

# 12.4 Electromagnetic Induction and Faraday's Law

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

**KEY WORDS** magnetic flux 磁通量 • faraday's law 法拉第定律 • lenz's law 楞次定律  
• electromagnetic induction 电磁感应

## Objective

Build the skills to answer exam questions on **electromagnetic induction and Faraday's law**.

You must be able to:

- define **magnetic flux** 磁通量 as  $\Phi = BA \cos \theta$
- state **Faraday's law** 法拉第定律: a changing flux induces an emf,  $\varepsilon = -\frac{\Delta \Phi}{\Delta t}$
- use **Lenz's law** 楞次定律 to find the direction of an induced current
- describe how generators and transformers use induction

## 1 Worked examples

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

### ■ Magnetic flux

$\Phi = BA \cos \theta$ , measured in webers, where  $\theta$  is the angle between the field and the loop's normal. Flux is greatest when the loop faces the field ( $\theta = 0$ ).

### ■ Faraday's law

$\varepsilon = -\frac{\Delta \Phi}{\Delta t}$ : a **changing** flux induces an emf. A faster change means a larger emf.

### ■ Lenz's law

The induced current flows so as to **oppose** the change in flux that produced it (the minus sign).

## 2 Practice

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**2.1** Find the magnetic flux through a  $0.20 \text{ m}^2$  loop lying face-on in a  $0.50 \text{ T}$  field. [2]

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**2.2** State what is needed to induce an emf in a coil. [1]

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**2.3** State Lenz's law. [1]

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## 3 Exam-style questions

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**3.1** Magnetic flux is [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A**  $BA \cos \theta$   
**B**  $BI\ell$   
**C**  $qvB$   
**D**  $\frac{\mu_0 I}{2\pi r}$

**3.2** The rule that an induced current opposes the change that causes it is [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A** Ohm's law  
**B** Faraday's law  
**C** Lenz's law  
**D** Kirchhoff's law

**3.3** The flux through a coil falls from  $0.40 \text{ Wb}$  to  $0.10 \text{ Wb}$  in  $0.20 \text{ s}$ .

(a) Find the size of the induced emf. [3]

(b) Name the law used. [1]