**Grade 9-12 Unpacked Advanced Math Standards – Algebra**

**9-12.A.1.1.A.** Students are able to write equivalent forms of rational algebraic expressions using properties of real numbers.

**Webb Level: 1**
**Bloom: Application**

**Verbs Defined:**
Write: determine
Using: applying

**Key terms defined:**
Equivalent forms: Having the same value when evaluated.
Rational algebraic expressions: A ratio of two or more algebraic expressions. It is not an equation.
Properties of real numbers: A set of mathematical rules or laws that results in an equivalent expression.

**Teacher Speak:**
Students are able to write (determine) equivalent forms of rational algebraic expressions by using (applying) properties of real numbers.

**Student Speak:**
- I can apply (use) the laws of exponents to simplify algebraic expressions.
- I can apply (use) the order of operations to simplify algebraic expressions.
- I can add, subtract, multiply and divide rational expressions (A ratio of two or more algebraic expressions. It is not an equation).
- I can determine which polynomials are factorable over the set of integers.

---

**9-12.A.1.2.A**. Students are able to **extend** the use of real number properties to expressions involving complex numbers.

**Webb Level: 2**
**Bloom: Application**

**Verbs Defined:**
**Extend**: expand

**Key terms defined:**
Real number properties: A set of mathematical rules or laws that results in an equivalent expression.
Expression: A mathematical combination of numbers, variables, and operations. It is **not** an equation.

Complex numbers: A number of the form $a+bi$ where a and b are real numbers and $i = \sqrt{-1}$.

**Teacher Speak:**
Students are able to extend (expand) the use of real number properties to expressions involving complex numbers.

**Student Speak**
I can add, subtract, multiply and divide complex numbers (A number of the form $a+bi$ where a and b are real numbers and $i = \sqrt{-1}$).

---

**9-12.A.2.1.A**. Students are able to **determine** solutions of quadratic equations.

**Webb Level: 1**
**Bloom: Analysis**

**Verbs Defined:**
**Determine:** derive

**Key terms defined:**
Quadratic equation: an equation containing $x^2$, a polynomial of degree 2 such that it can be transformed into $ax^2 + bx + c = 0, a \neq 0$.

**Teacher Speak:**
Students are able to determine (derive) solutions of quadratic equations and equations in quadratic form.

**Student Speak:**
- I can solve quadratic equations (an equation containing $x^2$, a polynomial of degree 2 such that it can be transformed into $ax^2 + bx + c = 0, a \neq 0$) by:
    - Factoring
    - Completing the square
    - Using the quadratic formula
    - Graphing (using appropriate technology)
- I can determine the nature of the roots.
- I can solve equations that are in quadratic form. (the form $y = au^2 + bu + c$, where u is any expression in x, and a, b, and c are real numbers).

---

**9-12.A.2.2.A.** Students are able to **determine** the solution of systems of equations and systems of inequalities.

**Webb Level:** ½

**Bloom: Application**

**Verbs Defined:**
**Determine:** find

**Key terms defined:**
Solutions: value or values of the variable(s) that make the statement true
Systems of equations: two or more equations
Systems of inequalities: two or more inequalities

**Teacher Speak:**
Students are able to determine (find) the solution of systems of equations and systems of inequalities.

**Student Speak:**
- I can solve a system of linear equations (two or more equations) using
  - Substitution
  - Graphing
  - Elimination (linear combination)
  - Matrices
- I can solve a system (two or more equations) that contains both linear and non-linear equations.
- I can solve a system of inequalities (two or more inequalities) by graphing.

---

**9-12.A.2.3.A.** Students are able to **determine** solutions to absolute value statements.

**Webb Level: 1**
**Bloom: Application**

**Verbs Defined:**
**Determine**: find

**Key terms defined:**
Solutions: value or values of the variable(s) that make the statement true
Absolute value statement: an equation or inequality in which the absolute value contains the variable

**Teacher Speak:**
Students are able to determine (find) solutions to absolute value statements.

**Student Speak:**
- I can solve equations and inequalities containing an absolute value statement (an equation or inequality in which the absolute value contains the variable).

