

Chapter P Prerequisites

Section P.1 Real Numbers

**Real numbers** The set of numbers formed by joining the set of rational numbers and the set of irrational numbers.

**Real number line** A line used to graphically represent the set of real numbers.

**Inequality** A statement that represents an order relationship.

**Absolute value** The magnitude or distance between the origin and the point representing a real number on the real number

Section P.2 Solving Equations

**Equation** A statement, usually involving  $x$ , that two algebraic expressions are equal.

**Extraneous solution** A solution that does not satisfy the original equation.

**Quadratic equation** An equation in  $x$  that can be written in the general form  $ax^2 + bx + c = 0$  where  $a$ ,  $b$ , and  $c$  are real numbers with  $a \neq 0$ .

Section P.3 The Cartesian Plane and Graphs of Equations

**Rectangular coordinate system** A plane (Cartesian plane) used to graphically represent ordered pairs of real numbers.

**Ordered pair** Two real numbers  $x$  and  $y$ , written  $(x, y)$ , which represent a point in the Cartesian plane.

**Graph of an equation** The set of all points that are solutions of the equation.

**Intercepts** The points at which a graph intersects the  $x$ - or  $y$ -axis.

**Symmetry** If a graph is folded along a dividing line and the portion of the graph on one side of the dividing line coincides with the portion of the graph on the other side of the dividing line, then the graph is said to have symmetry.

Section P.4 Linear Equations in Two Variables

**Slope** The number of units a nonvertical line rises (or falls) vertically for each unit of horizontal change from left to right.

**Parallel** Two distinct nonvertical lines are parallel if and only if their slopes are equal. That is,  $m_1 = m_2$ .

**Perpendicular** Two nonvertical lines are perpendicular if and only if their slopes are negative reciprocals of each other. That is,  $m_1 = -1/m_2$ .

Section P.5 Functions

**Function** A function  $f$  from a set  $A$  to a set  $B$  is a relation that assigns to each element  $x$  in the set  $A$  exactly one element  $y$  in the set  $B$ .

**Domain** The set of inputs of the function  $f$ .

**Range** The set of all outputs for the given set of inputs of the function  $f$ .

**Independent variable** A variable in an equation that represents a function that can take on any value for which the function is defined.

**Dependent variable** A variable in an equation that represents a function whose value depends on the value of the independent variable.

Section P.6 Analyzing Graphs of Functions

**Even function** A function  $y = f(x)$  is even if, for each  $x$  in the domain of  $f$ ,  $f(-x) = f(x)$ .

**Odd function** A function  $y = f(x)$  is odd if, for each  $x$  in the domain of  $f$ ,  $f(-x) = -f(x)$ .

Section P.7 Shifting, Reflecting, and Stretching Graphs

Section P.8 Combinations of Functions

**Arithmetic combination of functions** Two or more functions combined by the operations of addition, subtraction, multiplication, or division.

**Composition of functions** The composition of the function  $f$  with the function  $g$  is  $(f \circ g)(x) = f(g(x))$ .

Section P.9 Inverse Functions

**Inverse** Let  $f$  and  $g$  be two functions. If  $f(g(x)) = x$  for every  $x$  in the domain of  $g$  and  $g(f(x)) = x$  for every  $x$  in the domain of  $f$ , then  $g$  is the inverse of the function  $f$ . The function  $g$  is denoted by  $f^{-1}$ .

**Horizontal Line Test** A function  $f$  has an inverse if and only if no horizontal line intersects the graph of  $f$  at more than one point.

Chapter 1 Trigonometry

Section 1.1 Radian and Degree Measure

**Trigonometry** The Greek word for “measurement of triangles.”

**Central angle** of a circle An angle whose vertex is the center of the circle.

**Complementary angles** Two positive angles whose sum is  $\pi/2$  radians or  $90^\circ$ .

**Supplementary angles** Two positive angles whose sum is  $\pi$  radians or  $180^\circ$ .

**Degree** The most common unit of angle measure, denoted by the symbol  $^\circ$ . A measure of one degree ( $1^\circ$ ) is equivalent to a rotation of  $1/360$  of a complete revolution about the vertex of an angle.

