CAIE Physics IGCSE

Topic 4.5 - Electromagnetic Effects

Flashcards

What is electromagnetic induction?

What is electromagnetic induction?

The production of a potential difference caused by relative movement between a conductor and a magnetic field.

In what direction is the potential difference induced? (supplement)

In what direction is the potential difference induced? (supplement)

In the opposite direction to the movement which produced it.

When is a current produced?

When is a current produced?

When the ends of the coil are connected to a complete circuit.

How can you increase the induced EMF?

How can you increase the induced EMF?

- Moving the wire more quickly
- Increasing the length of wire
- Using a stronger magnetic field

How can you work out the direction of the induced current? (supplement)

How can you work out the direction of the induced current? (supplement)

Using Fleming's **right hand rule**, where current, magnetic field, and wire movement are all at right angles to one another along each axis.

How can electromagnetic induction be demonstrated experimentally with a coil and magnet?

How can electromagnetic induction be demonstrated experimentally with a coil and magnet?

- Move a magnet through a wire coil connected to a voltmeter.
- E.m.f. can be read on the voltmeter.

Or

- Move a wire connected to a voltmeter between two magnets.
- E.m.f. can be read on the voltmeter.

How are electrical generators set up? (supplement)

How are electric generators set up? (supplement)

A loop of wire between permanent magnets, spun by a turbine via a slip ring, which is connected to the circuit by carbon brushes to transmit the current.

Describe how an electrical generator works.
(supplement)

Describe how an electrical generator works. (supplement)

- A turbine spins the coil of wire between the magnets.
- The magnetic field changes as coil spins.
- A potential difference is induced.
- A current is produced and transmitted by the carbon brushes.

What kind of current is produced by an ordinary generator?
(supplement)

What kind of current is produced by an ordinary generator? (supplement)

An alternating current.

Describe what a graph of e.m.f. against time as the coil rotates shows.

(supplement)

Describe what a graph of e.m.f. against time as the coil rotates shows. (supplement)

The changing e.m.f. over time is caused by the varied positioning of the wire coil.

When vertical, the magnetic field is not cut through by the coil, so there is no e.m.f.

When horizontal, the magnetic field is cut through fastest so is at its maximum.

What is produced around a current carrying wire?

What is produced around a current carrying wire?

A magnetic field.

How can you determine the direction of a magnetic field around a straight wire?

How can you determine the direction of a magnetic field around a straight wire?

Using the Right Hand Grip Rule. Produce a thumbs-up shape with your right hand and point your thumb in the direction of the flow of current. The field lines wrap around in concentric circles in the direction of your fingers.

What is a solenoid?

What is a solenoid?

A coil of wire with a magnetic field, which can be used as an electromagnet.

What is the difference in the pattern and direction of a solenoid's magnetic field?

What is the difference in the pattern and direction of a solenoid's magnetic field?

It forms concentric circles around each side of the coil with the field direction from the north to the south pole.

How does coiling a wire affect the magnetic field strength?

How does coiling a wire affect the magnetic field strength?

It increases the field strength, as the magnetic fields of each turn of wire are added together.

How can you increase the strength of a solenoid magnet? (supplement)

How can you increase the strength of a solenoid magnet? (supplement)

- Using an iron core to carry field lines
- Increase the number of turns in the coil
- Increase the current

What is a solenoid with a soft iron core called?

What is a solenoid with a soft iron core called?

An electromagnet.

Why can an electromagnet be switched on and off?

Why can an electromagnet be switched on and off?

The iron core becomes a temporary (induced) magnet when the current is flowing.

What devices use the magnetic effect?

What devices use the magnetic effect?

Loudspeakers, and relays.

How can the pattern of a straight and linear wire's magnetic field experimentally?

How can the pattern of a straight and linear wire's magnetic field experimentally?

- Attach a thick wire vertically through a hole in the middle of cardboard or loop the wire through holes in the cardboard.
- Clamp it in a stand
- Attach the ends of the wire to a series circuit with a cell, ammeter, and variable resistor.
- Spread iron filings uniformly on the cardboard.
- Place a plotting compass on the cardboard.
- Run a current through the wire and tap the cardboard slightly.
- Iron filings will align along the magnetic field lines and the plotting compass will show the direction of the magnetic field.

