Greenhouse Circuit Test

Trace current and voltage to compare two heater layouts.

HS-PSII-5.5 "Explain and analyze simple arrangements of electrical components in series and parallel DC circuits in terms of current, resistance, voltage, and power. Use Ohm's and Kirchhoff's laws to analyze DC circuits."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the current and voltage rules for each layout, circle the equations, and number the three steps for finding the battery's power in the parallel layout.

Two Ways to Warm a Greenhouse

1 A student is testing two small resistive heaters for a model greenhouse. The student connects the same battery and two heaters in two ways: first end to end, then on separate branches. Assume the battery holds a constant voltage, the wires have negligible resistance, and each heater keeps the resistance shown in the data table.

GREENHOUSE HEATER TEST DATA

Part	Value
Battery	12 V
Heater A	6 Ω
Heater B	12 Ω

2 In a series circuit, current has just one path, so the same current passes through both heaters. Add their resistances to find the total resistance, then use Ohm's law, V = IR, to find the current from the battery. Each heater's voltage drop is its current multiplied by its resistance. Kirchhoff's loop law says the drops add to the battery voltage.

3 In a parallel circuit, both heaters connect across the battery, so each branch has the full battery voltage. Ohm's law gives each branch current. Kirchhoff's junction law says those currents add to the current leaving the battery. The battery's power output is P = VI, using battery voltage and total current. Compare both layouts before deciding which draws more power.

2 ANSWER WITH EVIDENCE

Use the passage

1. With the heaters in series, what are their total resistance and the current from the battery? Show your calculation.

2. In the series layout, find the voltage drop across each heater. How do the drops check Kirchhoff's loop law?

3. With the heaters in parallel, what current flows through each heater and from the battery? Show how Kirchhoff's junction law connects the three currents.

4. Calculate the battery's power output for each layout. Which layout draws more power, and why?

3 YOUR TURN

Your own words

Design a parallel circuit using a 12 V battery and two identical heaters that draws exactly 24 W from the battery. In three or four sentences, give each heater's resistance and current, the total current, and explain how Kirchhoff's junction law and P = VI check your design.

ANSWER KEY

Greenhouse Circuit Test

PART 1 · READ AND MARK

Underline the current and voltage rules for each layout, circle the equations, and number the three steps for finding the battery's power in the parallel layout. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	With the heaters in series, what are their total resistance and the current from the battery? Show your calculation.	**R = 6 Ω + 12 Ω = 18 Ω; I = 12 V ÷ 18 Ω = 2/3 A.**
2	In the series layout, find the voltage drop across each heater. How do the drops check Kirchhoff's loop law?	**Heater A: (2/3 A)(6 Ω) = 4 V. Heater B: (2/3 A)(12 Ω) = 8 V. The drops add to the battery's 12 V.**
3	With the heaters in parallel, what current flows through each heater and from the battery? Show how Kirchhoff's junction law connects the three currents.	**Heater A draws 12 V ÷ 6 Ω = 2 A; heater B draws 12 V ÷ 12 Ω = 1 A. The battery supplies 2 A + 1 A = 3 A.**
4	Calculate the battery's power output for each layout. Which layout draws more power, and why?	**Series: (12 V)(2/3 A) = 8 W. Parallel: (12 V)(3 A) = 36 W. Parallel draws more power because it draws more total current at the same battery voltage.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Each heater needs a resistance of 12 Ω because each branch has 12 V and must draw 1 A. Kirchhoff's junction law gives 1 A + 1 A = 2 A from the battery. The battery supplies P = VI = (12 V)(2 A) = 24 W.

Accept 0.667 A or 0.67 A for the series current, with reasonable rounding in calculations that use it. The open task requires two 12 Ω heaters in parallel, each drawing 1 A.