EAST PENN SCHOOL DISTRICT

Course Name:

Algebra 2 CP/Honors

Curriculum Proposal Date:

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Curriculum Developed by:

Kara Chamberlain, Maggie Zayaitz Ruhf, Shannon Wasilewski

ALGEBRA 2 CP/HONORS - FACTORING & SIMPLIFYING POLYNOMIALS AND RATIONAL EXPRESSIONS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

CC.2.2.HS.D.1 Interpret the structure of expressions to represent a quantity in terms of its context.

CC.2.2.HS.D.3 Extend the knowledge of arithmetic operations and apply to polynomials.

Transfer

Students will be able to independently use their learning to keep considering...

- ❑ Solve, analyze, and interpret non-linear expressions and different representations of those expressions
- ❑ Everything learned in Algebra 1 is connected to this work; mathematical relations are the same

Meaning

UNDERSTANDINGS

Students will understand that...

- ❑ Two things that look different can be equivalent to each other.
- ❑ Operations apply to functions

ESSENTIAL QUESTIONS

Students will keep considering...

- ❑ How do I factor a non-linear expression?
- ❑ How do I simplify polynomials?
- ❑ How do I simplify a rational expression?

Acquisition

Students will know...

- ❑ How to factor expressions (GCF, difference of perfect squares including higher degrees, sum/difference of perfect cubes, trinomials where a=1 and a≠1 including higher degrees, grouping)
- ❑ Simplify polynomial expressions by adding, subtracting and multiplying
- ❑ Simplify rational expressions by adding, subtracting, multiplying and dividing
- ❑ Simplify complex fractions

Students will be skilled at...

- ❑ Factor algebraic expressions, including difference of squares and trinomials. Note: Trinomials limited to the form ax^2 +bx+c where a is not equal to 1 (A2.1.2.2.1)
- ❑ Simplify rational algebraic expressions (A2.1.2.2.2)

ALGEBRA 2 CP/HONORS - SIMPLIFY RADICALS AND COMPLEX NUMBERS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

CC.2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers.

Transfer

Students will be able to independently use their learning to keep considering...

- ❑ Solve, analyze, and interpret non-linear expressions and different representations of those expressions
- ❑ Everything learned in Algebra 1 is connected to this work; mathematical relations are the same

Meaning

UNDERSTANDINGS

Students will understand that...

- ❑ It is possible to simplify negative radicands.
- ❑ There is an additional number system outside of real numbers.

ESSENTIAL QUESTIONS

Students will keep considering...

- ❑ Why do we need imaginary numbers?
- ❑ How do we apply skills about operations to complex numbers?

Acquisition

Students will know...

- ❑ $\sqrt{-1} = i$
- ❑ The pattern of simplifying the powers of i

Students will be skilled at...

- ❑ A2.1.1.1.1 Simplify/write square roots in terms of i (e.g., $\sqrt{-24} = 2i\sqrt{6}$).
- ❑ A2.1.1.1.2 Simplify/evaluate expressions involving powers of i (e.g., $i^6 + i^3 = -1 - i$).
- ❑ A2.1.1.2.1 Add and subtract complex numbers (e.g., $(7 - 3i) - (2 + i) = 5 - 4i$).
- ❑ A2.1.1.2.2 Multiply and divide complex numbers (e.g., $(7 - 3i)(2 + i) = 17 + i$).

