

AMERICAN INTERNATIONAL
SCHOOL OF LAGOS

High School Math Standards



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AISL GEOMETRY ACADEMIC STANDARDS

Geometry

In this technological age, mathematics is more important than ever. When students leave school, they are more and more likely to use mathematics in their work and everyday lives — operating computer equipment, planning timelines and schedules, reading and interpreting data, comparing prices, managing personal finances, and completing other problem-solving tasks. What they learn in mathematics and how they learn it will provide an excellent preparation for a challenging and ever-changing future.

The following mathematics standards have been established to make clear to teachers, students, and parents what knowledge, understanding, and skills students should acquire in Geometry:

Standard 1 — Points, Lines, Angles, and Planes

Students understand the relationship between geometric ideas and their representation with coordinate systems. They find lengths and midpoints of line segments, slopes, parallel and perpendicular lines, and equations of lines. They also construct lines and angles, explaining and justifying the processes they use.

Standard 2 — Polygons

Students identify and describe polygons (triangles, quadrilaterals, pentagons, hexagons, etc.), using terms such as regular, convex, and concave. They find measures of angles, sides, perimeters, and areas of polygons, justifying their methods. They apply transformations to polygons and they relate geometry to algebra by using coordinate geometry to determine congruence, similarity, symmetry, and tessellations.

Standard 3 — Quadrilaterals

Students classify and understand relationships among quadrilaterals (rectangle, parallelogram, kite, etc.). They find measures of sides, perimeters, and areas of quadrilaterals, justifying their methods. They relate geometry to algebra by using coordinate geometry to determine regularity, congruence, and similarity. They use properties of congruent and similar quadrilaterals to solve problems involving lengths and areas.

Standard 4 — Triangles

Students identify and describe various kinds of triangles (right, acute, scalene, isosceles, etc.). They define and construct altitudes, medians, and bisectors, and triangles congruent to given triangles. They prove that triangles are congruent or similar and use properties of these triangles to solve problems involving lengths and areas. They find measures of sides, perimeters, and areas of triangles, justifying their methods. They relate geometry to algebra by using coordinate geometry to determine regularity, congruence, and similarity. They understand and apply the inequality theorems of triangles.

Standard 5 — Right Triangles

Students prove the Pythagorean Theorem and apply it to solving problems, including those involving the altitudes of right triangles and triangles with special angle relationships. They define and understand the concepts of the trigonometric functions (sine, tangent, etc.), know and use basic relationships among these functions, and apply their knowledge of trig functions to solving word problems.

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Standard 6 — Circles

Students define and understand ideas related to circles (radius, tangent, chord, etc.). They perform constructions and prove theorems related to circles. They find measures of arcs and angles related to them, as well as measures of circumference and area, and they relate geometry to algebra by finding the equation of a circle in the coordinate plane.

Standard 7 — Polyhedra and Other Solids

Students describe and make regular and nonregular polyhedra (cube, pyramid, tetrahedron, octahedron, etc.). They explore relationships among the faces, edges, and vertices of polyhedra. They describe sets of points on spheres, using terms such as great circle. They describe symmetries of solids and understand the properties of congruent and similar solids.

Standard 8 — Mathematical Reasoning and Problem Solving

In a general sense, mathematics is problem solving. In all mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. At this level, students apply these skills to making conjectures, using axioms and theorems, understanding the converse and contrapositive of a statement, constructing logical arguments, and writing geometric proofs. They also learn about inductive and deductive reasoning and how to use counterexamples to show that a general statement is false.

As part of their instruction and assessment, students should also develop the following learning skills by Grade 12 that are woven throughout the mathematics standards:

Communication

The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies.

Representation

The language of mathematics is expressed in words, symbols, formulas, equations, graphs, and data displays. The concept of one-fourth may be described as a quarter, $\frac{1}{4}$, one divided by four, 0.25, $\frac{1}{8} + \frac{1}{8}$, 25 percent, or an appropriately shaded portion of a pie graph. Higher-level mathematics involves the use of more powerful representations: exponents, logarithms, π , unknowns, statistical representation, algebraic and geometric expressions. Mathematical operations are expressed as representations: +, =, divide, square. Representations are dynamic tools for solving problems and communicating and expressing mathematical ideas and concepts.

Connections

Connecting mathematical concepts includes linking new ideas to related ideas learned previously, helping students to see mathematics as a unified body of knowledge whose concepts build upon each other. Major emphasis should be given to ideas and concepts across mathematical content areas that help students see that mathematics is a web of closely connected ideas (algebra, geometry, the entire number system). Mathematics is also the common language of many other disciplines (science, technology, finance, social science,

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geography) and students should learn mathematical concepts used in those disciplines. Finally, students should connect their mathematical learning to appropriate real-world contexts.

Standard 1 Points, Lines, Angles, and Planes

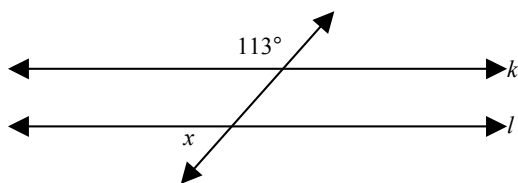
Students find lengths and midpoints of line segments. They describe and use parallel and perpendicular lines. They find slopes and equations of lines.

G.1.1 Find the lengths and midpoints of line segments in one- or two-dimensional coordinate systems.
Example: Find the length and midpoint of the line joining the points $A(3, 8)$ and $B(9, 0)$.

G.1.2 Construct congruent segments and angles, angle bisectors, and parallel and perpendicular lines using a straight edge and compass, explaining and justifying the process used.
Example: Construct the perpendicular bisector of a given line segment, justifying each step of the process.

G.1.3 Understand and use the relationships between special pairs of angles formed by parallel lines and transversals.

Example: In the diagram, the lines k and l are parallel. What is the measure of angle x ? Explain your answer.



G.1.4 Use coordinate geometry to find slopes, parallel lines, perpendicular lines, and equations of lines.
Example: Find an equation of a line perpendicular to $y = 4x - 2$.

