# *PLANNING SUPPORT BOOKLET*

**J259**

**For first teaching in 2016**

This support material booklet is designed to accompany the OCR GCSE (9–1) specification in Physics B and Combined Science B (Twenty First Century Science).

***DISCLAIMER***

This resource was designed using the most up to date information from the specification at the time it was published. Specifications are updated over time, which means there may be contradictions between the resource and the specification, therefore please use the information on the latest specification at all times.If you do notice a discrepancy please contact us on the following email address: [resources.feedback@ocr.org.uk](mailto:resources.feedback@ocr.org.uk)

# Introduction

This support material is designed to accompany the OCR GCSE (9-1) specification in Physics B (Twenty First Century) for teaching from September 2016.

The Planning Guidance table on the following pages sets out *suggested* teaching times for the topics within the specification. Note that we always recommend that individual centres plan their schemes of work according to their individual needs. Actual teaching times for topics will depend on the amount of practical work done within each topic and the emphasis placed on development of practical skills in various areas, as well as use of contexts, case studies and other work to support depth of understanding and application of knowledge and understanding. It will also depend on the level of prior knowledge and understanding that learners bring to the course.

The table follows the order of the topics in the specification. It is not implied that centres teach the specification topics in the order shown, centres are free to teach the specification in the order that suites them.

## Delivery guides

The column ‘Delivery guides’ refers to individual teacher guides available from the GCSE Physics B qualification page.

These Delivery guides provide further guidance and suggestions for teaching of individual topics, including links to a range of activities that may be used and guidance on resolving common misconceptions.

## Ideas about Science (P7) and Practical Work (P8)

Ideas about Science (P7) and Practical Skills (P8) are not explicitly reference in the high level planning table below, as these ideas and skills are expected to be developed in the context of Topics P1–P6. Links to P7 learning outcomes and suggested practical activities are included in the outline scheme of work. Indications of where PAG activities can be carried out should not be seen as an exhaustive list.

| **Chapter** | | **Teaching hours**  separate / combined | **Delivery Guides** | **PAG opportunities** | |
| --- | --- | --- | --- | --- | --- |
| **Chapter 1: Radiation and waves** | | | | | |
| 1.1 What are the risks and benefits of using radiation | 5 / 5 hours | | Radiation and waves – delivery guide |  |
| 1.2 What is climate change and what is the evidence for it? | 3 / 3 hours | | Radiation and waves – delivery guide |  |
| 1.3 How do waves behave? | 7 / 7 hours | | Radiation and waves – delivery guide | PAG4: measure the speed, frequency and wavelength of a wave  PAG8: Investigate the reflection and refraction |
| 1.4 What happens when light and sound meet different materials? (separate science only) | 7 / 0 hours | | Radiation and waves – delivery guide |  |
| **Total for chapter 1 = 22 / 15 hours** | | | | |
| **Chapter 2: Sustainable energy** | | | | |
| 2.1 How much energy do we use? | 4 / 4 hours | | Sustainable energy – delivery guide |  |
| 2.2 How can electricity be generated? | 5 / 5 hours | | Sustainable energy – delivery guide |  |
| **Total for chapter 2 = 9 / 9 hours** | | | | |
| **Chapter 3 Electric circuits** | | | | |
| 3.1 What is electric charge (separate science only) | 2 / 0 hours | | Electric circuits – delivery guide |  |
| 3.2 What determines the current in an electric circuit? | 4 / 4 hours | | Electric circuits – delivery guide | PAG6: Investigate the I-V characteristics of circuit elements |
| 3.3 How do series and parallel circuits work? | 5 / 5 hours | | Electric circuits – delivery guide | PAG7: Investigate the brightness of bulbs in series and parallel |
| 3.4 What determines the rate of energy transfer in a circuit? | 4 / 4 hours | | Electric circuits – delivery guide |  |
| 3.5 What are magnetic fields? | 4 / 3 hours | | Electric circuits – delivery guide |  |
| 3.6 How do electric motors work? | 3 / 3 hours | | Electric circuits – delivery guide |  |
| 3.7 What is the process inside an electric generator? (separate science only) | 4 / 0 hours | | Electric circuits – delivery guide |  |
| **Total for chapter 3 = 26 / 19 hours** | | | | |
| **Chapter 4 Explaining motion** | | | | |
| 4.1 What are forces? | 4 / 4 hours | | Explaining motion – delivery guide |  |
| 4.2 How can we describe motion? | 7 / 7 hours | | Explaining motion – delivery guide | PAG3: Investigate acceleration of a trolley down a ramp |
| 4.3 What is the connection between force and motion? | 12 / 9 hours | | Explaining motion – delivery guide |  |
| 4.4 How can we describe motion in terms of energy transfer? | 5 / 5 hours | | Explaining motion – delivery guide |  |
| **Total for chapter 4 = 28 / 25 hours** | | | | |
| **Chapter 5 Radioactive materials** | | | | |
| 5.1 What is radioactivity? | 6 / 6 hours | | Radioactive materials – delivery guide |  |
| 5.2 How can radioactive materials be used safely? | 3 / 3 hours | | Radioactive materials – delivery guide |  |
| 5.3 How can radioactive materials be used to provide energy? (separate science only) | 4 / 0 hours | | Radioactive materials – delivery guide |  |
| **Total for chapter 5 = 13 / 9 hours** | | | | |
| **Chapter 6 Matter – models and explanations** | | | | |
| 6.1 How does energy transform matter? | 5 / 5 hours | | Matter – delivery guide | PAG1: Determine the densities of a variety of objects both solid and liquid  PAG5: Determine the specific heat capacity of a metal |
| 6.2 How does the particle model explain the effects of heating? | 2 / 2 hours | | Matter – delivery guide |  |
| 6.3 How does the particle model relate to material under stress? | 4 / 4 hours | | Matter – delivery guide | PAG2: Investigate the effect of forces on springs |
| 6.4 How does the particle model relate to pressure in fluids? (separate science only) | 5 / 0 hours | | Matter – delivery guide |  |
| 6.5 How can scientific models help us understand the Big Bang? (separate science only) | 6 / 0 hours | | Matter – delivery guide |  |
| **Total for chapter 6 = 22 / 11 hours** | | | | |
| **Total teaching hours = 120 / 88 hours** | | | | |

