edexcel

Edexcel GCSE in Science

You're in Charge
(Concept approach)

January 2006

advancing learning, changing lives

Support material

Edexcel GCSE in Science
You're in Charge
(Concept approach)

Edexcel Limited is one of the leading examining and awarding bodies in the UK and throughout the world. It incorporates all the qualifications previously awarded under the Edexcel and BTEC brands. We provide a wide range of qualifications including general (academic), vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, our centres receive the support they need to help them deliver their education and training programmes to learners.

For further information please call Customer Services on 0870 240 9800, or visit our website at www.edexcel.org.uk

Authorised by Jim Dobson
Prepared by John Crew

Contents

Scheme of work for Topic 10: You're in Charge

LESSON 1: Renewable energy							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.1	7I Energy resources.	Know the advantages and disadvantages of renewable and non-renewable energy sources. Know the main steps involved in converting an energy source into electrical energy. Be able to suggest reasonable alternative technologies for producing electricity in the local area.	**Starter** Demonstrate various energy conversion methods using Science Year kit. Revise renewable/non-renewable energy sources via mind map that students complete. Demonstration 10.1: Water wheel. **Main** Use Multimedia Science School (MSS) Power Production tool or internet/textbook research to explore the stages for the production of electricity (energy source → turbine → generator). Use research/MSS worksheet to look at percentage conversion. Use MSS Game to look at economic, environmental and social factors. Alternatively, research this using internet or textbook. **Plenary** Students construct a table of good and bad points for different energy sources.	Energy conversion kit sent out to schools during Science Year 2001/2002 (alternatively, examples of dynamo, solar cell, etc). Multimedia Science School Power Production tool. (PLATO Learning, Multimedia Science School 11-16 edition Version 2.0.) www.darvill.clara.net/altenerg (excellent free resource with ready made worksheets). BBC Schools TV Young Foresight – Power production.	Evaluate whether renewable energies such as solar power and wind power can meet the UK's future electricity needs, and evaluate their economic, environmental and social impact.	N 2.2 2.3 ICT 2.1	
Homework: Students to do worksheet on renewable/non-renewable energy resources: Longman Science 1 E15, E16, E17.							

Scheme of work for Topic 10: You're in Charge

LESSON 2: The National Grid							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.1 P1 a 10.2	7I Energy resources. 7J Electrical circuits. 9I Energy and electricity.	Know the advantages and disadvantages of renewable and non-renewable energy sources. Be able to suggest reasonable alternative technologies for producing electricity in the local area. Consider advantages and disadvantages for different methods of electricity transmission.	**Starter** Show that a transformer may be used to convert a small voltage into a larger voltage and vice versa. **Main** Demonstrate a model of the National Grid, using demountable transformers and wires. Discuss important factors such as the need for step-up/down transformers to minimise energy losses. Benefits and drawbacks of overhead and underground cables. Labelling exercise to detail path of electricity between power station and power shower heater at home. **Plenary** Draw a diagram similar to that of the previous exercise showing the path of an underground distribution network. Annotate the diagram, to show any issues/problems that might be encountered.	Demountable transformers, ac voltmeters, ac power supply, lamps. Information from National Grid company www.nationalgrid.com/uk/ Other views at www.revolt.co.uk www.emfs.info	Evaluate whether renewable energies such as solar power and wind power can meet the UK's future electricity needs, and evaluate their economic, environmental and social impact. Consider the benefits and drawbacks when deciding about implementing technology, such as a new National Grid for distribution of electricity.	N 2.1 C 2.2 ICT 2.1 2.3	High voltage in wires. Ensure current kept low.
Homework: List appliances at home that have motors in them in preparation for the next lesson.							

