The mission of the Chardon Local Schools is high achievement for all students where learning is our most important work.

Course of Study — MATH
Revised November 2021
ALGEBRA II

COS — MATH — *Revised November 2021*

Algebra II

Number and Quantity Standards

Strand: THE REAL NUMBER SYSTEM

Power Objective: Extend the properties of exponents to rational exponents.

Learning Standards:
N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define 51/3 to be the cube root of 5 because we want (51/3) 3 = 5(1/3)3 to hold, so (51/3) 3 must equal 5.
N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Power Objective: Use properties of rational and irrational numbers.

Learning Standard:
N.RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Materials:
- Calculator (Desmos, TI-84)
- Board Adopted Materials

How Taught?

Teaching activities may include, but are not limited to:
- Direct Instruction
- Cooperative Groups
- Stations
- Data Driven Instruction
- Scaffolding

How Assessed?

Assessments may include, but are not limited to:
- Pre-Assessments (pre-tests, observation, anticipation guide, questioning, diagnostics)
- Formative Assessments (entry/exit slips, group work, reflections, discussions, writer's workshops, homework/classwork, self and peer evaluations, observations, conferences, rubrics)
- Summative Assessments (using rubrics; tests/exams, projects, creative assignments, presentations)

How Re-Taught?

Re-teaching activities may include, but are not limited to:
- breaking down concept into smaller components
- presenting the information again in a different way
- Universal Design for Learning principles offering students opportunities to experience and engage material in new and different way
- practice activities such as computer tutorials, games, hands-on activities
- review sessions

Algebra II

Number and Quantity Standards

Strand: THE COMPLEX NUMBER SYSTEM

Power Objective: Perform arithmetic operations with complex numbers.

Learning Standards:
N.CN.1 Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
N.CN.3 Find the conjugate of a complex number; use conjugates to find magnitudes and quotients of complex numbers.

Power Objective: Use complex numbers in polynomial identities and equations

Learning Standard:
N.CN.7 Solve quadratic equations with real coefficients that have complex solutions.
N.CN.8 Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$.
N.CN.9 Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

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Algebra II

Algebra Standards

Strand: SEEING STRUCTURE IN EXPRESSIONS

Power Objective: Interpret the structure of expressions.

Learning Standards:
A.SSE.1 Interpret expressions that represent a quantity in terms of its context. ★
a. Interpret parts of an expression, such as terms, factors, and coefficients.
b. Interpret complicated expressions by viewing one or more of their parts as a single entity.
A.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, to factor 3x(x − 5) + 2(x − 5), students should recognize that the "x − 5" is common to both expressions being added, so it simplifies to (3x + 2)(x − 5); or see x4 − y4 as (x2) 2 − (y2) 2 , thus recognizing it as a difference of squares that can be factored as (x2 − y2)(x2 + y2).

Power Objective: Write expressions in equivalent forms to solve problems

Learning Standards:
A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★
c. Use the properties of exponents to transform expressions for exponential functions. For example, 8t can be written as 23t.
(+)A.SSE.4 Derive the formula for the sum of a finite geometric series
(when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.★

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Algebra II

Algebra Standards

Strand: ARITHMETIC WITH POLYNOMIALS AND RATIONAL EXPRESSIONS

Power Objective: Perform arithmetic operations on polynomials.

Learning Standard:
A.APR.1 Understand that polynomials form a system analogous to the integers, namely, that they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
b. Extend to polynomial expressions beyond those expressions that simplify to forms that are linear or quadratic. (A2, M3)

Power Objective: Understand the relationship between zeros and factors of polynomials.

Learning Standards:
A.APR.2 Understand and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$. In particular, $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
A.APR.3 Identify zeros of polynomials, when factoring is reasonable, and use the zeros to construct a rough graph of the function defined by the polynomial.

Power Objective: Use polynomial identities to solve problems.

Learning Standards:
(+) A.APR.5 Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers. For example, by using coefficients determined for by Pascal's Triangle. The Binomial Theorem can be proved by mathematical induction or by a combinatorial argument.

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Teaching activities may include, but are not limited to:
- Direct Instruction
- Cooperative Groups
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Algebra II

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Power Objective: Rewrite rational expressions.	**How Assessed?**
Learning Standards: **A.APR.6** Rewrite simple rational expressionsG in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system. **A.APR.7** Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.	**Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, anticipation guide, questioning, diagnostics) ● Formative Assessments (entry/exit slips, group work, reflections, discussions, writer's workshops, homework/classwork, self and peer evaluations, observations, conferences, rubrics) ● Summative Assessments (using rubrics; tests/exams, projects, creative assignments, presentations)
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Algebra II

Algebra Standards

Strand: CREATING EQUATIONS

Power Objective: Create equations that describe numbers or relationships.

