Technical English

Civil Engineering and Construction

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Vorwort

Das Lehrwerk "**Technical English – Civil Engineering and Construction**" ist als Text- und Arbeitsbuch für Studierende eines Ingenieurstudiengangs an Hochschulen konzipiert, die ihre allgemeinen Englischkenntnisse mit entsprechender fachsprachlicher Terminologie vorzugsweise aus dem Bauingenieurwesen und verwandter Disziplinen verbessern und ergänzen möchten.

In **acht Modulen** werden Themen aus den Bereichen „**Mathematics, Physics, Chemistry, Building Materials, The Construction Site, Energy, Surveying und Jobs in the Building Industry**" behandelt. Diese Themen zielen auf die naturwissenschaftlichen und fachspezifischen Module ab, die im Allgemeinen für ein **Bachelorstudium im Bauingenieurwesen** relevant sind. Diese Module können nacheinander, aber auch einzeln und in beliebiger Reihenfolge bearbeitet werden.

Die **didaktische und methodische Vorgehensweise** des Buches richtet sich nicht nach sprachlich ansteigenden Schwierigkeitsgraden, sondern wird hauptsächlich durch die Inhalte bestimmt. Methodisch ist das Buch in Textteile und diverse Übungen (Tasks) zur Einübung der Terminologie gegliedert.
Durch eine reiche Bebilderung, Tabellen und Flowcharts usw. werden die Inhalte des Buches sehr gut veranschaulicht.

Ausgewählte **Grammatikkapitel** (Grammar Boxes) sowie kurze Übungen dazu dienen der Auffrischung gängiger grammatischer Gebiete, erheben aber keinen Anspruch auf Vollständigkeit. Sie wurden mit den Inhalten der Module abgestimmt.

Eine **Vokabelliste** nach jedem Modul, die ausführliche Vokabelliste am Ende des Buches sowie die online zur Verfügung stehenden **Lösungsvorschläge** machen das Buch für die Arbeit im **Seminarbereich** als auch für ein **Selbststudium** für solche Lerner geeignet, die sich idealerweise auf dem Übergang von **Level B2** zu **Level C1** des „**Gemeinsamen europäischen Referenzrahmen für Sprachen**" befinden und ihre fachspezifischen Englischkenntnisse weiter ausbauen möchten.

Während der Arbeit an diesem Lehrwerk haben zahlreiche Personen mit Rat und Tat hilfreich zur Seite gestanden; ihnen allen möchten wir hiermit danken. Besonderer Dank der Autorin aber gilt den **Studierenden** an der **Technischen Fachhochschule Georg Agricola**, die sie in ihren Seminaren mit Vorschlägen, aber auch mit Kritik zu Themen und Inhalten unterstützt haben.

Für konstruktive Kritik, aber auch für Lob zu diesem Lehrwerk sind wir immer offen und nehmen diese unter lektorat@europa-lehrmittel.de dankbar entgegen.

Frühjahr 2013 Autorin und Verlag

Table of Contents

1 Mathematics

1.1 Numbers and Simple Calculations

In relation to other sciences, **mathematics** is of fundamental importance to all technicians and engineers. Scientists need to be familiar with numbers, figures, mathematical signs, symbols and terms. In **algebra**, you use letters and symbols to express a relationship and in **geometry** you have different figures, shapes and angles. With mathematical terms, one can describe rules, structures, quantities and change. As an engineering student, you are probably well acquainted with all types of calculation; from pure mathematics to **applied mathematics in physics** or **computational mathematics in information technology**. Now you are required to express equations, values and quantities in English.

Notice! **Main differences in writing and reading English and German numbers**

Cardinal Numbers	**Example:**
• Tens and ones are separated by a dash.	• 44 forty-four
• The word "and" follows "hundred" when written in full.	• 215 two hundred and fifteen
• Thousands are separated by a comma.	• 1,306 one thousand, three hundred and six

TASK 1

Write in English.

