Transistors In Use

Topic

Electronic circuits

Introduction

In this experiment, you will make four small circuits using various electronic components to give you an insight into the use of electronic systems. In three the circuits, an input sensor whose resistance changes with differing condition of light or heat is used. This changing resistance alters the distribution of the supply voltage, affecting the voltage applied to the base of the transistor and causing it to either switch on or off (depending on the selection of input sensor for the task). In the fourth circuit, the input sensor (solar cell) generates a voltage depending on the level of light. This voltage is applied directly to the base of the transistor.

Time required

1 hr 20 minutes (20 minutes for each part)

Materials

All the circuits require:
2N3053 transistor
10 ohm resistor (0.25 watts)
100 ohm resistor (0.25 watts)
9 volt battery and snap connector
suitable connection system (e.g., a breadboard – see Experiment 9.01)

If you are using a breadboard, you will also need various short lengths of connecting wire (e.g., approximately no. 20 gauge, insulated, tinned copper wire with about 0.5 cm of insulation stripped away at each end).

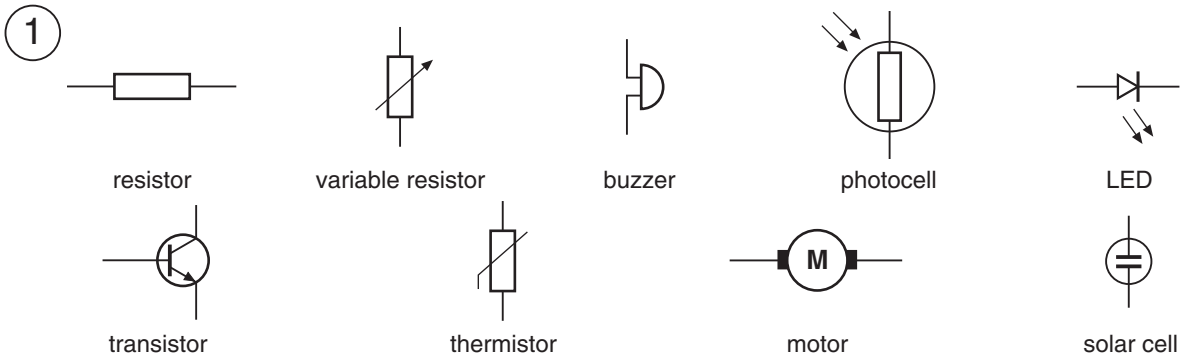
For Part A:
photocell (e.g., CdS photoresistor)
10 kilohm variable resistor
buzzer (miniature solid state buzzer)

For Part B:
photocell (e.g., CdS photoresistor)
100 kilohm variable resistor
5 mm (0.2 in.) LED (any color)
560 ohm resistor (0.25 watts)

For Part C:
4K7 bead thermistor
1 kilohm variable resistor
5 mm (0.2 in.) LED (any color)
560 ohm resistor (0.25 watts)

For Part D:
four 0.4 V solar cells (or other small solar cells generating about 1 volt) plus connectors
6 volt DC motor plus connectors
lamp with 60 watt spotlight bulb

Electronic components are available from suppliers such as RadioShack (http://www.radioshack.com). The appearance of the components may vary among suppliers. Simple wiring diagrams and circuit diagrams are given in this experiment to show the arrangement of the components. Diagram 1 below shows the symbols used in the circuit diagrams in this experiment.



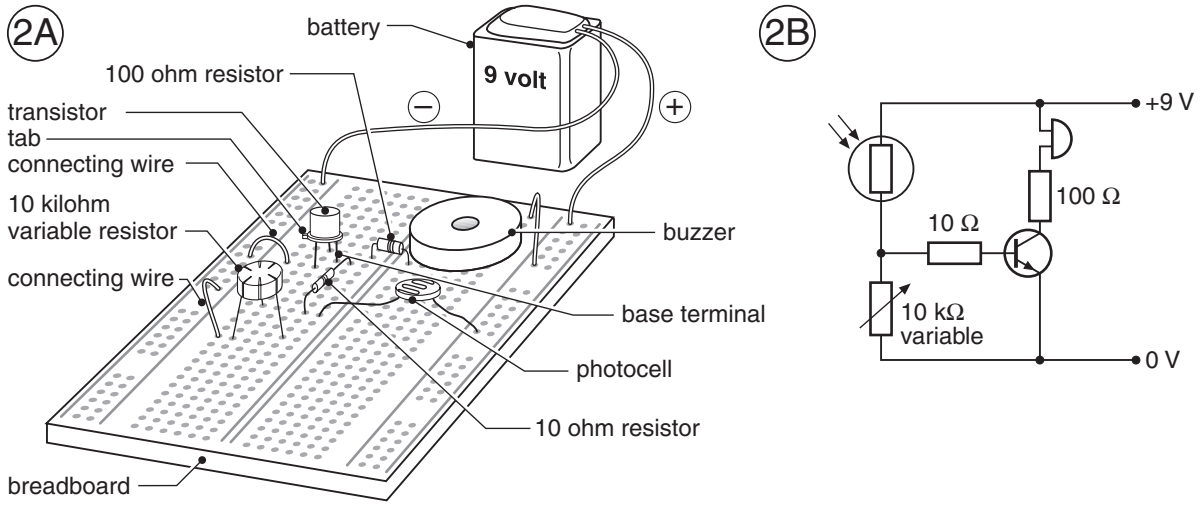
Symbols used in circuit diagrams

Safety note

Do not use an electrical outlet.

