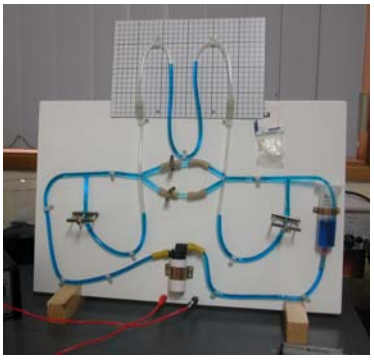
Serrata Water Circuit Board

Introduction:

Ohm's Law and the Water Circuit Board:



The relationship between voltage, current and resistance in a circuit is defined by Ohm's law, which may be: simply stated as: 'when a voltage is applied to a resistive circuit the current in Amperes will be proportional to the voltage and inversely proportional to the resistance in Ohms'. This relationship is represented mathematically be the formula:

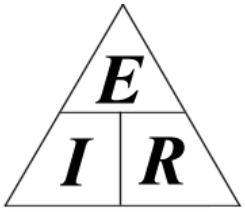
$$E = I \times R$$

where E is in Volts, I is in Amps and R is in Ohms.

this can be turned around to look like:

$$I = \frac{E}{R} \qquad R = \frac{E}{I}$$

If you find these difficult to remember, you may find the diagram on the right helpful: Simply cover the value you are looking for with your fingertip and the formula you require remains exposed.



Series and Parallel Circuits:

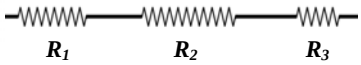
In all circuits, combinations of components are used to achieve various effects. It is often essential to be able to work out the equivalent values of components connected together. To do this, one must be able to work out whether the components are connected in 'series' or 'parallel' - or a combination of both.

In a series circuit, current flowing from the battery must pass through all the components. Because of this, the current is the same through all components.
In a parallel circuit, the current can take a number of different paths - so currents are not identical through various 'legs' of the circuit.

Resistors in series:

Resistors in a series circuit are simply added together to find the total resistance. In other words, a 10 ohm, 150 ohm and 1000 ohm resistors connected in series would be the equivalent of a single 1,160 ohm resistor. The formula is:

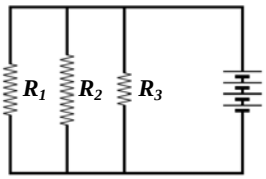
$$R_T = R_1 + R_2 + R_3 + \ldots$$



Resistors in parallel:

Resistors in a parallel circuit are a little more difficult. Here the reciprocals are added together to give the reciprocal of the total. The formula to use is:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

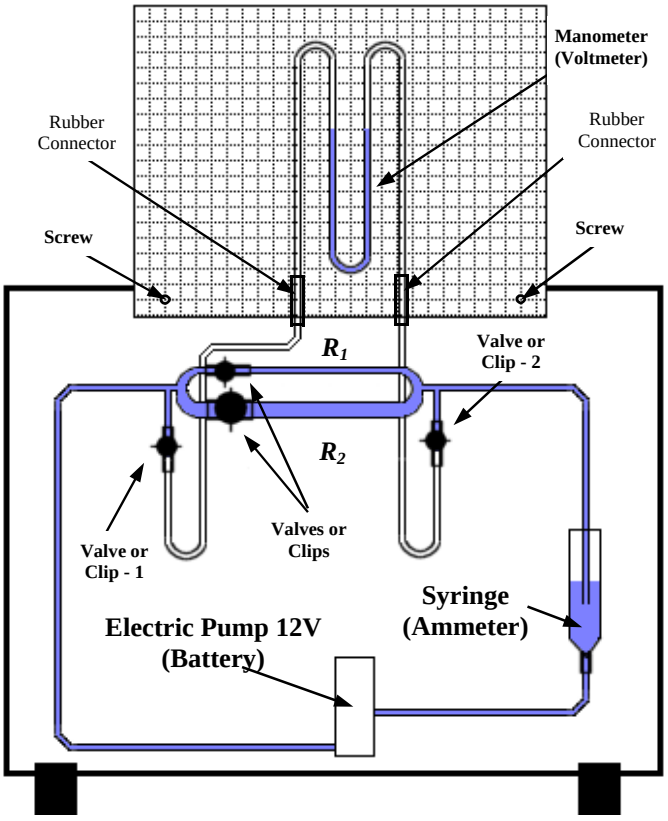


The Electric Circuit Simulator

is a working model which uses water to simulate an electric circuit and to assist in the understanding of the invisible nature of electricity. Water is pumped around a simple circuit to demonstrate movement of charge, resistors, an ammeter and a voltmeter.

1. Demonstrate a voltmeter:

Before the power is switched on, the water levels in the Manometer



(voltmeter) are observed to be at the same level. As the pump voltage is increased, the 'voltmeter' registers this by an increased water level in the right hand tube, which means higher pressure on the left side. With the power switched off, there is no movement in the 'ammeter'.

The electricity is present at all components in the circuit the instant the power is switched on; ie there is no delay between switching the power on and the charge arriving at the various components in the circuit. This can be demonstrated by the fact that the level of the water in the 'voltmeter' is rising immediately.

The unit demonstrates the need for connecting voltmeters in parallel and ammeters in series by showing that the 'ammeter' (which is in series) must actually be part of the circuit for it to work. The water has to flow through it just like the current flows through a real ammeter. If the 'ammeter' is broken or incorrectly connected, the circuit will not work just like it would not work in a real situation. It also shows that a voltmeter (connected in parallel is not actually part of the circuit and has little effect on the circuit. This can be clearly seen as no water flows through the 'voltmeter'.

2. Demonstrate resistance:

The Electric Circuit Simulator contains two 'resistors' in parallel.

At one point, the tube divides. The two sections represent different resistances: one tube has a much finer bore than the other. Clips enable one or the other or both sections to be opened or the flow through them adjusted: thus the effect on the current of different 'resistances' can be seen.

If the resistance of either of them is increased, the 'voltmeter' clearly demonstrates that the 'voltage drop' across them also increases, just like it would in a real electrical circuit.

Assembly:

Fix the voltmeter board to the top of the main board using the screws (supplied) as shown in the diagram.

Directions:

- Close both clips on both sides of the manometer.
- Disconnect the two rubber connections on both sides of the Manometer.
- Fill the manometer tube with water with few drops of stain which will make the water more visible. For the quantity of water - see the diagram.
- Connect back the manometer.
- Open both clips.
- Place a rheostat in series with a DC power supply (set to a maximum of 12 volts) and connect to the input terminals of the Electric Circuit Simulator water pump. Set the rheostat to maximum resistance.
- Fill the syringe with water with stain.
- Begin pumping water through the circuit and the water level of the right hand side tube of the voltmeter should rise higher than the left hand side. Do not let the level of water in the voltmeter rise completely to the top or else the voltmeter will become flooded and you will have to remove the water and re-start the system.
- Remove any air locks in the resistors by opening and closing each valve separately.
- Do not simultaneously fully close both valves or else the voltmeter will be flooded.
- Remove all air pockets in the circuit. Pockets of air trapped in the circuit can be moved by gently tapping the tubing.

The system is now ready to use and will stay in an operable state as long as the syringe is 3/4 full and the outlet tubes is kept submerged in the water.

THE PUMP SHOULD NOT BE USED WITHOUT WATER FLOWING THROUGH IT AND IT SHOULD NOT BE OVERHEATED BY RUNNING IT FOR EXTENDED PERIODS OF TIME.