Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P1]

Part A: Basic Electronics
Part B: Voltage Divider
Part C: TinkerCAD
Part D: Fritzing

Part A: Basic Electronics

A1. Make the following conversions

1) 3500 µA = ___3.5___ mA
2) 4.7 MΩ = __4700____ kΩ
3) 1510 kHz = ___1.51___ MHz
4) 0.3 µF = __300____ nF
5) 22 mA = ___22000___ µA
6) 100 nF = __100000____ pF
7) 30000 nF = __30____ µF
8) 150 µH = __ 0.15 __ mH
9) 2200 kΩ = _2.2_____ MΩ
10) 1.33 MHz = ___1330___ kHz

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P2]

A2. Write down the values and their colour codes of each given resistor.

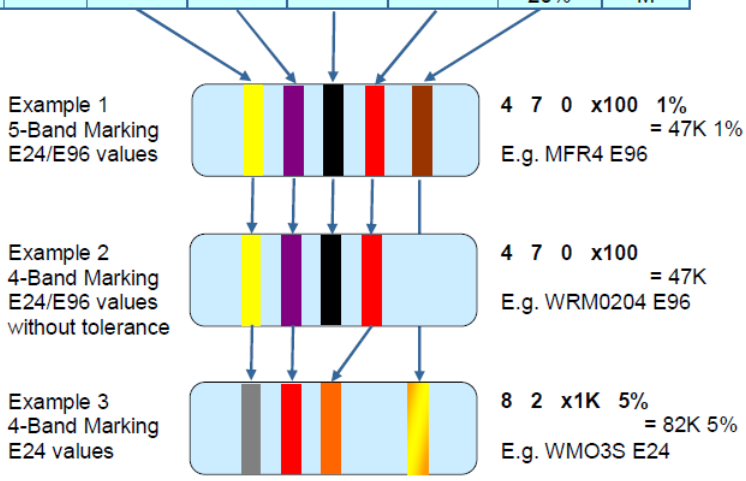
Example
5 Bands:
1st Band: White, 2nd Band: Brown, 3rd Band: Brown, 4th Band: Red, 5th Band: Brown
The value: 91 KΩ, %Error: 1%, Range: 90090 – 91910 Ω

1st Band	2nd Band	3rd Band	4th Band	5th Band	Value	% Error	Range
Red	Red	Brown	-	Gold	220 Ohm	5	209-231 Ω
Brown	Orange	-	-	Brown	1K Ohm	1	990-1010 Ω

Colour Code used on Welwyn Band-marked Resistors

Through-hole and MELF style resistors with colour band marking use the following colour code (reference IEC60062):

Colour	Value 1	Value 2	Value 3	Multiplier	Tolerance	
Silver				x 0.01	10%	K
Gold				x 0.1	5%	J
Black	0	0	0	x 1		
Brown	1	1	1	x 10	1%	F
Red	2	2	2	x 100	2%	G
Orange	3	3	3	x 1K		
Yellow	4	4	4	x 10K		
Green	5	5	5	x 100K	0.5%	D
Blue	6	6	6	x 1M	0.25%	C
Violet	7	7	7	x 10M	0.1%	B
Grey	8	8	8	x 100M	0.05%	A
White	9	9	9	x 1G		
Blank					20%	M



Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P3]

A3: If any, consider series circuits

Using Ohm's Law to calculate voltage flowing through each resistor

As the resistors are connected in series, the current that passes through both resistors is the same. But the voltage is not the same for both resisters. The input voltage of the circuit divides into both resisters. And the value of individual voltage depends on the resistance.

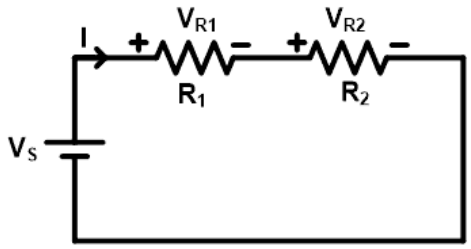


Figure 1: Two resistors are connected in series with the voltage source Vs

As shown in the above figure, two resistors R1 and R2 are connected in series with the voltage source Vs. The total current supplied by the source is I ampere (A). As all elements are connected in series, it will make a single loop and the current that passes through all elements is the same (I A).

The voltage across resistor R_1 is V_{R1} and the voltage across resistor R_2 is V_{R2}. And the total supplied voltage divides between both resistors. Hence, the total voltage is a sum of V_{R1} and V_{R2}.

$$V_S = V_{R1} + V_{R2} \ldots (2)$$

According to Ohm's Law, V = IR,

$$V_{R1} = IR_1 \ldots (3)$$

Similarly,

$$V_{R2} = IR_2 \ldots (4)$$

Therefore, substitute V_{R1} and V_{R2} in equation (2),

$$V_S = IR_1 + IR_2$$

$$V_S = I\,(R_1 + R_2)$$

$$I = V_S / (R_1 + R_2)$$

Now, put the value of current I in the equation (3) and (3=4),

$$V_{R1} = \{V_S / (R_1 + R_2)\}\, R_1$$

$$V_{R2} = \{V_S / (R_1 + R_2)\}\, R_2$$

Exercise 1: How much is the current, I, in a 500-kΩ resistor if its voltage is 25 V? Show your calculation.

Solution: V = IR 25 = I x 500000 I = 25 / 500000 I = 5x10^-5A

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P4]

Exercise 2: How much voltage will be dropped across a 40 kΩ resistance whose current is 250 μA? Show your calculation.

Solution:

V = IR

V = 250x10^-6 x 40x10^3

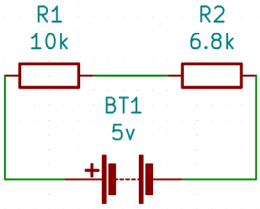
V = 10 V

Exercise 3:

Two resistors, 10 kΩ and 6.8 kΩ, connected in series with power supply 5V, find the following values.

- Current through each resistor
- Voltage dropped across each resistor

Show your calculation.



