MATHEMATICAL DICTIONARY

List of dictionary contents according to the following issues:

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Information about the project and lesson scenarios can be found at http://e-akademia.net/

Project partners:

Foundation " For Polonia", Machirz School in Lithuania and the National Polish School in Hungary.

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Słownik matematyczny jako materiał uzupełniający do prowadzenia lekcji matematyki z elementami podstaw przedsiębiorczości dla cudzoziemców został opracowany podczas realizacji projektu „**Różne kultury – jedna tożsamość**”, współfinansowanego ze środków Unii Europejskiej z programu ERASMUS+.

Informacje o projekcie oraz scenariusze do lekcji znajdziesz na portalu http://e-akademia.net/

Partnerzy projektu:

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1. BASIC CONCEPTS, REAL NUMBERS

Primary concept
A concept that is not defines (set, point)

Axiom, postulate
In a mathematical or logical system, this is the initial condition or assumption that we accept as true without proof and from which other assumptions or theorems can be received. On the basis of axioms, other theorems of this theory are formulated and proved. An example of an axiom in Euclidean geometry is, for example: "Two different points pass through one straight line".

Algorithm
A method of dealing with a set of commands with an indication of their order of execution

Constant
Fixed constant, unchanged, to which a defined value is assigned.

Deduction
A sequence of logical steps whose result is achieved exactly from the set of initial conditions (assumptions).

The Greek alphabet
Most of the letters of the Greek alphabet are used in mathematics as signatures. The following alphabet is given below, naming the letters big and small, as well as the name of the letter:
A, α - alpha, B, β - beta, Γ, γ - gamma, Δ, δ - delta, E , ε- epsilon .... Ω, ω - omega.

Numerals
Graphic characters by means of which numbers are written.

Arabic numerals
Usually, numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 are used for writing numbers. In addition to these, roman numerals are used less often.

Number
A one-digit number consisting of only the number of unity: 1 or 8 or 9
Two-digit - a × 10 + b × 1, where the **a**- tens digit , **b**- the units digit.
Three-digit - a × 100 + b × 10, + c, where the **a**- hundreds digit, **b**- tens digit, **c**- the units digit
Four-digit - a × 1000 + b × 100, + c × 10 + d, where **a**- thousands digit, **b**- hundreds digit, **c**- tens digit, **d**- units digit, etc. ...

Roman numerals, seven symbols
I – 1
V - 5
X – 10
L – 50
C – 100
D – 500
M – 1000

Serve to write numbers in the Roman system.

eg .: 41 - XLI

1924 – MCMXXIV

2017 – MMXVII

Element
A single item that belongs to the set

A neutral element
Is an element of a set that does not change the value of another element when we join it with that element.
For example, the neutral element of adding 0, because 2 + 0 = 2 and the neutral of multiplication is 1, because 2 × 1 = 1

Natural number
Number belonging to the set: {0,1,2,3,4, ...}

Integer
An integer is a whole natural number that can be positive, negative, or 0, another words- number belonging to the set: {..... -3, -2, -1,0,1,2,3,4 ...}

Decimal number
In short its the name of the rational number, which has a finite decimal expansion, e.g.: 12,45 or -0,0034

Rational number
A number that can be written as the quotient of $\frac{m,}{n}$, where **m** and **n** are integers, n≠0.
Rational numbers are:
-all natural numbers : 0,1,6,...
-integers : -4, -2, 0, 4, 100,...
-simple fractions, where the numerators and denominators are integers which cannot be zero $\frac{4}{13}$
-terminating decimals **:** 2,345
-recurring decimals :1,2 (46) = 1,24646464646 ....

Decimal fraction
It is a regular fraction with a denominator being the power of the number 10 with a natural exponent. Every decimal fraction can be written in decimal form without the use of a fractional line, but with a comma e.g: $\frac{117}{100} = 1,17.$ The number before the comma is called the integer part, and after the decimal point the fractional part

A non-terminating decimal fraction
A decimal fraction that after the comma has an infinite number of digits in the decimal notation, for example: 1,236573 .... or 1.333333 ... = 1, (3) or 12,345454545 .... = 12,3 (45) or 0.34175 ....

The fraction of periodic

The infinite periodic decimal fraction, or shortly periodic decimal fraction for example:12,121212....= 12,(12) or 1,2356356356...=1,2(356), the numbers in brackets, another words a repetitive group of digits is called a period.

Decimal form

Decimal number is generated when a decimal fraction is converted into a number in which the integer part and the fractional part can be distinguished, for example : $\frac{3}{100} = 0{,}03$, where the integer part is 0 and fractional is 03 after the decimal point.

Simple fraction

Each expression of the form $\frac{p}{q}$, where **p** is in the numerator (above the fractional line), **q** is in the denominator (under the fractional line), **p** and **q** must be integer and q different from zero.

Irrational number

Every real number that is not rational number, for example, $\sqrt{15}$, $\frac{\sqrt{3}}{2}$, π

Opposite numbers

These are two numbers whose sum is 0 - the neutral element of the addition. In a set R for each real number **a** exists - a number opposite to it **-a**, eg 2 and -2

The reciprocal of the number

For the number a ≠ 0, the number **a** and number $\frac{1}{a}$ are reversed. The number **a** and its reciprocal multiplication give the neutral element of multiplication ie 1. e.g.: 3 and $\frac{1}{3}$

Prime number

A natural number greater than **1**, which has exactly two divisors. Number **1** is not a prime number because it has one divisor. Number **0** is not prime because it has infinitely many divisors. Examples of prime numbers 2, 3, 5, 7, 11, 13, 17, 19, 23, ...

Composite number

A natural number that has more than two divisors. Examples of complex numbers: 4, 6, 8.9, ... The divisors of the number 8 are: 1,2,4,8

Divisor of numbers

The number that divides the given number without a remnant.

