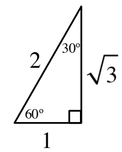
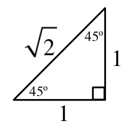
Glossary



30º-60º-90º triangle A special right triangle with acute angle measures of 30º and 60º. The side lengths are always in the ratio of $1:\sqrt{3}:2$. (p. 332)



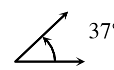
45º-45º-90º triangle A special right triangle with acute angle measures of 45º. The side lengths are always in the ratio of $1:1:\sqrt{2}$. (p. 332)

AA ~ (triangle similarity) If two angles of one triangle are congruent to the two corresponding angles of another triangle, then the triangles are similar. For example, given ΔABC and $\Delta A'B'C'$ with $\angle A \cong \angle A'$ and $\angle B \cong \angle B'$, then $\Delta ABC \sim \Delta A'B'C'$. You can also show that two triangles are similar by showing that *three* pairs of corresponding angles are congruent (which would be called AAA ~), but two pairs of angles are sufficient to demonstrate similarity. (p. 120)

AAS ≅ (triangle congruence) If two angles and a non-included side of one triangle are congruent to the corresponding two angles and non-included side of another triangle, the two triangles are congruent. Note that AAS ≅ is equivalent to ASA ≅. (p. 74)

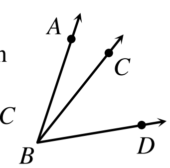
absolute value The absolute value of a number is the distance of the number from zero. Since the absolute value represents a distance without regard to direction, it is always a positive real number. For example, $|-7| = 7$, and $|7| = 7$. (p. 447)

acute angle An angle with a measure greater than 0º and less than 90º. One example is shown at right. Also see *obtuse angle*. (p. 14)

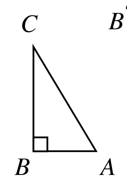


Addition Rule for Probability For any two events {A} and {B}, *P*(A or B) = *P*(A) + *P*(B) – *P*(A and B). Also see *Multiplication Rule for Probability*. (p. 171)

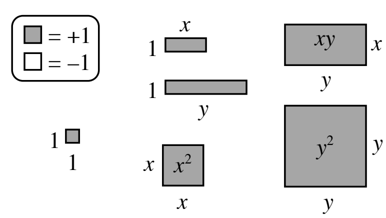
adjacent angles For two angles to be adjacent, they must satisfy these three conditions: The two angles must have a common side, they must have a common vertex, and they can have no interior points in common. This means that the common side must be between the two angles; no overlap between the angles is permitted. In the example at right, $\angle ABC$ and $\angle CBD$ are adjacent angles.



adjacent leg In a right triangle, the leg adjacent to an acute angle is the side of the angle that is not the hypotenuse. For example, in ΔABC shown at right, $\overline{AB}$ is the leg adjacent to $\angle A$. (p. 231)

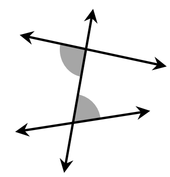


algebra tiles An algebra tile is a manipulative whose area represents a constant or variable quantity. The algebra tiles used in this course consist of large squares with dimensions x-by-x and y-by-y, rectangles with dimensions x-by-1, y-by-1, and x-by-y, and small squares with dimensions 1-by-1. These tiles are named by their areas: x^2, y^2, x, y, xy, and 1, respectively. The smallest squares are called "unit tiles". In this text, shaded tiles will represent positive quantities while unshaded tiles will represent negative quantities. (p. 41)



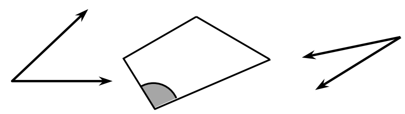
alpha (α) A Greek letter that is often used to represent the measure of an angle. Other Greek letters used to represent the measure of an angle include *theta* (θ) and *beta* (β). (p. 183)

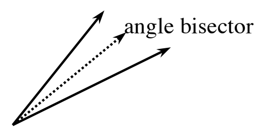
alternate interior angles Angles between a pair of lines that switch sides of a third intersecting line (called a transversal). For example, in the diagram at right, the shaded angles are alternate interior angles. If the lines intersected by the transversal are parallel, then the alternate interior angles are congruent. Conversely, if the alternate interior angles are congruent, then the two lines intersected by the transversal are parallel. Also see *same-side interior angles* and *corresponding angles*. (p. 58)



altitude See *height*.

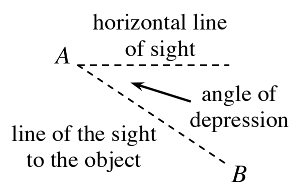
angle In general, an angle is formed by two rays joined at a common endpoint. Angles in geometric figures are usually formed by two segments with a common endpoint (such as the angle shaded in the figure at right). (p. 14)



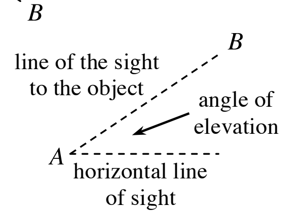


angle bisector A line segment or ray with an endpoint at the vertex of the angle that divides the angle into two equal pieces.

angle measure See *measurement*.

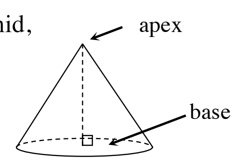


angle of depression When an object (B) is below the horizontal line of sight of the observer (A), the angle of depression is the angle formed by the line of sight to the object and the horizontal line of sight.



angle of elevation When an object (B) is above the horizontal line of sight of the observer (A), the angle of elevation is the angle formed by the line of sight to the object and the horizontal line of sight.

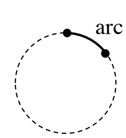
apex In a cone or pyramid, the apex is the point that is the farthest away from the flat surface (plane) that contains the base. In a pyramid, the apex is also the point at which the lateral faces meet. An apex is also sometimes called the vertex of a pyramid or cone. (p. 615)



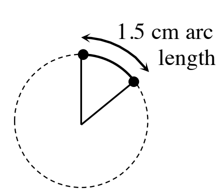
appreciation An increase in value.

approximate answer An answer that is not precisely accurate and not exact. For example, if the length of a side of a triangle is $\sqrt{10}$, the decimal approximation of the answer to the question "*How long is that side of the triangle?*" would be 3.162, while the exact answer would be $\sqrt{10}$. Also see *exact answer*. (p. 284)

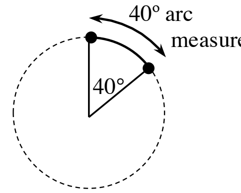
arc A connected part of a circle. Because a circle does not contain its interior, an arc is more like a portion of a bicycle tire than a slice of pizza. Also see *major arc*, *minor arc*, and *sector*. (p. 466)



arc length The length of an arc (in inches, centimeters, feet, etc.) is the distance from one of the arc's endpoints to the arc's other endpoint, measured around the circle. Note that arc length is different from arc measure. Arcs of two different circles may have the same arc measure (like 90°) but different arc lengths if one circle has a larger radius than the other. Also see *arc measure*. (p. 470)

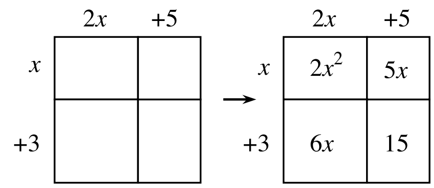


arc measure The measure of an arc's central angle. Note that arc measure is often measured in degrees but can also be measured in radians. It is different from arc length. Also see *arc length*. (p. 576)



area For a two-dimensional region, the number of non-overlapping square units needed to cover the region.

area model A type of diagram used to visualize multiplying expressions without algebra tiles. Each expression to be multiplied forms a side length of the rectangle, and the product is the sum of the areas of the sections of the rectangle. For example, the area model at right can be used to multiply $(2x + 5)$ by $(x + 3)$. (p. 41)



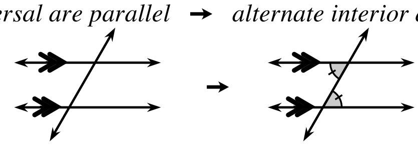
$(2x + 5)(x + 3) = 2x^2 + 11x + 15$

area as a product area as a sum

area model (for probability) See *probability area model*.

arrow diagram A pictorial representation of a conditional statement. The arrow points toward the conclusion of the conditional (the "then" part of the "If…, then" statement). For example, the conditional statement *"If two lines cut by a transversal are parallel, then alternate interior angles are congruent"* can be represented by the arrow diagram below. (p. 51)

Lines cut by a transversal are parallel → *alternate interior angles are congruent.*

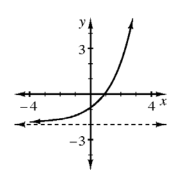


arrowheads To indicate a line on a diagram, we draw a segment with arrowheads on its ends. The arrowheads show that our diagram indicates a line, which extends indefinitely, as opposed to a segment, which has endpoints. Marks on pairs of lines or segments such as ">>" and ">>>" indicate that the lines or segments are parallel. Both types of marks are used in the diagrams above.

ASA ≅ (triangle congruence) If two angles and the included side of one triangle are congruent to the corresponding two angles and included side of another triangle, the triangles are congruent. Note that ASA ≅ is equivalent to AAS ≅. (p. 74)

association A relationship between two (or more) variables. An association between numerical variables can be displayed on a scatterplot, and described by its form, direction, strength, and outliers. Possible association between two categorical variables can be studied in a two-way table. If one variable increases as the other increases, the direction is said to be a positive association. If one variable increases as the other decreases, there is said to be a negative association. If there is no apparent pattern in the scatterplot, then the variables have no association. (p. 410)

asymptote In this course, a line that a graph of a curve approaches but never meets. An asymptote is often represented by a dashed line on a graph. For example, the graph at right has a horizontal asymptote at $y = -2$. A more complete definition of an asymptote requires some ideas from calculus.



auxiliary lines Segments and lines added to existing figures. Auxiliary lines are usually added to a figure to allow us to prove something about the figure.

average rate of change The average rate of change of a function over an interval is the change in the value of the dependent quantity divided by the change in the independent quantity. It is the change in the y-value divided by the change in the x-value for two distinct points on the graph, which is the slope of the line through these two distinct points. (p. 517)

axes In a coordinate plane, the two perpendicular number lines that intersect at the origin (0, 0). The x-axis is horizontal and the y-axis is vertical. See *coordinate axes* for an illustration.

axioms Statements accepted as true without proof. Also known as *postulates*.

b When the equation of a line is expressed in $y = mx + b$ form, the parameter b gives the y-intercept of the line. For example, the y-intercept of the line $y = -\frac{1}{3}x + 7$ is (0, 7). Also see $y = mx + b$.

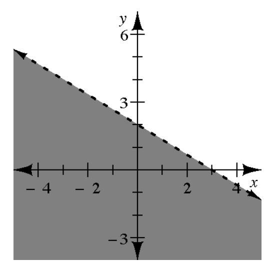
base (of a shape) (a) Triangle: any side of a triangle to which a height is drawn. There are three possible bases in each triangle; (b) Trapezoid: the two parallel sides; (c) Parallelogram (and rectangle, rhombus, and square): any side to which a height is drawn (there are four possible bases in each parallelogram); (d) Solid: see *cone, cylinder, prism,* and *pyramid*. (p. 548)

base (of an exponent) When working with an exponential expression in the form b^a, b is called the base. For example, 2 is the base in 2^5. (5 is the exponent, and 32 is the value.) Also see *exponent*.

beta (β) A Greek letter that is often used to represent the measure of an angle. Other Greek letters used to represent the measure of an angle include *alpha* (α) and *theta* (θ). (p. 183)

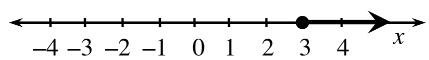
binomial An expression that is the sum or difference of exactly two terms, each of which is a monomial. For example, $-2x + 3y^2$ is a binomial. (p. 213)

boundary line or curve (1) A line or curve on a two-dimensional graph that divides the graph into two regions. A boundary line or curve is used when graphing inequalities with two variables. For example, the inequality $y < -\frac{2}{3}x + 2$ is graphed at right. The dashed boundary line has the equation $y = -\frac{2}{3}x + 2$. A boundary line is also sometimes called a "dividing line". (2) A line drawn parallel to and above or below the least squares regression line at a distance equivalent to the largest residual. The line determines the upper or lower limit on the values that a prediction is likely to be.



$y < -\frac{2}{3}x + 2$

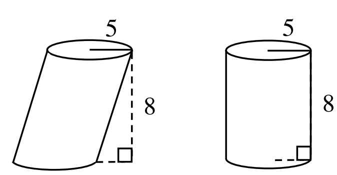
boundary point The endpoint of a ray or segment on a number line where an inequality is true. For strict inequalities (that is, inequalities involving < or >), the point is not part of the solution. We find boundary points by solving the equation associated with our inequality. For example, the solution to the equation $2x + 5 = 11$ is $x = 3$, so the inequality $2x + 5 \geq 11$ has a boundary point at 3. The solution to that inequality is illustrated on the number line at right. A boundary point is also sometimes called a "dividing point".



Cartesian Plane See *coordinate plane*.

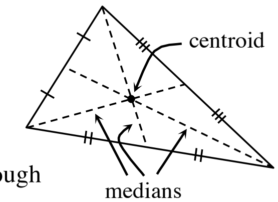
categorical data Data that can be put into categories (like what color you prefer, your hair color, or the state in which you were born), as opposed to numerical data that can be placed on a number line. Categorical data is often collected from surveys. Two-way tables are often used to determine associations between two categorical variables. Also see *two-way table*.