Solution:

I = VS / (R1 + R2)

I = 5 / (10x10^3 + 6.8x10^3 I = 5 / 16800

I = 297 μA

V1 = IR

V1 = 297x10^-6 x 10x10^3

V1 = 2.97V

V2 = IR

V2 = 297x10^-6 x 6.8x10^3

V2 = 2.0196V

Exercise 4:

How much current does a 800-W coffee maker draw from the 220 V power line? Show your calculation.

Solution:

P = IV

I = 800 / 220

I = 3.63 A

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P5]

Exercise 5:

Find the output voltage of each resistor where R_1 is 220Ω and R_2 is 1kΩ, and the input voltage is 9V.

Solution:

Vs = I (R1 + R2)
9 = I (220 + 1000)
I = 9 / 1220
I = 7377 µA

V1 = 9 / 1220 * 220
V1 = 1.623V
V2 = 9 / 1220 * 1000
V2 = 7.377V

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P6]

Exercise 6:

Find the output voltage of each resistor where R_1 is 1kΩ and R_2 is 220Ω, and the input voltage is 12V.

Solution:

Vs = I (R1 + R2)

12 = I (1000 + 220)

I = 12 / 1220

I = 9836 µA

V1 = 12 / 1220 * 1000

V1 = 9.836V

V2 = 12 / 1220 * 220

V2 = 2.164V

Exercise 7:

The input voltage is 5V, but the required output voltage is 3.3V, how much resistance value of resistors should be?

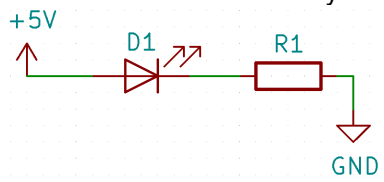
Solution: -

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P7]

A4: Consider the “RED LED” datasheet

(https://www.alliedelec.com/m/d/6355b8aba0b01578df0bb7b871ceefd7.pdf), the LED can handle a current of 20 mA (forward current) and the forward voltage or the voltage drop is 2 V before it risks heating up. If the LED is connected to a 5 V supply, what value of a resistor should we place in series? Draw a circuit and show your calculation.



V = IR

2 = 20x10^-6 x R

R = 1 / 10^-5

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P8]

Part B: Voltage Divider

A voltage divider is a simple circuit which turns a large voltage into a smaller one. The output voltage that is a fraction of the input, can be calculated by using two series resistors. These are various types of potentiometers aka variable resistors which can be used to create an adjustable voltage divider.

Schematic Circuit

A voltage divider involves applying a voltage source across a series of two resistors.

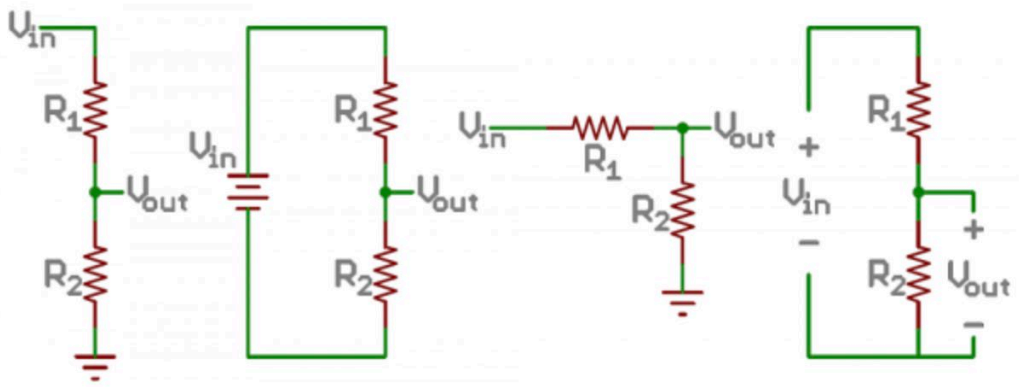


Figure 2: Examples of voltage divider schematics. Shorthand, longhand, resistors at same/different angles, etc.

The resistor closest to the input voltage (V_{in}) is R_1, and the resistor closest to ground is R_2. The voltage drop across R_2 is called V_{out}, that is the divided voltage.

Vout Computation

The voltage divider equation assumes that the three values are already known, the input voltage (V_{in}), and both resistor values (R_1 and R_2). Given those values, we can use this equation to find the output voltage (V_{out}) as followed equation.

$$V_{out} = V_{in} * (R2 / (R1 + R2)) \ldots (1)$$

This equation states that the output voltage is directly proportional to the input voltage and the ratio of R_1 and R_2.

These are simplifications that make evaluating a voltage dividing circuit just a little easier.

- First, if R_2 and R_1 are equal then the output voltage is half of the input, regardless of the resistors' values.
- If R_2 is much larger than R_1, then the output voltage will be very close to the input. There will be very little voltage across R_1.
- Conversely, if R_2 is much smaller than R_1, the output voltage will be tiny compared to the input. Most of the input voltage will be across R_1.

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092__ [P9]

Exercise 1: If R_1 is equal R_2,

Find the divider voltage, when there are two resistors of 500Ω and the input voltage is 5V.

Solution:

V_{in} = 5V

$R_1 = R_2$ = 500Ω

According to the Voltage Divider Equation,

V_{out} = V_{in} * (R2 / (R1 + R2))

= 5 x (500 / 500 + 500))

= 2.5V

Exercise 2: If R_2 is larger than R_1,

Find the divider voltage, when there are two resistors valued 500Ω and 1kΩ, and the input voltage is 9V.

Solution:

V_{in} = 5V

R_1 = 500Ω

R_2 = 1kΩ = 1000Ω

According to the Voltage Divider Equation,

V_{out} = V_{in} * (R2 / (R1 + R2))

= 5 x (500 / (500 + 1000))

= 1.67V

Exercise 3: If R_2 is smaller than R_1,

Find the divider volage, when there are two resistors valued 1kΩ and 500Ω, and the input voltage is 12V.