Standard 2 Polygons

Students identify and describe polygons and measure interior and exterior angles. They use congruence, similarity, symmetry, tessellations, and transformations. They find measures of sides, perimeters, and areas.

G.2.1 Identify and describe convex, concave, and regular polygons.
Example: Draw a regular hexagon. Is it convex or concave? Explain your answer.

G.2.2 Find measures of interior and exterior angles of polygons, justifying the method used.
Example: Calculate the measure of one interior angle of a regular octagon. Explain your method.

G.2.3 Use properties of congruent and similar polygons to solve problems.
Example: Divide a regular hexagon into triangles by joining the center to each vertex. Show that

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these triangles are all the same size and shape and find the sizes of the interior angles of the hexagon.

G.2.4 Apply transformations (slides, flips, turns, expansions, and contractions) to polygons to determine congruence, similarity, symmetry, and tessellations. Know that images formed by slides, flips, and turns are congruent to the original shape.

Example: Use a drawing program to create regular hexagons, regular octagons, and regular pentagons. Under the drawings, describe which of the polygons would be best for tiling a rectangular floor. Explain your reasoning.

G.2.5 Find and use measures of sides, perimeters, and areas of polygons. Relate these measures to each other using formulas.

Example: A rectangle of area 360 square yards is ten times as long as it is wide. Find its length and width.

G.2.6 Use coordinate geometry to prove properties of polygons such as regularity, congruence, and similarity.

Example: Is the polygon formed by connecting the points $(2, 1)$, $(6, 2)$, $(5, 6)$, and $(1, 5)$ a square?

Standard 3 Quadrilaterals

Students identify and describe simple quadrilaterals. They use congruence and similarity. They find measures of sides, perimeters, and areas.

G.3.1 Describe, classify, and understand relationships among the quadrilaterals: square, rectangle, rhombus, parallelogram, trapezoid, and kite.

Example: Use a drawing program to create a square, rectangle, rhombus, parallelogram, trapezoid, and kite. Judge which of the quadrilaterals has perpendicular diagonals and draw those diagonals in the figures. Give a convincing argument that your judgment is correct.

G.3.2 Use properties of congruent and similar quadrilaterals to solve problems involving lengths and areas.

Example: Of two similar rectangles, the second has sides three times the length of the first. How many times larger in area is the second rectangle?

G.3.3 Find and use measures of sides, perimeters, and areas of quadrilaterals. Relate these measures to each other using formulas.

Example: A section of roof is a trapezoid with length 4 m at the ridge and 6 m at the gutter. The shortest distance from ridge to gutter is 3 m. Construct a model using a drawing program, showing how to find the area of this section of roof.

G.3.4 Use coordinate geometry to prove properties of quadrilaterals, such as regularity, congruence, and similarity.

Example: Is rectangle $ABCD$ with vertices at $(0, 0)$, $(4, 0)$, $(4, 2)$, $(0, 2)$ congruent to rectangle $PQRS$ with vertices at $(-2, -1)$, $(2, -1)$, $(2, 1)$, $(-2, 1)$?

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Standard 4 Triangles

Students identify and describe types of triangles. They identify and draw altitudes, medians, and angle bisectors. They use congruence and similarity. They find measures of sides, perimeters, and areas. They apply inequality theorems.

G.4.1 Identify and describe triangles that are right, acute, obtuse, scalene, isosceles, equilateral, and equiangular.

Example: Use a drawing program to create examples of right, acute, obtuse, scalene, isosceles, equilateral, and equiangular triangles. Identify and describe the attributes of each triangle.

G.4.2 Define, identify, and construct altitudes, medians, angle bisectors, and perpendicular bisectors.

Example: Draw several triangles. Construct their angle bisectors. What do you notice?

G.4.3 Construct triangles congruent to given triangles.

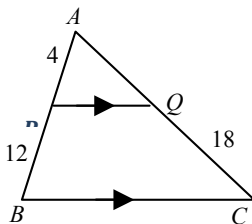
Example: Construct a triangle given the lengths of two sides and the measure of the angle between the two sides.

G.4.4 Use properties of congruent and similar triangles to solve problems involving lengths and areas.

Example: Of two similar triangles, the second has sides half the length of the first. The area of the first triangle is 20 cm^2 . What is the area of the second?

G.4.5 Prove and apply theorems involving segments divided proportionally.

Example: In triangle ABC , \overline{PQ} is parallel to \overline{BC} . What is the length of \overline{AQ} ?



G.4.6 Prove that triangles are congruent or similar and use the concept of corresponding parts of congruent triangles.

Example: In the last example, prove that triangles ABC and APQ are similar.

G.4.7 Find and use measures of sides, perimeters, and areas of triangles. Relate these measures to each other using formulas.

Example: The gable end of a house is a triangle 20 feet long and 13 feet high. Find its area.

G.4.8 Prove, understand, and apply the inequality theorems: triangle inequality, inequality in one triangle, and the hinge theorem.

Example: Can you draw a triangle with sides of length 7 cm, 4 cm, and 15 cm?

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G.4.9 Use coordinate geometry to prove properties of triangles such as regularity, congruence, and similarity.

Example: Draw a triangle with vertices at (1, 3), (2, 5), and (6, 1). Draw another triangle with vertices at (-3, -1), (-2, 1), and (2, -3). Are these triangles the same shape and size?

Standard 5 Right Triangles

Students prove the Pythagorean Theorem and use it to solve problems. They define and apply the trigonometric relations sine, cosine, and tangent.

G.5.1 Prove and use the Pythagorean Theorem.

Example: On each side of a right triangle, draw a square with that side of the triangle as one side of the square. Find the areas of the three squares. What relationship is there between the areas?

G.5.2 Use special right triangles ($30^\circ - 60^\circ$ and $45^\circ - 45^\circ$) to solve problems.

Example: An isosceles right triangle has one short side of 6 cm. Find the lengths of the other two sides.

G.5.3 Define and use the trigonometric functions (sine, cosine, tangent) in terms of angles of right triangles.

Example: In triangle ABC , $\tan A = \frac{1}{5}$. Find $\sin A$ and $\cot A$.

