LESSON MAKER PRO

Circuit Number Sense

Find voltage, current, and resistance in connected loads.

HIGH SCHOOL · P.6.d

P.6.d "Use mathematics and computational thinking to determine the voltage, current, and resistance for an entire circuit and at each resistor or load."

NAME _____ DATE _____

CIRCUIT RULES

Use V = IR for each resistor and for the whole circuit. In series, current is the same everywhere, resistances add, and resistor voltages add to the source voltage. In parallel, branches share a voltage, branch currents add, and 1/Rtotal = 1/R1 + 1/R2.

WORKED EXAMPLE

A 91 V source powers a 7 Ω resistor and a 6 Ω resistor in series. Find the total resistance and current, then the voltage across each resistor.

1. Rtotal = 7 Ω + 6 Ω = 13 Ω.
2. Itotal = 91 V / 13 Ω = 7 A. Each resistor carries 7 A.
3. V across 7 Ω = (7 A)(7 Ω) = 49 V.
4. V across 6 Ω = (7 A)(6 Ω) = 42 V. The voltages add to 91 V.

Answer: Total resistance: 13 Ω; total current: 7 A; voltage across 7 Ω: 49 V; voltage across 6 Ω: 42 V.

PRACTICE 6 problems

1 A 24 V source powers 8 Ω and 16 Ω resistors in series. Find the total resistance and current.

ANSWER _____

2 A 30 V source powers 10 Ω and 20 Ω resistors in series. Find the voltage across each resistor.

ANSWER _____

3 A 18 V source powers 9 Ω and 18 Ω resistors in parallel. Find the current through each resistor.

ANSWER _____

4 A 36 V source powers 12 Ω and 36 Ω resistors in parallel. Find the total current and equivalent resistance.

ANSWER _____

5 Two resistors are in series on a 40 V source. The current is 2 A, and one resistor is 15 Ω. Find the total resistance and the resistance of the other resistor.

ANSWER _____

6 Two resistors are in parallel on a 48 V source. The total current is 10 A, and one resistor is 8 Ω. Find the current through the other resistor and its resistance.

ANSWER _____

APPLY IT Show your work

1 A model of a gaming desk lamp has two resistive loads, 5 Ω and 10 Ω, connected in series to a 30 V supply. Find the total resistance and current, then the voltage across each load.

WORK SPACE

ANSWER _____

2 A portable fan has two motors modeled as 12 Ω and 24 Ω loads connected in parallel to a 12 V battery. Find the voltage and current at each motor, then the total current and equivalent resistance.

WORK SPACE

ANSWER _____

CHALLENGE One step up

A 36 V source powers a 4 Ω resistor in series with a parallel pair of 12 Ω and 6 Ω resistors. Find the equivalent resistance and total current. Then find the voltage and current at each resistor.

WORK SPACE AND ANSWER

Circuit Number Sense

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A 24 V source powers 8 Ω and 16 Ω resistors in series. Find the total resistance and current.	**24 Ω; 1 A**
2	A 30 V source powers 10 Ω and 20 Ω resistors in series. Find the voltage across each resistor.	**10 Ω resistor: 10 V; 20 Ω resistor: 20 V**
3	A 18 V source powers 9 Ω and 18 Ω resistors in parallel. Find the current through each resistor.	**9 Ω resistor: 2 A; 18 Ω resistor: 1 A**
4	A 36 V source powers 12 Ω and 36 Ω resistors in parallel. Find the total current and equivalent resistance.	**4 A; 9 Ω**
5	Two resistors are in series on a 40 V source. The current is 2 A, and one resistor is 15 Ω. Find the total resistance and the resistance of the other resistor.	**Total resistance: 20 Ω; other resistor: 5 Ω**
6	Two resistors are in parallel on a 48 V source. The total current is 10 A, and one resistor is 8 Ω. Find the current through the other resistor and its resistance.	**Other resistor: 4 A and 12 Ω**

PART 2 · APPLY IT

1. **Total resistance: 15 Ω; total current: 2 A; voltage across 5 Ω: 10 V; voltage across 10 Ω: 20 V.** Add the resistances to get 15 Ω, then divide 30 V by 15 Ω to get 2 A. Multiply 2 A by each load's resistance to find its voltage.
2. **12 Ω motor: 12 V and 1 A; 24 Ω motor: 12 V and 1/2 A; total current: 3/2 A; equivalent resistance: 8 Ω.** Each motor has 12 V across it, so divide 12 V by each resistance to find its current. Add the currents, then divide 12 V by the total current to get 8 Ω.

CHALLENGE

Equivalent resistance: 8 Ω; total current: 9/2 A. At 4 Ω: 18 V and 9/2 A. At 12 Ω: 18 V and 3/2 A. At 6 Ω: 18 V and 3 A.

Accept equivalent fractions or decimals with correct units. In the challenge, the parallel pair has an equivalent resistance of 4 Ω and shares 18 V.