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| 1. Concepts and Procedures | Priority Cluster | **D. Interpret the structure of expressions.**<br>(Target Description)<br>Tasks for this target will require students to recognize equivalent forms of an expression as determined by the structure of the expression. Tasks for Claims 2 and 4 will ask students to interpret expressions or parts of expressions in the context of a problem.<br><br>(Evidence Required)<br>The student uses the structure of an expression to identify ways of rewriting it.<br><br>(Range ALDs)<br>**Level 1** Students should be able to identify parts of an expression, such as terms, factors, coefficients, exponents, etc.<br>**Level 2** Students should be able to interpret parts of an expression, such as terms, factors, coefficients, exponents, etc. They should also be able to recognize equivalent forms of linear expressions.<br>**Level 3** Students should be able to recognize equivalent forms of expressions and use the structure of an expression to identify ways to rewrite it.<br>**Level 4** Students should be able to look for and use structure and repeated reasoning to make generalizations about the possible equivalent forms expressions can have. | 1, 2 | 2 | 0 | 19-22 |
| | | **E. Write expressions in equivalent forms to solve problems.**<br>(Target Description)<br>Tasks for this target will require students to choose or produce an equivalent form of an expression, including factoring a quadratic expression, completing the square, and using properties of exponents. Some of these tasks will connect the form of the expression to a property of the quantity represented by the expression.<br><br>(Evidence Required)<br>1. The student understands that the factored form of a quadratic expression reveals the zeros of the function it defines.<br>2. The student understands that completing the square for a quadratic expression reveals the maximum or minimum value of the function it defines.<br>3. The student uses the properties of exponents to transform exponential expressions. | 1,2 | | | |

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| | | (Range ALDs)<br>**Level 1** Students should be able to write a quadratic expression with integer coefficients and a leading coefficient of 1 in an equivalent form by factoring. They should be able to use properties of exponents to expand a single variable (coefficient of 1) with a positive integer exponent into an equivalent form and vice versa, e.g., $x^3 = xxx$.<br>**Level 2** Students should be able to write a quadratic expression with integer coefficients in an equivalent form by factoring or by completing the square. They should be able to use properties of exponents to expand a repeated single variable (coefficient of 1) with a nonnegative integer exponent into an equivalent form and vice versa, e.g., $x^0x^2x^3 = xxxxx = x^{2+3}$.<br>**Level 3** Students should be able to write a quadratic expression with rational coefficients in an equivalent form by factoring and by completing the square. They should be able to identify and use the zeros to solve or explain familiar problems, and they should be able to use properties of exponents to write equivalent forms of exponential functions with one or more variables, integer coefficients, and nonnegative rational exponents involving operations of addition, subtraction, and multiplication, including distributing an exponent across terms within parentheses.<br>**Level 4** Students should be able to find the maximum or minimum values of a quadratic function. They should be able to choose an appropriate equivalent form of an expression in order to reveal a property of interest when solving problems. | | | | |
| | | **F. Perform arithmetic operations on polynomials.**<br>(Target Description)<br>Tasks for this target will require students to add, subtract, and multiply polynomials.<br><br>(Evidence Required)<br>1. The student adds or subtracts polynomials.<br>2. The student multiplies polynomials.<br><br>(Range ALDs)<br>**Level 1** Students should be able to add, subtract, and multiply single variable polynomials of degree 2 or less.<br>**Level 2** Students should be able to add, subtract, and multiply multi-variable polynomials made up of monomials of degree 2 or less. They should | 2 | 1 | | |

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| | | understand that polynomials are closed under addition.<br>**Level 3** Students should be able to add, subtract, and multiply multi-variable polynomials of any degree and understand that polynomials are closed under subtraction and multiplication.<br>**Level 4** Students should understand and be able to explain that polynomials form a system analogous to the integers. | | | | |
| | | **G. Create equations that describe numbers or relationships.**<br>(Target Description)<br>Tasks for this target will require students to create equations and inequalities in one variable to solve problems. Other tasks will require students to create and graph equations in two variables to represent relationships between quantities.<br><br>(Evidence Required)<br>1. The student creates one variable equations arising from linear, quadratic, simple rational, and exponential functions in one variable.<br>2. The student creates one variable inequalities arising from linear, quadratic, simple rational, and exponential functions in one variable.<br>3. The student graphs equations or inequalities on coordinate axes with labels and scales to represent the solution to a contextual problem.<br>4. The student creates equations in two or more variables to represent relationships between quantities.<br><br>(Range ALDs)<br>**Level 1** Students should be able to create and use one-step linear equations in one variable to model a familiar situation and to solve a familiar problem.<br>**Level 2** Students should be able to create and use quadratic equations, linear equations, and linear inequalities in one and two variables to model a familiar situation and to solve a familiar problem. They should be able to graph a linear or a quadratic equation in two variables, and be able to rearrange a familiar formula or an unfamiliar linear formula in one or two variables for a particular given quantity.<br>**Level 3** Students should be able to create and use linear, quadratic, and rational equations and inequalities and exponential equations with an integer base and a polynomial exponent in multiple variables to model an unfamiliar situation and to solve an unfamiliar problem. They should be able to graph an equation in two variables and be able to rearrange a linear, a quadratic, an absolute value, a rational, or a cubic multi-variable formula for a particular | 1, 2 | 4-5 | | |

