NCFE Level 1 / 2 Technical Award in Engineering

CA2 - Applied science and mathematics in engineering

2.2.1 SI Units of Measurement - equations
Electricity
Lesson 6

Monday, 20 July 2026

Connect

Title

SI Units – Electricity equations

Today's Targets

Identify equations for electricity

Select which equations from a given list would be used for a specified engineering product or project

Connect:

w = m x g (weight = mass x gravity)
of 15290 grams ÷ 1000 = 15.29 kg (1)
15.29 kg x 9.81ms2 = 150 N (rounded from 149.9949 N) (1)

Millicandela

Mass	kg
Distance	m
Time	s
Current	A
Amount of substance	mol
Temperature	K
Light intensity	cd

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Today's title: SI Units – Electricity equations

Today's Targets

Identify equations for electricity

Select which equations from a given list

Today's Learning:

You must be able to:

Define current and voltage.

Define resistance and power.

Identify the units for current, voltage, power, and resistance.

Apply the correct formula to solve engineering problems.

You may also be able to:

Use a multimeter to measure the battery voltages

Prior Learning

CA1 Engineering disciplines

Future Learning

CA3

Reading engineering drawings

Literacy

International System (SI) Equation

Electricity Current Voltage Resistance Power

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Today's title: 2.2: Electricity equations

Your target

- Identify equations for electricity
- Select which equations from a given list would be used for a specified engineering product or project

Steps to success

- Apply data to a selected equation to complete a calculation for a specified engineering product or project

Path to progress

- Justify the selection of the equation
- Assess whether the correct calculation has been used

Key terms

International System (SI)
Equation
Electricity

WHY NOW?

Activate

Introduction

It is important to understand how mathematical and scientific equations are used in engineering disciplines to calculate the properties of:

- Electricity

In the development of products and projects.

The equations provided are not exhaustive, however, they are the ones most relevant to this level of study.

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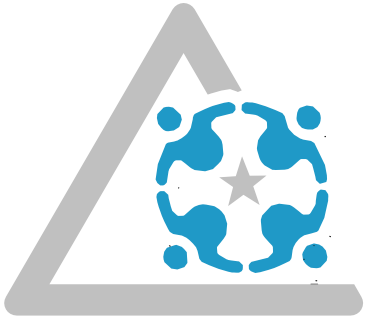
Electricity

What is the difference between current, voltage and resistance? How are they related?

Discuss in your table groups



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Electricity

It is important to begin by understanding the basics of voltage, current, and resistance. The concept of electricity can be difficult to understand as we can't see it. Electricity is the **movement of electrons and electrons create charge**.

We can use this charge to power our electronics and electricals.

Voltage is the difference in charge between two points.
Current is the rate at which charge is flowing.
Resistance is a measure of the opposition to current flow in an electrical circuit
Power is the rate of change of doing work.

Write these definitions in your work books.

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Electricity

power = voltage x current **P = V x I**

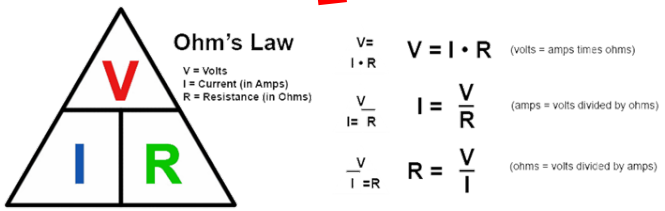
voltage = current x resistance **V = I x R**

current = power ÷ voltage **I = P ÷ V**

resistance = voltage ÷ current **R = V ÷ I**

There are many ways in which these equations would be applied throughout electrical and electronic engineering. However, they would also feature in the development of electrical parts in many other disciplines of engineering.

?