LCM

A few natural numbers are called the smallest of all common multiple of these numbers. For example :

LCM (9.12) = 36

GCD

Natural numbers are the largest natural numbers,which is a common divisor of these numbers, e.g.: GCD (18,12) = 6

Relatively prime number

Are those which have no common divisors, integers except -1 and 1, e.g.: 9 and 8

Summation
Action: a + b = c, where **a, b**-components, **c**-sum
Symbol: +. An operation to find the sum of two or more elements.
The inverse operation for addition is subtraction.
In arithmetic, the addition of numbers is variable : a + b = b + a,
and the combined i.e.: (a + b) + c = a + (b + c) and its neutral element is 0.

Subtraction
Action a-b = c, where a-is a minuend, b- subtrahend, c-difference (the result).

Multiplication
Action: a × b = c, where **a**- multiplicand, **b**- multiplier, **c**-product (multiple) Symbol: "×".
The operation of finding the product of two or more elements.
The reverse operation for multiplication is division.
In arithmetic, the multiplication of numbers is variable, i.e.: a × b = b × a and combined : (a × b) × c = a × (b × c) and its neutral element is one.

The combination of multiplication and summation
(a + b) × c = a × c + b × c

Multiplicand and multiplier
Numbers of the multiplication **(**product).

Factorization
Is the decomposition of a mathematical object into a product of other objects, or *factors*, which when multiplied together give the original.

Quotient
Division result a : b = c, where **a**- dividend, **b**- divisor, **c**- quotient (result).

Numerator
In fraction $\frac{p}{q}$ the number displayed above a line- **p**

Denominator
In fraction $\frac{p}{q}$ the number displayed below the line

Root
The root of n*th*-degree of the number **a**: $\sqrt[n]{a}$ **n**-the degree of the root (index,exponent,power), **a**- the radicand, e.g. $\sqrt[5]{14}$

Square root
The root of the second degree of a number **a** , for example: $\sqrt[2]{a} = \sqrt{a}$ for **a** ≥ 0 , that is: $\sqrt[2]{8} = \sqrt{8}$

Cube root
The root of the third degree of a number **a.** (The third degree of the number) e.g. $\sqrt[3]{a}$ that is: $\sqrt[3]{7}$

Degree of the root

A natural number greater than 1. We write the root in such way : $\sqrt[n]{a}$ **n**-the degree of the root (index) , that says "root of degree **n** of the number **a**."

Exponent (power)

a to the power **n**, that is : **n**-is the exponent of the number **a**, where $a^0 = 1$, and $a^n = a \cdot a \cdot a \cdot \ldots \cdot a$, and we multiply by n- times, **a**- base, **n**- exponent, **n** is a natural number

Degree of the product

e.g.: $(a \cdot b)^n$

Degree of quotient

e.g.: $\left(\frac{a}{b}\right)^n$

Exponential notation:

A positive integer a can be represented in the form of the product: $a = x \cdot 10^n$, where **x** is a number satisfying the condition 1≤ x <10 and **n** is an integer. For example, $326000000000 = 3{,}26 \cdot 10^{11}$
$0{,}00000097 = 9{,}7 \cdot 10^{-7}$

One

Name of the number $1 = 10^0$

Thousand

Name of the number $1\,000 = 10^3$

Million

Name of the number $1\,000\,000 = 10^6$

Billion

Name of the number $1\,000\,000\,000 = 10^9$

Approximation

By approximating a decimal number, we usually use a rounding rule that rejects the final digits of this number:

- when the first digit is dropped; 0, 1, 2, 3, 4 is the last digit left unchanged, ie when rounded to the whole $4.29 \approx 4$
- when the first digit is dropped; 5, 6, 7, 8, 9, the last digit of the preserved digits is increased by 1, i.e.: rounded to the whole $4.61 \approx 5$

Approximation with subnormality

When approximation is smaller, e.g.: 136,274 ≈136,27

Approximation with excess

When approximation is larger, e.g.: 136.275 ≈136.28

Accuracy

The number of valid digits in the number that determines the value of a certain size.

Percent (%)

1 % of a certain amount means $\frac{1}{100}$ of that amount

e.g.: 5% z 200 $\Leftrightarrow \frac{5}{100} \cdot 200 = 10$

Per-mille (‰)

1 ‰ of a certain amount means $\frac{1}{1000}$ of that amount

E.g. 5‰ from 200 $\Leftrightarrow \frac{5}{1000} \cdot 200 = 1$

Percentage point (p.p.)

This is the difference between two values of the same size (e.g. inflation) given in percentages. If the interest rate increased from 4% to 5%, the increase was 1pp, while the percentage was 25%

Formula

Arithmetical equality; we call two algebraic expressions connected by an equal sign, for example:
$S = V \times t$

Scale

A fraction that expresses the ratio of the length of a particular section in a technical drawing or map to its actual length eg 1: 250 means that 1cm on the map corresponds to 250cm

Unit

Fixed value of a certain size, used to express of other values of the same size.

Lengths:

1000mm (millimeter) = 100cm (centimeter) = 10dm (decimeter) = 1m (meter) = 0.001km (kilometer)

Mass

1000mg (milligram) = 1g (gram) = 0.1dag (decagram) = 0.001kg (kilogram); 1kg (kilogram) = 0.01q (centner) = 0.001t (ton)

Time: 3600s (second) = 60min (minute) = 1h (hour) = $\frac{1}{24}$ of a day; 1 week = 7 days;

1 quarter = 3 months

1 year ordinary = 365 days, 1leap year = 366 days

1 year = 365 or 366 days = 12 months = 4 quarters

Surface: $1m \times 1m = 1m^2$; $10m \times 10m = 100m^2 = 1a$; $100m \times 100m = 10000m^2 = 1ha$; 100a = 1ha; m-meter, a-ar, ha-hectare

Volume: $1cm^3 = 1ml$ (milliliter); $1dm^3 = 1l$ (liter); 100l = 1hl (hectolitre)

1 inch = 0.0254 m = 2.54 cm.