Cavalieri's Principle Two solids have the same volume if corresponding cross-sectional areas are the same. For example, an oblique solid has the same volume as the corresponding right solid with the same height, as long as all the cross-sections parallel to the bases have the same area. Also see *oblique prism (or cylinder)* and *oblique pyramid (or cone)*. (p. 600)



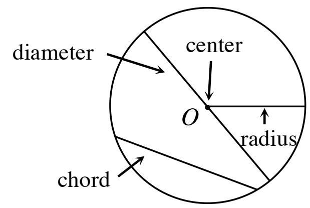
center (of a circle) On a flat surface, the fixed point from which all points on the circle are equidistant. Also see *circle*. (p. 552)

central angle In a circle or a regular polygon, the angle formed by two radii with its vertex at the center is called a central angle. (p. 460)

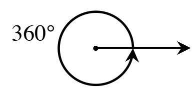


centroid The point at which the three medians of a triangle intersect. The centroid is also the center of balance of a triangle. See also *circumcenter* and *incenter*. (p. 433)

chord A line segment with its endpoints on a circle. A chord that passes through the center of a circle is called a diameter. Also see *circle*. (p. 571)



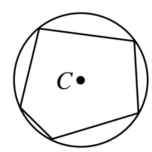
circle The set of all points on a flat surface that are the same distance from a fixed point. If the fixed point (center) is O, the symbol $\odot O$ represents a circle with center O. If the radius of the circle is r and the diameter of the circle is d, then the circumference of the circle is $C = 2\pi r$ or $C = \pi d$. The area of the circle is $A = \pi r^2$. The graphing form (also called center-radius form or standard form) of the equation of a circle with radius r and center (h, k) is $(x - h)^2 + (y - k)^2 = r^2$. The general form (also called expanded form) is $ax^2 + ay^2 + by + cy + d = 0$. (p. 552)



circular angle An angle with a measure of 360°.

circumcenter The center of the circle that passes through the vertices of a triangle. It can be found by locating the point of intersection of the perpendicular bisectors of the sides of the triangle. See also *centroid* and *incenter*. (p. 433)

circumference The perimeter of (distance around) a circle. (p. 466)

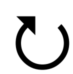


$\odot C$ circumscribes the pentagon.

circumscribed angle An angle whose rays are tangent to a circle.

circumscribed circle A circle circumscribes a polygon when it passes through all the vertices of the polygon. (p. 431)

clinometer A device used to measure angles of elevation and depression. (p. 194)



clockwise Clockwise identifies the direction of rotation shown in the diagram at right. The word literally means "in the direction of the rotating hands of a clock". The opposite of clockwise is *counterclockwise*.

closed set A set of numbers is said to be closed under an operation if the result of applying the operation to any two numbers in the set produces a number in the set. For example, the whole numbers are a closed set under addition because if you add any two whole numbers, the result is always a whole number. However, the whole numbers are not closed under division: if you divide any two whole numbers, you do not always get a whole number. (p. 223)

coefficient When variable(s) are multiplied by a number, the number is called a coefficient of that term. The numbers that are multiplied by the variables in the terms of a polynomial are called the coefficients of the polynomial. For example, 3 is the coefficient of $3x^2$. (p. 213)

coincide Two graphs coincide if they have all their points in common. For example, the graphs of $y = 2x + 4$ and $3y = 6x + 12$ coincide: both graphs are lines with a slope of 2 and a y-intercept of 4. When the graphs of two equations coincide, those equations share all the same solutions and have an infinite number of intersection points.

combination A combination is the number of ways we can select items from a larger set without regard to order. For instance, choosing a committee of 3 students from a group of 5 volunteers is a combination because the order in which committee members are selected does not matter. We write ${}_nC_r$ to represent the number of combinations of n things taken r at a time (or n choose r). For instance, the number of ways to select a committee of 3 students from a group of 5 is ${}_5C_3$. You can use Pascal's Triangle to find ${}_5C_3$ or use permutations and divide by the number of arrangements $\frac{{}_5P_3}{{}_3P_3} = \frac{5!}{3!2!}$. Formulas for combinations include ${}_nC_r = \frac{{}_nP_r}{r!} = \frac{n!}{r!(n-r)!}$. Also see *permutation*. (p. 664)

combining like terms Combining two or more like terms simplifies an expression by summing constants and summing those variable terms in which the same variables are raised to the same power. For example, combining like terms in the expression $3x + 7 + 5x - 3 + 2x^2 + 3y^2$ gives $8x + 4 + 2x^2 + 3y^2$. When working with algebra tiles, combining like terms involves putting together tiles with the same dimensions.

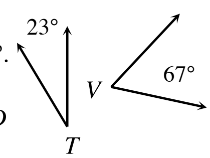
common factor A common factor is a factor that is the same for two or more terms. For example, x^2 is a common factor of $3x^2$ and $-5x^2y^2$.

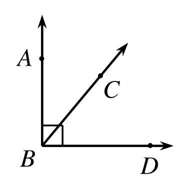
common ratio of corresponding sides See *ratio of similarity*.

compass (1) A tool used to draw circles; (2) A tool used to navigate Earth. A compass uses Earth's magnetic field to determine which direction is north.

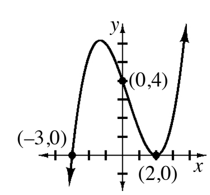
complement of an event The set of all the outcomes in the sample space that are not in the event. For example, if you randomly select one card from a deck of cards, the event {the card is a diamond} has a probability of $\frac{13}{52}$. The complement of the event is {the card is not a diamond} or {the card is a heart, spade, or club}, and has a probability of $1 - \frac{13}{52}$. (p. 171)

complementary angles Two angles whose measures add up to 90º. Angles T and V are complementary because $m\angle T + m\angle V = 90º$. Complementary angles may also be adjacent, like $\angle ABC$ and $\angle CBD$ in the diagram at far right. (p. 58)





complete graph A complete graph is one that includes everything that is important about the graph (such as intercepts and other key points, asymptotes, or limitations on the domain or range), and that makes the rest of the graph predictable based on what is shown. Points are plotted accurately. Both axes are labeled with the variable name and with the units of measurement. The scale on each axis should be marked in equal intervals and be appropriate to highlight key features. Connect continuous data but do not connect discrete data. Use arrowheads if the line or curve extends beyond the edge of the grid. For example, a complete graph of the equation $y = \frac{1}{3}(x-2)^2(x+3)$ is shown at right.



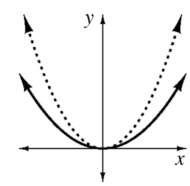
completing the square A standard procedure for rewriting a quadratic equation from standard form to perfect square form (or graphing form), or for rewriting the equation of a circle from general form to graphing form. One method for completing the square to rewrite $y = x^2 - 6x + 4$ in graphing form is shown at right. (p. 295)

$$\begin{aligned} y &= x^2 - 6x + 4 \\ y - 4 &= x^2 - 6x \\ y - 4 + 9 &= x^2 - 6x + 9 \\ y + 5 &= (x-3)^2 \\ y &= (x-3)^2 - 5 \end{aligned}$$

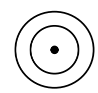
complex numbers Numbers written in the form $a + bi$ where a and b are real numbers are called complex numbers. Each complex number has a real part, a, and an imaginary part, bi. Note that real numbers are also complex numbers where $b = 0$, and imaginary numbers are complex numbers where $a = 0$. (p. 308)

compound interest Interest that is paid on both the principal and the previously accrued interest.

compress A term used informally to describe the relationship of a graph to its parent graph when the graph increases or decreases more slowly than the parent. For example, the solid parabola shown at right is a compressed version of its parent, shown as a dashed curve. (p. 501)



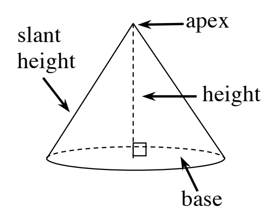
concentric circles Circles that have the same center. For example, the circles shown in the diagram at right are concentric. (p. 556)



conditional probability The probability of outcome A occurring, given that outcome B has already happened, is called the conditional probability of A given B. One way to calculate the conditional probability of A given B is to use the Multiplication Rule, $P(\text{A given B}) = \frac{P(\text{A and B})}{P(\text{B})}$. In many situations, it is possible to calculate the conditional probability directly from the data by counting the number of outcomes (or computing the probabilities) of A that are within the outcomes (probabilities) for B. Also see *Multiplication Rule for Probability*. (p. 414)

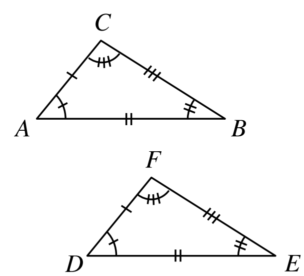
conditional statement A statement written in "If …, then …" form. For example, "*If a rectangle has four congruent sides, then it is a square*" is a conditional statement. (p. 46)

cone A three-dimensional figure that consists of a circular face called the base, a point called the apex that is not in the flat surface (plane) of the base, and the lateral surface that connects the apex to each point on the circular boundary of the base. The slant height of a cone is the distance from the circular boundary to the apex. Also see *right pyramid (or cone)* and *oblique pyramid (or cone)*. (p. 627)



congruence conditions See *triangle congruence theorems*.

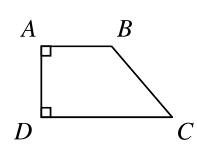
congruence statement A statement indicating that two figures are congruent. The order of the letters in the names of the shapes indicates which sides and angles are congruent to each other. For example, if $\Delta ABC \cong \Delta DEF$, then $\angle A \cong \angle D$, $\angle B \cong \angle E$, $\angle C \cong \angle F$, $\overline{AB} \cong \overline{DE}$, $\overline{BC} \cong \overline{EF}$, and $\overline{AC} \cong \overline{DF}$. (p. 71)



congruent Two shapes are congruent if there is a sequence of rigid transformations that carries one onto the other. The corresponding angles and sides of congruent polygons have equal measures. The symbol for congruent is $\cong$. Congruent shapes are similar and have a *scale factor* of 1. (p. 39)

conjecture An educated guess. Conjectures often result from noticing a pattern during an investigation. Conjectures are also often written in conditional ("If…, then…") form. Once a conjecture is proven, it becomes a theorem. (p. 19)

consecutive angles of a polygon The angles that occur at the two ends of any side of a polygon. For example, $\angle B$ and $\angle C$ are consecutive angles in the right trapezoid at right. (p. 375)



constant function A constant function is a function where every input value gives the same output value. For example, the function $f(x) = 5$ is a constant function because the output value is 5 for every value of x.

constant term A number that is not multiplied by a variable. In the expression $2x + 3(5 - 2x) + 8$, the number 8 is a constant term. The number 3 is not a constant term, because it is multiplied by a variable inside the parentheses.

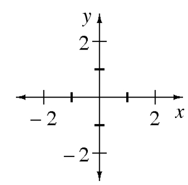
construction The process of using a straightedge and compass to solve a problem and/or create a geometric diagram. (p. 430)

continuous For this course, when the points on a graph are connected and it makes sense to connect them, we say the graph is continuous. A continuous graph will have no holes or breaks in it. This term will be more completely defined in a later course.

converse The converse of a conditional statement can be found by switching the hypothesis (the "if" part) and the conclusion (the "then" part). For example, the converse of "*If P, then Q*" is "*If Q, then P.*" Knowing that a conditional statement is true does not tell you whether its converse is true. (p. 81)

convex polygon A polygon is convex if any pair of points inside the polygon can be connected by a segment without leaving the interior of the polygon. Also see *non-convex polygon*. (p. 47)

coordinate axes For two dimensions, two perpendicular number lines, the x- and y-axes, that intersect where both are zero and that provide the scale(s) for labeling each point in a plane with its horizontal and vertical distance and direction from the origin (0, 0).



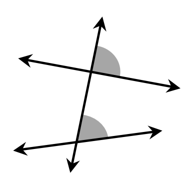
coordinate geometry The study of geometry on a coordinate graph.

coordinate graph A method of specifying points (x, y) by their relationship to two perpendicular linear axes, often labeled the x-axis and y-axis. Also known as a rectangular coordinate graph or a Cartesian coordinate graph. Also see *graph*.

coordinate plane A flat surface defined by two number lines meeting at right angles at their zero points. A coordinate plane is also sometimes called a "Cartesian Plane".

coordinates The numbers in an ordered pair (a, b) or triple (a, b, c) used to locate a point in the plane or in space in relation to a set of coordinate axes.

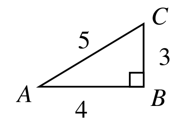
corresponding angles (1) When two lines are intersected by a third line (called a transversal), angles on the same side of the two lines and on the same side of the transversal are called corresponding angles. For example, the shaded angles in the diagram at right are corresponding angles. Note that if the two lines cut by the transversal are parallel, the corresponding angles are congruent. Conversely, if the corresponding angles are congruent, then the two lines intersected by the transversal are parallel; (2) Angles in two figures may also correspond. Also see *corresponding parts*, *alternate interior angles* and *same-side interior angles*. (p. 58)



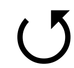
corresponding parts Points, sides, edges, or angles in two or more figures that are images of each other with respect to a sequence of transformations. If two figures are congruent, their corresponding parts are congruent to each other. (p. 74)

cosine inverse ($\cos^{-1}(x)$) See *inverse cosine*.

cosine ratio In a right triangle, the cosine ratio of an acute angle, A, is $\cos(A)=\frac{\text{length of adjacent side}}{\text{length of hypotenuse}}$. In the triangle at right, $\cos(A)=\frac{AB}{AC}=\frac{4}{5}$. On a unit circle, the cosine of an angle is the x-coordinate of the point where the ray of an angle in standard position intersects the unit circle. Also see *sine ratio, tangent ratio,* and *inverse cosine*. (p. 237)



counterclockwise Counterclockwise identifies the direction of rotation shown in the diagram at right. The opposite of counterclockwise is clockwise.

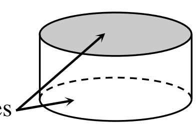


counterexample An example showing that a statement has at least one exception; that is, a situation in which the statement is false. For example, the number 4 is a counterexample to the hypothesis that all even numbers are greater than 7. (p. 98)

cube A polyhedron, all of whose faces are squares. (p. 611)

cube root The cube root of a number is the value that, when cubed (taken to the third power), gives the number. That is, the cube root of x is the value a such that $a^3 = x$. For example, the cube root of 8 is 2 because $8 = 2 \cdot 2 \cdot 2 = 2^3$. This is written $\sqrt[3]{8} = 2$. (p. 334)

cylinder (circular) A three-dimensional figure that consists of two parallel congruent circular regions (called bases) and a lateral surface containing segments connecting each point on the circular boundary of one base to the corresponding point on the circular boundary of the other. Also see *oblique prism (or cylinder)* and *right cylinder*. (p. 600)

bases


decagon A polygon with ten sides. (p. 47)

decision chart A method for counting the number of outcomes (the size of the sample space) for a sequence of probabilistic situations, often in which the order of the items matters. A tree diagram could be used to count the number of outcomes, but if the number of outcomes is large, a decision chart is more useful. For example, how many three-letter arrangements could be made by lining up any three blocks chosen from a set of 26 alphabet blocks, if the first letter must be a vowel and the blocks are not reused? There are three decisions (three blocks to be chosen), with 5 choices for the first letter (a vowel), 25 for the second, and 24 for the third. The total number of possibilities is:

$$\frac{5}{\text{1st decision}} \cdot \frac{25}{\text{2nd decision}} \cdot \frac{24}{\text{3rd decision}} = 3000 .$$

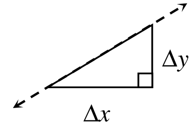
This decision chart is a short way to represent a tree with 5 branches for the first alphabet block, followed by 25 branches for each of those branches; each of those 125 branches would then have 24 branches representing the possibilities for the third alphabet block. Also see *Fundamental Counting Principle*. (p. 653)

deck of cards See *playing cards*.

decreasing function A function is decreasing if the y-value decreases as the x-value increases.

degree One degree is an angle measure that is $\frac{1}{360}$ of a full circle or $\frac{\pi}{180}$ radians.

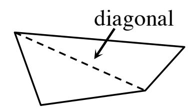
delta (Δ) A Greek letter that is often used to represent a difference, or change, in values. Its uses include Δx and Δy, which represent the lengths of the horizontal and vertical legs of a slope triangle, respectively.



dependent variable When one quantity's value depends on one or more others, it is called the dependent variable. For example, we might relate the speed of a car to the amount of force you apply to the gas pedal. Here, the speed of the car is the dependent variable; it depends on how hard you push the pedal. The dependent variable appears as the output value in an $x \rightarrow y$ table, and is usually placed relative to the vertical axis of a graph. We often use the letter y and the vertical y-axis for the dependent variable. When working with functions or relationships, the dependent variable represents the output value. Also see *independent variable*.

depreciation A decrease in value possibly because of normal wear and tear, age, decay. A decrease in price.

description of a function See *investigating a function*.



diagonal In a polygon, it is a line segment that connects any two vertices of the polygon but is not a side of the polygon. (p. 394)

diameter A line segment drawn through the center of a circle with both endpoints on the circle. The length of the segment is also called the diameter, and is usually denoted d. Note that the length of a circle's diameter is twice the length of its radius. Also see *circle*. (p. 466)

difference of squares A polynomial that can be factored as the product of the sum and difference of two terms. The general pattern is $x^2 - y^2 = (x + y)(x - y)$. For example, the difference of squares $4x^2 - 9$ can be factored as $(2x + 3)(2x - 3)$. (p. 288)

dilation (1) A transformation that vertically compresses or stretches the graph of a function. For example, the graph of $g(x) = 2(x^2 + 3x - 5)$ is a vertical dilation of the function $f(x) = x^2 + 3x - 5$ by a factor of 2. (2) A transformation that produces a figure similar to the original by proportionally shrinking or stretching the figure. In a dilation, a shape is stretched (or compressed) proportionally from a point, called the point of dilation. Also see *point of dilation*. (p. 104)

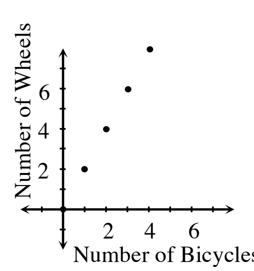
dimensional analysis The analysis of units of measurement as a check on the plausibility of solutions and mathematical models. Dimensional analysis is also used to convert from one unit of measure to another. For example, make Giant Ones out of the units to convert inches per hour to inches per minute.

$$\frac{96 \text{ in}}{1 \text{ hr}} \cdot \frac{1 \text{ hr}}{60 \text{ min}} = \frac{96}{60} \cdot \frac{\text{in}}{\text{min}} \cdot \frac{1}{1} \cdot \frac{\text{hr}}{\text{hr}} = \frac{1.6 \text{ in}}{1 \text{ min}}$$

dimensions The dimensions of a figure in a plane or in space tell how far it extends in each direction. (1) Flat figures have two dimensions (which can be labeled as base and height). For example, the dimensions of a rectangle might be 16 cm wide by 7 cm high. (2) Solids have three dimensions (such as width, height, and depth).

