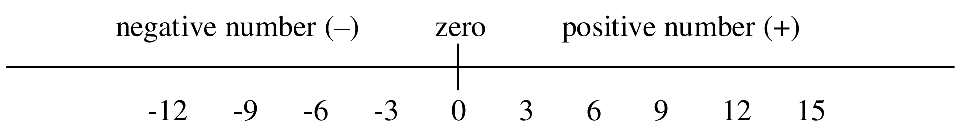
Mathematic formulas and laws

Numbers:

0 zero	10 ten	20 twenty	30 thirty
1 one	11 eleven	21 twenty-one	40 forty
2 two	12 twelve	22 twenty-two	50 fifty
3 three	13 thirteen	23 twenty-three	60 sixty
4 four	14 fourteen	24 twenty-four	70 seventy
5 five	15 fifteen	25 twenty-five	80 eighty
6 six	16 sixteen	26 twenty-six	90 ninety
7 seven	17 seventeen	27 twenty-seven	100 one hundred
8 eight	18 eighteen	28 twenty-eight	500 five hundred
9 nine	19 nineteen	29 twenty-nine	1000 one thousand

125: one hundred and twenty five
2 000 000 000: two billion
3,14: three point fourteen

1 000 000: one million
1 000 000 000 000: one trillion
1,73: one point seventy three



Number greater than zero (N>0) is a positive number. Example: 2, 7, 8, +11,…
Number smaller than zero (N<0) is a negative number. Example: –2, –7, – 8, –11,…

Basic mathematic operations:

	symbol	example	
Addition	+	3 + 8 = 11	three plus eight equals eleven
Subtraction	–	20 – 12 = 8	twenty minus twelve equals eight
Multiplication	× (·)	4 × 3 = 12	four times three equals twelve
Division	:	15 : 5 = 3	fifteen divided by five equals three

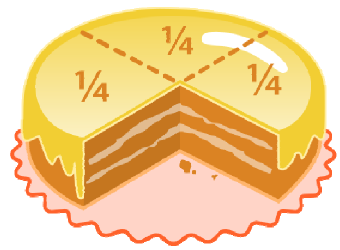
Multiplying a number several times by itself is called power. $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$ = two to the power 7 = $\mathbf{2^7} = 128$
The second power is also called a square: $a \times a = \boldsymbol{a^2}$ $(4 \times 4 = 4^2 = 16)$
The third power is named cube: $a \times a \times a = \boldsymbol{a^3}$ $(5\times 5 \times 5 = 125)$
The opposite of power is root.

A **square root** of a number x is a number a such that $a^2 = x$, or, in other words, a number a whose *square* is x.
Every positive number x has two square roots: $\sqrt{x} = \pm a$
Example: $\sqrt{9} = 3$ and $\sqrt{9} = -3$; because $3 \times 3 = 9$ and $(-3) \times (-3) = 9$.

A **cube root** of a number, denoted $\sqrt[3]{x}$ or $x^{1/3}$, is a number a such that $a^3 = x$.

Fractions

A **fraction** (from the Latin *fractus* = broken) is a number that represents a part of the whole.



$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$
one half	one third	one quarter

Fractions consist of a **numerator** and a **denominator**, the numerator represents a number of equal parts and the denominator represents how many of those parts make up the whole.

$$\frac{\text{numerator}}{\text{denominator}}$$

An example is $\frac{3}{4}$ or ¾ where the numerator 3 represents 3 equal parts of the whole and the denominator 4 tells us that 4 parts make up the whole.

A kind of fraction still in common use is the "per cent", in which the denominator is always 100. Thus 75 % in fraction form is 75/100.

Fractions also represent ratios and division. Thus the fraction 3/4 represents the ratio 3:4 (three to four) and the division 3 ÷ 4 (three divided by four).

Laws of exponents

The International Symbols Committee has adopted prefixes for denoting decimal multiples of units.

Numbers	Powers of ten	Prefixes	Symbols
1 000 000 000 000	10^{12}	tera	T
1 000 000 000	10^{9}	giga	G
1 000 000	10^{6}	mega	M
1 000	10^{3}	kilo	k
100	10^{2}	hecto	h
10	10^{1}	deca	da
0,1	10^{-1}	deci	d
0,01	10^{-2}	centi	c
0,001	10^{-3}	milli	m
0,000 001	10^{-6}	micro	µ
0,000 000 001	10^{-9}	nano	n
0,000 000 000 001	10^{-12}	pico	p

To multiply exponential quantities with same base, add the exponents. In the language of algebra, the rule is: $a^m \times a^n = a^{m+n}$. For example: $10^4 \times 10^2 = 10^{4+2} = 10^6$.

To divide exponential quantities with same base, subtract the exponents. In the language of algebra, the rule is: $\frac{a^m}{a^n} = a^{m-n}$. For example: $10^8 : 10^2 = 10^{8-2} = 10^6$.

