HS Target K

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

Content Domain: Functions
Target K [m]: F-IF.A Understand the concept of a function and use function notation.
Standards included in Target K: F-IF.A, F-IF.A.1, F-IF.A.3
Vertical Alignment
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Evidence Required
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Claim 1: Concepts and Procedures (DOK 1) Question Banks
Claim 2 Problem Solving Questions Banks
Claim 3 Communicating Reasoning Question Banks
Claim 4 Modeling and Data Analysis Question Banks

Content Domain: Functions

Target K [m]: F-IF.A Understand the concept of a function and use function notation.

Standards included in Target K: F-IF.A, F-IF.A.1, F-IF.A.3

F-IF.A Understand the concept of a function and use function notation.

F-IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

F-IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n - 1)$ for $n \geq 1$.

Vertical Alignment

Related Grade 8 standards

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.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.

8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2 giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.

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 distinguish between functions and non-functions. They should be able to state the domain and range given a graph.

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).

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 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.

Level 4 Students should be able to find the input for a given output when given in function notation.

Evidence Required

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).

2. The student understands that the graph of f is the graph of the equation y = f(x).

3. The student recognizes that sequences are functions whose domain is a subset of the integers.

Vocabulary
domain, range, function, input, output, sequence, relation, ordered pair(s)

Response Types
Multiple Choice, single correct response; Multiple Choice, multiple correct response; Matching Table; Graphing

Materials
functions defined by words, equations, tables, sets of ordered pairs, graphs, and sequences

Attributes
None

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

Claim 1 F-IF.1 DOK Level 1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Evidence Required
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).

Question Type 1: The student is presented with a set of 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.

1. The equation of any line in the coordinate plane can be written in the form Ax + By = C where A, B, and C are real numbers. Select all of the equations below that define y as a function of x.

A. $3x - 4y = -2$
B. $-9x + 0y = 78$
C. $0x + 56y = -11$

D. $-12x - 85y = 0$

Rubric: (1 point) The student correctly selects all options that represent y as a function of x (e.g., A, C, D).

Response Type: Multiple Choice, multiple correct response

Claim 1 F-IF.1 DOK Level 2

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Evidence Required
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).

Question Type 1: The student is presented with the domain and range of a function f(x), as well as two given values of the function.

1. The height in meters, h, of a model rocket above the ground is given t seconds after launch by the equation

$h = -5t^2 + 40t$ where $0 \le t \le 8$ and $0 \le h(t) \le 80$

Select all of the statements below that are true.

A. $h(0) = 0$
B. $h(10) = -100$
C. The height of the rocket is 0 meters after 8 seconds from the launch.
D. The rocket reaches a height of 320 feet.

2. A function, f, has domain $-10 \le x \le 20$ and range $-40 \le f(x) \le -10$.

$f(1) = -13$
$f(-10) = -40$

Select each statement that must be false about f(x).

A. $f(1) = 13$

B. f(–9) = 88
C. f(5) = –40
D. f(0) = 0
E. f(–15) = –20

Rubric: (1 point) The student correctly selects all valid options based on the stem (e.g., A, C; A, B, D, E).

Response Type: Multiple Choice, multiple correct response

Claim 1 F-IF.1 DOK Level 1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Evidence Required
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).

Question Type 1: The student is presented with three or four data tables.

1.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.

	Yes These points **might be**	**No** These points **cannot be**
A.		
B.		
C.		

A.

x	0	1	1	4	4
y	0	3	4	3	0

B.

x	0	1	2	3	4
y	0	1	0	1	0

C.