Procedure

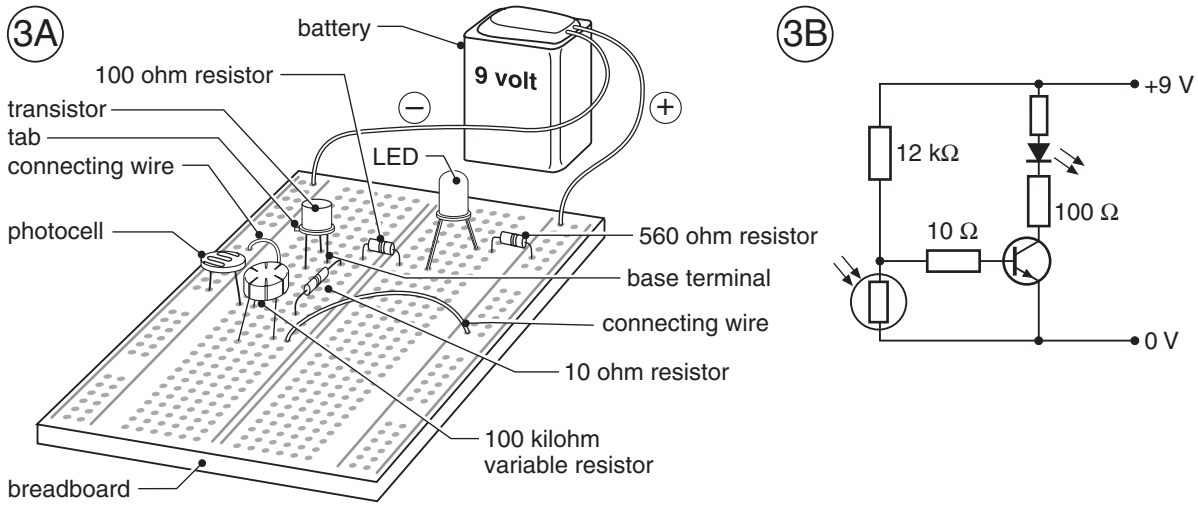
Part A: Switching on a circuit when a sensor is illuminated



Wiring diagram (A) and circuit diagram (B) for Part A

1. Connect the equipment as shown in diagram 2 above.
2. Cover the photocell with your finger.
3. Adjust the variable resistor to a value just below the point at which the buzzer sounds.
4. Remove your finger from the photocell.

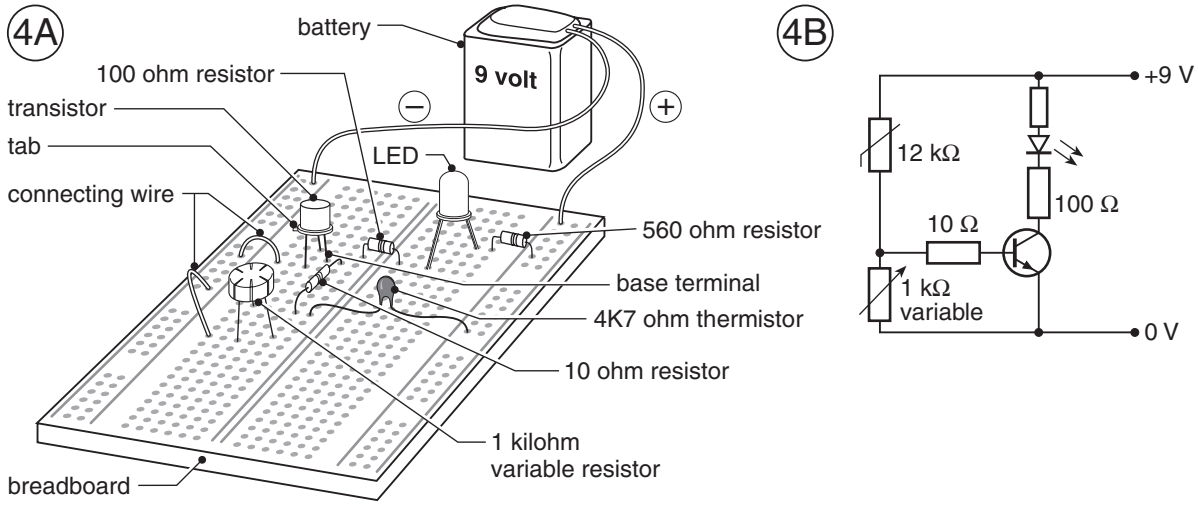
Part B: Switching lights on when the sensor is dark



Wiring diagram (A) and circuit diagram (B) for Part B

1. Connect the equipment as shown in diagram 3 above.
2. Adjust the variable resistor to a value just below the point at which LED stops glowing.
3. Cover the photocell with your finger.

