MATH – GRADE 11

Assessment Anchors & Eligible Content

Pennsylvania Department of Education

2007

M11.A Numbers and Operations

M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.

M11.A.1.1	Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, exponents and scientific notation). ***Reference: 2.1.8.A, 2.1.8.B, 2.1.11.A***	**M11.A.1.1.1**	Find the square root of an integer to the nearest tenth using either a calculator or estimation.
		M11.A.1.1.2	Express numbers and/or simplify expressions using scientific notation (including numbers less than 1).
		M11.A.1.1.3	Simplify square roots. (e.g., $\sqrt{24} = 2\sqrt{6}$)

M11.A Numbers and Operations

M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.

M11.A.1.2	Apply number theory concepts to show relationships between real numbers in problem solving settings. *Reference: 2.1.8.E*	M11.A.1.2.1	Find the Greatest Common Factor (GCF) and/or the Least Common Multiple (LCM) for sets of monomials.

M11.A Numbers and Operations
M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.

M11.A.1.3	Estimate the value of an irrational number. **Reference: 2.2.8.C**	**M11.A.1.3.1**	Locate/identify irrational numbers at the approximate location on a number line.
		M11.A.1.3.2	Compare and/or order any real numbers (rational and irrational may be mixed).

M11.A Numbers and Operations

M11.A.2 Understand the meanings of operations, use operations and understand how they relate to each other.

M11.A.2.1	Apply ratio and/or proportion in problem-solving situations. ***Reference: 2.2.11.A, 2.8.11.P***	**M11.A.2.1.1**	Solve problems using operations with rational numbers including rates and percents (single and multi-step and multiple procedure operations) (e.g., distance, work and mixture problems, etc.).
		M11.A.2.1.2	Solve problems using direct and inverse proportions.
		M11.A.2.1.3	Identify and/or use proportional relationships in problem solving settings.

M11.A Numbers and Operations

M11.A.2 Understand the meanings of operations, use operations and understand how they relate to each other.

M11.A.2.2	Use exponents, roots and/or absolute value to solve problems. ***Reference: 2.1.11.A***	**M11.A.2.2.1**	Simplify/evaluate expressions involving positive and negative exponents, roots and/or absolute value (may contain all types of real numbers - exponents should not exceed power of 10).
		M11.A.2.2.2	Simplify/evaluate expressions involving multiplying with exponents (e.g. $x^6 * x^7 = x^{13}$), powers of powers (e.g., $(x^6)^7 = x^{42}$) and powers of products $(2x^2)^3 = 8x^6$ (positive exponents only).

M11.A Numbers and Operations

M11.A.3 Compute accurately and fluently and make reasonable estimates.

M11.A.3.1 Apply the order of operations in computation and in problem-solving situations. ***Reference: 2.2.8.A***	**M11.A.3.1.1** Simplify/evaluate expressions using the order of operations to solve problems (any rational numbers may be used).

M11.A Numbers and Operations

   M11.A.3 Compute accurately and fluently and make reasonable estimates.

M11.A.3.2	Use estimation strategies in problem-solving situations. *Reference: 2.2.11.B, 2.2.11.D*	M11.A.3.2.1	Use estimation to solve problems.

M11.B Measurement

   M11.B.1   Demonstrate an understanding of measurable attributes of objects and figures, and the units, systems and processes of measurement.

Not assessed at grade 11.

M11.B Measurement

M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.

M11.B.2.1	Use and/or compare measurements of angles. *Reference:* *2.3.11.A, 2.3.11.B*	**M11.B.2.1.1**	Measure and/or compare angles in degrees (up to 360°) (protractor must be provided or drawn).

M11.B Measurement

M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.

M11.B.2.2	Use and/or develop procedures to determine or describe measures of perimeter, circumference, area, surface area and/or volume. (May require conversions within the same system.) *Reference: 2.3.8.A, 2.3.8.D*	**M11.B.2.2.1**	Calculate the surface area of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.
		M11.B.2.2.2	Calculate the volume of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.
		M11.B.2.2.3	Estimate area, perimeter or circumference of an irregular figure.
		M11.B.2.2.4	Find the measurement of a missing length given the perimeter, circumference, area or volume.

M11.B Measurement

M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.

