

Exercise walk-through

Kirchhoff's Junction Rule ■ 11.7

eXercise

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**

Method — The junction rule

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

Method — Why it holds

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

Method — 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.

Practice 2.1 ■ 1 mark

State Kirchhoff's junction rule.

Solution 2.1

Method: The junction rule

Worked steps

the total current into a junction equals the total current out **B1**.

Practice 2.2 ■ 1 mark

State the conservation law the junction rule expresses.

Solution 2.2

Method: The junction rule

Worked steps

conservation of charge **B1**.

Practice 2.3 ■ 2 marks

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

Solution 2.3

Method: The junction rule

Worked steps

$$I = 5.0 - 2.0 = 3.0 \text{ A} \quad \text{M1} \quad \text{A1}.$$

Exam-style 3.1 ■ 1 mark

By the junction rule, the current into a junction equals the current

A stored there

B out of it

C squared

D halved

Solution 3.1

Method: The junction rule

A stored there

B out of it 

C squared

D halved

Worked steps

B.

Exam-style 3.2 ■ 1 mark

The junction rule expresses conservation of

A energy

B charge

C momentum

D power

Solution 3.2

Method: The junction rule

A energy

B charge 

C momentum

D power

Worked steps

B.

Exam-style 3.3 ■ 2 marks

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 .

(b) Name the law used.

Solution 3.3

Worked steps

(a) $I = 8.0 - 3.0 - 2.0 = 3.0 \text{ A}$ **M1** **A1**. (b) Kirchhoff's junction rule **B1**.