

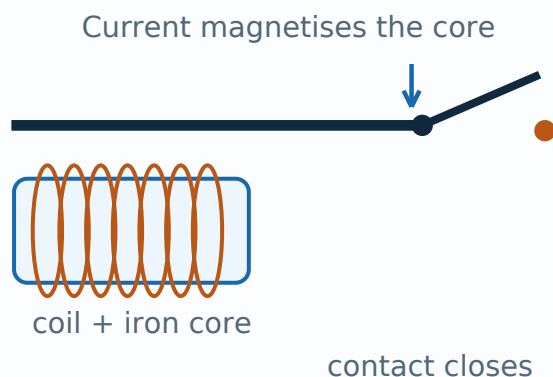
P7 Interpreting electromagnetic devices

Separate Physics extras | AQA 8463 | CORE

Use alongside the shared topic notes. Foundation + Higher content.

From current to motion

An electromagnet is a coil with an iron core. Current produces a magnetic field; the core becomes magnetised and strengthens the field.



In this simplified relay, the magnetised core attracts an iron armature. Its movement closes contacts in a separate circuit.

When the coil current stops, the core loses most of its magnetism and a spring can reopen the contacts.

Read an unfamiliar diagram

1. Trace the circuit containing the coil. Decide when current flows.
2. Identify the iron core and the part it can attract. Follow the mechanical movement.
3. Decide whether that movement opens or closes another circuit, strikes a bell, or lifts a magnetic load.
4. Explain what happens when the current stops. A spring or gravity often returns the moving part.

Label each link in the chain: current → magnetic field → attraction → movement → device output.

A coil does not attract every material. Iron is magnetic; many plastics and metals such as aluminium are not attracted in this simple model.

Apply the shared ideas

More current or an iron core can make the electromagnet stronger. More turns per unit length also strengthen the field of a solenoid.

A lifting magnet can pick up iron or steel when switched on and release it when switched off.

A relay allows one circuit to operate a switch in another. Use the supplied diagram to identify which contacts change.

For a self-interrupting bell, attraction opens the coil circuit; the magnet weakens; the spring restores the contact; the cycle repeats.

Tier boundary: this diagram interpretation is core Physics. Loudspeakers, induction, microphones and transformer calculations are Higher only.

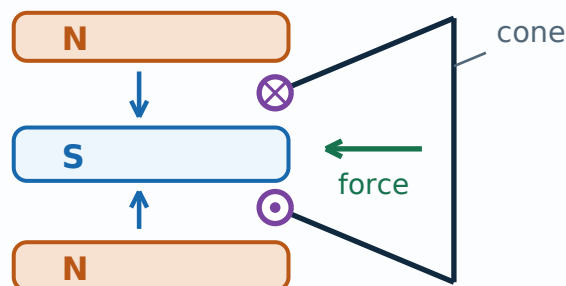
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P7 Loudspeakers and microphones

Separate Physics extras | AQA 8463 | HIGHER ONLY

Use alongside the shared topic notes. Higher-tier material is kept on this separate page.

Loudspeaker: electrical to sound



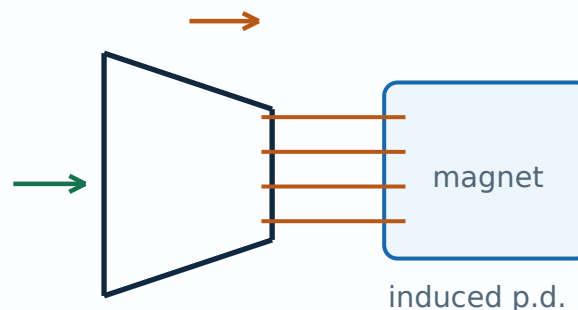
Coil current: ⊗ into page; ⊙ out of page

An alternating current in a coil produces a changing force in a permanent magnetic field: the motor effect.

The coil is attached to a cone. As current reverses, force reverses, so the cone vibrates and creates pressure variations in air.

The sound frequency matches the alternating current frequency. Headphones use the same principle.

Microphone: sound to electrical



sound moves diaphragm + coil

Sound pressure variations make a diaphragm and attached coil vibrate in a magnetic field.

Movement changes the magnetic field linked with the coil, inducing a potential difference. In a complete circuit an induced current flows.

The electrical signal follows the sound vibration. This is the generator effect, with energy transferred from sound to the electrical circuit.

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Keep the two effects distinct

Motor effect: current in a magnetic field produces a force. A loudspeaker turns a varying electrical signal into motion and sound.

Generator effect: movement relative to a field, or a changing field, induces p.d. A microphone turns motion into a varying electrical signal.

A stationary coil in an unchanging field does not produce a continuous induced p.d.

In both devices, the magnet provides the field and the coil is connected to the moving diaphragm or cone.

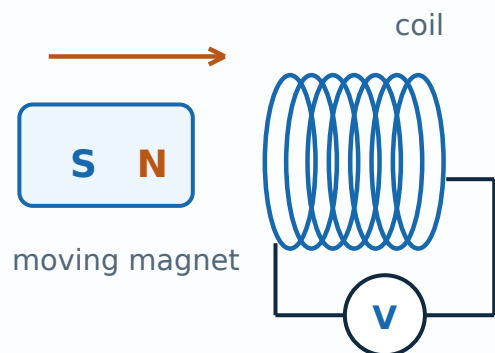
Explain in order: name the input → explain the coil's role → identify the physical effect → describe the output.