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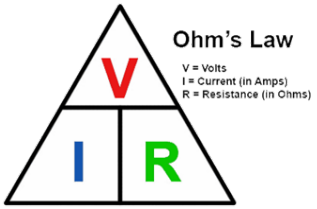
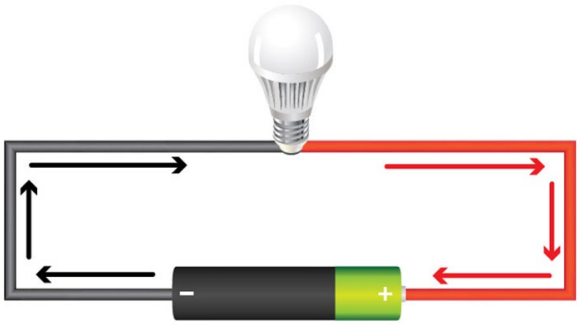
Electricity: Voltage



voltage = current x resistance **V = I x R**

Voltage, **provided by an energy source such as a battery**, is what causes current to flow.

Voltage is the pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop, enabling them to do work such as illuminating a light.



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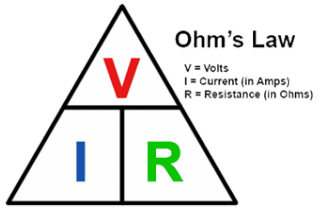
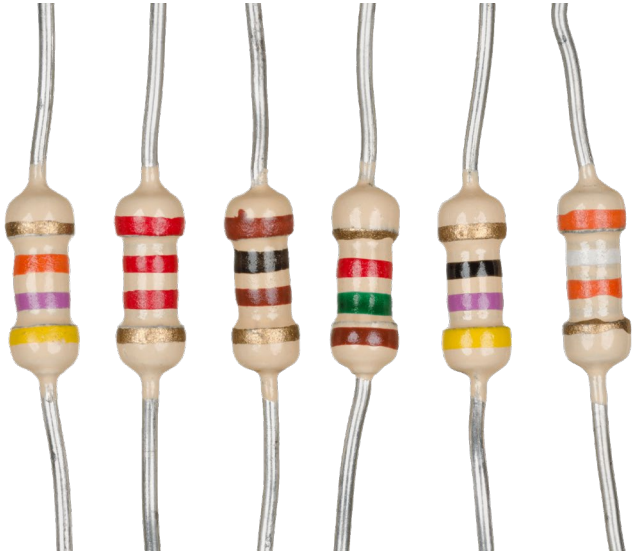
Electricity: Resistance



resistance = voltage ÷ current **R = V ÷ I**

A resistor is a component which reduces the flow of electrical current. The larger the resistor value the more the flow of current is reduced by.

Resistor values are given is **ohms Ω** and is referred to as resistance.



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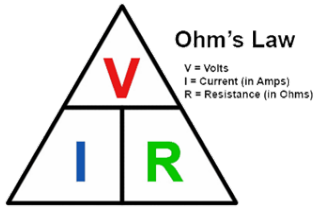
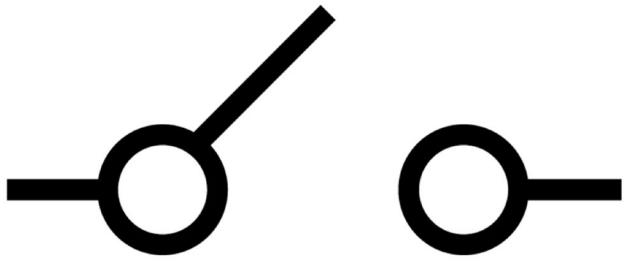
Electricity: Current



current = power ÷ voltage **I = P ÷ V**

Current is a measure of how much electric charge flows through a circuit. The more charge that flows, the bigger the current. No current can flow if the circuit is broken, for example, when a switch is open.



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Electricity: Power

power = voltage x current **P = V x I**

Electric power is the rate at which electrical energy is transferred by an electric circuit. The SI unit of power is the watt, one joule per second.

