HS Functions - SBA Claim 1 Example Stems

This document takes publicly available information about the Smarter Balanced Assessment (SBA) in Mathematics, namely the Claim 1 Item Specifications, and combines and edits them down to hopefully be more useful for teachers and others. The SBA Consortium is not involved in producing this document, so editing choices do not reflect any guidance from the SBA Consortium.

The SBA uses evidence based design, viewing the assessment as eliciting evidence of student proficiency. That evidence is meant to support Claims, which in math are (to paraphrase):

1. A student understands **concepts** and can perform **procedures**.
2. A student can **solve problems**.
3. A student can **reason** (and critique the reasoning of others).
4. A student can analyze and **model real-world contexts** using mathematics.

These claims will be assessed in a roughly 40%-20%-20%-20% split. Given that previous assessments would heavily focus on procedures, while in this framework they constitute 20% as a focus (though of course are needed for items across all claims), this represents a significant shift in assessment.

This document only looks at Claim 1 about concepts and procedures. Items written for Claim can look much like the Example Stems below. At other Claims items can vary more widely, as one would expect for multistep problems and authentic reasoning or modeling contexts.

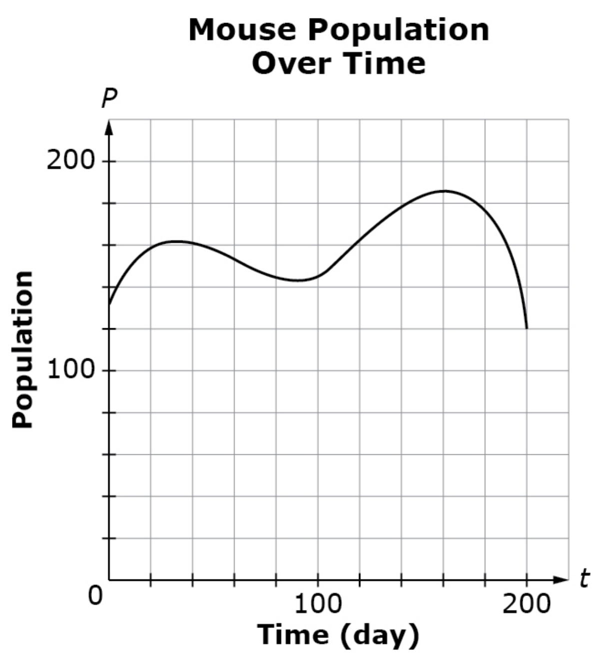
Claim 1 is divided into various Targets which correspond roughly to the Clusters within the Common Core State Standards in Mathematics. The items from different targets will be taken based on emphasis with [m] being major, [a] additional and [s] supporting.

Finally, in an era of anxiety about end-of-year assessment (which constitutes only part of the Smarter Balanced system), it should be said that these are offered primarily to promote teacher professional understanding. Practices such as using the Example Stems exclusively as learning targets are discouraged. SBA is designed as much as possible to assess authentic learning of mathematics as outlined in the Standards, so that authentic learning should guide instruction.

Target L [m]: Interpret functions that arise in applications in terms of the context.

Stimulus: The student is given a graph or table representing a function that models the relationship between two quantities in a real world situation familiar to 15- to 17-year-olds, e.g., temperature change over time, or population change over a period of time.

Example Stem 1: This graph shows the population of mice in a study, modeled as a function of time. The study begins on day 0.



Determine whether each statement is true according to the graph. Select True or False for each statement.

Statement	True	False
The mouse population was decreasing between day 40 and day 80.		
The least number of mice during the study was 130.		
The mouse population was at its greatest around day 160.		
There are two intervals where the mouse population is decreasing.		

Example Stem 2: This table shows the relationship between the height of a ball and its horizontal distance from the starting point when it is kicked from ground level into the air.

Horizontal Distance from Starting Point (ft)	0	2.5	3	5	6.5	8	10	10.5	13
Height (ft)	0	52.5	60	80	84.5	80	60	52.5	0

Determine whether each statement is true according to the table. Select True or False for each statement.

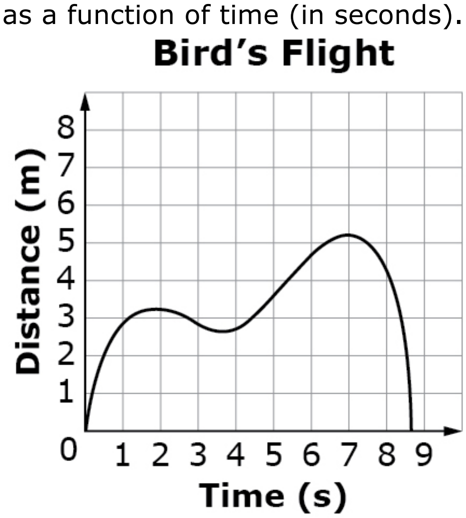
Statement	**True**	**False**
The height of the ball decreased from a distance of 2.5 to 6.5 feet from the starting point.		
The height of the ball was at its greatest when it was approximately 6.5 feet away from the starting point.		
The ball was on the ground exactly one time.		

Rubric: (1 point) The student correctly selects the true and false interpretations of key features represented by the graph or table (e.g. F, T, F).

Response Type: Matching Tables

Stimulus: The student is given a graph representing a function that models the relationship between two quantities in a real world situation familiar to 15- to 17-year-olds, e.g., temperature change over time, or population change over a period of time.

Example Stem: A bird flies out of its nest. This graph represents the distance it flies from its nest (in meters) as a function of time (in seconds).



Drag the star to mark the point on the graph that represents the bird's greatest distance from its nest. Then drag the circle to mark the point that represents the bird's return to its nest.

