

11.5 Compound DC Circuits

Name: _____ Class: _____ Date: _____

Total: 11 marks

Objective

Build the skills to answer exam questions on **compound DC circuits**.

You must be able to:

- combine resistors in **series** 串联 ($R_s = R_1 + R_2 + \dots$) and in **parallel** 并联 ($\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$)
- account for the **internal resistance** 内阻 of a real battery and its terminal voltage
- analyse a circuit with mixed series and parallel sections

1 Worked examples

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

■ Series and parallel

- **Series:** same current, $R_s = R_1 + R_2 + \dots$ (resistance adds up).
- **Parallel:** same voltage, $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$ (total is **less** than the smallest).

■ Internal resistance

A real cell has internal resistance r , so the terminal voltage is $V = \varepsilon - Ir$.

■ Example

Two $4.0\ \Omega$ resistors in parallel: $\frac{1}{R_p} = \frac{1}{4} + \frac{1}{4} \Rightarrow R_p = 2.0\ \Omega$.

2 Practice

2.1 Two $6.0\ \Omega$ resistors are connected in series. Find the total resistance. [1]

2.2 The same two $6.0\ \Omega$ resistors are connected in parallel. Find the total resistance. [2]

2.3 A battery of emf 12 V and internal resistance $0.50\ \Omega$ drives a current of 2.0 A. Find the terminal voltage. [2]

3 Exam-style questions

3.1 Resistors in series have a total resistance equal to [1]

- **A** less than the smallest
 - **B** the sum of the individual resistances
 - **C** their average
 - **D** their product
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3.2 Adding another resistor in parallel makes the total resistance [1]

- **A** larger
 - **B** smaller
 - **C** unchanged
 - **D** infinite
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3.3 A $3.0\ \Omega$ and a $6.0\ \Omega$ resistor are in parallel across a 12 V supply.

(a) Find the combined resistance. [2]

(b) Find the total current drawn from the supply. [2]

4 Go further

- work through the **11.5 Compound DC Circuits** lesson on the **Learn** page;
- read the **Electric Circuits** section of the AP Physics 2 handout on the **Know** page.

Solutions

2.1 $R_s = 6.0 + 6.0 = 12\ \Omega$.

2.2 $\frac{1}{R_p} = \frac{1}{6.0} + \frac{1}{6.0} = \frac{2}{6.0} \Rightarrow R_p = 3.0\ \Omega$.

2.3 $V = \varepsilon - Ir = 12 - 2.0(0.50) = 11\ \text{V}$.

3.1 B.

3.2 B.

3.3 (a) $\frac{1}{R_p} = \frac{1}{3.0} + \frac{1}{6.0} = \frac{3}{6.0} \Rightarrow R_p = 2.0\ \Omega$. (b) $I = \frac{V}{R_p} = \frac{12}{2.0} = 6.0\ \text{A}$.