Standard 6 Circles

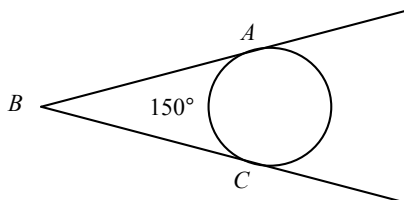
Students define ideas related to circles: e.g., radius, tangent. They find measures of angles, lengths, and areas. They prove theorems about circles. They find equations of circles.

G.6.1 Define and identify relationships among: radius, diameter, arc, measure of an arc, chord, secant, and tangent.

Example: What is the angle between a tangent to a circle and the radius at the point where the tangent meets the circle?

G.6.2 Define, find, and use measures of arcs and related angles (central, inscribed, and intersections of secants and tangents).

Example: Find the measure of angle ABC in the diagram below.



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G.6.3 Define, find, and use measures of circumference, arc length, and areas of circles and sectors. Use these measures to solve problems.

Example: Which will give you more: three 6-inch pizzas or two 8-inch pizzas? Explain your answer.

Standard 7

Polyhedra and Other Solids

Students describe and make polyhedra and other solids. They describe relationships and symmetries, and use congruence and similarity.

G.7.1 Describe and make regular and nonregular polyhedra.

Example: Is a cube a regular polyhedron? Explain why or why not.

G.7.2 Describe the polyhedron that can be made from a given net (or pattern). Describe the net for a given polyhedron.

Example: Make a net for a tetrahedron out of poster board and fold it up to make the tetrahedron.

G.7.3 Describe relationships between the faces, edges, and vertices of polyhedra.

Example: Count the sides, edges, and corners of a square-based pyramid. How are these numbers related?

G.7.4 Describe sets of points on spheres: chords, tangents, and great circles.

Example: On Earth, is the equator a great circle?

G.7.5 Identify and know properties of congruent and similar solids.

Example: Explain how the surface area and volume of similar cylinders are related.

G.7.6 Find and use measures of sides, volumes of solids, and surface areas of solids. Relate these measures to each other using formulas.

Example: An ice cube is dropped into a glass that is roughly a right cylinder with a 6 cm diameter. The water level rises 1 mm. What is the volume of the ice cube?

Standard 8

Mathematical Reasoning and Problem Solving

Students use a variety of strategies to solve problems.

G.8.1 Use a variety of problem-solving strategies, such as drawing a diagram, making a chart, guess-and-check, solving a simpler problem, writing an equation, and working backwards.

Example: How far does the tip of the minute hand of a clock move in 20 minutes if the tip is 4 inches from the center of the clock?

G.8.2 Decide whether a solution is reasonable in the context of the original situation.

Example: John says the answer to the problem in the first example is 12 inches. Is his answer reasonable? Why or why not?

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Students develop and evaluate mathematical arguments and proofs.

- G.8.3** Make conjectures about geometric ideas. Distinguish between information that supports a conjecture and the proof of a conjecture.
Example: Calculate the ratios of side lengths in several different-sized triangles with angles of 90° , 50° , and 40° . What do you notice about the ratios? How might you prove that your observation is true (or show that it is false)?
- G.8.4** Write and interpret statements of the form “if – then” and “if and only if.”
Example: Decide whether this statement is true: “If today is Sunday, then we have school tomorrow.”
- G.8.5** State, use, and examine the validity of the converse, inverse, and contrapositive of “if – then” statements.
Example: In the last example, write the converse of the statement.
- G.8.6** Identify and give examples of undefined terms, axioms, and theorems, and inductive and deductive proofs.
Example: Do you prove axioms from theorems or theorems from axioms?
- G.8.7** Construct logical arguments, judge their validity, and give counterexamples to disprove statements.
Example: Find an example to show that triangles with two sides and one angle equal are not necessarily congruent.
- G.8.8** Write geometric proofs, including proofs by contradiction and proofs involving coordinate geometry. Use and compare a variety of ways to present deductive proofs, such as flow charts, paragraphs, and two-column and indirect proofs.
Example: In triangle LMN , $LM = LN$. Prove that $\angle LMN \cong \angle LNM$.
- G.8.9** Perform basic constructions, describing and justifying the procedures used. Distinguish between constructing and drawing geometric figures.
Example: Construct a line parallel to a given line through a given point not on the line, explaining and justifying each step.

AISL HS ALGEBRA I ACADEMIC STANDARDS

ALGEBRA 1

In this technological age, mathematics is more important than ever. When students leave school, they are more and more likely to use mathematics in their work and everyday lives — operating computer equipment, planning timelines and schedules, reading and interpreting data, comparing prices, managing personal finances, and completing other problem-solving tasks. What they learn in mathematics and how they learn it will provide an excellent preparation for a challenging and ever-changing future.

The following mathematics standards have been established to make clear to teachers, students, and parents what knowledge, understanding, and skills students should acquire in Algebra I:

Standard 1 — Operations With Real Numbers

Students deepen their understanding of real numbers by comparing expressions involving square roots and exponents. They use the properties of real numbers to simplify algebraic formulas, and they convert between different measurement units using dimensional analysis.

Standard 2 — Linear Equations and Inequalities

Students solve linear equations to find the value of the variable and they rearrange formulas. They solve linear inequalities by using order properties of the real numbers, and they solve word problems involving linear equations, inequalities, and formulas.

Standard 3 — Relations and Functions

Students draw and interpret graphs of relations. They understand the concept of a function, find domains and ranges, and link equations to functions.

Standard 4 — Graphing Linear Equations and Inequalities

Students draw graphs of straight lines and relate their equations to their slopes and intercepts. They model situations with linear equations and use them to make predictions, and they graph linear inequalities in two variables.

Standard 5 — Pairs of Linear Equations and Inequalities

Students solve pairs of linear equations in two variables using both graphs and algebraic methods. They use pairs of linear equations to solve word problems, and they use graphs to solve pairs of linear inequalities in two variables.