x	–2	0	1	3	4
y	3	3	3	3	3

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

Response Type: Matching Table

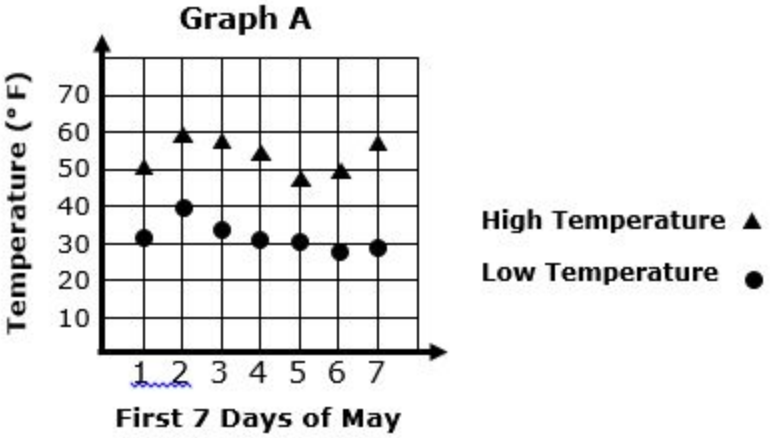
Claim 1 F-IF.1 DOK Level 2

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

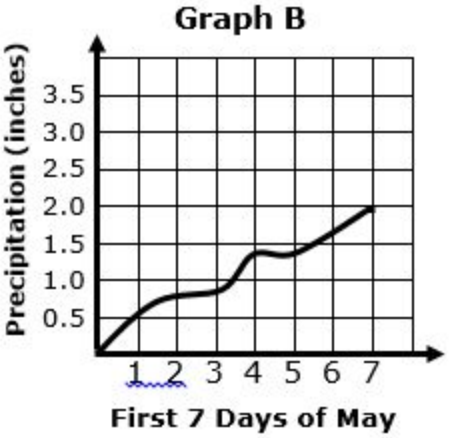
Evidence Required
The student understands that a function from one set (the domain) to another set (the range) assigns to each element of the domain exactly one element of the range (e.g., distinguish between functions and non-functions).

Question Type 1: The student is presented with a graph, and asked whether it represents the graph of a function.

1. The graphs below show different information about the weather in a large city in the U.S. for one week in May.



A.



B.

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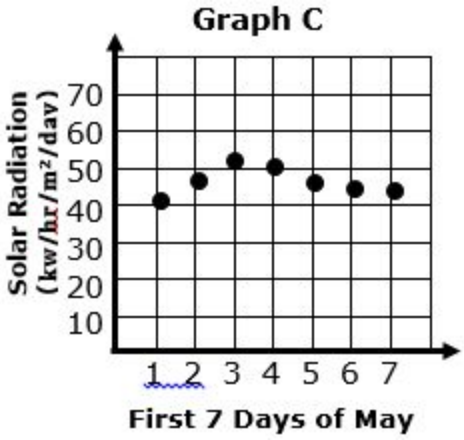
C. 

Determine whether each graph represents the given quantity as a function of time.

	True	False
Graph A represents temperature as a function of time.		
Graph B represents amount of accumulated precipitation as a function of time.		
Graph C represents the solar intensity as a function of time.		

Rubric: (1 point) The student chooses the correct responses (FTT).

Response Type: Matching Table

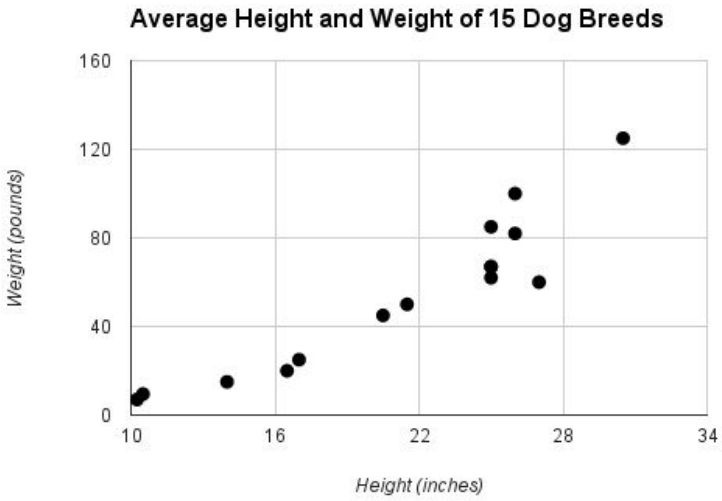
Claim 1 F-IF.1 DOK Level 1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Evidence Required
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).