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| | | given quantity.<br>**Level 4** Students should be able to rearrange polynomial, logarithmic, exponential, or trigonometric formulas with one or more variables to highlight a quantity of interest and be able to analyze in context to determine which quantity is of interest. | | | | |
| | | **H. Understand solving equations as a process of reasoning and explain the reasoning.**<br>(Target Description)<br>Tasks for this target will require students to solve radical and rational equations in one variable. Tasks that ask students to critique or justify a particular solution method will contribute evidence to Claim 3.<br><br>(Evidence Required)<br>1. The student solves radical and/or simple rational equations in one variable, including identifying the number and type of real solutions that might exist for the equation (e.g., one, two, infinite, or no real).<br>2. The student evaluates proposed solutions to radical or simple rational equations, and recognizes where extraneous solution(s) might arise during the solving of the equation.<br>3. The student solves radical or rational equations in multiple variables.<br>4. The student identifies equivalent equations to an equation with rational or radical expressions.<br><br>(Range ALDs)<br>**Level 1** Students should be able to explain solution steps for solving one-step linear equations in one variable.<br>**Level 2** Students should be able to look for and make use of structure to solve simple radical equations and simple rational equations in one variable in which the variable term is in the numerator and should understand the solution steps as a process of reasoning. They should be able to understand and explain solution steps for solving linear equations in one variable as a process of reasoning.<br>**Level 3** Students should be able to look for and make use of structure to solve simple radical and rational equations in one variable presented in various forms. They should be able to understand and explain solution steps for solving quadratic, radical, and rational equations in one variable as a process of reasoning.<br>**Level 4** Students should be able to give examples showing how extraneous | 1, 2 | | | |

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| | | solutions may arise and why they arise when solving linear, quadratic, radical, and rational equations. | | | | |
| | | **I. Solve equations and inequalities in one variable.**<br>(Target Description)<br>Tasks for this target will require students to solve linear equations and inequalities in one variable and solve quadratic equations in one variable. Tasks asking students to choose the appropriate method will contribute evidence to Claim 2 and 4.<br><br>(Evidence Required)<br>1. The student solves linear equations in one variable with numeric coefficients.<br>2. The student solves linear inequalities in one variable with numeric coefficients.<br>3. The student solves linear inequalities in one variable with letter coefficients or identifies appropriate value(s) of a letter coefficient given specific information about a variable in a linear equation or inequality.<br>4. The student solves quadratic equations in one variable by taking square roots, completing the square, using the quadratic formula, or by factoring.<br>5. The student recognizes when the quadratic formula gives complex solutions (no real solutions).<br>6. The student writes complex solutions for the quadratic formula in the form $a \pm bi$ where $a$ and $b$ are real numbers.<br>7. The student recognizes equivalent equations to given linear or quadratic equations in one variable.<br><br>(Range ALDs)<br>**Level 1** Students should be able to solve one-step linear equations in one variable.<br>**Level 2** Students should be able to solve one-step linear inequalities and quadratic equations in one variable with integer roots.<br>**Level 3** Students should be able to solve multi-step linear equations and inequalities and quadratic equations in one variable with real roots.<br>**Level 4** Students should be able to solve quadratic equations in one variable with complex roots. | 1, 2 | | | |
| | | **J. Represent and solve equations and inequalities graphically.** | 1, 2 | 2 | | |