# Outline Scheme of Work: P3 – Electric circuits

## Total suggested teaching time – 26 hours

### P3.1 What is electric charge? (2 / 0 hours)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects * the idea of electric field, forces acting across the space between objects not in contact | |
| Links to Mathematical Skills  * N/A | Links to Practical Activity Groups (PAGs)  * NA |

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| **Additional online learning opportunities**  As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. | |
| **Statement** | **Teaching activities** |
| P3.1.1, P3.1.2, P3.1.3 | Elevate [video](https://www.ocr.org.uk/Images/587852-p3-cup-elevate-video-static-electricity.mp4) can be used as flipped learning to introduce static electricity. |
| P3.1.1, P3.1.2, P3.1.3 | Alternative [video](https://ocr.org.uk/rpgphys6) from Cambridge International to introduce static electricity. |
| P3.1.3 | [Video](https://www.youtube.com/watch?v=_v4ugAwV59U) with clear explanation of electric fields to use as flipped learning. |

# Overview of P3.1 What is electric charge?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate science only) | P3.1.1 describe the production of static electricity, and sparking, by rubbing surfaces, and evidence that charged objects exert forces of attraction or repulsion on one another when not in contact  P3.1.2 explain how transfer of electrons between objects can explain the phenomena of static electricity | **Engage:** John Travoltage  Rubbing John’s foot on the carpet and moving his finger near the doorknob gives him an electric shock, and the flow of charges can be traced.  [View full activity in P3.1 What is electric charge? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg007-p31-what-is-electric-charge?activity=288893#288893)  **Explore**: use rods and cloths to explore the effect of statics, hang a rod from string from a clamp stand and show attraction and repulsion. Bending a thin stream of water with a charged rod also fascinates learners.  **Explain:** Van de Graaf experiments  <https://spark.iop.org/search?query=van%20der%20graaf>  **Extend:** Kelvin water dropper  A simple interactive model of Kelvin’s water dropper, which amplifies electrostatic charge differences between two vessels to the point where there is a discharge.  [View full activity in P3.1 What is electric charge? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg007-p31-what-is-electric-charge?activity=288899#288899)  **Evaluate**: Learners to write down an explanation as to how the Van de Graaf generator works, learners must talk about the movement of electrons in their answer. | Link to delivery guide Electric circuits  <http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf> |
| 2(1hr separate science only) | P3.1.3 explain the concept of an electric field and how it helps to explain the phenomena of static electricity | **Engage:** Gas station fire, static electricity starts a flash fire  A short piece of security camera footage in which a spark from a driver’s jumper at a petrol station causes a fire.  [View full activity in P3.1 What is electric charge? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg007-p31-what-is-electric-charge?activity=288901#288901)  **Explore:** Illicit pupils prior understanding of electric fields through open questioning  **Explain:** Electric fields experiment  A simple experiment to show electric field patterns using semolina and castor oil.  <https://spark.iop.org/electric-field-patterns>  **Extend:** Electromagnetism: Electrostatic force  Part one of a pair of videos linking electrostatics and magnetism, and observing some interesting links to other parts of the curriculum.  [View full activity in P3.1 What is electric charge? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg007-p31-what-is-electric-charge?activity=288897#288897)  **Evaluate:** Learners to write a paragraph explain how electric fields explain the phenomena of static electricity. These can be swapped with a partner to amend/improve. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |

# Outline Scheme of Work: P3 – Electric circuits

## Total suggested teaching time – 26 hours

### P3.2 What determines the current in an electric circuit? (4 / 4 hours)

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| --- | --- |
| Links to KS3 Subject content  * electric current, measured in amperes * potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as a ratio of potential difference (p.d.) to current * difference in resistance between conducting and insulating components (quantitative) | |
| Links to Mathematical Skills  * M1c * M3b * M3c * M3d * M4c * M4d | Links to Practical Activity Groups (PAGs)  * PAG 6: Investigate the I-V characteristics of circuit elements |

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| **Additional online learning opportunities**  As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. | |
| **Statement** | **Teaching activities** |
| P3.2.2 | Online [test](https://www.gcse.com/ctest.htm) which could be set as homework to practice *Q* = *It*. |
| P3.2.3, P3.2.4, P3.2.5, P3.2.6 | PAG 6 [alternative](https://www.ocr.org.uk/Images/473501-pag-activity-physics-circuits-suggestion-2.docx) – Mystery circuit elements - an alternative practical activity that could be used to identify circuit components from I-V characteristics. |
| P3.2.6 | P3.2 lesson 4 flipped learning [video](https://www.youtube.com/watch?v=ksPfzUjMbBk) on I-V characteristic graphs. |
| P3.2.6 | Flipped learning opportunity with information and questions from [cyberphysics](https://www.cyberphysics.co.uk/topics/electricity/basic_electricity/characteristics.htm). |