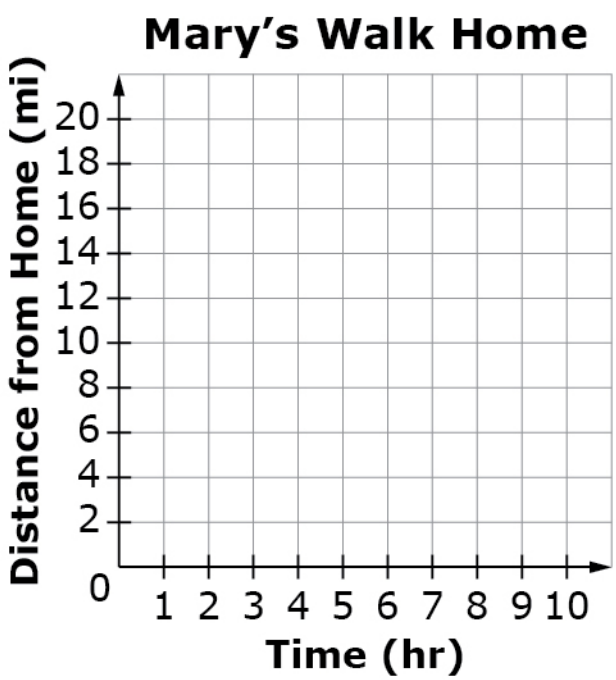
Interaction:
The student drags the star and circle to the correct points on the graph.

Rubric: (1 point) The student correctly identifies the point representing the bird's farthest distance from the nest and the point where the bird returns [e.g., approximately (7, 5.2) and (8.7, 0)].
Response Type: Hot Spot

Stimulus: The student is presented with a contextual situation, familiar to 15- to 17-year-olds, where a function can model a relationship between two quantities.

Example Stem 1: Mary is 10 miles from her home.

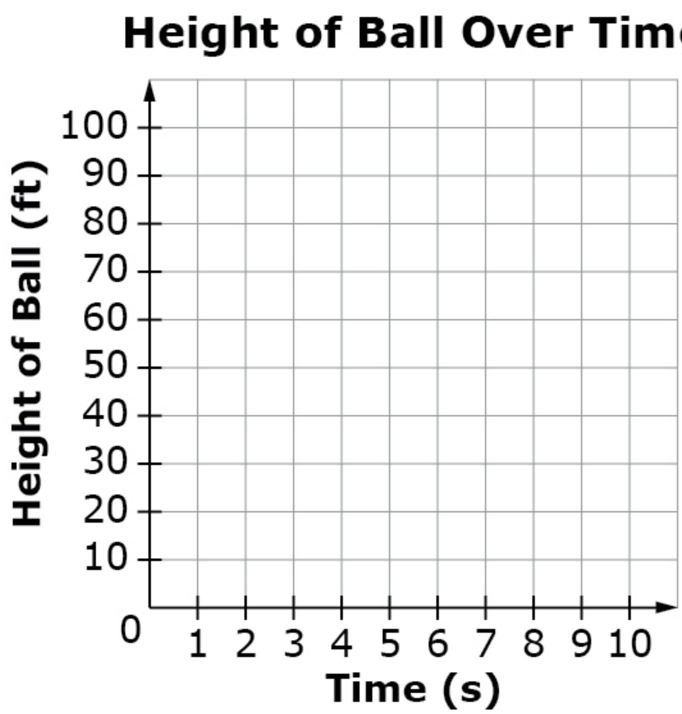
- She is returning home, walking at a constant speed of 2 miles per hour.
- Her distance from home can be modeled as a function of time.



Use the Add Point and Connect Line tools to graph Mary's distance from home as a function of time.
Interaction: The student uses the Add Point tool to place points on the grid, and the Connect Line tool to connect the points.

Rubric:
(1 point) The student creates the graph correctly.

Example Stem 2: A ball is on the ground. Jon kicks the ball into the air. Assume that the height of the ball can be modeled as a quadratic function with respect to time. It reaches a maximum height of 64 feet and lands on the ground 4 seconds later.



Use the Add Point tool to plot the points on the grid that represent

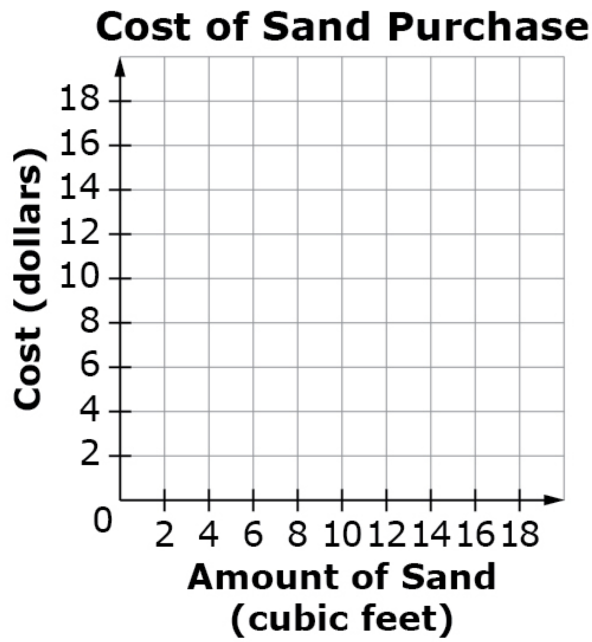
- when John kicks the ball,
- the ball at its highest point, and
- when the ball lands on the ground.

Interaction: The student uses the Add Point tool to place points on the grid.
Rubric:
(1 point) The student plots the points correctly.

Example Stem 3: A company is building a playground and needs to buy sand. The cost of sand is a function of the amount of sand purchased.

