FREE REVISION PACK

Electromagnetic Induction

AQA A-level Physics · 7408 · Specification 3.7.5.3–3.7.5.4

Easy Medium Hard Multiple choice · past-paper questions

9	9	≈ 15 min
QUESTIONS	TOTAL MARKS	SUGGESTED TIME*

Contents

Q	LEVEL	FOCUS	SOURCE	MARKS
1	Easy	emf graph from a flux–time graph	AQA June 2023 · A-level Paper 2 · Q22	1 mark
2	Easy	Magnets falling through rings	AQA June 2019 · A-level Paper 2 · Q27	1 mark
3	Easy	Phase between flux linkage and emf	AQA November 2020 · A-level Paper 2 · Q25	1 mark
4	Medium	Force on a second coil when a switch is closed	AQA June 2019 · A-level Paper 2 · Q26	1 mark
5	Medium	emf from a changing flux density	AQA November 2020 · A-level Paper 2 · Q26	1 mark
6	Medium	Mean emf over half a turn	AQA June 2025 · A-level Paper 2 · Q21	1 mark
7	Hard	emf as a coil turns through 90°	AQA June 2017 · A-level Paper 2 · Q22	1 mark
8	Hard	emf across a moving metal block	AQA June 2025 · A-level Paper 2 · Q22	1 mark
9	Hard	Which movements induce an emf?	AQA November 2021 · A-level Paper 2 · Q22	1 mark

Key ideas to have ready

- Magnetic flux $\Phi = BA$ (Wb); flux linkage $= N\Phi = BAN\cos\theta$.
- Faraday's law: induced emf = rate of change of flux linkage, $\varepsilon = N\Delta\Phi / \Delta t$. For a rod moving through a field, $\varepsilon = Blv$.
- Lenz's law: the induced current opposes the change that causes it, so a magnet falling through a complete ring is slowed down.
- A coil rotating in a field: $\varepsilon = BAN\omega \sin \omega t$, peak $BAN\omega$. The emf is a maximum when the flux linkage is zero, so they are $\pi/2$ out of phase.

How to use this pack

1. The questions are grouped into levels (Easy, Medium and Hard). Work through them in order, and check your answers at the end of each level before moving on.
2. Every question is multiple choice with one correct answer. Write down your working anyway; that is how you find mistakes.
3. The separate mark scheme uses the same numbers and explains every answer.

Levels are based on how students did in AQA's examiner reports where that information exists, plus our own difficulty rating. *About 1.5 minutes per question.

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Easy

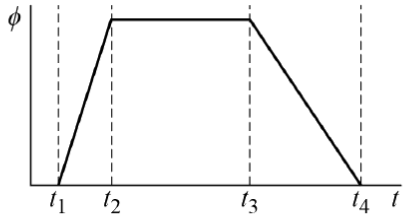
Definitions and one-step ideas. Most students get these right.

Questions 1–3

Only **one** answer per question is allowed. For each question, completely fill in the circle alongside the appropriate answer.

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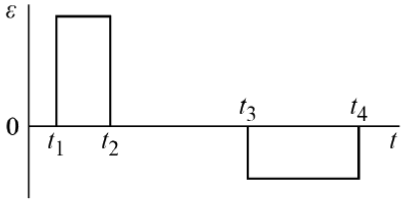
1 The magnetic flux ϕ in a coil varies with time t as shown.



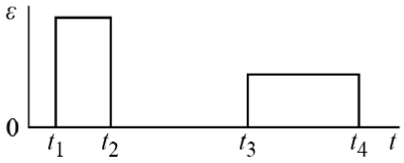
Which graph shows how the emf ε induced in the coil varies with t?

[1 mark]

