, “Blue”, “Green”.



Homework Task 3

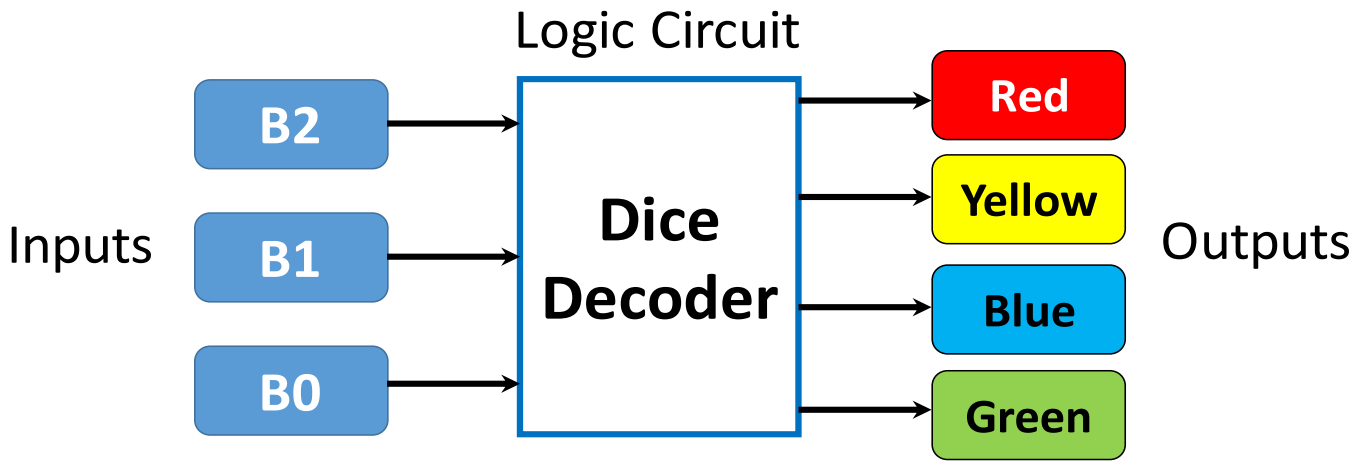
Given by 3 bit binary input B2, B1, B0.

Dice face	B2 B1 B0				Four Base Patterns			
					Red	Yellow	Blue	Green
	0	0	0					
1	0	0	1		√			
2	0	1	0			√		
3	0	1	1		√	√		
4	1	0	0			√	√	
5	1	0	1		√	√	√	
6	1	1	0			√	√	√
	1	1	1					

Homework Task 3

❖ Task

- Design a logic circuit to control the **four base patterns** (Red, Yellow, Blue and Green) displaying the dice face according to the binary input B2, B1, B0 indicating numbers 1 to 6.



Homework Task 3

In this Tutorial, we will show the design steps of "Red" pattern as an given example

Step 1: complete the truth table

B2	B1	B0	"Red"
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

Step 2: Draw K-map

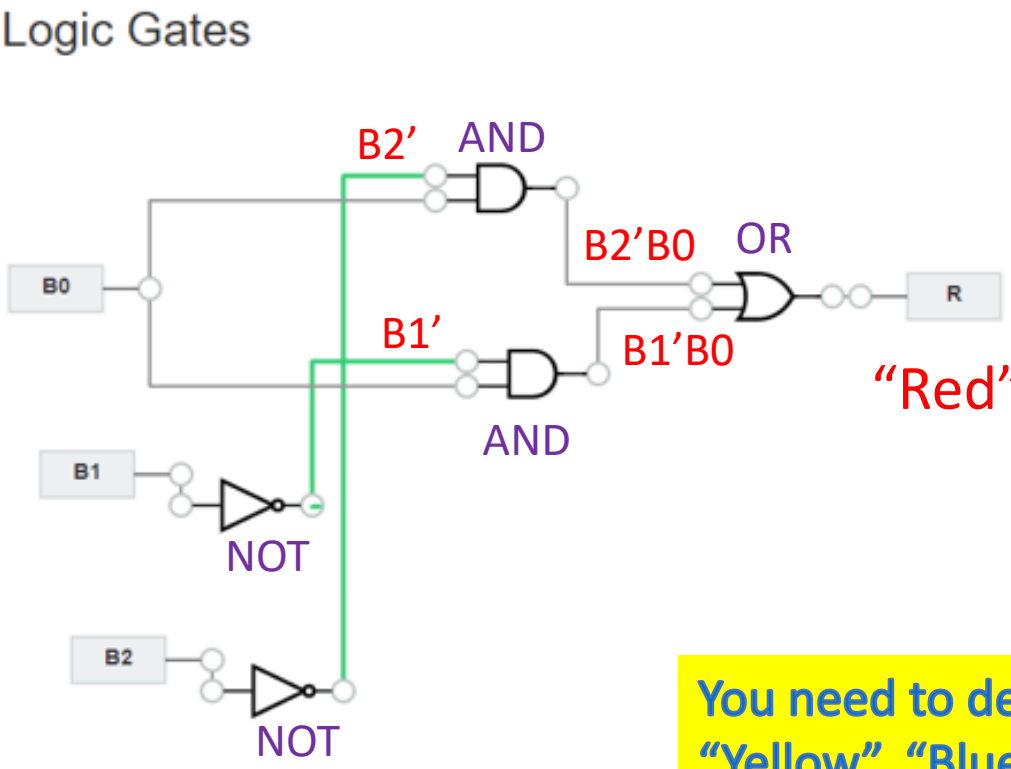
	B2'B1' 00	B2'B1 01	B2B1 11	B2B1' 10
B0' 0	0	0	0	0
B0 1	1	1	0	1

