13.3 Induced Currents and Magnetic Forces

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **induced currents and magnetic forces**.

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 → electrical → thermal)
- describe **eddy currents** 涡电流

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ 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.

■ Energy transfer

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

■ 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.

2 Practice

2.1 State the rule that gives the direction of an induced current. [1]

2.2 Explain why an induced current opposes the motion that produces it. [2]

2.3 Name the swirling induced currents in a solid conductor. [1]

3 Exam-style questions

3.1 An induced current always opposes the [1]

- **A** applied voltage
- **B** change that produces it
- **C** resistance of the wire
- **D** shape of the wire

3.2 Eddy currents are used in [1]

- **A** light bulbs
- **B** magnetic braking
- **C** batteries
- **D** fixed resistors

3.3 A metal loop is pulled out of a magnetic field region.

(a) State whether a current is induced in the loop. [1]

(b) State the direction of the magnetic force on the loop relative to its motion. [1]

(c) Describe the energy transfer as the loop is pulled out. [2]

4 Go further

- work through the **13.3 Induced Currents and Magnetic Forces** lesson on the **Learn** page;

- read the **Electromagnetic Induction** section of the AP Physics C: E&M handout on the **Know** page.

Solutions

2.1 Lenz's law.

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

2.3 eddy currents.

3.1 B.

3.2 B.

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