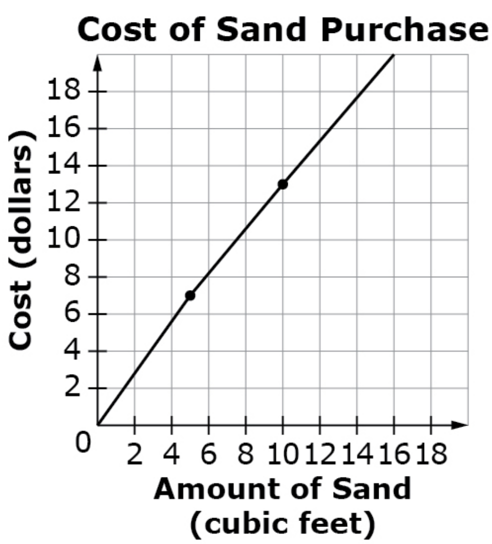
- The first 5 cubic feet cost $1.50 per cubic foot.
- An amount greater than 5 cubic feet and less than or equal to 10 cubic feet costs $1.25 per cubic foot.
- An amount over 10 cubic feet costs $1.00 per cubic foot.

Use the Add Point and Connect Line tools to create a graph to show the total cost of the sand (in dollars) as a function of the amount of sand purchased (in cubic feet).



Interaction: The student uses the Add Point tool and Connect Line tool to graph the linear segments of a piecewise function on the grid.

Rubric:
(1 point) The student creates the graph correctly.



Stimulus: The student is presented with a contextual situation, and asked to identify the domain of the function modeled by the given situation.

Example Stem: Billy buys light bulbs in packs of 8 for $20. The shipping cost is $10 regardless of the number of packs bought. Billy has only $120 to spend.

The cost per light bulb with respect to number of packs bought can be modeled by a function. Select the statement that correctly describes the domain of the function.

A. The domain is the set of all real numbers greater than or equal to 1 and less than or equal to 6.
B. The domain is the set of all real numbers greater than or equal to 0 and less than or equal to 5.
C. The domain is the set of all integers greater than or equal to 1 and less than or equal to 6.
D. The domain is the set of all integers greater than or equal to 0 and less than or equal to 5.

Rubric: (1 point) The student correctly selects the statement describing the domain or range of the function (e.g., D).
Response Types: Multiple Choice, single correct response

Stimulus: The student is presented with a contextual situation, and asked to identify the domain of the function modeled by the given situation.

Example Stem 1: A farmer is selling watermelons. She has 43 watermelons and plans to sell them for $3 each. The farmer's total sales, in dollars, is a function of the number of watermelons she sells.

Select **all** the statements that correctly describe the domain or range of this function.

A. The domain is the set of all integers from 0 to 43.
B. The domain is the set of all real numbers from 0 to 43.
C. The range is the set of all integers between 0 and 129.
D. The range is the set of all multiples of 3 from 0 to 129.
E. The range is the set of all multiples of 43 from 43 to 129.

Stimulus: The student is presented with a function in symbolic form, representing a context familiar to 15- to 17-year-olds.

Example Stem: Craig records the number of minutes, *m*, it takes him to mow *n* lawns in a table.

n	1	2	3	4	5	6
m(*n*)	33	64	89	109	124	139

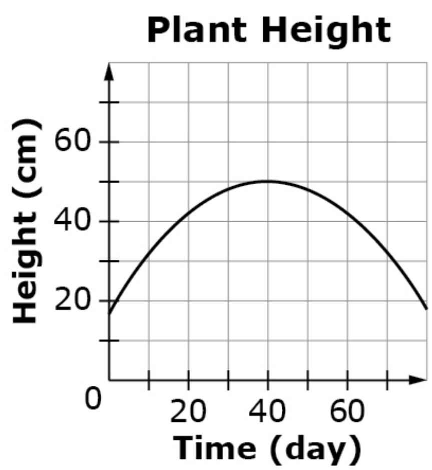
Select the average amount of time per lawn it takes Craig to mow the first 4 lawns. Round to the nearest minute per lawn.

A. 25 minutes per lawn
B. 27 minutes per lawn
C. 33 minutes per lawn
D. 74 minutes per lawn

Rubric: (1 point) The student identifies the correct value for the average rate of change (e.g., B).
Response Types: Multiple Choice, single correct response

Stimulus: The student is presented with a contextual situation, and the graph of the function modeled by the situation.

Example Stem: The height of a plant (in centimeters) is modeled as a function of time (in days). Consider this graph of the function.



Enter the average rate of change for the height of the plant, measured as centimeters per day, between day 0 and day 20.

Rubric:(1 point) The student correctly enters the rate of change given a possible range of answers (e.g., 1.2 ± 0.1).

Stimulus: The student is presented with a nonlinear function in symbolic form.

Example Stem: During the first years of growth the height of a tree can be modeled with the function
$h = -t^2 + 12t + 10$,
where t is the time in years since being planted and h is the height in inches**.**

Enter the average rate of change, in inches per year, from year 1 to year 5.

Rubric: (1 point) The student enters the correct answer for the average rate of change given the units (e.g., 6).

Target N [m]: Build a function that models a relationship between two quantities. (DOK 2)

Stimulus: Student is presented with a contextual situation.

Example Stem 1: Jane is making a rectangular garden. The length of the garden is 2 yards greater than its width, *w*, in yards.

Enter the function, *f(w)*, which describes the area, in square yards, of Maria's garden as a function of the width, *w*.

Example Stem 2: Barb traveled 300 miles during the first 5 hours of her trip. Barb then traveled at a constant speed of 50 miles per hour for the remainder of the trip.

Enter the function, *f(h),* which describes the average speed during the entire trip as a function of time, *h,* in hours, Barb traveled after her first 300 miles.

Example Stem 3: A washing machine was purchased for $256. It loses $\frac{1}{4}$ of its value each year.

Enter the function, *f*(*t*), which describes the value of the washing machine, in dollars, as a function of time in years, *t*, after the initial purchase.