Cardinal Numbers	• 21	• .....
	• 105	• .....
	• 4,444	• .....
Ordinal Numbers	• the first	• 1st
	• the second	• 2nd
	• the third	• 3rd
	• the fourth	• 4th
	• the fifth	• 5th
	• the sixth	• 6th
	• the nth	• nth

Pict. I: Galileo Galilei 1594–1642, mathematician

Notice! **Mind the Spelling**

five / fifth nine / ninth twelve / twelfth

TASK 2

Name three numbers and practice their spelling. Write in full.

1.	Even numbers	6,	six,
2.	Odd numbers	3,	three,
3.	Primenum bers	13,	thirteen,
4.	Square numbers	4,	four,
5.	Cube numbers	9,	nine,

TASK 3

Read the property values of nickel and then write the values of lead in full.

Properties of Nickel		The atomic number / density etc. of nickel is …
Atomic number	28	twenty-eight
Density	8.90 kg/dm³	eight point nine zero kilograms per cubic decimetre / per decimetre cubed
Melting t emperature	1453 °C	one thousand four hundred and fifty-three degrees Celsius
Thermal conductivity	90.5 W	ninety point five watts
Tensile strength	370 … 700 N/mm²	from three hundred and seventy to seven hundred newtons per square millimetre
Yield strength	70 MPa	seventy megapascals
Elastic modulus	197… 225 GPa	from one hundred and ninety-seven to two hundred and twenty-five gigapascals
Elongation at fracture	28 %	twenty-eight per cent

Properties of Lead		Complete in the same way.
Atomic number	82	1.
Density	11.3 kg/dm³	2.
Melting t emperature	327 °C	3.
Thermal conductivity	35.2 W	4.
Tensile strength	10 … 20 N/mm²	5.
Yield strength	7… 8 MPa	6.
Elastic modulus	17.5 GPa	7.
Elongation at fracture	max. 50 %	8.

1.2 Fractions, Powers, Roots

Fractions consist of a numerator (above the fraction bar) and a denominator (below the fraction bar). Fractions can be simple (½) or mixed (1 ½). You can do arithmetic calculations with fractions, i.e. you can add, subtract, multiply, divide or even cancel fractions.

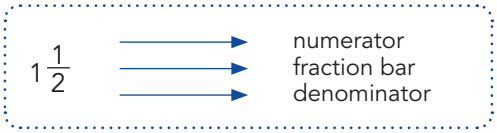
Example:

$\frac{1}{2}$ a half

$\frac{1}{3}$ a third

$\frac{1}{4}$ a quarter

$\frac{2}{5}$ two fifths



Powers mean to raise the value of a number to an exponent. Exponents allow us to write multiplications in short.

Example: $a^n = y$

a is the base

n is the exponent

y is the exponential value

x^2 means x is raised to the power of two, or x is squared

x^3 means x is raised to the power of three, or x is cubed

Pict. I: René Descartes 1596–1650, mathematician/philosopher

Notice!

Numbers with negative exponents can also be written as fractions. The base is then given a positive exponent and is placed as the denominator.

Example: $x^{-2} = \frac{1}{x^2}$

Roots are written with a radical sign √. You can have a square root, a cube root or the nth root of a number.

Powers of ten Positive numbers greater than 1 are expressed with a positive exponent and positive numbers less than 1 are expressed with a negative exponent.

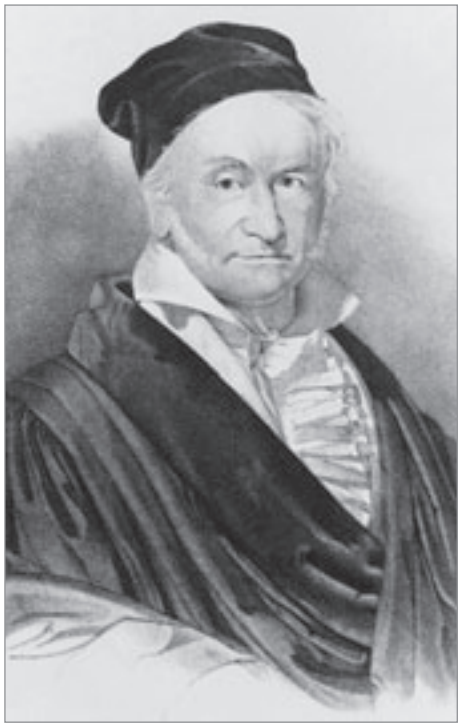
Pict. 2: Gottfried W. Leibniz 1646–1716, mathematician

