KESTEVEN AND SLEAFORD HIGH SCHOOL

Physics Scheme of Learning

P15: Electromagnetism

Intent – Rationale

P15 is the final topic for combined students and the penultimate topic for triple award students. It is a key opportunity to apply some mathematical skills to some challenging situations. Five mark calculation questions often involve using two equations, with the transformer this is an opportunity to practise linking equations together.

Magnets form a key part of everyday life, and modern life would not be the same without them. Learning about generator to produce electricity, motors to produce movement and a range of other applications such as speakers, microphones and maglev trains allow students to see Physics in a real world context.

There is also scope for a range of practical skills development through extensive practical work.

Sequencing – what prior learning does this topic build upon?	Sequencing – what subsequent learning does this topic feed into?
Topic 2 Phys Forces and Effects **Topic 5 Phys Magnets and Electromagnets** **GCSE P5 Electricity in the home**	• A level – Year 13 topic electromagnetism
What are the links with other subjects in the curriculum?	**What are the links to SMSC, British Values and Careers?**
• Base the content here on what you already know but there will be time in future to liaise further as part of our collaborative work	P15.3 Electromagnets in Devices SP3 P15.4 The Motor Effect GB4e
What are the opportunities for developing literacy skills and developing learner confidence and enjoyment in reading?	**What are the opportunities for developing mathematical skills?**
	• The use of several equations with transformer calculations. • The use of ratios with transformers turns calculations.

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P15: Electromagnetism

Intent – Concepts

What knowledge will students gain and what skills will they develop as a consequence of this topic?

Know

Use the 'right hand thumb rule' to draw the magnetic field pattern of a wire carrying an electric current.
Draw the magnetic field pattern for a straight wire carrying a current and for a solenoid.
Draw graphs of potential difference generated in the coil against time.
Draw and label both a.c. and d.c. generators.
Draw the magnetic field pattern of a bar magnet and describe how to plot the magnetic field pattern using a compass.

Apply

Describe how to distinguish between a magnetic material and a magnet by experiment.
Describe where the strongest point of a magnet is and how this is shown by the magnetic field pattern.
Describe how the strength of the magnet varies with distance from the magnet.
Describe how a step-up transformer and a step-down transformer affect the potential difference on the secondary coil compared to the primary coil.
Calculate the current drawn from the input supply to provide a particular power output.
$V_s \times I_s = V_p \times I_p$
Use simple ratios or the equation to calculate any unknown value. $V_p/V_s = n_p/n_s$
Describe what a generator does
Describe the effect on the induced potential difference, and induced current, of reversing the direction of motion of the conductor in a magnetic field.
Describe the effect on the induced potential difference, and induced current, of reversing the polarity of the magnets in a generator.
Describe how to make a simple d.c. generator from wire and permanent magnets.
Use and apply the equation: F = B I L to calculate any missing value when given other values.
Describe the effect on the magnetic field of changing the direction of the electric current.
Describe ways of increasing the magnetic field strength of a solenoid.
Describe what determines whether the output current of a generator is a.c. or d.c.
Describe how the magnetic effect of a current can be demonstrated.
Describe how an electric bell and EM relay works.

Extend

Explain why transformers used
Explain how an alternator generates a.c. and a dynamo generates d.c.
Explain how an electromagnet can be made from a solenoid.
Explain how a moving-coil microphone works
Explain how a moving-coil loudspeaker and headphones work
Explain what is meant by the motor effect.
Explain why a motor spins with respect to the magnetic field produced by a wire carrying an electric current and the magnetic field of the permanent magnets in the motor interacting.
Perform calculations to determine the potential difference on the primary or secondary coil or the number of turns on the primary or secondary coil when given the other values.
Explain how a step-up transformer will increase the potential difference in the secondary coil compared to the primary coil but it will also decrease the current
Explain the reason why in the National Grid system the p.d. across the power cables is increased only to decrease at the other side of the cables.
Explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic.