Scheme of work for Topic 10: You're in Charge

LESSON 3: The electric motor							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.4	8J Magnets and electric magnets.	Know that electricity is useful when its energy is transferred into other forms, mostly heat and motion. Know that a wire carrying a current will experience a force in a magnetic field. Know that a coil carrying a current in a magnetic field can be made to spin and act as a motor.	**Starter** Demonstrate the effect of a magnetic field on a current carrying conductor. Discuss observations. Explain that this effect is used in electric motors. **Main** Use MSS Electric Motor tool or motor kits. In practice, motor kits can take about 30 minutes to build. Discuss: a) force on a single wire in a magnetic field; b) force on a loop of wire; c) force on a coil of wire. Investigate the effect of increasing field strength/current and reversing the field/current. Use of a commutator to avoid tangling wires. **Plenary** Show students a selection of household appliances that have motors in them. Refer to homework from last lesson.	Wires, battery and horseshoe magnet. Multimedia Science School Electric Motor tool. (PLATO Learning, Multimedia Science School 11-16 edition Version 2.0.) Power supply, electric motor kits. www.practicalphysics.org www.sciencejoywagon.com Display of large range of electrical appliances.	Explain how a simple electric motor works.	C 2.1 ICT 2.1 WO 2.1 2.2	Students should limit the input voltage to avoid melting the insulation on wires in the motor coil.
Homework: Set worksheet of questions on the motor and forces on wires in fields, eg Longman Science 1 F12.							

Scheme of work for Topic 10: You're in Charge

LESSON 4: Electrical safety							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.11 P1 a 10.12	8J Magnets and electric magnets.	Explain how the earth wire, together with a fuse, provides protection for the user. Know how fuses and circuit breakers work.	**Starter** Show how 3-pin plugs and cables have live, neutral, earth wires and fuses and explain role of each. **Main** Experiment 10.4: Plugs Students label diagrams of plugs with colours and names of parts. Students explain what is wrong with samples of wrongly wired and damaged plugs. Demonstrate fuses, circuit breakers, RCCBs, and consider benefits/drawbacks of each. **Plenary** Past paper exam question on RCCBs of earth wires.	Display of incorrectly wired plugs, damaged plugs, fuses and circuit breakers. Power supply, different thicknesses of wire, ammeter, heat-proof mats, lamps.	Explain how the earth wire, together with a fuse, provides protection for the user. Describe the advantages of a residual current circuit breaker (RCCB).		If investigating fuses practically, beware of high temperatures. Use heat-proof mats.
Homework: Worksheet/questions on RCCB and plugs. Learn the colours and parts of a plug for a test.							

Scheme of work for Topic 10: You're in Charge

LESSON 5: Electrical power							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.5 P1 a 10.6	7J Electrical circuits. 9I Energy and electricity.	Know that as power is increased, more energy is transferred per second. Know that power is measured in Watts and that this relates to Joules/second. Know and use the equation P=IV.	**Starter** Quick test on labelling plugs. Discuss electric power. Include the equation P=IV. **Main** Give students questions to practise using P=IV. Explain that high power appliances transfer more Joules of energy per second than low power appliances. Provide pictures of electrical appliances and details of their power from a home shopping catalogue. Students put them in order of electrical power. **Plenary** Demonstration: Use an ammeter and voltmeter to record the energy input to an electrical device and calculate power. Compare the result to the power rating of the device and explain the observed differences as voltage is increased. Students should be encouraged to consider any forms of 'wasted' energy in preparation for next lesson.	Home shopping catalogue. Power packs, 12V lamps and other electrical devices, eg motor, that will show increase in power as voltage increased, ammeter, voltmeter.	Explain the concept of electrical power as the rate of transfer of electrical energy. Use the equation to calculate electrical power: Power = Current × Voltage.	N 2.2	
Homework: Students to find 10 electrical appliances around the home. Use their rating plates to find out their power and voltage, and calculate the current passing through the device. Suitable fuse sizes could be predicted.							

