HS Target G

Domain, Target, Standards, DOK, Vertical Alignments, Achievement Levels, Evidence Required, Vocabulary, Response Types, Materials, Attributes, Question Types, and Question Banks (Examples)

Content Domain: Algebra
Target G [m]: A-CED.A Create equations that describe numbers or relationships.
Standards included in Target G: A-CED.A, A-CED.A.1, A-CED.A.2
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Claim 2 Problem Solving Questions Banks
Claim 3 Communicating Reasoning Question Banks
Claim 4 Modeling and Data Analysis Question Banks

Content Domain: Algebra

Target G [m]: A-CED.A Create equations that describe numbers or relationships.

Standards included in Target G: A-CED.A, A-CED.A.1, A-CED.A.2

A-CED.A Create equations that describe numbers or relationships.

A-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions and simple rational and exponential functions.

A-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Vertical Alignment

Related Grade 8 standards

8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.

8.EE.C.7 Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until

an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8.F.A Define, evaluate, and compare functions.

8.F.A.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.

8.F.B Use functions to model relationships between quantities.

8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models and in terms of its graph or a table of values. 8.F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Achievement Level Descriptors

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.

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.

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 given quantity.

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.

Evidence Required

1. The student creates one variable equations arising from linear, quadratic, simple rational, and

exponential functions in one variable.

2. The student creates one variable inequalities arising from linear, quadratic, simple rational, and exponential functions in one variable.

3. The student graphs equations or inequalities on coordinate axes with labels and scales to represent the solution to a contextual problem.

4. The student creates equations in two or more variables to represent relationships between quantities.

Vocabulary
Inequality, exponential, quadratic, linear, equation

Response Types
Equation/Numeric; Graphing

Materials
two-way table of values, graphs of linear equations or inequalities, graphs of quadratic equations or inequalities graphs of exponential equations or inequalities

Attributes
Equations can be linear, quadratic, simple rational, or exponential.

Claim 1: Concepts and Procedures (DOK 1, 2) Question Banks
Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.

Claim 1 A-CED.A.1 DOK Level 2

Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions and simple rational and exponential functions.

Evidence Required
The student creates one variable equations arising from linear, quadratic, simple rational, and exponential functions in one variable.

Question Type 1: The student is presented with a contextual problem.

1. Consider the given equation that models a train's distance from its departing station, where:
    - y represents the distance in miles,
    - x represents the speed of the train in miles per hour, and
    - t represents the time traveled from the departing station in hours.

$y=xt$

Enter an equation for which the solution is the speed of the train, in miles per hour, where the train's distance from the departing station is 162 miles and it has traveled for 3 hours.

Rubric: (1 point) The student correctly enters an equation (e.g., 162=3x or any equation equivalent to x=54).

Response Type: Equation/Numeric

2. Consider the equation that gives the minimum stopping distance, d, in feet, for an automobile, where:

- v represents the automobile speed, in feet per second,
- s represents the driver's response time, in seconds, to apply the brakes, and
- m represents the coefficient of friction between the tires and the road.

$$d = vs + \frac{v^2}{64m}$$

Enter an equation for which the solution is the speed, in feet per second, of an automobile with a stopping distance of 200 feet, a driver's response time of 0.5 second, and a coefficient of friction equal to 0.8.

Rubric: (1 point) The student correctly enters an equation (e.g., equation equivalent to $200=0.5v+v^2/51.2$).

3. A sales clerk's daily earnings include $125 per day plus commission equal to x percent of his daily sales.

Enter an equation that can be used to find the commission percentage (x), if the clerk's daily sales are $1375 and his total earnings for that day are $180.

Rubric: (1 point) The student correctly enters an equation [e.g., $125+ x/100 \cdot 1375 =180$ or equivalent].

4. Jim can paint a house in 12 hours. Alex can paint the same house in 8 hours.

Enter an equation that can be used to find the time in hours, t, it would take Alex and Jim to paint the house together assuming they both work at the rates they work when working alone.

Rubric: (1 point) The student correctly enters an equation (e.g., $1/12+ 1/8= 1/t$ or equivalent).
Response Type: Equation/Numeric

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Claim 1 A-CED.A.1 DOK Level 2

Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions and simple rational and exponential functions.

Evidence Required
The student creates one variable equations arising from linear, quadratic, simple rational, and exponential functions in one variable.

Question Type 1: The student is presented with a contextual situation that can be represented by an inequality.

1. A clerk earns $125 per day, plus a commission equal to 10% of her sales, s. The clerk earns less than $180 on Monday.

Enter an inequality that represents all possible values for the clerk's sales, s, on Monday.