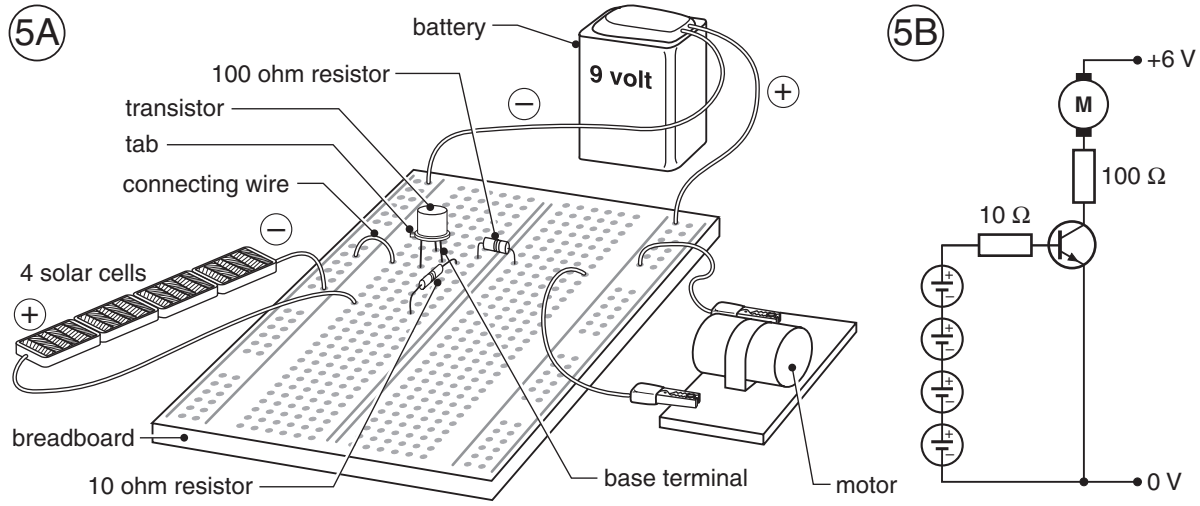
Part C: Switching on a light as the temperature rises



Wiring diagram (A) and circuit diagram (B) for Part C

1. Connect the equipment as shown in diagram 4 above.
2. Adjust the variable resistor to a value just below the point at which the LED lights.
3. Hold the bulb of the thermistor between your finger and thumb, and observe the LED.
4. Remove your finger and thumb from the thermistor, and observe the LED.

Part D Switching on a motor as the light level rises



Wiring diagram (A) and circuit diagram (B) for Part D

1. Connect the equipment as shown in diagram 5 above.
2. Shine the light on the solar cells.

Analysis

Part A: Switching on a circuit when a sensor is illuminated

1. What happened when the photocell was exposed (i.e., you removed your finger)?
2. Can you think of a use for this circuit?

Part B: Switching lights on when the sensor is dark

1. What happened when the photocell was covered by your finger?
2. Can you think of a use for this circuit?

Part C: Switching on a light as the temperature rises

1. What happened when the thermistor was warmed between your finger and thumb?
2. What happened when you removed your finger and thumb from the thermistor?
3. Can you think of a use for this circuit?

Part D Switching on a motor as the light level rises

1. What happened when the light was switched on?
2. Can you think of a use for this circuit?

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Part A: Switching on a circuit when a sensor is illuminated

1. The buzzer sounded.

2. This circuit could be the basis for a burglar alarm – if a light shone on the sensor (e.g., from a flashlight) in a room that was supposed to be dark, an alarm would sound. The level of light needed to switch on the circuit can be changed by adjusting the variable resistor.

Part B: Switching lights on when the sensor is dark

1. The LED glowed.
2. This circuit could turn on house lights as it gets dark in the evening. The light level at which the circuit switches on can be changed by adjusting the variable resistor.

Part C: Switching on a light as the temperature rises

1. The LED glowed.
2 The LED gradually stopped glowing.
3. This circuit could give a visual warning of overheating. There could be an audible warning if a buzzer were used in place of the LED. The temperature at which the circuit switches on can be changed by adjusting the variable resistor. This circuit could be tested using different heat sources (ice, radiator, etc.)

Part D: Switching on a motor as the light level rises

1. The motor started to turn.
2. The motor in such a circuit could be used to operate a blind to cover a window if the Sun shone onto the sensor.