# Overview of P3.2 What determines the current in an electric circuit?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate and combined) | P3.2.1 recall that current is a rate of flow of charge, that for a charge to flow, a source of potential difference and a closed circuit are needed and that a current has the same value at any point in a single closed loop  P3.2.2 recall and use the relationship between quantity of charge, current and time:  charge (C) = current (A) × time (s)  M1c, M3b, M3c, M3d | **Engage:** Does volts or amps kill you? Voltage, current and resistance  A short video about the relative dangers of different amounts of current and voltage on humans.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288949#288949)  **Explore:** Electric potential: Visualizing voltage with 3D animations  A video in which potential and potential difference are visualised using a gravitational analogy and CGI.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288956#288956)  **Explain**: Pupils should be given the opportunity to build some basic circuits, testing their knowledge and understanding from KS3.  **Extend:** Electric circuits: A battery (cell)  A partly interactive presentation about cells and DC circuits.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288951#288951)  **Evaluate**: Pupils show be given the opportunity to practice using the equation, including rearranging and converting between units. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 2 (1hr separate and combined) | P3.2.3 recall that current (*I*) depends on both resistance (*R*) and potential difference (*V*) and the units in which these quantities are measured  P3.2.4 recall and apply the relationship between *I*, *R*, and *V*, to calculate the currents, potential differences and resistances in d.c. series circuits,  potential difference (V) = current (A) × resistance (Ω)  M1c, M3b, M3c, M3d | **Engage:** Ohm’s law using emojis  A short video using emojis to represent charged particles and current flow.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288953#288953)  **Explore:** Ohm's law: Ohm's law, circuits, resistance  A simple activity in which voltage and resistance can be manipulated in a circuit to change current.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288942#288942)  **Explain:** Ohms law experiment  <https://spark.iop.org/ohms-law>  **Extend:** Temperature effects on resistance  A short explanation of resistance changes due to temperature in different materials.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288944#288944)  **Evaluate:** SAM question [J259-01](http://www.ocr.org.uk/Images/234632-unit-j259-01-breadth-in-physics-foundation-tier-sample-assessment-material.pdf) Question 8 | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [SAM](http://www.ocr.org.uk/Images/234632-unit-j259-01-breadth-in-physics-foundation-tier-sample-assessment-material.pdf) |
| 3 (1hr separate and combined) | P3.2.5 recall that for some components the value of *R* remains constant (fixed resistors) but that in others it can change as the current changes (e.g. heating elements, lamp filaments)  P3.2.6 a) use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties  M4c, M4d  P3.2.7 represent circuits with the conventions of positive and negative terminals, and the symbols that represent common circuit elements, including filament lamps, diodes, LDRs and thermistors | **Engage:** Electric potential: Visualizing voltage with 3D animations  A video in which potential and potential difference are visualised using a gravitational analogy and CGI.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288956#288956)  **Explore:** How to make a lemon battery  A short video showing how to make a lemon battery and exploding some myths about the experiment.  [View full activity in P3.2 What determines the current in an electric circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg008-p32-what-determines-the-current-in-an-electric-circuit?activity=288958#288958)  **Explain:** IV lamp practical  <https://spark.iop.org/iv-characteristic-filament-lamp>  **Extend:** Pupils show be given the opportunity to practice using the ohms law equation, including rearranging and converting between units.  **Evaluate:** SAM question [J259-02](http://www.ocr.org.uk/Images/234633-unit-j259-02-depth-in-physics-foundation-tier-sample-assessment-material.pdf) Question 9 | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [SAM](http://www.ocr.org.uk/Images/234633-unit-j259-02-depth-in-physics-foundation-tier-sample-assessment-material.pdf) |
| 4 (1hr separate and combined) | P3.2.7 represent circuits with the conventions of positive and negative terminals, and the symbols that represent common circuit elements, including filament lamps, diodes, LDRs and thermistors  P3.2.6 a) use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties  M4c, M4d  b) describe experiments to investigate the *I*-*V* characteristics of circuit elements. To include: lamps, diodes, LDRs and thermistors. Be able to draw circuit diagrams for the circuits used  P3.2.5 recall that for some components the value of *R* remains constant (fixed resistors) but that in others it can change as the current changes (e.g. heating elements, lamp filaments) | **Engage:** Show pupils a diode, lamp, LDR and thermistor, pupils to name the component and draw its circuit symbol  **Explore:** demo experiments  **Explain:** PAG 6: Investigate the I-V characteristics of circuit elements  **Extend:** PAG 6: Quiz questions  **Evaluate:** Give pupils the [Learner record sheet](https://www.ocr.org.uk/Images/295647-gcse-physics-learner-record-sheet.doc), from the reference materials section of the webpage. Pupils to tick skills covered. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [PAG](https://www.ocr.org.uk/Images/311746-pag-activity-physics-circuits-suggestion-1.docx)  Link to [Learner record sheet](https://www.ocr.org.uk/Images/295647-gcse-physics-learner-record-sheet.doc) |