Rubric: (1 point) The student correctly enters the inequality (e.g., inequality equivalent to $0.1v+125<180$).

2. A rectangular garden measuring 13 meters by 15 meters is to have a gravel pathway of constant width built all around it. There is enough gravel to cover 80 square meters or less.

Enter an inequality that represents all possible widths (w), in meters, of the pathway.

Rubric: (1 point) The student correctly enters an inequality equivalent to $(13+2w)(15+2w)-13(15)\leq 80$.

Response Type: Equation/Numeric

Claim 1 A-CED.A.2 DOK Level 2

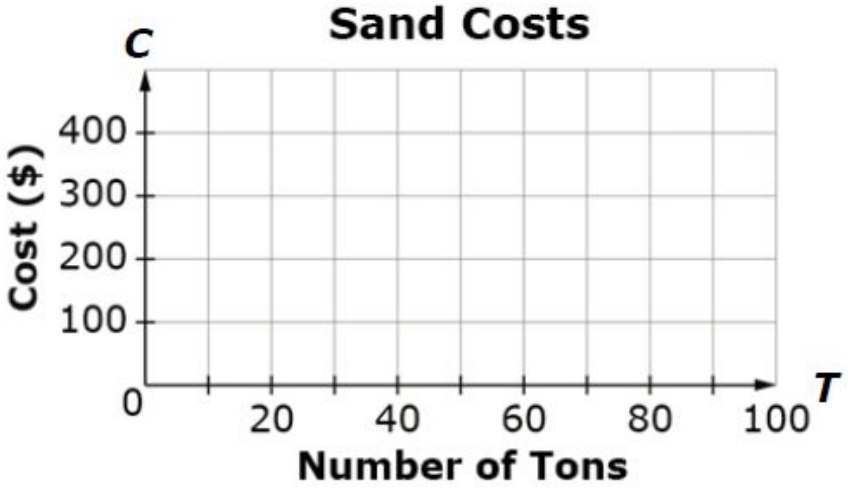
Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Evidence Required
The student graphs equations on the coordinate axes with labels and scales to represent the solution to a contextual problem.

Question Type 1: The student is presented with a contextual situation and a labeled coordinate grid.

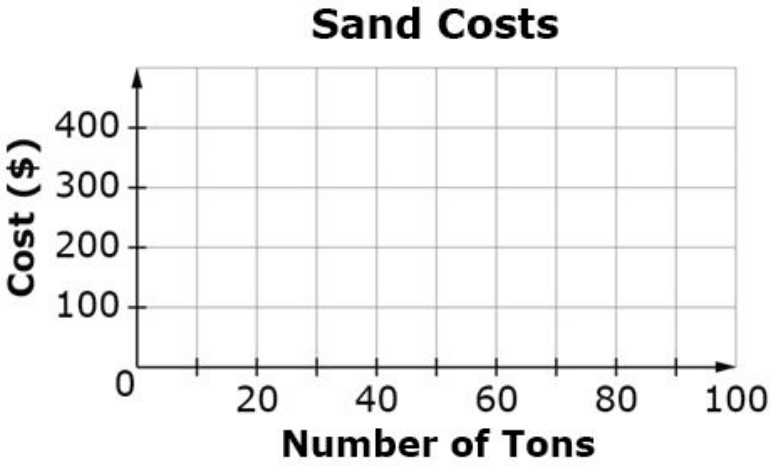
1. An elementary school is having sand delivered for the playground. Sadie's Sand charges $5.00 per ton of sand plus a delivery fee of $200. Greg's Sand Pit charges $12.00 per ton of sand plus a delivery fee of $50.

Use the Add Arrow tool to represent functions that show the cost C of buying T tons of sand from each company.



Interaction: The student uses the Add arrow tool to graph the functions represented in the context.

Rubric: (1 point) The student correctly graphs the functions.



Response Type: Graphing

Claim 1 A-CED.A.1 DOK Level 1

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Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions and simple rational and exponential functions.

Evidence Required
The student creates equations in two or more variables to represent relationships between quantities.

Question Type 1: The student is presented with a contextual situation.

1. Malik and Nora are playing a video game.
    - Malik starts with m points and Nora starts n points.
    - Then Malik gets 150 more points, while Nora loses 50 points.
    - Finally, Nora gets a bonus and her score is doubled.
    - Nora now has 50 more points than Malik.

Enter an equation that represents the relationship between m and n given the information above.

Rubric: (1 point) The student correctly enters the equation (e.g., equation equivalent to $2(n-50)=(m+150)+50$).

Response Type: Equation/Numeric

Claim 2 Problem Solving Questions Banks

Claim Descriptors and Targets

Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies.