Solution:

V_{in} = 5V

R_1 = 1kΩ = 1000Ω

R_2 = 500Ω

According to the Voltage Divider Equation,

V_{out} = V_{in} * (R2 / (R1 + R2))

= 5 x (1000 / (500 + 1000))

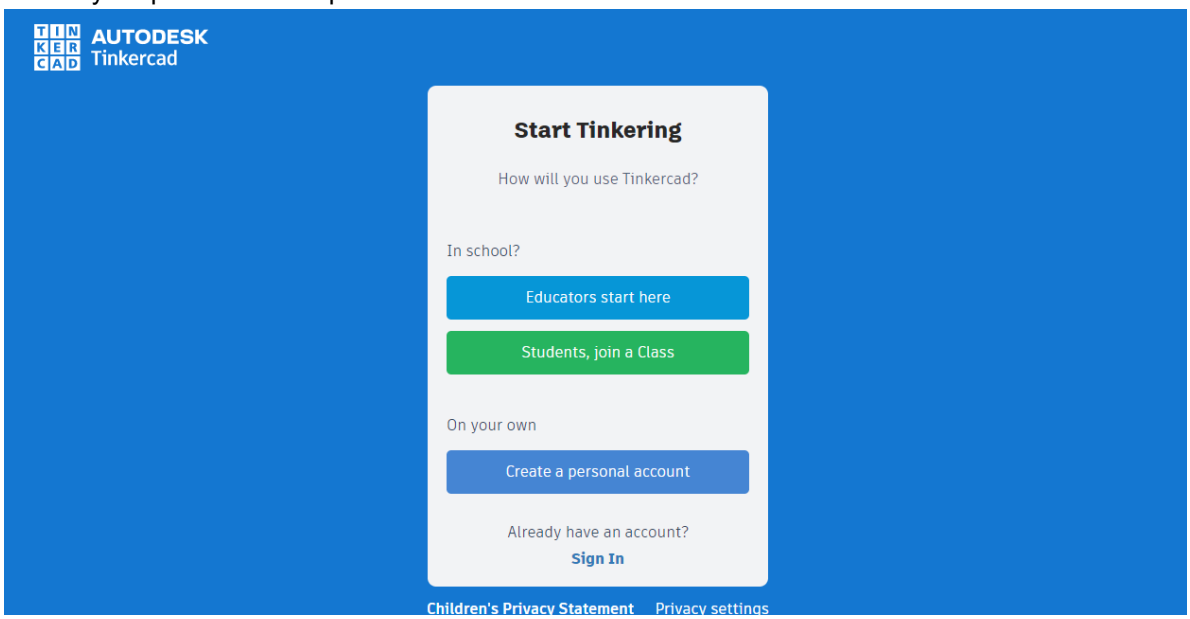
= 3.33V

Activity 2 Worksheet: TinkerCAD and Fritzing

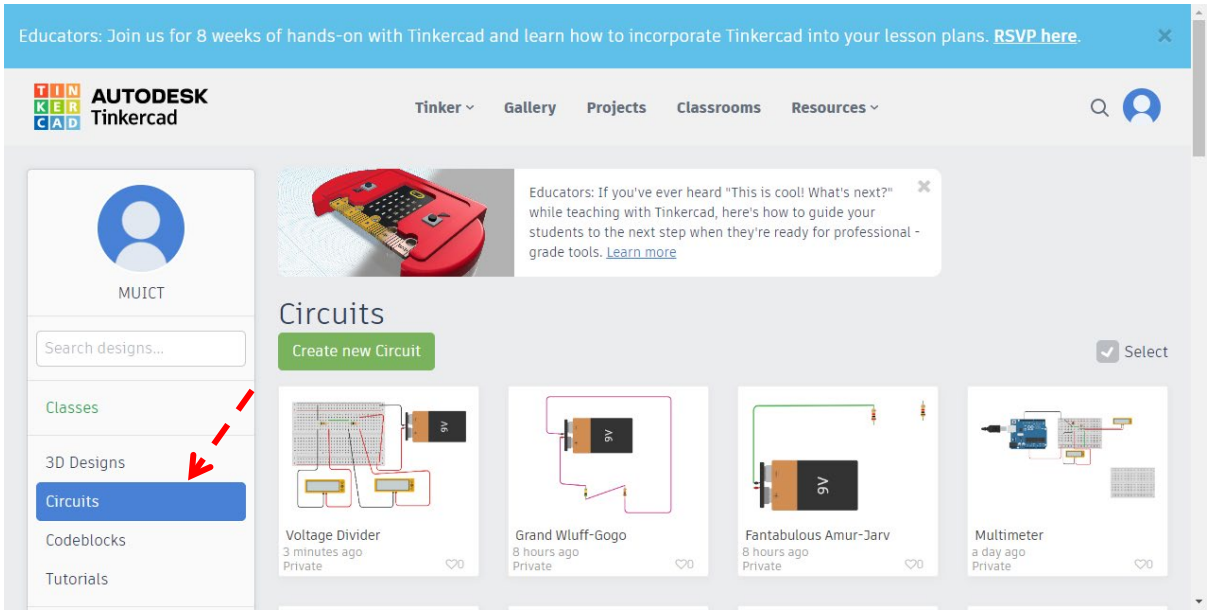
Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P10]

Part C: TinkerCAD

Create your personal at “https://www.tinkercad.com/”.



