

# ALGEBRA II

## PURPOSE:

Students will analyze, graph, and apply properties for the following functions: quadratic exponential, logarithmic, polynomial, and trigonometric. Students will also perform operations on matrices and solve matrix equations.

## BENCHMARKS AND INDICATORS:

### Number Sense

1.2 Demonstrates an understanding of the real number system; recognizes, applies, and explains their properties, and extends these properties to algebraic expressions

- **\*AII12K3a-e names, uses, and describes these properties with the real number system and demonstrates their meaning including the use of concrete objects**
  - a. commutative ( $a + b = b + a$  and  $ab = ba$ ), associative [ $a + (b + c) = (a + b) + c$  and  $a(bc) = (ab)c$ ], distributive [ $a(b + c) = ab + ac$ ], and substitution properties (if  $a = 2$ , then  $3a = 3 \times 2 = 6$ );
  - b. identity properties for addition and multiplication and inverse properties of addition and multiplication (additive identity:  $a + 0 = a$ , multiplicative identity:  $a \cdot 1 = a$ , additive inverse:  $+5 + -5 = 0$ , multiplicative inverse:  $8 \times 1/8 = 1$ );
  - a. symmetric property of equality (if  $a = b$ , then  $b = a$ );
  - b. addition and multiplication properties of equality (if  $a = b$ , then  $a + c = b + c$  and if  $a = b$ , then  $ac = bc$ ) and inequalities (if  $a > b$ , then  $a + c > b + c$  and if  $a > b$ , and  $c > 0$  then  $ac > bc$ );
  - e. zero product property (if  $ab = 0$ , then  $a = 0$  and/or  $b = 0$ )

1.3 Uses computational estimation with real numbers

- **\*AII13A1 adjusts original rational number estimate of a real-world problem based on additional information (a frame of reference) e.g., estimate how long it takes to walk from here to there; time how long it takes to take five steps and adjust your estimate (must be able to set up a proportion to solve these problems)**

1.4 Models, performs, and explains computation with real numbers and polynomials

- **\*AII14A1a,b,d generates and/or solves multi-step real-world problems with real number and algebraic expressions using computational procedures (addition, subtraction, multiplication, division, roots, and powers including logarithms), and mathematical concepts with**
  - a. applications from business, chemistry, and physics that involve addition, subtraction, multiplication, division, squares, and square roots when the formula are given as part of the problem and variables are defined, e.g., given  $F = ma$ , where  $F =$  force in newtons,  $m =$  mass in kilograms,  $a =$  acceleration in meters per second squared. Find the acceleration if a force of 20 newtons is applied to a mass of 3 kilograms.
  - b. volume and surface area given the measurement formulas of rectangular solids and cylinders e.g., a silo has a diameter of 8 feet and a height of 20 feet. How many cubic feet of grain can it store?

d. application of percents (2.4.A1a), e.g., given the formula  $A = P(1 + \frac{r}{n})^{nt}$ , A = amount, P= principal, r = annual interest, n compounding periods per year, t = number of years. If \$1,000 is placed in a savings account with a 6% annual interest rate and is compounded semiannually, how much money will be in the account at the end of 2 years? (could be percent increase or decrease problems)

- AII142f Simplify algebraic monomial expressions using the laws of exponents including negative and fractional exponents
- AII142gSimplify logarithmic expressions using the laws of logarithms
- AII142hSolves real life problems involving exponential growth and decay
- AII142i Computes the following operations with matrices:addition, scalar multiplication, multiplication.
- AII142j Find the inverse of a matrix
- AII14K operations with functions

## Algebra

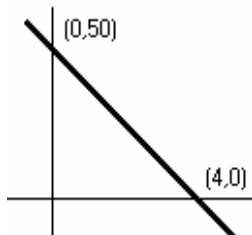
2.2 Uses variables, symbols, real numbers, and algebraic expressions to solve equations and inequalities in variety of situations

- **N\*AI22K3c Solves systems of linear equations with two unknowns using real coefficients and constants;**
- **N\*AI22A2a linear equations and inequalities both analytically and graphically, e.g., tickets for a school play are \$5 for adults and \$3 for students. You need to sell at least \$65 in tickets. Give an inequality and a graph that represents this situation and three possible solutions**
- AII22K3b Solves quadratic equations by taking the square root of both sides, factoring, and using the quadratic formula including complex solutions
- AII22K3a Solves difficult linear equations and inequalities( including compound) involving multiple terms with fraction and decimal coefficients with all types of solutions
- AII22K3f solves absolute value equations and inequalities
- AII22K3h solves multivariable equations for any one variable
- AII22K3i solves logarithmic and exponential equations (including natural logarithms)