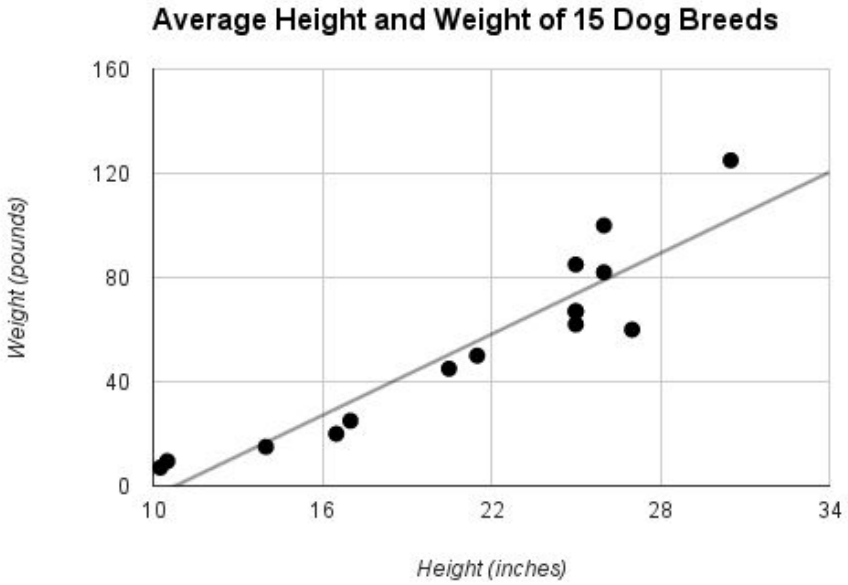
Question Type 1: The student is presented with a graph, and asked whether it represents the graph of a function.

1. The scatterplot represents the relationship between the average height and weight of 15 different dog breeds.



Height (inches)	10.25	27	25	25	17	21.5	16.5	25	10.5	26	25	20.5	14	26	30.5
Weight (pounds)	7	60	85	62	25	50	20	67	9.5	100	67	45	15	82	125

The second graph shows the same data with a line of best fit.



Which statement best describes the relationship displayed by the scatterplot and line of best fit?

A. Both the scatterplot and the line of best fit represent a function.
B. The scatterplot represents a function but the line of best fit does not.
C. The line of best fit represents a function but the scatterplot does not.
D. Neither represents a function.

2. Three different parabolas, each defined by a different equation, are shown in the coordinate plane.

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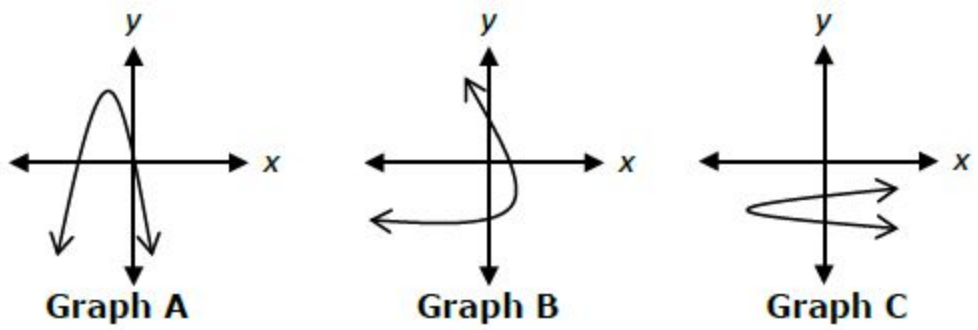

Which graph represents y as a function of x?

A. Graph A
B. Graph B
C. Graph C
D. None of the graphs

Rubric: (1 point) The student chooses the correct response (e.g., C, A).

Response Type: Multiple Choice, single correct response

Question Type 2: The student is prompted to select which of a set of relations represented with equations determines one variable as a function of the other variable.

1. The height in meters, h, of a model rocket above the ground is given t seconds after launch by the equation

h = –5t2 + 40t

Given this information, indicate whether each statement is true or false.

	True	False
The height of the rocket is a function of time.		
The time since launch is a function of the height.		