Rubric: (1 point) Student correctly enters the function describing the relationship between two quantities in the given contextual situation (e.g., $f(w) = w(w+2)$; $f(h) = \frac{300+50h}{5+h}$; $f(t) = \$256(0.75)^t$).
Response Type: Equation/Numeric

Stimulus: The student is presented with a contextual situation.

Example Stem 1: A researcher studies the growth of a fruit fly population. The researcher counts the number of fruit flies at noon each day. The results are in the table.

Day	Number of Fruit Flies
0	4
1	8
2	16
3	32

- $V(t)$= Total number of fruit flies after *t* days
- $V(0) = 4$

Enter the function for $t \geq 1$, which describes the number of fruit flies, $V(t)$, at noon on the t^{th} day in terms of the number of fruit flies at noon on the previous day, $V(t-1)$.

Example Stem 2: The height of the water level in a tank is 200 inches. The water level increases at a constant rate of 3 inches every day.

- $H(t)$= height of the water level after t days.
- $H(0) = 200$

Enter the function for $t \geq 1$ that describes the height of the water level, $H(t)$, on the t^{th} day in terms of the height of the water level at the same time on the previous day, $H(t-1)$.

Rubric: (1 point) Student correctly enters the recursive function describing the relationship between two quantities in the given contextual situation [e.g., *V(t)* = 2*V*(*t* – 1); $H(t) = H(t-1) + 3$)].
Response Type: Equation/Numeric

Stimulus: The student is presented with a contextual situation.

Example Stem 1: The first row in a theater has 8 seats, the second row has 11 seats, the third row has 14 seats and the fourth row has 17 seats.

- $f(r)$ = the number of seats in row r.
- $f(1) = 8$

Enter an equation, for $r \geq 2$, which describes the number of seats, $f(r)$, in the r^{th} row in terms of the number of seats in the $(r - 1)^{th}$ row, $f(r - 1)$. Assume that the pattern described applies to all rows.

Example Stem 2: The 13^{th} row in a theater has 41 seats, the 12^{th} row has 38 seats, the 11^{th} row has 35 seats and the 10^{th} row has 32 seats.

- $f(r)$ = the number of seats in row r.
- $f(1) = 5$

Enter an equation, for $r \geq 2$, which describes the number of seats, $f(r)$, in the r^{th} row in terms of the number of seats in the $(r-1)^{th}$ row, $f(r-1)$. Assume that the pattern described applies to all rows.

Rubric: (1 point) Student correctly represents the sequence using the recursive process [e.g., $f(r) = f(r-1) + 3$; $f(r) = f(r-1) + 3$].
Response Type: Equation/Numeric

Stimulus: The student is presented with an explicit or recursive function.

Example Stem 1: Consider this function in explicit form.

$$f(n) = 3n - 4; n \geq 1$$

Select the equivalent recursive function.

A. $f(1) = -1$
$f(n) = f(n-1) + 3;\ n \geq 2$

B. $f(1) = -1$
$f(n) = 3f(n-1);\ n \geq 2$

C. $f(0) = -4$
$f(n) = 3f(n-1);\ n \geq 2$

D. $f(0) = -4$
$f(n) = f(n-1) + 3;\ n \geq 2$

Example Stem 2: Consider this function in recursive form.

$$f(1) = -3$$
$$f(n) = 3f(n-1);\ n \geq 2$$

Select the equivalent explicit function for $n \geq 1$.

A. $f(n) = -3(n)$
B. $f(n) = -3(n-1)$
C. $f(n) = -3(3)^n$
D. $f(n) = -3(3)^{(n-1)}$

Rubric: (1 Point) Student selects the correct choice (e.g., A; D).

Response Type: Multiple Choice, single correct response

Stimulus: The student is presented with explicit and recursive functions.

Example Stem: Match each recursive function with the equivalent explicit function.

Functions	$f(n) = 3(10)^{(n-1)}$; $n \geq 1$	$f(n) = 3n + 7$; $n \geq 1$	$f(n) = 10(3)^{(n-1)}$; $n \geq 1$
$f(1) = 10$ $f(n) = 3f(n-1)$; $n \geq 2$			
$f(1) = 3$ $f(n) = 10f(n-1)$; $n \geq 2$			
$f(1) = 10$ $f(n) = f(n-1) + 3$; $n \geq 2$			

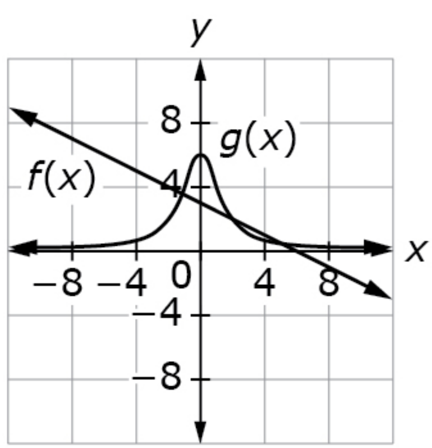
Click the appropriate box that matches the recursive function in the first column with its explicit function in the top row.

Interaction: The student is presented with three explicit functions in the first row and three recursive functions in the first column. The student selects the cell in the table that matches the functions.
Rubric:
(1 point) Student correctly matches all functions.

Functions	$f(n) = 3(10)^{(n-1)}$; $n \geq 1$	$f(n) = 3n + 7$; $n \geq 1$	$f(n) = 10(3)^{(n-1)}$; $n \geq 1$
$f(1) = 10$ $f(n) = 3f(n-1)$; $n \geq 2$			
$f(1) = 3$ $f(n) = 10f(n-1)$; $n \geq 2$			
$f(1) = 10$ $f(n) = f(n-1) + 3$; $n \geq 2$			

Stimulus: The student is presented with a graph of two functions.