- I can graph the solutions (value or values of the variable(s) that make the statement true) to absolute value inequalities (an inequality in which the absolute value contains the variable).

---

**9-12.A.3.1.A**. Students are able to **distinguish** between linear, quadratic, inverse variation, and exponential models.

**Webb Level: 1/2**
**Bloom: Analysis**

**Verbs Defined:**
**Distinguish:** recognize, classify

**Key terms defined:**
Linear model: A representation of a problem that can be expressed as an equation in the form y = mx + b where m represents the constant rate of change, or slope, and b represents some fixed value, or the y-intercept.
Quadratic model: A representation of a problem that can be expressed as an equation containing $x^2$, a polynomial of degree 2 such that it can be transformed into $y = ax^2 + bx + c, a \neq 0$.

Inverse variation model: A representation of a problem that can be expressed as $y = \frac{k}{x^n}$, where n is any natural number .
Exponential model: A representation of a problem that can be expressed as $y = a \cdot b^x, a \neq 0 \ \& \ b \neq 1$. This also includes logarithmic models, $y = \log_a x, a > 0, a \neq 1$.
Model: A representation of a problem that uses tables, graphs, or equations.

**Teacher Speak:**
Students are able to distinguish (recognize, classify) between linear, quadratic, inverse variation, and exponential models.

**Student Speak:**
- I can classify models (tables, graphs, or equations) as:
  - Linear (A representation of a problem that can be expressed as an equation in the form y = mx + b where m represents the constant rate of change, or slope, and b represents some fixed value, or the y-intercept.)
  - Quadratic (A representation of a problem that can be expressed as an equation containing $x^2$, a polynomial of degree 2 such that it can be transformed into $y = ax^2 + bx + c, a \neq 0$.)

  - Inverse variation (A representation of a problem that can be expressed as $y = \frac{k}{x^n}$, where n is any natural number .)
  - Exponential (A representation of a problem that can be expressed as $y = a \cdot b^x$, $a \neq 0$ & $b \neq 1$. This also includes logarithmic models, $y = \log_a x, a > 0, a \neq 1$.)
- I can describe the similarities and differences between:
  - linear models (A representation of a problem that can be expressed as an equation in the form y = mx + b where m represents the constant rate of change, or slope, and b represents some fixed value, or the y-intercept.)
  - quadratic models (A representation of a problem that can be expressed as an equation containing $x^2$, a polynomial of degree 2 such that it can be transformed into $y = ax^2 + bx + c, a \neq 0$.)
  - inverse variation models (A representation of a problem that can be expressed as $y = \frac{k}{x^n}$, where n is any natural number ) and
  - exponential models (A representation of a problem that can be expressed as $y = a \cdot b^x$, $a \neq 0$ & $b \neq 1$. This also includes logarithmic models, $y = \log_a x, a > 0, a \neq 1$.)

---

**9-12.A.3.2.A.** Students are able to **create** <u>formulas</u> to **model** relationships that are <u>algebraic</u>, <u>geometric</u>, <u>trigonometric</u>, and <u>exponential</u>.

**Webb Level: 1/2**
**Bloom: Synthesis**

**Verbs Defined:**
**Create**: write.
**Model**: Represent

**Key terms defined:**
<u>Formulas</u>: Equations that can be applied to set of problems that have common parameter.
<u>Algebraic:</u> A relation that can be classified as linear, quadratic, cubic, quartic, absolute value, square root, rational or piecewise.
<u>Trigonometric</u>: A function that can be modeled with the six trigonometric functions.
<u>Exponential</u>: A representation of a problem that can be expressed as $y = a \cdot b^x$, $a \neq 0$ & $b \neq 1$. This also includes logarithmic models, $y = \log_a x, a > 0, a \neq 1$.
<u>Geometric</u>: All of the conic sections: circles, parabolas, hyperbolas and ellipses.

**Teacher Speak:**
Students are able to create (write) equations to model (represent) relationships that are algebraic, geometric, trigonometric, and exponential.