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| | | (Target Description)<br>Tasks for this target will require students to interpret a line or curve as a solution set of an equation in two variables, including tasks that tap student understanding of points beyond the displayed portion of a graph as part of the solution set. Some of these tasks should explicitly focus on non-integer solutions (e.g., give three points on the graph of y = 7x + 2 that have x-values between 1 and 2).<br><br>Other tasks for this target will require students to approximate solutions to systems of equations represented graphically, including linear, polynomial, rational, absolute value, exponential, and logarithmic functions (often paired with 9-12.F Target L).<br><br>Other tasks for this target will require students to graph solutions to linear inequalities and systems of linear inequalities in two variables. In some of these tasks, students may be given points, sets of points, or regions and asked to determine whether the indicated point(s) or regions are part of a solution set.<br><br>(Evidence Required)<br>1. The student understands that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).<br>2. The student finds solutions (either exact or approximate as appropriate) to the equation $f(x) = g(x)$ using technology to graph functions, make tables of values, or find their successive approximations.<br>3. The student graphs the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality).<br>4. The student graphs the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.<br><br>(Range ALDs)<br>**Level 1** Students should be able to represent a linear equation with an integer-valued slope in two variables graphically on a coordinate plane.<br>**Level 2** Students should be able to represent linear equations and inequalities and quadratic equations with integer coefficients in one and two variables | | | | |

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| | | graphically on a coordinate plane and should understand that the plotted line or curve represents the solution set to an equation. They should be able to graph and estimate the solution of systems of linear equations.<br>**Level 3** Students should be able to represent polynomial, rational, absolute value, exponential, and logarithmic functions graphically. They should be able to graph and estimate the solution of systems of equations and systems of linear inequalities. They should understand that the plotted line, curve, or region represents the solution set to an equation or inequality.<br>**Level 4** Students should be able to explain why the *x*-coordinates of the points where *f(x)* and *g(x)* intersect compose the solution to *f(x) = g(x)*. | | | | |
| | | **K. Understand the concept of a function and use function notation.**<br>(Target Description)<br>Tasks for this target will require students to distinguish between relationships that represent functions and those that do not, including recognizing a sequence as a function. Other tasks will require students to identify the domain and range of a function, often in the context of problems associated with Claims 2-4.<br><br>(Evidence Required)<br>1. The student understands that a function from one set (the domain) to another set (the range) assigns to each element of the domain exactly one element of the range (e.g., distinguish between functions and non-functions).<br>2. The student understands that the graph of f is the graph of the equation *y = f(x).*<br>3. The student recognizes that sequences are functions whose domain is a subset of the integers.<br><br>(Range ALDs)<br>**Level 1** Students should be able to distinguish between functions and non-functions. They should be able to state the domain and range given a graph.<br>**Level 2** Students should understand the concept of a function in order to distinguish a relation as a function or not a function. They should be able to identify domain and range of a function given a graph of a quadratic, linear, cubic, or absolute function, and they should understand that the graph of a function *f(x)* is the graph of the equation *y = f(x)*.<br>**Level 3** Students should be able to use function notation to evaluate a function given in function notation for a particular input. They should be able | 1, 2 | 2 | | |

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| | | to identify the domain and range for any given function presented in any form, e.g., as a graph, a verbal description, or a sequence.<br>**Level 4** Students should be able to find the input for a given output when given in function notation. | | | | |
| | | **L. Interpret functions that arise in applications in terms of a context.**<br>(Target Description)<br>Interpret functions that arise in applications in terms of the context.<br><br>(Evidence Required)<br>1. The student interprets key features of a graph or a table representing a function modeling a relationship between two quantities.<br>2. The student sketches graphs showing key features given a verbal description of a relationship between two quantities that can be modeled with a function.<br>3. The student relates the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.<br>4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph.<br><br>(Range ALDs)<br>**Level 1** Students should be able to interpret linear functions in context, and given the key features of a linear graph, they should be able to identify the appropriate graph.<br>**Level 2** Students should be able to interpret quadratic and other polynomial functions in two variables in context of the situation, and given the key features of a graph of a polynomial function, they should be able to identify the appropriate graph. They should be able to specify the average rate of change from an equation of a linear function and approximate it from a graph of a linear function.<br>**Level 3** Students should be able to graph various types of functions and interpret and relate key features, including range and domain, in familiar or scaffolded contexts. They should be able to specify the average rate of change of a function on a given domain from its equation or approximate the average rate of change of a function from its graph.<br>**Level 4** Students should be able to interpret complex key features such as holes, symmetries, and end behavior of graphs and functions in unfamiliar problems or contexts. | 1, 2 | 3-4 | | |

