**Achievement Level Descriptors**

**Exceeding Expectations**
A student who performed at this level exceeded grade-level expectations by demonstrating mastery of the subject matter.

**Meeting Expectations**
A student who performed at this level met grade-level expectations and is academically on-track to succeed in the current grade in this subject.

**Partially Meeting Expectations**A student who performed at this level partially met grade-level expectations in this subject. The school, in consultation with the student’s parent/guardian, should consider whether the student needs additional academic assistance to succeed in this subject.

**Not Meeting Expectations**A student who performed at this level did not meet grade-level expectations in this subject. The school, in consultation with the student’s parent/guardian, should determine the coordinated academic assistance and/or additional instruction the student needs to succeed in this subject.

**MCAS Achievement Level Descriptors**

**Mathematics: Grade 10**

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations, and Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

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|  | **Partially Meeting Expectations** **On MCAS, a student at this level:** | **Meeting Expectations** **On MCAS, a student at this level:** | **Exceeding Expectations** **On MCAS, a student at this level:** |
| **Number and Quantity** | * Rewrites expressions involving integer exponents using the properties of exponents
* Uses units as a way to understand problems and chooses units consistently in formulas
* Chooses the scale and the origin in graphs and data displays
* Identifies significant figures in recorded measures and computed values based on the context given and the precision of the tools used to measure
* Identifies appropriate quantities for the purpose of descriptive modeling
 | * Rewrites expressions involving radical and rational exponents using the properties of exponents
* Performs operations on rational and irrational numbers
* Determines whether the solution of operations on two numbers would be rational or irrational
* Interprets units consistently in formulas and uses units to solve multi-step problems.
* Interprets the scale and the origin in graphs and data displays
* Defines appropriate quantities for the purpose of descriptive modeling
* Chooses a level of accuracy appropriate to limitations on measurement when reporting quantities
* Describes the effects of approximate error in measurement and rounding on measurements and on computed values from measurements
 | * Explains how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of radical exponents
* Explains why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational numbers is irrational; and that the product of a nonzero rational number and an irrational number is irrational
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| **Algebra** | * Usually interprets parts and structures of linear expressions
* Chooses an equivalent form of an expression to reveal properties of the quantity represented by the expression
* Identifies, combines and expands like terms when performing operations on polynomial expressions
* Creates linear equations and inequalities in one variable and uses them to solve problems
* Creates equations in two variables to represent relations between quantities
* Graphs the equations on coordinate axes with labels and scales
* Rearranges formulas to highlight a quantity of interest using the same reasoning as in solving equations
* Solves and explains each step in solving linear equations and inequalities in one variable
* Solves system of linear equations exactly and approximately
* Knows that the graph of an equation in two variables is the set of all its solutions
* Graphs the solutions of linear inequality in two variables
 | * Consistently interprets parts of an expression based on real-world context
* Usually interprets the structure of quadratic and exponential expressions with integer exponents
* Factors polynomial expressions
* Creates quadratic and exponential equations in one variable and uses them to solve problems
* Creates equations with more than two variables
* Represents constraints by linear equations/ inequalities and by systems of linear equations/inequalities
* Constructs viable arguments to justify or refute a solution method for linear equations/inequalities
* Usually solves linear equation/inequalities in one variable involving absolute value
* Solves a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically
* Finds and is able to explain the solutions of linear equations y = f(x) and y = g(x) approximately, using technology to graph the functions and make tables of values
* Graphs the solution set of a system of linear inequalities in two variables
 | * Interprets complicated expressions by viewing one or more of their parts as a single entity
* Chooses and produces an equivalent form of an expression to explain properties of the quantity represented by the expression
* Completes the square in a quadratic expression to reveal the maximum or minimum value of the function it defines
* Recognizes that the system of polynomials is similar to the system of integers in that they are both closed under certain operations
* Interprets solutions of linear equations or inequalities as viable or non-viable options in a modeling context
* Uses the method of completing the square to transform any quadratic equation in *x* into an equation of the form (*x* – *p*)2 = *q* that has the same solutions
* Derives the quadratic formula
* Recognizes when solutions of a quadratic equation results in non-real solutions and write them as a ± b*i* for real numbers a and b
* Proves that, given a system of equations in two variables, replacing one equation by the sum of that equation and a multiple of the other to produces a system with the same solutions
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| **Functions** | * Knows the structure of a function and uses function notation to evaluate and interpret functions
* Distinguishes between an arithmetic and a geometric sequence
* Interprets key features of graphs and tables for a function that models a relationship
* Calculates and interprets the average rate of change of a function presented symbolically or as a table
* Graphs linear functions to show intercepts
* Compares properties of functions each represented algebraically, graphically, numerically in tables, or by verbal descriptions
* Distinguishes between situations that model linear functions and exponential functions
* Constructs linear functions given a graph, a description of a relationship, or input-output pairs
* Draws comparisons between exponential and linear graphs
