Exercise walk-through

Kirchhoff's Loop Rule ▪ 11.6

eXercise

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

Method — The loop rule

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

Method — 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.

Method — Example

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

Practice 2.1 ▪ 1 mark

State Kirchhoff's loop rule.

Solution 2.1

Method: The loop rule

Worked steps

the sum of the potential differences around any closed loop is zero B1.

Practice 2.2 ▪ 1 mark

State the conservation law that the loop rule expresses.

Solution 2.2

Worked steps

conservation of energy B1.

Practice 2.3 ▪ 2 marks

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.

Solution 2.3

Method: Example

Worked steps

$9.0 = I(2.0 + 1.0) \Rightarrow I = 3.0$ A **M1** **A1**.

Exam-style 3.1 ▪ 1 mark

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

A a maximum

B zero

C equal to the emf only

D always negative

Solution 3.1

Method: The loop rule

A a maximum

B zero ✓

C equal to the emf only

D always negative

Worked steps

B.

Exam-style 3.2 ▪ 1 mark

The loop rule is a statement of conservation of

A charge

B energy

C momentum

D mass

Solution 3.2

A charge

B energy ✓

C momentum

D mass

Worked steps

B.

Exam-style 3.3 ▪ 2 marks

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.
(b) Find the current.

Solution 3.3

Method: Example

Worked steps

(a) $6.0 = I(4.0) + I(2.0)$ M1 A1. (b) $I = \dfrac{6.0}{6.0} = 1.0$ A B1.