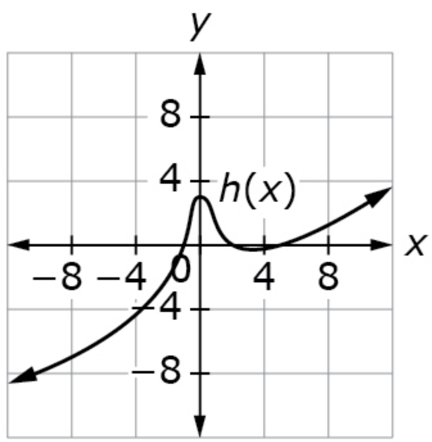
Example Stem: Consider this graph.

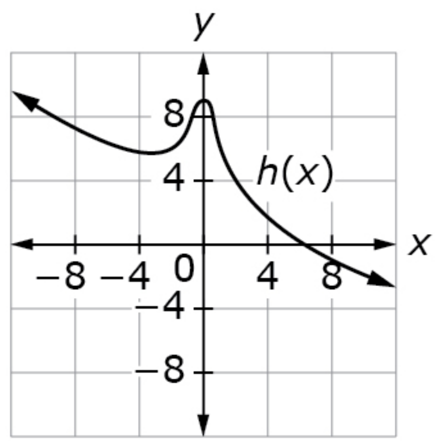


Using the graphs shown, select the graph that represents *h*(*x*), where function *h*(*x*) = *f*(*x*) + *g*(*x*).

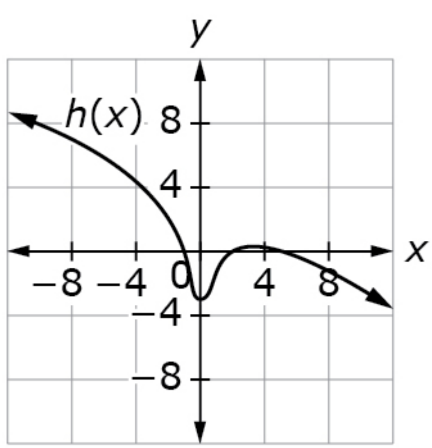
A.

B.

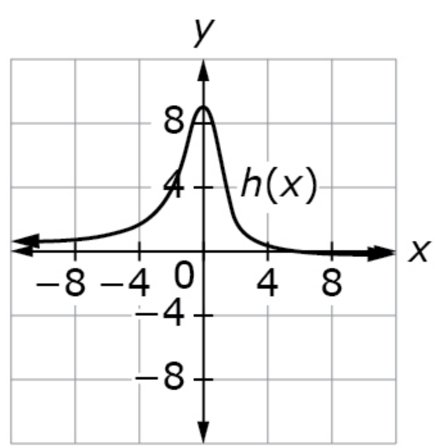




C.



D.



Rubric: (1 point) Student selects the correct graph for *h(x)* (e.g., B).
Response Type: Multiple Choice, single correct response

Source: Adapted from Illustrative Mathematics.

Stimulus: The student is presented with a contextual situation.

Example Stem: A theater needs to place seats in rows. The function, *f*(*r*), as shown below, can be used to determine the number of seats in each row, where *r* is the row number.

$f(1) = 8$
$f(r) = f(r - 1) + 3$

Use the function to complete the table indicating the number of seats in each of the first four rows of the theater.

Row number	Number of Seats
Row 1	
Row 2	
Row 3	
Row 4	

Rubric: (1 point) Student correctly enters the sequence from the recursive form into the table.

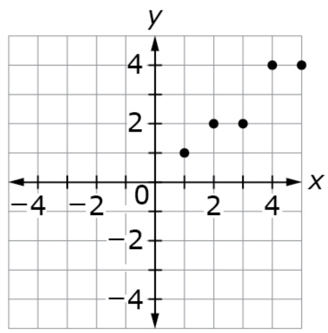
Row number	Number of Seats
Row 1	8
Row 2	11
Row 3	14
Row 4	17

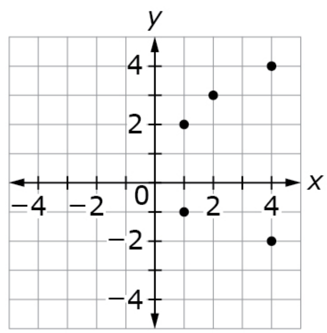
Response Type: Fill-in table

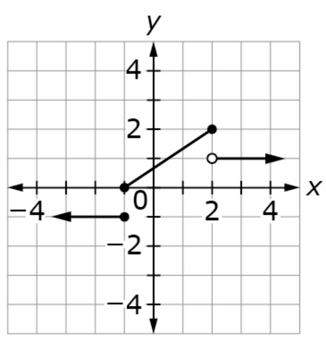
Target K [m]: Understand the concept of a function and use function notation. (DOK 1, 2)

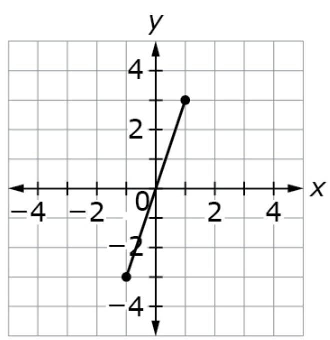
Stimulus: The student is presented with six graphs, representing a variety of functions and non-functions.

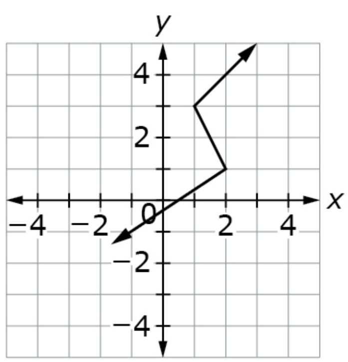
Example Stem 1: Select **all** graphs that are graphs of functions.

A. 

B. 

C. 

D. 

E. 

