Exercise walk-through

7.3

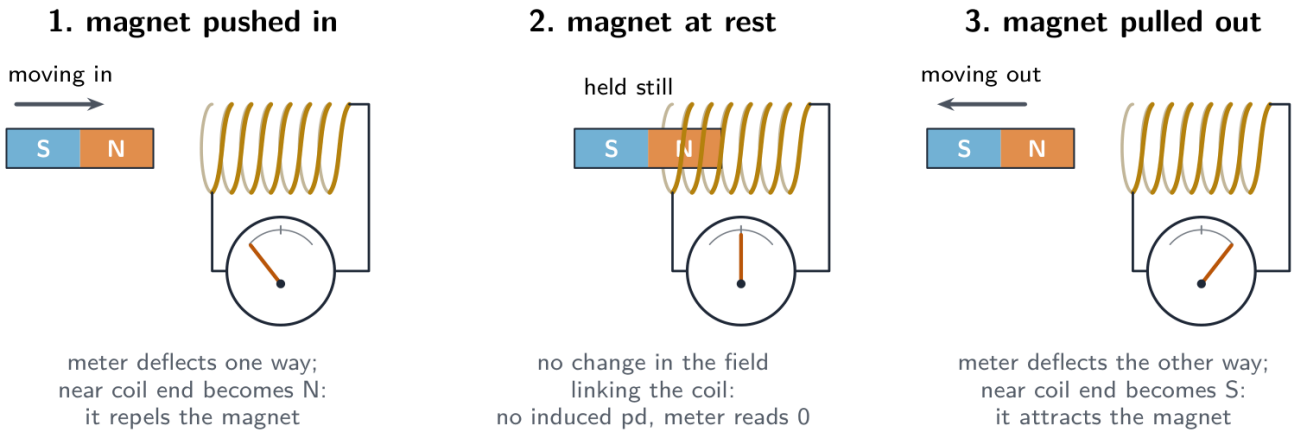
Induced potential, the generator effect and transformers – physics only, HT (4.7.3)

AQA · GCSE · Physics

The generator effect (physics only, HT)

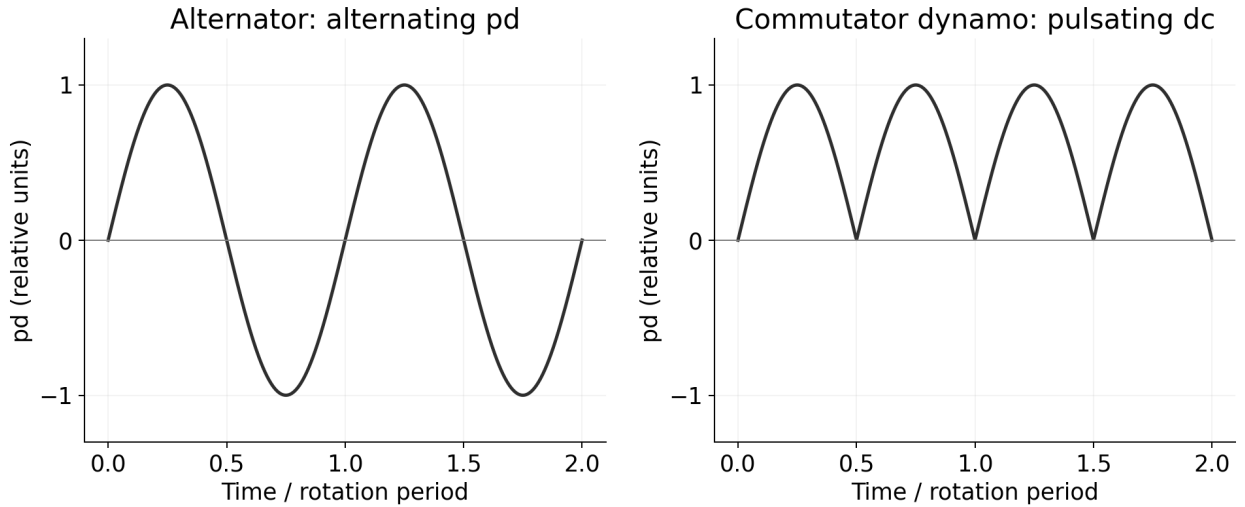
- the magnet or wire moves faster;
- the magnetic field is stronger;
- the coil has more turns.