E.g. 1 dozen = 12 pieces.

2. THE LANGUAGE OF MATHEMATICS

Sentence

In mathematical logic we call sentence as closed sentence each of which is either true or false. It is also called a statement

Alternative and negation of alternative

The alternative is two sentences linked by the "or" (symbol ∨).
The alternative is true only in the case where at least one of the sentences included in its composition is true e.g:
(p∨q) is true only in case if **p** is true or **q** is true, e.g: $x^2 - 1 = 0$ is equivalent

(x-1) (x+1)=0 and it is equivalent to the alternative
(x + 1) = 0 ∨ (x - 1) = 0 i.e.: the alternative
x = - 1 ∨x = 1.

The negation of the alternative is the conjugation of negations, e.g.:
[~ (p∨ q)] ⇔ [~ p ∧ ~ q]

For example, the condition ~ ($x^2 - 1 = 0$) is equivalent
$x^2 - 1 \neq 0$ is equivalent
(x-1) (x+1) ≠0 and it is equivalent to the conjunction
(x + 1) ≠ 0 ∧ (x - 1) ≠ 0, that is, the conjugation
x ≠ - 1 ∧ x ≠ 1.

Conjunction

The conjunction is two sentences connected by the conjunction "and" (symbol ∧).
The conjunction of a compound statement is only true if both the combining statements are true.
For example;
(p∧q) is true only in the case when **p** is true and **q** is true
For example, the diagonal of the square intersect at right angles and are diagonally in the square and meet in the middle.
The negation of conjuncture is an alternative to negations
[~(p∧ q)] ⇔ [~p ∨ ~q]

E.g.: Diagonals in a square do not intersect at right angles or do not intersect in half

Implication

Implication is two sentences connected by the " then " (symbol ⇒).
Implication is only a false statement when the truth is false
Implication is false statement only once when from the truth we have a lie as a result, i.e.: (p⇒q) is true statement only in case if **p** is true statement and **q** is true or:

p is false and **q** is true or
p is false and **q** is false,
p is predecessor of implication, **q** is the consequence

For example: if a quadrilateral is a square, then the quadrilateral is trapezoid.
The negation of the implication is:
$[\sim (p \Rightarrow q)] \Leftrightarrow [p \wedge (\sim q)]$
That is, the quadrilateral is a square and is not a trapezoid.

Equality
Equivalence is two sentences connected by the conjunctive "then and only then" (symbol ⇔).
Equivalence is true if both sentences have the same logical value, ie both sentences are true or both are false
($p \Leftrightarrow q$) is true if and only if:
p is true and **q** is true or **p** is false and **q** is false
e.g.:number 111 is divisible by 3 ⇔ 111 + 3 is divisible by 3
number 112 is divisible by 3 ⇔ 112 + 3 is divisible by 3

Hypothesis
Statement, theory, or formula we have to prove, but that to which there is an assumption that it's true.

Mathematical theorem.
The truth that arises from the certainty is called the theorem, and the process of showing a theorem to be correct is called a proof.
The most general form of the theorem is "If A, then B". Theorem consists of two parts: assumptions (if ...) and thesis (that is ...).
The theorem which is appeared from a given by the substitution of the assumptions with the thesis is called the inverse theorem.

Not every inverse theorem is true.
For example Pythagorean Theorem: If a triangle rectangular (assumption), then the sum of the squares of the lengths of right-angled triangles is equal to the squared length of the hypotenuse(thesis)

The inverse of the Pythagorean Theorem (replacing the thesis with the assumption):
If in a triangle the sum of the squares of the lengths of two shorter sides is equal to the square of the length of the longest side (an assumption), then the triangle is a right triangle (thesis).

The proof
Logical reasoning that the sentence, theorem, or mathematical formula is true. The proof consists of a set of basic assumptions called axioms or prerequisites, which are combined in accordance with the laws of logic. The thesis is based on assumptions.

Direct proof
A logical argument in which a theorem or logical statement is proved as the result of a sequence of subsequent steps originating from the initial assumptions which we know or suppose to be true.

Indirect proof
The method of proving statements, based on of negation the thesis and showing that it leads to contradiction.

Sufficient condition
Each condition (assumption) of the occurrence of a certain fact (mathematical thesis) from which this fact arises. In the implication "if p is q" being the theorem, a statement **p** is a satisfactory condition to come the statement **q**.

Necessary condition
Any conclusion (thesis) from the occurrence of a certain fact (assumption) of mathematics arising from this fact. In the implication "if p is q" being a statement, the statement **q** is a necessary condition to come the statement **p**

Set
To determine the set it should be determined what are its elements
Finite set - a set that has finite number of elements. E.g: the set of divisors of 3, i.e.: {1,3}
An infinite set- a set that has an infinite number of elements, e.g.: a set of natural numbers, {0,1,2,3,4 ...}
A collection that has no elements is called a empty set and is denoted by$\varnothing$.

Subset of a set
Set A is a subset of set B denotes $A \subset B$,
e.g.: $N \subset C \subset W \subset R$, $W \not\subset NW$, $NW \subset R$, where N - set of natural numbers, C - set of integers, W - set of rational numbers, NW - set of non-rational numbers , R - set of real numbers.