Rubric: (1 point) The student correctly selects all graphs of functions (e.g., A, D).
Response Type: Multiple Choice, multiple correct response

Stimulus: The student is presented with equations representing a variety of functions and non-functions. Equations may be linear, quadratic, polynomials, or absolute value. Students may graph or perform algebraic manipulations to check.

Example Stem: Select **all** equations that are equivalent to an equation that expresses *y* as a function of *x.*

A. $3x - 4y = -2$

B. $x - y^4 = 0$

C. $x^2 - 3y = 0$

D. $|x| + |y| = 2$

Rubric: (1 point) The student correctly selects all options that represent *y* as a function of *x* (e.g., A, C).
Response Type: Multiple Choice, multiple correct response

Stimulus: The student is presented with three or four data tables.

Example Stem: Some students are studying graphs of functions *y*= *f*(*x*) and other equations. Each table contains some points on a particular graph. Decide whether each set of points **might be** on the graph of a function or **cannot be** on the graph of a function.

<table>
<tr><th></th><th>Yes
These points
might be</th><th>No
These points
cannot be</th></tr>
<tr><td>A.<table><tr><td>x</td><td>0</td><td>1</td><td>1</td><td>4</td><td>4</td></tr><tr><td>y</td><td>0</td><td>3</td><td>4</td><td>3</td><td>0</td></tr></table></td><td></td><td></td></tr>
<tr><td>B.<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr></table></td><td></td><td></td></tr>
<tr><td>C.<table><tr><td>x</td><td>-2</td><td>0</td><td>1</td><td>3</td><td>4</td></tr><tr><td>y</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr></table></td><td></td><td></td></tr>
</table>

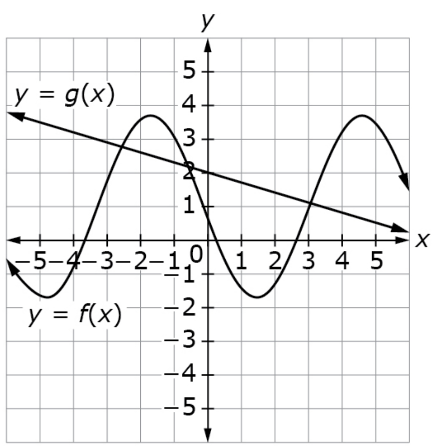
Rubric: (1 point) The student correctly identifies the true statement (e.g. NYY).
Response Type: Matching Tables

Stimulus: The student is presented with one or two functions and directed to use the “Add Point” tool to plot points that lie on those functions. If two functions are used, the item may be worth two points.

Example Stem:
The graphs of $y = g(x)$ and $y = f(x)$ are shown.

Use the “Add Point” tool to add a point that will satisfy each given condition.

- A point on the graph of g where $x=0$.
- A point on the graph of g where $f(x) > g(x)$.
- A point on the graph of f where $f(x) = 0$.



Rubric:
(2 points) The student correctly plots points defined by the conditions (e.g., A: The y-intercept of g; B: Any point on the graph of g sitting under the graph of f; C: Any of the three points where the graph of f crosses the x-axis).
(1 point) The student correctly plots two of the three points defined by the conditions.

Response Type: Graphing
Source: Adapted from Illustrative Mathematics

Stimulus: The student is presented with five terms of a sequence.

Example Stem:
Consider a sequence whose first five terms are
6, 12, 24, 48, 96.
Select the function (with domain of all integers $n \geq 1$) that can be used to define and continue this sequence.

A. $f(n) = 6n$

B. $f(n) = 6(n-1)$

C. $f(n) = 6n^2$

D. $f(n) = 6(2)^{n-1}$

Target M [m]: Analyze functions using different representations. (DOK 1, 2)

Stimulus: The student is presented with a function and a coordinate grid.

Example Stem 1: Given a linear function with a slope of $\frac{2}{3}$ and a *y*-intercept of 2:

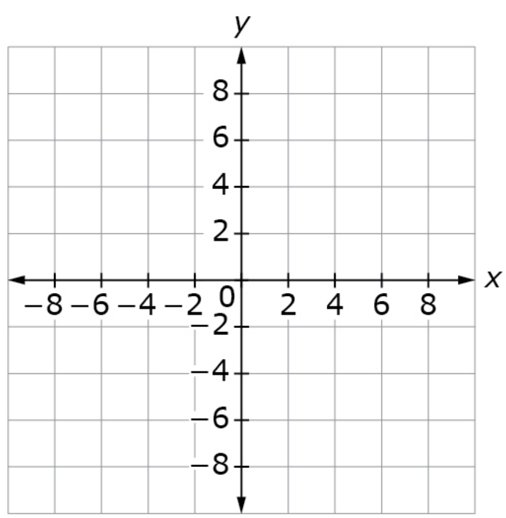
- Using the Add Arrow tool, draw a line on the coordinate grid to graph the function.
- Place a point on the line representing the *x*-intercept of the function.

Example Stem 2: Given the function $y = \frac{2}{3}x + 2$,

- Using the Add Arrow tool, draw a line on the coordinate grid to graph the function.
- Place a point on the line representing the *x*-intercept of the function.

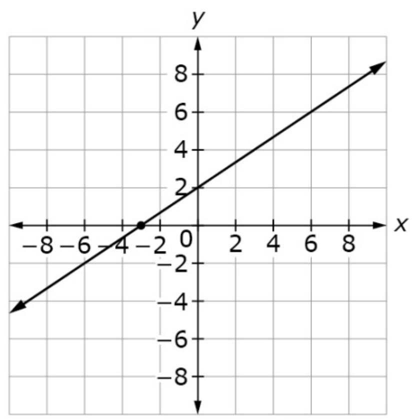
Example Stem 3: Given the function $y = \frac{1}{2}|2x - 1| + 2$,

- Use the Add Arrow tool to create a graph that represents the function.
- Place a point on the coordinate grid to show the *y*-intercept of the function.



