Exercise walk-through

Induced Currents and Magnetic Forces ▪ 13.3

eXercise

You must be able to

- determine the direction and size of a current **induced** by a changing flux
- explain why an induced current creates a **retarding force** 阻碍力
- analyse the energy transfer (mechanical $\rightarrow$ electrical $\rightarrow$ thermal)
- describe **eddy currents** 涡电流

Method — Induced current and retarding force

A changing flux drives an induced current whose direction (Lenz's law) **opposes** the change. In a moving conductor this makes a force that **resists** the motion.

Method — Energy transfer

To keep the conductor moving you must do **work**; that mechanical energy becomes electrical energy, then thermal energy in the resistance.

Method — Eddy currents

In a solid conductor, a changing flux drives swirling **eddy currents** — used in magnetic braking, and a cause of heating in transformer cores.

Practice 2.1 ▪ 1 mark

State the rule that gives the direction of an induced current.

Solution 2.1

Method: Induced current and retarding force

Worked steps

Lenz's law B1.

Practice 2.2 ▪ 2 marks

Explain why an induced current opposes the motion that produces it.

Solution 2.2

Method: Induced current and retarding force

Worked steps

the induced current opposes the change in flux B1, so the force it feels acts against the motion that is causing the change B1.

Practice 2.3 ▪ 1 mark

Name the swirling induced currents in a solid conductor.

Solution 2.3

Method: Eddy currents

Worked steps

eddy currents B1.

Exam-style 3.1 ▪ 1 mark

An induced current always opposes the

A applied voltage

B change that produces it

C resistance of the wire

D shape of the wire

Solution 3.1

Method: Induced current and retarding force

A applied voltage

B change that produces it ✓

C resistance of the wire

D shape of the wire

Worked steps

B.

Exam-style 3.2 ▪ 1 mark

Eddy currents are used in

A light bulbs

B magnetic braking

C batteries

D fixed resistors

Solution 3.2

Method: Eddy currents

A light bulbs

B magnetic braking ✓

C batteries

D fixed resistors

Worked steps

B.

Exam-style 3.3 ▪ 1 mark

A metal loop is pulled out of a magnetic field region.
(a) State whether a current is induced in the loop.
(b) State the direction of the magnetic force on the loop relative to its motion.
(c) Describe the energy transfer as the loop is pulled out.

Solution 3.3

Method: Induced current and retarding force

Worked steps

(a) yes B1. (b) opposite to the motion (it resists being pulled out) B1. (c) the work done pulling the loop becomes electrical energy in the induced current, then thermal energy in the loop's resistance B1 B1.