

Texas Essential Knowledge and Skills

Precalculus

Introduction.

- (1) In Precalculus, students continue to build on the K-8, Algebra I, Algebra II, and Geometry foundations as they expand their understanding through other mathematical experiences. Students use symbolic reasoning and analytical methods to represent mathematical situations, to express generalizations, and to study mathematical concepts and the relationships among them. Students use functions, equations, and limits as useful tools for expressing generalizations and as means for analyzing and understanding a broad variety of mathematical relationships. Students also use functions as well as symbolic reasoning to represent and connect ideas in geometry, probability, statistics, trigonometry, and calculus and to model physical situations. Students use a variety of representations (concrete, pictorial, numerical, symbolic, graphical, and verbal), tools, and technology (including, but not limited to, calculators with graphing capabilities, data collection devices, and computers) to model functions and equations and solve real-life problems.
- (2) As students do mathematics, they continually use problem-solving, language and communication, connections within and outside mathematics, and reasoning (justification and proof). Students also use multiple representations, technology, applications and modeling, and numerical fluency in problem-solving contexts.

Knowledge and skills.

(P.1) The student defines functions, describes characteristics of functions, and translates among verbal, numerical, graphical, and symbolic representations of functions, including polynomial, rational, power (including radical), exponential, logarithmic, trigonometric, and piecewise-defined functions.

The student is expected to:

- (A) describe parent functions symbolically and graphically, including $f(x) = x^n$, $f(x) = \ln x$, $f(x) = \log_a x$, $f(x) = 1/x$, $f(x) = e^x$, $f(x) = |x|$, $f(x) = a^x$, $f(x) = \sin x$, $f(x) = \arcsin x$, etc.;
- (B) determine the domain and range of functions using graphs, tables, and symbols;
- (C) describe symmetry of graphs of even and odd functions;

- (D) recognize and use connections among significant values of a function (zeros, maximum values, minimum values, etc.), points on the graph of a function, and the symbolic representation of a function; and
- (E) investigate the concepts of continuity, end behavior, asymptotes, and limits and connect these characteristics to functions represented graphically and numerically.

(P.2) The student interprets the meaning of the symbolic representations of functions and operations on functions to solve meaningful problems.

The student is expected to:

- (A) apply basic transformations, including $a \cdot f(x)$, $f(x) + d$, $f(x - c)$, $f(b \cdot x)$, and compositions with absolute value functions, including $|f(x)|$, and $f(|x|)$, to the parent functions;
- (B) perform operations including composition on functions, find inverses, and describe these procedures and results verbally, numerically, symbolically, and graphically; and
- (C) investigate identities graphically and verify them symbolically, including logarithmic properties, trigonometric identities, and exponential properties.

(P.3) The student uses functions and their properties, tools and technology, to model and solve meaningful problems.

The student is expected to:

- (A) investigate properties of trigonometric and polynomial functions;
- (B) use functions such as logarithmic, exponential, trigonometric, polynomial, etc. to model real-life data;
- (C) use regression to determine the appropriateness of a linear function to model real-life data (including using technology to determine the correlation coefficient);
- (D) use properties of functions to analyze and solve problems and make predictions; and
- (E) solve problems from physical situations using trigonometry, including the use of Law of Sines, Law of Cosines, and area formulas and incorporate radian measure where needed.

(P.4) The student uses sequences and series as well as tools and technology to represent, analyze, and solve real-life problems.

The student is expected to:

- (A) represent patterns using arithmetic and geometric sequences and series;

- (B) use arithmetic, geometric, and other sequences and series to solve real-life problems;
- (C) describe limits of sequences and apply their properties to investigate convergent and divergent series; and
- (D) apply sequences and series to solve problems including sums and binomial expansion.

(P.5) The student uses conic sections, their properties, and parametric representations, as well as tools and technology, to model physical situations.

The student is expected to:

- (A) use conic sections to model motion, such as the graph of velocity vs. position of a pendulum and motions of planets;
- (B) use properties of conic sections to describe physical phenomena such as the reflective properties of light and sound;
- (C) convert between parametric and rectangular forms of functions and equations to graph them; and
- (D) use parametric functions to simulate problems involving motion.

(P.6) The student uses vectors to model physical situations.

The student is expected to:

- (A) use the concept of vectors to model situations defined by magnitude and direction; and
- (B) analyze and solve vector problems generated by real-life situations.