OHM’S LAW

A Self-Study Tutorial

V = I × R

Voltage • Current • Resistance

Calculate any one quantity when you know the other two

Name: _____

Date: _____

Section 1: What Is Ohm's Law?

Ohm's Law is one of the most important and widely used principles in electricity. It describes the relationship between three key quantities in any electrical circuit:

Quantity	Symbol / Unit	What it means
Voltage	V (volts)	The electrical 'push' or pressure that drives current around a circuit
Current	I (amperes)	The flow of electric charge — how much electricity moves per second
Resistance	R (ohms, Ω)	The opposition to current flow — how hard the circuit resists the push

Ohm's Law — The Core Statement

The voltage across a conductor is directly proportional to the current flowing through it, provided temperature remains constant. Written as a formula: **V = I × R**

In plain English: if you double the voltage and keep resistance the same, the current doubles. If you double the resistance and keep voltage the same, the current halves.

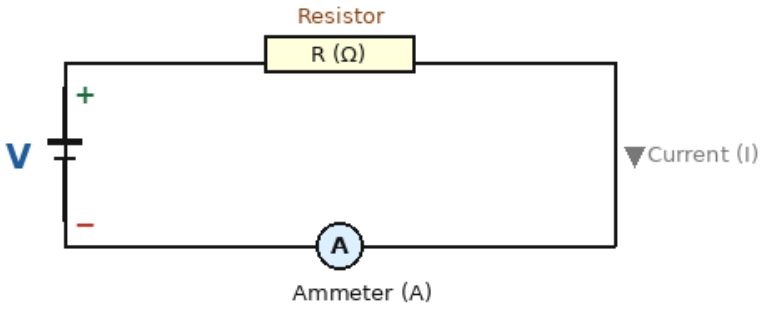

Figure 1: A basic series circuit showing V, I and R

Section 2: The Ohm’s Law Triangle

The Ohm’s Law triangle is a simple tool that lets you instantly see which formula to use, depending on which quantity you need to find.

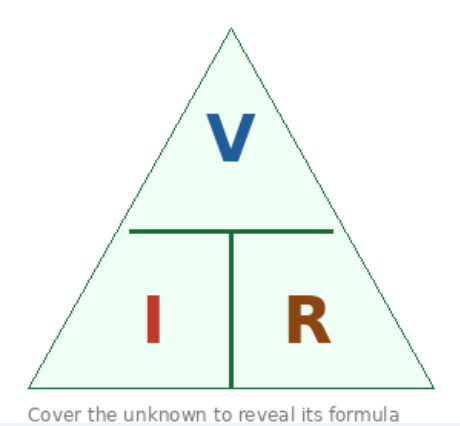

Figure 2: The Ohm’s Law triangle

How to use the triangle

1. Find the letter you want to calculate.
2. Cover it with your finger.
3. What remains shows you the formula:

Cover	Formula revealed
V	V = I × R
I	I = V ÷ R
R	R = V ÷ I

The Three Formulae — at a glance

V = I × R (to find Voltage) **I = V ÷ R** (to find Current) **R = V ÷ I** (to find Resistance)

Section 3: Calculating Each Quantity — Step by Step

3.1 Calculating Voltage (V = I × R)

Use when: you know the current (I) and the resistance (R) and need to find the voltage (V).

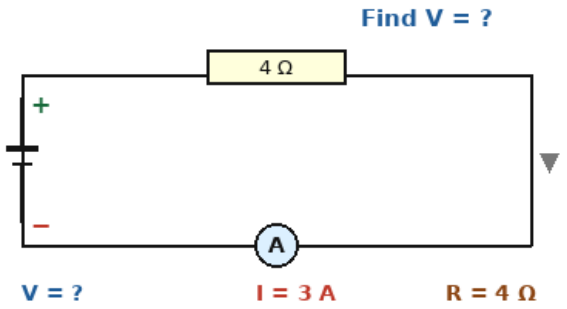

Figure 3: Find the voltage across a 4 Ω resistor with 3 A flowing through it

Worked Example — Finding Voltage

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

1. Write down what you know: I = 3 A, R = 4 Ω
2. Choose the correct formula: V = I × R
3. Substitute the values: V = 3 × 4 = **12 V**
4. State the answer with its unit: The voltage is 12 volts.

Check your answer

Does it make sense? Larger current or larger resistance should give a larger voltage. Here, both values are moderate, and 12 V is a reasonable result (a typical car battery is 12 V).

3.2 Calculating Current (I = V ÷ R)

Use when: you know the voltage (V) and the resistance (R) and need to find the current (I).