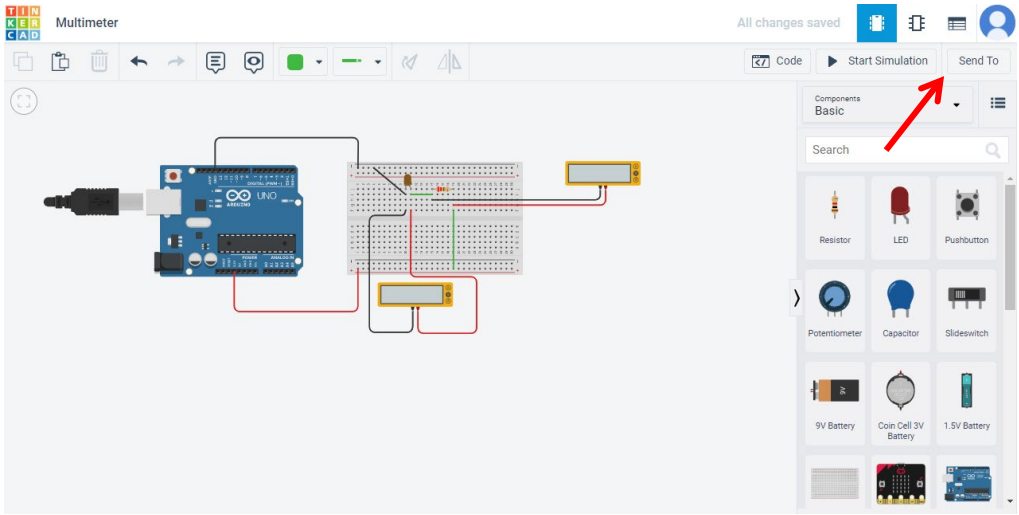
Go to “Circuits” tab and click it. At there you can draw schematic and make simulation of your electronic circuit.

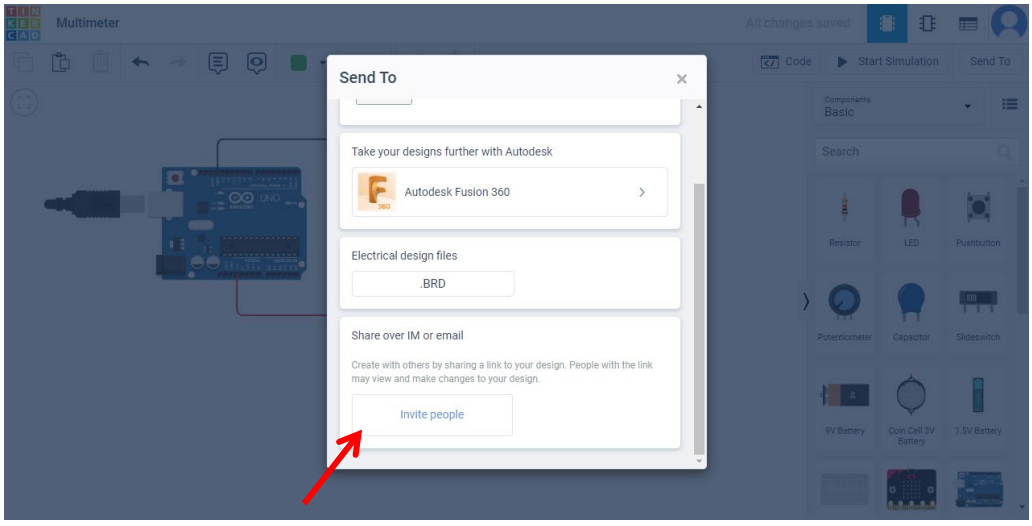


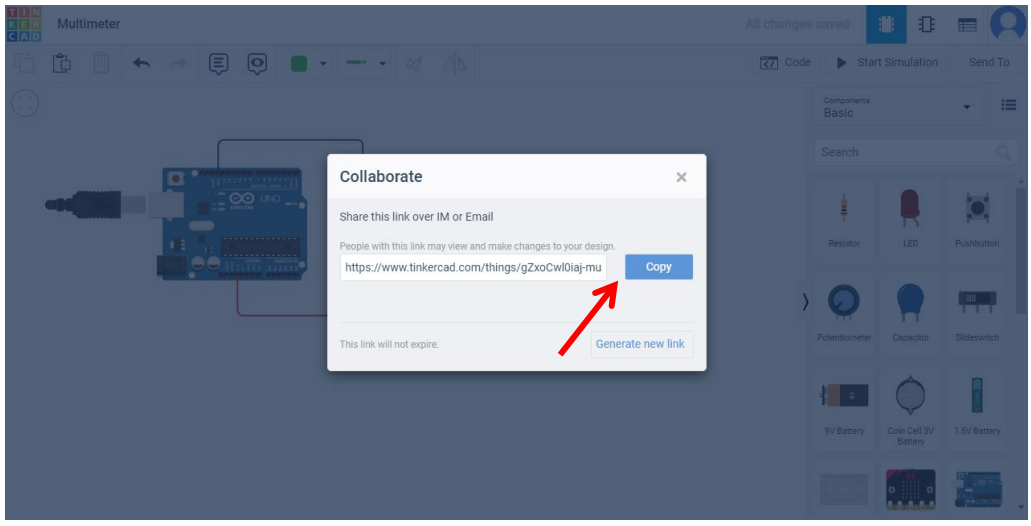
In the Tinkercad, you can share your circuit design with other people by clicking “Sent To” tab and then click “Invite People” button. At there you can see your Tinkercad circuit link which you can share to other people.

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P11]



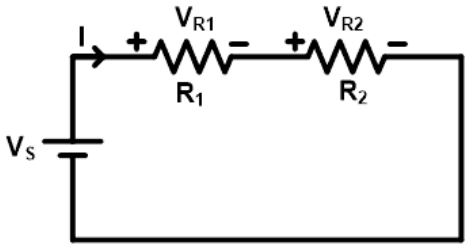




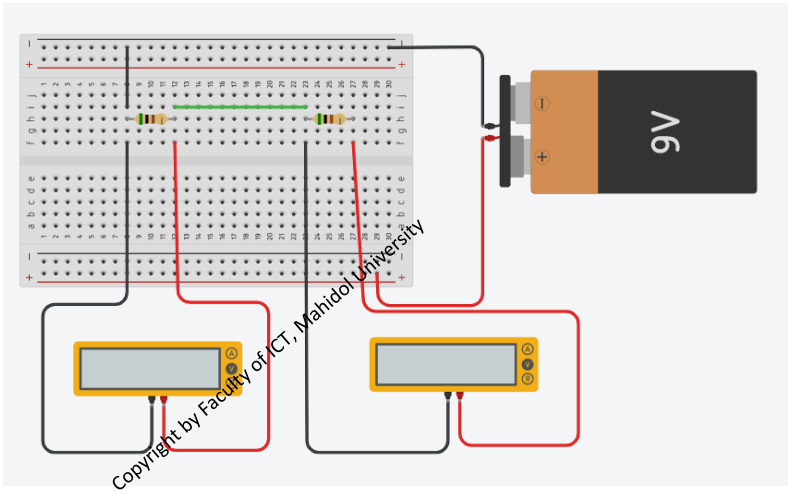
Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P12]

Exercise 1: Set up the voltage divider circuit as the following diagram in Tinkercad, where V_S is 9V (used 9V battery). Define $R_1$100 Ω and another R_2 as POT. Find the value of R_2 in order to obtain Vout = 3.3V. Let's use "multimeters" to check the voltage of each resistor.

