AP PHYSICS 2 • EXERCISE SHEET

11.6 Kirchhoff's Loop Rule

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

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 Ω and 1.0 Ω 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 Ω and 2.0 Ω in series.

(a) Write the loop equation. [2]

(b) Find the current. [1]

4 Go further

- work through the **11.6 Kirchhoff's Loop Rule** lesson on the **Learn** page;
- read the **Electric Circuits** section of the AP Physics 2 handout on the **Know** page.

Solutions

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

2.2 conservation of energy.

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

3.1 B.

3.2 B.

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