

# Exercise walk-through

Electric Current ■ 11.1

eXercise

## You must be able to

- define **electric current** 电流 as the rate of flow of charge,  $I = \frac{dQ}{dt}$
- distinguish **conventional current** from electron flow
- relate current to **current density** 电流密度 and **drift velocity** 漂移速度
- apply **conservation of charge** to steady current

## Method — Current

$$I = \frac{dQ}{dt}, \text{ measured in amperes. Over a steady flow, } I = \frac{\Delta Q}{\Delta t}.$$

## Method — Conventional current

The direction that **positive** charge would flow — opposite to the actual electron drift.

## Method — Microscopic picture

Current is carriers **drifting** slowly through the conductor; a potential difference across the conductor drives the flow, and charge is conserved.

## Practice 2.1 ■ 2 marks

A charge of 15 C flows past a point in 3.0 s. Find the current.

## Solution 2.1

## Worked steps

$$I = \frac{\Delta Q}{\Delta t} = \frac{15}{3.0} = 5.0 \text{ A} \quad \text{M1} \quad \text{A1}.$$

## Practice 2.2 ■ 1 mark

State the direction of conventional current relative to the electron flow.

## Solution 2.2

Method: Conventional current

### Worked steps

opposite to the electron flow **B1**.

## Practice 2.3 ■ 1 mark

State what drives a current through a conductor.

## Solution 2.3

Method: Microscopic picture

### Worked steps

a potential difference across it **B1**.

## Exam-style 3.1 ■ 1 mark

Electric current is defined as

**A**  $Q/V$

**B**  $\frac{dQ}{dt}$

**C**  $It$

**D**  $V/R$

## Solution 3.1

**A**  $Q/V$

**B**  $\frac{dQ}{dt}$



**C**  $It$

**D**  $V/R$

## Worked steps

B.

## Exam-style 3.2 ■ 1 mark

Conventional current flows in the direction of

- A** electron flow
- B** positive charge flow
- C** neutron flow
- D** no charge

## Solution 3.2

Method: Conventional current

- A electron flow
- B positive charge flow** 
- C neutron flow
- D no charge

### Worked steps

B.

## Exam-style 3.3 ■ 2 marks

A wire carries a steady current of 3.0 A.

- (a) Find the charge that passes in 20 s.
- (b) State the conservation law obeyed by a steady current.

## Solution 3.3

## Worked steps

(a)  $\Delta Q = I \Delta t = 3.0 \times 20 = 60 \text{ C}$  **M1** **A1**. (b) conservation of charge **B1**.