

## CLEP EXAMINATION: *Precalculus*

### DESCRIPTION OF THE EXAMINATION:

The Precalculus examination assesses student mastery of skills and concepts required for success in a first-semester calculus course. A large portion of the exam is devoted to testing a student's understanding of functions and their properties. Many of the questions test a student's knowledge of specific properties of the following types of functions: linear, quadratic, absolute value, square root, polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric, and piecewise-defined. Questions on the exam will present these types of functions symbolically, graphically, verbally, or in tabular form. A solid understanding of these types of functions is at the core of all precalculus courses, and it is a prerequisite for enrolling in calculus and other college-level mathematics courses.

The examination contains 48 questions, in two sections, to be answered in 90 minutes. Any time candidates spend on tutorials and providing personal information is in addition to the actual testing time.

- Section 1: 25 questions, 50 minutes.  
The use of an online graphing calculator (non-CAS) is allowed for this section. Only some of the questions will require the use of the calculator.
- Section 2: 23 questions, 40 minutes.  
No calculator is allowed for this section. Although most of the questions on the exam are multiple-choice, there are some questions that require students to enter a numerical answer.

### STUDY RESOURCES:

Most textbooks used in college-level precalculus courses cover the topics in the outline given earlier, but the approaches to certain topics and the emphasis given to them may differ. To prepare for the Precalculus exam, it is advisable to study one or more college textbooks, which can be found in most college bookstores. When selecting a textbook, check the table of contents against the "Knowledge and Skills Required" for this test. Additional suggestions for preparing for CLEP exams are given in "Preparing to Take CLEP Examinations."

CLEP TEST KNOWLEDGE AND SKILLS REQUIRED	MINNESOTA 9, 10, 11 STANDARDS	Notes
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	<b>Standards</b>	<b>Bench- mark #</b>	<b>Benchmarks</b>	
Algebraic Expressions, Equations and Inequalities <ul style="list-style-type: none"> <li>▪ Ability to perform operations on algebraic expressions</li> <li>▪ Ability to solve equations and inequalities, including linear, quadratic, absolute value, polynomial, rational, radical, exponential, logarithmic, and trigonometric</li> </ul>	Recognize linear, quadratic, exponential and other common functions in real world and mathematical situations; represent these functions with tables, verbal descriptions, symbols and graphs; solve problems involving these functions, and explain results in the original context.	9.2.2.1	Represent and solve problems in various contexts using linear and quadratic functions.	This CLEP assessment reflects a college course that, for the most part, is beyond MN standards. The skills required to perform the tasks indicated in the course content and the level to which they need to be performed are beyond the scope of the Minnesota Math Standards.
		9.2.2.2	Represent and solve problems in various contexts using exponential functions, such as investment growth, depreciation and population growth.	
		9.2.2.3	Sketch graphs of linear, quadratic and exponential functions, and translate between graphs, tables and symbolic representations. Know how to use graphing technology to graph these functions.	
		9.2.2.6	Sketch the graphs of common non-linear functions such as radical functions, absolute value functions, rational functions and polynomial functions including translations of these functions. Know how to use graphing technology to graph these functions.	
	Generate equivalent algebraic expressions involving polynomials and radicals; use algebraic properties to evaluate expressions.	9.2.3.1	Evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified points in their domains.	
		9.2.3.2	Add, subtract and multiply polynomials; divide a polynomial by a polynomial of equal or lower degree.	
		9.2.3.3	Factor common monomial factors from polynomials, factor quadratic polynomials, and factor the difference of two squares.	

		9.2.3.4	Add, subtract, multiply, divide and simplify algebraic fractions.	
		9.2.3.5	Check whether a given complex number is a solution of a quadratic equation by substituting it for the variable and evaluating the expressions, using arithmetic with complex numbers.	
<p>Functions: Concept, Properties, and Operations</p> <ul style="list-style-type: none"> <li>Ability to demonstrate an understanding of the concept of a function, the general properties of functions (e.g., domain, range), function notation, and to perform symbolic operations with functions (e.g., evaluation, inverse functions)</li> </ul>	<p>Understand the concept of function, and identify important features of functions and other relations using symbolic and graphical methods.</p>	9.2.1.1	Understand the definition of a function. Use functional notation and evaluate a function at a given point in its domain.	
		9.2.1.3	Find the domain of a function defined symbolically, graphically or in tabular form.	
<p>Representations of Functions: Symbolic, Graphical, and Tabular</p> <ul style="list-style-type: none"> <li>Ability to recognize and</li> </ul>	<p>Understand the concept of function, and identify important features of functions and other relations</p>	9.2.1.2	Distinguish between functions and other relations defined symbolically, graphically or in tabular form.	

<p>perform operations and transformations on functions presented symbolically, graphically, or in tabular form</p> <ul style="list-style-type: none"> <li>Ability to demonstrate an understanding of basic properties of functions and to recognize elementary functions (linear, quadratic, absolute value)</li> </ul>	using symbolic and graphical methods where appropriate.	9.2.1.4	Obtain information and draw conclusions from graphs of functions and other relations.	
		9.2.1.5	Identify the vertex, line of symmetry and intercepts of the parabola corresponding to a quadratic function, using symbolic and graphical methods, when the function is expressed in the form $f(x)=ax^2+bx+c$ , in the form $f(x)=a(x-h)^2+k$ , or in factored form.	
		9.2.1.6	Identify intercepts, zeros, maxima, minima and intervals of increase and decrease from the graph of a function.	
		9.2.1.7	Understand the concept of an asymptote and identify asymptotes for exponential functions and reciprocals of linear functions, using symbolic and graphical methods.	
		9.2.1.8	Make qualitative statements about the rate of change of a function, based on its graph or table of values.	
		9.2.1.9	Determine how translations affect the symbolic and graphical forms of a function. Know how to use graphing technology to examine translations.	
	Generate equivalent algebraic expressions involving polynomials and radicals; use algebraic	9.2.3.7	Justify steps in generating equivalent expressions by identifying the properties used. Use substitution to check the equality of expressions for some particular values of the variables; recognize that checking with	

	properties to evaluate expressions.		substitution does not guarantee equality of expressions for all values of the variables.	
<p>Analytic Geometry</p> <ul style="list-style-type: none"> <li>Ability to demonstrate an understanding of the analytic geometry of lines, circles, parabolas, ellipses and hyperbolas</li> </ul>	Know and apply the properties of geometric figures to solve real-world and mathematical problems and to logically justify results in geometry.	9.3.3.8	Know and apply properties of a circle to solve problems and logically justify results.	
	Solve real-world and mathematical geometric problems using algebraic methods.	9.3.4.7	Use algebra to solve geometric problems unrelated to coordinate geometry, such as solving for an unknown length in a figure involving similar triangles, or using the Pythagorean Theorem to obtain a quadratic equation for a length in a geometric figure.	
<p>Trigonometry and Its Applications</p> <ul style="list-style-type: none"> <li>Ability to demonstrate an understanding of the basic trigonometric functions and their inverses and to apply the basic trigonometric ratios and identities (in</li> </ul>	Solve real-world and mathematical geometric problems using algebraic methods.	9.3.4.1	Understand how the properties of similar right triangles allow the trigonometric ratios to be defined, and determine the sine, cosine and tangent of an acute angle in a right triangle.	
		9.3.4.2	Apply the trigonometric ratios sine, cosine and tangent to solve problems, such as determining lengths and areas in right triangles and in figures that can be decomposed into right triangles. Know how to use calculators, tables or other technology to evaluate trigonometric ratios.	

<p>right triangles and on the unit circle)</p> <ul style="list-style-type: none"> <li>▪ Ability to apply trigonometry in various problem-solving contexts</li> </ul>		9.3.4.3	Use calculators, tables or other technologies in connection with the trigonometric ratios to find angle measures in right triangles in various contexts.	
<p>Functions as Models</p> <ul style="list-style-type: none"> <li>▪ Ability to interpret and construct functions as models and to translate ideas among symbolic, graphical, tabular and verbal representations of functions</li> </ul>	<p>Represent real-world and mathematical situations using equations and inequalities involving linear, quadratic, exponential and nth root functions. Solve equations and inequalities symbolically and graphically. Interpret solutions in the original context.</p>	9.2.4.1	Represent relationships in various contexts using quadratic equations and inequalities. Solve quadratic equations and inequalities by appropriate methods including factoring, completing the square, graphing and the quadratic formula. Find non-real complex roots when they exist. Recognize that a particular solution may not be applicable in the original context. Know how to use calculators, graphing utilities or other technology to solve quadratic equations and inequalities.	
		9.2.4.2	Represent relationships in various contexts using equations involving exponential functions; solve these equations graphically or numerically. Know how to use calculators, graphing utilities or other technology to solve these equations.	
		9.2.4.3	Recognize that to solve certain equations, number systems need to be extended from whole numbers to integers, from integers to rational numbers, from rational numbers to real numbers and from real numbers to complex numbers. In particular, non-real complex numbers are needed to solve some quadratic equations with real coefficients.	

		9.2.4.4	Represent relationships in various contexts using systems of linear inequalities; solve them graphically. Indicate which parts of the boundary are included in and excluded from the solution set using solid and dotted lines.	
		9.2.4.5	Solve linear programming problems in two variables using graphical methods.	
		9.2.4.6	Represent relationships in various contexts using absolute value inequalities in two variables; solve them graphically.	
		9.2.4.7	Solve equations that contain radical expressions. Recognize that extraneous solutions may arise when using symbolic methods.	
		9.2.4.8	Assess the reasonableness of a solution in its given context and compare the solution to appropriate graphical or numerical estimates; interpret a solution in the original context.	

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