AP PHYSICS C: ELECTRICITY AND MAGNETISM • EXERCISE SHEET

11.7 Kirchhoff's Junction Rule

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

Objective

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

You must be able to:

- state **Kirchhoff's junction rule** 基尔霍夫电流定律, $\sum I_{\text{in}} = \sum I_{\text{out}}$
- explain it as a consequence of **conservation of charge** 电荷守恒
- write **junction equations** for the nodes of a circuit
- combine it with the loop rule to find **branch currents**

1 Worked examples

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

The junction rule

At any junction, $\sum I_{\text{in}} = \sum I_{\text{out}}$ —the current arriving equals the current leaving.

Why it holds

Charge cannot build up at a point, so it is conserved at every node.

Using it

Write a junction equation at each node and a loop equation for each loop, then solve the set for the unknown branch currents.

2 Practice

2.1 State Kirchhoff's junction rule. [1]

2.2 State the conservation law the junction rule expresses. [1]

2.3 At a junction, 5.0 A enters and two branches carry 2.0 A and I out. Find I. [2]

3 Exam-style questions

3.1 By the junction rule, the current into a junction equals the current [1]

- **A** stored there
- **B** out of it
- **C** squared
- **D** halved

3.2 The junction rule expresses conservation of [1]

- **A** energy
- **B** charge
- **C** momentum
- **D** power

3.3 At a node, 8.0 A enters by one wire; three branches leave carrying 3.0 A, 2.0 A, and I.

(a) Find I. [2]

(b) Name the law used. [1]

4 Go further

- work through the **11.7 Kirchhoff's Junction Rule** lesson on the **Learn** page;
- read the **Electric Circuits** section of the AP Physics C: E&M handout on the **Know** page.

Solutions

2.1 the total current into a junction equals the total current out.

2.2 conservation of charge.

2.3 $I = 5.0 - 2.0 = 3.0$ A.

3.1 **B**.

3.2 **B**.

3.3 (a) $I = 8.0 - 3.0 - 2.0 = 3.0$ A. (b) Kirchhoff's junction rule.