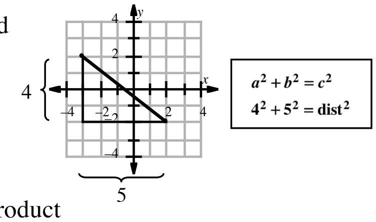
directrix A line that, along with a point (called a focus), defines a conic section (such as a parabola). For any point on a parabola, the length of the segment between the focus and the point is equal to the length of the segment perpendicular from the directrix to the point. (p. 554)

discrete graph A graph that consists entirely of separated points is called a discrete graph. For example, the graph shown at right is discrete. Also see *continuous*.



disjoint Another name for *mutually exclusive*. (p. 406)

distance formula An application of the Pythagorean Theorem to find the distance between two points in a plane. The distance between any two points (x_1, y_1) and (x_2, y_2) is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. In the example at right, the distance is $\sqrt{4^2 + 5^2}$ or $\sqrt{41}$.



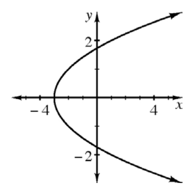
Distributive Property We use the Distributive Property to write a product of expressions as a sum of terms. The Distributive Property states that for any numbers or expressions a, b, and c, $a(b + c) = ab + ac$. For example, $2(x + 4) = 2 \cdot x + 2 \cdot 4 = 2x + 8$. We can demonstrate this with an area model.

2	$2 \cdot x$	$2 \cdot 4$
	x	$+ 4$

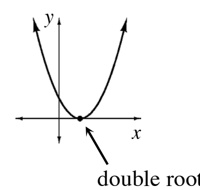
dividing line See *boundary line*.

dividing point See *boundary point*.

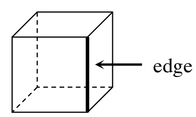
domain The set of all input values for a relationship or function. For example, the domain of the relationship graphed at right is $x \geq -3$. For variables, the domain is the set of numbers the variable may represent. Also see *input*. (p. 484)



double root A root of a function that occurs exactly twice. If an expression of the form $(x - a)^2$ is a factor of a polynomial, then the polynomial has a double root at $x = a$. The graph of the polynomial does not pass through the x-axis at $x = a$ but is tangent to the axis at $x = a$. (p. 352)



edge In three dimensions, a line segment formed by the intersection of two faces of a polyhedron. (p. 615)



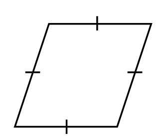
Elimination Method A method for solving a system of equations. The key step in using the Elimination Method is to add both sides of two equations to eliminate one of the variables. For example, the two equations in the system at right can be added together to get the simplified result $7x = 14$. We can solve this equation to find x, then substitute the x-value back into either of the original equations to find the value of y. (p. 83)

$$5x + 2y = 10$$
$$2x - 2y = 4$$

endpoint See *line segment* and *ray*.

equation A mathematical sentence in which two expressions appear on either side of an "equals" sign (=), stating that the two expressions are equivalent. For example, the equation $7x + 4.2 = -8$ states that the expression $7x + 4.2$ has the value -8. In this course, an equation is often used to represent a relationship between two quantities. For example, an equation for finding the area y of a tile pattern with figure number x might be written $y = 4x - 3$.

equilateral A polygon is equilateral if all its sides have equal length. The word equilateral comes from "equi" (meaning equal) and "lateral" (meaning side). Equilateral triangles not only have sides of equal length, but also angles of equal measure. However, a polygon with more than three sides can be equilateral without having congruent angles. For example, see the rhombus at right. (p. 25)



equilateral triangle A triangle with all sides of equal length. (p. 25)

equivalent Two expressions are equivalent if they have the same value. For example, 2 + 3 is equivalent to 1 + 4. Two equations are equivalent if they have all the same solutions. For example, $y = 3x$ is equivalent to $2y = 6x$. Equivalent equations have the same graph.

evaluate To evaluate an expression, substitute the value(s) given for the variable(s) and perform the operations according to the Order of Operations. For example, evaluating $2x + y - 10$ for $x = 4$ and $y = 3$ gives the value 1.

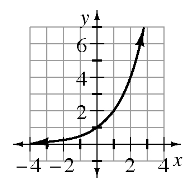
event One or more results of an experiment or a probabilistic situation. (p. 91)

exact answer An answer that is precisely accurate and not approximate. For example, if the length of a side of a triangle is exactly $\sqrt{10}$, the exact answer to the question "*How long is that side of the triangle?*" would be $\sqrt{10}$, while 3.162 would be a decimal approximation of the answer. Also see *approximate answer*. (p. 284)

expected value For this course, the expected value of a game is the average amount expected to be won or lost on each play of the game if the game is played many times. Expected value can be found by summing the probability of each outcome multiplied by its value. For example, if you play a game where you roll a die and win one point for every dot on the face that comes up, the expected value of this game is $(\frac{1}{6})1 + (\frac{1}{6})2 + (\frac{1}{6})3 + (\frac{1}{6})4 + (\frac{1}{6})5 + (\frac{1}{6})6 = 3.5$ points for each play. The expected value need not be a value that a player could actually win on a single play of the game. (p. 178)

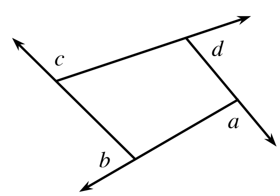
exponent In an expression of the form b^a, a is called the exponent. For example, in the expression 2^5, 5 is called the exponent. (2 is the base, and 32 is the value.) The exponent indicates how many times to use the base as a multiplier. For example, in 2^5, 2 is used 5 times: $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$. For exponents of zero, the rule is that for any number $x \neq 0$, $x^0 = 1$. For negative exponents, the rule is that for any number $x \neq 0$, $x^{-n} = \frac{1}{x^n}$, and $\frac{1}{x^{-n}} = x^n$. Also see *laws of exponents*.

exponential function An exponential function in this course has an equation of the form $y = ab^x + k$, where a is the initial value, b is positive and is the multiplier, and $y = k$ is the equation of the horizontal asymptote. An example of an exponential function is graphed at right.



expression An expression is a combination of individual terms separated by plus or minus signs. Numerical expressions combine numbers and operation symbols; algebraic (variable) expressions include variables. For example, $4 + (5 - 3)$ is a numerical expression. In an algebraic expression, if each of the following terms, $6xy^2$, 24, and $\frac{y-3}{4+x}$, are combined, the result may be $6xy^2 + 24 - \frac{y-3}{4+x}$. An expression does not have an "equals" sign. (p. 213)

exterior angle (of a polygon) When a side of a polygon is extended to form an angle with an adjacent side outside of the polygon, that angle is called an exterior angle. For example, the angles marked with letters in the diagram at right are exterior angles of the quadrilateral. Note that an exterior angle of a polygon is always adjacent and supplementary to an interior angle of that polygon. The sum of the exterior angles of a convex polygon is always 360°. Also see *interior angle (of a polygon)*. (p. 445)



Exterior Angle Theorem The measure of an exterior angle of a triangle is equal to the sum of the measures of the two remote (non-adjacent) interior angles of the triangle. (p. 445)

$\boldsymbol{f^{-1}(x)}$ Read this as "*f* inverse of *x*", the inverse function for $f(x)$. (p. 528)

factor (1) In arithmetic: When two or more integers are multiplied, each of the integers is a factor of the product. For example, 4 is a factor of 24 because $4 \cdot 6 = 24$. (2) In algebra: When two or more algebraic expressions are multiplied together, each of the expressions is a factor of the product. For example, x^2 is a factor of $-17x^2y^3$ because $(x^2)(-17y^3) = -17x^2y^3$. (3) To factor an expression is to write it as a product. For example, the factored form of $x^2 - 3x - 18$ is $(x - 6)(x + 3)$. (4) A factor is part of a product. A polynomial expression $p(x)$ is a factor of another polynomial expression $P(x)$ when there is a polynomial $q(x)$ such that $p(x)q(x) = P(x)$. In the equation $3x^2 - 9x + 6 = 3(x - 2)(x - 1)$, the expressions $(x - 2)$, $(x - 1)$, and 3 are factors. (p. 224)

factored completely A polynomial is factored completely if none of the resulting factors can be factored further using integer coefficients. For example, $-2(x + 3)(x - 1)$ is the completely factored form of $-2x^2 - 4x + 6$.

factored form A quadratic equation in the form $a(x + b)(x + c) = 0$, where a is nonzero, is said to be in factored form. For example, $-7(x + 2)(x - 1.5) = 0$ is a quadratic equation in factored form. (p. 279)

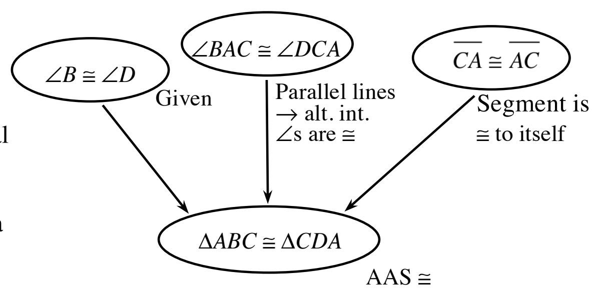
factorial A shorthand notation for the product of a list of consecutive positive integers from the given number to 1: $n! = n(n - 1)(n - 2)(n - 3) \cdot \ldots \cdot 3 \cdot 2 \cdot 1$. For example, $5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$. (p. 653)

fair game For the purposes of this course, a fair game has an expected value of 0 for all players. Therefore, over many plays, any player would expect to neither win nor lose points or money by playing a fair game. (p. 178)

Fibonacci sequence The sequence of numbers 1, 1, 2, 3, 5, 8, 13, …. Each term of the Fibonacci sequence (after the first two terms) is the sum of the two preceding terms. (p. 684)

flip See *reflection*.

flowchart A diagram showing an argument for a conclusion from certain evidence. A flowchart uses ovals connected by arrows to show the logical structure of the argument. When each oval has a reason stated next to it showing how the evidence leads to that conclusion, the flowchart represents a proof. See the example at right. (p. 77)



focus A point that, along with a line (called a directrix), can be used to define a conic section (like a parabola). For any point on a parabola, the length of the segment between the focus and the point is equal to the length of the segment perpendicular from the directrix to point. (p. 554)

fraction The quotient of two quantities in the form $\frac{a}{b}$ where b is not equal to 0.

fractional exponents Raising a number to a fractional exponent indicates a power as well as a root. $x^{a/b} = \sqrt[b]{x^a} = (\sqrt[b]{x})^a$. (p 339)

function A relationship in which for each input value there is one and only one output value. For example, the relationship $f(x) = x + 4$ is a function; for each input value (x) there is exactly one output value. In terms of ordered pairs (x, y), no two ordered pairs of a function have the same first member (x). Also see *investigating a function* and *function notation*. (p. 214)

function notation When an equation expressing a function is written using function notation, the function is given a name, most commonly "f", "g", or "h". The notation $f(x)$ represents the output of a function, named f, when x is the input. It is pronounced "f of x". For example, $g(2)$, pronounced "g of 2", represents the output of the function g when $x = 2$. If $g(x) = x^2 + 3$, then $g(2) = 7$.

Fundamental Counting Principle A method for counting the number of outcomes (the size of the sample space) of a probabilistic situation, often in which the order of the items matters. If event {A} has m outcomes, and event {B} has n outcomes after event {A} has occurred, then event {A} followed by event {B} has $m \cdot n$ outcomes. For a sequence of events, a tree diagram could be used to count the number of outcomes, but if the number of outcomes is large, a decision chart is more useful. Also see *decision chart*. (p. 653)

Fundamental Theorem of Algebra The Fundamental Theorem of Algebra states that every one-variable polynomial has at least one complex root (remember that every real number is also a complex number). This theorem can be used to show that every polynomial of degree n has n complex roots. (p. 352)

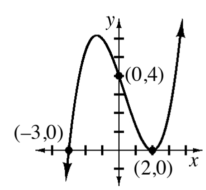
Giant One A fraction that is equal to 1. Multiplying any fraction by a Giant One will create a new fraction equivalent to the original fraction.

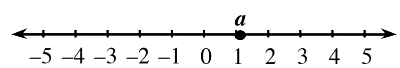
$$\frac{x-2}{x-3} \cdot \boxed{\frac{x-2}{x-2}} = \frac{(x-2)^2}{(x-3)(x-2)}$$

golden ratio The number $\frac{1+\sqrt{5}}{2}$, which is often labeled with the Greek letter phi (ϕ), pronounced "fee". (p. 680)

golden rectangle A rectangle whose side lengths are in the proportion of the golden ratio. (p. 681)

graph A graph represents numerical information spatially. The numbers may come from a table, situation (pattern), or equation/inequality. The graph of an equation is the set of points representing the coordinates that make the equation true. The direction to "graph an equation" or "draw a graph" means use graph paper, scale your axes appropriately, label key points, and plot points accurately. This is different from *sketching* a graph. The equation $y = \frac{1}{3}(x-2)^2(x+3)$ is graphed at right. Most of the graphs in this course show points, lines, and/or curves on a two-dimensional coordinate system or on a single axis called a number line. Also see *complete graph*.





graphic organizer (GO) A visual representation of concepts or ideas you have learned. It helps with brainstorming and/or organizing information and can make connections between ideas more clear. Examples are concepts maps, charts, and Venn diagrams.

graphing form A form of the equation of a function or relationship that clearly shows key information about the graph. For example, the graphing form for the general equation of a quadratic function is $y = a(x-h)^2 + k$. The vertex (h, k), the orientation (whether a is positive or negative), and the amount of stretch or compression based on $|a| > 1$ or $|a| < 1$ appear in the equation. (p. 501)

greater than One expression is greater than another if its value is larger. We indicate this relationship with the greater than symbol ">". For example, 4 + 5 is greater than 1 + 1. We write $4 + 5 > 1 + 1$.

greatest common factor (GCF) (1) For integers, the greatest positive integer that is a common factor of two or more integers. For example, the greatest common factor of 28 and 42 is 14. (2) For two or more algebraic monomials, the product of the greatest common integer factor of the coefficients of the monomials and the variable(s) in each algebraic term with the smallest degree of that variable in every term. For example, the greatest common factor of $12x^3y^2$ and $8xy^4$ is $4xy^2$. (3) For a polynomial, the greatest common monomial factor of its terms. For example, the greatest common factor of $16x^4 + 8x^3 + 12x$ is $4x$.

growth One way to analyze how the output value in a mathematical relationship changes as the input value increases. Growth can be represented by constant addition (as the slope of a linear function) or by multiplication (as the base of an exponential function).

height (1) Triangle: the length of a segment that connects a vertex of the triangle to a line containing the opposite base (side) and is perpendicular to that line; (2) Trapezoid: the length of any segment that connects a point on one base of the trapezoid to the line containing the opposite base and is perpendicular to that line; (3) Parallelogram (includes rectangle, rhombus, and square): the length of any segment that connects a point on one base of the parallelogram to the line containing the opposite base and is perpendicular to that line; (4) Pyramid and cone: the length of the segment that connects the apex to a point in the plane containing the figure's base and is perpendicular to that plane; (5) Prism or cylinder: the length of a segment that connects one base of the figure to the plane containing the other base and is perpendicular to that plane. Some texts make a distinction between height and altitude, where the altitude is the segment described in the definition above and the height is its length. (p. 615)

hemisphere Half of a sphere. A great circle of a sphere divides it into two congruent parts, each of which is called a hemisphere. Hemispheres can also be created by slicing a sphere with a plane passing through the sphere's center. If Earth is represented as a sphere, the Northern hemisphere is the portion of Earth north of (and including) the equator. Likewise, the Southern hemisphere is the portion of Earth south of (and including) the equator.