Section 1.2 Trigonometric Functions: The Unit Circle

**Unit circle** A circle of radius 1 centered at the origin and given by the equation  $x^2 + y^2 = 1$ . The basis for one of the perspectives of trigonometry.

**Period** A function  $f$  is periodic if there exists a positive real number  $c$  such that  $f(t + c) = f(t)$  for all  $t$  in the domain of  $f$ . The smallest number  $c$  for which  $f$  is periodic is called the period of  $f$ .

Section 1.3 Right Triangle Trigonometry

Section 1.4 Trigonometric Functions of Any Angle

**Reference angles** Let  $\theta$  be an angle in standard position. Its reference angle is the acute angle  $\theta'$  formed by the terminal side of  $\theta$  and the horizontal axis.

Section 1.5 Graphs of Sine and Cosine Functions

**Sine curve** The graph of the sine function.

**One cycle** of a trigonometric function. This means the same as one period of the function.

**Amplitude** Represents half the distance between the maximum and minimum values of  $y = a \sin x$  or  $y = a \cos x$  and is given by amplitude =  $|a|$ .

**Phase shift** The amount  $c/b$  by which the graph of  $y = a \sin bx$  is shifted to obtain the graph of  $y = a \sin(bx - c)$ .

Section 1.6 Graphs of Other Trigonometric Functions

**Damping factor** When a trigonometric function is multiplied by another function, this other function is called the damping factor.

Section 1.7 Inverse Trigonometric Functions

Section 1.8 Applications and Models

**Angle of elevation** The angle from the horizontal upward to an object.

**Angle of depression** The angle from the horizontal downward to an object.

**Bearings** A measure giving the acute angle a path or line of sight makes with a fixed north-south line. Used to give directions in surveying and navigation.

**Simple harmonic motion** The vibration, oscillation, or rotation of an object under ideal conditions such that the object's uniform and regular motion can be described by a sine or cosine function.

Chapter 2 Analytic Trigonometry

Section 2.1 Using Fundamental Identities

Section 2.2 Verifying Trigonometric Identities

Section 2.3 Solving Trigonometric Equations

Section 2.4 Sum and Difference Formulas

Section 2.5 Multiple-Angle and Product-to-Sum Formulas

**Chapter 3 Additional Topics in Trigonometry**

Section 3.1 Law of Sines

**Oblique triangle** A triangle that has no right angles.

Section 3.2 Law of Cosines

Section 3.3 Vectors in the Plane

**Vector  $\mathbf{v}$  in the plane** The set of all directed line segments that are equivalent to given directed line segment  $PQ$ , written  $\mathbf{v} = PQ$ .

**Standard position** The representative of a set of equivalent directed line segments whose initial point is the origin.

**Zero vector** A vector whose initial point and terminal point both lie at the origin; denoted by  $\mathbf{0} = \langle 0, 0 \rangle$ .

**Unit vector** A vector  $\mathbf{v}$  such that  $\|\mathbf{v}\| = 1$ .

**Standard unit vectors** The unit vectors  $\langle 1, 0 \rangle$  and  $\langle 0, 1 \rangle$ , denoted by  $\mathbf{i} = \langle 1, 0 \rangle$  and  $\mathbf{j} = \langle 0, 1 \rangle$ , which can be used to represent any vector  $\mathbf{v} = \langle v_1, v_2 \rangle$ .