Standard 6 — Polynomials

Students operate with polynomials, adding, subtracting, multiplying, dividing, and raising to powers. They find factors of polynomials, learning special techniques for factoring quadratics. They understand the relationships among the solutions of an equation, the zeros of a function, the x -intercepts of a graph, and the factors of a polynomial.

Standard 7 — Algebraic Fractions

Students simplify algebraic fractions, using what they have learned about factoring polynomials. They solve algebraic proportions.

Standard 8 — Quadratic, Cubic, and Radical Equations

Students draw graphs of quadratic, cubic, and rational functions. They derive the formula for solving quadratic equations and solve these equations by using the formula, by factoring, and by completing the square. They also solve equations that contain radical expressions and use graphing calculators to find approximate solutions of equations.

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Standard 9 — Mathematical Reasoning and Problem Solving

In a general sense, mathematics is problem solving. In all of their mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. At this level, students apply these skills to justifying the steps in simplifying functions and solving equations and to deciding whether algebraic statements are true. They also learn about inductive and deductive reasoning and how to use counterexamples to show that a general statement is false.

As part of their instruction and assessment, students should also develop the following learning skills by Grade 12 that are woven throughout the mathematics standards:

Communication

The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies.

Representation

The language of mathematics is expressed in words, symbols, formulas, equations, graphs, and data displays. The concept of one-fourth may be described as a quarter, $\frac{1}{4}$, one divided by four, 0.25, $\frac{1}{8} + \frac{1}{8}$, 25 percent, or an appropriately shaded portion of a pie graph. Higher-level mathematics involves the use of more powerful representations: exponents, logarithms, π , unknowns, statistical representation, algebraic and geometric expressions. Mathematical operations are expressed as representations: +, =, divide, square. Representations are dynamic tools for solving problems and communicating and expressing mathematical ideas and concepts.

Connections

Connecting mathematical concepts includes linking new ideas to related ideas learned previously, helping students to see mathematics as a unified body of knowledge whose concepts build upon each other. Major emphasis should be given to ideas and concepts across mathematical content areas that help students see that mathematics is a web of closely connected ideas (algebra, geometry, the entire number system). Mathematics is also the common language of many other disciplines (science, technology, finance, social science, geography) and students should learn mathematical concepts used in those disciplines. Finally, students should connect their mathematical learning to appropriate real-world contexts.

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Standard 1 Operations With Real Numbers

Students simplify and compare expressions. They use rational exponents and simplify square roots.

- A1.1.1 Compare real number expressions.
Example: Which is larger: 2^3 or $\sqrt{49}$?
- A1.1.2 Simplify square roots using factors.
Example: Explain why $\sqrt{48} = 4\sqrt{3}$.
- A1.1.3 Understand and use the distributive, associative, and commutative properties.
Example: Simplify $(6x^2 - 5x + 1) - 2(x^2 + 3x - 4)$ by removing the parentheses and rearranging. Explain why you can carry out each step.
- A1.1.4 Use the laws of exponents for rational exponents.
Example: Simplify $25^{\frac{3}{2}}$.
- A1.1.5 Use dimensional (unit) analysis to organize conversions and computations.
Example: Convert 5 miles per hour to feet per second: $\frac{5 \text{ mi}}{1 \text{ hr}} \leq \frac{1 \text{ hr}}{3600 \text{ sec}} \leq \frac{5280 \text{ ft}}{1 \text{ mi}} \approx 7.3$ ft/sec.

Standard 2 Linear Equations and Inequalities

Students solve linear equations and inequalities in one variable. They solve word problems that involve linear equations, inequalities, or formulas.

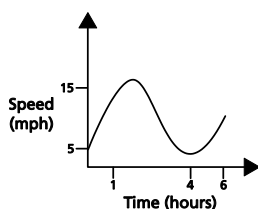
- A1.2.1 Solve linear equations.
Example: Solve the equation $7a + 2 = 5a - 3a + 8$.
- A1.2.2 Solve equations and formulas for a specified variable.
Example: Solve the equation $q = 4p - 11$ for p .
- A1.2.3 Find solution sets of linear inequalities when possible numbers are given for the variable.
Example: Solve the inequality $6x - 3 > 10$ for x in the set $\{0, 1, 2, 3, 4\}$.
- A1.2.4 Solve linear inequalities using properties of order.
Example: Solve the inequality $8x - 7 \leq 2x + 5$, explaining each step in your solution.
- A1.2.5 Solve combined linear inequalities.
Example: Solve the inequalities $-7 < 3x + 5 < 11$.
- A1.2.6 Solve word problems that involve linear equations, formulas, and inequalities.
Example: You are selling tickets for a play that cost \$3 each. You want to sell at least \$50 worth. Write and solve an inequality for the number of tickets you must sell.

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Standard 3 Relations and Functions

Students sketch and interpret graphs representing given situations. They understand the concept of a function and analyze the graphs of functions.

- A1.3.1 Sketch a reasonable graph for a given relationship.
Example: Sketch a reasonable graph for a person's height from age 0 to 25.
- A1.3.2 Interpret a graph representing a given situation.
Example: Jessica is riding a bicycle. The graph below shows her speed as it relates to the time she has spent riding. Describe what might have happened to account for such a graph.



- A1.3.3 Understand the concept of a function, decide if a given relation is a function, and link equations to functions.
Example: Use either paper or a spreadsheet to generate a list of values for x and y in $y = x^2$. Based on your data, make a conjecture about whether or not this relation is a function. Explain your reasoning.
- A1.3.4 Find the domain and range of a relation.
Example: Based on the list of values from the last example, what are the domain and range of $y = x^2$?

Standard 4 Graphing Linear Equations and Inequalities

Students graph linear equations and inequalities in two variables. They write equations of lines and find and use the slope and y-intercept of lines. They use linear equations to model real data.

- A1.4.1 Graph a linear equation.
Example: Graph the equation $3x - y = 2$.
- A1.4.2 Find the slope, x -intercept, and y -intercept of a line given its graph, its equation, or two points on the line.
Example: Find the slope and y -intercept of the line $4x + 6y = 12$.
- A1.4.3 Write the equation of a line in slope-intercept form. Understand how the slope and y -intercept of the graph are related to the equation.
Example: Write the equation of the line $4x + 6y = 12$ in slope-intercept form. What is the slope of this line? Explain your answer.