Name	Multiplication factor	Power of ten	Affix / Abbreviation
billion	1,000,000,000	10^{9}	giga / G
million	1,000,000	10^{6}	mega / M
thousand	1,000	10^{3}	kilo / k
hundred	100	10^{2}	hecto / h
ten	10	10^{1}	deca / da
one	1	10^{0}	
tenth	0.1	10^{-1}	deci
hundredth	0.01	10^{-2}	centi
thousandth	0.001	10^{-3}	milli
millionth	0.000 001	10^{-6}	micro
billionth	0.000 000 001	10^{-9}	nano

TASK 1

Match the English to the German words.

1. equals sign		a. Brüche
2. inequality		b. Einer
3. fractions		c. Aufrunden
4. integer		d. Gleichheitszeichen
5. tens		e. leere Menge
6. denominator		f. Nenner
7. rounding		g. Zähler
8. null set		h. Zehner
9. numerator		i. Ungleichheit
10. ones		j. ganze Zahl
11. radical sign		k. Quadratwurzel
12. square root		l. Wurzelzeichen
13. odd number		m. gerade Zahl
14. even number		n. ungerade Zahl



Pict. 1: Carl Friedrich Gauss 1777–1855, mathematician

TASK 2

Complete the table for these basic mathematical calculations.

Operation	Verb	Example
addition	to add	$5+4=9$
subtraction	to subtract	$45-5=40$
multiplication	to multiply by / times	$50 \cdot 5=250$
division	to divide by	$55:5=11$
fraction	to calculate the fraction	$2\frac{3}{4}$, $4\frac{2}{9}$
root extraction	to extract the root	$\sqrt{4}$, $\sqrt[3]{27}$, $\sqrt[4]{16}$
power	to raise to a power	x^2, x^3, x^4, x^n

Written in full:

1. Five plus four equals (or: is equal to) nine.
2.
3.
4.
5.
6.
7.

Signs and Symbols

Using signs and symbols, you can express whether a value is greater than or less than, equal to or only approximately equal to another value. A value can be written in brackets or can be within the limits of something.

Mathematical Signs

>	greater than	∫	integral of
<	less than	≈	approximately equal to
≠	is not equal to, is unequal to	f(x)	the function of *x*
∑	sum of	x_1	*x* sub one
|x|	the absolute value of *x*	( )	round brackets
n!	factorial *n*	[ ]	square brackets
%	percentage / per cent	{ }	braces, curly brackets
/	slash	*x*′	*x* prime

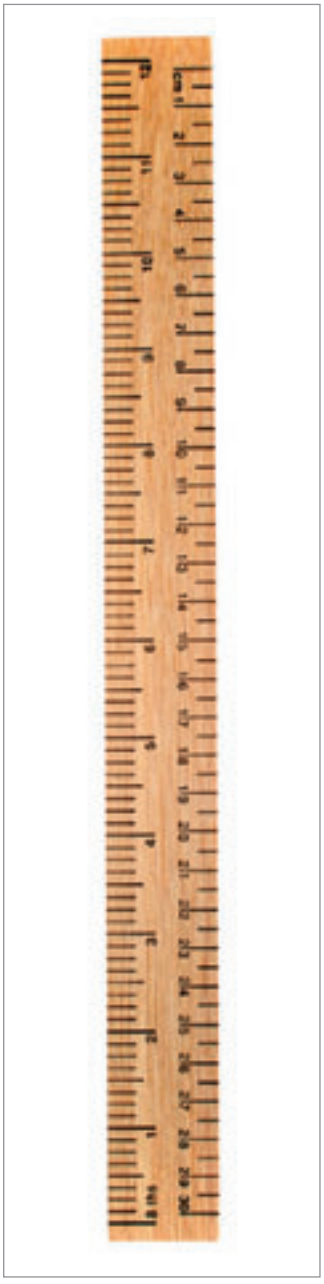
Measurements

There is more than one type of measurement system existing, e.g. the traditional UK or imperial system and the metric system, which is a decimal system of measurement.

