Materials required:

- multimeter
- range of resistances (100 Ω, 20 Ω, 10 Ω, 5 Ω, 2 Ω, 1 Ω)

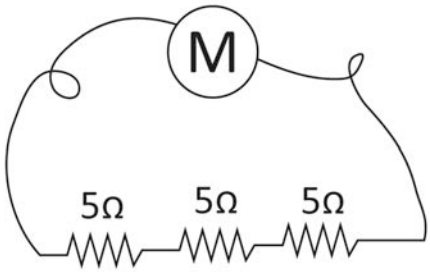
The purpose of these experiments is to explore the relationship between resistors in circuits, and total resistance they produce when connected in series, and in parallel.

A multimeter can be used to measure resistance by connecting it across any combination of resistors (resistors in series, parallel or series & parallel).

Part 1: Resistors in series

- Set multimeter to measure resistance.
- Connect three 5 Ω resistors in series, and measure resistance across the series connection (see Figure 1).
- Repeat this process for another four combinations of resistances in series, and record results in the table below.

Figure 1: Resistors in series

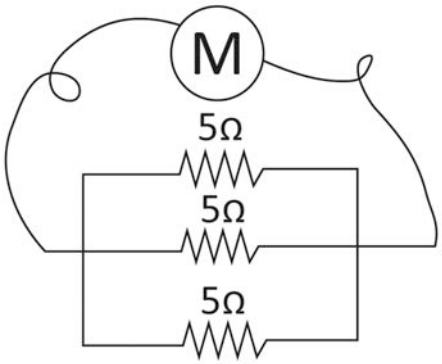


TRIAL	RESISTORS IN SERIES	TOTAL RESISTANCE
1	5 Ω, 5 Ω, 5 Ω	
2		
3		
4		
5		

Part 2: Resistors in parallel

- Set multimeter to measure resistance.
- Connect three 5 Ω resistors in parallel, and measure resistance across the parallel connection (see Figure 2).
- Repeat this process for another four combinations of resistors in parallel, and record results in the table below.

Figure 2: Resistors in parallel



TRIAL	RESISTORS IN PARALLEL	TOTAL RESISTANCE
1	5 Ω, 5 Ω, 5 Ω	
2		
3		
4		
5		

Part 3: Analysis of results

1. Observe results of the resistors in series experiment. Is there a relationship between the resistors and total resistance as measured by the multimeter? Explain your answer.

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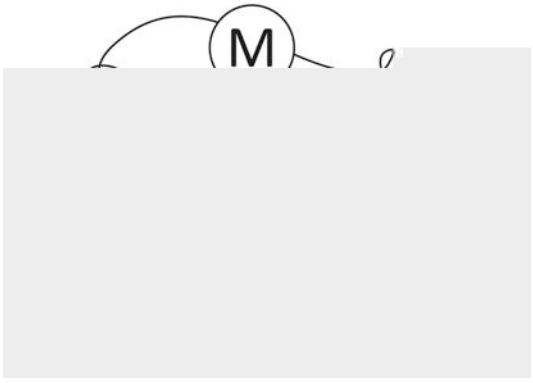
2. Observe results of the resistors in parallel experiment. Is there a relationship between the resistors and the total resistance as measured by the multimeter? Explain your answer. (If you find the answer to this question difficult, then do some research to find out the relationship. Test information you find, with data from your trials.)

- Resistors can also be connected in complex combinations, in series and parallel, as in the arrangement below (Figure 3).

Figure 3: Resistors in series and parallel



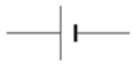
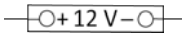
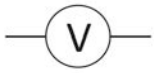
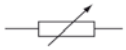
3. Using information obtained from the activity, calculate the total resistance in the arrangement, as measured by the multimeter.

Part 4: Building simple circuits

Materials required:

- power supply
- four 12 V lamps
- four switches

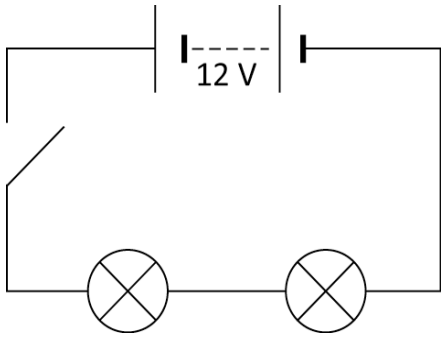
In this activity you will connect electrical components to circuits. Each component has a symbol so you know which to use. The table below includes some common symbols.

COMPONENT	SYMBOL	COMPONENT	SYMBOL
single cell (1.5 V)		switch	
multiple cells (battery)		fuse	
power supply (12 V)		voltmeter	
lamp		ammeter	
resistor		variable resistor (rheostat)	
resistor (alternative)		connecting wires	

Ammeters and voltmeters need to be connected into circuits with the correct polarity. That is, the positive terminal must be traced back to the positive terminal of the cell or power pack, and the negative terminal traced back to the negative terminal of the cell or power pack. Lamps, wired resistors, fuses, switches and rheostats do not have specific polarity, and can be connected to any terminal.

Figure 4, below, uses symbols to represent a circuit with two lamps in series, a switch and a battery.

Figure 4: Series circuit



For the following questions there are a number of tasks to complete. In each case the power supply should be set on 12 V DC output.

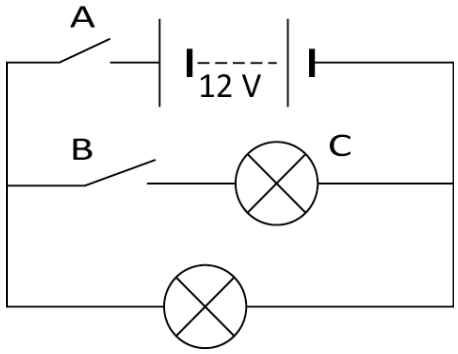
4. Construct a circuit that includes a power supply, four lamps and a switch that controls all four lamps. Draw a circuit diagram to represent the circuit.

5. Construct a circuit that includes a power supply, three lamps, and three switches, where each switch controls one lamp. Draw a circuit diagram to represent the circuit.

6. Construct a circuit that includes a power supply, lamp, and voltmeter, connected in parallel across the lamp; and an ammeter connected in series with the lamp. Record values registered by the ammeter and voltmeter and draw a circuit diagram to represent the circuit. (NOTE: Check with your teacher that the meters are connected with the correct polarity before you switch on the circuit.)

- Construct a circuit by following the circuit diagram in Figure 5. Take a note of the brightness of lamp C when it is 'on'.

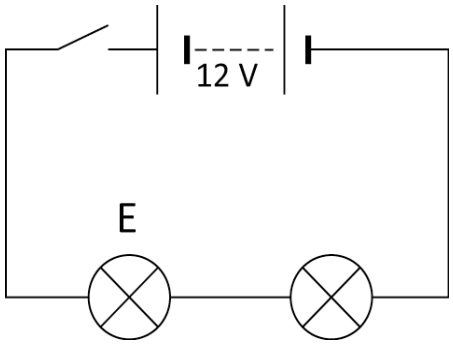
Figure 5: Circuit with two lamps in parallel



7. Why is it necessary to have both switch A and B 'on' before lamp C glows?

- Construct a circuit by following the circuit diagram (see Figure 6 below). Take a note of the brightness of lamp E when it is 'on'.

Figure 6: Circuit with two lamps in series



8. Compare the brightness of lamps C and E, and suggest why there is a difference in brightness.