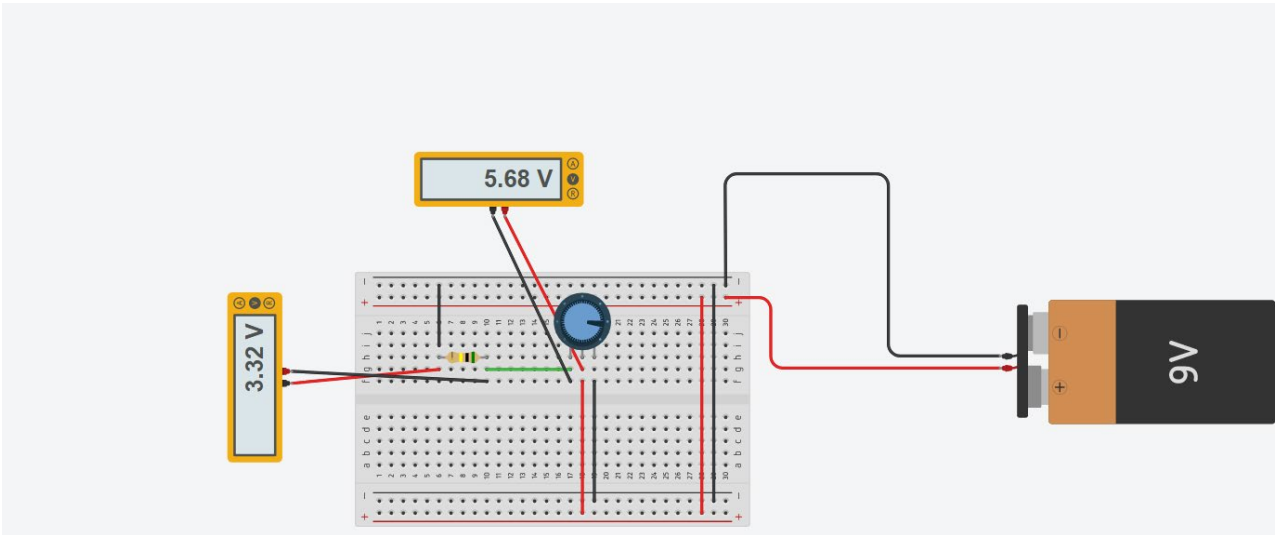


Example:



Show your result with screenshot and program.

R_2 = 1000 kΩ



Your Tinkercad URL: https://www.tinkercad.com/things/9InmRPGaDgP-sizzling-vihelmo/editel?sharecode=Bgbcegkuf75YGLJMBZi3JvpupcQZwQ-RtjWZxC7rZcw

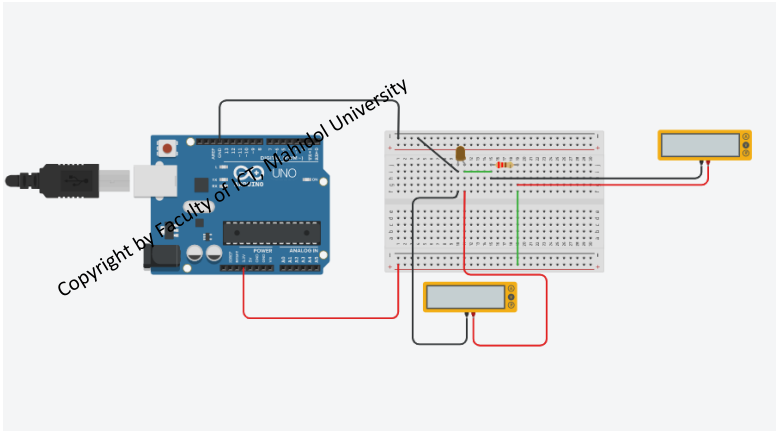
Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P13]

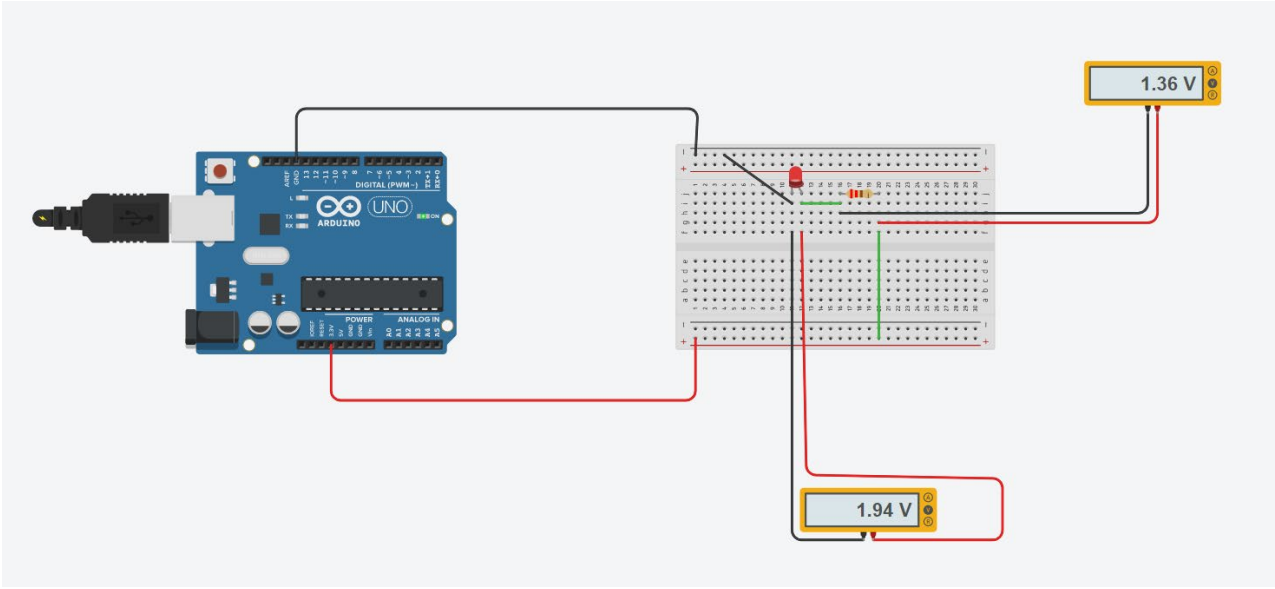
Exercise 2: Draw the following circuit at Tinkercad. Find out the output volage of LED and resistor using multimeter.