Scheme of work for Topic 10: You're in Charge

LESSON 6: Efficiency							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.7	7J Electrical circuits. 9I Energy and electricity.	Collect and use measurements of V and I to calculate power. Calculate energy used from measurements of power and time. Understand that appliances do not convert all of their input energy into useful energy, and that some energy is 'wasted'.	**Starter** Explain that electrical energy is wasted in electrical appliances. Discuss ways in which energy may be wasted. Discuss efficiency. **Main** Demonstration: Use a 12V electric heater to raise the temperature of a metal block or water in an insulated beaker. Calculate the amount of energy passed into the heater using measurements of current, voltage and time in seconds (IVt). This is the total input. Calculate the amount of energy gained by the metal block or the water (temp. rise x mass x specific heat capacity). This is the total output. Use: efficiency = $\frac{\text{useful output}}{\text{total input}}$ x 100% **Plenary** Show examples of normal and energy efficient light bulbs with a quoted efficiency. Students have to suggest the ways that energy is wasted. Students do past-paper question on calculating efficiency.	Voltmeter. Ammeter. Stopwatch. Electric heater (6-12V). Metal block with cavity for the heater or water in an insulated beaker. Thermometer (graduated in steps of $0.1^{o}C$). Normal and energy efficient light bulbs and their boxes with data.	Use the term 'efficiency' to be able to find efficiency from: $\frac{\text{useful output}}{\text{total input}} \times 100\%$ and recall this equation.	N 2.2 2.3 ICT 2.2	
Homework: Set questions on efficiency, eg use Longman science 1 E19.							

Scheme of work for Topic 10: You're in Charge

LESSON 7: The cost of electricity							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.9	9I Energy and electricity.	Understand that power is calculated from IV and that energy consumed is calculated from power x time. Know that mains electricity is charged for in units of kilowatt-hours. Use the equation to calculate the cost of electricity: cost = power x time x cost of 1kWh.	**Starter** Show students an electricity bill and explain the terms used, including the kWh. Tell students the cost per 1kWh, and the formula for calculations. **Main** Students use pictures/data from a home shopping catalogue to calculate the cost of running an appliance eg how much does it cost to dry your hair with a hairdryer/boil the kettle/have an electric fire on for an hour? **Plenary** Class discussion about how they could save money for their families.	Home shopping catalogues. There are a number of websites that allow calculation of running costs of appliances, eg www.ukpower.co.uk/running-costs-elec.asp Spreadsheet 10.6 electricity.	Use the equation to calculate the cost of electricity: cost = power × time × cost of 1kWh where power is measured in kilowatts and time is measured in hours.	C 2.1 N 2.1 2.2 2.3 ICT 2.1 2.2	
Homework: Set questions using the formula: Cost = power × time × cost of 1kWh.							

Scheme of work for Topic 10: You're in Charge

LESSON 8: Insulating your home							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.10	7I Energy resources. 8I Heating and cooling. 9I Energy and electricity.	Recognise that a lot of energy is wasted, which has social, economic and environmental consequences. Know that there are a number of energy-saving measures that can be taken. Predict whether a particular energy-saving measure is likely to be cost-effective.	**Starter** Discuss how the loss of thermal energy can be prevented using insulating materials. **Main** Ask students to identify different ways of insulating a house and which methods they think will be most effective. Students build an insulated 'house' to go over a beaker of hot water with a temperature probe and datalogger. Students monitor heat loss over a set period. **Plenary** Compare findings with rest of class, and compare with data about home insulation methods.	Temperature probes, dataloggers, hot water, beakers, selection of insulating materials. The link below gives access to a heat loss calculator (explanation quite technical, but easy to use) www.resurgence.org/energy/heac/	Plan a way to test whether an energy efficiency measure, such as insulating a home, is cost effective.	C 2.3 N 2.2 2.3 ICT 2.2 WO 2.1 2.2 PS 2.1 2.2 2.3	This will use large quantities of very hot water. Ensure all groups have safe access to hot water, and minimise spillages.
Homework: Students to write a report of the investigation.							