P7 Induction, alternators and dynamos

Separate Physics extras | AQA 8463 | HIGHER ONLY

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Induce a potential difference

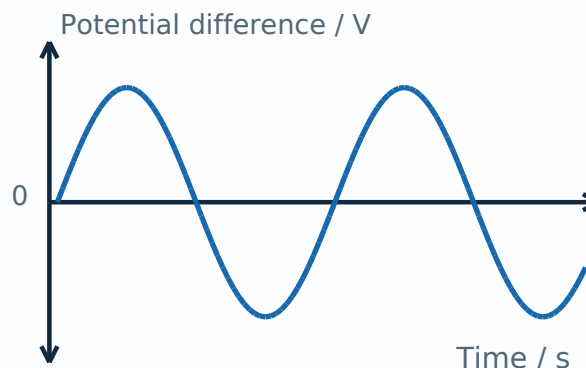


Relative movement between a conductor and magnetic field, or a changing field around it, induces p.d. A complete circuit allows induced current.

Faster change, a stronger field or more turns of wire can increase the induced p.d. Reversing motion or the field reverses its direction.

An induced current produces a magnetic field that opposes the original change. Work must be done to keep a generator moving.

Alternator: alternating output



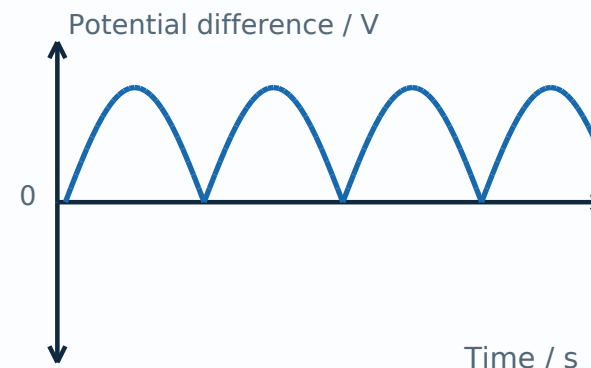
A coil rotates in a magnetic field. The induced p.d. reverses each half-turn, producing ac.

Slip rings and brushes maintain the electrical connection while allowing the coil to rotate.

Read the graph: positive and negative values show opposite directions of p.d. The time for one complete repeat is the period.

Faster rotation gives a higher frequency and can increase the peak p.d., if other factors stay constant.

Dynamo: one-direction output



A dynamo uses a split-ring commutator. It reverses the coil's connection to the external circuit every half-turn.

The external current stays in one direction: dc. Its size can still vary, giving the pulsing output shown.

Distinguish the coil's induced p.d. from the output after the commutator. The commutator changes the connections; it does not remove induction.

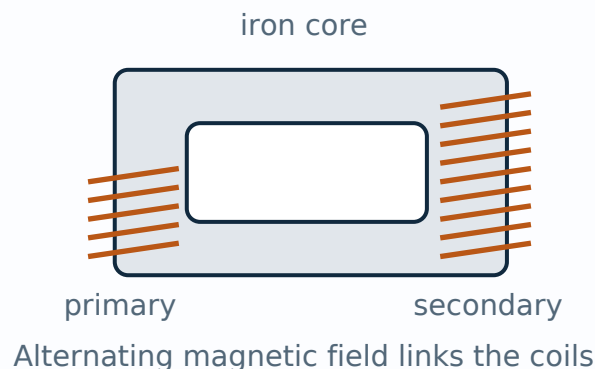
The output graphs are idealised teaching sketches.

P7 Transformers and power transmission

Separate Physics extras | AQA 8463 | HIGHER ONLY

Use alongside the shared topic notes. Higher-tier material is kept on this separate page.

A changing field links coils



Alternating current in the primary coil creates an alternating magnetic field in the iron core. This changing field induces p.d. in the secondary.

Iron is used because it is easily magnetised. A steady dc input does not give a continuous changing field, so it cannot produce a continuous transformer output.

More secondary turns gives a step-up transformer; fewer gives step-down.

Use turns and power ratios

$$\frac{V_p}{V_s} = \frac{n_p}{n_s}$$

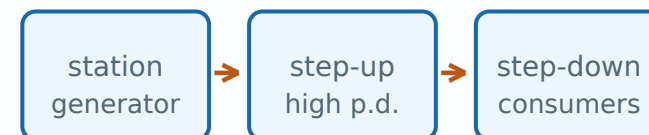
V_p and V_s are primary and secondary potential differences. n_p and n_s are the numbers of turns on the coils.

For an ideal (100% efficient) transformer, input power equals output power:

$$V_p I_p = V_s I_s$$

Example: 230 V primary, 460 turns; 24 turns secondary. $V_s = 230 \times 24 \div 460 = \mathbf{12\text{ V}}$. At 2.0 A output, power = 24 W, so $I_p = 24 \div 230 \approx \mathbf{0.104\text{ A}}$.

Why the Grid uses high p.d.



Same power: higher p.d. → lower current

Lower current → less heating of cables

For a given power, a higher transmission p.d. means a smaller current because $P = VI$.

$$\text{Pheating} = I^2 R$$

A lower current means less energy dissipated by heating the cables. Step-up transformers raise p.d. for transmission; step-down transformers reduce it near users.

Do not assume current stays the same when p.d. is changed while power is held constant.