Rubric: (1 point) The student chooses the correct responses (T, F).

Response Type: Matching Table

Claim 1 F-IF.1 DOK Level 2

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

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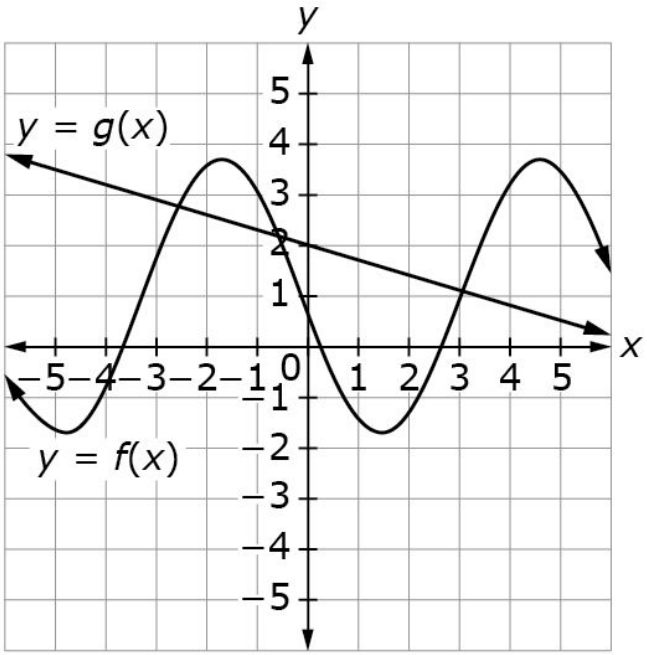
Evidence Required
The student understands that the graph of f is the graph of the equation y = f(x).

Question Type 1: 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.

1. 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.

Claim 1 F-IF.3 DOK Level 1

Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.

Evidence Required
The student recognizes that sequences are functions whose domain is a subset of the integers.

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Question Type 1: The student is presented with five terms of a sequence.

1. Consider a sequence whose first five terms are 6, 12, 24, 48, 96.

Select the function, with domain n = {1, 2, 3, 4, 5}, that defines this sequence.

A. $f(n) = 6n$
B. $f(n) = 6(n-1)$
C. $f(n) = 6n2$
D. $f(n) = 6(2)n-1$

Rubric: (1 point) The student correctly identifies the equation of the function defined by the sequence (e.g., D).

Response Type: Multiple Choice, single correct response

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

Kiki starts her run at 5:00 p.m. Let f(t) represent Kiki's speed, in miles per hour, t hours after she starts running for
$0 \le t \le 4$. The following information holds for the function f:

- f(1) = 5
- f(4) = 2
- f(2) = 8
- f(1) < f(3).

Kiki's fastest speed occurs at 7:00 p.m. Given this information, which of the following must be true? Select all that apply.

A. At 8:00 p.m., Kiki's speed was at least 5 miles per hour.
B. At 6:30 p.m., Kiki's speed was at most 8 miles per hour.
C. Kiki ran at most 32 miles.

Rubric: (1 point) The student selects all three options.

Response Type: Multiple-choice, multiple-select response

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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

The equation of a circle in the coordinate plane with center (0, 0) and radius 5 is shown:
$x^2 + y^2 = 25$
Fill in the table to show an example of two ordered pairs that show this equation does not define y as a function of x.

x	y

Rubric: (1 point) The student enters the coordinates of two points that have the same x-coordinates and different y-coordinates and that lie on the circle in the response box ($-5 \le x \le 5$ and $y = \pm\sqrt{25-x^2}$).

Response Type: Fill-in Table

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

The relationship between Jack's distance from home and the time since he left home is linear, as shown in the table.

Time (hrs)	Distance (mi)
0	7.5
2	17.5
4	27.5

Based on the values in the table, determine whether each statement is true. Select True or False for each statement.

Statement	True	False
Jack's initial distance from home is 7.5 miles.		
Jack's distance increases by 5 miles every 1 hour.		
Jack's distance from home at 3 hours is 23.5 miles.		

Rubric: (1 point) Student determines each statement as being either true or false (TTF).