Step 3: Find the logic expression

"Red" = B2'B0 + B1'B0

Homework Task 3

Step 4: Draw logic gates implementation diagram



"Red" = B2'B0 + B1'B0

You need to design for obtaining "Yellow", "Blue", "Green" patterns logic implementation diagrams as well.

Homework Task 3

Step 5: Construct the logic implementation circuit in **Tinkercad**

Note:

- You need to obtain all of the logic diagrams for the four light patterns first, then start working in Tinkercad
- It's recommended to count for how many NOT/AND/OR gates you need to use, ***plan your circuit layout***, in order to optimize your breadboard arrangement

Homework Task 3

❖ Logic Gate: NOT

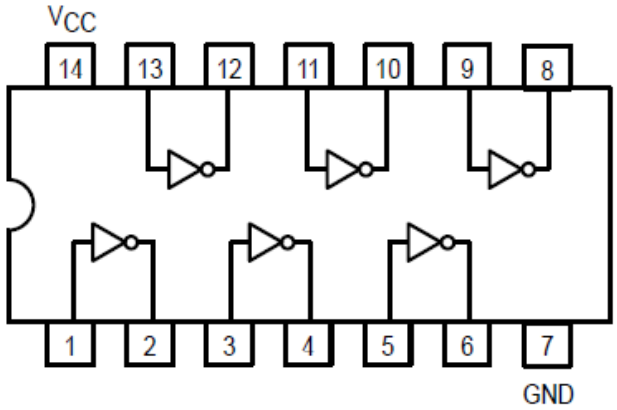
NOT: One input, one output

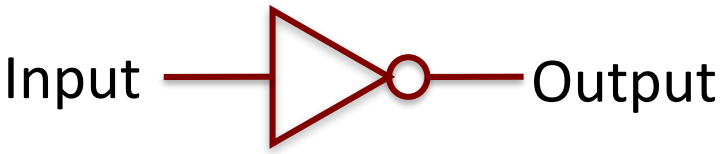
- Output is the “inversion” of input
- i.e. If input is 5V, then output is 0V

Input	Output
0	1
1	0

NOT Gates in Tinkercad

6 NOT gates on one IC





Homework Task 3

❖ Logic Gate: AND

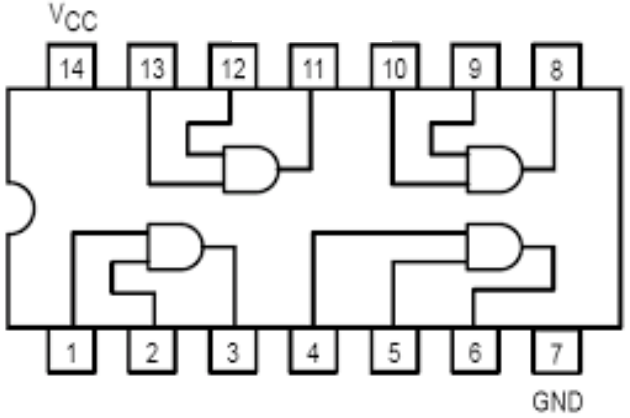
AND: Two inputs, one output

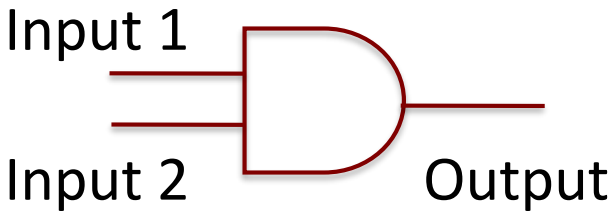
- Output is high only when both inputs are high