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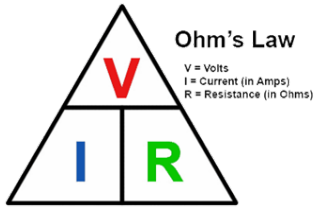
Question time - voltage



Using the equations and in your pairs, can you calculate the corresponding <u>voltage</u>:

I = 5 Amps	R = 1 Ohm
I = 3 Amps	R = 4 Ohm
I = 2 Amps	R = 3 Ohm

electrical:

power	P = V x I	power = voltage x current
voltage	V = I x R	voltage = current x resistance
current	I = P ÷ V	current = power ÷ voltage
resistance	R = V ÷ I	resistance = voltage ÷ current

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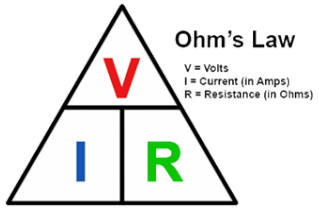
Activate

Question time – voltage - *answers*



Using the equations and in your pairs, can you calculate the corresponding <u>voltage</u>:

I = 5 Amps	R = 1 Ohm	**V = 5**
I = 3 Amps	R = 4 Ohm	**V = 12**
I = 2 Amps	R = 3 Ohm	**V = 6**

electrical:

power	P = V x I	power = voltage x current
voltage	V = I x R	voltage = current x resistance
current	I = P ÷ V	current = power ÷ voltage
resistance	R = V ÷ I	resistance = voltage ÷ current

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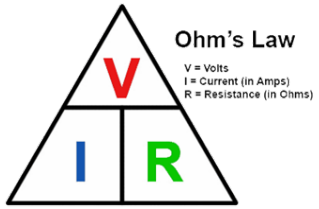
Question time - current



Using the equations and in your pairs, can you calculate the corresponding <u>current</u>:

V = 5 Volts	R = 1 Ohm
V = 12 Volts	R = 4 Ohm
V = 24 Volts	R = 12 Ohm

electrical:

○ power	P = V x I	power = voltage x current
○ voltage	V = I x R	voltage = current x resistance
○ current	I = P ÷ V	current = power ÷ voltage
○ resistance	R = V ÷ I	resistance = voltage ÷ current

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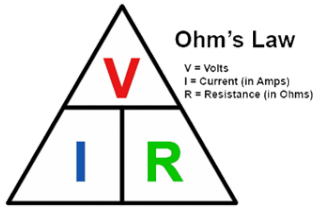
Activate

Question time - current - *answers*

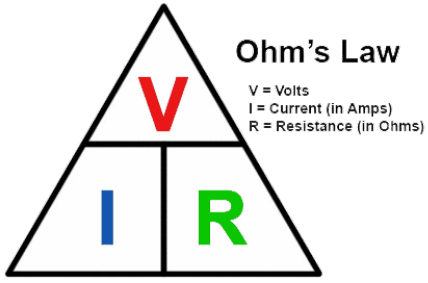


Using the equations and in your pairs, can you calculate the corresponding <u>current</u>:

V = 5 Volts	R = 1 Ohm	**I = 5A**
V = 12 Volts	R = 4 Ohm	**I = 3A**
V = 24 Volts	R = 12 Ohm	**I = 2A**

electrical:

power	P = V x I	power = voltage x current
voltage	V = I x R	voltage = current x resistance
current	I = P ÷ V	current = power ÷ voltage
resistance	R = V ÷ I	resistance = voltage ÷ current



$V = I \cdot R$ (volts = amps times ohms)

$I = \frac{V}{R}$ (amps = volts divided by ohms)

$R = \frac{V}{I}$ (ohms = volts divided by amps)

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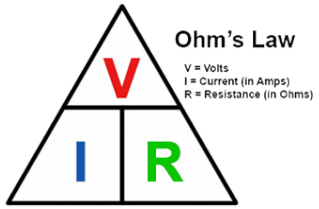
Activate

Question time - resistance



Using the equations and in your pairs, can you calculate the corresponding <u>resistance</u>:

V = 5 Volts	I = 5 Amps
V = 3 Volts	I = 6 Amps
V = 50 Volts	I = 10 Amps

electrical:

power	P = V x I	power = voltage x current
voltage	V = I x R	voltage = current x resistance
current	I = P ÷ V	current = power ÷ voltage
resistance	R = V ÷ I	resistance = voltage ÷ current