Scheme of work for Topic 10: You're in Charge

LESSON 9: Solar cells							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.8	7I Energy resources.	Know how solar cells work. Understand the problems with their use.	**Starter** Demonstrate light shining onto a solar cell produces electricity. **Main** Students use the internet or other sources of information to find data on solar cells. Students to compile report on a) different types of solar cell; b) efficiency of conversion; c) cost to produce electricity. Results to be presented as a leaflet or a presentation. **Plenary** Brief presentations from groups on data found in their survey. Show/discuss devices that are/can be run by solar cells, eg calculators, radios, garden lights, road signs.	Solar cell, voltmeter and light source. A starter list of websites is given, but this is by no means exhaustive or even definitive: www.soton.ac.uk/~solar/intro/start.htm www.newscientist.com www.nrel.gov www.epia.org/ www.narec.co.uk www.energyprojects.co.uk/index.htm. Alternatively, provide a selection of leaflets on solar cells eg from manufacturers.	Interpret data about the efficiency of solar cells and suggest why they are not yet in widespread use.	N 2.1 2.2 2.3 ICT 2.1 2.2 2.3	
Homework: Students to do calculations on payback times for solar cells compared to use of conventional electricity supply. Use websites above to find the cost of buying a solar cell and then find the cost of the same amount of electricity from a conventional supply. Calculate how long it will take to recoup the cost of purchase, assuming the solar cell costs nothing to run.							

Scheme of work for Topic 10: You're in Charge

LESSON 10: Medical uses of electricity							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
P1 a 10.3	7I Energy resources.	Be able to give information on how scientific ideas have changed over time in context of the medical uses of electricity, real and imagined.	**Starter** Introduce idea that this is a class project and show timeline outline. **Main** Students use internet or other sources of information to find details about medical uses of electricity over time and add to a timeline. **Plenary** Put up display on a corridor wall and add future imagined medical uses of electricity.	Computer room with internet access and printer or other sources of information on the medical uses of electricity. www.ecglibrary.com	Explore how scientific ideas change over time in context of the medical uses of electricity, real and imagined.	WO 2.1 2.2	
Homework: Write a detailed account for a scientific magazine of one of the medical uses of electricity.							

Demonstration 10.1: Water wheel

Notes for students

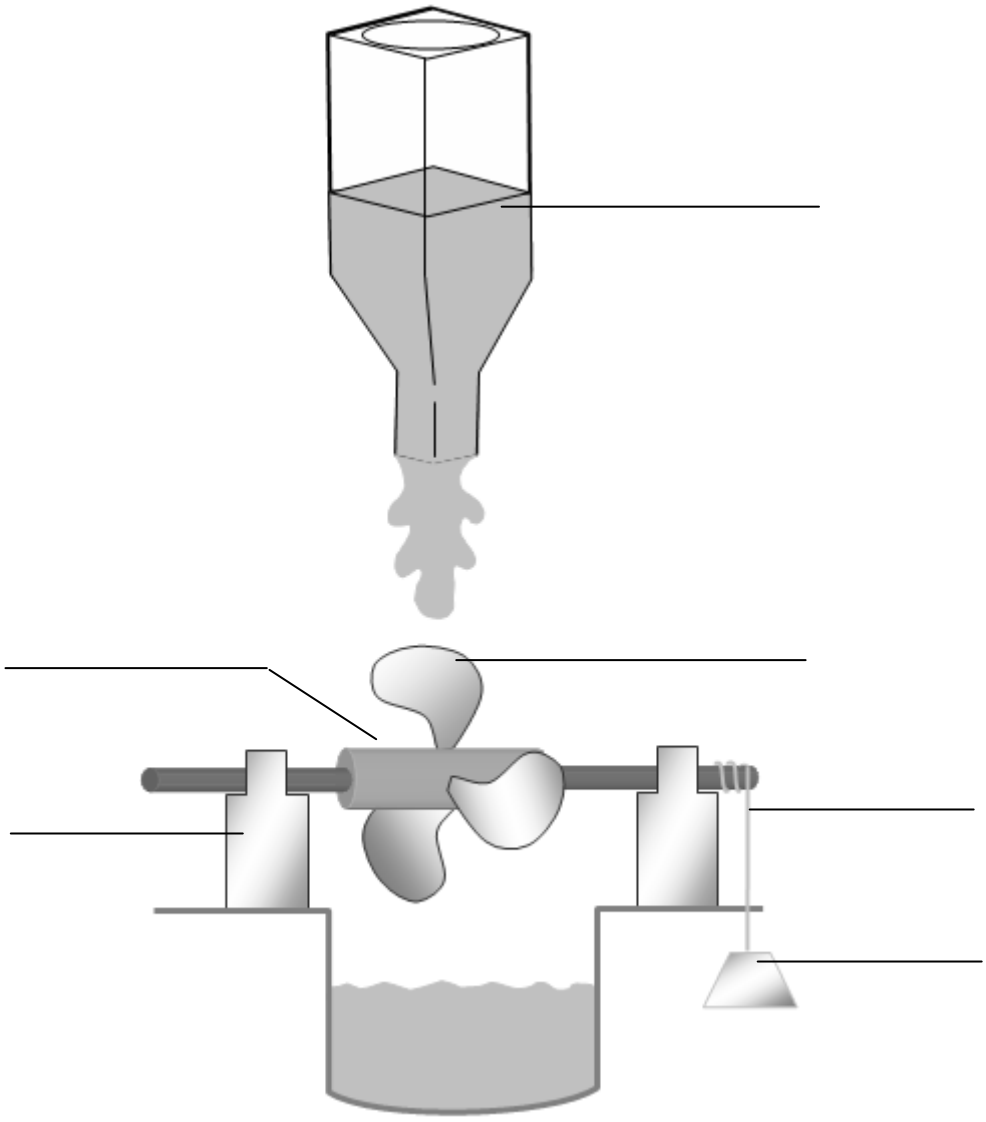
What you will learn from this demonstration