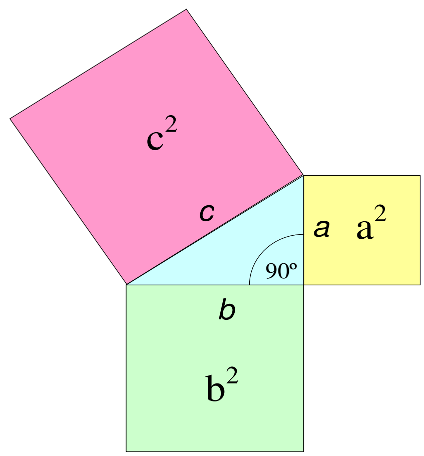
To raise an exponential quantity to a power, multiply the exponents. In the language of algebra, the rule is: $\left(a^m\right)^n = a^{m\times n}$. For example: $(10^3)^2 = 10^{3\times 2} = 10^6$.

Any number (except zero) raised to the zero power is one. In the language of algebra, the rule is: $a^0 = 1$. For example: $\frac{a^2}{a^2} = a^{2-2} = a^0 = 1$.

Any base with a negative exponent is equal to 1 divided by the base with an equal positive exponent. In the language of algebra: $a^{-x} = \frac{1}{a^x}$. For example: $10^{-3} = \frac{1}{10^3} = \frac{1}{1000} = 0{,}001$.

Pythagorean Theorem

In mathematics, the **Pythagorean theorem** (in American English) or **Pythagoras' theorem** (in British English) is a relation in Euclidean geometry among the three sides of a right triangle (*right-angled triangle* in British English). It states:



In any right triangle, the area of the square whose side is the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the squares whose sides are the two legs (the two sides that meet at a right angle).

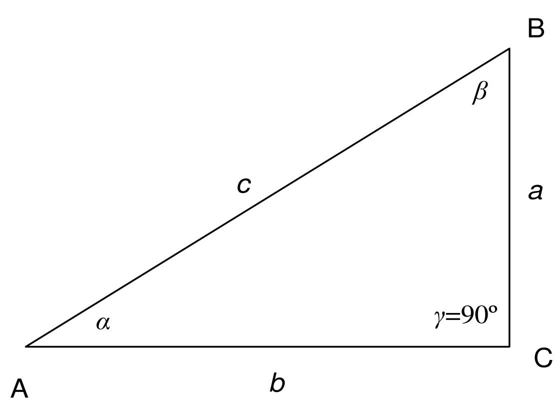
The theorem can be written as an equation:

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

where *c* represents the length of the hypotenuse, and *a* (altitude) and *b* (base) represent the lengths of the other two sides.

Trigonometric functions

In a right triangle, there are several relationships which always hold true. These relationships pertain to the length of the sides of a right triangle, and the way the lengths are affected by the angles between them. An understanding of these relationships, called trigonometric functions, is essential for solving many problems in a-c circuits such as power factor, impedance, voltage drops, and so forth.



Trigonometric functions apply to right triangles only!

Using the trigonometric functions, it is possible to determine the length of one or more sides of a triangle or the degrees of angles, depending on what is presently known about the triangle. For instance, if the lengths of any two sides (*a-b* or *b-c* or *c-a*) are known, the third side and the both angles α (alpha) and β (beta) can be determined. The triangle can also be solved if the length of any one side and one of the angles (α or β) are known.

The first basic fact regarding triangles is that in any triangle, the sum of the three interior angles of a triangle always equals 180º; $\alpha + \beta + \gamma = 180$. If one angle is 90º (a right angle) then the sum of other two angles must be 90º. If angle gamma is 90º, angle β is known, α can be quickly determined.

The second basic fact you must understand is that for every different combination of angles in a triangle, there is a definite ratio between the lengths of the three sides. The triangle consisting of the base, side *b*, the altitude, side *a*, and the hypotenuse, side *c*. The hypotenuse is always the longest side, and is always opposite the right angle.

Note that three ratios are shown to exist for the given value of α:

The sides ratio $\frac{base}{hypotenuse}$, which is always referred to as the **cosine** ratio of α	The sides ratio $\frac{altitue}{hypotenuse}$, which is always referred to as the **sine** ratio of α	The sides ratio $\frac{altitude}{base}$, or $\frac{opposite}{adjacent}$ which is always re-ferred to as the **tangent** ratio of α
$\cos\alpha = \frac{b}{c}$	$\sin\alpha = \frac{a}{c}$	$\tan\alpha = \frac{a}{b}$

Other important relationships of trigonometric functions:

$$\sin\alpha^2 + \cos\alpha^2 = 1 \qquad \Rightarrow \cos\alpha = \sqrt{1-\sin\alpha^2} \text{ or } \sin\alpha = \sqrt{1-\cos\alpha^2}$$

$$\tan\alpha = \frac{\sin\alpha}{\cos\alpha}$$

Formulas

Area of square	$S = a^2$	Cube volume	$V = a^3$
Circumference of circle	$O = 2\times\pi\times r$	Area of circle	$S = \pi\times r^2$
Cylinder volume	$V = \pi\times r^2\times h$	Rectangular prism volume	$V = a\times b\times c$