UK/US Units	Metric System
Units of Length	
1 inch	2.53 cm
1 foot	30.48 cm
1 yard	0.91 m
1 mile	1.6 km

UK/US Units	Metric System
Units of Mass	
1 ounce	28.35 g
1 (short) ton	0.9 t
1 pound	0.453 kg

UK/US Units	Metric System
Units of Capacity	
1 pint	0.568 l
1 quart = 2 pints	1.136 l
1 gallon = 8 pints	4.546 l



Pict. 1: Ruler [cm and inches]

Notice!

The imperial system and the US system use similar terms, but the relationships are not always the same:

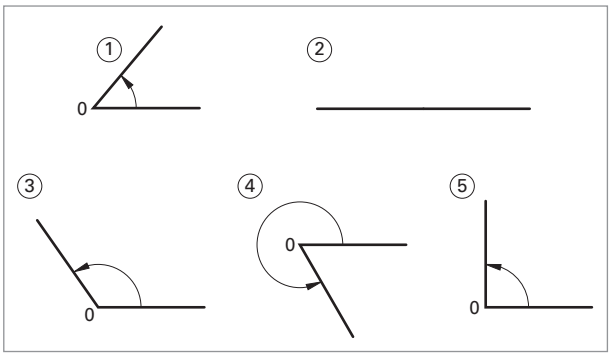
1 imperial gallon	= 4.54 litres	
1 imperial pint	= 0.56 litres	= 1.201 US pints
1 US gallon	= 3.78 litres	

1.3 Geometry

Geometry is a branch of mathematics that is concerned with the properties of angles, shapes, lines, curves, surfaces and solid objects.

Angles

An angle may be
① acute, ② flat,
③ obtuse, ④ reflex or
⑤ right.



Pict. 1: Angles

TASK 1

Fill in.

1. An angle of 90° is a right angle. .....
2. An angle which equals 180° is a/an .....
3. An angle which is less than 90° is a/an .....
4. An angle which is greater than 180° is a/an .....
5. An angle which is between 90° and 180° is a/an .....

Triangles

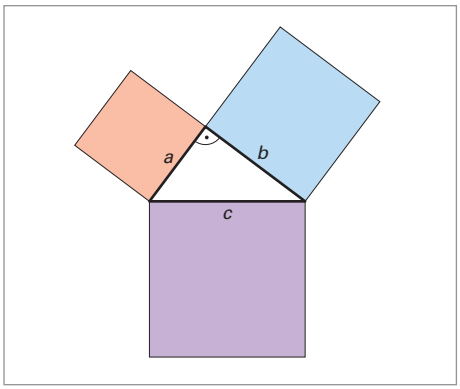
Triangles are geometric forms with three angles and three sides. They can be classified according to their sides or angles. Sides and angles can be calculated using the **Pythagoras' theorem**.

$a^2 + b^2 = c^2$

a = side

b = side

c = hypotenuse



Pict. 2: The Pythagorean theorem

TASK 2

Describe the Pythagorean theorem.

.....

.....

.....

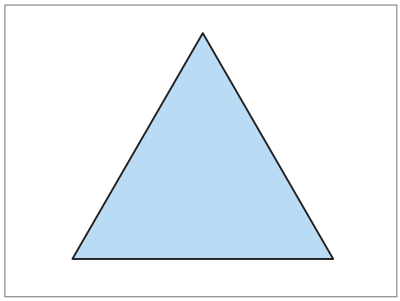
.....

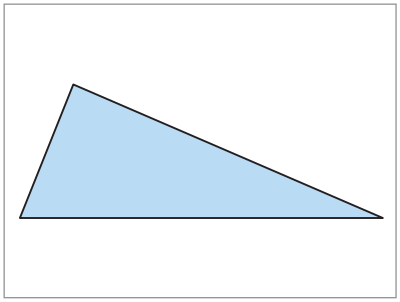
Sides or Legs of Triangles

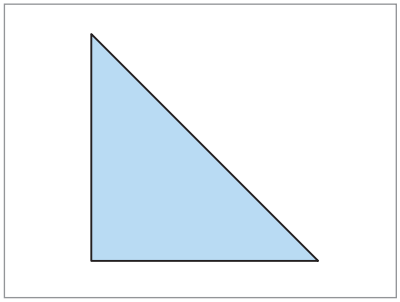
A scalene triangle has three sides all with different lengths.
An **isosceles** triangle has two sides or legs of equal length.
In an **equilateral** triangle all sides are equal.

