IGCSE Co-ordinated Sciences 0654
Unit 22: P14 Magnetism and Electricity & P15 Communication

Recommended Prior Knowledge
Students should appreciate basic ideas of electrical circuits from topic P7.

Context
This Unit has links with topic P7 provides knowledge and concepts that are useful for study of topic P20

Outline
Study of permanent magnets leads on to electromagnets and devices such as relays, electric motors and dynamos. Development of communication using heliographs, telegraph, telephone and radio signals is studied.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
ABC	Know that magnetic materials have the ability to attract some materials but to attract and repel each other. Understand the meaning of the term magnetic field and know that the Earth is surrounded by one.	Students should carry out a number of experiments to explore some of the properties of the magnetic field surrounding permanent magnets - a second example of 'action at a distance'. These experiments should include attraction of magnetic metals such as steel paper clips or nails, attraction and repulsion of poles, shape of field lines shown by using iron filings and/or by plotting compasses, experiments to magnetise and demagnetise samples of iron by mechanical and electrical means.	*IGCSE Physics* by Tom Duncan & Heather Kennett Chapter 45. *IGCSE Study Guide for Physics* by Mike Folland Topic 4. *Teaching and Assessing Practical Skills in Science* by Dave Hayward This site called 'Gallery of Electromagnetic Personalities' contains brief histories of 43 scientists who have made major contributions, from Ampere to Westinghouse: http://www.ee.umd.edu/

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AB	Know that forces can act on an electric current when in a magnetic field.	A study of the possibility of using electric power for vehicles is a good way of introducing electromagnetism. Students need to know that a current-carrying wire can generate the same type of field as a permanent magnet. The field lines around a wire carrying an electric current can be shown using iron filings and/or plotting compasses.	*IGCSE Physics* by Tom Duncan & Heather Kennett, Chapter 45. *IGCSE Study Guide for Physics* by Mike Folland, Topic 4. This site has a very full lesson plan including making an electromagnet: http://school.discovery.com/
ABC	Understand that an electric current can be induced in a wire moving relative to a magnetic field.	The generation of a current by moving a magnet in and out of a coil or wire connected to a sensitive meter can be demonstrated or set as a class practical. This can be extended to show the same effect using an electromagnet moved in and out of the coil and then by simply switching the electromagnet on and off. Students following the extended curriculum can carry out a series of investigations into the factors which affect the strength of an induced current. The experiments above can be extended to show the effects of the strength of the field (use a stronger permanent magnet or increase the current in the electromagnet), the speed of movement and the number of turns per metre in the coil.	*IGCSE Physics* by Tom Duncan & Heather Kennett, Chapter 48. *IGCSE Study Guide for Physics* by Mike Folland, Topic 4. *Teaching and Assessing Practical Skills in Science* by Dave Hayward
AB	Be able to apply this idea to understand the working of dynamos and alternators.	Students aiming for higher grades should study the working parts of dynamos and alternators, using diagrams and dismantled examples. Students may use the websites for information to make notes.	*IGCSE Physics* by Tom Duncan & Heather Kennett, Chapter 48. *IGCSE Study Guide for Physics* by Mike Folland, Topic 4. This site describes the working of an a.c. generator: http://www.pbs.org/ and a dynamo:

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			http://www.tiscali.co.uk/reference/e clopaedia/hutchinson/m0015973.html
AB	Know that the force on an electric current in a magnetic field is at right angles to the direction of the current and the field.	A series of demonstrations can be used to show the force acting on a current-carrying wire in an electric field and also the relative directions of field, current and force. This shows how an electric motor works.	*IGCSE Physics* by Tom Duncan & Heather Kennett, Chapter 46. *IGCSE Study Guide for Physics* by Mike Folland, Topic 4.
ABC	Be able to apply these ideas in understanding how an electric motor works.	Students will benefit by trying to construct their own simple d.c. motor. They can also be shown the website simulation. These same motors, run in reverse, can be shown to generate a voltage by electromagnetic induction. This work should lead to some understanding of the working of dynamos, alternators and power station generators.	*IGCSE Physics* by Tom Duncan & Heather Kennett, Chapter 46 & 48. *IGCSE Study Guide for Physics* by Mike Folland, Topic 4. *Teaching and Assessing Practical Skills in Science* by Dave Hayward Make a simple dc motor: http://home.hiwaay.net/~palmer/motor.html Simulation of a dc motor: http://www.sciencejoywagon.com/
AB	Appreciate that an electric current itself has a magnetic field and that this can be applied to the design of electromagnets and relays.	Students can carry out practical work to see how ideas about magnetic fields can be applied to electromagnets and relays.	*IGCSE Physics* by Tom Duncan & Heather Kennett, Chapter 45. *IGCSE Study Guide for Physics* by Mike Folland, Topic 4.
AB	Understand how, historically, the use of light greatly increased the speed of communication but that this required	Students can use mirrors out of doors to reflect the sun (heliographs) and so send messages using Morse code.	Morse code: http://about.com/

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	the use of a code.		http://www.qsl.net/ Heliograph: http://www.dself.dsl.pipex.com/index.htm
AB	Understand how the use of electrical signals has improved long-distance, high speed communication even further.	The speed and distance of communication possible with electromagnetic waves is shown by the use of radio.	History of radio: http://history.acusd.edu/gen/recording/radio.html
AB	Be able to describe the operation of the microphone and earphone and relate their operation to basic physical principles.	The workings of microphones, loudspeakers and telephones can be explored practically. The emphasis throughout is on the application of ideas already learnt. Digital coding of information can be likened to the earlier use of Morse code - the messages transmitted are far less likely to be corrupted.	*IGCSE Physics* by Tom Duncan & Heather Kennett, Chapter 45, 46 & 48.