

## ~ Mathematics Theory

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1. Explain the terms: set, subset, intersection, union and difference of sets, complement of set. Adduce examples. Define the term interval and specify the types of intervals.
  2. Explain the basic rules and methods of direct proof, indirect proof and proof by contradiction. Adduce examples.
  3. Explain the content of the term statement. Use concrete examples to define conjunction, alternative, implication, equivalence and explain their veracity values. Explain the importance of quantifier and use concrete example to show negation of the statement with quantifier.
  4. Define the numerical sets  $\mathbb{N}$ ,  $\mathbb{N}_+$ ,  $\mathbb{Z}$ ,  $\mathbb{Q}$ ,  $\mathbb{I}$ ,  $\mathbb{R}$  and their relationships. Define the terms: prime number, composite number, the least common multiple, the greatest common divisor, relative primes and use concrete example to explain the product of primes
  5. Explain the content of the terms: quadratic equation, roots of quadratic equation, discriminant. Use concrete example to show the relationship between roots and coefficients of the quadratic equation. Use concrete example to show the link between the solution of quadratic inequality, the roots of quadratic equation and the graph of quadratic function.
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6. Define function, its definition domain and range of values, its properties (monotony, boundedness and extremes). Use concrete examples to show when function is even or odd.
  7. Define linear function and quadratic function. Use concrete examples to show their properties and sketch their graphs. Explain the function of the coefficient of quadratic member in quadratic function.
  8. Define an exponential function, sketch its graph and describe basic properties of given function. Explain its relation to logarithmic function.
  9. Define the goniometric function  $y = \tan x$  (definition with functions sine and cosine and definition with unit circle). Sketch its graph and describe the basic properties of given function. What is the smallest period of this function?
  10. Define a power function and sketch its graph. Define a linear fractional function, use concrete example to explain the term: the asymptote of linear fractional function.
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11. Define a circle and explain the difference between circle and circumference. Explain the terms: chord of circle, arc of circle, sector of circle, area of circle, area of circle sector and Thales's theorem. Show variable possibilities of the mutual positions of two circles and explain how these positions relate to the difference between centres and radii of both circles.
  12. Define the triangle and explain the terms: median of triangle, centroid, altitude, transversal line, inscribed circle of triangle and circumcircle of triangle, triangle inequalities. Classify the triangles according to their angles and their sides.
  13. Write: Pythagorean theorem, sine rule and cosine rule. Explain how and when they can be used.
  14. Explain the terms: general equation and general Cartesian equation of the straight line. Use concrete example to explain the relation between the coefficients in general equations of parallel lines and perpendicular lines.
  15. Characterise the basic types of the parallelograms and trapezoids. Talk about the properties of their angles, sides and diagonals. Write the formulas for their circuits and areas. Explain the terms: convex polygon, regular polygon.
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16. Use concrete examples to name and explain the identical transformations in the plane. Find self-reflected points in each transformation.
  17. Define a circle as a set of the points of given property. Write the analytical equations of the circle with centre  $S[m, n]$  and radius  $r$ . Characterise mutual position of the straight line and circle if they are given analytically.
  18. Explain the terms: Cartesian coordinate system in the space, point and its coordinates. Choose 2 points A and B and calculate their distance. Calculate coordinates of the midpoint of abscissa AB.
  19. Characterise and use concrete example to show possibilities of mutual positions of 2 straight lines, line and plane, and 2 planes in the space (use a cube).

20. Explain the terms: solid, polyhedron, node, edge, face, tetrahedron, prism, block, cube, pyramid, cylinder, cone and sphere. Write formulas for their surfaces and volumes. Use concrete example to explain the term: net of the cube.
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21. Characterise and use concrete example to define the terms: angle of 2 straight lines, perpendicular lines and perpendicular planes, line perpendicular to plane, angle of line and plane, angle of 2 planes, orthogonal projection of point and line into plane, distance of 2 linear figures (2 points, point and plane, point and line, distance of 2 parallel lines, line and parallel plane and 2 parallel planes) in the space. (Use a cube)
22. Define a function. Explain the terms: graph of function, one-to-one function, inverse function, composite function, periodic function and constant function.
23. Define the terms: variations and variations with repetition, permutation, combinations. Use concrete examples to explain formulas for their calculations. Use concrete example to explain combinatorial rule of sum and of product.
24. Explain the terms: statistic population, modus, median, arithmetic mean, variance, standard deviation. Use concrete example to show the separation of population and its illustration by graph.
25. Explain the terms: factorial, combination number, Pascal's triangle. Use concrete example to show their use.
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26. Define the geometric sequence, explain the common ratio of a geometric sequence and analyse a geometric sequence given recurrently. Use the formulae for the  $n$ -th term and the sum of  $n$  terms of a geometric sequence. Adduce examples.
27. Define the arithmetic sequence, explain the 'difference' of such a sequence and the monotony (explain the relations). Explain the arithmetic sequence in the form of a recurrent expression. Use the formulae for the  $n$ -th term and the sum of  $n$  terms of an arithmetic sequence. Adduce examples.
28. Define a sequence (in general). Explain the monotony and the boundedness of a mathematical sequence using examples. Explain the recurrent expression of a sequence.
29. Define a logarithmic function and sketch its graphs. Analyse the basic properties and explain the relation to the exponential function. Explain the term 'logarithm'.
30. Define a goniometric function. Describe the properties of the following goniometric functions:  $y = \sin(x)$ ,  $y = \cos(x)$ . Compare and contrast the properties of the following functions:  $y = \sin(2x)$ ,  $y = 2\sin(x)$ . How do the parameters affect the functions?