

# COLLEGE ALGEBRA

College Algebra is the study of procedures necessary for proving algebraic statements by direct proof, indirect proof, and induction, and for solving algebraic problems involving complex numbers, expressions, equations, inequalities, graphs, logarithms, variations, matrices, progressions, or probabilities.

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## 1.0 Proof and Fundamental Concepts:

## PA Standards

Students structure valid proofs. They operate with complex numbers in rectangular and polar form, manipulate polynomials, and solve and graph polynomial equations.

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| 1.1 | Know the logical structure of algebra and prove algebraic statements by direct proof, indirect proof, and mathematical induction.                          | 2.4.11.A |
| 1.2 | Know the complex number system and add, subtract, multiply, divide, raise to a power, and extract roots of complex numbers in rectangular and polar forms. |          |
| 1.3 | Add, subtract, multiply, and divide polynomials and polynomial fractions and factor polynomials.   |          |
| 1.4 | Know and apply the laws of exponents.  |          |
| 1.5 | Graph and solve polynomial equations.  |          |

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## 2.0 Systems of Linear Equations and Matrices:

Students solve linear systems using a variety of methods, including matrices. They understand the connection between algebraic and geometric representations. Students apply systems of equations to solve linear programming problems.

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| 2.1 | Solve linear systems of equations in any number of variables by using the methods of elimination by addition, substitution, and Cramer's Rule. | 2.8.11.H    |
| 2.2 | Interpret and solve linear systems as coefficient matrices using row operations.   | 2.8.11.D, G |
| 2.3 | Reduce rectangular matrices to row echelon form.   | 2.8.11.I    |
| 2.4 | Perform addition and subtraction on matrices.  | 2.8.11.I    |

## PA Standards

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| 2.5  | Perform matrix multiplication and multiply matrices and scalars.   | 2.8.11.I |
| 2.6  | Demonstrate an understanding that linear systems are inconsistent (have no solutions), consistent (have exactly one solution), or dependent (have infinitely many solutions).  | 2.8.11.F |
| 2.7  | 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. | 2.8.11.J |
| 2.8  | Demonstrate an understanding of the inverse to a square matrix and apply that concept to solve systems of linear equations.  |          |
| 2.9  | Apply systems of equations to solve linear programming problems (e.g., system of restraints, objective function).  | 2.4.11.E |
| 2.10 | Compute the determinants of $2 \times 2$ and $3 \times 3$ matrices and interpret them geometrically.   |          |
| 2.11 | Know that a square matrix is invertible if, and only if, its determinant is non-zero, and compute the inverse to $2 \times 2$ and $3 \times 3$ matrices.   |          |

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### 3.0 Higher Degree and Special Equations:

Students use exponential and logarithmic functions. They investigate binomial expansions using a variety of methods. They solve problems involving variation and study conic sections.

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| 3.1 | Graph and interpret exponential and logarithmic functions.   | 2.8.11.S;<br>2.11.11.C |
| 3.2 | Determine sums of finite sequences of numbers and calculate the $n$ th term of infinite arithmetic and geometric series.       | 2.11.11.D              |
| 3.3 | Explore the connection between Pascal's Triangle and the coefficients of terms in a binomial expansion.                        |                        |
| 3.4 | Solve problems involving the expansion of binomials using the binomial theorem.  |                        |
| 3.5 | Determine roots and bounds of higher degree polynomials by applying the Factor Remainder Theorem and Descartes' Rule of Signs. |                        |

**PA Standards**

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| 3.6  | Solve problems of direct, inverse, joint, and combined variation.   | 2.4.11.E |
| 3.7  | Know the difference between combinations and permutations.  | 2.7.8.A  |
| 3.8  | Define and solve problems involving the principles of permutations and combinations, such as determining term coefficients in a binomial expansion. |          |
| 3.9  | Apply the counting principle of probability.  | 2.7.11.A |
| 3.10 | Identify, explore, and graph equations of conic sections.   | 2.9.11.G |