ALGEBRA 2 CP/HONORS - EXPONENTS AND LOGARITHMS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
CC.2.2.HS.D.6 Extend the knowledge of rational functions to rewrite in equivalent forms	*Students will be able to independently use their learning to keep considering...* ❑ Solve, analyze, and interpret non-linear expressions and different representations of those expressions ❑ Everything learned in Algebra 1 is connected to this work; mathematical relations are the same	
	Meaning	
	UNDERSTANDINGS *Students will understand that...* ❑ Logarithms and Exponents are inverses of each other. ❑ Radicals and Rational exponents are different representations of the same expression.	ESSENTIAL QUESTIONS *Students will keep considering...* ❑ How do you convert between radical and rational expressions? ❑ How do you simplify exponential expressions? ❑ How do you convert between common/natural logarithms and exponential form? ❑ Why are logarithms important?
	Acquisition	
	Students will know... ❑ Rewrite exponential form into logarithmic form ($y = \log_a x \rightarrow x = a^y$) ❑ The notation for common and natural logarithms ❑ The properties of logarithms (product rule, quotient rule and power rule)	*Students will be skilled at...* ❑ A2.1.2.1.1 Use exponential expressions to represent rational numbers. ❑ A2.1.2.1.2 Simplify/evaluate expressions involving positive and negative exponents and/or roots (may contain all types of real numbers— exponents should not exceed power of 10). ❑ A2.1.2.1.3 Simplify/evaluate expressions involving multiplying with exponents (e.g., $x^6 \bullet x^7 = x^{13}$), powers of powers (e.g., $(x^6)^7 = x^{42}$), and powers of products (e.g., $(2x^2)^3 = 8x^6$). Note: Limit to rational exponents. ❑ A2.1.2.1.4 Simplify or evaluate expressions involving logarithms and exponents (e.g., $\log_2 8 = 3$ or $\log_4 2 = ½$).

ALGEBRA 2 CP/HONORS - SOLVE NONLINEAR EQUATIONS - QUADRATICS AND POLYNOMIALS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

CC.1.HS.F.7 Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.

CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.
CC.2.2.HS.C.5 Construct and compare linear, quadratic, and exponential models to solve problems.
CC.2.2.HS.D.8 Apply inverse operations to solve equations or formulas for a given variable.
CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems.
CC.2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Transfer

Students will be able to independently use their learning to keep considering...

- ❏ CC.2.2.HS.D.9 Use reasoning to solve equations, and justify the solution method.

Meaning

UNDERSTANDINGS

Students will understand that...

- ❏ Solutions to a quadratic and polynomial equation represent (real and non-real).
- ❏ Multiple solving methods can obtain the same solution to the quadratic equation.
- ❏ The discriminant can be used to determine the appropriate solving method for quadratics.
- ❏ A polynomial equation can be broken down into products of linear and/or quadratic factors to solve.
- ❏ Recognizing when factors are solvable.

ESSENTIAL QUESTIONS

Students will keep considering...

- ❏ How do you algebraically solve a quadratic and polynomial equation?
- ❏ How are quadratic and polynomial equations different?

Acquisition

Students will know...

- ❏ How to solve quadratics by factoring (different two perfect squares, a = 1, a ≠ 1 and GCF), square root method and quadratic formula
- ❏ How to calculate the discriminant.
- ❏ How to solve polynomials using factoring (GCF, grouping, sum/difference of cubes, difference of perfect squares where the exponent is greater than 2, higher degree trinomials where a=1 and a≠1).
- ❏ How to write the quadratic and polynomial equations given the solutions.

Students will be skilled at...

- ❏ A2.1.3.1.1 Write and/or solve quadratic equations (including factoring and using the Quadratic Formula).

ALGEBRA 2 CP/HONORS - SOLVE NONLINEAR EQUATIONS - RADICALS, LITERAL AND ABSOLUTE VALUE

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

<table>
<tr><th>Standards</th><th colspan="2">Transfer</th></tr>
<tr><td rowspan="5">CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.
CC.2.2.HS.D.8 Apply inverse operations to solve equations or formulas for a given variable.
CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems.
CC.2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.</td><td colspan="2">Students will be able to independently use their learning to keep considering...
❑ CC.2.2.HS.D.9 Use reasoning to solve equations, and justify the solution method.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ Two things that look different can be equivalent to each other.
❑ The mathematical tools needed to solve each type of these equations.
❑ Equations can have extraneous solutions.</td><td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ How do you algebraically solve a radical equation and absolute value equation?
❑ How do you solve a literal equation for a specific variable?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know...
❑ How to isolate the radical and absolute value symbol in order to solve the equation
❑ The reasoning behind absolute value equations having two solutions
❑ How determine any extraneous solutions
❑ Inverse operations apply to numbers and variables to solve a literal equation</td><td>Students will be skilled at...
❑ A2.1.3.2.2 Use algebraic processes to solve a formula for a given variable (e.g., solve d = rt for r).</td></tr>
</table>

ALGEBRA 2 CP/HONORS - SOLVE NONLINEAR EQUATIONS - RATIONALS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

CC.2.1.HS.F.1 Apply and extend the properties of exponents to solve problems with rational exponents.

CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.

CC.2.2.HS.C.5 Construct and compare linear, quadratic, and exponential models to solve problems.

CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems.

CC.2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Transfer

Students will be able to independently use their learning to keep considering...

- ❏ CC.2.2.HS.D.9 Use reasoning to solve equations, and justify the solution method.

Meaning

UNDERSTANDINGS

Students will understand that...

- ❏ Basic rules of fractions apply to solving fractions with variables
- ❏ Clearing the denominator will result in a solvable equation (linear or quadratic)
- ❏ Equations can have extraneous solutions
- ❏ A whole number is a rational number.

ESSENTIAL QUESTIONS

Students will keep considering...

- ❏ How do you algebraically solve a rational equation?

Acquisition

Students will know...

- ❏ How to solve a rational equation by clearing the denominator
- ❏ How determine any extraneous solutions

Students will be skilled at...

- ❏ Solving a rational equation

ALGEBRA 2 CP/HONORS - SOLVE NONLINEAR EQUATIONS - LOGARITHMIC AND EXPONENTIAL

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.
CC.2.2.HS.C.5 Construct and compare linear, quadratic, and exponential models to solve problems.
CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems.
CC.2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Transfer

Students will be able to independently use their learning to keep considering...

- ❏ CC.2.2.HS.D.9 Use reasoning to solve equations, and justify the solution method.

Meaning

UNDERSTANDINGS

Students will understand that...

- ❏ Logarithms and Exponents are inverses of each other.
- ❏ Clearing the logarithmic will result in a solvable equation.

ESSENTIAL QUESTIONS

Students will keep considering...

- ❏ How do you algebraically solve logarithmic and exponential equations?

Acquisition

Students will know...

- ❏ How to solve a logarithmic equation
- ❏ Rewrite exponential form into logarithmic form
  ($y = \log_a x \rightarrow x = a^y$)
- ❏ How to apply the logarithmic properties to solve a logarithmic equation
- ❏ The difference between exponential growth and decay
- ❏ How to solve an exponential equation
- ❏ Logarithmic and exponential application word problems

Students will be skilled at...

- ❏ A2.1.3.1.3 Write and/or solve a simple exponential or logarithmic equation (including common and natural logarithms).
- ❏ A2.1.3.1.4 Write, solve, and/or apply linear or exponential growth or decay (including problem situations).

ALGEBRA 2 CP/HONORS - FIND INVERSES

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

<table>
<tr><th>Standards</th><th colspan="2">Transfer</th></tr>
<tr><td rowspan="5">CC.2.2.HS.C.4 Interpret the effects transformations have on functions, and find the inverses of functions.

CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.</td><td colspan="2">Students will be able to independently use their learning to keep considering...
❑ CC.2.2.HS.D.4 Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ There is a relationship between a relation/function and its inverse</td><td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ What is the relationship between inverse functions?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know...
❑ The difference between inverse relations and inverse function
❑ How to find the inverse of a relation or a function graphically and algebraically</td><td>Students will be skilled at...
❑ A2.2.1.1.3 Determine the domain, range, or inverse of a relation.
❑ Identify a function and its inverse graphically (reflection over the y = x line)</td></tr>
</table>