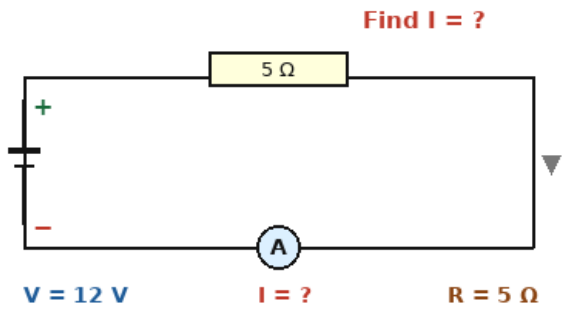

Figure 4: Find the current through a 5 Ω resistor connected to a 12 V supply

Worked Example — Finding Current

A 12 V battery is connected to a 5 Ω resistor. What current flows in the circuit?

1. Write down what you know: V = 12 V, R = 5 Ω
2. Choose the correct formula: I = V ÷ R
3. Substitute the values: I = 12 ÷ 5 = **2.4 A**
4. State the answer with its unit: The current is 2.4 amperes.

Check your answer

A 12 V source pushing through 5 Ω should give a moderate current — 2.4 A is reasonable. If resistance were doubled to 10 Ω, current would halve to 1.2 A.

3.3 Calculating Resistance (R = V ÷ I)

Use when: you know the voltage (V) and the current (I) and need to find the resistance (R).

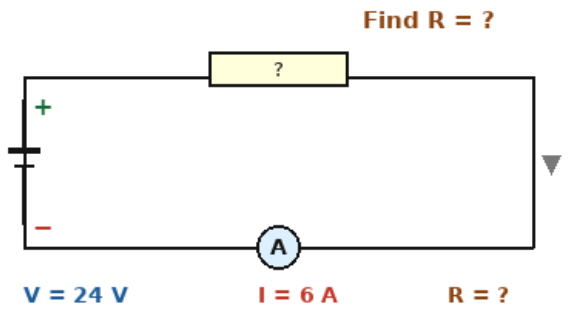

Figure 5: Find the resistance in a circuit with 24 V supply and 6 A current

Worked Example — Finding Resistance

A circuit has a 24 V power supply and a current of 6 A flows. What is the resistance?

1. Write down what you know: V = 24 V, I = 6 A
2. Choose the correct formula: R = V ÷ I
3. Substitute the values: R = 24 ÷ 6 = **4 Ω**
4. State the answer with its unit: The resistance is 4 ohms.

> **The Four-Step Method — use it every time**
>
> **Step 1:** Write down the known values with units. **Step 2:** Select the correct formula from the triangle. **Step 3:** Substitute numbers into the formula and calculate. **Step 4:** Write the answer with its correct unit (V, A, or Ω).

Section 4: Activities

Activity 1: Name the Formula

For each circuit, state which formula you would use and circle the quantity you are finding.

Known values	Find…	Formula to use
V = 20 V, R = 4 Ω	I = ?	
I = 5 A, R = 6 Ω	V = ?	
V = 15 V, I = 3 A	R = ?	
V = 9 V, R = 3 Ω	I = ?	
I = 2 A, R = 10 Ω	V = ?	

Activity 2: Calculate and Show Your Working

Use the four-step method for each question. Show all working clearly.

Question 1 — Find the Voltage

A resistor of 8 Ω has a current of 2 A flowing through it. Calculate the voltage.

Step 1 — Known values:

_____

Step 2 — Formula:

_____

Step 3 — Calculation:

_____

Step 4 — Answer:

_____

Question 2 — Find the Current

A 30 V supply is connected across a 6 Ω resistor. Calculate the current.

Step 1 — Known values:

_____

Step 2 — Formula:

_____

Step 3 — Calculation:

_____

Step 4 — Answer:

_____

Question 3 — Find the Resistance

A current of 4 A flows when a voltage of 20 V is applied. Find the resistance.

Step 1 — Known values:

_____

Step 2 — Formula:

_____

Step 3 — Calculation:

_____

Step 4 — Answer:

_____

Activity 3: Real-World Scenarios

Scenario 1 — The Torch Bulb

A torch bulb has a resistance of 10 Ω. It is connected to a 6 V battery.

Question: What current flows through the bulb?

Working:

_____

Answer: _____

Scenario 2 — The Electric Heater

An electric heater draws a current of 5 A from a 230 V mains supply.

Question: What is the resistance of the heater element?

Working:

_____

Answer: _____

Scenario 3 — The Car Battery

A car starter motor has a resistance of 0.5 Ω and draws a current of 24 A.

