Aim ↬ To study the operation of a transistor as a switch.

Equipment Required ↬

Power supply, NPN transistor, resistor, LED, breadboard, connecting wires, multimeter.

Theory ↬

A transistor, a semiconductor device, can be used as a switch by operating it in its cutoff and saturation regions. In an NPN transistor, the emitter is connected to the negative terminal, and the collector is connected to the load, such as an LED. The base receives a small current to control the larger current flowing from the collector to the emitter. When the transistor is in cutoff (base current is zero), it acts as an open switch, preventing current flow. When sufficient base current is applied, the transistor enters saturation, acting as a closed switch, allowing current to flow through the collector-emitter path, and the LED lights up.

In cutoff mode, no current flows because the transistor is fully off, and the voltage across the collector-emitter is high. In saturation mode, the transistor is fully on, and the voltage across the collector-emitter drops, allowing current to flow through the load. This switching behavior makes transistors ideal for controlling devices like LEDs, motors, or relays in digital and analog circuits.

The switching action depends on the value of the base current, which can be controlled using a resistor. By adjusting the base current, the transistor can be driven into saturation or cutoff, making it act like a switch.

Procedure ↬

1. Place the breadboard on a flat surface.
2. Connect the negative terminal of the power supply to the emitter of the transistor.
3. Connect the collector of the transistor to one terminal of the LED, and the other terminal of the LED to the positive terminal of the power supply through a resistor.
4. Connect a resistor between the base of the transistor and the positive terminal of the power supply to limit the base current.
5. Apply voltage to the base to turn on the transistor and allow current to flow through the collector-emitter path, illuminating the LED.
6. To turn off the transistor, remove or reduce the base voltage, cutting off the current flow and switching off the LED.

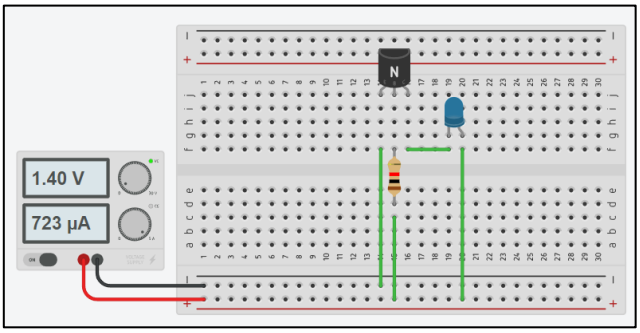

Fig. i) Switch OFF

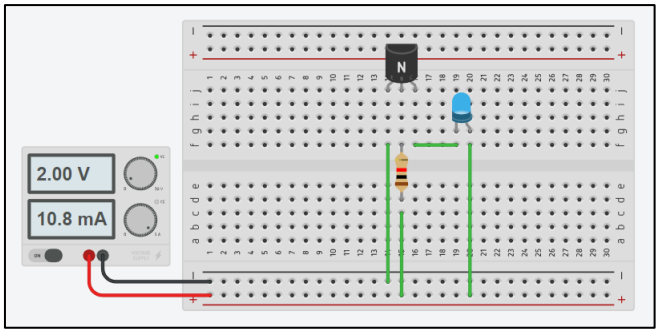

Fig. ii) Switch ON

The impact of the supply voltage is significant; increasing the supply voltage generally increases the current flowing through the LED, leading to a brighter light output until the LED reaches its maximum rated forward current. Conversely, lowering the voltage reduces brightness.

Result ↬

The transistor successfully functioned as a switch, turning the LED on and off depending on the base voltage.

Conclusion ↬

The experiment demonstrated how a transistor can be used as an electronic switch, operating between cutoff and saturation modes to control current flow through a load.

Precautions ↬

- Ensure correct connections for the transistor's terminals to avoid damage.
- Use appropriate resistor values to prevent excessive current through the base or load.
- Avoid exceeding the transistor's maximum voltage and current ratings.