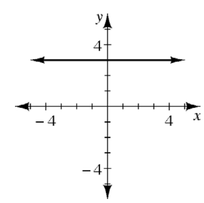
heptagon A polygon with seven sides. (p. 47)

hexagon A polygon with six sides. (p. 47)

HL ≅ (triangle congruence) If the hypotenuse and one leg of one right triangle are congruent to the hypotenuse and corresponding leg of another right triangle, the two right triangles are congruent. Note that this congruence condition applies only to right triangles. (p. 74)

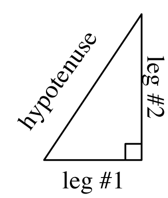
horizontal Parallel to the horizon. The x-axis of a coordinate graph is the horizontal axis.

horizontal lines Horizontal lines are "flat" and run left to right in the same direction as the x-axis. Horizontal lines have equations of the form $y = b$, where b can be any number. For example, the graph at right shows the horizontal line $y = 3$. The slope of any horizontal line is 0. The x-axis has the equation $y = 0$ because y is equal to zero everywhere on the x-axis.



horizontal shift Used with parent graphs and general equations for functions and relationships such as $y = a(x - h)^2 + k$. This type of transformation is a horizontal translation of a graph that moved left or right in relation to its parent graph. The horizontal shift will be h units to the right if h is positive, to the left if h is negative. (p. 501)

hypotenuse The side of a right triangle opposite the right angle. Note that legs of a right triangle are always shorter than its hypotenuse. Also see *legs*. (p. 237)



hypothesis (1) A term scientists use to mean an "educated guess" (or what mathematicians call a conjecture), based on data, patterns, and relationships. For instance, having looked at multiples of five, you might form a hypothesis that every multiple of five ends in the digit 0 or the digit 5. (2) In an "If…, then…" statement, the "if" portion is called the hypothesis. For example, in the statement "If $x = 3$, then $x^2 = 9$," the hypothesis is "$x = 3$".

"If …, then …" statement A statement written in the form "If …, then …". Also known as a conditional statement. (p. 46)

image The shape that results from a transformation, such as a translation, rotation, reflection, or dilation. Also see *translation*, *rotation*, *reflection*, and *dilation*. (p. 35)

imaginary numbers The set of numbers created by multiplying the imaginary number i by every possible real number. The imaginary number i is defined as the square root of –1, or $i = \sqrt{-1}$. Therefore $i^2 = -1$. They are not positive, negative, or zero. These numbers are solutions of equations of the form x^2 = (a negative number). In general, imaginary numbers follow the rules of real number arithmetic (e.g. $i + i = 2i$). (p. 308)

incenter The center of the circle inscribed in a triangle. It can be found by locating the point at which the angle bisectors of a triangle intersect. See also *centroid* and *circumcenter*. (p. 433)

increasing function A function is increasing if the y-value increases as the x-value increases.

independent events If the outcome of a probabilistic event does not affect the probability of another event, the events are independent. For example, assume you plan to roll a normal six-sided die twice and want to know the probability of rolling a 1 twice. The result of the first roll does not affect the probability of rolling a 1 on the second roll; the events are independent. If two events {A} and {B} are independent, then P(A given B) = P(A). The converse is also true. Alternatively, by rewriting the Multiplication Rule, if two events are independent, then P(A and B) = P(A) · P(B). Again, the converse is also true. (p. 414)

independent variable When one quantity's value changes in a way that does not depend on the value of another quantity, the value that changes independently is represented with the independent variable. For example, we might relate the speed of a car to the amount of force you apply to the gas pedal. Here, the amount of force applied may be whatever the driver chooses, so it represents the independent variable. The independent variable appears as the input value in an $x \rightarrow y$ table, and is usually placed relative to the horizontal axis of a graph. We often use the letter x and the horizontal x-axis for the independent variable. When working with functions or relationships, the independent variable represents the input value. Also see *dependent variable*.

indirect proof See *proof by contradiction*.

inequalities with absolute value If k is any positive number, an inequality of the form $|f(x)| > k$ is equivalent to the statement $f(x) > k$ or $f(x) \le -k$, and $|f(x)| < k$ is equivalent to the statement $-k < f(x) < k$. For example, you can solve the inequality $|5x - 6| > 4$ by solving the two inequalities $5x - 6 > 4$ or $5x - 6 < -4$.

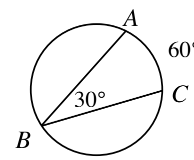
inequality An inequality consists of two expressions on either side of an inequality symbol. For example, the inequality $7x + 4.2 < -8$ states that the expression $7x + 4.2$ has a value less than –8. (p. 506)

inequality symbols The symbol ≤ read from left to right means "less than or equal to". The symbol ≥ read from left to right means "greater than or equal to". The symbols < and > mean "less than" and "greater than", respectively. For example, "7 < 13" means that 7 is less than 13.

infinity The concept that something is without limit or unending. The symbol for infinity is ∞. Note that infinity is an idea, not a number, even though it is often treated as a number.

input value The input value is the independent variable in a relationship, a replacement value for a variable in a function or relationship, or the first number in an ordered pair. The set of all possible input values is the domain of a function. We substitute the input value into our equation to determine the output value. For example, if we have an equation for how much your phone bill will be if you talk a certain number of minutes, the number of minutes you talk is the input value. The input value appears first in an $x \rightarrow y$ table, and is represented by the variable x.

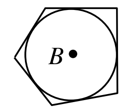
inscribed angle An angle with its vertex on the circle and sides intersecting the circle at two distinct points. In the figure at right, $\angle ABC$ is an inscribed angle. (p. 576)



Inscribed Angle Theorem The measure of an inscribed angle is half the measure of its intercepted arc. Likewise, the measure of an intercepted arc is twice the measure of an inscribed angle whose sides pass through the endpoints of the arc.

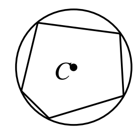
In the figure at right, if $m\overset{\frown}{AC} = 60°$, then $m\angle ABC = 30°$. (p. 576)

inscribed circle A circle is inscribed in a polygon if each side of the polygon intersects the circle at exactly one point. (p. 431)



$\odot B$ is inscribed in the pentagon.

inscribed polygon A polygon is inscribed in a circle if each vertex of the polygon lies on the circle. (p. 574)

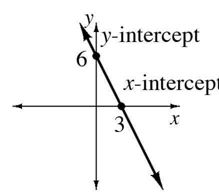


The pentagon is inscribed in $\odot C$.

integer Any whole number or the opposite of a whole number: … –3, –2, –1, 0, 1, 2, 3, …

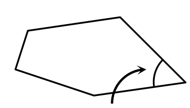
intercepted arc The arc of a circle bounded by the points where the two sides of an inscribed angle meet the circle. In the circle above right, $\angle ABC$ intercepts $\overset{\frown}{AC}$. (p. 570)

intercepts Points where a graph crosses the axes. x-intercepts are points at which the graph crosses the x-axis and y-intercepts are points at which the graph crosses the y-axis. On the graph at right, the x-intercept is (3, 0) and the y-intercept is (0, 6).

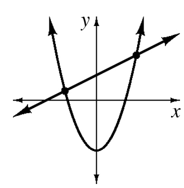


interest An amount paid which is a percentage of the principal. For example, a savings account may offer 4% annual interest, which means it will pay \$4.00 in interest for a principal of \$100 kept in the account for one year.

interior angle (of a polygon) An angle formed by two consecutive sides of the polygon. The vertex of the angle is a vertex (corner) of the polygon. The sum of the interior angles of a polygon with n-sides is $180°(n-2)$. (p. 438)



intersection A point of intersection is a point that the graphs of two or more equations have in common. Graphs may intersect in one, two, several, many, or no points. The coordinates of each point of intersection satisfy the equations of both (or all) graphs. (p. 504)

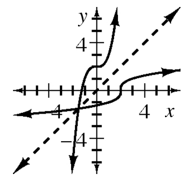


intersection of two events The intersection of the two events {A} and {B} is a new event that includes all the outcomes in which both A *and* B will occur. For example, if event {A} is the thirteen diamond-suited cards in a deck of playing cards, and {B} is the four Aces, then the event {A intersection B} contains 1 outcome: {A♦}. Also see *union of two events*. (p. 171)

interval A set of numbers between two given numbers.

inverse cosine ($\mathbf{cos^{-1}(x)}$) Read as the inverse of cosine x, $\cos^{-1}(x)$ is the measure of the angle with cosine x. The inverse of the cosine function is the function that "undoes" cosine. When the ratio between the lengths of two sides of a right triangle is known, $\sin^{-1}(x)$, $\cos^{-1}(x)$, or $\tan^{-1}(x)$, can be used to find the measure of one of the triangle's acute angles. Note that the notation refers to the inverse of the cosine function, *not* $\frac{1}{\cos(x)}$. Also see *inverse sine* and *inverse tangent*. (p. 245)

inverse function A function that "undoes" what the original function does. The inverse of a function performs in reverse order the inverse operation for each operation of the function. The graph of an inverse function is a reflection of the original function across the line $y = x$. For example, $y = x^3 + 2$ is equivalent to $x = \sqrt[3]{y-2}$; its inverse function is written $y = \sqrt[3]{x-2}$. Sometimes the domain of a function must be restricted to ensure that its inverse is also a function. (p. 528)



inverse operations Subtraction is the inverse operation for addition and vice versa, division for multiplication, square root for squaring, and more generally taking the n^{th} root for raising to the n^{th} power. (p. 239)

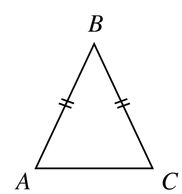
inverse sine ($\sin^{-1}(x)$) Read as the inverse of sine x, $\sin^{-1}(x)$ is the measure of the angle with sine x. The inverse of the sine function is the function that "undoes" sine. When the ratio between the lengths of two sides of a right triangle is known, $\sin^{-1}(x)$, $\cos^{-1}(x)$, or $\tan^{-1}(x)$, can be used to find the measure of one of the triangle's acute angles. Note that the notation refers to the inverse of the sine function, *not* $\frac{1}{\sin(x)}$. Also see *inverse cosine* and *inverse tangent*. (p. 245)

inverse tangent ($\tan^{-1}(x)$) Read as the inverse of tangent x, $\tan^{-1}(x)$ is the measure of the angle with tangent x. The inverse of the tangent function is the function that "undoes" tangent. When the ratio between the lengths of two sides of a right triangle is known, $\sin^{-1}(x)$, $\cos^{-1}(x)$, or $\tan^{-1}(x)$, can be used to find the measure of one of the triangle's acute angles. Note that the notation refers to the inverse of the tangent function, *not* $\frac{1}{\tan(x)}$. Also see *inverse cosine* and *inverse sine*. (p. 245)

investigating a function To investigate a function means to make a complete graph of the function and to write down everything you know about the function. Some things to consider are shape, line of symmetry, whether the graph opens upward or downward, asymptotes, whether the function is increasing or decreasing, x- and y-intercepts, domain and range, maximum or minimum, continuous or discrete, and whether it is a function. Also see *complete graph*.

irrational numbers The set of numbers that cannot be expressed in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$. For example, π and $\sqrt{2}$ are irrational numbers. (p. 284)

isosceles trapezoid A convex quadrilateral with a line of symmetry bisecting one pair of opposite sides. It is a special case of a trapezoid. In any isosceles trapezoid two opposite sides (the bases) are parallel, and the two other sides (the legs) are of equal length. (p. 48)

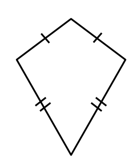


isosceles triangle A triangle with at least two sides of equal length. (p. 15)

Isosceles Triangle Theorem If a triangle is isosceles, then the base angles (which are opposite the congruent sides) are congruent. For example, if ΔABC is isosceles with $\overline{BA} \cong \overline{BC}$, then the angles opposite these sides are congruent; that is, $\angle A \cong \angle C$. (p. 79)

justify To give a logical reason supporting a statement or step in a proof. More generally, to use facts, definitions, rules, and/or previously proven conjectures in an organized sequence to convincingly demonstrate that your claim (or your answer) is valid (true).

kite A quadrilateral with two distinct pairs of consecutive congruent sides. (p. 376)



lateral edge See *pyramid*.

lateral face See *pyramid*.

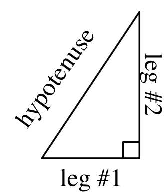
lateral surface (1) All the faces of a prism or pyramid, with the exception of the base(s); (2) On a cone, the surface not including the circular base. The lateral surface connects the apex to each point on the circular boundary of the base. (p. 615)

lateral surface area The sum of the areas of all the lateral surfaces of a polyhedron or solid. (p. 615)

laws of exponents

Law	Examples	
$x^m x^n = x^{m+n}$ for all x	$x^3x^4 = x^{3+4} = x^7$	$2^5 \cdot 2^{-1} = 2^4$
$\frac{x^m}{x^n} = x^{m-n}$ for $x \neq 0$	$x^{10} \div x^4 = x^{10-4} = x^6$	$\frac{5^4}{5^7} = 5^{-3}$
$(x^m)^n = x^{mn}$ for all x	$(x^4)^3 = x^{4 \cdot 3} = x^{12}$	$(10^5)^6 = 10^{30}$
$x^0 = 1$ for $x \neq 0$	$\frac{y^2}{y^2} = y^0 = 1$	$9^0 = 1$
$x^{-1} = \frac{1}{x}$ for $x \neq 0$	$\frac{1}{x^2} = (\frac{1}{x})^2 = (x^{-1})^2 = x^{-2}$	$3^{-1} = \frac{1}{3}$
$x^{m/n} = \sqrt[n]{x^m}$ for $x \geq 0$	$\sqrt{k} = k^{1/2}$	$y^{2/3} = \sqrt[3]{y^2}$

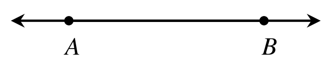
legs The two sides of a right triangle that form the right angle. Note that the legs of a right triangle are always shorter than its hypotenuse. Also see *hypotenuse*.



less than (1) One expression is less than another if its value is not as large. We indicate this relationship with the less than symbol "<". For example, 1 + 1 is less than 4 + 5. We write 1 + 1 < 4 + 5. (2) We sometimes say that one amount is a certain quantity less than another amount. For example, a student movie ticket might cost two dollars *less than* an adult ticket.

