

13.4 Inductance

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS inductor 电感器 • inductance 电感 • back emf 反电动势 • henry 亨利
• emf 电动势

Objective

Build the skills to answer exam questions on **inductance**.**You must be able to:**

- define **inductance** 电感 and its unit the **henry** 亨利
- relate the **back emf** 反电动势 to the rate of change of current, $\varepsilon = -L \frac{dI}{dt}$
- calculate the **energy stored** in an inductor, $U = \frac{1}{2}LI^2$
- relate stored energy to the magnetic **energy density** $u = \frac{B^2}{2\mu_0}$

1 Worked examples

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

■ Inductance

$L = \frac{N\Phi_B}{I}$, measured in henries (H). It measures how much flux linkage a current produces.

■ Back emf

$\varepsilon = -L \frac{dI}{dt}$ — an inductor opposes **changes** in current with an induced (back) emf.

■ Energy stored

$U = \frac{1}{2}LI^2$, held in the magnetic field (energy density $u = \frac{B^2}{2\mu_0}$).

2 Practice

2.1 An inductor produces a back emf of 6.0 V when the current changes at 3.0 A s⁻¹. Find its inductance. [2]

2.2 Find the energy stored in a 0.50 H inductor carrying 4.0 A. [2]

2.3 State the SI unit of inductance. [1]

3 Exam-style questions

3.1 The back emf across an inductor is [1]

- | | |
|---|--------------------|
| A | LI |
| B | $-L \frac{dI}{dt}$ |
| C | $\frac{1}{2}LI^2$ |
| D | I/L |

3.2 The energy stored in an inductor is [1]

- | | |
|---|-------------------|
| A | LI |
| B | $\frac{1}{2}LI^2$ |
| C | $\frac{1}{2}L^2I$ |
| D | LI^2 |

3.3 A 0.20 H inductor carries a current rising at 5.0 A s^{-1} .

(a) Find the back emf. [2]

(b) Find the energy stored when the current reaches 3.0 A. [2]