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| | | **M. Analyze functions using different representations.**<br>(Target Description)<br>Tasks for this target will ask students to graph functions (linear, quadratic, square root, cube root, piecewise-defined, polynomial, exponential, and logarithmic) by hand or using technology and compare properties of two functions represented in different ways. Some tasks will focus on understanding equivalent forms that can be used to explain properties of functions and may be associated with 9–12 Algebra Target H.<br><br>(Evidence Required)<br>1. Students graph functions expressed symbolically and show key features of the graph.<br>2. Students write an exponential function defined by an expression in an equivalent form using the properties of exponents to reveal and explain different properties of the function and to classify them as representing exponential growth or decay.<br>3. Students compare properties of two functions each represented in a different way (e.g., as equations, functions, tables, graphs, or written descriptions).<br><br>(Range ALDs)<br>**Level 1** Students should be able to graph a linear function by hand or by using technology. They should be able to compare properties of two linear functions represented in different ways. They should be able to identify equivalent forms of linear functions.<br>**Level 2** Students should be able to graph linear and quadratic functions by hand; graph square root, cube root, piecewise-defined, polynomial, exponential, and logarithmic functions by hand or by using technology; compare properties of two quadratic or two other functions of the same type, i.e., linear to linear, represented in different ways; and understand equivalent forms of linear and quadratic functions. They should be able to compare properties of two trigonometric functions represented in the same way.<br>**Level 3** Students should be able to analyze and compare properties of two functions of different types represented in different ways and understand equivalent forms of functions. They should be able to graph trigonometric functions by hand and by using technology.<br>**Level 4** Students should be able to graph a variety of functions, including | 1, 2, 3 | | | |

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| | | linear, quadratic, square root, cube root, piecewise-defined, polynomial, exponential, logarithmic, and trigonometric, by hand and by using technology. They should be able to analyze and explain relationships between various types of functions and the behaviors of the functions and be able to determine which equivalent form is most appropriate for a given task. | | | | |
| | | **N. Build a function that models a relationship between two quantities.**<br>(Target Description)<br>Tasks for this target will require students to write a function (recursive or explicit, as well as translate between the two forms) to describe a relationship between two quantities.<br><br>(Evidence Required)<br>1. The student writes explicit or recursive functions to describe relationships between two quantities from a context.<br>2. The student translates between explicit formulas and recursively defined functions.<br>3. The student understands a function as a model of the relationship between two quantities.<br><br>(Range ALDs)<br>**Level 1** Students should be able to identify an explicit or a recursive function and determine the steps for calculation from a context requiring up to two steps. They should be able to add and subtract two linear functions.<br>**Level 2** Students should be able to build an explicit or a recursive function to describe or model a relationship between two quantities and determine the steps for calculation from a context. They should be able to add, subtract, and multiply linear and quadratic functions.<br>**Level 3** Students should be able to translate between explicit and recursive forms of a function. They should be able to add, subtract, multiply, and divide functions.<br>**Level 4** Students should be able to determine when it is appropriate to combine functions using arithmetic operations in context. | 2 | | | |
| | Supporting Cluster | **O. Define trigonometric ratios and solve problems involving right triangles.**<br>(Target Description)<br>Tasks for this target will be posed to elicit student understanding of the relationship between similar triangles and their side ratios. Other tasks will ask students to explain and use the relationship between the sine and cosine of complementary angles, some of which should appear in aspects of | 1 ,2 | 2 | | |

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| | | problems designed to elicit evidence for Claim 2.<br><br>Tasks asking students to use trigonometric ratios and the Pythagorean Theorem in applied problems will contribute evidence to Claims 2 and 4.<br><br>(Evidence Required)<br>1. The student uses the definitions of trigonometric ratios for acute angles in a right triangle.<br>2. The student uses similar triangles to define and determine trigonometric ratios in right triangles.<br>3. The student explains and uses the relationship between the sine and cosine of complementary angles.<br>4. The student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context.<br><br>(Range ALDs)<br>**Level 1** Students should be able to identify trigonometric ratios and use the Pythagorean Theorem to solve for the missing side in a right triangle in familiar real-world or mathematical contexts with scaffolding.<br>**Level 2** Students should be able to define trigonometric ratios and should know the relationship between the sine and cosine of complementary angles. They should be able to use the Pythagorean Theorem in unfamiliar problems and trigonometric ratios in familiar problems to solve for the missing side in a right triangle with some scaffolding.<br>**Level 3** Students should be able to use the Pythagorean Theorem, trigonometric ratios, and the sine and cosine of complementary angles to solve unfamiliar problems with minimal scaffolding involving right triangles, or finding the missing side or missing angle of a right triangle.<br>**Level 4** Students should be able to solve unfamiliar, complex, or multistep problems without scaffolding involving right triangles. | | | | |
| | | **P. Summarize, represent, and interpret data on a single count or measurement variable.**<br>(Target Description)<br>Tasks for this target will require students to use appropriate statistics to explain difference in shape, center, and spread of two or more different data sets, including the effect of outliers. | 2 | 1-2 | | |