What happens when a current-carrying wire interacts with an external magnetic field?

What happens when a current-carrying wire interacts with an external magnetic field?

It experiences a force, pushing the wire out of/away from the field perpendicularly.

Describe the mechanism of this effect.

Describe the mechanism of this effect.

- When a current-carrying wire produces a magnetic field within the field of a permanent magnet, the two fields interact.
- The wire experiences a force pushing it away from the magnetic field, at right angles to the direction of the permanent field and the current.

How can you predict the direction of the force on a current-carrying conductor? (supplement)

How can you predict the direction of the force on a current-carrying conductor? (supplement)

Using Fleming's left hand rule.

Thu**m**b = **M**ovement

First finger = **F**ield

Se**c**ond finger = **C**urrent

What kind of current is used in Fleming's rule? (supplement)

What kind of current is used in Fleming's rule? (supplement)

Conventional current.

How can the force on a current-carrying conductor be demonstrated experimentally?

How can the force on a current-carrying conductor be demonstrated experimentally?

Placing a current-carrying wire between two magnets on a balance will show movement when a current is passed through the wire. Reversing the current or magnetic field reverses the force direction, and so movement.

What happens when beams of charged particles enter a magnetic field? (supplement)

What happens when beams of charged particles enter a magnetic field? (supplement)

Force is exerted on the charged particles perpendicular to the velocity (direction) of the charge, changing the velocity so the direction of the applied force changes and results in a circular motion of the particle beam (deflected).

Which factors affect the strength of the force exerted?

Which factors affect the strength of the force exerted?

- The length of wire placed in the field
- The current in the wire
- The strength of the permanent field

What happens when a current carrying solenoid is placed in a magnetic field and what component is this the basis of?

What happens when a current carrying solenoid is placed in a magnetic field and what component is this the basis of?

The force acts in opposite directions on either side of the coil, so having a turning effect.

This is the basis of a d.c. motor.

Which factors affect the strength of the turning effect?

Which factors affect the strength of the motor force?

- The length of wire placed in the field
- The current in the wire
- The strength of the permanent field

How does the d.c. motor's split ring commutator work? (supplement)

How does the d.c. motor's split ring commutator work? (supplement)

Unlike a slip ring, it disconnects and reconnects from the carbon brushes every half rotation, switching the current as the coil continues to spin from momentum and is flipped when reconnected.

What is a transformer formed of?

What is a transformer formed of?

Two wire coils wrapped around a soft iron core.

What is a transformer's function?

What is a transformer's function?

To transform the voltage of alternating currents, either stepping up (increasing) or stepping down (decreasing) the voltage.

Where is a transformer commonly used to step up / down voltage?

Where is a transformer commonly used to step up / down voltage?

In the national power grid.

The voltage is stepped up in power lines to reduce power loss and stepped down at houses.

What equation explains why higher voltage reduces power loss? (supplement)

What equation explains why higher voltage reduces power loss? (supplement)

$$power = (current)^2 \times resistance$$

$$P = I^2R$$

How do transformers work?
(supplement)

How do transformers work? (supplement)

- An alternating current flows through the primary coil, producing an alternating magnetic field.
- This causes the secondary coil to experience a changing magnetic field, inducing a potential difference, which produces an alternating current in the secondary coil.

How are step up transformers built to increase voltage?

How are step up transformers built to increase voltage?

There are more coils in the second coil experiencing the change, so a larger p.d. is induced.

State one assumption used in transformer calculations. (supplement)

State one assumption used in transformer calculations. (supplement)

The transformer is 100% efficient (the power is assumed to be the same in both coils), so IpVp=IsVs.

Give the transformer equation linking number of coils and p.d.

Give the transformer equations linking the number of coils and p.d.

$$\frac{N_1}{N_2} = \frac{V_1}{V_2}$$