<h1 style="text-align:center">Experiment: <u>Resistors in Series and Parallel Using the Digital Multimeter</u></h1>

Instructions will be given at the beginning of the lab period on using the **digital multimeter**. See also the document "Using the Digital Multimeter". Follow all instructions very carefully. **If you blow the fuse in your multimeter, you may not be able to complete this experiment.** If in doubt, have the circuit checked before you connect the battery. For any experiment, start by drawing the scheme by your hand, draw by big dots the terminals locations for each circuit element and then build it on the desk by referring to your scheme. For uncertainty calculations, in all cases, assume that the relative uncertainty related to **scale reading** is 0.8%.

1) Choose three resistors labelled 100, 200 and 300 Ω. For each resistor, use the circuit shown to measure the **potential** difference across the resistor (by a voltmeter) and the **current** flowing through it (by a multimeter). From these measurements, calculate the **true resistance** of each. _Report the results in a table to the appropriate number of significant figures and use these values in subsequent exercises._
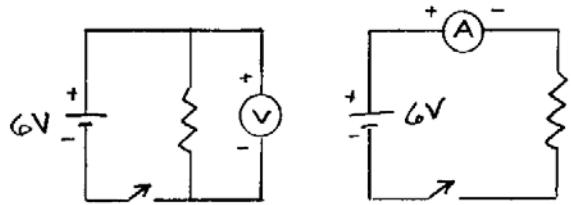
2) Connect the three resistors in series and measure the total potential difference across and the current through the combination as shown. (If you have only the multimeter meter, use it first in the position of the voltmeter, then change the scale setting and connect it in the position of the ammeter.) Show that the equivalent resistance of the combination,
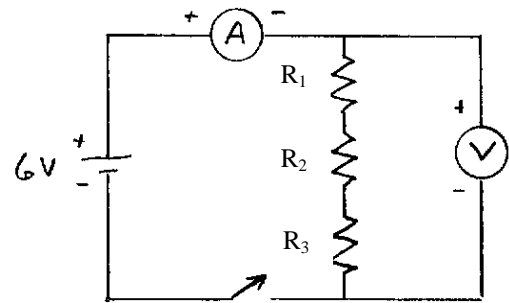
$R_{EQ} = V/I$ is equal to $R_{EQ} = R_1 + R_2 + R_3$.

Measure the potential difference across each individual resistance by connecting the voltmeter in parallel with each resistance in turn. How are these potential differences related to the total potential difference of the combination? Measure the current through each of the resistances by moving the ammeter from where it is to between R_1 and R_2, then between R_2 and R_3, then between R_3 and the switch. Remember that the **ammeter** must <u>always</u> be **in series** with the resistance. How are these currents related to the total current through the combination?

3) Connect the three resistors in parallel as shown and measure the potential difference across and the current through the combination. Show that the equivalent resistance of the combination, $R_{EQ} = V/I$, satisfies the relationship:
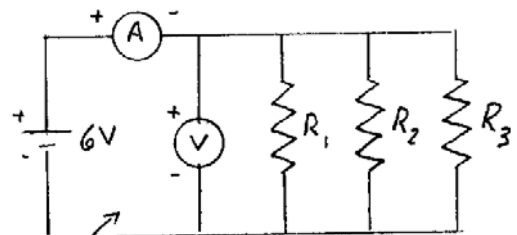
$1/R_{EQ} = 1/R_1 + 1/R_2 + 1/R_3$

Move the voltmeter around to measure the potential difference to terminals of each resistor. How are the found values with respect to the potential difference across the combination?

Move the ammeter around to measure the current through each of the resistors individually. Remember that there **must always** be **some resistance in series** with the **ammeter**. NEVER CONNECT AN AMMETER IN PARALLEL WITH THE BATTERY. If you are not sure about the connection, leave the switch open and have the circuit checked. How are these currents related to the total current through the combination?

4) Use the circuit shown to measure the internal resistance ("r") of the **6 volt battery**. When the switch is open, the voltmeter measures the ideal emf (ε). When the switch is closed, the voltmeter measures the terminal voltage. Take two voltage readings, one with the switch open, the other with it closed. **N.B. Do not leave the switch closed for more than a few seconds at a time - just long enough to obtain the readings.**