TASK 3

Name the triangle types.







1. ..... 2. ..... 3. .....

2-D and 3-D Shapes

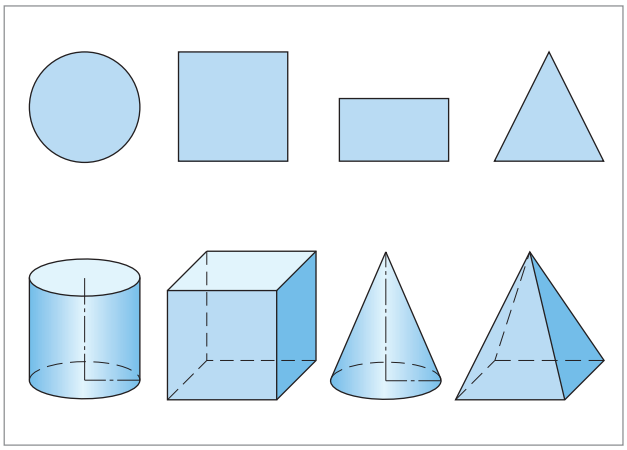
Objects have forms or shapes with different dimensions regarding length, width, height or depth. They can be drawn or presented in two or three dimensions. **Two dimensional shapes** (2-D) are flat forms with length and width. **Three dimensional shapes** (3-D) additionally have depth or thickness, as they are seen in reality.

TASK 4

Enter the words into the right columns.

cone … cube … cylinder … hexagon … polygon … prism
pyramid … rectangle … sphere … square … triangle

2-D Shapes	3-D Shapes
square	cube



Pict. 1: 2-D and 3-D Shapes

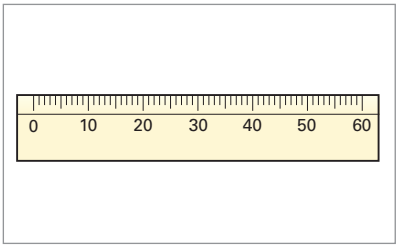
A Geometric Set

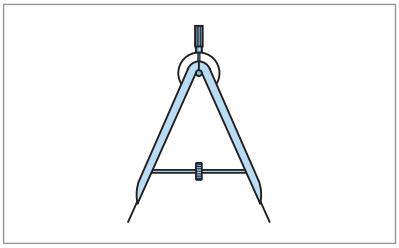
Even if most engineering or technical drawings are done by computer simulations, **hand-held instruments** for drawing geometric figures are still in use.

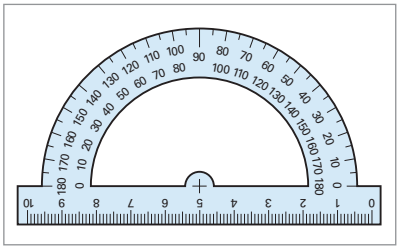
TASK 5

Match the words to the instruments.

a pair of compasses … protractor … ruler







1. ……

2. ……

3. ……

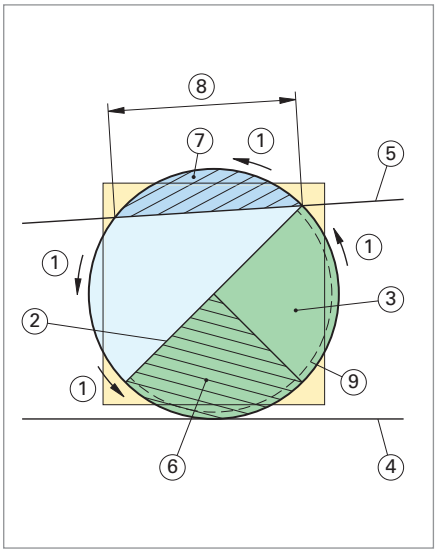
Circles

Circles are round flat forms drawn with a pair of compasses. They can be divided into parts, e. g. radius, diameter, circumference etc. Each part can be calculated using the irrational number Pi (π) which is 3.14.

