

MATHEMATICS I (2012-13) ORAL EXAM REQUIREMENTS

Numbers of definitions and theorems as read on the lectures and appear in Lecture Notes <https://www.karlin.mff.cuni.cz/~murtin/mathematicsI.pdf>

Key notions.

- Supremum and infimum (Definition 1.4)
- Limit of a sequence – proper, improper (Definitions 2.4 and 2.8)
- Neighborhood of a point (Definition 3.9)
- Limit of a function (Definition 3.10)
- Continuity of a function at a point (Definitions 3.13, 3.14)
- Continuity of a function on an interval (Definition 3.15)
- Extremum of a function – maximum, minimum (Definition 3.16)
- Derivative of a function at a point (Definition 3.23)
- Inflection point (Definition 3.28)
- Convex and concave functions (Definition 3.29)

Definitions.

- Set bounded from below, bounded from above, bounded set, upper, lower bound (Definition 1.3)
- Maximum, minimum of a set (Definition 1.5)
- Integer part (Theorem 1.5)
- Sequence bounded from below, bounded from above, bounded sequence (Definition 2.2)
- Monotonicity of a sequence (Definition 2.3)
- Convergent sequence (Definition 2.4)
- Subsequence (Definition 2.5)
- Mapping and related notions (Definitions 3.1 and 3.2)
- Mapping onto, injective, bijective mapping (Definition 3.3)
- Inversion mapping (Definition 3.3)
- Monotonicity of a function (Definition 3.5)
- Odd, even function (Definition 3.6)
- Periodic function, period (Definition 3.7)
- Function bounded from below, bounded from above, bounded function (Definition 3.8)
- Punctured neighbourhood of a point (Definition 3.9)
- Limit from the right, limit from the left (Definition 3.12)
- Natural logarithm (Theorem 3.15)
- Local extremum of a function – local maximum, local minimum (Definition 3.17 = 3.16')
- Exponential function (Definition 3.17)
- Value a^b (Definition 3.18)
- Logarithm to the base a (Definition 3.20)
- Trigonometric functions (Theorem 3.19, Definition 3.21)
- Cyclometric functions (Definition 3.22)
- Derivative of a function from the right, from the left (Definition 3.24)

- n -th derivative (Definition 3.26)
- Tangent line to a graph (Definition 3.27)
- Strictly convex, strictly concave functions (Definition 3.29)
- Asymptote (Definition 3.30)

Theorems with proofs.

- De Morgan Laws (Theorem 1.3)
- Binomial Theorem (Example after Theorem 1.3)
- Supremum Theorem (Theorem 1.4)
- Existence of Integer Part (Theorem 1.5)
- Archimede Property (Theorem 1.6)
- Density of the rationals (Theorem 1.8)
- Uniqueness of limit (Theorem 2.1)
- Limit and boundedness of a sequence (Theorem 2.2)
- Limit of a subsequence (Theorem 2.3)
- Arithmetics of proper limits (Theorem 2.4)
- Triangle Inequality (Proposition 2.5)
- Limit of a product of bounded sequence and a sequence converging to 0 (Theorem 2.6)
- Limits preserve ordering (Theorem 2.7)
- Sandwich Theorem (Theorem 2.8)
- Monotonicity and limit (Theorem 2.10)
- Uniqueness of limit of function (Theorem 3.1)
- Limit and boundedness of a function (Theorem 3.2)
- Arithmetics of limits (Theorem 3.3)
- Limits and inequalities (Theorem 3.5)
- Limit of composition (Theorem 3.6)
- Heine Theorem (Theorem 3.7)
- Limit of monotone function (Theorem 3.8)
- Continuous images of intervals (Theorem 3.10)
- Continuous functions on closed bounded intervals (Theorem 3.12)
- Continuity and attainment of extrema (Theorem 3.13)
- Properties of logarithm (Proposition 3.16)
- Properties of exponential function (Proposition 3.17)
- Derivative and continuity (Theorem 3.22)
- Arithmetics of derivatives (Theorem 3.23)
- Derivative of composed function (Theorem 3.24)
- Necessary condition of local extremum (Theorem 3.26)
- Rolle Theorem (Theorem 3.27)
- Lagrange Theorem (Theorem 3.28)
- Monotonicity and the sign of derivative (Theorem 3.29)
- Necessary condition for inflection point (Theorem 3.32)
- Computation of asymptote (Theorem 3.35)

Theorems without proofs.

- Existence of n -th root (Theorem 1.7)

- Density of the irrationals (Theorem 1.8)
- Arithmetics of improper limits (Theorem 2.9)
- Bolzano-Weierstrass Theorem (Theorem 2.11)
- Bolzano (Darboux) Theorem (Theorem 3.9)
- Continuity of inversion function (Theorem 3.14)
- Existence of natural logarithm (Theorem 3.15)
- Existence of sine (Theorem 3.19)
- Properties of sine (Theorem 3.20)
- Derivative of inversion function (Theorem 3.25)
- l'Hospital Rule (Theorem 3.30)
- Computation of derivative from the right/from the left (Theorem 3.31)
- Sufficient condition for inflection point (Theorem 3.33)
- Convexity/concaveness and the sign of the second derivative (Theorem 3.34)