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- A1.4.4 Write the equation of a line given appropriate information.
Example: Find an equation of the line through the points (1, 4) and (3, 10), then find an equation of the line through the point (1, 4) perpendicular to the first line.
- A1.4.5 Write the equation of a line that models a data set and use the equation (or the graph of the equation) to make predictions. Describe the slope of the line in terms of the data, recognizing that the slope is the rate of change.
Example: As your family is traveling along an interstate, you note the distance traveled every 5 minutes. A graph of time and distance shows that the relation is approximately linear. Write the equation of the line that fits your data. Predict the time for a journey of 50 miles. What does the slope represent?
- A1.4.6 Graph a linear inequality in two variables.
Example: Draw the graph of the inequality $6x + 8y \geq 24$ on a coordinate plane.

Standard 5 **Pairs of Linear Equations and Inequalities**

Students solve pairs of linear equations using graphs and using algebra. They solve pairs of linear inequalities using graphs. They solve word problems involving pairs of linear equations.

- A1.5.1 Use a graph to estimate the solution of a pair of linear equations in two variables.
Example: Graph the equations $3y - x = 0$ and $2x + 4y = 15$ to find where the lines intersect.
- A1.5.2 Use a graph to find the solution set of a pair of linear inequalities in two variables.
Example: Graph the inequalities $y \leq 4$ and $x + y \leq 5$. Shade the region where both inequalities are true.
- A1.5.3 Understand and use the substitution method to solve a pair of linear equations in two variables.
Example: Solve the equations $y = 2x$ and $2x + 3y = 12$ by substitution.
- A1.5.4 Understand and use the addition or subtraction method to solve a pair of linear equations in two variables.
Example: Use subtraction to solve the equations: $3x + 4y = 11$ and $3x + 2y = 7$.
- A1.5.5 Understand and use multiplication with the addition or subtraction method to solve a pair of linear equations in two variables.
Example: Use multiplication with the subtraction method to solve the equations: $x + 4y = 16$ and $3x + 2y = -3$.
- A1.5.6 Use pairs of linear equations to solve word problems.
Example: The income a company makes from a certain product can be represented by the equation $y = 10.5x$ and the expenses for that product can be represented by the equation $y = 5.25x + 10,000$, where x is the amount of the product sold and y is the number of dollars. How much of the product must be sold for the company to reach the break-even point?

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Standard 6 Polynomials

Students add, subtract, multiply, and divide polynomials. They factor quadratics.

- A1.6.1 Add and subtract polynomials.
Example: Simplify $(4x^2 - 7x + 2) - (x^2 + 4x - 5)$.
- A1.6.2 Multiply and divide monomials.
Example: Simplify $a^2b^5 \div ab^2$.
- A1.6.3 Find powers and roots of monomials (only when the answer has an integer exponent).
Example: Find the square root of a^2b^6 .
- A1.6.4 Multiply polynomials.
Example: Multiply $(n + 2)(4n - 5)$.
- A1.6.5 Divide polynomials by monomials.
Example: Divide $4x^3y^2 + 8xy^4 - 6x^2y^5$ by $2xy^2$.
- A1.6.6 Find a common monomial factor in a polynomial.
Example: Factor $36xy^2 + 18xy^4 - 12x^2y^4$.
- A1.6.7 Factor the difference of two squares and other quadratics.
Example: Factor $4x^2 - 25$ and $2x^2 - 7x + 3$.
- A1.6.8 Understand and describe the relationships among the solutions of an equation, the zeros of a function, the x -intercepts of a graph, and the factors of a polynomial expression.
Example: A graphing calculator can be used to solve $3x^2 - 5x - 1 = 0$ to the nearest tenth. Justify using the x -intercepts of $y = 3x^2 - 5x - 1$ as the solutions of the equation.

Standard 7 Algebraic Fractions

Students simplify algebraic ratios and solve algebraic proportions.

- A1.7.1 Simplify algebraic ratios.
Example: Simplify $\frac{x^2 - 16}{x^2 + 4x}$.
- A1.7.2 Solve algebraic proportions.
Example: Create a tutorial to be posted to the school's Web site to instruct beginning students in the steps involved in solving an algebraic proportion. Use $\frac{x+5}{4} = \frac{3x+5}{7}$ as an example.

AISL HS ALGEBRA I ACADEMIC STANDARDS

Quadratic, Cubic, and Radical Equations

Students graph and solve quadratic and radical equations. They graph cubic equations.

- A1.8.1 Graph quadratic, cubic, and radical equations.
Example: Draw the graph of $y = x^2 - 3x + 2$. Using a graphing calculator or a spreadsheet (generate a data set), display the graph to check your work.
- A1.8.2 Solve quadratic equations by factoring.
Example: Solve the equation $x^2 - 3x + 2 = 0$ by factoring.
- A1.8.3 Solve quadratic equations in which a perfect square equals a constant.
Example: Solve the equation $(x - 7)^2 = 64$.
- A1.8.4 Complete the square to solve quadratic equations.
Example: Solve the equation $x^2 - 7x + 9 = 0$ by completing the square.
- A1.8.5 Derive the quadratic formula by completing the square.
Example: Prove that the equation $ax^2 + bx + c = 0$ has solutions $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
- A1.8.6 Solve quadratic equations using the quadratic formula.
Example: Solve the equation $x^2 - 7x + 9 = 0$.
- A1.8.7 Use quadratic equations to solve word problems.
Example: A ball falls so that its distance above the ground can be modeled by the equation $s = 100 - 16t^2$, where s is the distance above the ground in feet and t is the time in seconds. According to this model, at what time does the ball hit the ground?
- A1.8.8 Solve equations that contain radical expressions.
Example: Solve the equation $\sqrt{x+6} = x$.
- A1.8.9 Use graphing technology to find approximate solutions of quadratic and cubic equations.
Example: Use a graphing calculator to solve $3x^2 - 5x - 1 = 0$ to the nearest tenth.

