

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 θ 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

2.1 Find the magnetic flux through a 0.20 m^2 loop lying face-on in a 0.50 T field. [2]

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

2.3 State Lenz's law. [1]

3 Exam-style questions

3.1 Magnetic flux is [1]

- | | |
|---|--------------------------|
| 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 | 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 Wb to 0.10 Wb in 0.20 s .

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

(b) Name the law used. [1]