ALGEBRA 2 CP/HONORS - CHARACTERISTICS OF GRAPHS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context. CC.2.2.HS.D.4 Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs. CC.2.3.HS.A.10 Translate between the geometric description and the equation for a conic section.	*Students will be able to independently use their learning to keep considering...* ❑ What information is a graph showing?	
	Meaning	
	UNDERSTANDINGS *Students will understand that...* ❑ There is a difference graphically between real and non-real solutions. ❑ The transformation rules apply to linear and nonlinear functions.	ESSENTIAL QUESTIONS *Students will keep considering...* ❑ How do the changes on an equation relate to the graph? ❑ How do we connect the functions to graphs?
	Acquisition	
	Students will know... ❑ How to determine the parent function that correlates to the equation and/or the graph. ❑ The key characteristics of graphs (solutions/zeroes, end behavior, min/max, turning points, intercepts, increase/decrease intervals, asymptotes and domain/range). ❑ To describe transformation in relation to the parent function given the equation or the graph (horizontal and vertical shifts, reflections and stretches/shrinks).	*Students will be skilled at...* ❑ A2.2.1.1.4 Identify and/or determine the characteristics of an exponential, quadratic, or polynomial function (e.g., intervals of increase/decrease, intercepts, zeros, and asymptotes). ❑ A2.2.2.1.3 Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.

ALGEBRA 2 CP/HONORS - QUADRATICS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer
CC.2.2.HS.C.2 Graph and analyze functions, and use their properties to make connections between the different representations. CC.2.2.HS.C.4 Interpret the effects transformations have on functions, and find the inverses of functions. CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships. CC.2.1.HS.F.3 Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. CC.2.3.HS.A.10 Translate between the geometric description and the equation for a conic section.	*Students will be able to independently use their learning to keep considering...* ❑ What is the relationship between the equation and graph?

Meaning

UNDERSTANDINGS	ESSENTIAL QUESTIONS
Students will understand that... ❑ There is a connection between the quadratic function, tables of values and the visual representation of the graph. ❑ When there is a change to the quadratic equation, there is a change in the graphical representation. ❑ A quadratic function in standard form and vertex form will produce the same graph. ❑ The transformation rules apply to linear and nonlinear functions.	*Students will keep considering...* ❑ How does the quadratic equation relate to the graph of the quadratic function? ❑ How do quadratic equations model real-world applications? ❑ How are real and non-real solutions of a quadratic equation related to the graph of the related quadratic function?

Acquisition

Students will know...	*Students will be skilled at...*
❑ How to graph the key characteristics of a quadratics (vertex, axis of symmetry, intercepts) using a table of values. ❑ How to graph using transformation rules of a quadratic equation related to the parent quadratic function (horizontal and vertical shifts, reflections and stretches/shrinks). ❑ How to graph a quadratic in standard form and vertex form. ❑ How to determine the solutions of a quadratic from the graph.	❑ A2.2.2.1.1 Create, interpret, and/or use the equation, graph, or table of a polynomial function (including quadratics). ❑ A2.1.3.2.1 Determine how a change in one variable relates to a change in a second variable (e.g., $y = 4/x$; if x doubles, what happens to y?). ❑ A2.2.2.2.1 Identify or describe the effect of changing parameters within a family of functions (e.g., $y = x^2$ and $y = x^2 + 3$, or $y = x^2$ and $y = 3x^2$).

ALGEBRA 2 CP/HONORS - OTHER NONLINEAR FUNCTIONS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

<table>
<tr><th>Standards</th><th colspan="2">Transfer</th></tr>
<tr><td rowspan="6">CC.2.2.HS.C.2 Graph and analyze functions, and use their properties to make connections between the different representations.

CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships.

CC.2.1.HS.F.3 Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.</td><td colspan="2">Students will be able to independently use their learning to keep considering...
❑ What is the relationship between the function and graph?</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ There is a connection between the nonlinear function, tables of values and the visual representation of the graph.
❑ When there is a change to the nonlinear equation, there is a change in the graphical representation.
❑ The transformation rules apply to linear and nonlinear functions.</td><td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ How does the equation relate to the graph?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know...
❑ How to graph the key characteristics of an absolute value function and radical functions using a table of values.
❑ How to sketch the key characteristics of a polynomial function (end behavior, turning points, intercepts).
❑ How to graph logarithmic and exponential functions using a table of values. Including asymptotes. There is a connection between the quadratic function, tables of values and the visual representation of the graph.
❑ How to graph using transformation rules related to the parent function (horizontal and vertical shifts, reflections and stretches/shrinks).</td><td>Students will be skilled at...
❑ A2.1.3.2.1 Determine how a change in one variable relates to a change in a second variable (e.g., $y = 4/x$; if x doubles, what happens to y?).
❑ A2.2.2.2.1 Identify or describe the effect of changing parameters within a family of functions (e.g., $y = x^2$ and $y = x^2 + 3$, or $y = x^2$ and $y = 3x^2$).
❑ A2.2.2.1.4 Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).
❑ A2.2.2.1.2 Create, interpret, and/or use the equation, graph, or table of an exponential or logarithmic function (including common and natural logs)</td></tr>
</table>