AISL HS ALGEBRA I ACADEMIC STANDARDS

Standard 9

Mathematical Reasoning and Problem Solving

Students use a variety of strategies to solve problems.

A1.9.1 Use a variety of problem-solving strategies, such as drawing a diagram, making a chart, guess-and-check, solving a simpler problem, writing an equation, and working backwards.

Example: Fran has scored 16, 23, and 30 points in her last three games. How many points must she score in the next game so that her four-game average does not fall below 20 points?

A1.9.2 Decide whether a solution is reasonable in the context of the original situation.

Example: John says the answer to the problem in the first example is 10 points. Is his answer reasonable? Why or why not?

Students develop and evaluate mathematical arguments and proofs.

A1.9.3 Use the properties of the real number system and the order of operations to justify the steps of simplifying functions and solving equations.

Example: Given an argument (such as $3x + 7 > 5x + 1$, and therefore $-2x > -6$, and therefore

$x > 3$), provide a visual presentation of a step-by-step check, highlighting any errors in the argument.

A1.9.4 Understand that the logic of equation solving begins with the assumption that the variable is a number that satisfies the equation and that the steps taken when solving equations create new equations that have, in most cases, the same solution set as the original. Understand that similar logic applies to solving systems of equations simultaneously.

Example: Try “solving” the equations $x + 3y = 5$ and $5x + 15y = 25$ simultaneously. Explain what went wrong.

A1.9.5 Decide whether a given algebraic statement is true always, sometimes, or never (statements involving linear or quadratic expressions, equations, or inequalities).

Example: Is the statement $x^2 - 5x + 2 = x^2 + 5x + 2$ true for all x , for some x , or for no x ? Explain your answer.

A1.9.6 Distinguish between inductive and deductive reasoning, identifying and providing examples of each.

Example: What type of reasoning are you using when you look for a pattern?

A1.9.7 Identify the hypothesis and conclusion in a logical deduction.

Example: What is the hypothesis and conclusion in this argument: If there is a number x such that $2x + 1 = 7$, then $x = 3$?

A1.9.8 Use counterexamples to show that statements are false, recognizing that a single counterexample is sufficient to prove a general statement false.

Example: Use the demonstration-graphing calculator on an overhead projector to produce an example showing that this statement is false: all quadratic equations have two different solutions.

AISL ALGEBRA II ACADEMIC STANDARDS

ALGEBRA 11

In this technological age, mathematics is more important than ever. When students leave school, they are more and more likely to use mathematics in their work and everyday lives — operating computer equipment, planning timelines and schedules, reading and interpreting data, comparing prices, managing personal finances, and completing other problem-solving tasks. What they learn in mathematics and how they learn it will provide an excellent preparation for a challenging and ever-changing future.

The following mathematics standards have been established to make clear to teachers, students, and parents what knowledge, understanding, and skills students should acquire in Algebra II:

Standard 1 — Relations and Functions

Students recognize and graph polynomial, rational, and algebraic functions. They understand the concept of functional notation and use it to combine functions by composition. They solve equations and inequalities by examining their graphs and interpret situations as functions in graphs, formulas, and words.

Standard 2 — Linear and Absolute Value Equations and Inequalities

Students graph linear equations and inequalities involving absolute value. They use a variety of methods to solve systems of up to three linear equations in up to three variables, and they model data with linear equations and make predictions from the results.

Standard 3 — Quadratic Equations and Functions

Students extend the number system by defining complex numbers, relating them to the real numbers, and using them to solve quadratic equations. They draw graphs of quadratic functions and apply transformations to the functions. They find and interpret zeros and maximum and minimum values, and solve word problems. They also solve equations containing radicals and solve pairs of equations.

Standard 4 — Conic Sections

Students write equations and draw graphs of conic sections (circle, ellipse, parabola, and hyperbola), thus relating an algebraic representation to a geometric one.

Standard 5 — Polynomials

Students understand and use the binomial theorem for positive integer powers. They learn techniques for factoring polynomials in order to solve equations and related word problems. They find approximate solutions of equations using graphing technology and write equations with given solutions. They understand the relationships among the solutions of an equation, the zeros of a function, the x -intercepts of a graph, and the factors of a polynomial.

Standard 6 — Algebraic Fractions

Students understand and use the concepts of negative and fractional exponents. They add, subtract, multiply, divide, and simplify algebraic fractions. They solve equations involving algebraic fractions and solve related word problems. They also solve problems of direct, inverse, and joint variation.

AISL ALGEBRA II ACADEMIC STANDARDS

Standard 7 — Logarithmic and Exponential Functions

Students understand the concepts of logarithmic and exponential functions. They graph exponential functions and solve problems of growth and decay. They understand the inverse relationship between exponents and logarithms and use it to prove laws of logarithms and to solve equations. And they convert logarithms between bases and simplify logarithmic expressions.

Standard 8 — Sequences and Series: DOES NOT APPLY

Standard 9 — Counting Principles and Probability

Students understand and apply counting principles to find permutations and combinations and related probabilities.

Standard 10 — Mathematical Reasoning and Problem Solving

In a general sense, mathematics is problem solving. In all of their mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. At this level, students apply these skills to justifying the steps in simplifying functions and solving equations and to deciding whether algebraic statements are true. They also learn how to use counterexamples to show that a general statement is false.

Standard 11- Trigonometry

Students evaluate trigonometric functions of any angles (sin, cos, tan, sec, csc, cot) They use radian measures and degree measures. They also graph the sin, cosine, tangent, cotangent and cosecant functions.

As part of their instruction and assessment, students should also develop the following learning skills by Grade 12 that are woven throughout the mathematics standards:

Communication

The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies.

