

11.6 Kirchhoff's Loop Rule

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS conservation of energy 能量守恒 • kirchhoff's loop rule 基尔霍夫电压定律
• series 串联

Objective

Build the skills to answer exam questions on **Kirchhoff's loop rule**.

You must be able to:

- state **Kirchhoff's loop rule** 基尔霍夫电压定律: the sum of potential differences around any closed loop is zero
- explain the loop rule as a statement of **conservation of energy** 能量守恒
- apply the loop rule to write equations for a circuit

1 Worked examples

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

■ The loop rule

Around any closed loop, $\sum V = 0$: the potential rises across the battery equal the drops across the resistors.

■ Why it holds

A charge returning to its start has the **same** potential energy, so the total change around the loop is zero — this is conservation of energy.

■ Example

A single loop with a 12 V battery and resistors R_1 , R_2 in series: $12 = IR_1 + IR_2$.

2 Practice

2.1 State Kirchhoff's loop rule.

[1]

2.2 State the conservation law that the loop rule expresses.

[1]

2.3 A single loop has a 9.0 V battery and resistors $2.0\ \Omega$ and $1.0\ \Omega$ in series. Write the loop equation and find the current.

[2]

3 Exam-style questions

3.1 Kirchhoff's loop rule states that around a closed loop the sum of the potential differences is

[1]

- A a maximum
- B zero
- C equal to the emf only
- D always negative

3.2 The loop rule is a statement of conservation of

[1]

- A charge
- B energy
- C momentum
- D mass

3.3 A single loop contains a 6.0 V battery and resistors of $4.0\ \Omega$ and $2.0\ \Omega$ in series.

(a) Write the loop equation.

[2]

(b) Find the current.

[1]

Solutions

2.1 the sum of the potential differences around any closed loop is zero.

2.2 conservation of energy.

2.3 $9.0 = I(2.0 + 1.0) \Rightarrow I = 3.0 \text{ A}$.

3.1 B.

3.2 B.

3.3 (a) $6.0 = I(4.0) + I(2.0)$. (b) $I = \frac{6.0}{6.0} = 1.0 \text{ A}$.