Components:

- Arduino Uno R3
- Breadboard
- Resistors 220 Ω
- LED
- Two multimeters



Show your result with screenshot and program.



Your Tinkercad URL: https://www.tinkercad.com/things/apS5tJsa6be-smashing-kieran-gaaris/editel?sharecode=8y4Stjj3lFxEClDIIXJHlv3OJm3TV2n8zgNrQQ7OYWI

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P14]

Exercise 3: Draw the following circuit at your Tinkercad.

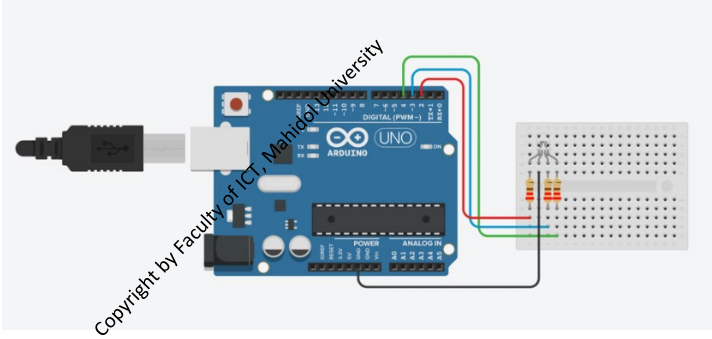
Components:

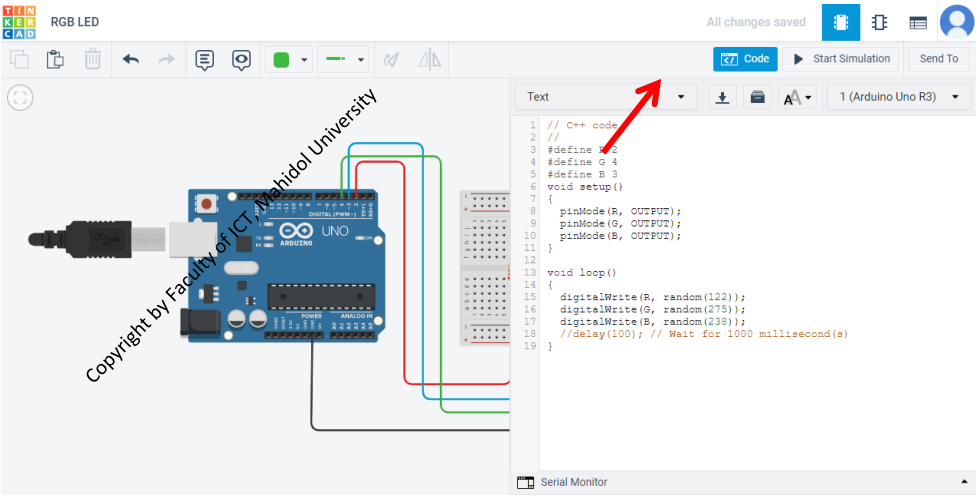
Arduino Uno R3

Breadboard

Three Resistors each 220 Ω

RGB LED





Copy the following code at the coding section.

```
#define R 2
#define G 4
#define B 3

void setup(){
      pinMode(R, OUTPUT);
      pinMode(G, OUTPUT);
      pinMode(B, OUTPUT);
}

void loop(){
      analogWrite(R, random(255));
      analogWrite(G, random(255));
      analogWrite(B, random(255));
    delay(200);
}
```

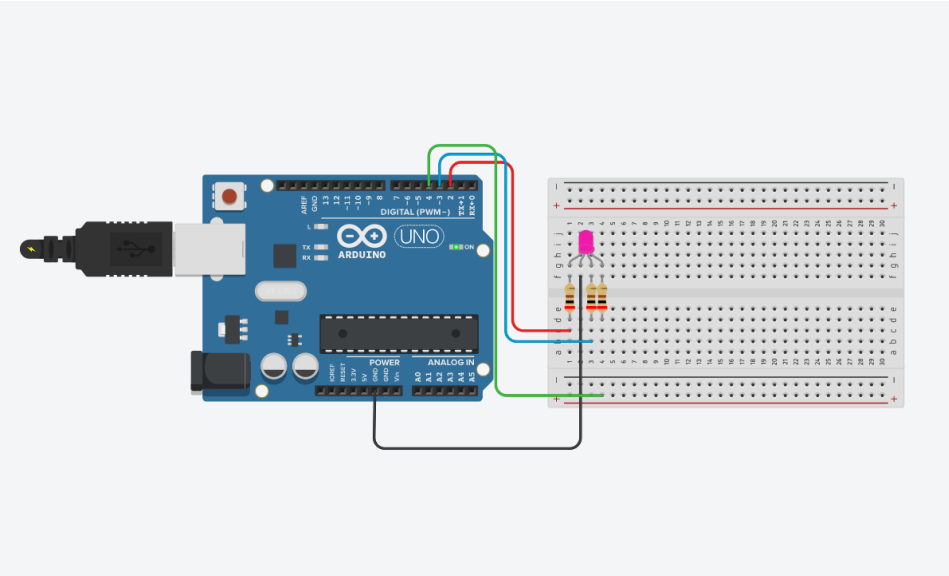
Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P15]

If you change the “delay” value in the code from 200 to 1000, What will happen?