Learning Standards:

A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations and inequalities arising from linear, quadratic, simple rational, and exponential functions. ★ c. Extend to include more complicated function situations with the option to solve with technology. (A2, M3)

A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.★
c. Extend to include more complicated function situations with the option to graph with technology. (A2, M3)

A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.★ (A1, M1)
a. While functions will often be linear, exponential, or quadratic, the types of problems should draw from more complicated situations. (A2, M3)

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.★
d. While functions will often be linear, exponential, or quadratic, the types of problems should draw from more complicated situations. (A2, M3)

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Algebra II

Algebra Standards

Strand: REASONING WITH EQUATIONS AND INEQUALITIES

Power Objective: Understand solving equations as a process of reasoning and explain the reasoning.

Learning Standard:
A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Power Objective: Solve systems of equations.

Learning Standard:
A.REI.6 Solve systems of linear equations algebraically and graphically. (+)
b. Extend to include solving systems of linear equations in three variables, but only algebraically. (A2, M3)

Power Objective: Represent and solve equations and inequalities graphically.

Learning Standard:
A.REI.11 Explain why the x-coordinates of the points where the graphs of the equation $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, making tables of values, or finding successive approximations.

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Algebra II

Functions Standards

Strand: INTERPRETING FUNCTIONS

Power Objective: Interpret functions that arise in applications in terms of the context.

Learning Standards:
F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include the following: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.★(A2, M3)
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.★
c. Emphasize the selection of a type of function for a model based on behavior of data and context. (A2, M3)
F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. ★ (A2, M3)

Power Objective: Analyze functions using different representations.

Learning Standards:
F.IF.7 Graph functions expressed symbolically and indicate key features of the graph, by hand in simple cases and using technology for more complicated cases. Include applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.★
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c. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. (A2, M3)
d. Graph polynomial functions, identifying zeros, when factoring is reasonable, and indicating end behavior. (A2, M3)
f. Graph exponential functions, indicating intercepts and end behavior, and trigonometric functions, showing period, midlineG, and amplitude. (A2, M3)
g. Graph rational functions, identifying zeros and asymptotes when factoring is reasonable, and indicating end behavior. (A2, M3)
h. Graph logarithmic functions, indicating intercepts and end behavior. (A2, M3)
F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. (A2, M3)
b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of changeG in functions such as $y = (1.02)t$, and $y = (0.97)t$ and classify them as representing exponential growth or decay. (A2, M3)
F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. (A2, M3)

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Algebra II

Functions Standards

Strand: BUILDING FUNCTIONS

Power Objective: Build a function that models a relationship between two quantities.

Learning Standards:
F.BF.1 Write a function that describes a relationship between two quantities.★
b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model. (A2, M3)
c. Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.

Power Objective: Build new functions from existing functions.

Learning Standards:
F.BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. (A2, M3)
F.BF.4 Find inverse functions. b. Read values of an inverse function from a graph or a table, given that the function has an inverse. (A2, M3)
c. Verify by composition that one function is the inverse of another. (A2, M3)
d. Find the inverse of a function algebraically, given that the function has an inverse. (A2, M3)

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Algebra II

Functions Standards

Strand: LINEAR, QUADRATIC, AND EXPONENTIAL MODELS	
Power Objective: Construct and compare linear, quadratic, and exponential models, and solve problems **Learning Standards:** **F.LE.4** For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.★	**How Taught?** **Teaching activities may include, but are not limited to:** ● Direct Instruction ● Cooperative Groups ● Stations ● Data Driven Instruction ● Scaffolding
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Algebra II

<u>Geometry Standards</u>

Strand: SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY G.SRT

Power Objective: Define trigonometric ratios, and solve problems involving right triangles.	**How Taught?** **Teaching activities may include, but are not limited to:** ● Direct Instruction ● Cooperative Groups ● Stations ● Data Driven Instruction ● Scaffolding
Learning Standards: **G.SRT.8** Solve problems involving right triangles. ★ b. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★ (A2, M3)	
Power Objective: Apply trigonometry to general triangles.	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, anticipation guide, questioning, diagnostics) ● Formative Assessments (entry/exit slips, group work, reflections, discussions, writer's workshops, homework/classwork, self and peer evaluations, observations, conferences, rubrics) ● Summative Assessments (using rubrics; tests/exams, projects, creative assignments, presentations)
Learning Standards: **G.SRT.9** Derive the formula $A = 1/2\ ab\ \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. **G.SRT.10** Explain proofs of the Laws of Sines and Cosines and use the Laws to solve problems. a. Extend right triangle trigonometry to include obtuse angles. **G.SRT.11** Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles, e.g., surveying problems, resultant forces.	
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Algebra II

Statistics and Probability Standards

Strand: INTERPRETING CATEGORICAL AND QUANTITATIVE DATA

Power Objective: Summarize, represent, and interpret data on two categorical and quantitative variables. **Learning Standards:** **S.ID.6** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. ★ a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions, or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models. (A2, M3) b. Informally assess the fit of a function by discussing residuals. (A2, M3)	**How Taught?** **Teaching activities may include, but are not limited to:** ● Direct Instruction ● Cooperative Groups ● Stations ● Data Driven Instruction ● Scaffolding
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