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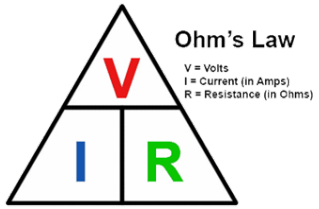
Activate

Question time - resistance *- answers*



Using the equations and in your pairs, can you calculate the corresponding <u>resistance</u>:

V = 5 Volts	I = 5 Amps	**R = 1 Ohm**
V = 3 Volts	I = 6 Amps	**R = 0.5 Ohm**
V = 50 Volts	I = 10 Amps	**R = 5 Ohm**

electrical:

power	P = V x I	power = voltage x current
voltage	V = I x R	voltage = current x resistance
current	I = P ÷ V	current = power ÷ voltage
resistance	R = V ÷ I	resistance = voltage ÷ current

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Demonstrate

1. Calculate the **voltage** in the following circuits:

I = 2A	R = 10 Ohms	V=
I = 5A	R = 2 Ohms	V=
I = 100A	R = 2.3 Ohms	V=

2. Calculate the **current** in the following:

V = 10V	R = 2 Ohms	I=
V = 120V	R = 40 Ohms	I=
V = 230V	R = 5 Ohms	I=

3. Calculate the **resistance** in the following:

V = 230V	I = 10A	R=
V = 12V	I = 1.5A	R=
V = 60V	I = 2A	R=

4. Calculate the **missing values**.

I = 5 Amps	R =	V = 12 V
I =	R = 4 Ohm	V = 20 V
I = 7 Amps	R= 0.3 Ohm	V =
I = 2 Amps	R =	V = 3V
I=	R = 220 Ohm	V = 24V

5. A household kettle heats water using an electrical heater that is connected to a 240 volt mains supply. The power of the heater is 1.5 kW (1500 watts). Calculate the **current** going through the kettle.

Show your working out.

_____

_____

6. An 18 V cordless drill uses 750 mAh of current. Calculate its **resistance** in Ohms.

Show your working out.

_____

_____

7a. A hair dryer has a power rating of 920W. It is operated from the mains supply. (You should know that the mains supply is 230V). Calculate the **current** in the hair dryer when operating.

Show your working out.

_____

_____

7b. Calculate the **resistance** of the hair dryer.

_____

_____

_____

25 minutes!

*When switched on, a mains powered grilling machine has a current of 3.1A in it. Calculate the **power** of the machine.*

electrical:

- power — P = V x I — power = voltage x current
- voltage — V = I x R — voltage = current x resistance
- current — I = P ÷ V — current = power ÷ voltage
- resistance — R = V ÷ I — resistance = voltage ÷ current

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Upgrade

Voltage would be measured using a multimeter.

A multimeter has 2 probes a black which is the cathode and a red which is the anode.

The cathode (- black cable) goes into the ‘COM’ common socket and the anode (+ red cable) goes into the ‘V’ voltage/Ohms socket.

Check the multimeter is working Set the dial to read continuity (musical note), touch the probes together, if it beeps, it is working.

Most multimeters are not autoranging, meaning you will need to set the correct range for the voltage you expect to measure. If you're not sure, start with the highest setting.

Measure the voltage of the sample batteries and complete the upgrade table.

BATTERY	FULLY CHARGED	TEST READING
AA, AAA, C or D	1.5V	
CR2032	3V	
Silver Flat Pack	3.7V	
PP3 (9V)	9V	
Car Battery	12.6V	

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Consolidate

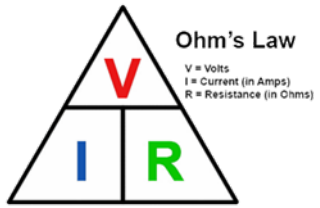
Can you remember the equations for...

power = voltage x current

voltage = current x resistance

current = power ÷ voltage *or* voltage ÷ resistance

resistance = voltage ÷ current



Next lesson…

We will learn about…

…how science and mathematics is applied in engineering and the equations which are used to describe and calculate geometry.