The sum of the sets A and B (denoted $A \cup B$)
The sum of $A \cup B$ is the sum of all numbers that are in the set A or of the set B, i.e. :
$x \in (A \cup B) \Leftrightarrow [x \in A \text{ lub } x \in B]$

The product (common part) of sets A and B (we denote $A \cap B$)
The product of $A \cap B$ are all numbers, which are in the set A and set B,
i.e.: $x \in (A \cap B) \Leftrightarrow [x \in A \text{ i } x \in B]$

The difference between sets A and B (we denote $A \setminus B$)
To the difference $A \setminus B$ we take all the numbers that belong to the set A and do not belong to the set B, ie:
$x \in (A \setminus B) \Leftrightarrow [x \in A \text{ i } x \notin B]$

Addition of set A (we denote A')
The addition of A is the whole set, not belonging to A, i.e.: $A' = \Omega \setminus A$, where Ω is the whole space.

Inequality
Two values are connected by a sign of inequality: "<" -is less than, ">" - is greater than, "≤" - is less than or equal to, "≥"- is greater than or equal to.
Inequalities "<" and ">" are called strict inequalities, while inequalities, "≤" and "≥" are non-strict

Solution set
A solution set is the group of numbers that can satisfy an equation (inequality).

Equivalent Inequalities
Equivalent inequalities are inequalities with the same solutions

Equality
Two values linked by equality sign.

To solve the equation (inequality)
It means to find all the numbers that will give you a true sentence after substitutions.

E.g.: $x^2 = 4 \Leftrightarrow$ (x=2 lub x= -2)

$x^2 < 0 \Leftrightarrow x \in \varnothing$

Algebraic expression

A mathematical expression consisting of one or more algebraic symbols (ie, constants or variables), combined by the signs of the operation (+, -, ·,:,), and possibly parentheses, in accordance with the rules of mathematical notation

The simplest algebraic expressions are single constants (e.g. 5) and variables (e.g. *x*). monomial ($-3a^3$ b), binomial (e.g. $3x^3$ y- $2xy^2$) or polynomials (e.g. $2x^5 + 4x^2 - 3xy + 1$)

Monomial

An algebraic expression that is a number, a letter (variable), or a product of numerical and literal factors, for example: $-3 \cdot a^3 \cdot b = -3a^3b$

Coefficient of the monomial

A the numeric factor of a monomial that we write usually at the beginning, e.g.: for a monomial $3xy^4z$ the coefficient is a number 3

Binomial

An algebraic expression with two variables, e.g.: $3x + 2y^3$

Polynomial

Polynomial is an algebraic expression which is the sum of variable monomials, which we call the terms of polynomials, e.g.: $3x^2 - 2xy + \sqrt{2}y$

Algebraic sum

It is an algebraic expression made up of monomials joined by the mathematical symbols: addition and subtraction e.g.: 2x + y = z

The irrational expression

It is an algebraic expression, in which there are roots: $\sqrt[3]{xy - z} - 2xy$

Rational expression

An algebraic expression written in the form of a quotient of two polynomials, where the divisor can not be zero $(a^3 - 2ab) : (2x)$

Value of algebraic expression

A numerical value obtained by inserting in place of variables (letters) a given number and performing the indicated actions.

Algebraic Equality (formula)

Two algebraic expressions connected by an equality sign |a|.

| a | = a, when a is non negative or | a | = -a, when a is negative. E.g.: | 2 | = 2, | -2 | = - (-2) = 2

Error

Measurement inaccuracy or a certain value

Absolute error
Indicates how different the measured value from the exact calculation or measurement is independent of the corresponding standard value. This error is derived from the formula:
absolute error = |x−a|

where: **x** - is the exact value, **a** - the approximation of the number **x**
E.g: the fence is 122.5 meters long. The measurements made by the students were 120 meters.
Absolute error | 122,5 – 120 | = 2,5m

Relative error
We count on the formula and express it in percentages:
Relative error = $\frac{błąd\ bezwzględny}{|wartość\ rzeczywista|} \cdot 100\% = \frac{|x-a|}{|x|} \cdot 100\%$,
where: **x** - is the exact value, **a**- is the measured value
E.g: the fence is 122.5 meters long. The measurements made by the students were 120 meters.
Relative error = $\frac{|122,5-120|}{|122,5|} \cdot 100\% = \frac{2,5}{122,5} \cdot 100\% = 2,04\%$

3. FUNCTIONS

Scale
Graphical representation of the scale.

Zero point
The point to which the number is assigned. The point divides the numerical axis into two half-axes: positive (to which point belongs) and negative. We call it the starting point of the numerical axis.

Single point
The point to which the number 1 is assigned

Numeric axis
Straight, on which two points are marked: the unit point and the zero point dividing the axis into two half-lines.

Vertical axis
Y axis (OY) or ordinate axis.

Horizontal axis
X axis, OX or abscissas axis .

Ordered pair
A pair of numbers or elements for which order is specified - indicates which element is first, and which is second, etc.

Coordinate system
The rectangular coordinate system on the plane we call two axes oriented perpendicularly to each other, with a common zero point denoting the letter O. This point is called the origin of the coordinate system and denotes O (0,0) or O = (0,0)

Coordinate
If point A has coordinates (x, y), then we call the first coordinate (abscissa) of point A, and y is called the second coordinate (ordinate) of point A and write A (x, y) or A = (x, y)

Cartesian product
This is a set of ordered pairs (x, y) where $x \in A$ and $y \in B$. $AXB = \{(x, y): x \in A \wedge y \in B\}$.

Function
A function is called assignment, which assigns to each element of one set the element of another set. Functions are often defined as the relation between elements of two sets. Each element of one set, called the domain, exactly corresponds to one element of the second set, called the counter. The field elements are arguments, and the counts are the values of the function.

Graph
A drawing showing the relationship between numbers or values.

