

# IGCSE Co-ordinated Sciences 0654

## Unit 20: Electricity

### Recommended Prior Knowledge

Students have an understanding of the concept of energy transfer. They need to be able to make simple calculations and to rearrange formulae.

### Context

This Unit covers Topics P7 and P8. The concept of electric charge links with C7 Ions and electrolysis, and will be met again in P17 Radioactivity. Energy and electricity links strongly with C15 Batteries.

### Outline

Students use circuits to understand the concepts of electric current, voltage and resistance. They investigate series and parallel circuits.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
P7	<p>Appreciate the need for a complete circuit when making use of electricity.</p> <p>Appreciate that energy can be transferred by an electric current and that the current can be read by an ammeter.</p> <p>Be able to explain how ammeters are used in circuits and what they measure.</p> <p>Understand that the readings on ammeters in simple and branching circuits conform to the idea that the behaviour of electricity in a circuit is analogous to the behaviour of, for</p>	<p>Use simple circuits to demonstrate this.</p> <p>Use simple circuits to measure current. Students can build circuits following simple diagrams, and draw diagrams from actual circuits.</p> <p>Extension students should build series and parallel circuits and record current in various places; ask them to look for a pattern in their results.</p>	<p>This site contains a series of useful pages relating to electricity. <a href="http://www.galaxy.net~k12/electric/index.shtml">http://www.galaxy.net~k12/electric/index.shtml</a></p> <p><i>IGCSE Physics</i>, Hodder, Duncan T and Kennet H, pages 180–183</p>

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	<p>example, currents of liquids in pipes.</p> <p>Be aware of the dangers of electricity and state the hazards of poor insulation, overloading and damp conditions.</p>	<p>Provide a picture or cartoon illustrating a range of hazards, and ask students to identify them and explain the risks they pose.</p> <p>The effect of a fuse can be illustrated by using a very thin wire (e.g. a strand of iron wool in a circuit powered by two 1.5 V cells). The wire will burn out and break the circuit.</p>	<p><i>IGCSE Physics</i>, Hodder, Duncan T and Kennet H, pages 203–205</p>
	<p>Know that an electric current is a flow of charge.</p>	<p>A Van de Graaf generator can be used with a microammeter to show that current is a flow of charge.</p>	<p>For some interesting information about static electricity from the Theater of Electricity, including a video of how the Van de Graaf generator works:  <a href="http://www.mos.org">http://www.mos.org</a>  Click on Theater of Electricity, then video gallery.</p>
	<p>Know that electric charge is measured in coulombs and that a flow rate of one coulomb per second is called one ampere.</p>	<p>A Van de Graaf generator can be used with a microammeter to show that current is a flow of charge.</p>	<p>For an interesting way to teach about charge and current using an OHP  <a href="http://eskimo.com">http://eskimo.com</a></p>
	<p>Appreciate that electric charge produced by friction is the same charge which, moving around a circuit, produces an electric current.</p>	<p>Students can carry out simple experiments to illustrate static electricity, e.g. strips of insulating material (e.g. Perspex and cellulose acetate) rubbed with a cloth to show attraction and repulsion. Balloons or cling film can also be give a larger scale result.</p>	<p>This site has useful introductory work on static electricity.  <a href="http://sciencemadesimple.com">http://sciencemadesimple.com</a></p> <p><i>IGCSE Physics</i>, Hodder, Duncan T and Kennet H, pages 174–176 and 180–182</p>
P8	<p>Be able to apply the idea of voltage numerically to circuits containing more than one component and apply correctly the term <i>potential difference</i>.</p>	<p>An analogy with water being pumped round a closed system can be useful here to enable students to have a mental picture, which helps them to distinguish between current (the water) and the energy that is being used to drive it around the circuit.</p>	<p>A good introductory lesson on current and emf.  <a href="http://www.mos.org">http://www.mos.org</a></p> <p><i>IGCSE Physics</i>, Hodder, Duncan T and Kennet H, pages 184–187.</p>

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	<p>Know that a potential difference of one volt is equivalent to an energy difference of one joule per coulomb of charge.</p>		
	<p>Understand that the 'voltage' of an electrical supply is a measure of the energy it can transfer from an electrical supply elsewhere and that it can be measured with a voltmeter.</p>	<p>Students should build circuits and measure potential differences with a voltmeter.</p>	
	<p>Be able to explain how voltmeters are used in circuits and what they measure.</p>		
	<p>Be able to use the relationship <i>power = voltage x current</i></p>		<p><i>IGCSE Physics</i>, Hodder, Duncan T and Kennet H, page 197.</p>
	<p>Understand the meaning of the term <i>electrical resistance</i> and know that <i>the resistance of a component (in ohms) = voltage across component / current through component</i></p>		<p>This site shows the relationship between voltage and current (unfortunately called 'amperage') and resistance. Students can change the resistance and voltage in a circuit, switch on and see the effect on the lamp. <a href="http://jersey.uoregon.edu">http://jersey.uoregon.edu</a></p>
	<p>Appreciate the experimental evidence leading to Ohm's Law.</p>	<p>Extension students can investigate this relationship experimentally.</p>	<p><i>IGCSE Physics</i>, Hodder, Duncan T and Kennet H, page 188–191</p>

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	<p>Be able to work out the combined resistance of two resistors in series.</p> <p>Be able to work out the combined resistance of two resistors in parallel.</p>	<p>Measurements of current in series and parallel circuits (e.g. with cells and lamps) should form the basis of the work on combinations of resistors.</p>	<p><i>IGCSE Physics</i>, Hodder, Duncan T and Kennet H, pages 188–191</p>
	<p>Appreciate the factors affecting the resistance of a component: length of wire, temperature of wire and cross section of wire.</p>	<p>Students can investigate the effect of the length or cross section of a wire on its resistance; this is good opportunity for them to plan and carry out their own investigation.</p>	