

F.IF.A.1: Define Functions

FUNCTIONS

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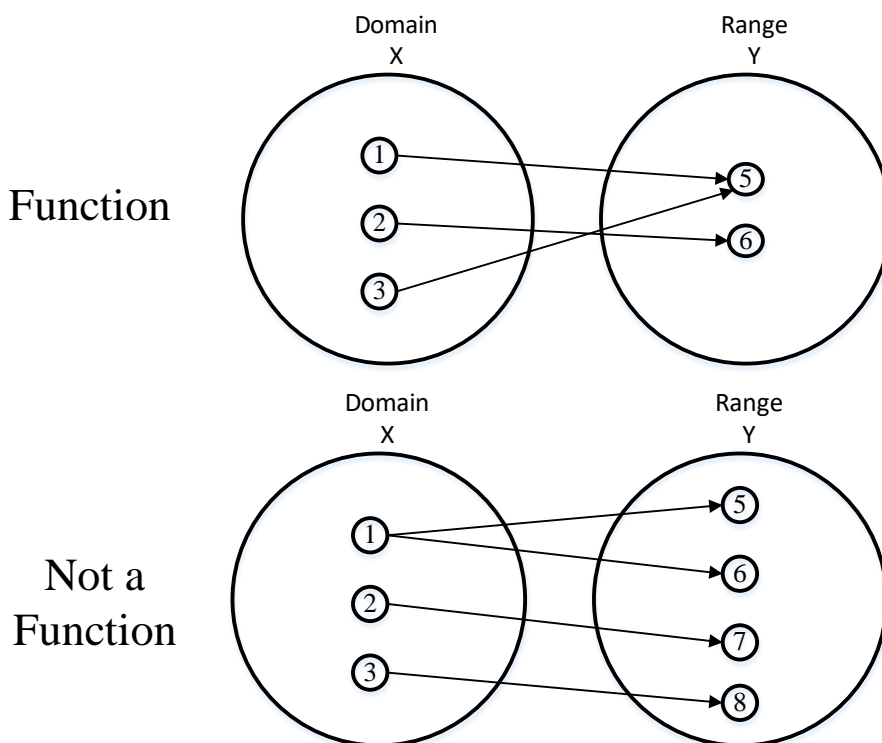
A. Understand the concept of a function and use function notation.

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 $y = f(x)$.

Overview of Lesson

- activate prior knowledge and review learning objectives (see above)
- explain vocabulary and/or big ideas associated with the lesson
- connect assessment practices with curriculum
- model an assessment problem and solution strategy
- facilitate guided discussion of student activity
- facilitate guided practice of student activity
- [Selected problem set\(s\)](#)
- facilitate a summary and share out of student work
- Homework – Write the Math Assignment

Function: A rule that assigns to each number x in the **function's domain** (x -axis) a unique number $f(x)$ in the function's **range** (y -axis). A function takes the input value of an independent variable and pairs it with one and only one output value of a dependent variable.

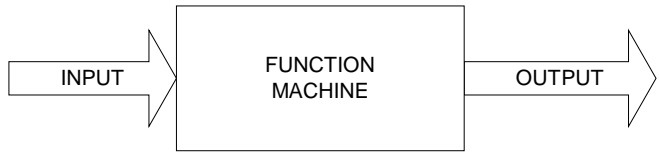
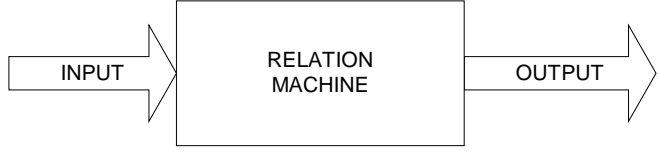


Expressed as ordered Pairs:

Function: (1,5) (2,6) (3,5)

Not a Function: (1,5) (2,7) (3,8) (1,6)

Lesson Plan

| | |
|---|--|
|  | <p>Function: A function is a relation that assigns exactly one value of the dependent variable to each value of the independent variable. A function is always a relation. Example: $y=2x$</p> |
|  | <p>Relation: A relation may produce more than one output for a given input. A relation may or may not be a function. Example: $y^2 = x$ $y = \sqrt{x}$ This is not a function, because when $x=16$, there is more than one y-value. $\sqrt{16} = \pm 4$.</p> |

A function can be represented four ways. These are:

- a context (verbal description)
- a function rule (equation)
- a table of values
- a graph.