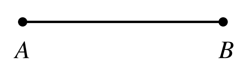
like terms Two or more terms that contain the same variable(s), with corresponding variables raised to the same power. For example, $5x$ and $2x$ are like terms. Also see *combining like terms*.

line Graphed, a line is made up of an infinite number of points, is one-dimensional, and extends without end in two directions. It is made up of points and has no thickness. A line can be named with a letter (such as l), but also can be labeled using two points on the line, such as $\overleftrightarrow{AB}$ above. A line is a mathematically undefined term in geometry. Also see *ray* and *line segment*. In two dimensions, a line is the graph of an equation in standard form $ax + by =$ c. Also see $y = mx + b$. (p. 14)

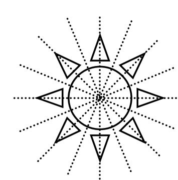


line of reflection See *reflection*. (p. 35)

line segment The portion of a line between two points. A line segment is named using its endpoints. For example, the line segment at right may be named either $\overline{AB}$ or $\overline{BA}$. (p. 14)



line of symmetry A line that divides a shape into two congruent parts that are reflections of each other across the line. If you fold a shape over its line of symmetry, the shapes on both sides of the line will match each other perfectly. Some shapes have more than one line of symmetry, such as the example at right. Other shapes may only have one line of symmetry or no lines of symmetry. (p. 260)



linear equation An equation with at least one variable of degree one and no variables of degree greater than one. The graph of a linear equation of two variables is a line in the plane. $Ax + By = C$ is the standard form of a linear equation. Also see $y = mx + b$. (p. 24)

linear factor A factor of the form $(ax + b)$.

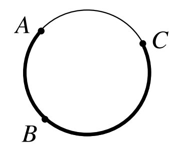
linear function A polynomial function of degree one or zero, with general equation $f(x) = a(x - h) + k$. The graph of a linear function is a line. Also see *linear equation*. (p. 24)

linear inequality An inequality with a boundary line represented by a linear equation.

linear scale factor See *scale factor* and *ratios of similarity*. (p. 609)

logical argument A logical sequence of statements and reasons that lead to a conclusion. A logical argument can be written in a paragraph, represented with a flowchart, or documented in a two-column proof.

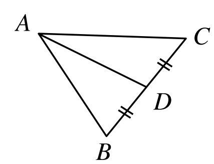
m When the equation of a line is expressed in $y = mx + b$ form, the parameter m gives the slope of the line. For example, the slope of the line $y = -\frac{1}{3}x + 7$ is $-\frac{1}{3}$.



major arc An arc with a measure greater than 180º. Each major arc has a corresponding minor arc that has a measure that is less than 180º. A major arc is named with three letters on the arc. For example, the highlighted arc at right is the major arc $\overset{\frown}{ABC}$. (p. 571)

maximum value The largest value in the range of a function. For example, the y-coordinate of the vertex of a parabola that opens downward. (p. 484)

measurement For the purposes of this course, a measurement is an indication of the size or magnitude of a geometric figure. For example, an appropriate measurement of a line segment would be its length. Appropriate measurements of a square would include not only the length of a side, but also its area and perimeter. The measure of an angle represents the number of degrees of rotation from one ray to the other about the vertex.

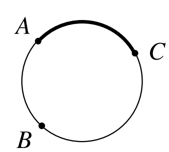


median (of a triangle) A line segment that connects a vertex of a triangle with the midpoint of the side opposite to the vertex. For example, since D is a midpoint of $\overline{BC}$, then $\overline{AD}$ is a median of ΔABC. The three medians of a triangle intersect at a point called the centroid. (p. 429)

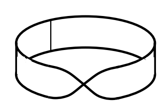
midpoint A point that divides a segment into two segments of equal length. For example, point D is the midpoint of $\overline{BC}$ in ΔABC in the example for median (of a triangle). (p. 382)

midsegment A segment joining the midpoints of two sides of a triangle. (p. 400)

minimum value The smallest value in the range of a function. For example, the y-coordinate of the vertex of a parabola that opens upward. (p. 484)



minor arc An arc with a measure less than 180º. Each minor arc has a corresponding major arc that has a measure that is more than 180°. Minor arcs are named using the endpoints of the arc. For example, the highlighted arc at right is named $\overset{\frown}{AC}$. (p. 571)

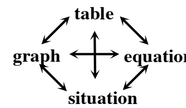


Möbius strip A one-sided surface in a closed loop that can be formed by giving a rectangular strip of paper a half-twist and affixing its ends. (p. 17)

model A model is a mathematical way of describing a real situation. It can be as simple as adding numbers as a way to calculate how much someone has spent, but most models involve approximations and estimations. The weather predictions that you see on the news are based on complex models that rely on calculations done by very large computer programs. Also see *regression*. (p. 377)

monomial An expression with only one term. It can be a number, a variable, or the product of a number and one or more variables. For example, 7, $3x$, $-4ab$, and $3x^2y$ are each monomials. (p. 213)

multiple representations web An organizational tool we use to keep track of connections between the four representations of relationships between quantities emphasized in this course. In this course, we emphasize four different ways of representing a numerical relationship: with a graph, table, situation (pattern), or equation or inequality. (p. 264)



Multiplication Rule for Probability For two events, {A} and {B}, $P(\text{A and B}) = P(\text{A given B}) \cdot P(\text{B})$, or equivalently, $P(\text{A given B}) = \frac{P(\text{A and B})}{P(\text{B})}$. When two events are independent, then $P(\text{A given B}) = P(\text{A})$, and the Multiplication Rule can be rewritten as $P(\text{A and B}) = P(\text{A}) \cdot P(\text{B})$. Also see *Addition Rule for Probability*. (p. 414)

mutually exclusive Two events are mutually exclusive if they have no outcomes in common. (p. 406)

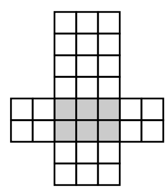
***n*-gon** A polygon with n sides. A polygon is often referred to as an n-gon when we do not yet know the value of n. (p. 438)

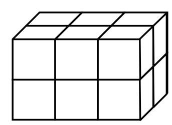
natural numbers The natural numbers are the positive integers, { 1, 2, 3, . . . }. They are also called the counting numbers. (p. 351)

negative exponent The value of a number raised to a negative exponent is the reciprocal of the number raised to the absolute value of the exponent. That is, $x^{-a} = \frac{1}{x^a}$ for $x \neq 0$.

negative number A negative number is a number less than zero. (p. 351)

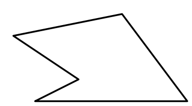
net A diagram that, when folded, forms the surface of a three-dimensional solid. A net is essentially the faces of a solid laid flat. It is one of several ways to represent a three-dimensional diagram. The diagram at right is a representation of the solid at the far right. Note that the shaded region of the net indicates the (bottom) base of the solid.





nonagon A polygon with nine sides. (p. 47)

non-convex polygon A polygon that is not convex. An example of a non-convex polygon is shown at right. Also see *convex polygon*. (p. 47)

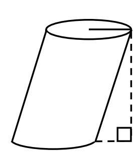


number line A diagram representing all real numbers as points on a line. All real numbers are assigned to points. The numbers are called the coordinates of the points and the point for which the number 0 is assigned is called the origin. Also see *boundary point*.

number system The organizational structure used to categorize numbers into complex numbers, imaginary numbers, real numbers, rational numbers, irrational numbers, integers, fractions, whole numbers, negative integers, zero, and natural numbers. (p. 351)

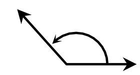
numerical data Data that can be represented on a number line.

oblique prism (or cylinder) A prism (or cylinder) is oblique when its lateral surface(s) are not perpendicular to the base. See figure at right. Also see *Cavalieri's Principle*. (p. 600)



oblique pyramid (or cone) A pyramid (or cone) is oblique when its apex is not directly above the center of the base. (p. 614)

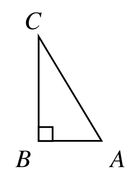
obtuse angle Any angle that measures between (but not including) 90º and 180º. Also see *acute angle*.



octagon A polygon with eight sides. (p. 47)

one-dimensional Not having any width or depth. Lines and curves are one-dimensional.

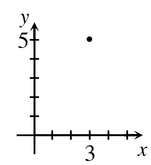
opposite (1) In algebra: Two numbers are opposites if they are the same distance from zero, but one is positive and one is negative. For example, 5 and –5 are opposites. The opposite of a number is sometimes called its additive inverse, indicating that the sum of a number and its opposite is zero. (2) In geometry: In a figure, opposite means "across from". For example, in a triangle, an opposite side is the side that is across from a particular angle and is not a side that makes the angle. For example, the side $\overline{AB}$ in ΔABC at right is opposite $\angle C$, while $\overline{AC}$ is opposite the right angle. (p. 231)



opposite interior angles See *remote interior angles*.

Order of Operations The specific order in which certain operations are to be carried out to evaluate or simplify expressions. The order is: parentheses (or other grouping symbols), exponents (powers or roots), multiplication and division (from left to right), and addition and subtraction (from left to right).

ordered pair A pair of numbers written (x, y) used to represent the coordinates of a point in an xy-plane where x represents the horizontal distance from 0 and y is the vertical distance from 0. The input and output values of a function or relationship can be represented as ordered pairs where x is the input and y is the output. For example, the ordered pair (3, 5) represents the point shown in bold at right.



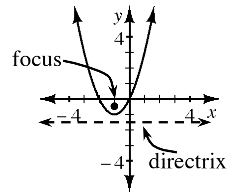
orientation (of a figure) Orientation refers to the placement and alignment of a figure in relation to others or an object of reference (such as coordinate axes). Unless it has rotation symmetry, the orientation of a figure changes when it is rotated (turned) less than 360°. Also, the orientation of a shape changes when it is reflected, except when reflected across a line of symmetry.

origin The point on a coordinate plane where the x- and y-axes intersect is called the origin. This point has coordinates (0, 0). The point assigned to zero on a number line is also called the origin.

outcome The result of a probabilistic situation. The set of all possible outcomes of a probabilistic situation is called the sample space. Also see *event*.

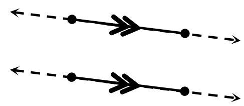
output value The output value is the dependent variable in a relationship. When we substitute the input value into our equation, the result is the output value. For example, if we have an equation for how much your phone bill will be if you talk a certain number of minutes, the amount of your phone bill is the output value. The output value appears second in an $x \to y$ table, and is represented by the variable y. When working with functions, the output value, an element of the range, is the value that results from applying the equation for the function to an input value. For the function $f(x) = x^2 - 73$, when the input is 10, the output is 27. Function notation shows how the function operates on the input to produce the output: $f(10) = 10^2 - 73 = 27$.

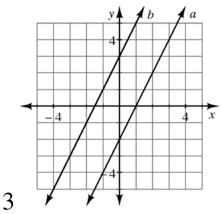
parabola A parabola is a conic section created by slicing a cone with a plane parallel to a lateral edge of the cone. Parabolas are most commonly seen in algebra courses as the graphs of quadratic equations. Two commonly used forms of quadratic equations are standard form $y = ax^2 + bx + c$ and graphing form $y = a(x - h)^2 + k$, with the vertex of the parabola at (h, k).



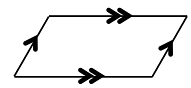
A parabola is also described as the set of all points that are equidistant from a single point (the focus) and a line (the directrix). (p. 554)

parallel lines Two lines on a flat surface are parallel if they never intersect (no matter how far they are extended). Two line segments on a flat surface are parallel if the lines they lie on never intersect. There is a constant distance between two parallel lines (or line segments). Parallel lines have the same slope. Identical arrow markings are used to note parallel lines or line segments as shown in the diagrams at right. For example, the graphs of $y = 2x + 3$ and $y = 2x - 2$ are parallel (see diagram at right). When two equations have parallel graphs, the equations have no solutions in common. (p. 51)



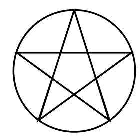


parallelogram A quadrilateral with two pairs of parallel sides. (p. 376)



pentagon A polygon with five sides. (p. 47)

pentagram A pentagram is created by connecting five equally-spaced points on the circumference of a circle. Note that all the corresponding lengths and angles are equal to each other. (p. 679)



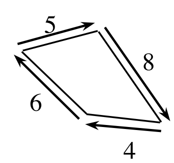
percent A ratio that compares a number to 100. Percents are often written using the "%" symbol. For example, 0.75 is equal to $\frac{75}{100}$ or 75%. (p. 91)

perfect square For numbers, a whole number that can be written as the second power of another whole number. For example, 1, 4, 9, 16, and 25 are perfect squares. See also *perfect square form* and *perfect square trinomials*. (p. 228)

perfect square form A quadratic equation in the form $(ax + b)^2 = c$, where a is nonzero, is said to be in perfect square form. For example, $(2x + 3)^2 = 20$ is a quadratic equation in perfect square form. (p. 288)

perfect square trinomials Trinomials of the form $a^2x^2 + 2abx + b^2$, where a and b are nonzero real numbers, are known as perfect square trinomials and factor as $(ax + b)^2$. For example, the perfect square trinomial $9x^2 - 24x + 16$ can be factored as $(3x - 4)^2$. (p. 228)

perimeter The distance around the exterior of a figure on a flat surface. For a polygon, the perimeter is the sum of the lengths of its sides. The perimeter of a circle is also called the circumference. (p. 21)

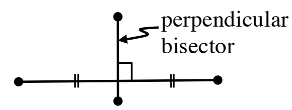


Perimeter =
5 + 8 + 4 + 6 = 23 units

permutation A permutation is an arrangement in which the order of selection matters. For example, a batting line-up is a permutation because it is an ordered list of players. If each of five letters, A, B, C, D, E is printed on a card, the number of three letter sequences you can make by selecting three of the five cards is a permutation. Permutations can be represented with tree diagrams, decision charts, and their value calculated by using the formula for ${}_nP_r = \frac{n!}{(n-r)!}$. In the example given above, ${}_5P_3 = \frac{5!}{2!} = \frac{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{2 \cdot 1} = 5 \cdot 4 \cdot 3 = 60$. Also see *combination*. (p. 658)

perpendicular Two rays, line segments, or lines that meet (intersect) to form a right angle (90º) are called perpendicular. The slopes of lines that are perpendicular are opposite reciprocals. A line and a flat surface can also be perpendicular if the line does not lie on the flat surface, but intersects it and forms a right angle with every line on the flat surface passing through the point of intersection. A small square at the point of intersection of two lines or segments indicates that the lines are perpendicular. (p. 385)

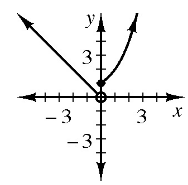
perpendicular bisector The perpendicular bisector of a line segment is a line segment, line, or ray that is perpendicular to the original segment and passes through its midpoint. (p. 385)



phi (ϕ) A Greek letter, pronounced "fee", that represents the golden ratio. $\phi = \frac{1+\sqrt{5}}{2}$ (p. 680)

pi (π) The ratio of the circumference (C) of the circle to its diameter (d). For every circle, $\pi = \frac{\text{circumference}}{\text{diameter}} = \frac{C}{d}$. Numbers such as 3.14, 3.14159, or $\frac{22}{7}$ are approximations of π. (p. 466)

piecewise-defined function A function composed of parts of two or more functions, also called a piecewise function. Each part is a function with a restricted (limited) domain. (p. 520)



plane A plane is an undefined term in geometry. It is a two-dimensional flat surface that extends without end. It is made up of points and has no thickness.

playing cards A standard deck of playing cards contains the following 52 cards:

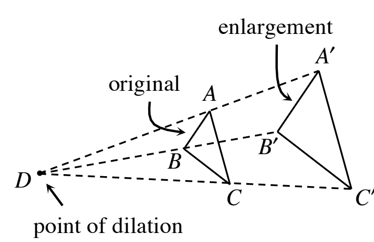
- 13 cards with red hearts (♥), numbered 2 through 10, Jack, Queen, King, and Ace
- 13 cards with red diamonds (♦), numbered 2 through 10, Jack, Queen, King, and Ace
- 13 cards with black spades (♠), numbered 2 through 10, Jack, Queen, King, and Ace
- 13 cards with black clubs (♣), numbered 2 through 10, Jack, Queen, King, and Ace

The face cards are the Jacks, Queens, and Kings (Aces are not considered face cards).