Interaction: The student will graph lines using the Add Arrow tool and/or plot points using the Add Point tool.

Rubric: (2 points) The student graphs the correct line and plots the point at the correct location that represents a key feature [e.g., Example Stem 1, draws a correct line and plots the *x*-intercept located at (-3, 0)].
(1 point) The student graphs the correct line or plots the point at the correct location that represents a key feature (e.g., [e.g., Example Stem 1, draws a correct line OR plots the *x*-intercept located at (-3, 0)].



Response Type: Graphing

Stimulus: The student is presented with a function and a coordinate grid.

Example Stem 1: Given the function $y = -x^2 + x + 6$,

- Place a point on the coordinate grid to show each *x*-intercept of the function.
- Place a point on the coordinate grid to show the maximum value of the function.

Example Stem 2: Given the function $y = \sqrt{x+4} - 1$,

- Place a point on the coordinate grid to show each *x*-intercept of the function
- Place a point on the coordinate grid to show the *y*-intercept of the function.

Example Stem 4: Given this piecewise-defined function:

$$y = \begin{cases} -2x + 5 & \text{for } x < -1 \\ 3x^2 + 4 & \text{for } -1 \le x \le 1 \\ -4x^2 + 11 & \text{for } x > 1 \end{cases}$$

- Place **four** points on the coordinate grid to show the values of *y* when *x* = -2, -1, 0, and 2.

Example Stem 5: Given the function $y = 4x^3 + 8x^2 - 21x$,

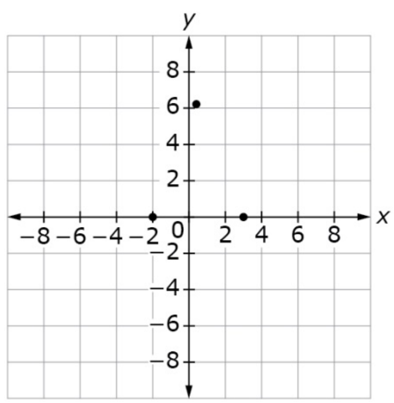
- Place a point on the coordinate grid to show each *x*-intercept of the function.
- Place a point on the coordinate grid to show each relative maximum or minimum value of the function.

Example Stem 6: Given the function $y = 3^{x-1} - 2$,

- Place a point on the coordinate grid to show each *x*-intercept of the function.
- Place a point on the coordinate grid to show each relative maximum or minimum value of the function.

Interaction: The student will graph lines using the Add Arrow tool appropriate to the example stem (single or double) and/or plot points using the Add Point tool.

Rubric: (2 points) The student plots the correct points that represent each different key feature. (e.g., Example Stem 1, student plots both *x*-intercepts and the maximum value).
(1 point) The student correctly plots 1 of 2 key features called for OR creates a graph but incorrectly identifies a key feature (e.g., in Example Stem 1, student plots the maximum value only OR both *x*-intercepts only.)



Note: Both *x*-intercepts represent one key feature so both are required to earn a point. For example, in Example Stem 1 both *x*-intercepts represent one key feature (1 point), and the maximum point represents another key feature (1 point).

Stimulus: The student is presented with a quadratic function.

Example Stem:
Enter an equation for the line of symmetry for the function $f(x) = -8x^2 + 16x + 2$.

Rubric:
(1 point) The student enters the correct equation (e.g., $x = 1$).
Response Type: Equation/Numeric

Stimulus: The student is presented with a quadratic function used in a context.

Example Stem 1:
John launches a toy rocket into the air. The rocket's height (*d)* in feet with respect to time (*t*) in seconds, can be modeled by the quadratic function, $d = -16t^2 + 16t + 32$**.**

Enter the maximum height, in feet, of the rocket.

Example Stem 2:
John launches a toy rocket into the air. The rocket's height (*d)* in feet with respect to time (*t*) in seconds, can be modeled by the quadratic function, $d = -16t^2 + 16t + 32$**.**

Enter the number of seconds it took for the rocket to hit the ground after it was launched.

Stimulus: The student is presented with multiple functions.

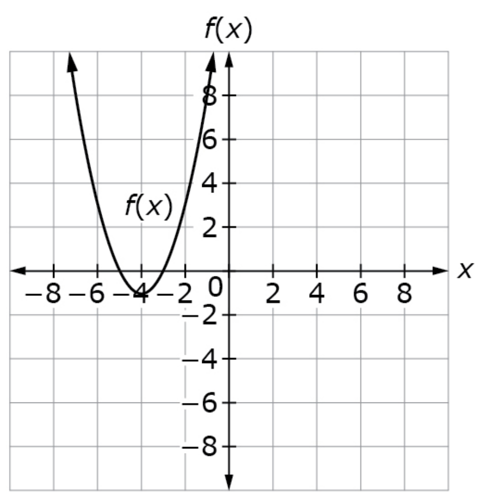
Example Stem: Determine whether each function represents exponential growth or decay. Select the correct option for each function.

Function	Growth	Decay
$f(x) = (1/2)^{x}$		
$f(x) = (3/2)^{4x}$		
$f(x) = (7/8)^{4x}$		
$f(x) = (4/3)^{\frac{x}{12}}$		
$f(x) = 3(1/3)^{\frac{x}{12}}$		

Rubric:
(1 point) The student correctly sorts the exponential functions (e.g., Decay, Growth, Decay, Growth, Decay).

Stimulus: The student is presented with two functions that must be represented in two different ways. Functions can be represented as a table of values, a graph, a function equation, or a written description.

Example Stem: The graph represents *f*(*x*) and the table shows some values of another quadratic function *g*(*x*).



x	−4	−3	−2	−1	0	1	2	3	4	5	6
***g*(*x*)**	0	−9	−16	−21	−24	−25	−24	−21	−16	−9	0

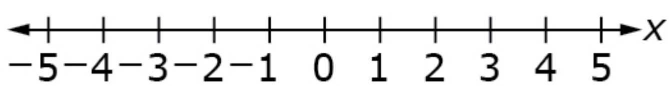
Select whether each statement is True or False about the given functions.