Ans: it will delay the led to change the color.

Show your result with screenshot and program.



```
#define R 2
#define G 4
#define B 3

void setup(){
    pinMode(R, OUTPUT);
    pinMode(G, OUTPUT);
    pinMode(B, OUTPUT);
}

void loop(){
    analogWrite(R, random(255));
        analogWrite(G, random(255));
        analogWrite(B, random(255));
    delay(1000);
}
```

Your Tinkercad URL: https://www.tinkercad.com/things/5nP2721Vkdh-bodacious-leelo-waasa/editel?sharecode=4haGSmPMVcnt42vFoLen8UKRkEgo4T7LsMeo7m-TdFI

Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P16]

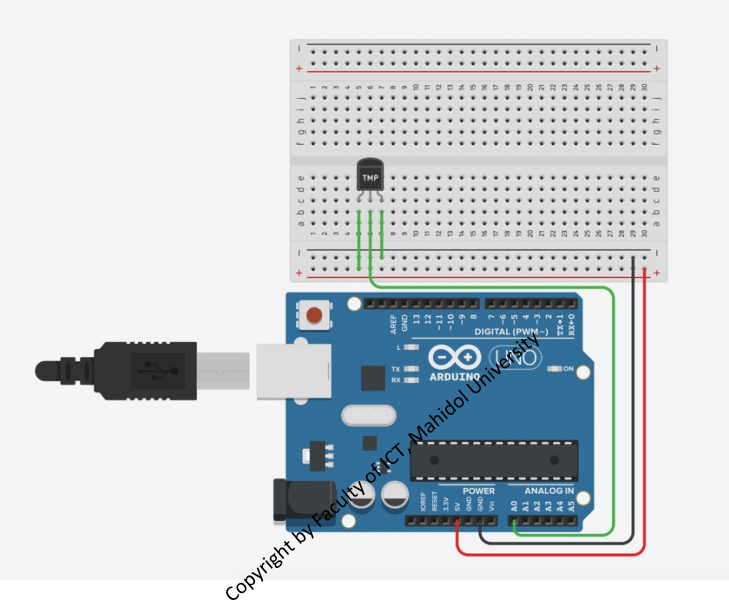
Exercise 4: Draw the following circuit at your Tinkercad.

Components:

Breadboard

Arduino Uno R3

Temperature Sensor [TMP36]



Copy the following code at the coding section. Understand the code and answer the question.

```
int baselineTemp = 0;
int celsius = 0;
int fahrenheit = 0;

void setup()
{
  pinMode(A0, INPUT);
  Serial.begin(9600);

  pinMode(2, OUTPUT);
  pinMode(3, OUTPUT);
  pinMode(4, OUTPUT);
}

void loop()
{
  baselineTemp = 40;

  celsius = map(((analogRead(A0) - 20) * 3.04), 0, 1023, -40, 125);

  fahrenheit = ((celsius * 9) / 5 + 32);
  Serial.print(celsius);       // L1
  Serial.print(" C, ");        // L2
  Serial.print(fahrenheit);    // L3
  Serial.println("F");         // L4

  delay(1000);
}
```

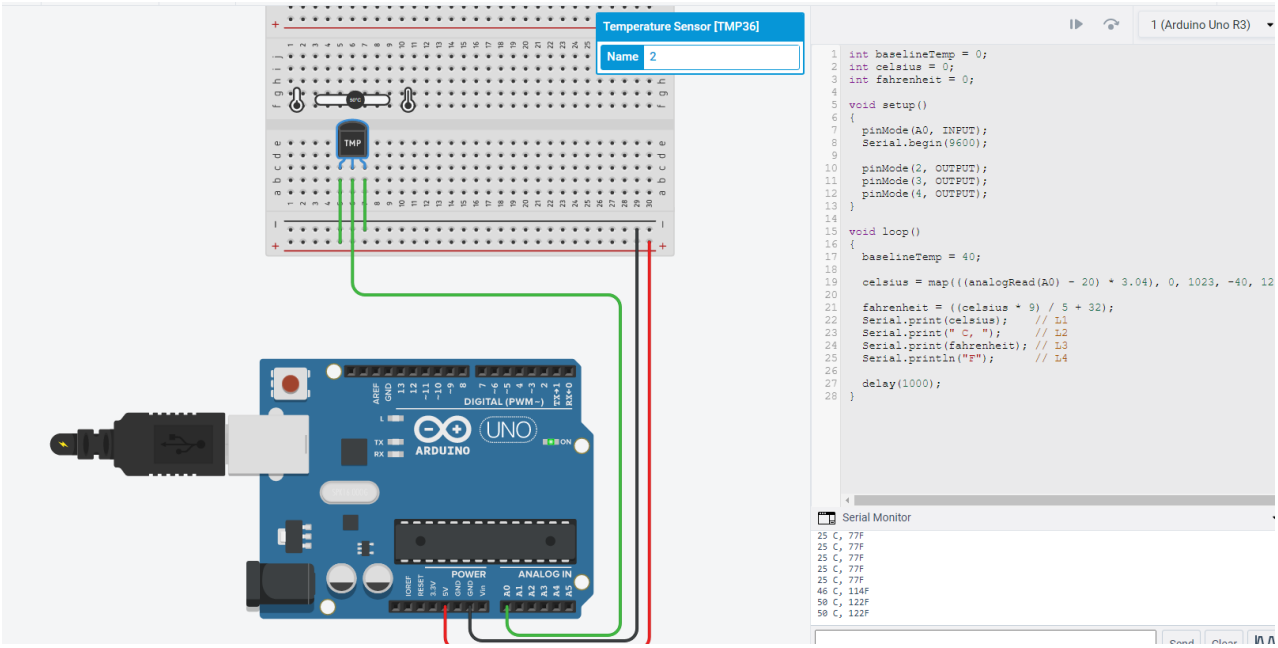
Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P17]

Check the serial monitor and what is the output result.