In this demonstration you will find out how a water wheel can be used to lift an object.

What you do

1 Watch the demonstration by your teacher.

2 Draw and label the apparatus.



Questions

How can this water wheel be used to produce electricity?

Demonstration 10.1: Water wheel

Notes for teachers and technicians

Aim

In this demonstration students will find out how water can be used to generate electricity.

Previous skills, knowledge and understanding required

- 7I Energy resources.

Equipment and chemicals required

1 Turbine on cork.

2 Spindle.

3 Large plastic bottle of water.

4 Supports for spindle.

5 String.

6 Masses (5 g, 10 g, etc.)

See diagram on the previous page.

Health and safety issues

Take care with water near electrical sockets.

Delivery strategies

- Ask students to name alternative energy resources. When water is mentioned, ask them to elaborate on how falling water can be used.
- Before you add the masses, ask students how the turning motion can be used.
- Then ask students how this turning can produce electricity.

Links with other GCSE Science topics

Topic 9 describes how to produce an electric current by rotating a magnet in a coil of wire, as in a dynamo.

Links with KS3

This demonstration builds on the following skills, knowledge and understanding from KS3:

- 7I energy resources.
- 9I energy and electricity.

Suggestions for further work

1 An investigation into the best design for a water wheel could be done as a class competition. See who can lift the greatest mass.

2 This could be coupled with a similar demonstration using a hairdryer to simulate wind power. See Longman Higher Science 1 page 196.

Experiment 10.4: Plugs

What you will learn from this experiment

In this experiment you will find out how to correctly wire a plug.

What you will know when you finish this experiment

1 The names and colours of the parts of a plug.

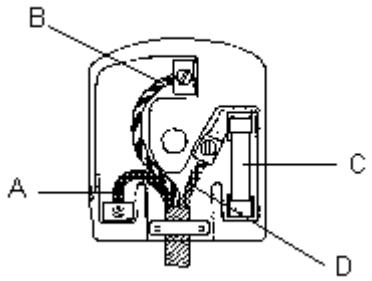
2 How to wire a plug correctly.

