



PRE-CALCULUS Learning Objectives



TRIGONOMETRY

The learner will

- ☑ understand the notion of angle and how to measure it, in both degrees and radians.
- ☑ convert between degrees and radians.
- ☑ know the definition of sine and cosine as y- and x-coordinates of points on the unit circle and be familiar with the graphs of the sine and cosine functions.
- ☑ know the identity $\cos^2(x) + \sin^2(x) = 1$.
- ☑ prove that this identity is equivalent to the Pythagorean theorem (i.e., students can prove this identity by using the Pythagorean theorem and, conversely, they can prove the Pythagorean theorem as a consequence of this identity).
- ☑ prove other trigonometric identities and simplify others by using the identity $\cos^2(x) + \sin^2(x) = 1$. For example, students use this identity to prove that $\sec^2(x) = \tan^2(x) + 1$.
- ☑ graph functions of the form $f(t) = A \sin(Bt + C)$ or $f(t) = A \cos(Bt + C)$ and interpret A, B and C in terms of amplitude, frequency, period and phase shift.
- ☑ know the definitions of the tangent and cotangent functions and graph them.
- ☑ know the definitions of the secant and cosecant functions and graph them.
- ☑ know that the tangent of the angle that a line makes with the x-axis is equal to the slope of the line.
- ☑ know the definitions of the inverse trigonometric functions and graph the functions.
- ☑ compute, by hand, the values of the trigonometric functions and the inverse trigonometric functions at various standard points.
- ☑ demonstrate an understanding of the addition formulas for sines and cosines and their proofs and use those formulas to prove and/or simplify other trigonometric identities.
- ☑ demonstrate an understanding of half-angle and double-angle formulas for sines and cosines and use those formulas to prove and/or simplify other trigonometric identities.
- ☑ use trigonometry to determine unknown sides or angles in right triangles.
- ☑ know the law of sines and the law of cosines and apply those laws to solve problems.
- ☑ determine the area of a triangle, given one angle and the two adjacent sides.
- ☑ be familiar with polar coordinates.
- ☑ determine polar coordinates of a point given in rectangular coordinates and vice versa.
- ☑ represent equations given in rectangular coordinates in terms of polar coordinates.
- ☑ be familiar with complex numbers.
- ☑ represent a complex number in polar form and know how to multiply complex numbers in their polar form.
- ☑ know DeMoivre's theorem and give nth roots of a complex number given in polar form.
- ☑ be adept at using trigonometry in a variety of applications and word problems.

ALGEBRA

The learner will

- ☑ prove simple laws of logarithms.
- ☑ understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- ☑ judge the validity of an argument according to whether the properties of real numbers, exponents and logarithms have been applied correctly at each step.
- ☑ use the definition of logarithms to translate between logarithms in any base.
- ☑ understand and use the properties of logarithms to simplify logarithmic numeric expressions and identify their approximate values.



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MATHEMATICAL ANALYSIS

The learner will

- ☑ be familiar with and apply polar coordinates and vectors in the plane. In particular, they can translate between polar and rectangular coordinates and can interpret polar coordinates and vectors graphically.
- ☑ be adept at the arithmetic of complex numbers.
- ☑ use the trigonometric form of complex numbers and understand that a function of a complex variable can be viewed as a function of two real variables.
- ☑ know the proof of DeMoivre's theorem.
- ☑ give proofs of various formulas by using the technique of mathematical induction.
- ☑ know the statement of and apply the fundamental theorem of algebra.
- ☑ be familiar with conic sections, both analytically and geometrically.
- ☑ take a quadratic equation in two variables; put it in standard form by completing the square and using rotations and translations, if necessary; determine what type of conic section the equation represents and determine its geometric components (foci, asymptotes, etc.).
- ☑ take a geometric description of a conic section - for example, the locus of points whose sum of its distances from $(1, 0)$ and $(-1, 0)$ is 6 - and derive a quadratic equation representing it.
- ☑ find the roots and poles of a rational function and graph the function and locate its asymptotes.
- ☑ demonstrate an understanding of functions and equations defined parametrically and graph them.
- ☑ be familiar with the notion of the limit of a sequence and the limit of a function as the independent variable approaches a number or infinity.
- ☑ determine whether certain sequences converge or diverge.

LINEAR ALGEBRA

The learner will

- ☑ perform addition and subtraction on vectors, multiply vectors by scalars.
- ☑ demonstrate an understanding that linear systems are inconsistent (have no solutions), have exactly one solution or have infinitely many solutions.
- ☑ demonstrate an understanding of the geometric interpretation of vectors and vector addition (by means of parallelograms) in the plane and in three-dimensional space.
- ☑ interpret geometrically the solution sets of systems of equations - for example, the solution set of a single linear equation in two variables is interpreted as a line in the plane, and the solution set of a two-by-two system is interpreted as the intersection of a pair of lines in the plane.
- ☑ compute the determinants of 2×2 and 3×3 matrices and be familiar with their geometric interpretations as the area and volume of the parallelepipeds spanned by the images under the matrices of the standard basis vectors in two-dimensional and three-dimensional spaces.
- ☑ compute the scalar (dot) product of two vectors in n -dimensional space and know that perpendicular vectors have zero dot product.

RESOURCES

Prentice-Hall Pre-Calculus (2005 ed.)

Internet research, applications and modeling.

PASCO measurement devices, laboratory investigations and supplemental materials.