**Student Speak:**

- I can classify information portrayed in graphs and/or tables as:
  - algebraic (A relation that can be classified as linear, quadratic, cubic, quartic, absolute value, piecewise, square root, or rational.)
  - geometric (All of the conic sections: circles, parabolas, hyperbolas and ellipses.)
  - trigonometric (A function that can be modeled with the six trigonometric functions.)
  - exponential (A representation of a problem that can be expressed as $y = a \cdot b^x,\ a \neq 0\ \&\ b \neq 1$. This also includes logarithmic models, $y = \log_a x,\ a > 0,\ a \neq 1$.)
- once I determine (or am given) the type of relationship, I can write the equation.

---

**9-12.A.3.3.A**. Students are able to **use** <u>sequences</u> and <u>series</u> to **model** relationships.

**Webb Level: 2**
**Bloom: Analysis**

**Verbs Defined:**
**Use:** apply
**Model:** show or write

**Key terms defined:**
<u>Sequences:</u> A function whose domain is the set of consecutive natural numbers and whose range is an ordered list of numbers.
<u>Series</u>: Sum of the terms in a finite or infinite sequence.

**Teacher Speak:**
Students are able to use (apply) sequences and series to model (show or write) relationships.

**Student Speak:**

- I can use sequence (a function whose domain is the set of consecutive natural numbers and whose range is an ordered list of numbers) notation to write the terms of a sequence.
- I can use summation notation to write and find sums.
- I can find the sum of finite and infinite sequences (function whose domain is the set of consecutive natural numbers and whose range is an ordered list of numbers.)

- I can find the nth term of an arithmetic or geometric sequence (A function whose domain is the set of consecutive natural numbers and whose range is an ordered list of numbers).
- I can write the recursive and explicit formula of an arithmetic or geometric sequence (A function whose domain is the set of consecutive natural numbers and whose range is an ordered list of numbers).

---

**9-12.A.4.1.A**. Students are able to **determine** the <u>domain</u>, <u>range</u>, and <u>intercepts</u> of a <u>function</u>.

**Webb Level: 1**
**Bloom: Analysis**

**Verbs Defined:**
**Determine**: find

**Key terms defined:**
<u>Domain:</u> The set of inputs. The set of possible values for x or the independent variable.
<u>Range:</u> The set of outputs. The set of possible values for y or f(x) or the dependent variable.
<u>Intercepts</u>: The value(s) where the graph of a function crosses the axes.
<u>Function</u>: A mathematical relation that associates each object in a set with exactly one value.

**Teacher Speak:**
Students are able to determine (find) the domain, range, and intercepts of a function.

**Student Speak:**
Given a function in any form (numerical, graphical, or algebraic), I can find:

- Domain (The set of inputs. The set of possible values for x or the independent variable.)
- Range (The set of outputs. The set of possible values for y or f(x) or the dependent variable.)
- Intercepts (The value(s) where the graph of a function crosses the axes.)
- Horizontal asymptotes
- Vertical asymptotes

---

**9-12.A.4.2.A**. Students are able to **describe** the behavior of a <u>polynomial</u>, given the <u>leading coefficient</u>, <u>roots,</u> and <u>degree.</u>

**Webb Level: 2**
**Bloom: Analysis**

**Verbs Defined:**

**Describe**: Identify.

**Key terms defined:**
Polynomial: Sum of two or more monomials (i.e. $a_1x^n + a_2x^{n-1} + a_3x^{n-2} + ... + a_{n-1}x + a_n; a_1 \neq 0$). In this standard all polynomials are single variable.
Leading coefficient: The coefficient of the highest degree monomial in a polynomial.
Roots: The zeros of the polynomial. It is also the x-intercept if the roots are real.
Degree: The exponent of a single variable polynomial.

**Teacher Speak:**
Students are able to describe (identify) the behavior of a polynomial, given the leading coefficient, roots, and degree.

**Student Speak:**

- Given a single variable polynomial (Sum of two or more monomials (i.e. $a_1x^n + a_2x^{n-1} + a_3x^{n-2} + ... + a_{n-1}x + a_n; a_1 \neq 0$)) with the leading coefficient (The coefficient of the highest degree monomial in a polynomial.), roots (The zeros of the polynomial. It is also the x-intercept if the roots are real.) and degree (The exponent of a single variable polynomial), I can sketch the general shape of the polynomial.
- Given the graph of a polynomial (Sum of two or more monomials (i.e. $a_1x^n + a_2x^{n-1} + a_3x^{n-2} + ... + a_{n-1}x + a_n; a_1 \neq 0$)), I can find the roots (The exponent of a single variable polynomial).
- Given a polynomial function:
  - I can state the maximum number of roots (The exponent of a single variable polynomial) including multiplicities.
  - I can state the maximum number of turning points (relative max and min).