The graph of the function
The function graph $f: X \rightarrow Y$ is a set of all points with coordinates $(x, f(x))$, where $x \in X$.

Domain
A set of numbers or quantities, for which certain action is defined.

Zero of a function
For $y = f(x)$, we call such its argument for which the function value is zero.

Increasing Function
If for any two arguments x_1, x_2 the condition is satisfied if $x_1 < x_2$, than $f(x_1) < f(x_2)$

Decreasing function
If for any two arguments x_1, x_2 the condition is satisfied if $x_1 < x_2$, than $f(x_1) > f(x_2)$

Constant function
If for any two arguments x_1, x_2 the condition is satisfied if $x_1 < x_2$, than $f(x_1) = f(x_2)$

Non-decreasing function
A function that is growing or constant

Non-increasing function
A function that is decreasing or constant

Continuous function
A function that does not have sudden changes in values in the whole field. Each point is a point of continuity. It does not break up in any place.

Multivariate function
It is a function of $f: X \rightarrow Y$, which assigns different values to different arguments, i.e. the inequality $f(a) \neq f(b)$ for any argument $a,b \in D$ results from inequalities $a \neq b$

Even function
If for any two arguments x,- x $\in$D, the condition f (x) = f (-x) is satisfied, ie if the function graph is symmetrical to the axis OY. e.g.: y = cos x

An odd function
If for any two arguments x,- x $\in$D, the condition f (-x) = -f (x) is satisfied, i.e.: if the function graph is symmetric to the point (0,0) i.e.: y = sin x

Periodic function
A function for which there is a period T. The periodic function has infinitely many periods of form kT_1, k$\in$C i.e.: trigonometric functions .

Linear function
The real function of the real variable f: R $\rightarrow$ R is given by the formula f (x) = a x + b, where **a** and **b** are certain fixed real numbers, called coefficients. The line function is a straight line

Equations of a Straight Line
Equation of form f (x) = a x + b where a, b $\in$R, a - direction coefficient = tg α, where the α- angle of the straight line to the positive half axis OX, and **b**- the point of intersection of the line with the axis OY,

General Form of Equation of a Line
Equation of the form Ax + By + C = 0

Square function (square triangle)
$f(x) = a x^2 + b x + c$, a ≠ 0 , D = R -. general form,
$f(x) = a (x - p)^2 + q$ – is the canonical form, where p = $p = \frac{-b}{2a}$, q = $\frac{-\Delta}{4a}$, (p , q) – vertex of a parabola
f (x) = a (x – x_1) (x – x_2) – character multiplicative, for $\Delta \geq 0$ and $x_1, x_2 = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$
Its graph is a parabola.

A degree function
The function of the form $f(x) = x^c$, c$\in$R. The domain of the function and its graph depend on the exponent of power. Special cases are the functions:
$f(x) = x^2$ whose graph is a parabola. $f(x) = x^{-1} = \frac{1}{x}$, x$\in$R\{0}, the graph of which is hyperbole

The exponential function
Functional form $f(x) = a^x$, a > 0, a ≠1, D = R. Its graph is the exponential curve.

Logarithmic function
Functional form $f(x) = \log_a x$, a > 0, a ≠ 1, D = R_+. The graph is a logarithmic curve.

Trigonometric functions
Functions of form: f (x) = sin x, D = R; f (x) = cos x, D = R; f (x) = tg x and cos x ≠ 0; f (x) = ctg x and sin x ≠ 0. The diagrams are named: sinusoidal, cosine, tangent
and cotangent. These functions are periodic.

Module
Function of form: f (x) = | x | , D = R. Its graph is two rays y = x and y = - x with the beginning at the point (0,0) contained in the upper field of the coordinate system.

Signum function (sign)
A function that accepts a value of +1 for a positive argument, a value for -1 for a negative argument, and a value of 0 for an argument equal to 0, D = R. The function is a linear interval. It is not continuous.

Asymptote
Straight line, to which the curve approaches an infinitesimal distance, when the point moves away infinitely over the branch of the curve, e.g.: hyperbola has two asymptotes

Proportion
Equality of two relations.

Direct proportionality
The relationship between the two variables x and y, defined by the formula y = ax, where a ≠ 0, called the coefficient of proportionality. E.g.: y = 2x, straight line graph.

Inverse proportionality
The dependence between two variables **x** and **y**, the formula $y = \frac{a}{x}$, $x \neq 0$where **a** is any number different from zero.
For example, $y = \frac{1}{x}$, $x \neq 0$, then the graph is a hyperbola.

4. PLANIMETRY

Flat geometry (planimetry)
Branch of mathematics dealing with sets of points, lines, planes, curves, their relations, properties, transformations of figures, and the measure set on the variety of shapes.

Geometric plane figure
Each set of plane points, eg point, line, curve, plane, circle, square, triangle, polygon.

Curve
A geometric figure, which is the sum of a finite number of segments that meet the following conditions: 1) any two sections have at most one common point, 2) segments can be arranged so that the end of the first segment is the beginning of the second, the end of the second segment was the beginning of the third, etc.

Closed curve
line, which the end of the last segment coincides with the beginning of the first episode.

Straight line
Simple is the so-called primary notion, we interpret it as a special case of the unlimited lines on both sides.

Ray
One of two parts of a straight line defined by any point belonging to a straight line. Each of these parts together with the point is a ray. The point is called the beginning of the ray

Line segment
At the ends A and B is the set of all points of the line AB lying between the points A and B along with these points.

Zero segment
A one-point set is also an segment

Length
The distance of two points calculated along the curve (or straight line) on which they lie.

The length of the segment
The real number that we find by determining how many times the unit segment is in a given segment.

The length of the curve
The sum of the sides length of this curve.

Equal segments
Two segments of equal length.

Collinear points
Points that belong to one straight line.

