

11.3 Resistance, Resistivity, and Ohm's Law

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS resistance 电阻 • resistivity 电阻率 • ohm's law 欧姆定律 • ohmic 欧姆性
• series 串联

Objective

Build the skills to answer exam questions on **resistance, resistivity, and Ohm's law**.**You must be able to:**

- state **Ohm's law** 欧姆定律, $V = IR$, and identify ohmic behaviour
- relate **resistance** 电阻 to geometry, $R = \frac{\rho L}{A}$
- distinguish **resistivity** 电阻率 (a material property) from resistance (an object property)
- calculate **equivalent resistance** in series and parallel

1 Worked examples

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

■ Ohm's law

 $V = IR$. A device is **ohmic** if R is constant (a straight I - V line).

■ Resistance and resistivity

 $R = \frac{\rho L}{A}$: **resistivity** ρ is a property of the **material**; **resistance** R also depends on the length L and area A of the object.

■ Combining

Series: $R = R_1 + R_2 + \dots$; parallel: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$

2 Practice

2.1 A 12 V supply drives 3.0 A through a resistor. Find its resistance. [2]

2.2 State how doubling a wire's length changes its resistance (same material and area). [1]

2.3 State the difference between resistivity and resistance. [2]

3 Exam-style questions

3.1 Resistance relates to geometry by [1]

- A $\frac{\rho A}{L}$
- B $\frac{\rho L}{A}$
- C $\frac{L}{\rho A}$
- D ρLA

3.2 Resistivity is a property of the [1]

- A object's shape
- B material
- C current
- D voltage

3.3 A wire has resistivity $1.7 \times 10^{-8} \, \Omega \text{ m}$, length 2.0 m, and area $1.0 \times 10^{-6} \text{ m}^2$.

(a) Find its resistance. [2]

(b) The wire is stretched to twice its length (its volume unchanged, so its area halves). Find the new resistance. [2]

Solutions

2.1 $R = \frac{V}{I} = \frac{12}{3.0} = 4.0 \, \Omega$.

2.2 it doubles ($R \propto L$).

2.3 resistivity is a property of the material alone; resistance also depends on the object's length and cross-sectional area.

3.1 B.

3.2 B.

3.3 (a) $R = \frac{\rho L}{A} = \frac{(1.7 \times 10^{-8})(2.0)}{1.0 \times 10^{-6}} = 0.034 \, \Omega$. (b) length $\times 2$ and area $\div 2$ give $R \times 4 = 0.136 \, \Omega$.