

9 Electricity – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
charge	电荷	_____	_____	_____
Electric current	电流	_____	_____	_____
Potential difference	电势差	_____	_____	_____
power	功率	_____	_____	_____
Resistance	电阻	_____	_____	_____
Ohm's law	欧姆定律	_____	_____	_____
resistivity	电阻率	_____	_____	_____

Recall

At IGCSE you built circuits. Bring this with you:

- Current is the flow of electricity; you used $V = IR$.
- You compared series and parallel circuits.

At AS we define current and voltage from **charge** 电荷 and energy, and add resistivity.

New ideas

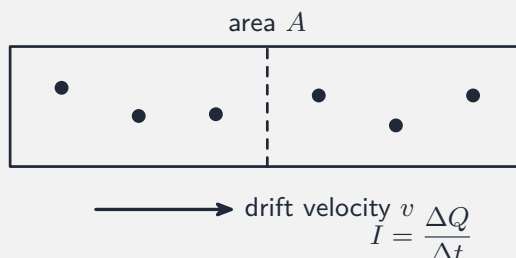
■ 1 Current is the flow of charge

Electric current 电流 is the rate at which charge flows:

$$I = \frac{Q}{t},$$

where Q is charge in coulombs (C), t is time, and I is in amperes (A).

Worked example. If 60 C of charge flows in 20 s: $I = \frac{60}{20} = 3.0$ A.



■ 2 Potential difference and power

Potential difference 电势差 (voltage) is the energy given to each unit of charge:

$$V = \frac{W}{Q}.$$

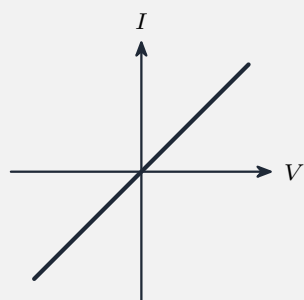
Electrical **power** 功率 is

$$P = VI = I^2R = \frac{V^2}{R}.$$

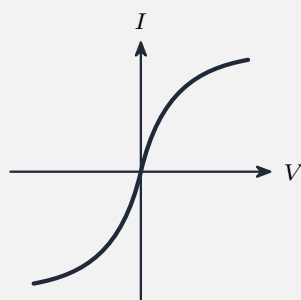
Worked example. A bulb at 12 V carrying 2.0 A: $P = VI = 12 \times 2.0 = 24$ W.

■ 3 Resistance and resistivity

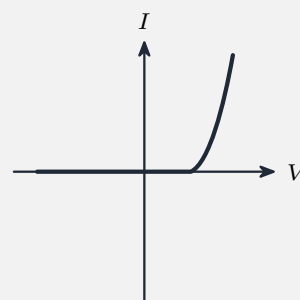
Resistance 电阻 is $R = \frac{V}{I}$. **Ohm's law** 欧姆定律 says that for a metal at constant temperature the current is proportional to the voltage.



ohmic conductor



filament lamp

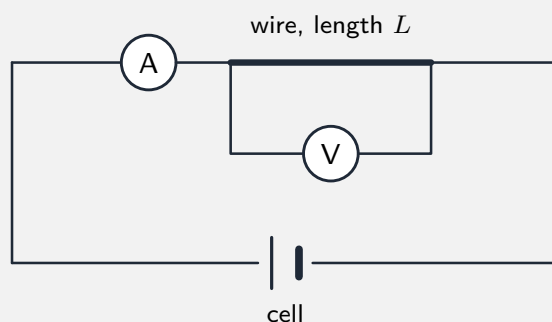


diode

A wire's resistance depends on the material through its **resistivity** 电阻率 ρ :

$$R = \frac{\rho L}{A},$$

where L is length and A is cross-sectional area.



Worked example. A 2.0 m copper wire of area $1.0 \times 10^{-6} \text{ m}^2$ ($\rho = 1.7 \times 10^{-8} \Omega \text{ m}$):

$$R = \frac{\rho L}{A} = \frac{(1.7 \times 10^{-8})(2.0)}{1.0 \times 10^{-6}} = 3.4 \times 10^{-2} \Omega.$$

Watch out: resistivity ρ is a property of the *material* (fixed for copper); resistance R also depends on the wire's length and thickness.

Practice

9.1 A charge of 45 C flows through a lamp in 15 s. Find the current. [2]

9.2 A resistor has 6.0 V across it and a current of 0.50 A. Find its resistance. [2]

9.3 A heater works at 230 V and draws 4.0 A. Find its power. [2]

9.4 A $5.0\ \Omega$ resistor carries a current of $2.0\ \text{A}$. Find the power dissipated using $P = I^2R$. [2]

9.5 A wire has resistivity $1.7 \times 10^{-8}\ \Omega\text{m}$, length $2.0\ \text{m}$ and area $5.0 \times 10^{-7}\ \text{m}^2$. Find its resistance. [2]

9.6 Two wires are of the same material and length, but one is twice as thick. Explain which has the lower resistance. [2]

9.7 Challenge. A wire is stretched to twice its length; its volume stays the same, so its cross-sectional area halves. State the factor by which its resistance changes. [2]