Please change the program L1-L4 to print the output result in one line like "XX degree Celsius = XX degree Fahrenheit".

Show your result with screenshot and program.



Your Tinkercad URL: https://www.tinkercad.com/things/3n7NBXBNIvq-surprising-gaaris/editel?sharecode=Jdaf_u4-GlDsrogDXh7GICDvujFbB4-kGhj7xrVRcZc

Activity 2 Worksheet: TinkerCAD and Fritzing

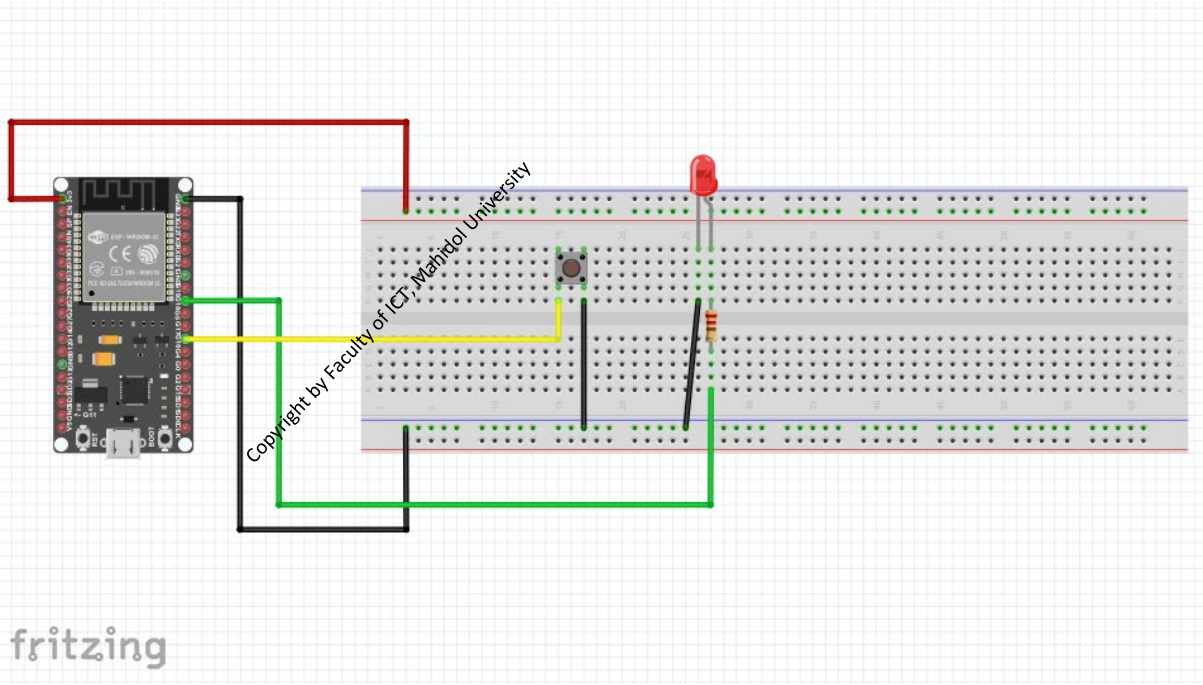
Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P18]

Part D: Fritzing

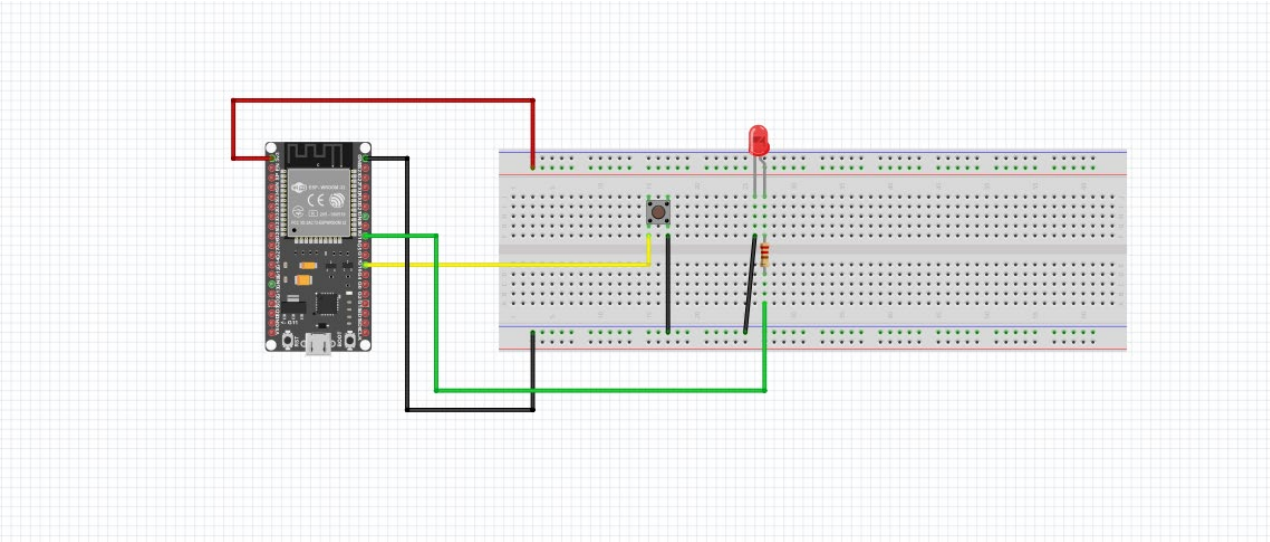
Sign up a new account for Fritzing at here "**https://fritzing.org/**" and then download it for your respective operating system.

Exercise

Draw the following circuits in fritzing.



Answer: Your circuit screenshot in Firtzing from both breadboard and schematic views.



Activity 2 Worksheet: TinkerCAD and Fritzing

Name ____Chancheep Mahacharoensuk_____ID ___ 6288092_ [P19]