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| | | (Evidence Required)<br>1. The student will be able to represent data on the real number line with a dot plot, histogram, or box plot.<br>2. The student will be able to use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.<br>3. The student will be able to interpret the differences in shape, center, and spread in the context of the data sets.<br>4. The student will be able to interpret the effects of outliers on the shape, center, and spread of a data set.<br><br>(Range ALDs)<br>**Level 1** students should be able to describe a data set in terms of center and spread and represent data graphically.<br>**Level 2** students should be able to describe and use appropriate statistics to interpret and explain differences in shape, center, and spread of two or more different data sets, including box plots, histograms, or dot plots, representing familiar contexts. They should be able to identify the mean and the median and select the appropriate one for representing the center of the data for data sets.<br>**Level 3** students should be able to use appropriate statistics to interpret, explain, and summarize differences in shape, center, and spread of two or more different data sets of varying complexity and levels of familiarity, including the effect of outliers. They should be able to select the appropriate choice of spread as interquartile range or standard deviation based on the selection of center, and use the standard deviation of a data set to fit to a normal distribution.<br>**Level 4** students should be able to interpret data to explain why a data value is an outlier and interpret and explain differences in the approximate areas under the normal curve of two or more data sets. | | | | |
| | | **A. Extend the properties of exponents to rational exponents.**<br>(Target Description)<br>Tasks for this target will require students to use the definition of radicals and rational exponents and identify equivalent numeric and algebraic expressions involving rational exponents and radicals. Tasks for this target will require students to find the exact value of numbers expressed in terms of rational exponents or estimate their magnitude, where appropriate. Claim 3 tasks will | 1, 2 | 1 | | |

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| | | tap student understanding of the properties of exponents and their ability to identify flawed reasoning applied to this target.<br><br>(Evidence Required)<br>1. The student rewrites expressions in radical form into an equivalent expression with rational exponents.<br>2. The student rewrites expressions with rational exponents into an equivalent expression in radical form.<br>3. The student uses the properties of exponents to write equivalent expressions involving radicals and rational exponents.<br>4. The student solves equations that require an understanding of the definitions of radicals and rational exponents.<br>5. The student finds exact or approximate values of numeric expressions involving rational exponents or radicals.<br>6. The student compares expressions involving rational exponents or radicals with other numbers.<br><br>(Range ALDs)<br>**Level 1** Students should be able to rewrite expressions with rational exponents of the form (1/*n*) to radical form and vice versa.<br>**Level 2** Students should be able to look for and use structure to extend the properties of integer exponents to multiply and divide expressions with rational exponents that have common denominators.<br>**Level 3** Students should be able to rewrite expressions with rational exponents of the form (*m*/*n*) to radical form, and vice versa, and look for and use structure to extend the properties of integer exponents to all laws of exponents on radical expressions and expressions with rational exponents.<br>**Level 4** Students should be able to identify the exponent property used when rewriting expressions, and recognize when laws of exponents cannot be used to rewrite an expression. | | | | |
| | | **B. Use properties of rational and irrational numbers.**<br>(Target Description)<br>Tasks for this target will require students to demonstrate understanding of operations with rational and irrational numbers. Tasks that ask students to explain why operations with rational and irrational numbers lead to either rational or irrational numbers will contribute evidence to Claim 3.<br><br>(Evidence Required) | 1, 2 | | | |

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| | | 1. The student provides examples of addition or multiplication problems that will have sums or products of a specified type (either rational or irrational).<br>2. The student determines whether the sum of two numbers is a rational number or an irrational number.<br>3. The student determines whether the product of two numbers is a rational number or an irrational number.<br>4. The student provides an abstract generalization that the sum or product of any two rational numbers is rational, the sum of a rational number and an irrational number is irrational, and the product of a nonzero rational number and an irrational number is irrational.<br><br>(Range ALDs)<br>**Level 1** students should be able to identify the difference between a rational and an irrational number.<br>**Level 2** students should be able to perform operations on rational and irrational numbers.<br>**Level 3** students should be able to understand and explain that the sum and product of a rational number and a nonzero irrational number are irrational.<br>**Level 4** students should be able to provide a specific example given a generalization statement, such as the sum of a rational number and an irrational number is irrational. | | | | |
| | | **C. Reason quantitatively and use units to solve problems**<br>(Target Description)<br>Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.<br><br>(Evidence Required)<br>1. The student chooses units consistently in formulas.<br>2. The student chooses the scales for graphs and data displays.<br>3. The student chooses appropriate quantities for answering a question in a real-world context.<br><br>(Range ALDs)<br>**Level 1** students should be able to choose the units in a formula, correctly scale a graph with unit increments, and identify a quantity from a graph with a scale in unit increments of a specified measurement. | 1, 2 | 1 | | |