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What subject specific language will be used and developed in this topic?	What opportunities are available for assessing the progress of students?
alternator an alternating current generator **dynamo** a direct-current generator **electromagnet** an insulated wire wrapped round an iron bar that becomes magnetic when there is a current in the wire **electromagnetic induction** the process of inducing a potential difference in a wire by moving the wire so it cuts across the lines of force of a magnetic field **Fleming's left-hand rule** a rule that gives the direction of the force on a current-carrying wire in a magnetic field according to the directions of the current and the field **generator effect** the production of a potential difference using a magnetic field **induced magnetism** magnetism of an unmagnetised magnetic material by placing it in a magnetic field **magnetic field** the space around a magnet or a current-carrying wire **magnetic field line** line in a magnetic field along which a magnetic compass points – also called a line of force **magnetic flux density** a measure of the strength of the magnetic field defined in terms of the force on a current-carrying conductor at right angles to the field lines **motor effect** when a current is passed along a wire in a magnetic field, and the wire is not parallel to the lines of the magnetic field, a force is exerted on the wire by the magnetic field **solenoid** a long coil of wire that produces a magnetic field in and around the coil when there is a current in the coil **split-ring commutator** metal contacts on the coil of a direct current motor that connects the rotating coil continuously to its electric power supply **step-down transformer** electrical device that is used to step-down the size of an alternating potential difference **step-up transformer** electrical device that is used to step-up the size of an alternating potential difference **transformer** electrical device used to change an (alternating) voltage. See also step-up transformer and step-down transformer	Completion of a P15 end of topic test P15.3 Electromagnets in Devices - Answering of past exam questions through the assessed homework P15.7 Transformers - Answering of past exam questions through the assessed homework 2 P15.8 Transformers in Action - Assessment of calculations through Isaac Physics homework task on transformers - https://isaacphysics.org/assignment/7dd5a936-2b27-45e8-8bd3-7344d45a845c

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Intent – Concepts

Lesson title	Learning challenge	Higher level challenge	Suggested activities and resources
P15.1 Magnetic Fields	Can I describe how to distinguish between a magnetic material and a magnet by experiment? Can I describe where the strongest point of a magnet is and how this is shown by the magnetic field pattern? Can I describe how the strength of the magnet varies with distance from the magnet? Can I draw the magnetic field pattern of a bar magnet and describe how to plot the magnetic field pattern using a compass?	Can I explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic?	
P15.2 Magnetic Fields and Electric Currents	Can I describe how the magnetic effect of a current can be demonstrated? Can I use the 'right hand thumb rule' to draw the magnetic field pattern of a wire carrying an electric current? Can I draw the magnetic field pattern for a straight wire carrying a current and for a solenoid? Can I describe the effect on the magnetic field of changing the direction of the electric current? Describe ways of increasing the magnetic field strength of a solenoid?	Can I explain how an electromagnet can be made from a solenoid?	
P15.3 Electromagnets in Devices	Can I describe how an electric bell and EM relay works?	Can I explain how a moving-coil loudspeaker and headphones work? Can I explain how a moving-coil microphone works?	
P15.4 The Motor Effect	Can I use and apply the equation :$F = B I L$ to calculate any missing value when given other values?	Can I explain what is meant by the motor effect? Can I explain why a motor spins with respect to the magnetic field produced by a wire carrying an electric current and the magnetic field of the permanent magnets in the motor interacting?	
P15.5 The Generator Effect	Can I describe what a generator does? Can I describe the effect on the induced potential difference, and induced current, of reversing the direction of motion of the conductor in a magnetic field?	Can I describe the effect on the induced potential difference, and induced current, of reversing the polarity of the magnets in a generator?	
P15.5& The AC & DC Generator	Can I describe how to make a simple d.c. generator from wire and permanent magnets? Can I draw and label both a.c. and d.c. generators? What determines whether the output current of a generator is a.c. or d.c.? Can I draw/interpret graphs of potential difference generated in the coil against time?	Can I explain how an alternator generates a.c. and a dynamo generates d.c?	
P15.7 Transformers	Can I describe how a step-up transformer and a step-down transformer affect the potential difference on the secondary coil compared to the primary coil?	Can I explain why transformers used?	

		Can I explain the reason why in the National Grid system the p.d. across the power cables is increased only to decrease at the other side of the cables?	
P15.8 Transformers in Action	Can I calculate the current drawn from the input supply to provide a particular power output? $V_s \, x \, I_s \; = \; V_p \, x \, I_p$ Can I perform calculations to determine the potential difference on the primary or secondary coil or the number of turns on the primary or secondary coil when given the other values.? Can I use simple ratios or the equation to calculate any unknown value. $\frac{V_p}{V_s} = \frac{n_p}{n_s}$?	Can I explain how a step-up transformer will increase the potential difference in the secondary coil compared to the primary coil but it will also decrease the current?	