Question: What voltage does the battery supply to the starter motor?

Working:

_____

Answer: _____

Activity 4: Sketch the Circuit

For each question below, draw a simple circuit sketch in the box provided, label the known values, and calculate the missing quantity.

Problem A: V = 18 V, R = 9 Ω. Find I.	Problem B: I = 3 A, R = 7 Ω. Find V.
Circuit sketch: Answer: _____	Circuit sketch: Answer: _____

Activity 5: True or False?

Circle TRUE or FALSE. Write a correction on the line if the statement is false.

1. If voltage is doubled and resistance stays the same, current doubles. TRUE / FALSE

Correction: _____

2. The formula for finding resistance is R = I × V. TRUE / FALSE

Correction: _____

3. Ohm's Law applies when temperature is kept constant. TRUE / FALSE

Correction: _____

4. In the triangle, covering V reveals I × R. TRUE / FALSE

Correction: _____

Section 5: Self-Check Quiz

Instructions

Answer all questions without referring to earlier sections. When finished, turn to Section 6 for the answer key. Award yourself the points shown for each correct answer.

Part A: Multiple Choice (1 point each)

1. Ohm's Law states that V = :

a) a) V + R
b) b) I × R
c) c) I ÷ R
d) d) R ÷ I

2. A circuit has V = 10 V and R = 2 Ω. The current is:

a) a) 20 A
b) b) 0.2 A
c) c) 5 A
d) d) 8 A

3. The unit of resistance is the:

a) a) volt
b) b) ampere
c) c) watt
d) d) ohm

4. In the Ohm's Law triangle, covering I reveals:

a) a) V ÷ R
b) b) V × R
c) c) R ÷ V
d) d) V + R

5. If resistance doubles and voltage stays the same, the current:

a) a) doubles
b) b) stays the same
c) c) halves
d) d) becomes zero

Part B: Short Answer (2 points each)

6. A 9 V battery is connected to a 3 Ω resistor. Calculate the current.

Working: _____ Answer: _____

7. A current of 2 A flows through a 7 Ω resistor. What is the voltage?

Working: _____ Answer: _____

8. A 12 V circuit has a current of 4 A. What is the resistance?

Working: _____ Answer: _____

9. Write the three rearrangements of Ohm's Law.

V = _____ I = _____ R = _____

10. State Ohm's Law in one sentence (no formula).

_____
_____

My Score: _____ / 15

Section 6: Answer Key

For Students

Only turn to this page after completing the quiz. Reviewing your mistakes is the most valuable part of self-study!

Activity 1: Name the Formula — Answers

Known values	Find	Formula
V=20 V, R=4 Ω	I	I = V ÷ R = 5 A
I=5 A, R=6 Ω	V	V = I × R = 30 V
V=15 V, I=3 A	R	R = V ÷ I = 5 Ω
V=9 V, R=3 Ω	I	I = V ÷ R = 3 A
I=2 A, R=10 Ω	V	V = I × R = 20 V

Activity 2: Calculate and Show Your Working — Answers

Q1 — Voltage

V = I × R = 2 × 8 = 16 V

Q2 — Current

I = V ÷ R = 30 ÷ 6 = 5 A

Q3 — Resistance

R = V ÷ I = 20 ÷ 4 = 5 Ω

Activity 3: Real-World Scenarios — Answers

Scenario 1

I = V ÷ R = 6 ÷ 10 = 0.6 A. A current of 0.6 amperes flows through the bulb.

Scenario 2

R = V ÷ I = 230 ÷ 5 = 46 Ω. The heater element has a resistance of 46 ohms.

Scenario 3

V = I × R = 24 × 0.5 = 12 V. The battery supplies 12 volts to the starter motor.

Activity 5: True or False? — Answers

1. TRUE
2. FALSE — The formula for resistance is R = V ÷ I (not V × I).
3. TRUE
4. TRUE

Quiz Answer Key

Q	Answer	Q	Answer
1	b) I × R	**6**	I = 9÷3 = 3 A
2	c) 5 A	**7**	V = 2×7 = 14 V
3	d) ohm	**8**	R = 12÷4 = 3 Ω
4	a) V ÷ R	**9**	V=I×R, I=V÷R, R=V÷I
5	c) halves	**10**	Voltage = current × resistance (at constant temp)

Scoring Guide

Score	Level	Next Step
13–15	Excellent!	Move on to series & parallel circuits
9–12	Good — almost there	Review the sections for questions you missed
0–8	Keep practising	Re-read Sections 2 & 3 and redo Activities 2 & 3

Well done for completing this unit! ⚡