# Outline Scheme of Work: P3 – Electric circuits

## Total suggested teaching time – 26 hours

### P3.3 How do series and parallel circuits work? (5 / 5 hours)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge * potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as a ratio of potential difference (p.d.) to current | |
| Links to Mathematical Skills  * M1c * M3b * M3c * M3d | Links to Practical Activity Groups (PAGs)  * PAG 7: Investigate the brightness of bulbs in series and parallel |

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| --- | --- |
| **Additional online learning opportunities**  As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. | |
| **Statement** | **Teaching activities** |
| P3.3.2 | YouTube [video](https://www.youtube.com/watch?v=YoxxwHmLBf0) explaining variable resistor circuits which can be used as flipped learning. |
| P3.3.2 | Bitesize practical activity [link](https://www.bbc.co.uk/bitesize/guides/zq3wtv4/revision/4) which could be used as flipped learning for PAG 7. |

# Overview of P3.3 How do series and parallel circuits work?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate and combined) | P3.3.1 relate the potential difference between two points in the circuit to the work done on, or by, a given amount of charge as it moves between these points  potential difference (V) = work done (energy transferred) (J) ÷ charge (C)  M1c, M3b, M3c, M3d  P3.3.2 a) describe the difference between series and parallel circuits: to include ideas about how the current through each component and the potential difference across each component is affected by a change in resistance of a component | **Engage**: Electrical circuits, AC and DC  A partly interactive presentation about series and parallel circuits.  [View full activity in P3.3 How do series and parallel circuits work? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg009-p33-how-do-series-and-parallel-circuits-work?activity=290126#290126)  **Explore:** Circuit builder interactive  Another circuit simulator; a little simpler, but also easier to use.  [View full activity in P3.3 How do series and parallel circuits work? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg009-p33-how-do-series-and-parallel-circuits-work?activity=290120#290120)  **Explain:** Series and parallel circuits: A water analogy  A video featuring an experiment to model the behaviour of resistors in series and in parallel using water.  [View full activity in P3.3 How do series and parallel circuits work? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg009-p33-how-do-series-and-parallel-circuits-work?activity=290124#290124)  **Extend:** Pupils show be given the opportunity to practice using the equation, including rearranging and converting between units.  **Evaluate:** SAM question [J259-03](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) Question 4 | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [transition guide series and parallel circuits](http://www.ocr.org.uk/Images/258258-series-and-parallel-circuits-transition-guide.pdf)  Link to [SAM](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) |
| 2 (1hr separate and combined) | P3.3.2 a) describe the difference between series and parallel circuits: to include ideas about how the current through each component and the potential difference across each component is affected by a change in resistance of a component  b) describe how to practically investigate the brightness of bulbs in series and parallel circuits. Be able to draw circuit diagrams for the circuits used  *PAG7* | **Engage**: Show pupils a diode, lamp, LDR and thermistor, pupils to name the component and draw its circuit symbol  **Explore:** demo experiments  **Explain:** PAG 7: Investigating the brightness of bulbs in series and parallel  **Extend**: PAG 7: Quiz questions  **Evaluate:** Give pupils the Learner record sheet, from the reference materials section of the webpage. Pupils to tick skills covered. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [PAG](https://www.ocr.org.uk/Images/324542-pag-activity-physics-series-and-parallel-circuits-suggestion-1.docx)  Link to [Learner record sheet](https://www.ocr.org.uk/Images/295647-gcse-physics-learner-record-sheet.doc) |
| 3 (1hr separate and combined) | P3.3.3 explain, why, if two resistors are in series the net resistance is increased, whereas with two in parallel the net resistance is decreased  *qualitative only* | **Engage:** resistors in series and parallel [video](https://www.youtube.com/watch?v=x2EuYqj_0Uk)  **Explore:** Circuit construction kit (DC Only), Virtual lab: Circuits, light bulbs, batteries  A flexible Java application modelling a circuit. Users can investigate the effects of combining different components in various ways.  [View full activity in P3.3 How do series and parallel circuits work? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg009-p33-how-do-series-and-parallel-circuits-work?activity=290118#290118)  **Explain:** [experiment](http://www.umsl.edu/~physics/files/pdfs/Electricity%20and%20Magnetism%20Lab/Exp4.SeriesParallel.pdf) resistors in series and parallel  **Extend:** Pupils come up with an analogy for resistors in circuits.  **Evaluate:** SAM question [J259-03](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) question 4 | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [transition guide series and parallel circuits](http://www.ocr.org.uk/Images/258258-series-and-parallel-circuits-transition-guide.pdf)  Link to [SAM](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) |
| 4 (1hr separate and combined) | P3.3.4 solve problems for circuits which include resistors in series, using the concept of equivalent resistance  M1c, M3b, M3c, M3d | **Engage:** Electric circuits: Basics of the voltage and current laws  A follow-on visualisation video from those in the previous subtopic, in which a continuation of the gravitational analogy using CGI is used to explore the behaviour of circuits.  [View full activity in P3.3 How do series and parallel circuits work? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg009-p33-how-do-series-and-parallel-circuits-work?activity=290122#290122)  **Explore:** practice problems equivalent resistance  <http://physics.info/circuits-r/practice.shtml>  **Explain:** watch this [video](https://www.youtube.com/watch?v=r0OfAIEa878) about resistors connected in series  **Extend:** pupils then complete practical shown in the video.  **Evaluate:** Pupils show be given the opportunity to solve problem using the concept of equivalent resistance. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [transition guide series and parallel circuits](http://www.ocr.org.uk/Images/258258-series-and-parallel-circuits-transition-guide.pdf) |
| 5 (1hr separate and combined) | P3.3.5 explain the design and use of d.c. series circuits for measurement and testing purposes including exploring the effect of:  a) changing current in filament lamps, diodes, thermistors and LDRs  b) changing light intensity on an LDR  c) changing temperature of a thermistor (NTC only) | **Engage**: Question: how can we build a sensing circuit?  **Explore:** pupils to research the uses of potential dividers and feedback uses to the class  **Explain:** potential divider practical <https://www.stem.org.uk/resources/elibrary/resource/26280/episode-118-potential-dividers>  **Extend:** Thermistor experiment  A video demonstration of an experiment to calibrate a thermistor.  [View full activity in P3.3 How do series and parallel circuits work? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg009-p33-how-do-series-and-parallel-circuits-work?activity=290128#290128)  **Evaluate:** potential divider [questions](http://www.petervis.com/GCSE_Design_and_Technology_Electronic_Products/Potential_Divider/Potential_Divider_Questions.html) | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [transition guide series and parallel circuits](http://www.ocr.org.uk/Images/258258-series-and-parallel-circuits-transition-guide.pdf) |