Representation

The language of mathematics is expressed in words, symbols, formulas, equations, graphs, and data displays. The concept of one-fourth may be described as a quarter, $\frac{1}{4}$, one divided by four, 0.25,

$\frac{1}{8} + \frac{1}{8}$, 25 percent, or an appropriately shaded portion of a pie graph. Higher-level mathematics involves the use of more powerful representations: exponents, logarithms, π , unknowns, statistical representation, algebraic and geometric expressions. Mathematical operations are expressed as representations: +, =, divide, square. Representations are dynamic tools for solving problems and communicating and expressing mathematical ideas and concepts.

AISL ALGEBRA II ACADEMIC STANDARDS

Connections

Connecting mathematical concepts includes linking new ideas to related ideas learned previously, helping students to see mathematics as a unified body of knowledge whose concepts build upon each other. Major emphasis should be given to ideas and concepts across mathematical content areas that help students see that mathematics is a web of closely connected ideas (algebra, geometry, the entire number system). Mathematics is also the common language of many other disciplines (science, technology, finance, social science, geography) and students should learn mathematical concepts used in those disciplines. Finally, students should connect their mathematical learning to appropriate real-world contexts.

Standard 1

Relations and Functions

Students graph relations and functions and find zeros. They use function notation and combine functions by composition. They interpret functions in given situations.

A2.1.1 Recognize and graph various types of functions, including polynomial, rational, and algebraic functions.

Example: Draw the graphs of the functions $y = x^4 - x^2$, $y = \frac{7}{x-2}$, and $y = \sqrt{x+2}$.

A2.1.2 Use function notation. Add, subtract, multiply, and divide pairs of functions.

Example: Let $f(x) = 7x + 2$ and $g(x) = x^2$. Find the value of $f(x) \cdot g(x)$.

A2.1.3 Understand composition of functions and combine functions by composition.

Example: Let $f(x) = x^3$ and $g(x) = x - 2$. Find $f(g(x))$.

A2.1.4 Graph relations and functions with and without graphing technology.

Example: Draw the graph of $y = x^3 - 3x^2 - x + 3$.

A2.1.5 Find the zeros of a function.

Example: In the last example, find the zeros of the function; i.e., find x when $y = 0$.

A2.1.6 Solve an inequality by examining the graph.

Example: Find the solution for $x^3 - 3x^2 - x + 3 < 0$ by graphing $y = x^3 - 3x^2 - x + 3$.

A2.1.7 Graph functions defined piece-wise.

Example: Sketch the graph of $f(x) = \begin{cases} x + 2 & \text{for } x \geq 0 \\ -x^2 & \text{for } x > 0 \end{cases}$.

A2.1.8 Interpret given situations as functions in graphs, formulas, and words.

Example: You and your parents are going to Boston and want to rent a car at Logan International Airport on a Monday morning and drop the car off in downtown Providence, R.I., on the following Wednesday. Find the rates from two national car companies and plot the costs on a graph. Decide which company offers the best deal. Explain your answer.

AISL ALGEBRA II ACADEMIC STANDARDS

Standard 2

Linear and Absolute Value Equations and Inequalities

Students solve systems of linear equations and inequalities and use them to solve word problems. They model data with linear equations.

- A2.2.1 Graph absolute value equations and inequalities.
Example: Draw the graph of $y = 2x - 5$ and use that graph to draw the graph of $y = |2x - 5|$.
- A2.2.2 Use substitution, elimination, and matrices to solve systems of two or three linear equations in two or three variables.
Example: Solve the system of equations: $x - 2y + 3z = 5$, $x + 3z = 11$, $5y - 6z = 9$.
- A2.2.3 Use systems of linear equations and inequalities to solve word problems.
Example: Each week you can work no more than 20 hours all together at the local bookstore and the drugstore. You prefer the bookstore and want to work at least 10 more hours there than at the drugstore. Draw a graph to show the possible combinations of hours that you could work.
- A2.2.4 Find a linear equation that models a data set using the median fit method and use the model to make predictions.
Example: You light a candle and record its height in centimeters every minute. The results recorded as (time, height) are (0, 20), (1, 18.3), (2, 16.5), (3, 14.8), (4, 13.2), (5, 11.5), (6, 10.0), (7, 8.2), (9, 4.9), and (10, 3.1). Find the median fit line to express the candle's height as a function of the time and state the meaning of the slope in terms of the burning candle.

Standard 3

Quadratic Equations and Functions

Students solve quadratic equations, including the use of complex numbers. They interpret maximum and minimum values of quadratic functions. They solve equations that contain square roots.

- A2.3.1 Define complex numbers and perform basic operations with them.
Example: Multiply $7 - 4i$ and $10 + 6i$.
- A2.3.2 Understand how real and complex numbers are related, including plotting complex numbers as points in the plane.
Example: Plot the points corresponding to $3 - 2i$ and $1 + 4i$. Add these complex numbers and plot the result. How is this point related to the other two?
- A2.3.3 Solve quadratic equations in the complex number system.
Example: Solve $x^2 - 2x + 5 = 0$ over the complex numbers.
- A2.3.4 Graph quadratic functions. Apply transformations to quadratic functions. Find and interpret the zeros and maximum or minimum value of quadratic functions.
Example: Find the zeros for $y = x^2 - 4$. If $y = x^2 - 4$ has a maximum or minimum value, give the ordered pair corresponding to the maximum or minimum point.

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- A2.3.5 Solve word problems using quadratic equations.
Example: You have 100 feet of fencing to make three sides of a rectangular area using an existing straight fence as the fourth side. Construct a formula in a spreadsheet to determine the area you can enclose and use the spreadsheet to make a conjecture about the maximum area possible. Prove (or disprove) your conjecture by solving an appropriate quadratic equation.
- A2.3.6 Solve equations that contain radical expressions.
Example: Solve the equation $\sqrt{x+9} = 9 - \sqrt{x}$.
- A2.3.7 Solve pairs of equations, one quadratic and one linear or both quadratic.
Example: Solve the system of equations $y = x^2 - 5x + 1$, $x + y + 2 = 0$.

Standard 4 Conic Sections

Students write equations of conic sections and draw their graphs.

There are no student learning outcomes in this standard for this course.

Standard 5 Polynomials

Students use the binomial theorem, divide and factor polynomials, and solve polynomial equations.