Figure: The generator effect (physics only, HT)



- Moving a magnet into or out of a coil induces a potential difference; a still magnet induces none.
- Match each part of the diagram to the text.

Figure: The generator effect (physics only, HT) (2)



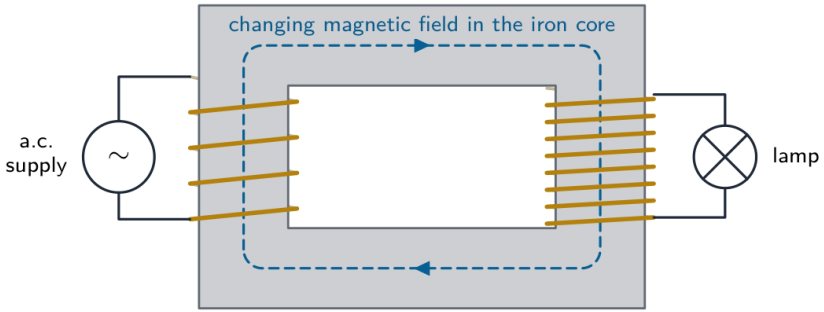
- An alternator gives an alternating pd that changes direction; a dynamo gives a pd that rises and falls but never reverses.
- Match each part of the diagram to the text.

Transformers (physics only, HT)

- A **transformer** has two coils of wire, the primary coil and the secondary coil, wound on an iron core.
- Iron is used because it is easily magnetised.
- An alternating current in the primary coil produces a changing magnetic field in the iron core.
- This changing field passes through the secondary coil and induces an alternating potential difference across it.

$$\frac{V_p}{V_s} = \frac{n_p}{n_s} \qquad V_s I_s = V_p I_p$$

Figure: Transformers (physics only, HT)



$$\frac{V_p}{V_s} = \frac{n_p}{n_s} \qquad V_s I_s = V_p I_p \quad (100\,\%\text{ efficient})$$

more secondary turns than primary turns here: a step-up transformer

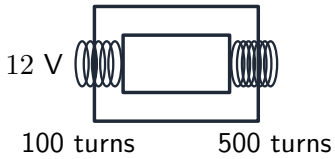
- A **transformer**: the changing field in the iron core links the primary and secondary coils.
- Match each part of the diagram to the text.

Exercises 2.1·2.2

2.1 State two ways to produce a changing magnetic field linkage and induce a potential difference in a conductor. [2]

induced pd

2.2 A transformer has 100 primary and 500 secondary turns; input 12 V. Calculate the output pd. [2]



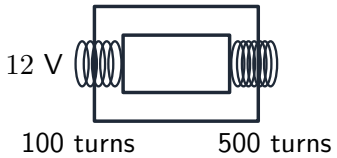
Exercises 2.1·2.2

2.1 State two ways to produce a changing magnetic field linkage and induce a potential difference in a conductor. [2]

induced pd

2.1 The conductor cuts magnetic field lines, or the field linking it changes.

2.2 A transformer has 100 primary and 500 secondary turns; input 12 V. Calculate the output pd. [2]



2.2

$$V_s = V_p \times \frac{n_s}{n_p} = 12 \times \frac{500}{100} = \mathbf{60}\ \text{V}$$

(equation C1, answer A1)