M11.B.2.3	Describe how a change in one dimension of a figure (2 or 3 dimensional) affects other measurements of that figure. *Reference: 2.3.8.E*	M11.B.2.3.1	Describe how a change in the linear dimension of a figure affects its perimeter, circumference, area or volume.
		Σ	• How does changing the length of the radius of a circle affect the circumference of the circle?
		Σ	• How does changing the length of the edge of a cube affect the volume of the cube?
		Σ	• How does changing the length of the base of a triangle affect the area of the triangle?

M11.C Geometry

M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships.

M11.C.1.1	Identify and/or use parts of circles and segments associated with circles. *Reference: 2.9.11.F*	**M11.C.1.1.1**	Identify and/or use the properties of a radius, diameter and/or tangent of a circle (given numbers should be whole.)
		M11.C.1.1.2	Identify and/or use the properties of arcs, semicircles, inscribed angles and/or central angles.

M11.C Geometry

M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships.

M11.C.1.2	Recognize and/or apply properties of angles, triangles and quadrilaterals. ***Reference: 2.9.8.D, 2.9.11.C***	**M11.C.1.2.1** Identify and/or use properties of triangles (e.g., medians, altitudes, angle bisectors, side/angle relationships, Triangle Inequality Theorem). **M11.C.1.2.2** Identify and/or use properties of quadrilaterals (e.g., parallel sides, diagonals, bisectors, congruent sides/angles and supplementary angles). **M11.C.1.2.3** Identify and/or use properties of isosceles and equilateral triangles

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M11.C Geometry

M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships.

M11.C.1.3	Use properties of congruence, correspondence and similarity in problem-solving settings involving two- and three-dimensional figures. ***Reference: 2.9.11.B***	**M11.C.1.3.1**	Identify and/or use properties of congruent and similar polygons or solids.

M11.C Geometry

M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships.

M11.C.1.4	Solve problems involving right triangles using the Pythagorean Theorem. *Reference: 2.10.11.B*	M11.C.1.4.1	Find the measure of a side of a right triangle using the Pythagorean Theorem (Pythagorean Theorem included on the reference sheet).

M11.C Geometry

M11.C.2 Identify and/or apply concepts of transformations or symmetry.

Not assessed at grade 11.

M11.C Geometry

M11.C.3 Locate points or describe relationships using the coordinate plane.

M11.C.3.1	Solve problems using analytic geometry. **Reference: 2.9.11.G**	**M11.C.3.1.1**	Calculate the distance and/or mid-point between 2 points on a number line or on a coordinate plane (formula provided on the reference sheet).
		M11.C.3.1.2	Relate slope to perpendicularity and/or parallelism (limit to linear algebraic expressions; slope formula provided on the reference sheet).

M11.D Algebraic Concepts

M11.D.1 Demonstrate an understanding of patterns, relations and functions.

M11.D.1.1	Analyze and/or use patterns or relations. ***Reference: 2.8.11.Q, 2.8.11.A, 2.8.11.O***	**M11.D.1.1.1**	Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.
		M11.D.1.1.2	Determine if a relation is a function given a set of points or a graph.
		M11.D.1.1.3	Identify the domain, range or inverse of a relation (may be presented as ordered pairs or a table).

M11.D Algebraic Concepts

M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.

M11.D.2.1	Write, solve and/or graph linear equations and inequalities using various methods. *Reference: 2.8.8.F, 2.8.11.D, 2.8.11.H, 2.8.11.J, 2.8.11.N, 2.8.11.L, 2.8.11.K*	**M11.D.2.1.1**	Solve compound inequalities and/or graph their solution sets on a number line (may include absolute value inequalities).
		M11.D.2.1.2	Identify or graph functions, linear equations or linear inequalities on a coordinate plane.
		M11.D.2.1.3	Write, solve and/or apply a linear equation (including problem situations).
		M11.D.2.1.4	Write and/or solve systems of equations using graphing, substitution and/or elimination (limit systems to 2 equations).
		M11.D.2.1.5	Solve quadratic equations using factoring (integers only – not including completing the square or the Quadratic Formula).

M11.D Algebraic Concepts

M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.

M11.D.2.2	Simplify expressions involving polynomials. **Reference: 2.8.11.S**	**M11.D.2.2.1**	Add, subtract and/or multiply polynomial expressions (express answers in simplest form – nothing larger than a binomial multiplied by a trinomial).
		M11.D.2.2.2	Factor algebraic expressions, including difference of squares and trinomials (trinomials limited to the form ax^2+bx+c where a is not equal to 0).
		M11.D.2.2.3	Simplify algebraic fractions.

