GET BETTER AT PHYSICS · MARK SCHEME

Electromagnetic Induction: tiered multiple choice

AQA A-level Physics · 7408 · Specification 3.7.5.3–3.7.5.4 · 9 questions · 9 marks

1 mark per correct letter | Worked reasoning for every question | **How students did** = from AQA examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
A	A	C	D	C	A	C	D	A

Easy

Questions 1–3

1 **A**

emf graph from a flux–time graph · AQA June 2023 · A-level Paper 2 · Q22

ε = −dΦ/dt, the negative of the gradient. From t_1 to t_2 the flux rises steeply at a constant rate, giving a constant emf. From t_2 to t_3 the flux is constant, so there is no emf. From t_3 to t_4 the flux falls more slowly, giving a smaller constant emf of the opposite sign: graph A.

Watch out: emf depends on the gradient of the flux graph, not on the size of the flux.

2 **A**

Magnets falling through rings · AQA June 2019 · A-level Paper 2 · Q27

As Q falls through the complete ring it induces a current that, by Lenz's law, opposes its motion, so Q is slowed. The ring around R has a gap, so no current can flow and there is no opposing force. P and R arrive together, followed by Q.

Watch out: An emf is still induced in the broken ring, but without a complete circuit there is no current and no force.

3 **C**

Phase between flux linkage and emf · AQA November 2020 · A-level Paper 2 · Q25

The emf is the rate of change of flux linkage. When the flux linkage is at its maximum it is momentarily not changing, so the emf is zero; when the flux linkage passes through zero it is changing fastest. They are a quarter of a cycle apart: π/2 rad.

Medium

Questions 4–6

4 **D**

Force on a second coil when a switch is closed · AQA June 2019 · A-level Paper 2 · Q26

When the switch closes, the current in P grows, so the flux through Q increases and a current is induced in Q. By Lenz's law it opposes the change, so Q is repelled: the force on Q is to the right. Once the current in P is steady, the flux stops changing and the force falls back to zero: it increases then decreases.

Watch out: An induced current only flows while the flux is changing.

How students did: In June 2019 this was answered much less well than most of Section B.

5 **C**

emf from a changing flux density · AQA November 2020 · A-level Paper 2 · Q26

emf ∝ gradient of the B–t graph. Up to t_1, B falls at a steady rate: a constant emf. From t_1 to t_2, B rises at a steeper steady rate: a larger constant emf of the opposite sign: graph C.

Watch out: Compare the steepness of the two lines to decide which emf is bigger.

How students did: Between 30% and 50% of students got this right in November 2020.

6 **A**

Mean emf over half a turn · AQA June 2025 · A-level Paper 2 · Q21

With the plane of the coil horizontal and parallel to the field, the flux linkage is zero. After half a turn (π rad) the coil is horizontal again, so the flux linkage is zero again. The total change in flux linkage is zero, so the mean emf over that time is 0.

> **Watch out:** Mean emf = total change in flux linkage ÷ time. The emf is not zero during the half-turn, but it averages to zero.

How students did: Just under a third of students got this right in June 2025.

Hard

Questions 7–9

7 **C**

emf as a coil turns through 90° · AQA June 2017 · A-level Paper 2 · Q22

Area = $\pi \times 0.030^2 = 2.83 \times 10^{-3}$ m^2. Initial flux linkage = NBA = $20 \times 0.090 \times 2.83 \times 10^{-3} = 5.1 \times 10^{-3}$ Wb-turns. After turning 90° it is zero. emf = $5.1 \times 10^{-3} \div 0.20 = 25$ mV.

> **Watch out:** Use the radius (30 mm), not the diameter, in πr^2; using 60 mm gives 100 mV (D).

8 **D**

emf across a moving metal block · AQA June 2025 · A-level Paper 2 · Q22

ε = Blv, where l is the length at right angles to both the vertical field and the velocity: the 5.0 cm depth. ε = $2.5 \times 10^{-3} \times 0.050 \times 0.050 = 6.25 \times 10^{-6}$ V = 6.25 μV.

> **Watch out:** Pick the dimension that is perpendicular to both B and v. The 30.0 cm length is along the motion.

How students did: Only around a quarter of students got this right in June 2025.

9 **A**

Which movements induce an emf? · AQA November 2021 · A-level Paper 2 · Q22

The coil's plane is parallel to the field, so no flux passes through it. Sliding it left or towards Y, or spinning it about Z in its own plane, leaves it parallel to the field: the flux stays zero. Only rotating it about YY′ tilts the coil across the field and changes the flux: one change.

> **Watch out:** An emf needs a change in flux linkage, not just movement inside a field.

How students did: Under 25% of students got this right in November 2021.

End of mark scheme. Answers from AQA's published keys; explanations written for this pack. AQA material is © AQA. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

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