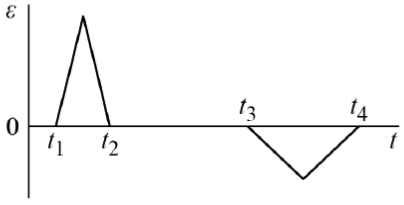
A



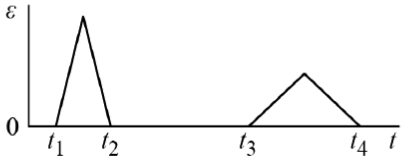
B



C



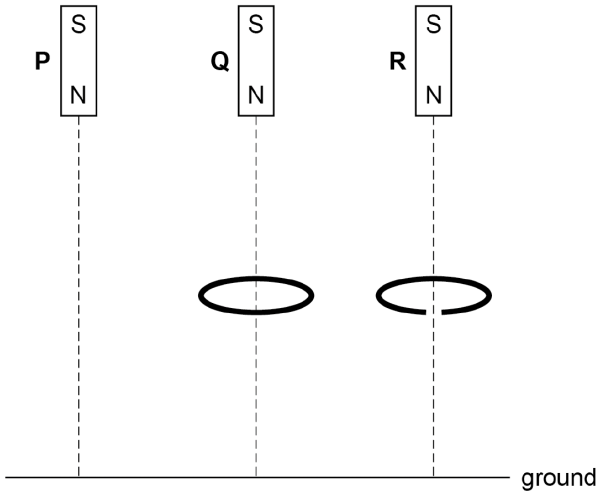
D



AQA June 2019 · A-level Paper 2 · Q27

2 Three identical magnets **P**, **Q** and **R** are released simultaneously from rest and fall to the ground from the same height.

P falls directly to the ground.
Q falls through the centre of a thick horizontal conducting ring.
R falls through a similar ring that has a gap cut into it.



In which order do the magnets reach the ground?

[1 mark]

A **P** and **R** arrive together, followed by **Q**. ⬭

B **P** and **Q** arrive together, followed by **R**. ⬭

C **P** arrives first, followed by **Q** which is followed by **R**. ⬭

D All three magnets arrive simultaneously. ⬭

AQA November 2020 · A-level Paper 2 · Q25

3 An alternating emf is induced in a coil rotating in a magnetic field.

What is the phase difference between the magnetic flux linkage through the coil and the emf?

[1 mark]

A 0 ⬭

B $\frac{\pi}{3}\text{rad}$ ⬭

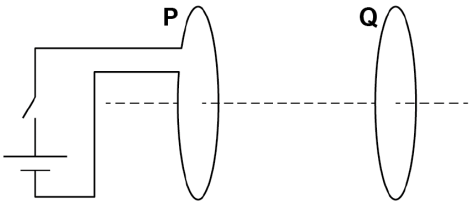
C $\frac{\pi}{2}\text{rad}$ ⬭

D $\pi\,\text{rad}$ ⬭

Medium Two or three steps. Roughly a third to a half of students get these right. **Questions 4–6**

AQA June 2019 · A-level Paper 2 · Q26

4 A coil **P** is connected to a cell and a switch.
A second closed coil **Q** is parallel to **P** and is arranged on the same axis.



When the switch is closed, coil **Q** experiences a force.

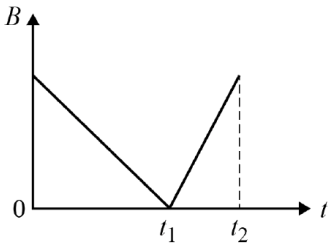
Which row describes the force on **Q**?

[1 mark]

	Force	Direction of force	
A	increases to constant value	to left	⬭
B	increases to constant value	to right	⬭
C	increases then decreases	to left	⬭
D	increases then decreases	to right	⬭

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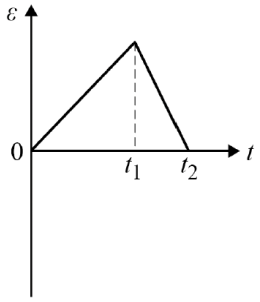
5 The diagram shows the variation with time t of the magnetic flux density B of the field linking a coil.



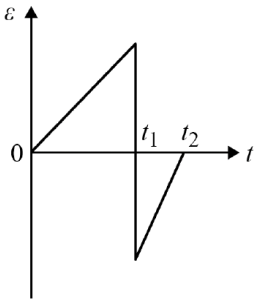
Which graph shows the variation of induced emf ε in the coil during this time interval?

[1 mark]

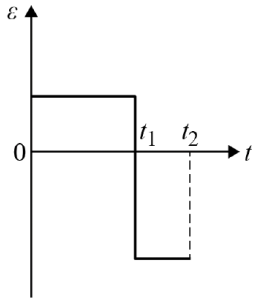
A



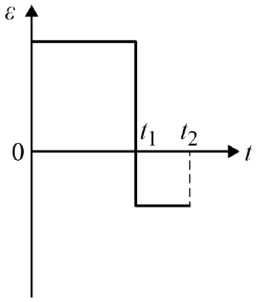
B



C

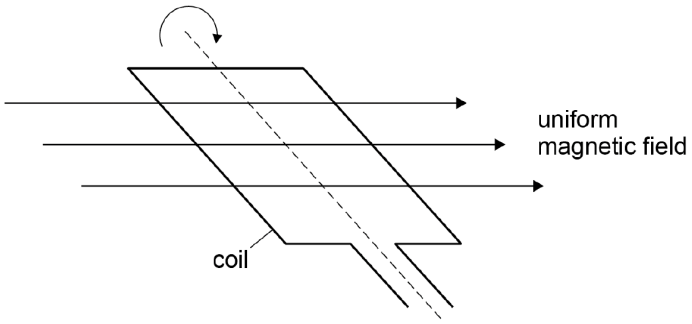


D



AQA June 2025 · A-level Paper 2 · Q21

6 A coil rotates at a constant angular speed in a uniform horizontal magnetic field.
The diagram shows the instant when the plane of the coil is horizontal.



cross-sectional area of coil = 20×10^{-3} m^2
number of turns in coil = 500 turns
magnetic flux density = 50 mT
frequency of rotation = 50 Hz

What is the mean induced emf, in V, as the coil rotates through π rad from the position shown?