3 Be able to spot problems with an incorrectly wired plug.

How you may be assessed

1 Your teacher will inspect your plug when you think it is wired correctly.

2 You could be asked to pass your plug to another group to decide how well it is wired.



What you do

1 Get a plug, a piece of electrical cable, wire cutters, wire strippers and screwdrivers.

2 Watch as your teacher demonstrates how to wire the plug correctly.

3 Label the wires and their colours on the diagram above. What is the item marked ‘C’?

4 Wire your own plug. Make sure you have put all the wires in the correct places and tightened everything appropriately.

5 Give your plug to your teacher to check.

6 Label the above diagram of a plug and colour the wires correctly.

7 Write down a list of at least five points to remember when wiring a plug.

Experiment 10.4: Plugs

Notes for teachers and technicians

Aim

In this experiment students will find out how to wire a plug.

Previous skills, knowledge and understanding required

- 7J electrical circuits.

Skills, knowledge and understanding to be gained

1 The names and colours of the parts of a plug.

2 How to wire a plug correctly.

3 Be able to spot problems with an incorrectly wired plug.

Equipment and chemicals required

1 Plugs that have been altered so that they won't fit into mains sockets. Pins can have small screws inserted to make them too big to go in.

2 Electrical cable – 50cm lengths.

3 Wire cutters/strippers.

4 Screwdrivers.

5 Fuses.

Health and safety issues

1 Emphasise that students should not be fiddling with their plugs at home under any circumstances.

2 Make sure that the electricity main switch is turned off for the whole classroom for this lesson.

3 Make it clear to students that they must not attempt to use these plugs.

Delivery strategies

- Explain that in the past when you bought a hairdryer it came without a plug. Ask students why they think this was done, and why the law has now changed so that electrical appliances have to have a plug on. Explain that it is still important to know how a plug is wired so that they can mend/replace damaged plugs when they are homeowners.
- This can be a very frustrating practical for less dexterous students so explain that this is not everyone's 'cup of tea' but you want them all to attempt it.
- More dextrous students can assist the less able when they have finished – but must not take over.
- Line up the plugs and ask students to mark their own attempts.
- More-able students could write a detailed instruction leaflet on how to wire a plug.
- Ensure that students have a plug each to work on then more able students can't do all the work.
- If students have to work in pairs, get them to decide who is the most confident and this student is not allowed to touch the plug – they have to instruct the other student.

Experiment 10.4: Plugs

Links

This experiment builds on the following skills, knowledge and understanding from KS3:

- 7J electrical circuits.

Suggestions for further work/homework

Exercise: Fault spotting (eg see question 6 on page 233, Longman Higher Science 1)

Activity 10.5: The electric motor

What you will learn from this activity

In this activity you will find out more about the electric motor.

What you will know when you finish this activity

1 The important parts of an electric motor.

2 Be able to describe how the motor can be changed to speed it up/reverse the direction.

3 Be able to apply your knowledge of the motor to current-carrying wires in an electric field.

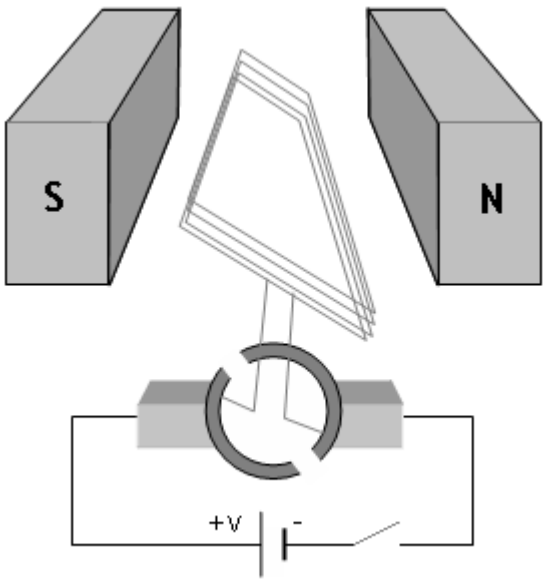
How you may be assessed

Your teacher will show you the correct answers to check after you have finished.

What you do

1 List equipment that uses an electric motor.

2 Label the following diagram of an electric motor using the following labels: permanent magnet, coil, split-ring commutator.