 | * Interprets symmetries of graphs and tables in terms of the quantities
* Relates the domain of a function to its graph
* Estimates the rate of change from a graph.
* Graphs functions and uses the properties of functions to create equivalent functions
* Interprets zeros, maximum/minimum values, and symmetry of the graph
* Writes quadratic and exponential functions to describe relationship between quantities
* Determines an explicit expression or steps for calculation from a context
* Writes arithmetic and geometric sequences both recursively and with an explicit formula
* Identifies the effect on a graph of a function by replacing f(x) with f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k
* Finds the inverse of a linear function
* Constructs exponential functions given a graph, a description of a relationship, or input-output pairs
* Draws comparisons between exponential and quadratic graphs
* Interprets the parameters in a linear function
 | * Recognizes that sequences are functions that are sometimes defined recursively
* Interprets relative maximums and minimums and end behavior of graphs and tables in terms of the quantities
* Uses graphs to show relative maximums and minimums; symmetries; and end behavior
* Graphs piecewise-defined functions, including step functions
* Creates equivalent functions to explain different properties of the function
* Uses process of completing the square in a quadratic function to show zeros, maximum/minimum values, and symmetry of the graph
* Determines a recursive process, or steps for calculation from a context
* Uses recursive and explicit formulas to model situations, and translates between the two forms
* Utilizes technology to experiment with cases and illustrates an explanation of the effects on the graph of linear, quadratic, exponential, or absolute value functions
* Interprets the parameters in an exponential function
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| **Geometry** | * Knows precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc
* Represents rigid transformations in the plane
* Compares transformations that preserve distance and angle to those that do not and identifies a sequence of transformations that will carry a given figure onto another
* Finds angle sum and exterior angle of triangles, angles created when parallel lines are cut by a transversal, and angle-angle criterion for similarity of triangles
* Uses congruence and similarity criteria for triangles to solve problems
* Uses Pythagorean Theorem to solve right triangles
* Uses coordinates to compute perimeters of polygons and areas of triangles and rectangles
* Uses volume formulas for cylinders, cones, and spheres to solve problems
 | * Uses geometric descriptions of rigid motions to solve problems
* Applies properties of polygons to the solutions of problems
* Verifies experimentally the properties of dilations given by a center and a scale factor
* Uses congruence and similarity criteria for triangles to prove relationships in geometric figures
* Knows that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles
* Uses Pythagorean Theorem to solve right triangles in applied problems
* Identifies relationships among inscribed angles, radii, and chords
* Uses the fact that the length of the arc intercepted by an angle is proportional to the radius to solve problems
* Uses the slope criteria for parallel and perpendicular lines to solve geometric problems
* Finds the point on a directed line segment between two given points that partitions the segment in a given ratio
* Uses volume formulas for pyramids to solve problems
 | * Develops definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments
* Explains how the criteria for triangle congruence follow from the definition of congruence in terms of rigid motions
* Makes formal geometric constructions
* Proves theorems about:
	+ triangles
	+ parallelograms
	+ circles
	+ polygons
* Proves the Pythagorean Theorem using triangle similarity
* Explains the relationship between the sine and cosine of complementary angles.
* Uses trigonometric ratios to solve right triangles in applied problems
* Uses relationships among inscribed angles, radii, and chords to solve problems
* Derives the formula for the area of a sector.
* Derives the equation of a circleto find the center and the radius
* Derives the equation of a parabola given a focus and directrix
* Uses coordinates to prove simple geometric theorems algebraically, including the distance formula and its relationship to the Pythagorean Theorem
* Proves the slope criteria for parallel and perpendicular lines
* Uses dissection arguments, Cavalieri’s principle, and informal limit arguments to give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone
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| **Statistics and Probability** | * Represents data with plots on the real number line
* Usually uses statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets
* Usually interprets differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers)
* Interprets relative frequencies in the context of the data
* Represents data on two quantitative variables on a scatter plot and describes how the data are related
* Fits a linear function for a scatter plot that suggests a linear association and interprets the slope and the intercept of the model
* Informally assesses the fit of a function by plotting and analyzing residuals
* Describes events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events
* Constructs and interprets two-way frequency tables of data when two categories are associated with each object being classified
 | * Consistently uses statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets
* Consistently interprets differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers)
* Recognizes possible associations and trends in the data contained in a two-way frequency table
* Fits a linear function to the data and uses the fitted function to solve problems in the context of the data
* Computes and interprets the correlation coefficient of a linear fit
* Distinguish between dependent and independent events
* Uses a two-way table to approximate conditional probabilities
* Recognizes the concepts of conditional probability and independence in everyday language and everyday situations
* Applies the addition rule to calculate probabilities
 | * Applies the addition rule and interprets the answer in terms of the model
* Distinguishes between correlation and causation
* Knows that the conditional probability of A given B is P(A and B)/P(B) and uses it to solve problems
* Explains the concepts of conditional probability and independence in everyday language and everyday situations
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