

Exercise walk-through

10.1

Current, potential difference and resistance

International Baccalaureate · IB Diploma · Physics · HL

10.1 Current, potential difference and resistance

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS current • potential difference

Objective

Current, potential difference and resistance. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

1 Key knowledge and worked examples

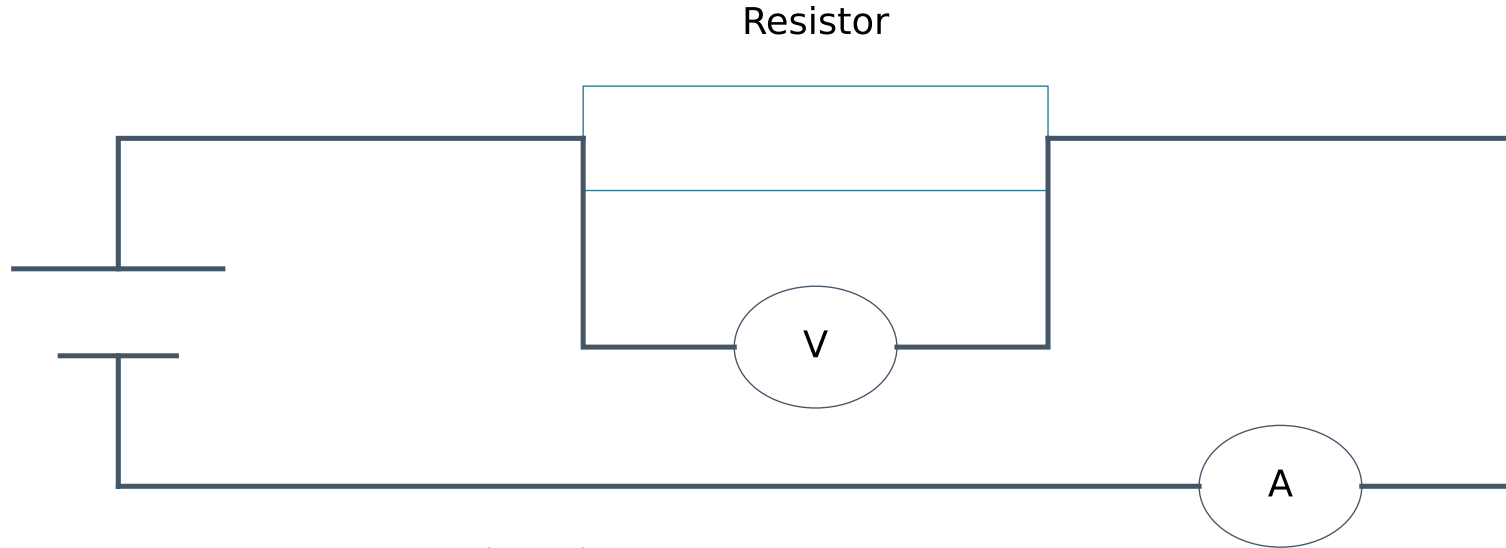
■ What would explain this observation?

- A lamp becomes dimmer when another is added in series. **Current** and energy transfer depend on the whole circuit, not only one lamp.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- Current is charge passing per time. **Potential difference** is energy transferred per charge. Resistance is potential difference divided by current for a stated operating point.

- current: Rate of flow of charge; potential difference: Energy transferred per unit charge.



DC supply in series

Ammeter in series; voltmeter across resistor

■ Choose evidence that can test it

- Current is the same through components in series. Potential differences add around the series path. In parallel, branches share the same potential difference, while branch currents sum at a junction.
- Place an ammeter in series and a voltmeter in parallel. For an I-V investigation, change voltage in steps, reverse polarity when appropriate and limit current to reduce heating.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions

fit this case, then rearrange before substitution.

- Known: a resistor has 6.0 V across it and carries 0.30 A. Use $R = V/I$. $R = 6.0/0.30 = 20$ ohms. Power = VI. Power = $6.0 \times 0.30 = 1.8$ W. These quantities describe the same operating point.

Example:

A component has 12 V across it and carries 0.40 A. Find resistance. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Current is not used up by a lamp. A filament heats up, so its resistance need not remain constant as voltage changes.

- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A lamp uses up electric current as charge passes through it. This claim is false: Current is not used up by a lamp. A filament heats up, so its resistance need not remain constant as voltage changes.

Key:

Current, potential difference and resistance: Current is the same through components in series. Potential differences add around the series path. In parallel, branches share the

same potential difference, while branch currents sum at a junction.

Exercises 2.1·2.3

2.1 How is a voltmeter connected to measure voltage across a resistor? Choose one answer.

- **A** In parallel with the resistor
- **B** In series only
- **C** Across the ammeter only

[1]

2.2 A component has 12 V across it and carries 0.40 A. Find resistance. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: A lamp uses up electric current as charge passes through it.

[2]

Exercises 2.1-2.3

2.1 How is a voltmeter connected to measure voltage across a resistor? Choose one answer.

- **A** In parallel with the resistor
- **B** In series only
- **C** Across the ammeter only

[1]

2.1 A Current is the same through components in series. Potential differences add around the series path. In parallel, branches share the same potential difference, while branch currents sum at a junction.

2.2 A component has 12 V across it and carries 0.40 A. Find resistance. Show the relation, substitution and units. [2]

2.2 $R = V/I = 12/0.40 = 30 \, \Omega$.

2.3 Decide whether this claim is true and justify: A lamp uses up electric current as charge passes through it. [2]

2.3 False. Current is not used up by a lamp. A filament heats up, so its resistance need not remain constant as voltage changes.

Exercises 2.4·3.1

2.4 Rate of flow of charge: write the technical term.

[1]

3 Exam-style questions

3.1 Connect two $30\ \Omega$ resistors in parallel across 12 V. Find total resistance, total current and power; compare one resistor alone.

[4]

Exercises 2.4·3.1

2.4 Rate of flow of charge: write the technical term.

[1]

3 Exam-style questions

2.4 current. current means Rate of flow of charge.

3.1 Connect two $30\ \Omega$ resistors in parallel across 12 V. Find total resistance, total current and power; compare one resistor alone.

[4]

3.1 $R=15\ \Omega$, $I=0.80\ \text{A}$, $P=9.6\ \text{W}$. Each branch draws 0.40 A and 4.8 W. One resistor alone draws 0.40 A and 4.8 W; the same voltage does not imply the same total current.