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| | | **Level 2** students should be able to reason quantitatively to choose and interpret the units in a formula given in a familiar context, including making measurement conversions between simple units and identifying a quantity from a graph with the scale in increments of various sizes. They should be able to use units to guide the solution of a familiar multi-step problem with scaffolding.<br>**Level 3** students should be able to reason quantitatively to choose and interpret the units in a formula given in an unfamiliar context, including making measurement conversions between compound units, and to define appropriate quantities or measurements in familiar contexts with some scaffolding to construct a model. They should be able to identify appropriate levels of measurement precision in context and to choose and interpret the scale and origin of a graph or data display. They should be able to use units to guide the solution of an unfamiliar multi-step problem without scaffolding.<br>**Level 4** students should be able to define appropriate quantities or measurements in unfamiliar contexts with little to no scaffolding to construct a model. | | | | |
| 2. Problem Solving<br>4. Modeling and Data Analysis | Problem Solving (drawn across content domains) | **A. Apply mathematics to solve well-posed problems arising in everyday life, society , and the workplace.**<br>(General Task Model Expectations )<br>1. Mathematical information from the context is presented in a table, graph, or diagram, or is extracted from a verbal description or pictorial representation of the context.<br>2. Solving the problem requires either using units, setting up and solving an equation or system of equations, building and interpreting equations or functions that represent relationships between quantities, finding or calculating geometric measures, or reasoning about geometric figures in the plane.<br>3. The problem may require the integration of concepts and skills from multiple domains.<br>4. The task does not indicate by key words or other scaffolding which operations, constructions, or transformations are to be performed or in what order.<br>5. Difficulty of the task may be varied by varying (a) the difficulty of extracting information from the context, (b) the number of steps, or (c) the complexity of the expressions, equations, functions, or geometric figures used. | 2, 3 | 2 | 1-2 | 8-10 |

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| | | **B. Select and use appropriate tools strategically.**<br>(General Task Model Expectations)<br>1. The student uses a tool or makes a strategic selection of tools in the course of solving a problem.<br>2. Mathematical information is presented in a table, graph, diagram, or equation or is extracted from a verbal description or pictorial representation of a context.<br>3. Tools include drawing tools, graphing tools, and geometric transformation tools.<br><br>**C. Interpret results in the context of a situation.**<br>(General Task Model Expectations)<br>1. Student is asked to solve a well-posed problem arising in a context from everyday life, society, or the workplace, and then to interpret the solution in terms of the context.<br>2. Possible interpretations include: giving the units of an answer and explaining their meaning, interpreting parameters in a function or parts of an expression, interpreting the solution to an equation, interpreting a statement involving function notation. Problems involving interpreting data are more likely to fit Claim 4 than Claim 2C.<br>3. Because the focus is on interpreting the solution, items in this task model will generally have lower cognitive demand in the problem solving phase than items in Task Models 1 and 2.<br>4. Mathematical information from the context is presented in a table, graph, or diagram, or is extracted from a verbal description or pictorial representation of the context.<br>5. Solving the problem requires either using units, writing an expression in an equivalent form, setting up and solving an equation or system of equations, or interpreting and building functions, performing a geometric construction or transformation, or calculating geometric measures.<br><br>**D. Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).**<br>(General Task Model Expectations)<br>1. The student is presented with a mathematical problem in a real-world context where the quantities of interest are not named explicitly, are named but represented in different ways, or the relationship between the quantities | 1, 2, 3 | 1 | | |