Non-collinear points
Points that do not belong to one straight line.

Convex figure
A geometric figure in which each segment with ends belonging to this figure is included in this figure.

Concave figure
A figure that is not convex.

Angle
Each of the two parts of the plane bounded by two rays with a common beginning along with the rays.
The units for angles are radians [rad] and degree [°]

Side of an angle
One of the rays forming a given angle.

The zero angle
An angle whose sides coincide and form an angle of 0 °

Full angle
An angle whose sides coincide and forms a cat with a 360 ° angle

Straight angle
Angle, whose sides extend to form a straight line. Measure 180 °

Right angle
The angle whose measure is 90 °

Acute angle
Angle whose measure is greater than 0 ° and less than 90 °

Obtuse angle
Angle whose measure is greater than 90 ° but less than 180 °

Convex angle
This is the angle whose interior is a convex figure.

Concave angle
This is the angle whose interior is a concave figure.

Angle directed
The angle whose sides have been ordered, the first side is called the initial and the second -the end. It can be a positive angle: the angle measure is positive or the angle is negative: the angle measure is negative.

Equal angles
Otherwise, these angles are congruent.

Angle measure
The real number that we find determines how many times the unit angle to which we assign the measure is in a given angle.

Adjacent angles
Two convex angles that have a common apex and one joint side, and the other two sides extend to form a straight line. The sum of measures of adjacent angles is equal

Point angles
Two convex angles, for which the sides of one of them are extensions of the sides of the other. The apex angles are equal.

Corresponding and alternating angles
Two convex angles, for which the sides of one of them are extensions of the sides of the other. The apex angles are equal.

Corresponding and alternate angles
They have equal measures

Polygon exterior angles
Angle adjacent to the convex internal angle

Angle inscribed in a circle (circumference)
The convex angle, whose vertex belongs to the circumference, and the sides are semi-straight, containing the chords of the circle (circumference).

Center angle of the circle (circumference)
Angle with a vertex in the center of this circle (circumference).

Triangle
A polygon that has three sides.

Sharp triangle
Triangle, which all internal angles are sharp.

Right triangle
A triangle whose one of interior angles is direct.

Obtuse triangle
A triangle whose one of the internal angles is an obtuse angle.

Equilateral triangle
A triangle in which all sides have equal lengths.

Isosceles triangle
A triangle that has at least two sides of equal length.

The congruent triangles
A triangle, each side of which has a different length.

Similar triangles
These are triangles, which are similar figures on the scale k.

Symmetry of the segment
Straight perpendicular to this section and passing through the middle of the segment. In each triangle, symmetrical intersect at one point and this is the center of the circle described in this triangle.

A bisector of the angle
Ray, lying at an equal distance from the sides of the angle. The bisector has a beginning at the apex of the angle and divides the cat into half. In each triangle, the bisectors intersect at one point and this is the center of the circle inscribed in this triangle.

Median of a triangle
A section connecting any vertex of the triangle with the center of the opposite side. In each triangle the middle intersect at one point and this is the center of gravity of the triangle. The middle intersect in a ratio of 2: 1

The height of the triangle
A segment derived from a given vertex of a triangle and perpendicular to a line containing the opposite side of the triangle, connecting the vertex to the point belonging to that side or to its extension. In each triangle, heights intersect at one point and this is the orthocenter of the triangle.

Quadrangle
A polygon that has four sides.

Trapezoid
A quadrangle that has at least one pair of parallel sides.

Isosceles trapezoid
Trapeze, in which the sides are of equal length.

Rectangular trapezoid
Trapezoid, in which one of the arms is perpendicular to the bases.

Parallelogram
A quadrangle, each of which has two opposite sides parallel.

Rectangle
A square with all angles equal.

Diamond
A quadrangle, all sides of which are of equal length. Diamond diagonals intersect at a right angle and intersect in the middle.

Square
A quadrangle that has all sides and angles equal.

Kite
Convex quadrilateral, having two pairs of adjacent sides of equal length. The two opposite angles of the kite are equal. Its diagonals are perpendicular to each other, and the shorter one is divided by half for a longer one. The field of kite is equal to the half of the product of the diagonal length.

Polygon
A set of plane points bounded by a closed curve, along with that curve. Otherwise-polygon.

Convex polygon
A polygon that is a convex geometric figure. A polygon is convex if and only if all its internal angles are convex or all diagonals are contained in this polygon.

Polygon concave
A polygon that is not a convex polygon. In a concave polygon, at least one diagonal is not included in it, and at least one internal angle is larger than a semi-solid angle.

Regular polygon
Convex polygon, which has all sides of equal length and its internal angles have equal measures, eg equilateral triangle, square

Polygon diagonal
The segment connecting the vertices of a polygon that is not a side of the polygon.

The perimeter of the polygon
The length of the curve limiting that polygon.

Area of a flat figure
The real number that we find, determining how many times the unit square to which we assign an equal field fits in a given figure, i.e. how many such squares fills this figure.

Sine
The trigonometric function of the acute angle α in a right-angled triangle is represented by the ratio of the length of of the hypotenuse that is lying opposite the angle α , to the length of the hypotenuse.

Cosine
The trigonometric function of the acute angle α in a right-angled triangle is given as the ratio of the length of the hypotenuse that is lying at an angle α , to the length of the hypotenuse.

Tangent
The trigonometric function of the acute angle α in a right-angled triangle is defined as the ratio of the length of the hypotenuse that lies opposite the angle α to the length of the hypotenuse that is lying at an angle α

Cotangent
The trigonometric function of the acute angle α in a right-angled triangle is determined by the ratio of the length of the hypotenuse that lies at an angle α to the length of the hypotenuse that is lying opposite the angle

Radian
One radian is the angle subtended at the center of a circle by an arc that is equal in length to the radius of the circle .

