Name _____ Class _____

LESSON 2: Introduction to Resistance

Activity 1: Resistors in Series & Parallel

Build Project 7 – Light Emitting Diode

a. Turn on the switch and describe the brightness. _____

b. Build Project 8. Reverse the direction of the LED (D1) in the circuit. What happens to the light? _____ Explain why? _____

c. Replace the LED (D1) with a lamp (L1). Turn on the switch. Describe what happens. Explain the result.

_____

Which uses more electric power (watts) a LED or incandescent light? _____

d. Replace the lamp (L1) with the LED (D1). The resistor in this circuit is _____ Ω. Remove the R1 resistor and replace it with the 10K Ω resistor (R4). Describe what happens to the light when the switch is turned on. Compare it to the brightness from part A. _____

Why does this happen? _____

Build Projects 98 & 99 – Simple Water Alarm & Simple Salt Water Alarm

a. Build the circuit but leave the jumper wires out of the cup. What happens when you turn on the switch? _____ Why? _____

b. Place the jumper wires in a cup of water. The circuit is now _____. (open or closed)

c. Based on this activity, is water an insulator or conductor? _____

d. Add about 1 teaspoon of table salt to the cup of water and stir. Insert the ends of the jumper wires. Compare the sounds from the speaker WITHOUT the salt and WITH the salt in the water. _____

_____

Activity 2: Resistors in Series & Parallel

At times, you may not want the full amperage or voltage to your load. Just as a faucet can control the flow of water, an adjustable or **variable resistor** can control the flow of electrons in a circuit.

Build Project 110 – Adjustable Tone Generator

The project demonstrates how resistor values can change the frequency of an oscillator.

a. Turn on the slide switch. Describe the sound you hear. _____

b. Is the LED on or off? _____ Is the LED bright or dim? _____

c. Slide the switch on the variable (adjustable) resistor. Describe what happens to the tone? _____ _____ Describe what happens to the LED brightness. _____

d. If a faucet controls the flow of water, a resistor controls the flow of _____.

Build Project 172 – Red and Green Control

Describe what happens in each part:

a. With the slide switch **on** and the variable resistor set to the **left,** which LED is illuminated?

_____

b. With the same set up as in part A, describe what happens when you also turn **on** the press switch (S2)?

_____

c. With the slide switch (S1) **on** and the press switch (S2) **on**, describe what happens when you slide the variable resistor to the **right** side? _____

d. Turn **off** the slide switch (S1) and turn the press switch (S2) **on**. With the variable resistor slide on the **right**, describe what happens to the green LED. _____

e. When the variable resistor is on the **left** and the slide switch (S1) is **on**, explain why the red light brightens. Use the terms *current* and *resistance* in your answer. _____

_____

f. Describe a place in your home where you may find a variable resistor in a circuit. _____

Activity 3: Photoresistors

Some materials, such as cadmium sulfide, change their resistance when light shines on them. Electronic parts made with these light-sensitive materials are called **photoresistors**. Their resistance decreases as the light becomes brighter.

Build Project 272 – Photoresistor Control

a. With the switch on, describe the brightness of the LED. _____

b. Describe the brightness of the LED when you limit the light entering the photoresistor with your finger.

_____

c. Shine a flashlight directly on the photoresistor. What happens to the brightness of the LED?

_____

d. What is happening to the resistance and current as you cover the photoresistor? _____

_____

Build Project 107 – Automatic Street Lamp

In this project, you will use a variable resistor AND a photoresistor. You will also use parts Q1 PNP and Q2 NPN. These pieces are transistors. A **transistor** can be described as a current amplifier. It uses a small amount of current to control a larger amount of current. They allow current to flow in one direction, like in an LED. The arrows on the parts Q1 and Q2 indicate the direction of current flow.

a. Press the press switch (S2) on and set the variable resistor so the lamp (L2) is barely lit. Slowly cover the photoresistor with your finger. Describe what happens to the lamp. _____
b. Explain what is happening to the current to the lamp when the photoresistor is covered. _____

_____

Street lamps work on this principle. They turn off to save electricity during the day but turn on at night or during a storm for safety.

Extension: Build Project 276 – LED Fan Rotation Indicator

a. Is this circuit wired in series, parallel or both? _____
b. Which way (clockwise or counter clockwise) does the fan turn when you turn on the slide switch (S1)? _____ The positive side of the battery is connected to the positive side of the motor. The polarity of the motor determines the way it rotates.
c. Why does only one LED light turn on? _____
d. Push the press switch (S2). The motor rotates _____ (clockwise or counter clockwise) and the _____ (red or green) LED lights up.
e. Now place the fan on the motor and turn on one of the switches but not both. One of the lamps is lit as the motor spins, but now the LED is dim. The motor needs a lot of current to spin the fan but only a small about of current without it (less resistance). In this circuit, a lamp is lit when the motor current is high, and a LED is lit when the motor current is low. Which has a higher resistance, the LED or lamp?

_____

Extension: Build Project 173 – Current Controllers

Note: Electricity will take the path of least resistance.

a. With the circuit complete, turn on the slide switch (S1). Describe the brightness of the LED. _____ This circuit is in series. The 5.1K Ω (R3) controls the resistance. Trace the path of the electrons with your finger.
b. Turn off the slide switch (S1) and turn on the press switch (S2). Compare the brightness of the LED with just the press switch (S2) on. _____ Trace the path of the electrons in this circuit with your finger.

Placing resistors in series increases the total resistance, so the current is decreased to the LED.

$R_1 + R_2 = \text{Resistance}_{\text{series}}$ or in this circuit, 1KΩ + 10K Ω = 11K Ω

c. Turn on both switches. Compare the brightness with both switches on compared to only one switch.

_____

Placing resistors in parallel decreases the total resistance, so the current is increased to the LED.

$$\frac{1}{R_1} + \frac{1}{R_2} = \text{Resistance}_{\text{parallel}}$$ or in this circuit, 1/1KΩ + 1/5.1K = 1.2 k Ω

When you decrease the resistance, you increase the current. In this parallel circuit, the LED is brighter. The relationship between voltage, current and resistance is Ohm's Law.