Preliminary topics of the
Mathematics Exam for Pharmacy students

Year 2015-2016

Series A

Basic algebra:
Working with fractions, powers. Identities and rules for powers.

Fundamental concepts:
Definition of functions. Domain, range and graph of a function. Composition of functions. One-to-one functions. Inverse function: determination, properties, graph, examples.

Properties of functions: even/odd functions, periodic functions, bounded and monotone functions. Extremal values (maximum/minimum) of functions. Examples.

Elementary functions and their properties:
Linear functions, straight lines: slope, equations (point-point, point-slope), graph, monotonicity.
Arithmetic sequences, and applications in life sciences
Power functions with integer, rational, and irrational exponents: domain, range, graph, properties, second order functions
Trigonometric functions (sin *x*, cos *x*, tan *x*, cot *x*): definition, period, domain, range, graph.
The exponential and logarithm functions: definition for integer, rational and irrational exponents, domain, range and graph. Half-life for exponential functions. Comparison of the functions of different basis. Identities and working with exponentials and logarithms.
Geometric sequences in life sciences, population growth, compound interest.
Models of repeated drug dosing at 0^{th} and 1^{st} order elimination.
Elementary transformations of functions.
Logarithmic scales, logarithmic transformations and logarithmic plots of functions. Lin-Log, Log-Lin, Log-Log plots and their application in recognizing exponential, power and log shapes.

Limit, continuity
Intuitive definition of limit. Graphical examples, continuity of functions.

Derivative

The derivative of a function: definition (difference and differential quotient), general meaning (average and instantaneous rate of change) and geometrical meaning (slope of secant and tangent line). Equation of the tangent line, theorem on the continuity of differentiable functions. Graphical differentiation, plotting the derivative by the graph of the function. Differentiation rules. Derivatives of elementary functions (x^n, sin *x*, cos *x*, **tan *x*, cot *x***, a^x, e^x, **$\log_a x$ and ln *x***). Examples.

Relation between the properties of the function (monotonicity, concavity, extremal and inflexion points) and the properties of the derivative. Conditions for extremal values (min/max), of derivatives. Examination of functions using first and second derivatives.

Examples: $e^{-ax} - e^{-bx}$ $(0 < a < b)$ $f(x) = e^{-x^2}; f(x) = xe^{-x^2};$

$$f(x) = \frac{1}{e^{ax} + A}; a > 0; f(x) = \frac{1}{e^{-ax} + A}; a > 0.$$

Characterizing the properties of the function by the graph of the derivatives.

Series B

Indefinite integral

The antiderivative of a function. Geometrical meaning. Tangent field and finding antiderivatives for graphically given functions. Basic properties. Indefinite integrals of elementary functions. Methods of indefinite integration: by parts and by substitution. Method of separating to elementary fractions.

Definite integral:

Upper and lower sums, definition, geometrical meaning. Properties, integral mean and its applications.

Integral function (other names: upper bound function, area function), fundamental theorem of Calculus, Newton-Leibniz formula. Numerical integration (left, right and trapezoid formulas).

Applications: area between the graphs of two functions, volume of bodies of surface revolution, finding the function from its derivative and the role of the initial values. Variation of functions as the area under the derivative.