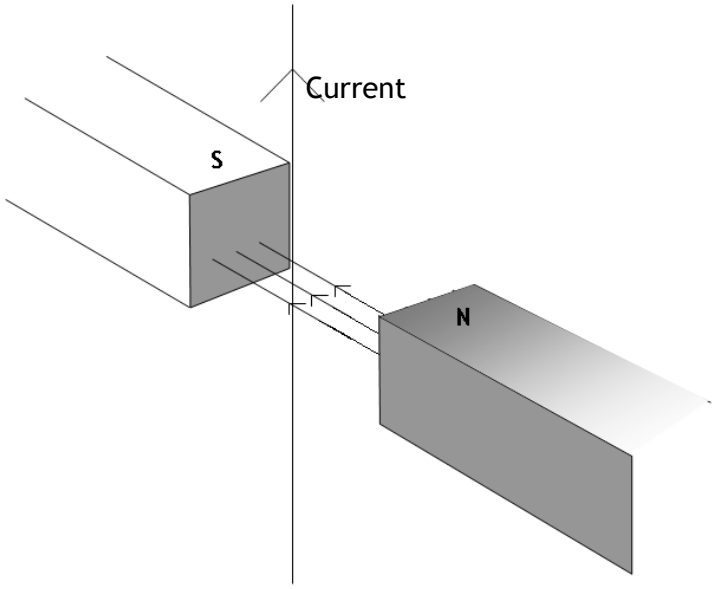


3 Build a motor.

4 Using the motor you have made, try to make it speed up. Write down 4 ways in which you can do this.

Activity 10.5: The electric motor

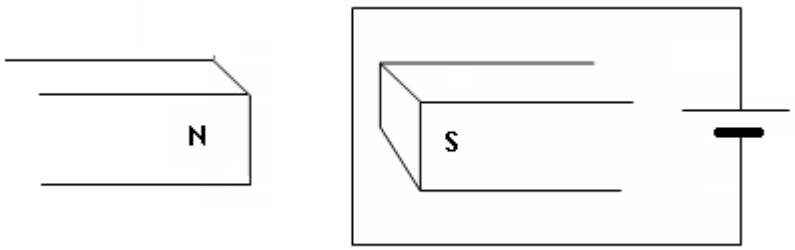
5 Look at the following diagram of a current-carrying wire in an electric field. Using your work on motors put an arrow on the diagram to show the direction of the force on the wire.



6 State two things you would do to increase the size of the force on the wire.

7 Would there still be a force on a wire that ran along the magnetic field?

8 (i) Draw on the following diagram: a) the direction of the current; b) the magnetic field and its direction; c) the direction in which the wire will move.
(ii) How could you make the wire move in the opposite direction?



Activity 10.5: The electric motor

Notes for teachers and technicians

Aim

In this activity students will find out more about the electric motor.

Skills, knowledge and understanding to be gained

1 Know the important parts of an electric motor.

2 Be able to describe how the motor can be changed to speed it up/reverse the direction.

3 Be able to apply their knowledge to current-carrying wires in an electric field.

Previous skills, knowledge and understanding required

1 7J electrical circuits.

2 8J magnets and electromagnets.

Materials required

1 Motor kits.

2 You may want to demonstrate current-carrying wires in magnetic fields to answer the questions on the accompanying student activity sheet.

Health and safety issues

Take care with current electricity.

Delivery strategies

- This is designed to reinforce concepts after students have built the electric motor from a kit.
- Get students to work as independently as possible and reassure them you will help them to correct their work when they have finished.
- Show the answers to questions with demos to keep students interested.
- Get the students to learn the labels and Fleming's left hand rule for a test next lesson.
- More-able students: discuss Fleming's left hand rule in detail and get them to answer problems using it.

Links with KS3

This activity builds on the following skills, knowledge and understanding from KS3:

- 7J Electric circuits
- 8J Magnets and electromagnets.

Resources

Multimedia science school motors.

January 2006

For more information on Edexcel and BTEC qualifications please contact
Customer Services on 0870 240 9800
or http://enquiries.edexcel.org.uk
or visit our website: www.edexcel.org.uk

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH