Higher Education Math Placement
Placement Assessment Problem Types

1. Whole Numbers, Fractions, and Decimals

1.1 Operations with Whole Numbers
   - Addition with carry
   - Subtraction with borrowing
   - Multiplication with carry
   - Introduction to multiplication of large numbers
   - Division with carry
   - Introduction to exponents
   - Order of operations: Problem type 1
   - Order of operations: Problem type 2
   - Order of operations with whole numbers and exponents: Basic

1.2 Equivalent Fractions and Ordering
   - Equivalent fractions
   - Simplifying a fraction
   - Fractional position on a number line
   - Plotting fractions on a number line
   - Writing an improper fraction as a mixed number
   - Writing a mixed number as an improper fraction
   - Ordering fractions with same denominator
   - Ordering fractions

1.3 Operations with Fractions
   - Addition or subtraction of fractions with the same denominator
   - Introduction to addition or subtraction of fractions with different denominators
   - Addition or subtraction of fractions with different denominators
   - Product of a fraction and a whole number
   - Introduction to fraction multiplication
   - Fraction multiplication
   - Fraction division
   - Division involving a whole number and a fraction
   - Mixed arithmetic operations with fractions
1.4 Decimal Place Value
   Rounding decimals
   Ordering decimals

1.5 Operations with Decimals
   Addition of aligned decimals
   Decimal addition
   Subtraction of aligned decimals
   Multiplication of a decimal by a power of ten
   Multiplication of a decimal by a whole number
   Decimal multiplication: Problem type 1
   Division of a decimal by a power of ten
   Division of a decimal by a whole number
   Converting a fraction to a terminating decimal

2. Percents, Proportions, and Geometry

2.1 Percentages
   Converting between percentages and decimals
   Converting a percentage to a fraction
   Converting a fraction to a percentage
   Writing a ratio as a percentage
   Percentage of a whole number
   Applying the percent equation
   Finding the sale price given the original price and percent discount
   Finding the original price given the sale price and percent discount

2.2 Proportions
   Solving a proportion of the form \( \frac{x}{a} = \frac{b}{c} \)
   Simple word problem on proportions
   Word problem on proportions: Problem type 1
   Word problem on proportions: Problem type 2

2.3 Perimeter and Area
   Perimeter of a square or a rectangle
   Finding the missing length in a figure
   Finding a side length given the perimeter and side lengths with variables
   Area of a square or a rectangle
   Area of a piecewise rectangular figure
   Area of a triangle
   Area of a parallelogram
   Finding the side length of a rectangle given its perimeter or area
   Circumference and area of a circle
   Perimeter involving rectangles and circles
   Area involving inscribed figures
2.4 Volume and Surface Area
   Volume of a rectangular prism
   Volume of a cylinder
   Surface area of a cube or a rectangular prism
   Surface area of a cylinder

2.5 Angles and Triangles
   Solving equations involving vertical angles
   Sum of the angle measures of a triangle
   Finding an angle measure for a triangle with an extended side

2.6 Similar Figures
   Similar polygons
   Indirect measurement

3. Signed Numbers, Linear Equations and Inequalities

3.1 Integers
   Absolute value of a number
   Integer addition: Problem type 1
   Integer addition: Problem type 2
   Integer subtraction: Problem type 1
   Integer subtraction: Problem type 2
   Integer subtraction: Problem type 3
   Integer multiplication and division

3.2 Signed Fractions and Decimals
   Signed fraction addition: Basic
   Signed fraction addition: Advanced
   Signed fraction multiplication: Basic
   Signed fraction multiplication: Advanced
   Signed decimal addition with three numbers

3.3 Signed Numbers and Exponents
   Exponents and integers: Problem type 1
   Exponents and signed fractions
   Exponents and order of operations

3.4 Algebraic Expressions
   Writing a simple variable expression for a real-world situation
   Evaluating a linear expression in two variables
   Evaluating a quadratic expression in one variable

3.5 Properties of Real Numbers
   Distributive property: Whole number coefficients
   Distributive property: Integer coefficients
Combining like terms: Integer coefficients
Combining like terms: Advanced

3.6 Solving a Linear Equation with One Occurrence of the Variable
   Additive property of equality with decimals
   Additive property of equality with integers
   Additive property of equality with a negative coefficient
   Multiplicative property of equality with whole numbers
   Multiplicative property of equality with decimals
   Multiplicative property of equality with integers
   Multiplicative property of equality with signed fractions
   Solving a two-step equation with integers
   Solving a two-step equation with signed fractions

3.7 Solving a Linear Equation with Several Occurrences of the Variable
   Solving a linear equation with several occurrences of the variable: Variables on the same side and distribution
   Solving a linear equation with several occurrences of the variable: Variables on both sides and distribution
   Solving a linear equation with several occurrences of the variable: Fractional forms with binomial numerators
   Solving equations with zero, one, or infinitely many solutions

3.8 Applications with Linear Equations
   Translating a sentence into a one-step equation
   Translating a sentence into a two-step expression
   Solving a simple word problem using the formula \( d = rt \)
   Solving a word problem with two unknowns using a linear equation
   Solving a value mixture problem using a linear equation

3.9 Solving an Inequality
   Graphing a linear inequality on the number line
   Graphing a compound linear inequality on the number line
   Solving a linear inequality: Problem type 1
   Solving a linear inequality: Problem type 2
   Solving a linear inequality: Problem type 3
   Solving a linear inequality: Problem type 4
   Solving a compound linear inequality: Problem type 1
   Solving a compound linear inequality: Problem type 2

3.10 Solving an Equation or Inequality with Absolute Value
   Solving an equation involving absolute value: Basic
   Solving an inequality involving absolute value: Basic

3.11 Solving a Multivariable Equation for a Variable
   Introduction to algebraic symbol manipulation
4. Lines and Systems of Linear Equations

4.1 Graphing Lines
- Plotting a point in the coordinate plane
- Finding a solution to a linear equation in two variables
- Graphing a line given its equation in slope-intercept form
- Graphing a line given its equation in standard form
- Graphing a vertical or horizontal line

4.2 Slope of a Line
- Finding slope given the graph of a line on a grid
- Finding slope given two points on the line
- Finding the slope of a line given its equation
- Slopes of parallel and perpendicular lines: Problem type 1

4.3 Equation of a Line
- Finding x- and y-intercepts of a line given the equation: Advanced
- Writing the equation of a line given the slope and a point on the line
- Writing the equation of the line through two given points

4.4 Solving a System of Linear Equations
- Graphically solving a system of linear equations
- Solving a simple system using substitution
- Solving a system of linear equations using elimination with multiplication and addition
- Solving a system that is inconsistent or consistent dependent

4.5 Graphing Linear Inequalities in the Plane
- Graphing a linear inequality in the plane: Standard form
- Graphing a linear inequality in the plane: Vertical or horizontal lines
- Graphing a system of linear inequalities

4.6 Applications with Lines and Systems
- Interpreting line graphs
- Interpreting the graphs of two functions
- Writing an equation and drawing its graph to model a real-world situation
- Application problem with a linear function: Problem type 1
- Solving a value mixture problem using a system of linear equations
- Solving a distance, rate, time problem using a system of linear equations
- Solving a percent mixture problem using a system of linear equations
- Solving a word problem using a 3 by 3 system of linear equations
5. Relations and Functions

5.1 Sets and Intervals
- Set builder and interval notation
- Union and intersection of finite sets

5.2 Evaluating Functions
- Evaluating functions: Problem type 1
- Evaluating a piecewise-defined function
- Variable expressions as inputs of functions
- Sum, difference, and product of two functions

5.3 Domain and Range
- Domain and range from ordered pairs
- Domain and range from the graph of a continuous function
- Domain of a square root function
- Domain of a rational function

5.4 Graphs of Functions and their Transformations
- Vertical line test
- Finding local maxima and minima of a function given the graph
- Translating the graph of a function: One step
- Transforming the graph of a function by reflecting over an axis
- Transforming the graph of a function by shrinking or stretching
- Writing an equation for a function after a vertical translation
- Writing an equation for a function after a vertical and horizontal translation
- Graphing a simple cubic function
- Graphing a function involving a square root

5.5 Composition of Functions and Inverse Functions
- Composition of two functions: Basic
- Inverse functions: Problem type 1
- Inverse functions: Problem type 2

6. Integer Exponents and Factoring

6.1 Properties of Exponents
- Writing a positive number without a negative exponent
- Writing a negative number without a negative exponent
- Introduction to the product rule of exponents
- Product rule with positive exponents
- Product rule with negative exponents
- Introduction to the quotient rule of exponents
- Quotients of expressions involving exponents
- Quotient rule with negative exponents: Problem type 1
- Introduction to the power rule of exponents
Power rule with positive exponents
Power rule with negative exponents: Problem type 1
Power rule with negative exponents: Problem type 2
Using the power and product rules to simplify expressions with positive exponents

6.2 Scientific Notation
Scientific notation with positive exponent
Scientific notation with negative exponent

6.3 Operations with Polynomials
Simplifying a sum or difference of two univariate polynomials
Multiplying a monomial and a polynomial: Univariate with positive leading coefficients
Multiplying a monomial and a polynomial: Multivariate
Multiplying binomials with leading coefficients of 1
Multiplying binomials that are a sum and a difference of two terms: Univariate
Squaring a binomial: Univariate
Multiplication involving binomials and trinomials in two variables

6.4 Factoring Polynomials
Greatest common factor of two monomials
Factoring out a monomial from a polynomial: Univariate
Factoring out a monomial from a polynomial: Multivariate
Factoring a quadratic with leading coefficient 1
Factoring a quadratic with leading coefficient greater than 1
Factoring a product of a quadratic trinomial and a monomial
Factoring a difference of squares
Factoring a polynomial by grouping: Problem type 1

7. Quadratic and Polynomial Functions

7.1 Solving a Quadratic Equation
Solving equations written in factored form
Completing the square
Finding the roots of a quadratic equation with leading coefficient 1
Finding the roots of a quadratic equation with leading coefficient greater than 1
Solving a quadratic equation needing simplification
Applying the quadratic formula: Exact answers
Discriminant of a quadratic equation
Solving a word problem using a quadratic equation with rational roots
Solving a word problem using a quadratic equation with irrational roots

7.2 Solving a Quadratic Inequality
Solving a quadratic inequality written in factored form

7.3 Graphing a Quadratic Function
Graphing a parabola of the form $y = ax^2$
Graphing a parabola of the form $y = (x-a)^2 + c$
Graphing a parabola of the form $y = ax^2 + bx + c$: Integer coefficients
Rewriting a quadratic function to find the vertex of its graph
Finding the $x$-intercept(s) and the vertex of a parabola

7.4 Polynomial Functions
Finding zeros of a polynomial function written in factored form
Finding $x$- and $y$-intercepts given a polynomial function
Determining the end behavior of the graph of a polynomial function
Inferring properties of a polynomial function from its graph

7.5 Circles
Graphing a circle given its equation in standard form
Graphing a circle given its equation in general form

8. Rational Expressions and Functions

8.1 Simplifying Rational Expressions
Least common multiple of two monomials
Simplifying a ratio of polynomials: Problem type 1
Ratio of multivariate polynomials
Adding rational expressions with common denominators
Adding rational expressions with different denominators: $ax$, $bx$
Adding rational expressions with different denominators: $x+a$, $x+b$
Multiplying rational expressions: Problem type 1
Multiplying rational expressions: Problem type 2
Dividing rational expressions: Problem type 1
Complex fractions without variables: Problem type 1
Complex fraction: Problem type 1
Complex fraction: Problem type 3

8.2 Division of Polynomials
Dividing a polynomial by a monomial: Univariate
Polynomial long division: Problem type 1

8.3 Solving Rational Equations
Solving a rational equation that simplifies to a linear equation: Problem type 1
Solving a rational equation that simplifies to a linear equation: Problem type 2
Solving a rational equation that simplifies to a linear equation: Problem type 3
Solving a rational equation that simplifies to a quadratic equation: Problem type 2

8.4 Direct and Inverse Variations
Word problem on direct variation
Word problem on inverse variation
Writing an equation that models variation
8.5 Graphing Rational Functions
   Sketching the graph of a rational function: Constant over linear
   Sketching the graph of a rational function: Linear over linear

