**Exercises for Electricity, Power, and Work unit**

1. Create a circuit using two batteries in series and a light bulb. Use a Digital Multi Meter (DMM) to measure the electrical potential in Volts between the positive and negative terminals in the circuit. Now add a second light bulb to the circuit in series with the first. How does the brightness of each bulb compare to when there was only one in the circuit? Use a volt meter to measure the voltage between the positive terminal of the battery and the wire just after the first bulb, and then just after the second bulb. Record the results. Now create a circuit with the two light bulbs in parallel. Record the brightness and the voltage across each bulb.

Explain your results.

**Simple circuit with one bulb**

|  |  |
| --- | --- |
| Bulb brightness |  |
| Voltage drop (V) |  |

**Circuit with two bulbs in series**

|  |  |  |
| --- | --- | --- |
|  | First bulb | Second bulb  |
| Bulb brightness |  |  |
| Voltage drop (V) |  |  |

**Circuit with two bulbs in parallel**

|  |  |  |
| --- | --- | --- |
|  | First bulb | Second bulb  |
| Bulb brightness |  |  |
| Voltage drop (V) |  |  |

2. Build 5 elector magnets, each with different lengths of wire wrapped around the iron nails; 10 cm, 20 cm, 30 cm, 40 cm, and 50 cm. In each case there should be an extra 10 cm on each end of the wire so you can connect it to a battery. So the “10 cm” coil will actually be made using a 30 cm length of wire, and so forth. Connect each magnet to a battery and add as many paper clips as possible to a magnetic chain from the tip of the nail. Record the maximum number of paper clips in each case. Then make a graph of the maximum number of paper clips held versus the length of wire used to make the windings. Explain why the graph looks like it does.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Length of wire in coil (cm) | 10 | 20 | 30 | 40 | 50 |
| Max. no. of paper clips |  |  |  |  |  |

3. Build a simple motor from the kit provided. Be sure to pay attention to the instructions on how to remove the insulation on opposite sides of the wire that contacts the battery clips. Once you get your motor to rotate, perform the following experiments:

a. Note the direction the motor turns. Can you get it to go in the opposite direction? Explain.

b. Now remove the magnet and flip it over. Then restart your motor. Does it turn in the same direction as before? Why?

c. Now turn the battery around and restart the motor. Did the direction of rotation remain the same? Explain why.

d. Think of the electric motor as a system. Identify the source of energy and the fate of that energy in the spinning motor system. In your answer use the following terms: electro-chemical energy, kinetic energy (energy of movement) and heat. Is the electric motor a closed system (does all the energy stay in the system) or is it an open system (does some energy exchange with the environment?)?

4. Use a piece of citrus fruit to create a battery. Put a copper penny in one side of the fruit and a steel paper clip on the other side. Measure the voltage with a volt meter. Record the result: \_\_\_\_\_\_.

Now try to use the fruit battery to light an LED bulb. Does it work? Explain what is creating the electricity.