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| | | is not immediately clear.<br>2. The student is asked to solve a problem that may require the integration of concepts and skills from multiple domains.<br>3. Target 2D identifies a key step in the modeling cycle, and is thus frequently present in problems with real-world contexts. Note that Target 2D is rarely the primary target for an item, but is frequently a Secondary or Tertiary Target for an item with primary alignment to 2A, 2B, or 2C; see example items for many of the task models in those Targets. | | | | |
| | Modeling and Data Analysis (drawn across content domains) | **A. Apply mathematics to solve problems arising in everyday life, society, and the workplace.**<br>(General Task Model Expectations)<br>1. The student is asked to solve a problem arising in everyday life, society, or the workplace using functions, geometric modeling, probability, or statistics.<br>2. Information needed to solve the problem has a level of complexity that is not present in items within Claim 2 Target A. For example, the student may be required to<br>• ignore extraneous information, and extract relevant information,<br>• identify information that is not given in the problem and request or conduct research to find it,<br>• make a reasoned estimate for one or more quantities and use that estimate to solve the problem, and/or<br>• make strategic decisions about a solution that takes into account time, cost, or new information.<br>3. The student must select a mathematical or statistical model themselves.<br>4. Tasks in this model often have secondary alignments to other Claim 4 targets, in particular Target 4D, requiring the student to interpret results in the context of the problem, and Target 4F, requiring students to identify quantities and map relationships between them.<br>5. Problems in this model may have more than one possible solution.<br>6. The student is often required to draw upon knowledge from different domains, including knowledge from earlier grade-levels.<br>7. Students often have access to a calculator. Some items are best answered without a calculator, promoting strategic use of the calculator.<br><br>**D. Interpret results in the context of a situation.**<br>(General Task Model Expectations)<br>1. The student is presented with a problem situation in everyday life, society, or the workplace or a mathematical model of such a situation. The student | 2, 3 | 1 | 1-3 | |

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| | | interprets the solution to the problem in terms of the context, in terms of the model, or compares the results of the model with the real-world data it represents.<br>• Item types with a primary alignment to 4D focus on interpreting results in terms of the model or comparing the results of the model with the real-world data it represents.<br>• It is not necessary for a student to generate a complete solution for problems with a primary alignment to this target.<br>2. Tasks in Targets 4A, 4C, 4E, and 4F frequently have this target as a tertiary or quaternary alignment because students must interpret their results in terms of the context.<br>3. The student is often required to draw upon knowledge from different domains, including knowledge from earlier grade-levels. | | | | |
| | | **B. Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem.**<br>(General Task Model Expectations)<br>1. The student is presented with a multi-step problem with little or no scaffolding, or<br>2. The student must make estimates or choose between different reasonable assumptions in order to solve the problem.<br>3. Note that Target 4B is never the primary target for an item, but is frequently a Tertiary or Quaternary Target for an item with primary alignment to other targets; see, for example, items in Task Models for 4A, 4C, and 4E. | | | | |
| | | **E. Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon.**<br>(General Task Model Expectations)<br>1. The student is presented with a problem arising in everyday life, society, or the workplace. The student either<br>• chooses between competing mathematical models to solve the problem (which may depend on different interpretations of the problem),<br>• evaluates a partial or complete (possibly incorrect) solution to the problem, or<br>• constructs a mathematical model to solve the problem.<br>Note: It is not necessary that a student constructs a complete solution to the problem for this target. | 2, 3, 4 | 1 | | |

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| | | 2. Tasks in this model can also assess Target 4B (Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem). Thus some tasks should plausibly entail a chain of reasoning to complete the task, not just a single step.<br>3. The student is often required to draw upon knowledge from different domains, including knowledge from earlier grade-levels. | | | | |
| | | **C. State logical assumptions being used.**<br>(General Task Model Expectations)<br>1. The student is presented with a problem arising in everyday life, society, or the workplace. The student either<br>• identifies information or assumptions needed to solve the problem,<br>• researches additional information needed to solve the problem, or<br>• provides a reasoned estimate of a quantity needed to solve the problem.<br>It is not necessary that a student constructs a complete solution to the problem for this target.<br>2. Tasks in this model generally have either more information than is needed solve the problem (and students identify the relevant information) or not enough information (and students must provide a reasoned estimate).<br>3. The student is often required to draw upon knowledge from different domains, including knowledge from earlier grade- levels.<br>4. Tasks in this model sometimes ask students to choose one of two or more reasonable models, and then to draw the appropriate conclusion base on their choice without evaluating the appropriateness of that choice.<br>5. Tasks for this target may also assess Target 4F.<br><br>**F. Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).**<br>(General Task Model Expectations)<br>1. Students are presented with a mathematical problem in a real-world context where the quantities of interest are not named explicitly, are named but represented in different ways, or the relationship between the quantities is not immediately clear.<br>2. The student is asked to solve a problem that may require the integration of concepts and skills from multiple domains. | 1, 2, 3 | 1 | | |