Statement	True	False
The minimum *x* value of *f*(*x*) is greater than the minimum *x* value of *g*(*x*).		
The value of *x* when *f*(*x*) is at its minimum is less than the value of *x* when *g*(*x*) is at its minimum.		
Both *x* intercepts of *g*(*x*) occur when *x* is greater than zero.		
The line of symmetry of *f*(*x*) is *x* = 1.		

Rubric:
(1 point) The student correctly identifies each statement as True or False (e.g., TTFF).
Response Type: Matching Tables

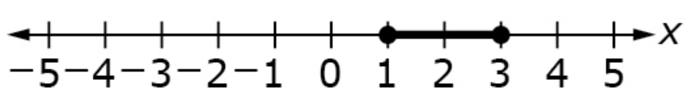
Stimulus: The student is given two different functions (square root, cube root, piecewise-defined, or absolute value) and a number line representing the *x*-axis, and asked to indicate where the functions have a shared key feature.

Example Stem: In which interval(s) on the *x*-axis are the functions $f(x) = \frac{1}{2}|2x| + 2$ and $g(x) = -2x^2 + 12x - 16$ increasing?
Click the interval(s) on the number line that represents where **both** functions are increasing.



Interaction: The student will click on intervals on the number line using Hot Spots.

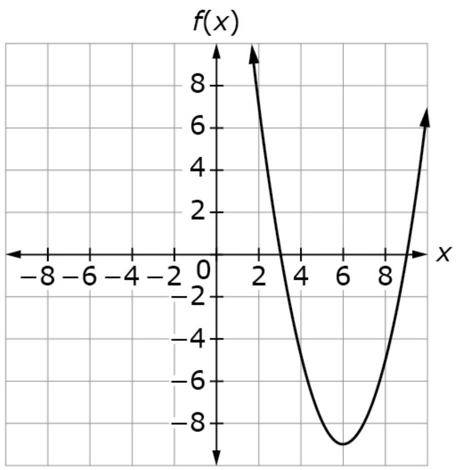
Rubric:
(1 point) The student clicks on the correct intervals (e.g., [1, 3]).



Response Type: Hot Spot

Stimulus: The student is presented with the graph of a quadratic function and a table of equations that may or may not represent the function.

Example Stem: Determine whether each equation in the table represents the graph of the function shown? Select Yes or No for each equation.



Function	Yes	No
$f(x) = (x - 3)(x - 9)$		
$f(x) = (x + 3)(x - 9)$		
$f(x) = (x + 6)(x - 9)$		
$f(x) = (x - 3)^2 - 18$		
$f(x) = (x - 6)^2 - 9$		

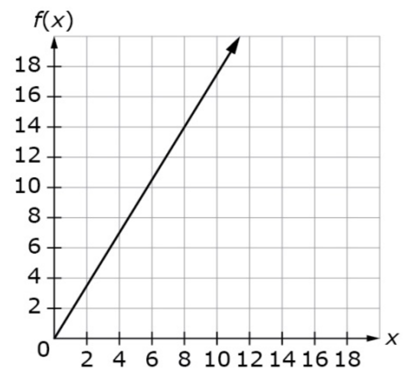
Rubric:
(1 point) Student correctly selects the functions that could be represented by the given graph (e.g., YNNNY).
Response Type: Matching Tables

Stimulus: The student is presented with three functions in various forms (graphs, table of values, etc.) and a matching table that includes the equations of the three functions.

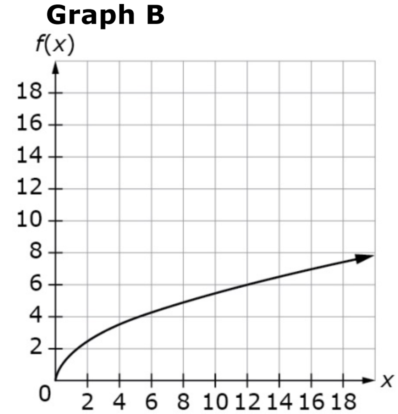
Note: If tables are given, the ordered pairs should show key features (zeros, etc.).

Example Stem 1: Select the appropriate box to indicate the match of each graph to its equation.

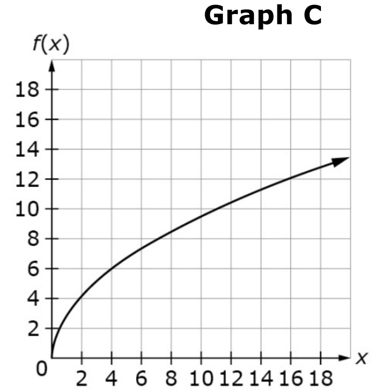
Graph A



Graph B



Graph C



Equation	Graph A	Graph B	Graph C
$f(x) = x\sqrt{3}$			
$f(x) = 3\sqrt{x}$			
$f(x) = \sqrt{3x}$			

Rubric:
(1 point) The student correctly matches the functions with the graph (e.g., Table A, Table C, Table B).

Example Stem 2: Select the appropriate box to indicate the match of each table of values to its equation.

Table A

x	$f(x)$
1	1.73
2	3.46
4	6.92
6	10.38
8	13.84

Table B

x	$f(x)$
1	1.73
2	2.45
4	3.46
6	4.24
8	4.90

Table C

x	$f(x)$
1	3.00
2	4.24
4	6.00
6	7.35
8	8.49

Equation	Table A	Table B	Table C
$f(x) = x\sqrt{3}$			
$f(x) = 3\sqrt{x}$			
$f(x) = \sqrt{3x}$			

Rubric:
(1 point) The student correctly matches the functions with the table (e.g., Table A, Table C, Table B).