9. Radicals and Rational Exponents

9.1 Simplifying Expressions with Radicals
   Square root of a rational perfect square
   Square root simplification
   Square root of a perfect square monomial
   Simplifying a radical expression: Problem type 1
   Simplifying a sum of radical expressions
   Simplifying a product of radical expressions
   Rationalizing the denominator of a radical expression
   Rationalizing the denominator of a radical expression using conjugates

9.2 Solving Equations with Radicals
   Solving a radical equation that simplifies to a linear equation: One radical
   Solving a radical equation that simplifies to a linear equation: Two radicals
   Solving a radical equation that simplifies to a quadratic equation: One radical

9.3 Pythagorean Theorem and the Distance Formula
   Pythagorean Theorem
   Distance between two points in the plane

9.4 Higher Roots
   Cube root of an integer
   Simplifying a higher radical: Problem type 1
   Simplifying a higher radical: Problem type 2

9.5 Rational Exponents
   Rational exponents: Basic
   Rational exponents: Negative exponents and fractional bases
   Rational exponents: Powers of powers
   Rational exponents: Products and quotients

10. Exponentials and Logarithms

10.1 Properties of Logarithms
   Converting between logarithmic and exponential equations
   Converting between natural logarithmic and exponential equations
   Evaluating a logarithmic expression
   Basic properties of logarithms
   Expanding a logarithmic expression: Problem type 1
   Writing expressions as a single logarithm
   Change of base for logarithms: Problem type 1
10.2 Solving Logarithmic and Exponential Equations
- Solving a logarithmic equation: Problem type 1
- Solving a logarithmic equation: Problem type 2
- Solving a logarithmic equation: Problem type 3
- Solving a logarithmic equation: Problem type 4
- Solving a logarithmic equation: Problem type 5
- Solving an exponential equation: Problem type 1
- Solving an exponential equation: Problem type 2
- Solving an exponential equation: Problem type 3

10.3 Graphing Logarithmic and Exponential Functions
- The graph, domain, and range of an exponential function
- The graph, domain, and range of a logarithmic function
- Translating the graph of a logarithmic or exponential function

10.4 Applications with Exponential Functions
- Evaluating an exponential function that models a real-world situation
- Solving a word problem using an exponential equation: Problem type 1

11. Trigonometry

11.1 Angles
- Converting between degree and radian measure: Problem type 1
- Sketching an angle in standard position
- Reference angles: Problem type 1
- Coterminal angles
- Arc length and central angle measure

11.2 Right Triangle Trigonometry
- Sine, cosine, and tangent ratios
- Using a trigonometric ratio to find a side length in a right triangle
- Using a trigonometric ratio to find an angle measure in a right triangle
- Finding trigonometric ratios given a right triangle
- Solving a triangle with the law of sines: Problem type 1
- Solving a triangle with the law of cosines

11.3 Unit Circle
- Finding coordinates on the unit circle for special angles
- Trigonometric functions and special angles: Problem type 1
- Trigonometric functions and special angles: Problem type 2
- Finding values of trigonometric functions given information about an angle: Problem type 1
- Finding values of trigonometric functions given information about an angle: Problem type 2
11.4 Graphing Trigonometric Functions
   Amplitude and period of sine and cosine functions
   Amplitude, period, and phase shift of sine and cosine functions
   Sketching the graph of a sine or cosine function: Problem type 1
   Sketching the graph of a sine or cosine function: Problem type 2

11.5 Inverse Trigonometric Functions
   Values of inverse trigonometric functions
   Composition of a trigonometric function and an inverse trigonometric function: Problem type 2

11.6 Trigonometric Identities
   Simplifying trigonometric expressions
   Sum and difference identities: Problem type 2
   Double-angle identities: Problem type 2

11.7 Trigonometric Equations
   Finding solutions in an interval for a basic equation involving sine or cosine
   Finding solutions in an interval for a basic tangent, cotangent, secant, or cosecant equation
   Finding solutions in an interval for a trigonometric equation using Pythagorean identities
   Solving a basic trigonometric equation involving sine or cosine