LESSON MAKER PRO

Power the Circuit

Use Ohm's law to analyze series and parallel circuits.

HIGH SCHOOL · PS.3

PS.3 "Construct an explanation of the ways in which modern science uses both magnetic and electric concepts to create usable products. a. Construct an argument using evidence to support the claim that field forces exist between objects and act..."

NAME _____ DATE _____

CURRENT, VOLTAGE, AND RESISTANCE

Ohm's law is V = I × R, where V is voltage in volts, I is current in amperes, and R is resistance in ohms. In series, resistances add, and the same current passes through each load. In parallel, each branch has the full supply voltage, so find each branch's current and add the currents to get the total.

WORKED EXAMPLE

A 15 V supply powers two resistors in series, one 5 Ω and one 10 Ω. What is the circuit current?

1. Add the series resistances: R = 5 + 10 = 15 Ω.
2. Use Ohm's law: I = V/R = 15/15 = 1 A.

Answer: 1 A

PRACTICE 6 problems

1 A single 6 Ω resistor is connected to an 18 V supply. What current flows through it?

ANSWER _____

2 A circuit has a 24 V supply and a current of 3 A. What is its resistance?

ANSWER _____

3 A current of 4 A flows through a 6 Ω resistor. What is the voltage across it?

ANSWER _____

4 A 6 Ω resistor and a 3 Ω resistor are connected in series to an 18 V supply. What is the circuit current?

ANSWER _____

5 A 24 V supply powers the two resistors in series shown in the table. What is the circuit current, and what is the voltage across resistor B?

SERIES CIRCUIT

Resistor	Resistance
A	4 Ω
B	8 Ω

ANSWER _____

_____

6 The two resistors in the table are connected in parallel to a 12 V supply. What is the total current?

PARALLEL CIRCUIT

Branch	Resistance
A	6 Ω
B	3 Ω

ANSWER _____

APPLY IT Show your work

1 At a club's phone-charging station, two test loads are connected in parallel to an 18 V supply. One has a resistance of 6 Ω, and the other has a resistance of 9 Ω. What total current do the loads draw?

WORK SPACE

ANSWER _____

2 A heated jacket prototype uses two heating sections connected in series to a 12 V battery. Their resistances are 2 Ω and 4 Ω. What current flows through both sections, and what is the voltage across the 4 Ω section?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A maker tests a 30 V power supply using the circuit in the table. Resistor A is in series with a group made of branches B and C in parallel. What is the total current, and what current flows through each parallel branch? Show your reasoning.

TEST CIRCUIT

Part	Connection	Resistance
A	Series resistor	6 Ω
B	Parallel branch	8 Ω
C	Parallel branch	8 Ω

WORK SPACE AND ANSWER

Power the Circuit

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A single 6 Ω resistor is connected to an 18 V supply. What current flows through it?	**3 A**
2	A circuit has a 24 V supply and a current of 3 A. What is its resistance?	**8 Ω**
3	A current of 4 A flows through a 6 Ω resistor. What is the voltage across it?	**24 V**
4	A 6 Ω resistor and a 3 Ω resistor are connected in series to an 18 V supply. What is the circuit current?	**2 A**
5	A 24 V supply powers the two resistors in series shown in the table. What is the circuit current, and what is the voltage across resistor B?	**Circuit current: 2 A; voltage across B: 16 V**
6	The two resistors in the table are connected in parallel to a 12 V supply. What is the total current?	**6 A**

PART 2 · APPLY IT

1. **5 A** Each load has 18 V across it. Their currents are 18/6 = 3 A and 18/9 = 2 A, for a total of 5 A.
2. **Current: 2 A; voltage across the 4 Ω section: 8 V** The total resistance is 2 + 4 = 6 Ω, so the current is 12/6 = 2 A. The voltage across the 4 Ω section is 2 × 4 = 8 V.

CHALLENGE

The parallel group has a resistance of 4 Ω because two equal 8 Ω branches have half that resistance. Total resistance is 6 + 4 = 10 Ω, so total current is 30/10 = 3 A. The voltage across the parallel group is 3 × 4 = 12 V, giving each branch a current of 12/8 = 1.5 A.

Accept equivalent Ohm's law calculations and correct answers with units. In the challenge, students may instead divide the 3 A total current equally between the identical parallel branches.