---

**9-12.A.4.3.A**. Students are able to **apply** transformations to graphs and **describe** the results.

**Webb Level: 2**
**Bloom: Analysis**

**Verbs Defined:**
**Apply:** Use
**Describe:** Identify

**Key terms defined:**
Transformation: A rule that sets up a one to one correspondence between sets of points.

**Teacher Speak:**

Students are able to apply (use) transformations to graphs and describe (identify) the results.

**Student Speak:**

- Given a relation, I can describe the transformations that are applied to the parent relation.
- Given the description of transformations to relations, I can the write the relation.
- Given the graph of a relation, I can write the equation of the relation.
- I can describe a horizontal translation to a graph (f(x-a)).
- I can describe a vertical translation to a graph. (f(x) + a).
- I can describe the reflection over the x-axis to a graph. (f(-x)).
- I can describe the reflection over the y-axis to a graph (-f(x)).
- I can describe a stretch or shrink (dilation to a graph). (f(ax).

---

**9-12.A.4.4.A.** Students are able to apply properties and definitions of trigonometric, exponential, and logarithmic expressions.

**Webb Level: 2/3**
**Bloom: Application**

**Verbs Defined:**
**Apply:**Use

**Key terms defined:**
Trigonometric Expression: An expression that uses one of three trigonometric functions (sine, cosine, or tangent) or their reciprocals (cosecant, secant, cotangent).
Exponential Expression: Any expression of the form $a \cdot b^x; b \geq 0, a \neq 0$
Logarithmic Expression: An expression of the form $\log_a b, a > 0, a \neq 1, b > 0$

**Teacher Speak:**
Students are able to apply (use) properties and definitions of trigonometric, exponential, and logarithmic expressions.

**Student Speak:**

- I can convert from exponential form to logarithmic form and vice-verse.
- I can use the product rule, quotient rule and power rule to simplify logarithmic expressions.
- I can solve logarithmic, exponential and trigonometric equations.
- I can simplify trigonometric and exponential expressions.
- I can verify trigonometric identities.

**9-12.A.4.5.A**. Students are able to **describe** characteristics of nonlinear functions and relations.

**Webb Level: 2**
**Bloom: Analysis**

**Verbs Defined:**
**Describe:** Explain

**Key terms defined:**
Characteristics: Key features of a function. This includes but is not limited to vertex, end behavior, shape, intercepts (both and x and y), symmetry (both rotational and lines), domain and range, centers and radii, directrix, foci, major axis, minor axis, amplitude, and phase shift, continuous or discontinuous, and concavity
Non-linear: A representation of a problem that can be expressed as an equation that has a degree other than 1 or is piecewise.

**Teacher Speak:**
Students are able to describe (explain) characteristics of nonlinear functions and relations.

**Student Speak:**
I can describe the key characteristics of:

- Any trigonometric function.
- Any conic section (circle, parabola, hyperbola, ellipse).
- Any non-linear algebraic function (rational expressions, absolute value, square root, cubic, quartic and other higher-degree polynomials.)

---

**9-12.A.4.6.A.** Students are able to graph solutions to linear inequalities.

**Webb Level: 1**
**Bloom: Application**

**Verbs Defined:**
**Graph**: Represent

**Key terms defined:**
Linear inequality: A comparison of two first degree expressions. The comparisons can be $<, >, \leq, \geq$.

**Teacher Speak:**
Students are able to graph (represent) solutions to linear inequalities (A comparison of two first degree expressions. The comparisons can be $<, >, \leq, \geq$.).

**Student Speak:**

- I can solve a linear inequality algebraically.
- I can match the graph of an inequality with its algebraic representation.
- I can determine the type boundary created by the inequality (solid or dashed).
- I can shade the correct side (half-plane).