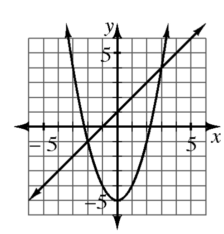
point An undefined term in geometry. A point has no dimensions but can be located by its coordinates on a number line, in a plane, or in space.

point of concurrency The single point where two or more lines intersect on a plane. For the points of concurrency of a triangle, see *circumcenter, centroid,* and *incenter*. (p. 433)

point of dilation The point from which a figure is stretched proportionally when the figure is dilated. For example, in the diagram at right, ΔABC is dilated to form $\Delta A'B'C'$. Notice that while a dilation changes the size and location of the original figure, it does not rotate or reflect the original. While lengths can change, angles do not change under a dilation. (p. 104)

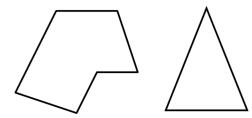


point of intersection A point of intersection is a point that the graphs of two equations have in common. For example, (3, 4) is a point of intersection of the two graphs shown at right. Two graphs may have one point of intersection, several points of intersection, or no points of intersection. The ordered pair representing a point of intersection gives a solution to the equations of each of the graphs. (p. 504)



point-slope form The point-slope form of the equation of a line is $y - k = m(x - h)$ where (h, k) are the coordinates of a point on the line. It is called the point-slope form of a linear equation or function because it shows the slope m and a point (h, k) that is on the graph of the line. For example, given a line that has a slope of $\frac{5}{3}$ and contains the point $(3, -4)$, its equation can be written $y + 4 = \frac{5}{3}(x - 3)$. To find the equation of the line in $y = mx + b$ form, we solve the point-slope form equation for y. Also see $y = mx + b$ or *slope-intercept form*.

polygon A two-dimensional closed figure of three or more line segments (sides) connected end to end. Each segment is a side and only intersects the endpoints of its two adjacent sides. Each point of intersection is a vertex. At right are two examples of polygons. Also see *regular polygon*. (p. 47)



polynomial An algebraic expression that involves at most the operations of addition, subtraction, and multiplication. A polynomial in one variable is an expression that can be written as the sum of terms of the form: (any number) $\cdot\, x^{\text{(whole number)}}$. These polynomials are usually arranged with the powers of x in order, starting with the highest, left to right. The numbers that multiply the powers of x are called the coefficients of the polynomial. For example, $x^8 - 4x^6 + 6x^2$ is a polynomial. (p. 213)

positive number A positive number is a number greater than zero. Zero is neither positive nor negative. (p. 351)

postulates Statements accepted as true without proof. Also known as *axioms*.

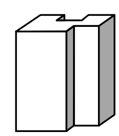
power A number or variable raised to an exponent in the form x^n. See *exponent*.

prime notation When a polygon is transformed, the image is often named using prime notation. For example, the image of point B would be labeled B' (read as "B prime"). (p. 35)

prime number A positive integer with exactly two factors. The only factors of a prime number are 1 and itself. For example, the numbers 2, 3, 17, and 31 are all prime. 31 has no factors other than 1 and 31.

principal Initial investment or capital. An initial value.

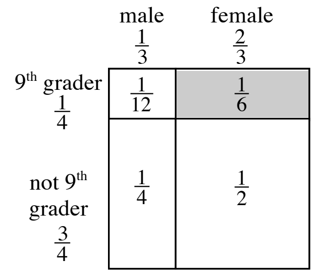
prism A three-dimensional figure that consists of two parallel congruent polygons (called bases) and a lateral surface containing segments connecting each point on each side of one base to the corresponding point on the other base. The lateral surface of a prism consists of parallelograms. Also see *right prism* and *oblique prism*. (p. 548)



probabilistic situation A situation in which the outcomes are determined by random processes.

probability The probability that an event A, with a finite number of equally likely outcomes, will occur is the number of outcomes for event A divided by the total number of equally likely outcomes. This can be written as $\frac{\text{number of outcomes for event A}}{\text{total number of possible outcomes}}$. A probability p is a ratio, $0 \le p \le 1$. (p. 91)

probability area model A model that uses the area of rectangles to represent the probabilities of possible outcomes when considering two *independent* events. For example, suppose you are going to randomly select a student from a classroom. If the probability of selecting a female student from the room is $\frac{2}{3}$ and the probability of selecting a 9th grader from the room is $\frac{1}{4}$, the area of the shaded rectangle at right represents the probability that a randomly selected student is a female 9th grader ($\frac{2}{3} \cdot \frac{1}{4} = \frac{1}{6}$). A "generic" area model enables you to find the probabilities of outcomes without drawing a diagram to scale. Also see *tree diagram*. (p. 164)



Area model

probability table Another name for *two-way table*. (p. 403)

profit The amount of money after expenses have been accounted for.

proof A convincing logical argument that uses definitions and previously proven conjectures in an organized sequence to show that a conjecture is true. A proof can be written in a paragraph, represented with a flowchart, or documented in a formal two-column proof. (p. 19)

proof by contradiction A proof that begins by assuming that an assertion is true and then shows that this assumption leads to a contradiction of a known fact. This demonstrates that the assertion is false. Also known as an indirect proof. (p. 98)

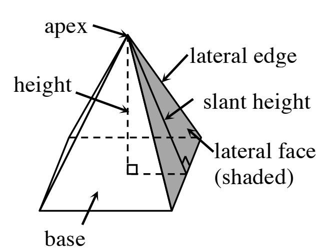
proportion Equal ratios are described as a proportion. Also, an equation stating that two ratios (fractions) are equal. For example, the equation $\frac{x-8}{2x+1} = \frac{5}{6}$ is a proportion and the equation below is a proportion. A proportion is a useful type of equation to set up when solving problems involving proportional relationships. (p. 102)

$$\frac{68 \text{ votes for Mr. Mears}}{100 \text{ people surveyed}} = \frac{34 \text{ votes for Mr. Mears}}{50 \text{ people surveyed}}$$

proportional relationship Two ratios are in a proportional relationship if a proportion can be set up that relates the ratios. (p. 102)

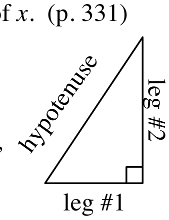
protractor A geometric tool used for measuring the number of degrees in an angle.

pyramid A polyhedron with a polygonal base formed by connecting each vertex of the base to a single point (the apex) that is above the flat surface containing the base. The lateral faces of a pyramid are the triangles formed by connecting consecutive vertices of the base to the apex. Lateral edges are two of the sides of these lateral triangular faces. The slant height is the height of a lateral triangular face. Also see *right pyramid (or cone)* and *oblique pyramid (or cone)*. (p. 615)



Pythagorean Identity For trigonometric functions, $\sin^2(x) + \cos^2(x) = 1$ for any value of x. (p. 331)

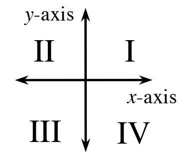
Pythagorean Theorem The statement relating the lengths of the legs of a right triangle to the length of the hypotenuse: $(\text{leg } \#1)^2 + (\text{leg } \#2)^2 = \text{hypotenuse}^2$. The Pythagorean Theorem is powerful because if you know the lengths of any two sides of a right triangle, you can use this relationship to find the length of the third side. (p. 472)



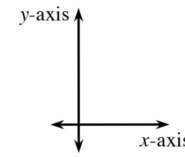
Pythagorean Triple Any three positive integers a, b, and c that make the relationship $a^2 + b^2 = c^2$ true. Commonly used Pythagorean Triples include 3, 4, 5 and 5, 12, 13. (p. 332)

quadrants The coordinate plane is divided by its axes into four quadrants. The quadrants are numbered as shown in the first diagram at right. When graphing data that has no negative values, we sometimes use a graph showing only the first quadrant.

4-quadrant graph:



1st-quadrant graph:



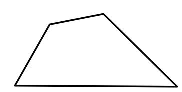
quadratic equation Any equation where at least one term has degree 2 and no term has degree higher than 2. A one-variable quadratic equation can be written in standard form $ax^2 + bx + c = 0$, where a, b, and c are real numbers and a is nonzero. For example, $3x^2 - 4x + 7.5 = 0$ is a quadratic equation. (p. 270)

quadratic expression An expression that can be written in the form $ax^2 + bx + c$, where a, b, and c are real numbers and a is nonzero. For example, $3x^2 - 4x + 7.5$ is a quadratic expression. (p. 215)

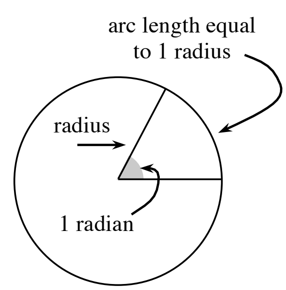
Quadratic Formula The Quadratic Formula states that if $ax^2 + bx + c = 0$ and $a \neq 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. For example, if $5x^2 + 9x + 3 = 0$, then $x = \frac{-9 \pm \sqrt{9^2 - 4(5)(3)}}{2(5)} = \frac{-9 \pm \sqrt{21}}{10}$. (p. 301)

quadratic function A quadratic equation that can be written $y = ax^2 + bx + c$ where a does not equal 0 is also a quadratic function where x is the independent variable and y is the dependent variable. Its graph is a parabola with a vertical orientation. The graphing form of a quadratic function is $f(x) = a(x - h)^2 + k$. Also see *graphing form* and *parabola*. (p. 259)

quadrilateral A closed polygon with four sides. For example, the shape at right is a quadrilateral. (p. 47)



radian The ratio of the arc length to the radius for any sector of a circle. A central angle with measure 1 radian intercepts an arc with length equal to 1 radius of the circle. The ratio will be constant for a given central angle, regardless of the length of the radius of the circle. Along with degrees, radians are a very common unit of measurement for the central angle of a circle. 1 radian = $\frac{180}{\pi}$ degrees. (p. 464)



radical An expression in the form $\sqrt{a}$, where $\sqrt{a}$ is the positive square root of a. For example, $\sqrt{49} = 7$. Also see *square root* and *simple radical form*. (p. 284)

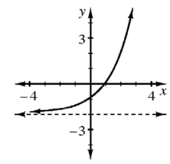
radical form Fractional exponents with a base of x in the form of $x^{m/n}$ can also be written in radical form as $(\sqrt[n]{x})^m$ or $\sqrt[n]{x^m}$. Also called exact form. Also see *approximate answer*, *simple radical form*, and *laws of exponents*. (p. 284)

radicand The expression under a radical sign. For example, in the expression $3 + 2\sqrt{x - 7}$, the radicand is $x - 7$. (p. 284)

radius (plural: radii) (1) Of a circle: A line segment drawn from the center of a circle to a point on the circle. Note that the length of a circle's radius is half the length of the circle's diameter. Also see *circle*. (2) Of a regular polygon: A line segment that connects the center of a regular polygon with a vertex. For both a circle and regular polygon, the length of the segment is also called the radius, and is usually denoted r. (p. 466)

random An outcome is random if it happens by chance; that is, its result cannot be predicted from previous outcomes. A sequence of several random outcomes in a row will have no predictable order or pattern. For example, the outcome of rolling a die is random because the outcome cannot be predicted, and many rolls in a row will have no predictable pattern.

range The set of all output values for a function or relationship. For example, the range of the function graphed at right is $y > -2$. It consists of all the values of the dependent variable, that is, every number that y can represent for the function $f(x) = y$. Also see *domain*. (p. 484)



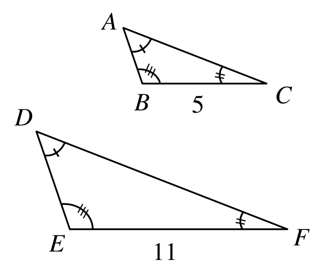
rate A ratio comparing two quantities, often a comparison of time. For example, miles per hour.

ratio A ratio compares two quantities by division. A ratio can be written using a colon, but is more often written as a fraction. For example, in the two similar triangles shown below, a ratio can be used to compare the length of $\overline{BC}$ in ΔABC with the length of $\overline{EF}$ in ΔDEF. This ratio can be written as 5:11 or as the fraction $\frac{5}{11}$.

rational number A number that can be written as a fraction $\frac{a}{b}$ where a and b are integers and $b \neq 0$. (p. 284)

ratios of proportionality See *scale factor*.

ratios of similarity $r : r^2 : r^3$ The ratio of any pair of corresponding sides of two similar figures. This means that once it is determined that two figures are similar, all of their pairs of corresponding sides have the same ratio. For example, for the similar triangles ΔABC and ΔDEF at right, the ratio of similarity is $\frac{5}{11}$. The ratio of similarity can also be called the linear scale factor.

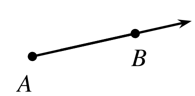


When a two-dimensional figure is enlarged (or reduced) proportionally, its lengths and area change. If the linear scale factor is r, then all lengths (such as sides, perimeter, and heights) of the original figure are multiplied by a factor of r while the area is multiplied by a factor of r^2.

When a solid is enlarged (or reduced) proportionally, its lengths, surface area, and volume also change. If the linear scale factor is r, then the surface area is multiplied by a factor of r^2 and the volume is multiplied by a factor of r^3. Thus, if a solid is enlarged proportionally by a linear scale factor of r, then the new edge lengths, surface area, and volume can be found using the relationships below. (p. 609)

New edge length = $r \cdot$ (corresponding edge length of original polyhedron)
New surface area = $r^2 \cdot$ (original surface area)
New volume = $r^3 \cdot$ (original volume)

ray A ray is part of a line that starts at one point and extends without end in one direction. In the example at right, ray $\overrightarrow{AB}$ is part of $\overleftrightarrow{AB}$ that starts at point A and contains all the points of $\overleftrightarrow{AB}$ that are on the same side of A as point B, including point A. Point A is the endpoint of $\overrightarrow{AB}$. (p. 14)



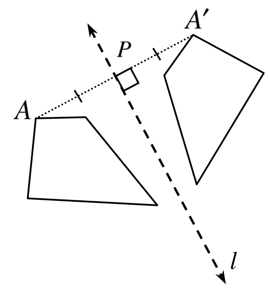
real numbers Irrational numbers together with rational numbers form the set of the real numbers. For example, the following are all real numbers: $2.78, -13267, 0, \frac{3}{7}, \pi, \sqrt{2}$. All real numbers are represented on the number line. (p. 284)

reasoning See *logical argument* and *proof*.

reciprocal The reciprocal of a nonzero number is its multiplicative inverse; that is, the reciprocal of x is $\frac{1}{x}$. For a number in the form $\frac{a}{b}$, where a and b are nonzero, the reciprocal is $\frac{b}{a}$. The product of a number and its reciprocal is 1. For example, the reciprocal of 12 is $\frac{1}{12}$, and $12 \cdot \frac{1}{12} = 1$.

