Unit 6: Electricity 2

Recommended prior knowledge
It is likely that this section of the course will be studied after *Electricity 1* although there is certainly scope for dealing with electrostatics before *Electricity 1* should a teacher wish to do so. Likewise, $P = IV$ could be left until after unit 1 and treated almost as a topic in its own right; it fits in very well with *fuses* and *RCCBs (Residual Current Circuit Breakers* and *safety precautions* in general. The coulomb is a unit which students are unlikely to have encountered elsewhere and might well come after meeting the idea of rates and the equation $Q = It$.

Students commonly confuse magnetism and electrostatics and it is wise to separate the topics – perhaps by putting them into separate years in the course; it is good if the correct use of terms like *pole, north, south* and *magnetise* can be fully understood before terms like *charge, positive, negative* and *charging* are met with or vice versa.

Context
This part of the course completes the pure electricity topics that the Cambridge IGCSE syllabus requires although the distinction between *Electricity 1* and *Electricity 2* is somewhat arbitrary and could quite happily be taught together or subdivided differently should a teacher prefer. Some teachers will prefer to deal with electricity in its entirety and them move on to other units and deal with them whilst other teachers will teach a little electricity, move on to something else and then keep returning to it and cover it in small sections; this is a matter of taste and not one of right or wrong.

Outline
As with the previous electricity unit, it contains ideas that do not immediately and directly relate to the familiar experience of many students and the concepts student tend to find somewhat vague and intangible. The teacher is likely to concentrate here on the experiments that can be used underline the handling of information and obtaining the correct numerical answer rather than attempting to instill a philosophical and fundamental understanding of the ideas in the abstract. Calculation and formula manipulation are likely to emphasised. It is also a topic where the use of units and unit symbols will be important.

(Please note: **(S)** in **bold** denotes material in the Supplement (Extended syllabus) only)

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
4.2 (a)	Describe simple experiments to show the production and detection of electrostatic charges State that there are positive and negative charges State that unlike charges attract and that like charges repel Describe an electric field as a region in which an electric charge experiences a force Distinguish between electrical conductors and insulators and give typical examples	Use simple experiments with 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 used to give a larger scale result. Students are always impressed when a charged rod diverts a stream of flowing water. Remember wood can act as a conductor when discharging electrostatically charged objects. Show this and remind students not to use wooden objects when rescuing someone from electrocution.	This website has useful introductory work on static electricity; www.sciencemadesimple.com/static.html For teachers' interest, look at; www.amasci.com/emotor/sticky.html IGCSE Physics Coursebook CD-ROM Activity Sheet 17.1 IGCSE Physics Coursebook CD-ROM Activity Sheet 17.2 Unit 6: Past Paper Question Core 2
4.2 (a) (S)	**State that charge is measured in coulombs** **State the direction of lines of force and describe simple field patterns.** **Give an account of charging by induction** **Recall and use the simple electron model to distinguish between conductors and insulators**	**For more able students electric field patterns can be demonstrated. (e.g. two electrodes dipped in castor oil, contained in a petri dish. The electrodes are connected to a high voltage supply and semolina grains sprinkled around the electrodes show the field pattern).** **Also charging by induction can be shown using a gold-leaf electroscope.**	This website seeks to deal with some common misconceptions about static electricity – good background for the teacher: www.eskimo.com/~billb/emotor/stmiscon.html For an interesting way to teach about charge and current using an overhead projector demonstration see: www.eskimo.com/~billb/redgreen.html Unit 6: Past Paper Question Extension 1

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
4.3 (a) & (b)	Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), lamps, ammeters, voltmeters, magnetising coils, transformers, bells, fuses and relays Understand that the current at every point in a series circuit is the same Give the combined resistance of two or more resistors in series State that, for a parallel circuit, the current from the source is larger than the current in each branch State that the combined resistance of two resistors in parallel is less than that of either resistor by itself State the advantages of connecting lamps in parallel in a lighting circuit	Students can be given experience of these components as parts of working circuits (perhaps a circus arrangement), setting circuits up from given diagrams and drawing circuit diagrams of actual circuits. Measure the current at different points in a series circuit.	What is electricity? www.education.leeds.ac.uk/research/cssme/ElecCircuitsScheme.pdf This website shows the relationship between voltage 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: www.jersey.uoregon.edu/vlab/Voltage/ IGCSE Physics Coursebook CD-ROM Activity Sheet 19.2

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
4.3 (a) (b) (S)	**Draw and interpret circuit diagrams containing diodes and transistors** **Recall and use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply** **Recall and use the fact that the current from the source is the sum of the currents in the separate branches of a parallel circuit** **Calculate the effective resistance of two resistors in parallel**	**This work can then be extended with more able students to circuits containing a diode (perhaps a 'problem-solving' exercise) and to a more detailed approach to series and parallel circuits.** **Measurements of current in series and parallel circuits (e.g. with cells and lamps) could form the basis of the work on combinations of resistors.** **Demonstrate with ammeters that the current flowing into a junction equals that flowing out.**	Unit 6: Past Paper Question Core 1 Unit 6: Past Paper Question Core 3
4.4 (b)	State the hazards of - damaged insulation - overheating of cables - damp conditions Show an understanding of the use of fuses and circuit-breakers	The heating effect work can be extended to use a very thin wire (e.g. strand of iron wool in a circuit powered by two 1.5V cells). A short piece of iron wool will 'burn out' illustrating the action of a fuse.	www.youtube.com/watch?v=Ym1a9_aXEv8 IGCSE Physics Coursebook CD-ROM Activity Sheet 19.4