Exercise 2.3

2.3 State why a transformer's core is iron. [1]

transformer core

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transformer core

2.3 Iron is easily magnetised, so the changing primary field is carried strongly to the secondary coil.

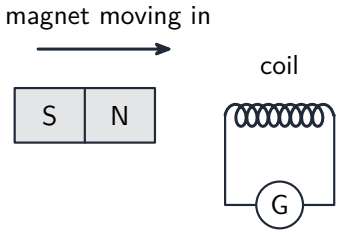
Exercise 3.1

3.1 A magnet is pushed into a coil connected to a sensitive meter.

(a) Explain why the meter deflects. [2]

(b) State two changes that increase the deflection. [2]

(c) The magnet is pulled out faster. State what happens to the induced pd's size and direction, and explain using the opposing field. [3]



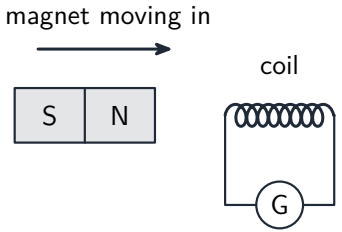
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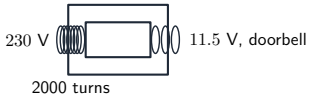
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3.1 (a) The magnet moving into the coil changes the magnetic field around the coil; the changing field induces a pd, driving a current through the meter. **3.1** (b) Any two: move the magnet faster; use a stronger magnet; more turns on the coil. **3.1** (c) The pd is larger (faster change) and reversed in direction (the flux through the coil now decreases instead of increasing); the induced current's own field opposes the change – reinforcing the field while the magnet leaves, opposing it while the magnet enters.

Exercise 3.2

3.2 A transformer steps 230 V down to 11.5 V for a doorbell; the primary has 2000 turns.

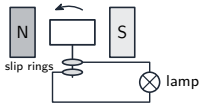


(a) Calculate the secondary turns. [3]

(b) The bell draws 0.50 A. Calculate the primary current (assume 100% efficiency). [3]

(c) Explain why the transformer only works with alternating current. [2]

3.3 A bicycle generator uses a rotating coil and slip rings, with no split-ring commutator: it is an alternator. At its stated operating point it powers a 6.0 V, 3.0 W lamp. The system is unregulated.



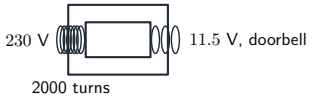
(a) Sketch the pd–time graph for one full rotation and name the output type. [2]

(b) Calculate the lamp's current. [2]

(c) Starting below the lamp's maximum rating, the rider pedals faster with the same connected lamp and no regulation. Describe the output graph and expected initial brightness change. [3]

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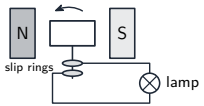


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3.2 (a)

$$n_s = n_p \times \frac{V_s}{V_p} = 2000 \times \frac{11.5}{230} = \mathbf{100} \text{ turns}$$

(equation C1, substitution C1, answer A1) **3.2** (b) Power out: $P = V_s I_s = 11.5 \times 0.50 =$

Full solution on next slide

Full solution 3.2

3.2 (a)

$$n_s = n_p \times \frac{V_s}{V_p} = 2000 \times \frac{11.5}{230} = \mathbf{100} \text{ turns}$$

(equation C1, substitution C1, answer A1) **3.2** (b) Power out: $P = V_s I_s = 11.5 \times 0.50 = 5.75$ W (C1); input current:

$$I_p = \frac{P}{V_p} = \frac{5.75}{230} = \mathbf{0.025} \text{ A}$$

(C1, A1) **3.2** (c) A transformer needs a **changing** field in the core; alternating current continually changes the primary's field, inducing a pd in the secondary – steady direct current gives a steady field and no sustained secondary pd. Switching on or off can briefly induce a pd.

3.3 (a) A sine-like curve crossing zero once per half rotation; ac output. **3.3** (b)

$$I = \frac{P}{V} = \frac{3.0}{6.0} = \mathbf{0.50} \text{ A}$$

(C1, A1) **3.3** (c) In this stated alternator, the peaks come more frequently (higher frequency) and the peaks are higher (faster rotation, larger induced pd); the lamp is brighter because more energy is transferred per second.