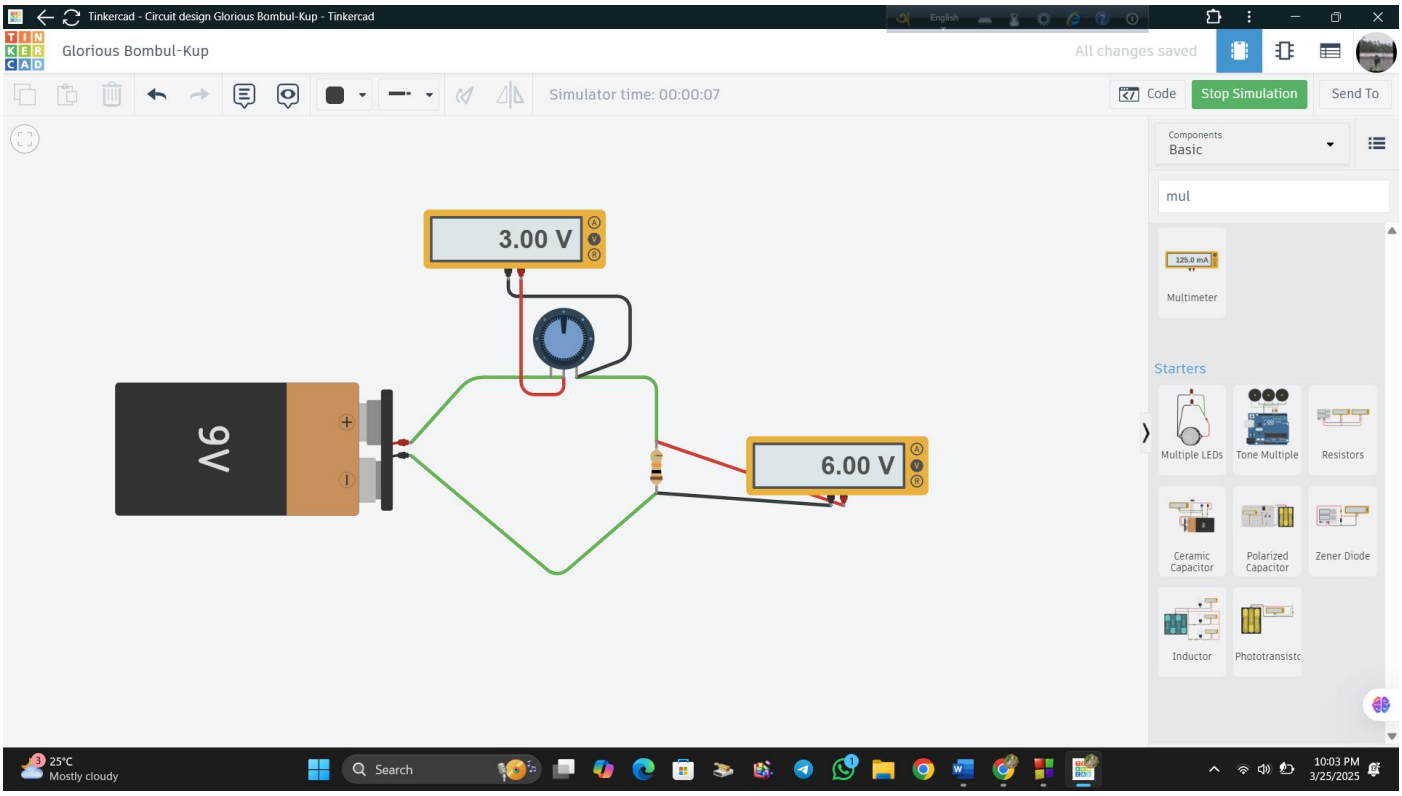
Potentiometer Working & Applications

1. Working Principle of Potentiometer:

- A potentiometer is a **three-terminal resistor** with a sliding contact that acts as an **adjustable voltage divider**.
- The three terminals are **VCC, Signal (wiper), and Ground**.
- By turning the **knob**, the **wiper moves**, changing the **resistance** and **voltage drop** across it.
- When the wiper is near **VCC**, resistance and voltage drop are **minimum**. As it moves toward **GND**, resistance and voltage drop **increase**.



2. Applications of Potentiometer:

1. **As a Variable Resistor (Rheostat):**
    - Connected to a **digital multimeter** in resistance mode.
    - By rotating the **knob**, the resistance varies from **0Ω to max (10kΩ)**.
    - Used for **brightness control, volume control, and sensor calibration**.
2. **As a Voltage Divider:**
    - Used to **divide voltage** in a circuit based on the voltage division formula: $V_{R2}=V_{total}\times R2/(R1+R2)$
    - Instead of manually changing **R1**, a **potentiometer** is used to vary the voltage across **R2 dynamically**.
    - Example: Used in **sensor circuits and analog input adjustments**.

3. Arduino-Based LED Brightness Control Using Potentiometer:

- **Components Required:**
    - Arduino
    - Potentiometer (10kΩ)
    - LED
    - Jumper Wires
    - Breadboard
- **Arduino Code:**

```
const int potPin = A0;  // Potentiometer connected to analog pin A0
const int ledPin = 9;   // LED connected to PWM pin 9
int potValue = 0;       // Variable to store potentiometer value
void setup() {
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);}
void loop() {
  potValue = analogRead(potPin); // Read potentiometer value (0-1023)
  int brightness = map(potValue, 0, 1023, 0, 255); // Scale to 0-255
  analogWrite(ledPin, brightness); // Adjust LED brightness
  Serial.print("Potentiometer Value: ");
  Serial.println(potValue);
  delay(100);}
```

- **How it Works:**
    - The **potentiometer** is connected to **A0**, and the **LED** is connected to **pin 9** (PWM).
    - The **potentiometer value** (0-1023) is read and mapped to **LED brightness (0-255)**.
    - The **LED brightness changes** as the potentiometer is rotated.

4. Conclusion:

- The **potentiometer** acts as both a **variable resistor** and a **voltage divider**.
- It is **useful for analog input control**, such as **LED dimming, motor speed control, and sensor calibration**.
- Using **Arduino**, the potentiometer can **precisely control voltage-based applications** dynamically.