M11.D Algebraic Concepts
M11.D.3   Analyze change in various contexts.

M11.D.3.1	Describe and/or determine change.	M11.D.3.1.1	Identify, describe and/or use constant or varying rates of change.
	Reference: 2.8.8.J, 2.11.8.B	M11.D.3.1.2	Determine how a change in one variable relates to a change in a second variable (e.g., y=4/x, if x doubles, what happens to y?).

M11.D Algebraic Concepts

M11.D.3 Analyze change in various contexts.

M11.D.3.2	Compute and/or use the slope of a line. **Reference: 2.8.11.J, 2.8.11.L**	**M11.D.3.2.1**	Apply the formula for the slope of a line to solve problems (formula given on reference sheet).
		M11.D.3.2.2	Given the graph of the line, 2 points on the line, or the slope and a point on a line, write or identify the linear equation in point-slope, standard and/or slope-intercept form.
		M11.D.3.2.3	Compute the slope and/or y-intercept represented by a linear equation or graph.

M11.D Algebraic Concepts

M11.D.4 Describe or use models to represent quantitative relationships.

M11.D.4.1	Interpret and/or use linear, quadratic and/or exponential functions and their equations, graphs or tables. *Reference: 2.8.11.K, 2.8.11.Q*	M11.D.4.1.1	Match the graph of a given function to its table or equation.

M11.E Data Analysis and Probability

M11.E.1 Formulate or answer questions that can be addressed with data and/or organize, display, interpret or analyze data.

M11.E.1.1	Appropriately display and/or use data in problem-solving settings. *Reference: 2.6.11.A, 2.6.8.E*	M11.E.1.1.1	Create and/or use appropriate graphical representations of data, including box-and-whisker plots, stem-and-leaf plots or scatter plots.
		M11.E.1.1.2	Analyze data and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots or scatter plots).

M11.E Data Analysis and Probability

M11.E.2 Select and/or use appropriate statistical methods to analyze data.

M11.E.2.1	Use measures of central tendency to describe a set of data. **Reference: 2.6.8.A, 2.6.11.A**	**M11.E.2.1.1**	Calculate or select the appropriate measure of central tendency (mean, mode or median) of a set of data given or represented on a table, line plot or stem-and-leaf plot.
		M11.E.2.1.2	Calculate and/or interpret the range, quartiles and interquartile range of data.
		M11.E.2.1.3	Describe how outliers affect measures of central tendency.

M11.E Data Analysis and Probability

M11.E.3 Understand and/or apply basic concepts of probability or outcomes.

M11.E.3.1	Apply probability and/or odds to practical situations. ***Reference: 2.7.11.A, 2.7.11.E***	**M11.E.3.1.1**	Find probabilities for independent, dependent or compound events and represent as a fraction, decimal or percent).
		M11.E.3.1.2	Find, convert and/or compare the probability and/or odds of a simple event.

M11.E Data Analysis and Probability

M11.E.3 Understand and/or apply basic concepts of probability or outcomes.

M11.E.3.2	Apply counting techniques in problem-solving settings. *Reference: 2.7.8.A*	M11.E.3.2.1	Determine the number of permutations and/or combinations or apply the fundamental counting principle. (Formula provided on the reference sheet).

M11.E Data Analysis and Probability

M11.E.4 Develop and/or evaluate inferences and predictions or draw conclusions based on data or data displays.

M11.E.4.1	Make predictions using data displays and probability. ***Reference: 2.7.8.E, 2.6.11.D***	**M11.E.4.1.1**	Estimate or calculate to make predictions based on a circle, line, bar graph or given situation.
		M11.E.4.1.2	Use probability to predict outcomes

M11.E Data Analysis and Probability

M11.E.4 Develop and/or evaluate inferences and predictions or draw conclusions based on data or data displays.

| M11.E.4.2 | Analyze and/or interpret data on a scatter plot and/or use a scatter plot to make predictions.

Reference: 2.6.11.C, 2.6.11.D | M11.E.4.2.1 | Draw, find and/or write an equation for a line of best fit for a scatter plot. |
| | | M11.E.4.2.2 | Make predictions using the equations or graphs of best-fit lines of scatter plots. |