TASK 6

Translate into German.

English	German
1. circumference	
2. diameter	
3. semicircle	
4. tangent	
5. secant	
6. sector	
7. segment	
8. chord	
9. arc	



Pict. 1: Parts of a circle

TASK 7

Match the definitions to the parts of a circle.

arc … chord … circumference … diameter
radius … sector … segment … semicircle

1. Its formula is π · d or 2π · r, which is the total distance around the edge of a circle. .....
2. It is a portion of a curve or part of the circumference. .....
3. It is a straight line joining the centre of a circle to a point on its circumference. .....
4. It is twice the radius and a straight line through the centre of a circle. .....
5. It is part of a circle formed by two radii and the arc between them. .....
6. A half circle is a … .....
7. It is a straight line linking two points on a circle or a curve. .....
8. It is a part of a circle which is separated from the rest by a chord across it. .....

Vocabulary Module 1

abbreviation	Abkürzung
acute (-angled)	spitz (-winklig)
add, to	addieren
affix	Vorsatz, -silbe
angle	Winkel
approximately	ungefähr
arc	Bogen
brace	Klammer (math.)
bracket	Klammer (math.)
branch	Zweig
cancel, to	hier: kürzen
cardinal number	Kardinalzahl
chord	Sehne
circle	Kreis
circumference	Umfang
cone	Kegel
cube	Kubik-
curly (bracket)	geschweift(e) (Klammer)
dash	Bindestrich
denominator	Nenner
density	Dichte
depth	Tiefe
diameter	Durchmesser
dimension	Abmessung
divide, to	dividieren
draw, to	zeichnen
elastic modulus	Elastizitätsmodul
elongation at fracture	Bruchdehnung
enter, to	einsetzen, einfügen
equals sign	Gleichheitszeichen
equation	Gleichung
equilateral	gleichseitig
even (number)	gerade (Zahl)
even if	selbst wenn
figure	Abbildung
flat	flach
foot	Fuß (engl. Maßeinheit)
fraction	Bruch
fraction bar	Bruchstrich
geometric set	Geozeichengerät
hand-held	tragbar
hexagon	Sechseck
imperial system	Maßeinheitensystem in GB
inch	Zoll (engl. Maßeinheit)
integer	Ganzzahl
isosceles	gleichschenklig
leg	Schenkel (Dreieck)
letter	Buchstabe
melting temperature	Schmelztemperatur
metric system	metrisches System
multiply, to	multiplizieren
number	Zahl
numerator	Zähler
obtuse (-angled)	stumpf (-winklig)
odd (number)	ungerade (Zahl)
ordinal number	Ordnungszahl
ounce	Unze (engl. Gewichtseinheit)
pair of compasses	Zirkel
polygon	Vieleck
power	Potenz
power of ten	Zehnerpotenz
prime (number)	Prim- (Zahl)
proper(ly)	richtig, genau
protractor	Winkelmesser
Pythagoras' theorem	Satz des Pythagoras
Pythagorean theorem	Satz des Pythagoras
radical sign	Wurzelzeichen
raise to the power, to	potenzieren; ‚hoch'
rectangle	Rechteck
reflex (-angled)	überstumpf
relationship	Verhältnis
root	Wurzel
root extraction	Wurzelziehen
ruler	Lineal
scalene	ungleichseitig
sector	Abschnitt
shape	Form
solid object	Festkörper
spelling	Schreibweise
sphere	Kugel
square (number)	Quadrat- (Zahl)
subtract, to	subtrahieren
surface	Oberfläche
technical drawing	technische Zeichnung
tensile strength	Zugfestigkeit
thermal conductivity	Wärmeleitfähigkeit
thickness	Dicke
triangle	Dreieck
value	Wert
well acquainted with	sich gut auskennen mit
width	Breite
yard	Yard (engl. Maßeinheit)
yield strength	Streckgrenze

2 Physics

2.1 Important Physical Quantities

Physics is the science of the properties and nature of matter. Natural processes, derived laws and results of physical measurements are described using specific terms, symbols, quantities and units.
In physical processes, the form, the position, or the state of a body changes.
The form is changed, for example, when a piece of material is deformed, compressed or bent.
The position is changed, for example, when construction materials are stacked to create buildings.
The state of matter changes, for example, when water (a liquid), which is sprayed on hot stones, evaporates (becomes gaseous) because of rising temperatures.