Trigonometric identity
Equality for all values of variables occurring only as arguments of trigonometric functions and belonging to the fields of these functions.

5. ANALYTICAL GEOMETRY

Vector
A quantity that has magnitude ,direction and length

Vector zero
When its beginning and end coincide. Vector zero $\vec{0}$

Connected vector
$\overrightarrow{AB}$ - is an ordered pair of points (A, B) where A - the origin of the vector, B - the end of the vector. A vector bound differently - a bound vector

Opposite vectors
They are and only if their respective coordinates are opposite numbers.

The distance of a point from the straight line
The length of the segment perpendicular to the straight line, whose one end is the given point, and the other end is the point belonging to the straight line.

Distance between (two) straight parallel
The length of each segment perpendicular to these straight lines, with ends belonging to these straight lines

Circle
A set of plane points whose distance from a fixed point called the center of the circle is not greater than the radius of the circle equation $(x – a)^2 + (y – b)^2 \leq r^2$, where S = (a, b) and r - radius of the circle.

Circumference
A set of plane points whose distance from a fixed point called the center of the circle is equal to the length of the radius. Circle equation $(x – a)^2 + (y – b)^2 = r^2$, where S = (a, b) and r - radius of a circle

Circular ring
A geometric figure limited by two concentric circumferences

Radius of a circumference (circle)
A segment with ends at points O and A, where point A belongs to a circumference
(circle), and O is the center of a circumference (circle). The radius is marked with a letter **r**

Chord
The segment connecting any two points on the circumference (circle)

Diameter
The longest chord of the circumference (circle), it passes through the center of the circumference (circle).

Semicircle
One of the parts of the circle, which are divided by its diameter. Each diameter of the circle determines two semicircles, which in total form a circle. The semi-circle contains the diameter that marks this semicircle.

Semi circumference
Arc based on the diameter of the **circumference**. Each diameter designates two semi circumferences
Each semi circumference
includes the ends of the diameter defining this semi circumference

Section of the wheel
A geometric figure, being part of a circle bounded by two rays and circumference arc

The circumference described on the triangle (quadrilateral)
A circumference that passes through all the vertices of a triangle (quadrangle).

Circumference inscribed in a triangle (quadrangle)
The circumference which is tangent to each side of the triangle (quadrangle).

The mutual position of two circles: O1 with center in A and radius R and O2 with center in B and radius r
- external tangents - $| AB | = R + r$
- internal tangents - $| AB | = | R - r | > 0$ - disconnected externally - $| AB | > R + r$
- intersecting $| R - r | < | AB | < R + r$ - disconnected internally- $| AB | < | R - r |$

Mutual position of a circle and a straight line
Tangent to circumference - circumference tangent to a straight line, if the straight line and circumference have one common point. The radius of the circumference in relation to the tangent is always at right angles.Tangent of circumference - a straight line that crosses two points.

External to the circle - Straight line and circumference do not have common points

Isometry
Geometric transformation that preserves the distance of points. Axial symmetry - reflection in relation to a simple line. Center symmetry - reflection in relation to the point
Transformation [shift] on the vector. Rotate around a given point at a given angle.

Congruent figures
These are two geometrical figures F and F' for which there is an isometric transformation such that the image of Figure F is Figure F'

Homothety
Whith the centre in point O and the scale k, k≠0 is a transformation of the plane that each point P considers

a point P' that: $\overrightarrow{AP'} = k \cdot \overrightarrow{AP}$

Similarity with the scale k, k> 0
Transformation of the plane which assigns points A 'and B' to each two points A and B such that: | A'B '| = k × | A B |

Similar figures
These are two geometrical figures F and F 'for which there is a geometrical transformation, called similarity, such that the image of figure F is figure F'.

6. SEQUENCES

Sequence
An ordered set of numbers. Every its element can be written as an algebraic function of the position of that element in a given sequence. The finite sequence has a finite number of words.

Subsequent element
The next element of this sequence follows the sequence element.

Arithmetic sequence
A sequence in which the difference between any word and the previous word is constant. The difference between two consecutive string words called the difference of the arithmetic sequence.

Geometric sequence (geometric progression)
A sequence in which the ratio of each word to the previous word is constant. This ratio is called the quotient of the geometric sequence and denoted by **q**.

7 . STEREOMETRY

Spatial geometry (stereometry)
Science about geometrical figures in three-dimensional space.

Spatial figure (solid)
Any set of points of three-dimensional space.

Rectangular projection on the plane
A rectangular projection on the plane P in the direction of line 1 is a parallel projection in which the line l is perpendicular to the projection plane

A rectangular projection on the straight line
A rectangular projection on straight line k in the direction of line 1 is a parallel projection in which the line l is perpendicular to the projection plane

The distance of two parallel planes
Is the distance of any straight line lying on one plane from the plane of the other.

The distance of the point from the plane
The distance of a point A from the plane P is called the length of the segment AA', where the point A' is a rectangular projection of a point A on the plane P

The distance of the straight line from the plane
The distance of any point of the straight line that must be parallel to the plane, from that plane.

Convex polyhedron
Polyhedron, which is a convex figure.

Regular polyhedron
Convex polyhedron, (Platonic solid) whose walls are all congruent polygons and each of its vertices belongs to the same number of faces.

Prism
A polyhedron having two parallel faces called bases that are convex polygons. Other faces, called sides are parallelograms formed by sections connecting the tops of the opposite bases. If the side of the prism are rectangles, the prism is called a straight one. Otherwise, the prism is slanted. The triangular prism has triangles in the bases and three sides. The rectangular prism has quadrilateral in the bases and four sides. The cube is a special case of such a prism.