ALGEBRA 2 CP/HONORS - REGRESSION MODELS

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

<table>
<tr><th>Standards</th><th colspan="2">Transfer</th></tr>
<tr><td rowspan="6">CC.2.4.HS.B.2 Summarize, represent, and interpret data on two categorical and quantitative variables.

CC.2.4.HS.B.3 Analyze Linear models to make interpretations based on the data.

CC.2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</td><td colspan="2">Students will be able to independently use their learning to keep considering...
❑ CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ Conclusions can be made by Interpreting given data.
❑ A line of best represents the best description of the data</td><td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ What is the relationship between two quantitative variables?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know...
❑ How to analyze scatter plots (correlation).
❑ The basics of an equation of a line
❑ Recognize appropriate solutions to predicted data</td><td>Students will be skilled at...
❑ A2.2.1.1.1 Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.
❑ A2.2.3.1.1 Draw, identify, find, interpret, and/or write an equation for a regression model (lines and curves of best fit) for a scatter plot.
❑ A2.2.3.1.2 Make predictions using the equations or graphs of regression models (lines and curves of best fit) of scatter plots.</td></tr>
</table>

ALGEBRA 2 CP/HONORS - PROBABILITY

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

<table>
<tr><th>Standards</th><th colspan="2">Transfer</th></tr>
<tr><td rowspan="6">CC.2.4.HS.B.4 Recognize and evaluate random processes underlying statistical experiments.

CC.2.4.HS.B.5 Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.

CC.2.4.HS.B.6 Use the concepts of independence and conditional probability to interpret data.

CC.2.4.HS.B.7 Apply the rules of probability to compute probabilities of compound events in a uniform probability model.</td><td colspan="2">Students will be able to independently use their learning to keep considering...
❑ CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ Probability and odds can be used to make predictions.</td><td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ How can we use simple and compound probabilities to make predictions?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know...
❑ Probability vocabulary (probability experiment, sample space, event, outcome, theoretical and experimental probability)
❑ How to calculate basic and compound probabilities
❑ The Fundamental Counting Principle
❑ Difference between combinations and permutations
❑ How to calculate the odds of an event</td><td>Students will be skilled at...
❑ A2.2.3.2.1 Use combinations, permutations, and the fundamental counting principle to solve problems involving probability.
❑ A2.2.3.2.2 Use odds to find probability and/or use probability to find odds.
❑ A2.2.3.2.3 Use probability for independent, dependent, or compound events to predict outcomes.</td></tr>
</table>

ALGEBRA 2 CP/HONORS - ARITHMETIC AND GEOMETRIC SEQUENCE

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

<table>
<tr><th>Standards</th><th colspan="2">Transfer</th></tr>
<tr><td rowspan="5">CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.</td><td colspan="2">Students will be able to independently use their learning to keep considering...
❑ Relationships exist between sequences and functions</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ Relationships exist between arithmetic sequences and linear functions
❑ Relationships exist between geometric sequences and exponential functions</td><td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ How to find and extend patterns between given values?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know...
❑ Sequence vocabulary (sequence, term, common difference, common ratio, finite and infinite)
❑ The difference between an arithmetic and geometric sequence</td><td>Students will be skilled at...
❑ A.2.2.1.1.2 Identify and or extended a pattern as either a arithmetic or geometric sequence (e.g. given a geometric sequence find the 20th term)</td></tr>
</table>