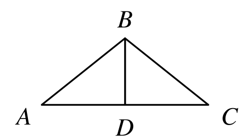
rectangle A quadrilateral with four right angles. (p. 376)

reflection When a figure is reflected across a line of reflection, such as the figure at right, it appears that the figure is "flipped" over the line. However, formally, a reflection across a line of reflection is defined as a function that assigns each point (such as A) to a unique image point (such as A') so that the line of reflection is the perpendicular bisector of the segments connecting the points and their images (such as $\overline{AA'}$). Therefore, $AP = A'P$. (p. 35)



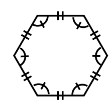
reflection symmetry See *symmetry*.

Reflexive Property The Reflexive Property states that any expression is always equal to itself. That is, $a = a$. This property is often useful when proving that two triangles that share a side or an angle are congruent. For example, in the diagram at right, since ΔABD and ΔCBD share a side ($\overline{BD}$), the Reflexive Property justifies that $BD = BD$. (p. 79)



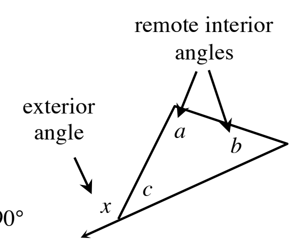
regression A method for finding a best-fit line or curve through a set of points on a scatterplot. The most common type of regression is finding the least squares regression line. Other regressions include: exponential regressions (fitting $y = ab^x$), quadratic regressions (fitting $y = ax^2 + bx + c$), and power regressions (fitting $y = ax^b$). (p. 674)

regular polygon A polygon is regular if it is a convex polygon with congruent angles and congruent sides. For example, the shape at right is a regular hexagon. (p. 47)



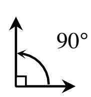
relationship (1) An equation that relates two or more variables. (2) For this course, a relationship is a way that two objects (such as two line segments or two triangles) are connected. Common geometric relationships between two figures include being similar (when two figures have the same shape, but not necessarily the same size) and being congruent (when two figures have the same shape and the same size).

remote interior angles If a triangle has an exterior angle, the remote interior angles are the two angles not adjacent to the exterior angle. Also called opposite interior angles. (p. 85)

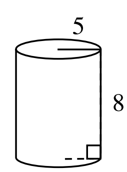


rhombus A quadrilateral with four congruent sides. (p. 376)

right angle An angle that measures 90°. A small square is used to note a right angle, as shown in the example at right. (p. 12)



right prism (or cylinder) A prism (or cylinder) with lateral surface(s) that are perpendicular to the base. See the figure at right.



right pyramid (or cone) A pyramid (or cone) with its apex directly above the center of the base. (p. 614)

right trapezoid A trapezoid with two right angles. (p. 375)

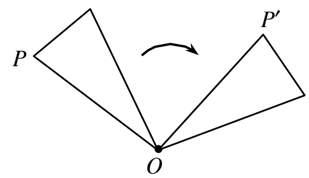
right triangle A triangle that has one right angle. The side of a right triangle opposite the right angle is called the hypotenuse, and the two sides adjacent to the right angle are called legs. Note that legs of a right triangle are always shorter than its hypotenuse. (p. 332)

rigid motions See *rigid transformations*. (p. 35)

rigid transformations Movements of figures that preserve their shape and size. Examples of rigid transformations are reflections, rotations, and translations. Also called rigid motions or "isometries". Also see *similarity transformations*. (p. 35)

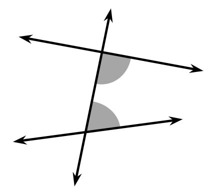
roots (of a polynomial function) The roots of a polynomial function $f(x)$ are the values of x such that $f(x) = 0$. For example, the roots of $f(x) = (x - 4)(2x + 3)$ are $x = 4$ and $x = -\frac{3}{2}$, because these are the solutions to the equation $(x - 4)(2x + 3) = 0$. The x-intercepts of a function's graph are the real roots of the function. Roots can be real or complex, but complex roots must be found algebraically. (p. 352)

rotation Formally, a rotation about a point O is a function that assigns each point (P) in the plane a unique point (P') so that all angles of rotation $\angle POP'$ have the same measure (which is the angle of rotation) and $OP = OP'$. (p. 35)



rotation symmetry See *symmetry*. (p. 35)

same-side interior angles Two angles between two lines and on the same side of a third line that intersects them (called a transversal). The shaded angles in the diagram at right are an example of a pair of same-side interior angles. Note that if the two lines that are cut by the transversal are parallel, then the two angles are supplementary (add up to 180º). Conversely, if the two angles are supplementary, then the two lines that are cut by the transversal are parallel. Also see *alternate interior angles* and *corresponding angles*. (p. 58)

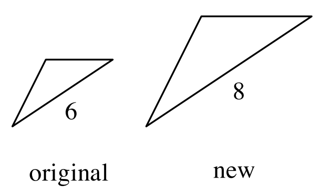


sample space With probability, all the possible outcomes. (p. 91)

SAS ≅ (triangle congruence) Two triangles are congruent if two sides and the included angle of one triangle are congruent to the corresponding two sides and included angle of another triangle. (p. 74)

SAS ~ (triangle similarity) If two triangles have two pairs of corresponding sides that are proportional and the included angles are congruent, then the triangles are similar. (p. 120)

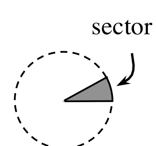
scale factor The amount each side of a figure is multiplied by when the figure is proportionally enlarged or reduced in size. It is written as the ratio of a length in the new figure (image) to a length in the original figure. For the triangles at right, the scale factor is $\frac{8}{6}$ or $\frac{4}{3}$. Also see *ratios of similarity*. (p. 102)



scalene triangle A triangle with no congruent sides. (p. 15)

secant (of a circle) A line that intersects a circle at two distinct points. (p. 579)

sector A region formed by two radii of a central angle and the arc between their endpoints on the circle. You can think of it as a portion of a circle and its interior, resembling a piece of pizza. (p. 466)



segment See *line segment*.

semicircle In a circle, a semicircle is an arc with endpoints that are endpoints of any diameter of the circle. It is a half circle and has a measure of 180º. (p. 574)

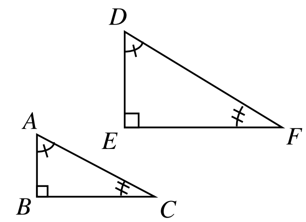
side of an angle One of the two rays that form an angle.

side of a polygon See *polygon*.

similar figures Two shapes are similar if there is a sequence of rigid motions, followed by a dilation, that carries one onto the other. The corresponding angles of similar polygons are congruent, and the corresponding sides are proportional. The symbol for similar is ~. Also see *ratios of similarity*. (p. 101)

similarity conditions See *triangle similarity theorems*. (p. 120)

similarity statement A statement that indicates that two figures are similar. The order of the letters in the names of the shapes in the similarity statement indicates which sides and angles correspond to each other. For example, $\Delta ABC \sim \Delta DEF$ is a similarity statement. It indicates that $\angle A$ corresponds to $\angle D$, and $\overline{AB}$ corresponds to $\overline{DE}$. (p. 113)



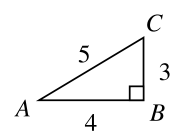
similarity transformations Transformations of figures that preserve their shape, but not necessarily their size. Examples of similarity transformations are reflections, rotations, translations, and dilations. Also see *rigid transformations*. (p. 113)

simple radical form A number $r\sqrt{s}$ is in simple radical form if no square of an integer divides s and s is not a fraction or the denominator of a fraction; that is, there are no perfect square factors (square numbers such as 4, 9, 16, etc.) under the radical sign and no radicals in the denominator. For example, $5\sqrt{12}$ is not in simple radical form since 4 (the square of 2) divides 12. But $10\sqrt{3}$ is in simple radical form and is equivalent to $5\sqrt{12}$. A radical should not remain in the denominator. For example, $\sqrt{\frac{3}{4}}$ should be rewritten $\sqrt{\frac{3}{1}} \cdot \sqrt{\frac{1}{4}} = \frac{\sqrt{3}}{\sqrt{4}} = \frac{\sqrt{3}}{2}$ to eliminate the radical in the denominator. (pp. 284, 324)

simplify To simplify an expression is to write a less complicated expression with the same value. A simplified expression has no parentheses and no like terms. For example, the expression $3 - (2x + 7) - 4x$ can be simplified to $-4 - 6x$. When working with algebra tiles, a simplified expression uses the fewest possible tiles to represent the original expression.

sine inverse ($\sin^{-1}(x)$) See *inverse sine*. (p. 245)

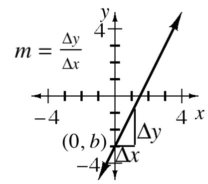
sine ratio In a right triangle, the sine ratio of an acute angle ($\angle A$) is $\sin(A) = \frac{\text{length of opposite side}}{\text{length of hypotenuse}}$. In the triangle at right, $\sin(A) = \frac{BC}{AC} = \frac{3}{5}$. Also see *cosine ratio, tangent ratio,* and *inverse sine*. (p. 237)

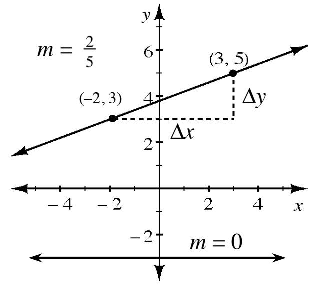


slant height See *pyramid* or *cone*. (p. 615)

slide See *translation*.

slope The ratio of the vertical change to the horizontal change between any two points on a line that describes how steep (or flat) a line is. Slope can be positive, negative, or zero, but a line has only one slope. Slope is the ratio $\frac{\text{vertical change}}{\text{horizontal change}}$ or $\frac{\text{change in } y\text{-value}}{\text{change in } x\text{-value}}$, sometimes written $\frac{\Delta y}{\Delta x}$. For any two points (x_1, y_1) and (x_2, y_2) on a given line, the slope is $\frac{y_2 - y_1}{x_2 - x_1}$. For example, the slope of a line through the points $(3, -5)$ and $(-7, 2)$ is $\frac{2-(-5)}{-7-3} = -\frac{7}{10}$. When the equation of a line is written in $y = mx + b$ form, m is the slope of the line. Some texts refer to slope as the ratio of the "rise over the run". A line has a positive slope if it slopes upward from left to right on a graph, a negative slope if it slopes downward from left to right, zero slope if it is horizontal, and an undefined slope if it is vertical. Slope is interpreted in context as the amount of change in the y-variable for an increase of one unit in the x-variable. (p. 183)





slope angle The acute angle a line forms with the x-axis on a coordinate graph. Also see *slope triangle*. (p. 191)

slope ratio See *slope*. (p. 183)

slope triangle A slope triangle is a right triangle drawn on a graph of a line so that the hypotenuse of the triangle is part of the line. The vertical leg length is the change in the y-value (Δy); the horizontal leg length is the change in the x-value (Δx). We use the lengths of the legs in the triangle to calculate the slope ratio $\frac{\Delta y}{\Delta x}$. (p. 183)

slope-intercept form A linear equation written in the form $y = mx + b$ is written in slope-intercept form. In this form, m is the slope of the line and the point $(0, b)$ is the y-intercept.

solid A closed three-dimensional shape and all of its interior points. Examples include regions bounded by pyramids, cylinders, and spheres. (p. 548)

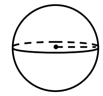
solution The number or numbers that when substituted into an equation or inequality make the equation or inequality true. Solutions to equations and inequalities in one variable are single numbers. For example, $x = 4$ is a solution to the equation $3x - 2 = 10$ because $3x - 2$ equals 10 when $x = 4$. A solution to a two-variable equation is sometimes written as an ordered pair (x, y). For example, $x = 3$ and $y = -2$ is a solution to the equation $y = x - 5$; this solution can be written as $(3, -2)$. There may be any number of solutions for an equation or inequality, from 0 to infinitely many. Equations with no solutions, such as $|x-5| = -3$, are never true. Equations with one, several, or many solutions, such as $x(x + 3)(x - 7) = 0$ are sometimes true, and equations or identities such as $5(2x - 4) = 10x - 20$ are always true. (p. 305)

solve (1) To find all the solutions to an equation or an inequality (or a system of equations or inequalities). For example, solving the equation $x^2 = 9$ gives the solutions $x = 3$ and $x = -3$. (2) Solving an equation for a variable gives an equivalent equation that expresses that variable in terms of other variables and constants. For example, solving $2y - 8x = 16$ for y gives $y = 4x + 8$. The equation $y = 4x + 8$ has the same solutions as $2y - 8x = 16$, but $y = 4x + 8$ expresses y in terms of x and some constants.

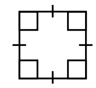
space The set of all points in three dimensions.

special right triangles A right triangle with particular notable features that can be used to solve problems. Sometimes, these triangles can be recognized by the angles, such as the 45º-45º-90º triangle (also known as an "isosceles right triangle") and the 30º-60º-90º triangle. (p. 332)

sphere The set of all points in space that are the same distance from a fixed point. The fixed point is the center of the sphere and the distance is its radius. (p. 646)



square A quadrilateral with four right angles and four congruent sides. (p. 376)



square root The square root of a number is the value that when multiplied by itself gives the number. "Square root" always refers to a positive number. Also see *radical*. (p. 334)

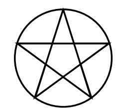
SSS ≅ (triangle congruence) Two triangles are congruent if all three pairs of corresponding sides are congruent. (p. 74)

SSS ~ (triangle similarity) If two triangles have all three pairs of corresponding sides that are proportional (this means that the ratios of corresponding sides are equal), then the triangles are similar. (p. 120)

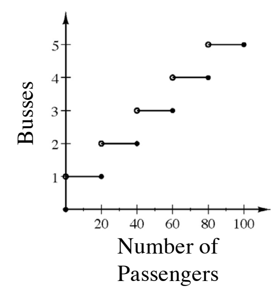
standard form (linear function) A linear equation written in the form $Ax + By = C$ is written in standard form. For linear functions, $B \neq 0$.

standard form (quadratic function) The standard form of the equation of a quadratic function is $y = ax^2 + bx + c$ where $a \neq 0$. (p. 215)

star polygon A star polygon is created by connecting equally-spaced points on the circumference of a circle. The star polygon to the right is commonly called a pentagram. (p. 683)

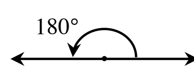


step function A special kind of piecewise function (a function composed of parts of two or more functions). A step function has a graph that is a series of line segments that often looks like a set of steps. (p. 520)



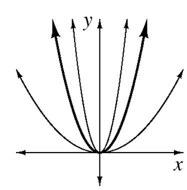
stoplight icon The icon (shown at right) will appear periodically throughout the text. Problems that display this icon contain errors of some type. (p. 16)

straight angle An angle that measures 180º. This occurs when the rays of the angle point in opposite directions, forming a line.



straightedge A tool used as a guide to draw lines, rays, and segments. A ruler has measurement markings while a straightedge does not.

stretch factor Used to describe the effect of a in the graphing form of a quadratic, cubic, absolute value, or exponential function. For $a > 1$ or $a < -1$, the outputs increase or decrease faster than the outputs for the parent functions, and the graphs are described as being stretched upwards or downwards in relation to the parent graph. (p. 501)



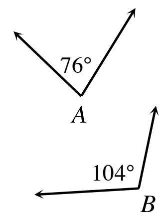
stretch point See *point of dilation*.