Straight prism
Prism whose side edges are perpendicular to the bases, otherwise we talk about the prism that it is sloping.

Correct prism
Correct prism - a prism the basis of which are the right polygons..

Cube
A cuboid whose faces are all squares.

Parallelepiped
Prism whose bases are parallelograms.

Cuboid
Parallelepiped all of whose faces are rectangles.

Pyramid
A polyhedron whose one face,is called the base of a pyramid, is a polygon, and the other faces, called sides, are triangles with a common vertex, called the vertex of the pyramid.

Right pyramid
A straight pyramid whose basis is a regular polygon.

Simple pyramid
A pyramid, on the basis of which a circumference can be described, and a base of a pyramid's height coincides with the center of a circumference described on the basis.

Base of a pyramid height
The common point of the pyramid height and its base.

Tetrahedron
The triangular pyramid

A regular tetrahedron
A tetrahedron built of four equilateral triangles. A regular tetrahedron is a right triangular pyramid.

Cross-section of the prism (pyramid)
The common part of the prism (pyramid) with the plane intersecting all its lateral edges.

Diagonal cross-section of the prism (pyramid)
Part of the common prism (pyramid) with a plane passing through its two edges not belonging to one face.

Volume
Symbol: *V*. a measure of the volume of space occupied by a solid body or a limited closed surface. A unit of volume in SI is cubic meter (m^3).

Inclination angle
This is the angle between the straight intersecting plane (non-perpendicular to it) and the given plane, i.e. the angle between this straight line and its rectangular projection on the plane. This angle is called the angle of the slope of the line to the plane.

Dihedral angle
Each of the two parts of space designated by two planes with a common edge along with these edges

The measure of a Dihedral angle
A measure of a flat, or linear angle, which is a common part of a dihedral angle and a plane perpendicular to its edge

Solid body rotation
A solid generated by a rotating flat figure, relative to a line called the axis of rotation.

Roller
A roller is a rotating body obtained by rotating a rectangle around a line containing its side.

Cone
A rotational body obtained by rotating a right triangle around a line containing one of the rectangles of this triangle

Ellipse
A solid body of rotation obtained from the rotation of the wheel around the line containing the diameter of the wheel.

Sphere
Rotation body obtained from the rotation of a circle around a line containing the diameter of a circle.

The ellipse described on the polyhedron
It is a ellipse in which the polyhedron is contained and all its vertices belong to the surface of the sphere. We say that the polyhedron is inscribed in a ellipse.

A ellipse inscribed in a polyhedron
All of its faces are tangent (meaning they have one common point) to the sphere.

8. STATISTICS ELEMENTS

Statistical characteristic
The property of a statistical sample that makes it not representative of the entire totality

Diagram
Graphical presentation of statistical data, i.e.giving the value of a variable, called a statistical characteristic, registered during the statistical research.

Circular diagram (pie chart)
A graph in which the quantitative ratio is represented by pie slices.

Bar diagram
A graph in which the quantitative ratio is represented by vertical or horizontal posts.

9. ELEMENTS OF ENTREPRENEURSHIP

Gross
Cash value, including VAT (accounts payable).

Product price
This is the monetary value of this product, which depends on the costs incurred to obtain it.

Price of balance
The price of a product or service at which the demand and supply for this product or service are equalized.

Income
Any monetary and natural income received by the physical or legal person for a certain period

The cost function
The function y = K (x), which is the number of pieces or kilograms of the product produced, therefore, the output x, assigns the cost (total) K (x) [to PLN] incurred for this product.

The supply function
It is an assignment $y = S(c)$, according to which the variable price corresponds to the supply of a given product $S(c)$.

Demand function
This is a function $y = P(c)$ that assigns the variable price of the product to the number of units sold in this product, and, therefore, the volume of demand $P(c)$.

The revenue function
Assigning x a unit of a certain product of a sale $U(x)$ from their sale.
Assign a certain product to sales units from their sale $y = U(x)$

Percentage margin"from the hundred"

Called the overhead is the ratio of the quota margin to the net purchase price expressed as a percentage. Responds to the question "If the % of price A of net sale is higher than the net purchase of price B?". Otherwise "If the % of A sale price is higher in relation to the purchase price B?" That is- $\frac{A-B}{B} \cdot 100\%$

Percentage margin"in hundred"
Ratio of the amount margin to the net selling price expressed as a percentage. It answers the question "If" the % of price B of net purchase is lower than the net selling price A? "Otherwise" If the purchase price B is lower than the sales price A " $\frac{A-B}{A} \cdot 100\%$

Margin
It can be a margin quota or expressed as a percentage. There are two types of interest margin called: the "in hundred" margin and the "from the hundred" margin.

Quota margin

Expressed in units of payment, as the difference between the sale price of the product and the cost of its purchase (profit from sales)

Nett
Value excluding VAT (gross price - VAT = net price).

Rise
Part of the amount spent on the purchase of the goods and added to the purchase price to ensure profit from the sale. The markup is expressed as a percentage, it is a percentage margin "from a hundred"

Suggestion
The amount of goods and services offered for sale at a given price and at a specified time.

Demand
Demand for specific goods or services, and thus the amount of goods or services that the customers will buy at a given price within a certain time.

Revenue
The total amount of money received from the sale of goods for a certain period, for example, daily store revenue

Value Added Tax
Is a type of general consumption tax that is collected incrementally, based on the increase in value of a product or service at each stage of production or distribution.

Profit
A financial gain, especially the difference between the amount earned and the amount spent in buying, operating, or producing some.

The author of the mathematical dictionary:

Agata Kubiak, a teacher of mathematics of the General Educational Non-public College of Saint Stanislaw Kostka in Warsaw.
Translation: Tłumaczenie: Tetiana Stetsyk.