# Outline Scheme of Work: P3 – Electric circuits

## Total suggested teaching time – 26 hours

### P3.4 What determines the rate of energy transfer in a circuit? (4 / 4 hours)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * comparing power ratings of appliances in watts (W, kW) * comparing amount of energy transferred (J, kJ, KW hour) * other processes that involve energy transfers: completing an electrical circuit | |
| Links to Mathematical Skills  * M1c * M3b * M3c * M3d | Links to Practical Activity Groups (PAGs)  * N/A |

# Overview of P3.4 What determines the rate of energy transfer in a circuit?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate and combined) | P3.4.1 describe the energy transfers that take place when a system is changed by work done when a current flows through a component  P3.4.2 explain, with reference to examples, how the power transfer in any circuit device is related to the energy transferred from the power supply to the device and its surroundings over a given time:  power (W) = energy (J) ÷ time (s)  M1c, M3b, M3c, M3d | **Engage:** How do current and energy differ?  **Explore:** Get pupils to draw an energy transfer diagram for a circuit of their choice  **Explain:** practical – using an energy meter to measure power <https://spark.iop.org/using-energymeter-measure-power-electrical-circuits>  **Extend:** Pupils show be given the opportunity to practice using the equation, including rearranging and converting between units.  **Evaluate:** the electricity handbook, get pupils to start a handbook writing down all the important terms that they’ve covered so far in this chapter. Define the term, give the units it is measured in, its symbol and any equations that can be used to calculate it. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 2 (1hr separate and combined) | P3.4.3 recall and use the relationship between the potential difference across the component and the total charge to calculate the energy transferred in an electric circuit when a current flows through a component:  energy transferred (work done) (J) = charge (C) × potential difference (V)  M1c, M3b, M3c, M3d | **Engage:** electricity [song](https://www.youtube.com/watch?v=g-9EwBpQDdg)  **Explore:** quick quiz, make cards with key terms on. Give pupils mini white boards and get them to write and hold up the unit for each term you hold up.  **Explain:** practical <https://www.stem.org.uk/elibrary/resource/26282/episode-120-energy-transfer-in-electric-circuits>  **Extend:** Pupils show be given the opportunity to practice using the equation, including rearranging and converting between units.  **Evaluate:** Pupils add to their handbook any new terms and equations that they came across this lesson. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 3 (1hr separate and combined) | P3.4.4 recall and apply the relationships between power transferred in any circuit device, the potential difference across it, the current through it, and its resistance:  power (W) = potential difference (V) × current (A)  power (W) = (current (A))2 × resistance (Ω)  M1c, M3b, M3c, M3d | **Engage:** Power line on metal swing  A short video of an electrical fire caused by a power line falling on a metal swing.  [View full activity in P3.4 What determines the rate of energy transfer in a circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg010-p34-what-determines-the-rate-of-energy-transfer-in-a-circuit?activity=290137#290137)  **Explore:** Give pupils equations and get them to draw circuits and explain how they think they can measure the power in a circuit.  **Explain:** pupils to complete practical measuring the p.d., current and resistance in a circuit and calculate the power.  **Extend:** Pupils should be given the opportunity to practice using the equation, including rearranging and converting between units. This [worksheet](http://www.physicsclassroom.com/getattachment/curriculum/circuits/circuit4.pdf) could help.  **Evaluate:** Pupils add to their handbook any new terms and equations that they came across this lesson. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 4 (1hr separate and combined) | P3.4.5 use the idea of conservation of energy to show that when a transformer steps up the voltage, the output current must decrease and vice versa  Select and use the equation:  potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil  M1c, M3b, M3c, M3d  P3.4.6 explain how transmitting power at higher voltages is more efficient way to transfer energy | **Engage:** Transformers are awesome!  A medium-length (18 minutes) video about transformers, which goes into some advanced details but strongly reiterates some basic mathematical relationships and answers one or two questions more able learners may have.  [View full activity in P3.4 What determines the rate of energy transfer in a circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg010-p34-what-determines-the-rate-of-energy-transfer-in-a-circuit?activity=290139#290139)  **Explore:** Transmission lines  A very simple interactive graphic with a power source, transformers and light bulbs to represent energy transfer in which users can alter the voltage between transformers.  [View full activity in P3.4 What determines the rate of energy transfer in a circuit? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg010-p34-what-determines-the-rate-of-energy-transfer-in-a-circuit?activity=290133#290133)  **Explain:** demo transmission lines<https://www.stem.org.uk/elibrary/resource/27022/power-lines>  **Extend:** Pupils show be given the opportunity to practice using the equation, including rearranging and converting between units. Here are some [calculations](http://www.darvill.clara.net/multichoice/transform.htm).  **Evaluate:** Pupils add to their handbook any new terms and equations that they came across this lesson. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |

# Outline Scheme of Work: P3 – Electric circuits

## Total suggested teaching time – 26 hours

### P3.5 What are magnetic fields? (4 / 4hours)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * magnetic poles, attraction and repulsion * magnetic fields by plotting compass, representation of field lines * Earth’s magnetism, compass and navigation | |
| Links to Mathematical Skills  * N/A | Links to Practical Activity Groups (PAGs)  * N/A |

|  |  |
| --- | --- |
| **Additional online learning opportunities**  As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. | |
| **Statement** | **Teaching activities** |
| P3.5.1 | Bitesize [introduction to magnets](https://www.bbc.co.uk/bitesize/guides/zxxbkqt/revision/1) can be used as flipped learning. |
| P3.5.1 | [Question 11 on paper 3](https://ocr.org.uk/rpgphys13) of this Cambridge International resource could be used as a plenary or homework. |
| P3.5.1 | [Quiz](https://www.footprints-science.co.uk/index.php?quiz=Magnets) on magnets that could be used as plenary or homework. |
| P3.5.2 | A Bitesize [resource](https://www.bbc.co.uk/bitesize/guides/zxxbkqt/revision/2) that could be used as flipped learning for lesson 2 and the test as a homework. |
| P3.5.2 | [Short clip](https://www.ocr.org.uk/Images/587853-p4-cup-elevate-video-iron-filings-in-a-magetic-field.mp4) of iron filings showing magnetic field from CUP Elevate. |
| P3.5.5 | [Video](https://ocr.org.uk/rpgphys8) from Cambridge International on electromagnets can be used as flipped learning. |
| P3.5.9 | Short [animation](https://www.youtube.com/watch?v=LKuHuyaRiHg) explaining how loudspeakers work can be used as flip learning. |
| P3.5.9 | Bitesize [explanation](https://www.bbc.co.uk/bitesize/guides/z9f92nb/revision/5) of how loudspeakers work which can be used as flipped learning. |

# Overview of P3.5 What are magnetic fields?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate and combined) | P3.5.1 describe the attraction and repulsion between unlike and like poles for permanent magnets  P3.5.2 describe the characteristics of the magnetic field of a magnet, showing how strength and direction change from one point to another | **Engage:** How do magnets work?: James May's Q and A  A short video in which James May explains magnetism.  [View full activity in P3.5 What are magnetic fields? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg011-p35-what-are-magnetic-fields?activity=290147#290147)  **Explore:** Magnets and electromagnets: Magnetism, magnetic field, electromagnets  An interactive Java application in which a magnet and an electromagnet can be moved relative to a compass.  [View full activity in P3.5 What are magnetic fields? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg011-p35-what-are-magnetic-fields?activity=290145#290145)  **Explain:** Investigating with magnets – pupils use magnets and compasses to plot field lines of one and two magnets, showing attraction and repulsion.  **Extend:** Electromagnetism – magnetic force: The four fundamental forces of physics  [View full activity in P3.5 What are magnetic fields? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg011-p35-what-are-magnetic-fields?activity=290141#290141)  **Evaluate:** SAMs question [J259-01](http://www.ocr.org.uk/Images/234632-unit-j259-01-breadth-in-physics-foundation-tier-sample-assessment-material.pdf) Question 3 | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [SAM](http://www.ocr.org.uk/Images/234632-unit-j259-01-breadth-in-physics-foundation-tier-sample-assessment-material.pdf) |
| 2 (1hr separate and combined) | P3.5.3 explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic  P3.5.4 describe the difference between permanent and induced magnets | **Engage:** Magnetic field lines, 3D  A [video](https://www.youtube.com/watch?v=8llkHQtaOlg) of a simple experiment with a suspension of iron filings to show magnetic field lines in three dimensions.  **Explore:** Why earth's magnetic shield matters  A short video about Earth’s magnetosphere.  [View full activity in P3.5 What are magnetic fields? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg011-p35-what-are-magnetic-fields?activity=290149#290149)  **Explain:** practical electromagnetic induction  <http://www.allaboutcircuits.com/textbook/experiments/chpt-2/electromagnetic-induction-experiment/>  **Extend:** Melt metal with magnets  A short video of a piece of metal being melted by an electromagnet with no contact.  [View full activity in P3.5 What are magnetic fields? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg011-p35-what-are-magnetic-fields?activity=290151#290151)  **Evaluate:** How does a compass work? Pupils discuss and write a paragraph to explain. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 3 (1hr separate and combined) | P3.5.5 describe how to show that a current can create a magnetic effect  P3.5.6 describe the pattern and directions of the magnetic field around a conducting wire  P3.5.7 recall that the strength of the field depends on the current and the distance from the conductor | **Engage:** [Richard Feynman](https://www.youtube.com/watch?v=MO0r930Sn_8) on magnets  A ten-minute video of Richard Feynman being asked to explain magnetic attraction and repulsion.  **Explore:** The Lenz effect: Aluminium, moving magnets, electricity, and magnetism  A [short video](https://www.youtube.com/watch?v=yk4ACjzDFRY) demonstrating interactions between a moving magnet and a non-ferromagnetic electrical conductor.  **Explain:** Electric fields practical  <https://spark.iop.org/electric-field-patterns>  **Extend:** FWS: [Doing SCIENCE! with ferrofluid](https://www.youtube.com/watch?v=1EuyZ5Lml4k)  A short video about ferrofluids, including a brief description of how to make one.  **Evaluate:** SAM [J259-03](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) Question 6 | Link to [SAM](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) |
| 4 (1hr separate and combined) | P3.5.8 explain how the magnetic effect of a solenoid can be increased  **P3.5.9 explain how a solenoid can be used to generate sound in loudspeakers and headphones** | **Engage:** How do speakers work?  A [short video](https://www.youtube.com/watch?v=lTkzxfIX4EY) showing the basic mechanism of a speaker and a simple speaker made from a cardboard sheet.  **Explore:** Discuss the use of magnets in loudspeakers and headphones  **Explain:** practical making a loudspeaker  <https://spark.iop.org/model-loudspeaker>  **Extend:** Faraday’s Law 1.0.2  An interactive Java application allowing users to move a magnet relative to coils in order to produce a voltage.  [View full activity in P3.5 What are magnetic fields? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg011-p35-what-are-magnetic-fields?activity=290143#290143)  **Evaluate:** Learners produce a magnetism revision handbook | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |

# Outline Scheme of Work: P3 – Electric circuits

## Total suggested teaching time – 26 hours

### P3.6 How do electric motors work? (3 / 3 hours)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * the magnetic effect of a current, electromagnets, D.C. motors (principles only) | |
| Links to Mathematical Skills  * M1b * M1c * M3b * M3c * M3d | Links to Practical Activity Groups (PAGs)  * N/A |

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| **Additional online learning opportunities**  As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. | |
| **Statement** | **Teaching activities** |
| P3.6.3 | [Video](https://www.youtube.com/watch?v=jxFB_CWKj5M) to show how to use *F* = *BIL* - can be used as flipped learning. |
| P3.6.3 | [Worksheet](https://www.tes.com/teaching-resource/p7-magnetism-force-on-a-current-carrying-wire-11666999) for homework on *F* = *BIL*. |
| P3.6.4 | CUP Elevate [resource](https://www.ocr.org.uk/Images/587854-p4-cup-elevate-resource-electric-motors.zip) that can be used as flipped learning to introduce electric motors. |
| P3.6.4 | [Video](https://www.youtube.com/watch?v=47_fyzZEjxw) recapping how electric motors work and showing a practical explanation of how loudspeakers work which can be used as flipped learning. |

# Overview of P3.6 How do electric motors work?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate and combined) | **P3.6.1 describe the interaction forces between a magnet and a current-carrying conductor to include ideas about magnetic fields** | **Engage:** [video](https://www.youtube.com/watch?v=F1PWnu01IQg) showing force on a current carrying wire with a huge magnet  **Explore:** Magnetic field around a wire  A simple [interactive page](https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/magnetic-field-around-a-wire-i) in which the magnetic field around a current-carrying wire is shown.  **Explain:** practical force on a current carrying conductor  <https://spark.iop.org/force-wire-carrying-current-magnetic-field>  **Extend:** Discuss what pupils found in their experiment. How could they increase the force produced?  **Evaluate:** Pupils write a paragraph to explain force on a current carrying conductor in a magnetic field. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 2 (1hr separate and combined) | **P3.6.2 show that Fleming’s left-hand rule represents the relative orientations of the force, the conductor and the magnetic field**  **P3.6.3 select and apply the equation that links the force (F) on a conductor to the strength of the field (B), the size of the current (I) and the length of conductor(l) to calculate the forces involved:**  **force (N) = magnetic field strength (T) × current (A) × length of conductor (m)**  M1b, M1c, M3b, M3c, M3d | **Engage:** [Flemings left hand rule](https://www.youtube.com/watch?v=8li1Vp8vLaI)  **Explore:** Right and left hand rules  A very [basic page](https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/right-and-left-hand-rules) with graphics showing both the right hand rule and Fleming’s left hand rule.  **Explain:** Pupils show be given the opportunity to practice using the equation, including rearranging and converting between units  **Extend**: Electric motor  An [interactive application](https://animatedscience.co.uk/electric-motor) in which the user can set voltage, number of magnets and number of coils on a simple virtual motor to observe the effect on its motion.  **Evaluate:** Pupils draw a labelled diagram or label a diagram given to them showing Fleming’s left hand rule and what each finger represents. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 3 (1hr separate and combined) | **P3.6.4 explain how the force on a conductor in a magnetic field is used to cause rotation in the rectangular coil of a simple electric motor**  ***– detailed knowledge of the construction of motors not required*** | **Engage**: demo a simple electric motor. Use a kit if you have one available  **Explore:** [It really spins around](http://www.euhou.net/index.php/exercises-mainmenu-13/classroom-experiments-and-activities-mainmenu-186/195-it-really-spins-around-simple-models-of-electric-motor)!: Simple models of electric motor  A set of simple motors that can be made with easily available materials.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](https://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg012-p36-how-do-electric-motors-work?activity=290169#290169)  **Explain:** the electric motor practical  <https://spark.iop.org/electric-motor>  **Extend:** [DIY MOTOR School Project](https://www.youtube.com/watch?v=vg2dOxxwcA0) DC electric motor with commutator  A more advanced DC motor with commutator and brushes.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](https://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg012-p36-how-do-electric-motors-work?activity=290171" \l "290171)  **Evaluate:** SAM question [J259-04](http://www.ocr.org.uk/Images/234636-unit-j259-04-depth-in-physics-higher-tier-sample-assessment-material.pdf) Question 8 | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf)  Link to [SAM](http://www.ocr.org.uk/Images/234636-unit-j259-04-depth-in-physics-higher-tier-sample-assessment-material.pdf) |