[1 mark]

A 0 ⬭

B 0.50 ⬭

C 100 ⬭

D 157 ⬭

Hard Several steps, often with a trap built in. Fewer than 3 in 10 students get these right. **Questions 7–9**

AQA June 2017 · A-level Paper 2 · Q22

7 A coil with 20 circular turns each of diameter 60 mm is placed in a uniform magnetic field of flux density 90 mT.

Initially the plane of the coil is perpendicular to the magnetic field lines as shown in **Figure X**.

Figure X

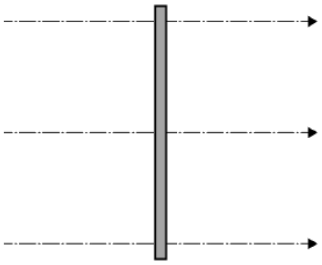
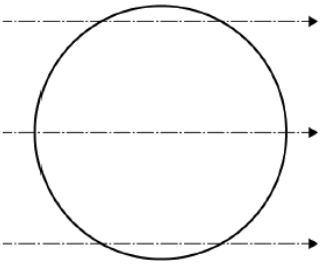


Figure Y



The coil is rotated about a vertical axis by 90° in a time of 0.20 s so that its plane becomes parallel to the field lines as shown in **Figure Y**.
Assume that the rate of change of flux linkage remains constant.

What is the emf induced in the coil?

[1 mark]

A zero ○

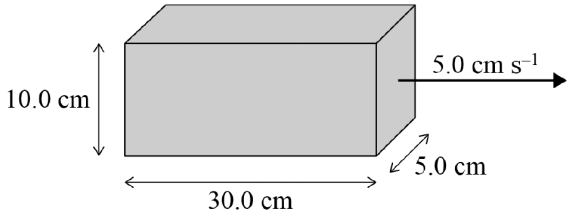
B 1.3 mV ○

C 25 mV ○

D 100 mV ○

AQA June 2025 · A-level Paper 2 · Q22

8 A metal block has dimensions $30.0\ \text{cm} \times 10.0\ \text{cm} \times 5.0\ \text{cm}$ as shown.



The block is moved at a constant horizontal velocity of $5.0\ \text{cm s}^{-1}$ through a uniform vertical magnetic field so that an emf is induced across the block.

The magnetic field has a magnetic flux density of $2.5\ \text{mT}$.

What is the induced emf?

[1 mark]

A $150\ \mu\text{V}$ ⬭

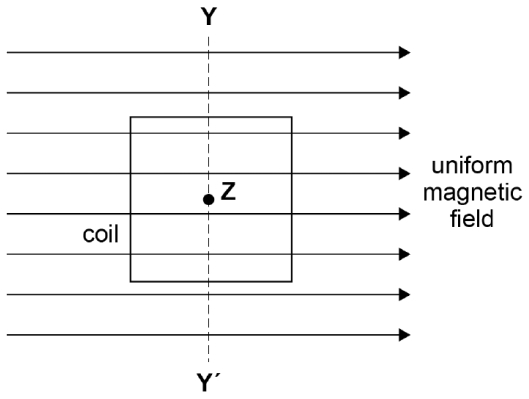
B $37.5\ \mu\text{V}$ ⬭

C $12.5\ \mu\text{V}$ ⬭

D $6.25\ \mu\text{V}$ ⬭

AQA November 2021 · A-level Paper 2 · Q22

9 The diagram shows a square coil with its plane parallel to a uniform magnetic field.



The coil always remains within the magnetic field.
There are four possible changes to the position of the coil:

- moving it to the left
- moving it towards **Y**
- rotating it about the axis **YY´**
- rotating it about an axis **Z** that is at its centre and perpendicular to the plane of the coil.

How many of these changes will result in an induced emf in the coil while the change occurs?

[1 mark]

A one ⬭

B two ⬭

C three ⬭

D four ⬭

End of questions. Check your answers with the matching mark scheme. More free packs and 1-to-1 tuition:
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