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| | | **G. Identify, analyze, and synthesize relevant external resources to pose or solve problems.**<br>(General Task Model Expectations)<br>Measured in performance tasks only, students should have access to external resources to support their work in posing and solving problems (e.g., finding or constructing a set of data or information to answer a particular question or looking up measurements of a structure to increase precision in an estimate for a scale drawing). Constructed response items should incorporate "hyperlinked" information to provide additional detail (both relevant and extraneous). | 3, 4 | 0 | | |
| 3. Communicating Reasoning | Communicating Reasoning (drawn across content domains) | **A. Test propositions or conjectures with specific examples.**<br>(General Task Model Expectations)<br>1. Items for this target should focus on the core mathematical work that students are doing around the real number system, algebra, functions, and geometry.<br>2. In response to a claim or conjecture, the student should:<br>• Find a counterexample if the claim is false,<br>• Find examples and non-examples if the claim is sometimes true, or<br>• Provide supporting examples for a claim that is always true without concluding that the examples establish that truth, unless there are only a finite number of cases and all of them are established one-by-one. The main role for using specific examples in this case is for students to develop a hypothesis that the conjecture or claim is true, setting students up for work described in Claim 3B.<br>3. False or partially true claims that students are asked to find counterexamples for should draw upon frequently held mathematical misconceptions whenever possible.<br>4. Note: Use appropriate mathematical language in asking students for a single example. While a single example can be used to refute a conjecture, it cannot be used to prove one is always true unless that is the one and only case.<br><br>**D. Use the technique of breaking an argument into cases.**<br>(General Task Model Expectations)<br>1. Items for this target should focus on the core mathematical work that students are doing around the real number system, algebra, functions, and geometry.<br>2. The student is given | 2, 3 | 3 | 0-2 | 8-10 |

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| | | • A problem that has a finite number of possible solutions, some of which work and some of which don't, or<br>• A proposition that is true in some cases but not others.<br>3. Items for Claim 3 Target D should either present an exhaustive set of cases to consider or expect students to consider all possible cases in turn in order to distinguish it from items in other targets. | | | | |
| | | **B. Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures.**<br>(General Task Model Expectations)<br>1. Items for this target should focus on the core mathematical work that students are doing around the real number system, algebra, functions, and geometry.<br>2. Items for this target can require students to solve a multi-step, well-posed problem involving the application of mathematics to a real-world context. The difference between items for Claim 2A and Claim 3B is that the focus in 3B is on communicating the reasoning process in addition to getting the correct answer.<br>3. Many machine-scorable items for these task models can be adapted to increase the autonomy of student's reasoning process but would require hand-scoring.<br><br>**E. Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is.**<br>(General Task Model Expectations)<br>1. Items for this target should focus on the core mathematical work that students are doing around the real number system, algebra, functions, and geometry.<br>2. The student is presented with valid or invalid reasoning and told it is flawed or asked to determine its validity. If the reasoning is flawed, the student identifies, explains, and/or corrects the error or flaw.<br>3. The error should be more than just a computational error or an error in counting, and should reflect an actual error in reasoning.<br>4. Analyzing faulty algorithms is acceptable so long as the algorithm is internally consistent and it isn't just a mechanical mistake executing a standard algorithm. | 2, 3, 4 | 3 | | |
| | | **C. State logical assumptions being used.**<br>(General Task Model Expectations)<br>1. Items for this target should focus on the core mathematical work that | 2, 3 | 2 | | |

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| | | students are doing around the real number system, algebra, functions, and geometry.<br>2. For some items, the student must explicitly identify assumptions that<br>• Make a problem well-posed, or<br>• Make a particular solution method viable.<br>3. When possible, items in this target should focus on assumptions that are commonly made implicitly and can cause confusion when left implicit.<br>4. For some items, the student will be given a definition and be asked to reason from that definition.<br><br>**F. Base arguments on concrete referents such as objects, drawings, diagrams, and actions.**<br>(General Task Model Expectations)<br>In earlier grades, the desired student response might be in the form of concrete referents. In later grades, concrete referents will often support generalizations as part of the justification rather than constituting the entire expected response.<br><br>**G. At later grades, determine conditions under which an argument does and does not apply. (For example, area increases with perimeter for squares, but not for all plane figures.)**<br>(General Task Model Expectations)<br>Target 3G is a closely related extension of the expectations in Targets 3A, 3B, 3C, and 3D, and as with those targets, is often a tertiary alignment for items in those targets. Students often test propositions and conjectures with specific examples (as described in Target 3A) for the purpose of formulating conjectures about the conditions under which an argument does and does not apply. Students then must explicitly describe those conditions (as in Target 3C). Expectations for Target 3D include determining conditions under which an argument is true given cases—the next step is articulating those cases autonomously. | | | | |