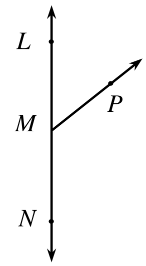
substitution Replacing a variable or expression with a number, another variable, or another expression. For example, when evaluating the function $f(x) = 5x - 1$ for $x = 3$, substitute 3 for x to get $f(3) = 5(3) - 1 = 14$.

Substitution Method A method for solving a system of equations by replacing one variable with an expression involving the remaining variable(s). For example, in the system of equations at right, the first equation tells you that y is equal to $-3x + 5$. We can substitute $-3x + 5$ in for y in the second equation to get $2(-3x + 5) + 10x = 18$, then solve this equation to find x. Once we have x, we substitute that value back into either of the original equations to find the value of y.

$$y = -3x + 5$$
$$2y + 10x = 18$$

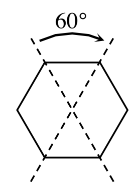
supplementary angles Two angles a and b for which $a + b = 180°$. Each angle is called the supplement of the other. In the example at right, angles A and B are supplementary. Supplementary angles are often adjacent. For example, since $\angle LMN$ is a straight angle, then $\angle LMP$ and $\angle PMN$ are supplementary angles because $m\angle LMP + m\angle PMN = 180°$. (p. 58)





surface area The sum of all the area(s) of the surface(s) of a three-dimensional solid. For example, the surface area of a cylinder is the sum of the areas of its top base, its bottom base, and its lateral surface. (p. 548)

symmetry (1) Rotation symmetry: A shape has rotation symmetry when it can be rotated for less than 360° and it appears not to change. For example, the hexagon at right appears not to change if it is rotated 60° clockwise (or counterclockwise); (2) Reflection symmetry: A shape has reflection symmetry when it appears not to change after being reflected across a line. The regular hexagon at right also has reflection symmetry across any line drawn through opposite vertices, such as those shown in the diagram. (3) There are no polygons with translation symmetry but a line can have translation symmetry as it can be translated on to itself. See *reflection, rotation,* and *line of symmetry*. (p. 7)



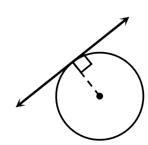
system of equations A system of equations is a set of equations with the same variables that has more than one unknown. Solving a system of equations means finding one or more solutions that make each of the equations in the system true. A solution to a system of equations gives a point of intersection of the graphs of the equations in the system. There may be zero, one, or several solutions to a system of equations. For example, $(1.5, -3)$ is a solution to the system of equations at right; setting $x = 1.5$, $y = -3$ makes both of the equations true. Also, $(1.5, -3)$ is a point of intersection of the graphs of these two equations. (p. 83)

$$y = 2x - 6$$
$$y = -2x$$

systematic list A list created by following a system (an orderly process). (p. 154)

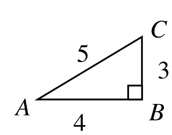
table The tables used in this course represent numerical information by organizing it into columns and rows. The numbers may come from a graph, situation (pattern), or equation.

tangent A line on the same flat surface as a circle that intersects the circle in exactly one point. A tangent of a circle is perpendicular to a radius of the circle at their point of intersection (also called the point of tangency). (p. 601)



tangent inverse ($\tan^{-1}(x)$) See *inverse tangent*. (p. 245)

tangent ratio In a right triangle, the tangent ratio of an acute angle, A, is $\tan(A) = \frac{\text{length of opposite side}}{\text{length of adjacent side}}$. In the triangle at right, $\tan(A) = \frac{3}{4}$. Also see *sine ratio, cosine ratio,* and *inverse tangent*. (p. 195)



term A single number, variable, or product of numbers and variables. A monomial is a term. (p. 213)

theorem A conjecture that has been proven to be true. Some examples of theorems are the Pythagorean Theorem and the Triangle Angle Sum Theorem. (p. 39)

theoretical probability A calculated probability based on the possible outcomes when each outcome has the same chance of occurring: $\frac{\text{number of successful outcomes}}{\text{total number of possible outcomes}}$. (p. 91)

theta (θ) A Greek letter that is often used to represent the measure of an angle. Other Greek letters used to represent the measure of an angle include *alpha* (α) and *beta* (β). (p. 183)

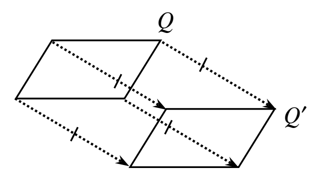
three-dimensional An object that has height, width, and depth.

transformation (of a function) The conversion of a function to a corresponding function. Transformations often slide, reflect, stretch, and/or compress graphs of functions. For example, the transformation of $f(x) + k$ moves the graph of the function up or down by an amount k. The transformation $f(-x)$ reflects the graph of the function across the y-axis. (p. 501)

transformation (of a geometric shape) Four kinds of transformations are considered: reflection, rotation, translation, and dilation. All of them preserve shape, and the first three preserve size. See each term for its particular definition. (p. 35)

Transitive Property of Equality The Transitive Property of Equality states that if $a = b$ and $b = c$, then $a = c$. For example, if $x = 2y$ and $2y = 13$, then x must equal 13. (p. 79)

translation Formally, a translation is a function that assigns each point (Q) in the plane a unique point (Q') so that all line segments connecting an original point with its image have equal length and are parallel. (p. 35)



translation symmetry See *symmetry*. (p. 7)

transversal A line that intersects two or more other lines on a flat surface (plane). In this course, we often work with a transversal that intersects two parallel lines. (p. 58)

trapezoid A quadrilateral with at least one pair of parallel sides. (p. 376)

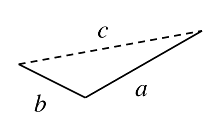
tree diagram A model used to organize the possible outcomes and the respective probabilities of two or more events. (p. 164)

triangle A polygon with three sides. (p. 47)

Triangle Angle Sum Theorem The sum of the measures of the interior angles in any triangle is 180°. (p. 55)

triangle congruence theorems Theorems that use the minimum number of congruent corresponding parts to prove that two triangles are congruent. They are: SSS ≅, SAS ≅, AAS ≅, ASA ≅, and HL ≅. (p. 74)

Triangle Inequality In a triangle with side lengths a, b, and c, c must be less than the sum of a and b and greater than the difference of a and b. In the example at right, a is greater than b (that is, $a > b$), so the possible values for c are all numbers such that $c > a - b$ and $c < a + b$. (p. 56)



Triangle Midsegment Theorem The segment that connects the midpoints of any two sides of a triangle measures half the length of the third side and is parallel to that side. (p. 400)

triangle similarity theorems Theorems that use the minimum number of congruent and/or proportional corresponding parts to prove that two triangles are similar. They are: SSS ~, SAS ~, and AA ~. (p. 120)

trigonometric ratios See *sine ratio*, *cosine ratio*, *tangent ratio*, *inverse sine*, *inverse cosine*, and *inverse tangent*. (p. 237)

trigonometry Literally, the "measure of triangles". In this course, this word is used to refer to the development of triangle tools such as trigonometric ratios (sine, cosine, and tangent) and the Laws of Sines and Cosines. (p. 181)

trinomial A polynomial that is the sum or difference of exactly three terms, each of which is a monomial. For example, $x^2 + 6x + 9$ is a trinomial. (p. 213)

turn See *rotation*.

two-column proof A form of proof in which statements are written in one column as a list and the reasons for the statements are written next to them in a second column. (p. 384)

two-dimensional An object having length and width.

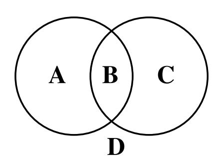
two-way table A way to display categorical two-variable data. The categories of one of the variables is the header of the rows, while the other variable is the header of the columns. The entries in the table can be counts (frequencies) or percents (relative frequencies). (p. 398)

union of two events The union of the two events {A} and {B} is a new event that includes all the outcomes that either A will occur *or* B will occur. For example, if event {A} is the thirteen diamond-suited cards in a deck of playing cards, and {B} is the four Aces, then the event {A union B} contains 16 outcomes: {all the diamonds (including the A♦), A♥, A♣, and A♠}. Also see *intersection of two events*. (p. 171)

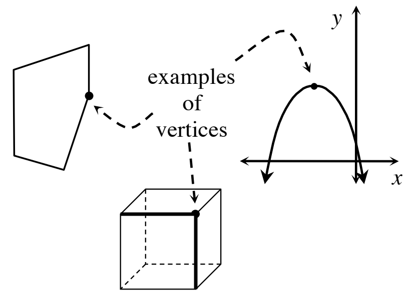
unit of measure A standard quantity (such as a centimeter, second, square foot, or gallon) that is used to measure and describe an object. A single object can be measured using different units of measure, which will usually yield different results. For example, a pencil may be 80 mm long, meaning that it is 80 times as long as a unit of 1 mm. However, the same pencil is 8 cm long, so that it is the same length as 8 cm laid end-to-end. (This is because 1 cm is the same length as 10 mm.)

variable A symbol used to represent one or more numbers. In this course, letters of the English or the Greek alphabet are used as variables. For example, in the expression $3x - (8.6xy + z)$, the variables are x, y, and z.

Venn diagram A type of diagram used to classify objects. It is usually composed of two or more overlapping circles representing different conditions. An item is placed or represented in the Venn diagram in the appropriate position based on the conditions it meets. In the example of the Venn diagram at right, if an object meets one of two conditions, it is placed in region A or C but outside region B. If an object meets both conditions, it is placed in the intersection (B) of both circles. If an object does not meet either condition, it is placed outside of both circles (region D). (p. 6)



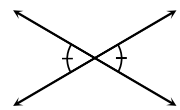
vertex (plural: vertices) (1) For a two-dimensional geometric shape, a vertex is a point where two or more line segments or rays meet to form a "corner", such as in a polygon or angle. (2) For a three-dimensional polyhedron, a vertex is a point where the edges of the solid meet. Also see *apex*. (3) On a graph, a vertex can be used to describe the highest or lowest point on the graph of a parabola or absolute value function (depending on the graph's orientation). (pp. 14, 501)



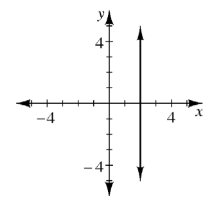
vertex form The vertex form for the equation of a quadratic function (also called *graphing form*) is written $y = a(x - h)^2 + k$.

vertical At right angles to the horizon. On a coordinate graph, the y-axis runs vertically.

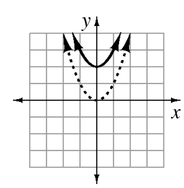
vertical angles The two opposite (that is, non-adjacent) angles formed by two intersecting lines. "Vertical" is a relationship between pairs of angles, so one angle cannot be called vertical. Angles that form a vertical pair are always congruent. (p. 58)



vertical lines Vertical lines run up and down in the same direction as the y-axis and are parallel to it. All vertical lines have equations of the form $x = a$, where a can be any number. For example, the graph at right shows the vertical line $x = 2$. The y-axis has the equation $x = 0$ because x equals zero everywhere on the y-axis. Vertical lines have an undefined slope.



vertical shift Used to describe the location of a graph in relation to its parent graph, the shift is the vertical distance (up or down) of each point on the graph from the corresponding point on the parent graph. This type of transformation is a vertical translation. For example, each point on the graph of $y = x^2 + 2$ is two units higher than its corresponding point on $y = x^2$. In a general equation such as $y = a(x - h)^2 + k$, the vertical shift is represented by k. (p. 501)



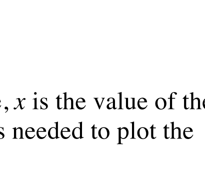
volume A measurement of the size of the three-dimensional region enclosed within an object. It is expressed as the number of $1 \times 1 \times 1$ unit cubes (or parts of cubes) that fit inside a solid. (p. 548)

whole numbers The positive integers and zero, $\{0, 1, 2, 3, \ldots\}$. (p. 223)

***x*-axis** The horizontal number line on a coordinate graph. See *axes*.

***x*-coordinate** In an ordered pair, (x, y), that represents a point in the coordinate plane, x is the value of the x-coordinate. That is, the x-coordinate is the horizontal distance from the y-axis that is needed to plot the point.

***x*-intercept(s)** The point(s) where a graph intersects the x-axis. A graph may have several x-intercepts, no x-intercepts, or just one. We sometimes report the x-intercepts of a graph with coordinate pairs, but since the y-coordinate is always zero, we often just give the x-coordinates of x-intercepts. For example, we might say that the x-intercepts of the graph at right are $(0, 0)$ and $(2, 0)$, or we might just say that the x-intercepts are 0 and 2. In two dimensions, the coordinates of the x-intercept are $(x, 0)$. See *intercepts*. (p. 269)



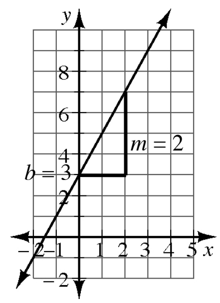
$x \rightarrow y$ table A table that represents pairs of related values. The input value x appears in the first row or column, and the output value y appears in the second. The $x \rightarrow y$ table at right contains input and output pairs for the equation $y = x^2 - 3$.

x	y
-3	6
-2	1
-1	-2
0	-3
1	-2
2	1

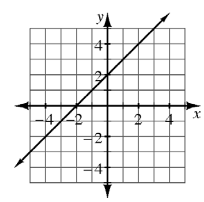
***y*-axis** The vertical number line on a coordinate graph. See *axes*.

***y*-coordinate** In an ordered pair, (x, y), which represents a point in the coordinate plane, y is the value of the y-coordinate. That is, the y-coordinate is the vertical distance from the x-axis that is needed to plot the point.

$y = mx + b$ When two quantities x and y have a linear relationship, that relationship can be represented with an equation in $y = mx + b$ form. The parameter m is the slope, and b is the y-intercept of the graph. For example, the graph at right shows the line represented by the equation $y = 2x + 3$, which has a slope of 2 and a y-intercept of 3. This form of a linear equation is also called the slope-intercept form.



***y*-intercept(s)** The point(s) where a graph intersects the y-axis. A function has at most one y-intercept; a relationship may have several. The y-intercept of a graph is important because it often represents the starting value of a quantity in a real-world situation. For example, on the graph of a tile pattern the y-intercept represents the number of tiles in Figure 0. We sometimes report the y-intercept of a graph with a coordinate pair, but since the x-coordinate is always zero, we often just give the y-coordinate of the y-intercept. For example, we might say that the y-intercept of the graph at right is $(0, 2)$, or we might just say that the y-intercept is 2. When a linear equation is written in $y = mx + b$ form, b tells us the y-intercept of the graph. For example, the equation of the graph at right is $y = x + 2$ and its y-intercept is 2. In two dimensions, the coordinates of the y-intercept are $(0, y)$. See *intercepts*. (p. 269)



zero factorial Zero factorial is defined to be 1, that is, $0! = 1$. (p. 664)

zero power The result of raising any number (except zero) to the zero power is 1. $x^0 = 1$ for any number $x \neq 0$.

Zero Product Property When the product of two or more factors is zero, at least one of the factors must equal zero. That is, if $a \cdot b = 0$, then either $a = 0$ or $b = 0$ (or both). This property is used to solve equations in factored form. For example, given the equation $(x - 4)(x + 5) = 0$, $x - 4 = 0$ or $x + 5 = 0$ (or both). You can see that $x = 4$ and $x = -5$ are solutions and that they are the only possible solutions because there are no other numbers that make either factor zero. The Zero Product Property can be used to solve factorable quadratic equations. (p. 275)

zeros of a function See *roots (of a polynomial function)*. (p. 269)