- A2.5.1 Divide polynomials by others of lower degree.
Example: Divide $2x^3 - 3x^2 + x - 6$ by $x^2 + 2$.
- A2.5.2 Factor polynomials completely and solve polynomial equations by factoring.
Example: Solve $x^3 + 27 = 0$ by factoring.
- A2.5.3 Use graphing technology to find approximate solutions for polynomial equations.
Example: Approximate the solution(s) of $x^4 - 3x^3 + 2x - 7 = 0$ to the nearest tenth.
- A2.5.4 Use polynomial equations to solve word problems.
Example: You want to make an open-top box with a volume of 500 square inches from a piece of cardboard that is 25 inches by 15 inches by cutting squares from the corners and folding up the sides. Find the possible dimensions of the box.
- A2.5.5 Write a polynomial equation given its solutions.
Example: Write an equation that has solutions $x = 2$, $x = 5i$ and $x = -5i$.
- A2.5.6 Understand and describe the relationships among the solutions of an equation, the zeros of a function, the x -intercepts of a graph, and the factors of a polynomial expression.
Example: Solve the equation $x^4 + x^3 - 7x^2 - x + 6 = 0$, given that $x - 2$ and $x + 3$ are factors of $x^4 + x^3 - 7x^2 - x + 6$.

AISL ALGEBRA II ACADEMIC STANDARDS

Standard 6 Algebraic Fractions

Students use negative and fractional exponents. They simplify algebraic fractions and solve equations involving algebraic fractions. They solve problems of direct, inverse, and joint variation.

- A2.6.1 Understand and use negative and fractional exponents.
Example: Simplify $(2a^{-2}b^3)^4 (4a^3b^{-1})^{-2}$.
- A2.6.2 Add, subtract, multiply, divide, and simplify algebraic fractions.
Example: Simplify $\frac{x^2-4}{x^5} + \frac{x^3-8}{x^8}$.
- A2.6.3 Simplify complex fractions.
Example: Simplify $(\frac{5}{x-2} + \frac{2}{x+3}) \div (\frac{1}{x+3} + \frac{7}{x-2})$.
- A2.6.4 Solve problems of direct, inverse, and joint variation.
Example: One day your drive to work takes 10 minutes and you average 30 mph. The next day the drive takes 15 minutes. What is your average speed that day?

Standard 7 Logarithmic and Exponential Functions

Students graph exponential functions and relate them to logarithms. They solve logarithmic and exponential equations and inequalities. They solve word problems using exponential functions.

- A2.7.1 Graph exponential functions.
Example: Draw the graphs of the functions $y = 2^x$ and $y = 2^{-x}$.
- A2.7.2 Prove simple laws of logarithms.
Example: Use the fact that $a^x \cdot a^y = a^{x+y}$ to show that $\log_a(pq) = \log_a p + \log_a q$.
- A2.7.3 Understand and use the inverse relationship between exponents and logarithms.
Example: Find the value of $\log_{10}(10^7)$.
- A2.7.4 Solve logarithmic and exponential equations and inequalities.
Example: Solve the equation $\log_2 x = 5$.
- A2.7.5 Use the definition of logarithms to convert logarithms from one base to another.
Example: Write $\log_{10} 75$ as a logarithm to base 2.
- A2.7.6 Use the properties of logarithms to simplify logarithmic expressions and to find their approximate values.
Example: Simplify $\log_3 81$.

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- A2.7.7 Use calculators to find decimal approximations of natural and common logarithmic numeric expressions.
Example: Find a decimal approximation for $\ln 500$.

Standard 8 **Sequences and Series**

Students define and use arithmetic and geometric sequences and series.

There are no learner outcomes for Standard 8 in this course.

Standard 9 **Counting Principles and Probability**

Students use fundamental counting principles to compute combinations, permutations, and probabilities.

- A2.9.1 Understand and apply counting principles to compute combinations and permutations.
Example: There are 5 students who work in a bookshop. If the bookshop needs 3 people to operate, how many days straight could the bookstore operate without the same group of students working twice?

Standard 10 **Mathematical Reasoning and Problem Solving**

Students use a variety of strategies to solve problems.

- A2.10.1 Use a variety of problem-solving strategies, such as drawing a diagram, guess-and-check, solving a simpler problem, writing an equation, and working backwards.
Example: The swimming pool at Roanoke Park is 24 feet long and 18 feet wide. The park district has determined that they have enough money to put a walkway of uniform width, with a maximum area of 288 square feet, around the pool. How could you find the maximum width of a new walkway?
- A2.10.2 Decide whether a solution is reasonable in the context of the original situation.
Example: John says the answer to the problem in the first example is 20 feet. Is that reasonable?

Students develop and evaluate mathematical arguments and proofs.

- A2.10.3 Decide if a given algebraic statement is true always, sometimes, or never (statements involving rational or radical expressions or logarithmic or exponential functions).
Example: Is the statement $(a^x)^y = a^{xy}$ true for all x , for some x , or for no x ?
- A2.10.4 Use the properties of number systems and the order of operations to justify the steps of simplifying functions and solving equations.
Example: Simplify $2(x^3 - 3x^2 + x - 6) - (x - 3)(x + 4)$, explaining why you can take each step.

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- A2.10.5 Understand that the logic of equation solving begins with the assumption that the variable is a number that satisfies the equation and that the steps taken when solving equations create new equations that have, in most cases, the same solution set as the original. Understand that similar logic applies to solving systems of equations simultaneously.
Example: A student solving the equation $\sqrt{x+6} = x$ comes up with the solution set $\{-2, 3\}$. Explain why $\{-2, 3\}$ is not the solution set to this equation, and why the “check” step is essential in solving the equation.

Standard 11 **Trigonometry**

Students graph trigonometric functions

- A2.11.1 Define and use radian and degree measures. Use angles to model and solve real life problems.
- A2.11.2 Identify a unit circle and describe its relationship to real numbers. Evaluate trigonometric functions using the unit circle.
- A2.11.3 Evaluate trigonometric functions of acute angles. Use the fundamental trigonometric identities.