**Direction angle** The angle (measured counterclockwise) that a unit vector makes with the positive  $x$ -axis.

Chapter 4 Complex Numbers

Section 4.1 Complex Numbers

**Complex numbers** The set of numbers obtained by adding real number to real multiples of the imaginary unit  $i$ .

**Complex conjugates** A pair of complex numbers of the form  $a + bi$  and  $a - bi$ .

Section 4.2 Complex Solutions of Equations

Section 4.3 Trigonometric Form of a Complex Number

**Real axis** The horizontal axis in the complex plane.

**Imaginary axis** The vertical axis in the complex plane.

**Absolute value of a complex number  $a + bi$**  The distance between the origin  $(0, 0)$  and the point  $(a, b)$ .

Section 4.4 DeMoivre's Theorem

**$n$ th roots of unity** The  $n$  distinct  $n$ th roots of 1.

## Chapter 5 Exponential and Logarithmic Functions

Section 5.1 Exponential Functions and Their Graphs

**Algebraic functions** Functions of  $x$  that can be expressed as a finite number of sums, differences, multiples, quotients, powers and roots.

**Transcendental functions** Functions that are not algebraic.

**Natural base  $e$**  The irrational number  $e \approx 2.718281828 \dots$ .

**Continuous compounding** Increasing the number of compoundings in the compound interest formula without bound leads to continuous compounding, which is given by the formula  $A = Pe^{rt}$ .

Section 5.2 Logarithmic Functions and Their Graphs

**Common logarithmic function** The logarithmic function with base 10.

**Natural logarithmic function** The logarithmic function with base  $e$  given by  $f(x) = \ln x, x > 0$ .

Section 5.3 Properties of Logarithms

Section 5.4 Exponential and Logarithmic Equations

Section 5.5 Exponential and Logarithmic Models

**Bell-shaped curve** The graph of a Gaussian model.

**Logistic curve** A model for describing populations initially having rapid growth followed by a declining rate of growth.

**Sigmoidal curve** Another name for a logistic growth curve.

## Chapter 6 Topics in Analytic Geometry

Section 6.1 Lines

**Inclination** (of a nonhorizontal line) The positive angle  $\theta$  (less than  $\pi$ ) measured counterclockwise from the  $x$ -axis to the line.

**Angle between two lines** The smaller angle of the two pairs of opposite angles (one acute and one obtuse) formed by the intersection of two distinct lines in a plane.

Section 6.2 Introduction to Conics: Parabolas

**Directrix** A fixed line in the plane from which each point on a parabola is the same distance as the distance from the point to a fixed point in the plane.

**Focus** A fixed point in the plane from which each point on a parabola is the same distance as the distance from the point to a fixed line in the plane.

**Focal chord** A line segment that passes through the focus of a parabola and has endpoints on the parabola.

**Latus rectum** The specific focal chord perpendicular to the axis of a parabola.

**Tangent** A line is tangent to a parabola at a point on the parabola if the line intersects, but does not cross, the parabola at the point.

Section 6.3 Ellipses

**Foci** Distinct fixed points in the plane such that the sum of the distances from each point on an ellipse is constant.

**Vertices** Points of intersection of an ellipse and the line through its foci.

**Major axis** The chord connecting the vertices of an ellipse.

**Center** The midpoint of the major axis of an ellipse.

**Minor axis** The chord perpendicular to the major axis at the center of an ellipse.

Section 6.4 Hyperbolas

**Branches** The two disconnected parts of the graph of a hyperbola.

**Transverse axis** The line segment connecting the vertices of a hyperbola.

**Conjugate axis** The line segment in a hyperbola of length  $2b$  joining  $(0, b)$  and  $(0, -b)$  [or  $(-b, 0)$  and  $(b, 0)$ ].

Section 6.5          Rotation of Conics

**Invariant under rotation** A term or quantity in the equation of a conic that remains the same during a rotation of the coordinate axes through an angle  $\theta$ .

**Discriminant** The quantity  $B^2 - 4AC$ , of the general conic equation  $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$ , which can be used to classify the type of conic.

Section 6.6          Parametric Equations

**Parameter** A third variable introduced to represent a curve in the plane.

Section 6.7          Polar Coordinates

Section 6.8          Graphs of Polar Equations

Section 6.9          Polar Equations of Conics