Input 1	Input 2	Output
0	0	0
0	1	0
1	0	0
1	1	1

AND Gates in Tinkercad

4 AND gates on one IC





Homework Task 3

❖ Logic Gate: OR

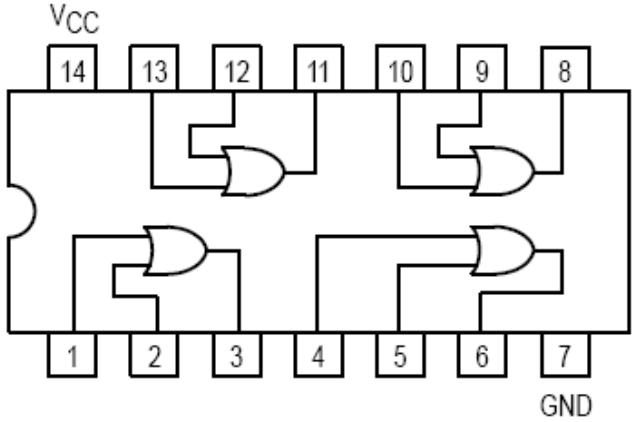
OR: Two inputs, one output

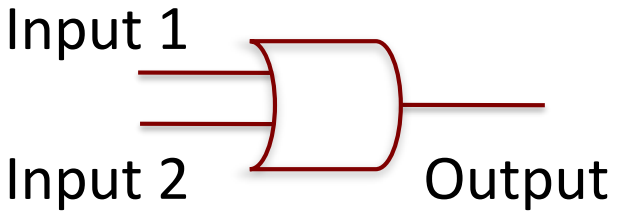
- Output is low only when both inputs are low

Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	1

OR Gates in Tinkercad

4 OR gates on one IC

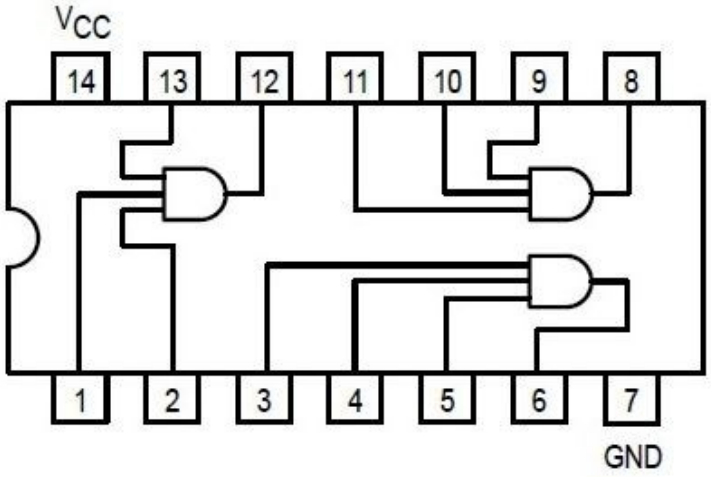


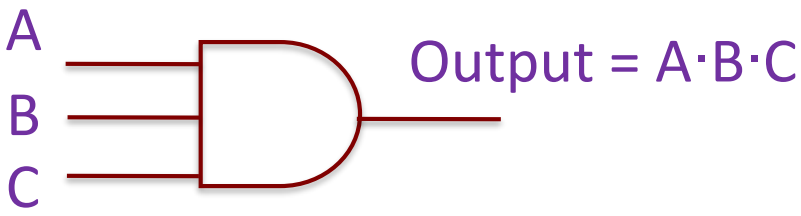


Homework Task 3

❖ 3-Input AND Gate

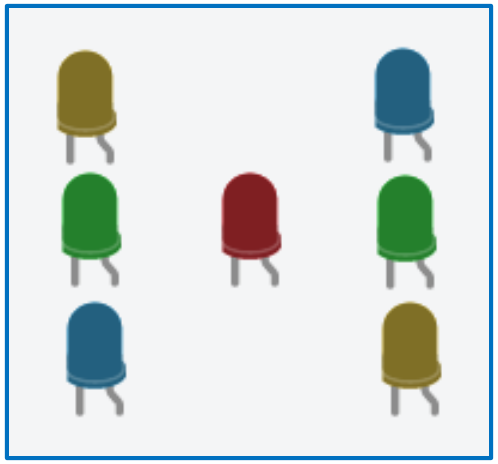
3 gates on one IC





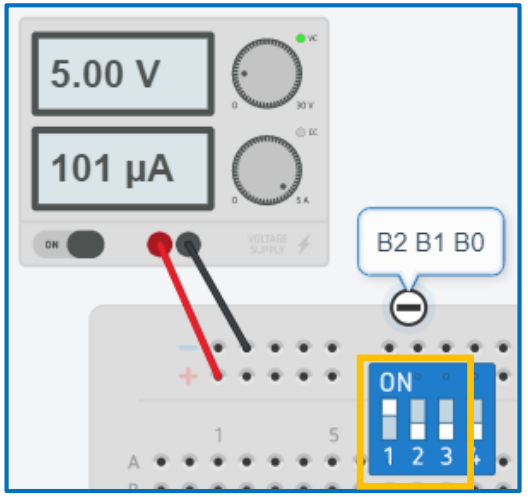
Homework Task 3

- **Arrange your LED lights as below**



**add 1kΩ resistor for protection!!!

- **DIP Switch to easily change the input B2B1B0**



Homework Task 3

❖ Q17 in Task 3: Use your own SID number

Display Dice Face of number "**y**", where **y**=mod(x, 6) + 1

Let x be the last digit of your student ID.

Your student ID: 12345678
Your Dice Face number "**y**" = mod(8, 6) + 1 = 3
Your binary input: B2B1B0=011

Dice face	B2 B1 B0		Four Base Patterns			
			Red	Yellow	Blue	Green
3	0 1 1		√	√		