

**Overview**

In this unit your students should:

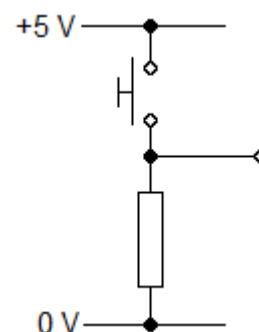
- be reminded of a useful model of electricity
- learn the distinction between current, charge, voltage and power
- learn how to use switches and resistors to generate digital signals
- practice the use of  $P = VI$  and  $V = IR$
- meet the use of breadboard, power supplies and multimeters

This should not require more than 3 hours of class time.

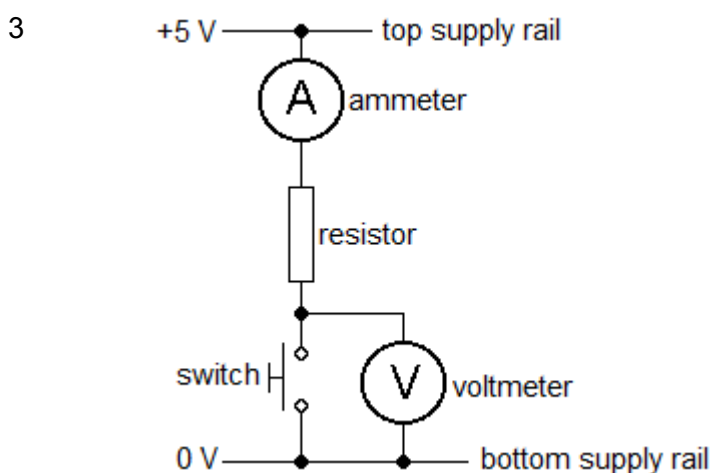
Hour	Suggested Activity
1	<p>Briefly remind them of the basic model of electricity and introduce the idea of high and low as alternative names for +5 V and 0 V.</p> <p>Go straight into practical work with <b>Switches in series and parallel</b>. You will need to explain how breadboard works, show them how to use a multimeter as a voltmeter and introduce them to power supply arrangements.</p> <p>You might want to mention the terms AND and OR when discussing the results of their practical work.</p> <p>Run through some examples of the use of <math>P = VI</math> and <math>V = IR</math>, showing them how to deal with prefixes and transposition.</p> <p>Ask students to study <b>1.1</b> from the text book and complete page 1 of the exercises for <b>Digital Inputs</b> before the next session.</p>
2	<p>Show them how to use a multimeter to measure resistance and current, then launch them straight on to <b>Current in resistors</b>. They will need access to the <b>Discrete Components</b> data sheet for the resistor colour code. They should use breadboard for step 6 of the practical, giving them more practice in using it.</p> <p>Discuss their responses to the <b>Digital Inputs</b> exercises before setting them questions 1, 2 and 3 from page 15 of the text book.</p>
3	<p>Start them straight away on page 2 of the exercises for <b>Digital Inputs</b>. Encourage them to find the answers together, as the discussion should promote their understanding.</p> <p>Then set them to answering questions 4 and 5 on page 15 of the text book.</p> <p>Finish the session by getting them to mark their own answers to questions 1 - 5.</p> <p>Ask students to study <b>1.2</b> from the text book and complete questions 1 and 2 of the <b>Combining Signals</b> exercises before the next session.</p>

**Model Answers**

- 1 An open switch allows no flow of charge, so no current in the resistor and no voltage drop across it, leaving the output at 0 V. A closed switch allows the flow of charge, so there is a current in the resistor. The switch connects the top supply rail directly to the output, so it has a voltage of +5 V.



- 2 (a)  $I = V/R = 5 / 120 = 4.2 \times 10^{-2}$  A or 42 mA  
 (b)  $P = VI = 5 \times 42 \times 10^{-3} = 2.1 \times 10^{-1}$  W or 210 mW  
 (c) 250 mW, the nearest value above 210 mW



- 4 Maximum safe current  $I = P/V = 250 \times 10^{-3} / 30 = 8.3 \times 10^{-3}$  A  
 Smallest safe value of resistor  $R = V/I = 30 / 8.3 \times 10^{-3} = 3.6 \times 10^3 \Omega$  or 3.6 k $\Omega$
- 5 (a) Both ends of the resistor will be at +5 V, so voltage drop = 0 V, so current = 0 A.  
 (b)  $I = V/R = 5 / 22 \times 10^3 = 2.3 \times 10^{-4}$  A = 0.23 mA or 230  $\mu$ A  
 (c) Pressing either L or R connects the output directly to 0 V. Only when neither are pressed is there no charge flow, resulting in a voltage drop of 0 V across the resistor, leaving the output at +5 V.