2.3 Analyzes functions .

- **\*AI23K6 recognizes how changes in the constant and/or slope within a linear function changes the appearance of a graph**
- **\*AI23A2 interprets the meaning of the x- and y- intercepts, slope, and/or points on and off the line on a graph in the context of a real-world situation, e.g., the graph below represents a tank full of water being emptied. What does the y-intercept represent? What does the x-intercept represent? What is the rate at which it is emptying? What does the point (2, 25) represent in this situation? What does the point (2,30) represent in this situation?**

The Water Tank x axis=hours y axis = gallons



- AII23K2 Matches names, equations, and graphs for the following functions: quadratic, absolute value, reciprocal, logarithmic, exponential: and determines x- and y- intercepts, vertex, axis of symmetry, ect.
- AII23K3 Determine if a relation (given in any format) is a function
- AII23K5 Identify domain and range for a relation (given in many formats)
- AII23K7 Uses function notation
- AII23K8 Performs operation with functions (review squaring a binomial)

## 2.5 Graph and analyze polynomials

- AII25K1 Factor cubics in the form  $x^3 + y^3$  and  $x^3 - y^3$
- AII25K2 Uses synthetic division to factor polynomials
- AII25K3 Names and classifies polynomials
- AII25K4 Graph polynomials (frozen curves)

## Geometry

### 3.1 Recognizes geometric figures and compares and justifies their properties of geometric figures

- **\*AII31A1a applying the Pythagorean Theorem, e.g., when checking for square corners on concrete forms for a foundation, determine if a right angle is formed by using the Pythagorean Theorem;**

### 3.3 Recognizes and applies transformations on two- and three-dimensional figures

- **\*AII33A1 analyzes the impact of transformations on the perimeter and area of circles, rectangles, and triangles and volume of rectangular prisms and cylinders (2.4.A1f), e.g., reducing by a factor of  $\frac{1}{2}$  multiplies an area by a factor of  $\frac{1}{4}$  and multiplies the volume by a factor of  $\frac{1}{8}$ , whereas, rotating a geometric figure does not change perimeter or area**
- AII33A4 Analyzes and explains transformations on a function given an equation: absolute value, quadratic, linear, exponential, logarithmic, reciprocal, and square root

### 3.4 Uses an algebraic perspective to analyze the geometry of two- and three-dimensional figures

- **\*AII34K4 finds and explains the relationship between the slopes of parallel and perpendicular lines (2.4.K1f), e.g., the equation of a line  $2x + 3y = 12$ . The slope of this line is  $-\frac{2}{3}$ . What is the slope of a line perpendicular to this line?**
- **\*AII34K6 recognizes the equation of a line and transforms the equation into slope-intercept form in order to identify the slope and y-intercept and uses this information to graph the line**

### 3.5 Uses trigonometry to find missing parts for any triangle on or off the coordinate plane

- AII35K1 Uses trigonometric ratios, law of cosines, law of sines, to find the missing parts of triangles
- AII35K2 Convert degrees to radians and vice versa
- NAII35K3 Uses special triangles to find trig ratios and angle measures on the coordinate plane
- NAII35K4 Uses the unit circle to find trig ratios for the quadrantal angles and vice versa

## Data

4.1 Applies probability theory to draw conclusions, generate convincing arguments, make predictions and decisions, and analyze decisions including the use of concrete objects in a variety of situation

- **\*AII41K3 explains the relationship between probability and odds and computes one given the other**

4.2 Collects, organizes, displays, explains, and interprets numerical (rational) and non-numerical data sets

- **AII42K4 explains the effects of outliers on the measures of central tendency (mean, median, mode) and range and interquartile range of a real number data set**
- **\*AII42K5 approximates a line of best fit given a scatter plot and makes predictions using the graph or the equation of that line**
- **\*AII42A1a-h uses data analysis (mean, median, mode, range, quartile, interquartile range) in real-world problems with rational number data sets to compare and contrast two sets of data, to make accurate inferences and predictions, to analyze decisions, and to develop convincing arguments from these data displays**
  - a. frequency tables and line plots;**
  - b. bar, line, and circle graphs;**
  - c. Venn diagrams or other pictorial displays;**
  - d. charts and tables;**
  - e. stem-and-leaf plots (single and double);**
  - f. scatter plots**
  - g. box-and-whiskers plots;**
  - h. histograms**