Volume, Mass, Density

Volume: Each body has a specific volume. The unit of volume is the cubic metre (**m³**).

Mass: Each body has a mass. The unit of mass is the kilogram (**kg**).
The mass of a static body is independent of the place where the body is.

Density: The relation of mass to volume. The unit of density is **kg/dm³**.

TASK 1

Fill in the gaps using the following words.

density … mass … volume

1. The ..... of an object depends on the mass and the volume. Different materials of the same mass mostly have different volumes.
2. Each object has a particular ..... .
   The unit of ..... is m³.
3. The unit of ..... is the kilogram.
4. density = .../volume
5. ..... = volume · density
6. volume = mass/ .....

Pict. 1: Daniel Bernoulli 1700–1782, physicist

Power, Work, Forces, Energy

Physics deals with forces, work, power and different forms of energy and its conversion. Power, work, forces and energy are not the same. Energy and power can be electrical or mechanical.

Energy	The ability to do work.	$E = Q \cdot V$
Work	The application of force to produce movement.	$W = F \cdot d$
Power	Work done in a period of time.	$P = W/t$
Force	Mass times acceleration.	$F = m \cdot a$

Q = charge

V = voltage

d = distance

Pict. 1: Alessandro Volta 1745–1827, physicist

TASK 2

Test your knowledge. Complete the table below. Use the following units.

hertz … joules … newtons … ohms … pascals … volts … watts

Quantity	Measured in	Formula	Written in full
energy	joules	$E = Q \cdot V$	energy equals charge times voltage
pressure			
work			
force			
power			
frequency			
resistance			
potential difference			

In physics, the unit of energy is the "joule". Energy can be different in form and type. We may have potential or kinetic energy as well as electrical, heat or light energy.
Energy cannot be destroyed, but transformed from one form to the other.

Milestones in Physics

Mankind has been inventing things throughout history. However, from the 16th century onwards, findings and developments could be explained on a more precise or scientific level. A real age of discovery started when those findings were translated into laws.

Motion, gravitation, electric or magnetic forces, the transfer of heat and electricity and the behaviour of gases, all belong to the field of physics.

Even though we know a lot about the physical nature of atoms, atomic or nuclear physics is still a vast field to be discovered. The following table gives a short overview of the **history of physics** from the 16th century onwards. Most of the scientific developments and inventions mentioned here, such as Ohm's law on the relationship of current, voltage and resistance, are still important today.

Dates	Physicist	Discovery, Invention or Development
1594 – 1642	Galilei	Experimental work on the motion of bodies and free fall of objects; pendulum motion and theory of elasticity
1602 – 1686	Guericke	Physics of vacuum, experiment with two hemispheres sticking together because of vacuum; invention of vacuum pump
1642 – 1726	Newton	Differential and integral calculus; laws of motion; theory of gravitation; apple analogy
1700 – 1782	Bernoulli	Bernoulli's principle of aerodynamics and hydrodynamics; kinetic theory of gases
1736 – 1806	Coulomb	Electricity and magnetism; laws of friction, soil mechanics
1745 – 1827	Volta	Electric cell; electrolyte as a conductor of electricity
1789 – 1854	Ohm	Ohm's law on electrical resistance
1791 – 1867	Faraday	Electromagnetism; electromagnetic rotation and induction
1824 – 1907	Kelvin	Thermodynamics; electricity
1845 – 1923	Röntgen	X-ray; 1901 Nobel Prize in Physics
1852 – 1908	Becquerel	Discovery of radioactivity; 1903 Nobel Prize in Physics
1857 – 1894	Hertz	Electromagnetic waves
1879 – 1955	Einstein	Theory of gravitation; theory of relativity; 1921 Nobel Prize in physics

Pict. 1: Georg Simon Ohm

Pict. 2: William Thomson Kelvin

Pict. 3: Wilhelm Conrad Röntgen