Wire resistance $R = \rho\frac{l}{S}$

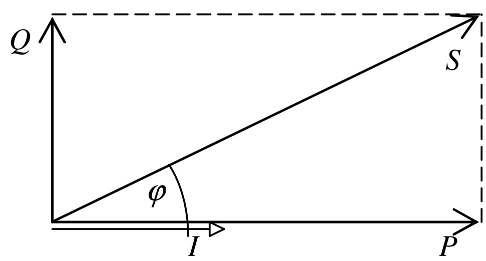
Electrical resistance $R = \frac{U}{I}$

Electrical power $P = U \times I$

Electro-technical applications

In previous problems, the sides of the triangles were given in meters, inches and units. When applying trigonometry to A/C circuit problems, these units of measure will be replaced by such measurements as ohms, amperes, volts, and watts. Angle φ will often be referred to as the phase angle. However, the solution of these A/C problems is obtained in exactly the same manner as the foregoing triangle problems. Only units and some terminology are changed.

Problem 1:



Version I.

$$S = \sqrt{P^2 + Q^2}$$

$$P = \sqrt{S^2 - Q^2}$$

$$Q = \sqrt{S^2 - P^2}$$

Version II.

$$S = \frac{P}{\cos\varphi}$$

$$P = S \cdot \cos\varphi$$

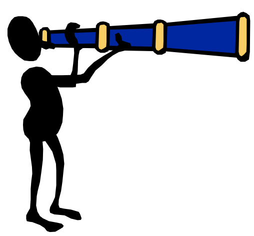
$$Q = S \cdot \sin\varphi$$

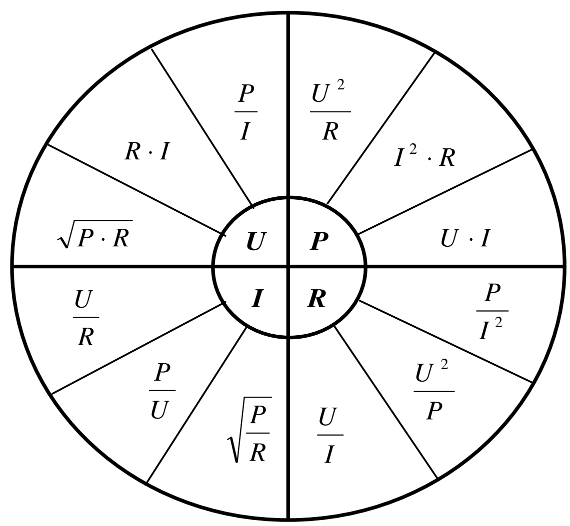
$$\cos\varphi = \frac{P}{S}$$

Problem 2:

Summary of basic electrical formulas which you should know:

R – resistance
U – voltage
I – current
P – power





VOCABULARY

decimal point – desatinná čiarka
square root – druhá odmocnina
cube root – tretia odmocnina
fraction – zlomok, podiel
numerator – čitateľ
denominator – menovateľ
angle – uhol
relationship – vzťah, pomer
pertain – týkať sa
essential – základný, nevyhnutný
measurement – meranie
volume – objem
area – plocha, obsah
side opposite – protiľahlá strana

equation – rovnica
equation with two unknowns – rovnica s dvoma neznámymi
addition – sčítanie
sum, addition – súčet
subtraction – odčítanie
difference – rozdiel
multiplication – násobenie
product – súčin
division – delenie
hypotenuse – prepona
altitude – odvesna *a*
base – odvesna *b*
side adjacent – priľahlá strana

fuctions	how to read
1/2	one half
3 3/4	three and three quarters
0,5	o point five; zero point five; nought point five
6,005	six point zero zero five
$a + b$	*a* plus *b*
$c - d$	*c* minus *d*
$e \pm f$	*e* plus or minus *f*
ab; $a \cdot b$; $a \times b$	*a* times *b*; *a* multiplied by *b*
$c \div d$	*c* divided by *d*
$a = b$	*a* equals *b*; *a* is equal to *b*
$x \neq y$	*x* is not equal to *y*
a/b	*a* solidus *b*; *a* slant *b*
$\frac{x}{y}$	*x* over *y*
$\frac{ab}{c+d}$	*a* times *b* over *c* plus *d*
$a \equiv b$	*a* is identical to *b*
$a!$	*a* factorial; factorial *a*
$x < y$	*x* is less then *y*
$x > y$	*x* is greater then *y*
$x \leq y$	*x* is less then or equal to *y*
a_b	*a* subscript *b*
a^2	*a* squared
a^{xy}	*a* to the power *xy*
$\sqrt[3]{a}$	cube root of *a*
$\sqrt[n]{m}$	n^{th} root of *m*
$\sin \alpha$	sine α
$\cos \varphi$	cosine φ
$\log x$	log of *x*
$\sum_{x=1}^{n} a_x$	the sum *a* from *x* equals one to *n*

Fundamental geometrical notions

point	bod
intersection	priesečník
straight line	priamka
axis (of symmetry)	os (súmernosti)
parallel	rovnobežný
perpendicular	kolmý
right angle	pravý uhol
acute angle	ostrý uhol
obtuse angle	tupý uhol
curve	krivka
arc	oblúk
right triangle	pravouhlý trojuholník
trapezium	lichobežník
polygom	mnohouholník