# Outline Scheme of Work: P3 – Electric circuits

## Total suggested teaching time – 26 hours

### P3.7 What is the process inside an electric generator? (4 / 0 hours)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * N/A | |
| Links to Mathematical Skills  * M1c * M3b * M3c | Links to Practical Activity Groups (PAGs)  * N/A |

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| **Additional online learning opportunities**  As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. | |
| **Statement** | **Teaching activities** |
| P3.7.6, P3.7.7 | Cambridge International [resource](https://ocr.org.uk/rpgphys15) - Electromagnetism paper 3 Q9 and Electromagnetism paper 4 Q8b. Can be used as homework. |
| P3.7.6, P3.7.7 | Alternative [transformer calculations](http://www.darvill.clara.net/multichoice/transform.htm) for homework. |

# Overview of P3.7 What is the process inside an electric generator?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate science only) | **P3.7.1 recall that a change in the magnetic field around a conductor can give rise to an induced potential difference across its ends, which could drive a current**  **P3.7.2 explain the action of a moving coil microphone in converting the pressure variations in sound waves into variations in current in electrical circuits** | **Engage:** How do microphones work?  A short video explaining how different kinds of microphones work.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg013-p37-what-is-the-process-inside-an-electric-generator?activity=290185#290185)  **Explore:** Generator: Generator, magnetism, magnetic field  An interactive Java application featuring a virtual magnet, electromagnet, transformer and generator.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg013-p37-what-is-the-process-inside-an-electric-generator?activity=290175#290175)  **Explain:** microphone demo  <https://spark.iop.org/sound-waves>  **Extend:** Guitar pickup  A simple demonstration of the principles by which electric guitar pickups work.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg013-p37-what-is-the-process-inside-an-electric-generator?activity=290181#290181)  **Evaluate**: compare loudspeakers to microphones – get pupils to discuss how the two work, hopefully they will come up with the idea that microphones are loud speakers in reverse. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 2 (1hr separate science only) | **P3.7.3 recall that the direction of the induced potential difference drives a current which generates a second magnetic field that would oppose the original change in field**  **P3.7.4 use ideas about electromagnetic induction to explain a potential difference / time graph showing the output from an alternator being used to generate a.c.**  **P3.7.5 explain how an alternator can be adapted to produce a dynamo to generate d.c., including explaining a potential difference time graph** | **Engage:** explanation of generators – You could show this [video](https://www.youtube.com/watch?v=9jg-3Y1bTyI)  **Explore:** Generator: AC  A simple Java application showing an AC generator.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg013-p37-what-is-the-process-inside-an-electric-generator?activity=290177#290177)  **Explain:** Generation of alternating current  A presentation explaining AC generation.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg013-p37-what-is-the-process-inside-an-electric-generator?activity=290183#290183)  **Extend:** Generator: DC  A simple Java application showing a DC generator.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg013-p37-what-is-the-process-inside-an-electric-generator?activity=290179#290179)  **Evaluate:** Potential difference- time graphs pupils explain the graphs for a.c. and d.c. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 3 (1hr separate science only) | **P3.7.6 explain how the effect of an alternating current in one circuit in inducing a current in another is used in transformers**  **P3.7.7 describe how the ratio of the potential differences across the two circuits of a transformer depends on the ratio of the numbers of turns in each**  **P3.7.8 apply the equations linking the potential differences and numbers of turns in the two coils of a transformer, to the currents and the power transfer involved and relate these to the advantages of power transmission at high voltages:**  **a) potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil**  **b) potential difference across primary coil ÷ potential difference across secondary coil = number of turns in primary coil ÷ number of turns in secondary coil**  M1c, M3b, M3c | **Engage:** How transformers work  A short video explaining how transformers work.  [View full activity in P3.7 What is the process inside an electric generator – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt03-p3-electric-circuits/delivery-guide-gpbdg013-p37-what-is-the-process-inside-an-electric-generator?activity=290173#290173)  **Explore:** Get learners to write down everything they recall about transformers from the previous topic.  **Explain:** Make a model of a transformer  <https://spark.iop.org/collections/transformers>  **Extend:** Pupils show be given the opportunity to practice using the equation, including rearranging and converting between units  **Evaluate:** Pupils mind map electricity and magnetism for revision of the entire chapter. | Link to delivery guide [Electric circuits](http://www.ocr.org.uk/Images/281595-electric-circuits-delivery-guide.pdf) |
| 4 | End of chapter quiz | Pupils to complete the [End of chapter quiz P***3***](https://interchange.ocr.org.uk/Downloads/Twenty-First-Century-Physics-Quizzes.zip). Aftercompletion pupils to swap and mark quizzes.  Pupils use their quizzes to create a revision list from Chapter ***3.*** | [End of chapter quiz P3](https://interchange.ocr.org.uk/Downloads/Twenty-First-Century-Physics-Quizzes.zip) is available on OCR interchange, a login will be required |

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