Example 1

The $1000 prize for a lottery is to be divided evenly among the winners. Initially, there are x winners.
However, one more winner comes forward, causing each winner to receive $50 less.

Enter an equation that represents the situation and can be used to solve for x, the initial number of winners.
Enter your equation in the response box.

Rubric: (1 point) The student creates a correct equation (e.g., $1000/x-50=1000/x+1$).

Response Type: Equation/Numeric

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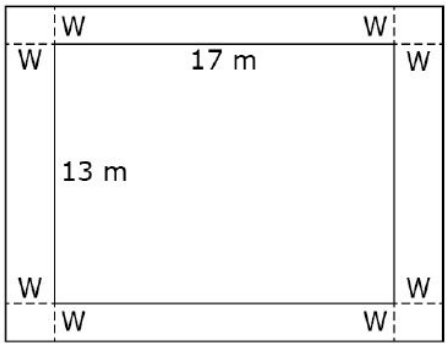
Example 2

A rectangular garden, shown in the diagram, measures 13 meters by 17 meters. The garden has a cement walkway around its perimeter, as shown. The width, W, of the walkway remains constant on all four sides, as shown in the figure. The garden and walkway have a combined area of 396 square meters.



Part A
Enter an equation in the first response box that can be used to find the width, W.
Part B
Determine the width, W (in meters), of the walkway. Enter your answer in the second response box.

Rubric: (2 points) The student enters the correct equation and width in the response boxes [(13+2W)(17+2W)=396; 2.5].
(1 point) The student answers only one part correctly.

Response Type: Equation/Numeric (2 response boxes)

Commentary on Example Item 2C.1a: A variation of this item would ask for the dimensions of the garden rather than asking for the width).

Claim 3 Communicating Reasoning Question Banks

Claim Descriptors and Targets

Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.

Example 1

Proposition 1 The sum of two linear polynomials with integer coefficients is always a linear polynomial with integer coefficients.

The Closure of the Integers Under Addition The sum of two integers is always an integer

The Commutative Property If A and B are real numbers, then A + B = B + A

The Associative Property If A, B, and C are real numbers, then (A + B) + C = A + (A + C)

The Distributive Property If A, B, and C are real numbers, then A(B + C) = AB + AC

The Any-Order Property of Addition The sum of two or more real numbers can be performed in any order or any grouping.

The outline of a proof of Proposition 1 is shown. Add one or more justifications for steps 3, 4, and 5 of the proof.

Statement	Justification
1. Given $p(x) = ax+b$ and $q(x) = cx+d$ where a, b, c, and d are integers.	Hypothesis
2. $p(x) + q(x) = (ax+b) + (cx+d)$	By Definition
3. $p(x) + q(x) = (ax+cx) + (b+d)$	
4. $p(x) + q(x) = (a+c)x + (b+d)$	
5. $(a+c)$ and $(b+d)$ are integers	
6. So $p(x) + q(x)$ is a linear polynomial with integer coefficients.	Conclusion

Rubric: (1 point) The student provides a correct justification for each step of the proof (Example below. Note that for step (3), students can either cite the any-order property of addition or cite the commutative and associative properties together).

Statement	Justification
1. Given $p(x) = ax+b$ and $q(x) = cx+d$ where a, b, c, and d are integers.	Hypothesis
2. $p(x) + q(x) = (ax+b) + (cx+d)$	By Definition
3. $p(x) + q(x) = (ax+cx) + (b+d)$	**The Any-Order Property of Addition**
4. $p(x) + q(x) = (a+c)x + (b+d)$	**The Distributive Property**
5. $(a+c)$ and $(b+d)$ are integers	**The Closure of the Integers Under Addition**
6. So $p(x) + q(x)$ is a linear polynomial with rational coefficients.	Conclusion

Response Type: Drag and Drop

Claim 4 Modeling and Data Analysis Question Banks

Claim Descriptors and Targets

Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

Example 1

Maia deposited $5500 in a bank account. The money earns interest annually, and the interest is deposited back into her account.

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Maia uses an online calculator to determine the amount of money she will have in the account at the end of each year. Follow these steps to use the calculator for each row in the table.

- Select number of years.
- Select “Find Amount.”

The amount of money that Maia will have in her account at the end of the selected year, up to 12 years, will appear in the table.

You may use the calculator as many times as you need to help solve the problem.

Enter an equation that models the amount of money, y, Maia will have in the account at the end of t years.

Rubric: (1 point) The student is able to determine an equation to fit the situation [e.g., y=5500(1.03)t].

Response Type: Equation/Numeric