Function Rules show the relationship between dependent and independent variables in the form of an equation with two variables.

- The **independent** variable is the **input** of the function and is typically denoted by the x-variable.
- The **dependent** variable is the **output** of the function and is typically denoted by the y-variable.

All linear equations in the form $y = mx + b$ **are functions except vertical lines**.

2nd degree and higher equations may or may not be functions.

Tables of Values show the relationship between dependent and independent variables in the form of a table with columns and rows:

- The **independent** variable is the **input** of the function and is typically shown in the left column of a vertical table or the top row of a horizontal table.
- The **dependent** variable is the **output** of the function and is typically shown in the right column of a vertical table or the bottom row of a horizontal table.

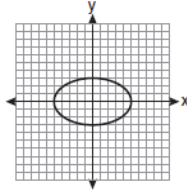
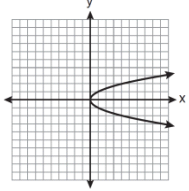
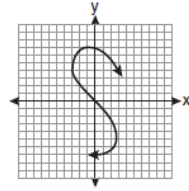
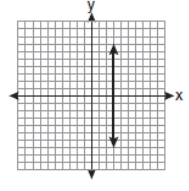
| Function | | Not A Function | |
|----------|---|----------------|---|
| x | y | x | y |
| 1 | 5 | 1 | 5 |
| 2 | 6 | 2 | 6 |
| 3 | 7 | 3 | 7 |
| 4 | 8 | 4 | 8 |
| 5 | 9 | 2 | 9 |

Graphs show the relationship between dependent and independent variables in the form of line or curve on a coordinate plane:

- The value of **independent** variable is **input** of the function and is typically shown on the **x-axis** (horizontal axis) of the coordinate plane.
- The value of the **dependent** variable is the **output** of the function and is typically shown on the **y-axis** (vertical axis) of the coordinate plane.

Vertical Line Test: If a vertical line passes through a graph of an equation more than once, the graph is *not* a graph of a **function**.

If you can draw a vertical line through any value of x in a relation, and the vertical line intersects the graph in two or more places, the relation is not a function.

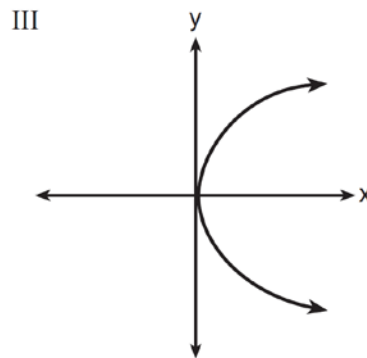
| | | | |
|--|--|---|--|
|  <p>Circles and Ellipses ...are not functions.</p> |  <p>Parabola-like graphs that open to the side ...are not functions.</p> |  <p>S-Curves ...are not functions</p> |  <p>Vertical lines ...are not functions.</p> |
|--|--|---|--|

REGENTS PROBLEMS TYPICAL OF THIS STANDARD

1. Which representations are functions?

I

| x | y |
|---|-----|
| 2 | 6 |
| 3 | -12 |
| 4 | 7 |
| 5 | 5 |
| 2 | -6 |



II $\{(1,1), (2,1), (3,2), (4,3), (5,5), (6,8), (7,13)\}$

IV $y = 2x + 1$

- a. I and II
 b. II and IV
 c. III, only
 d. IV, only

Lesson Plan

2. Which table represents a function?

a.

| | | | | |
|-------------|---|---|---|---|
| x | 2 | 4 | 2 | 4 |
| f(x) | 3 | 5 | 7 | 9 |

b.

| | | | | |
|-------------|---|----|----|---|
| x | 0 | -1 | 0 | 1 |
| f(x) | 0 | 1 | -1 | 0 |

c.

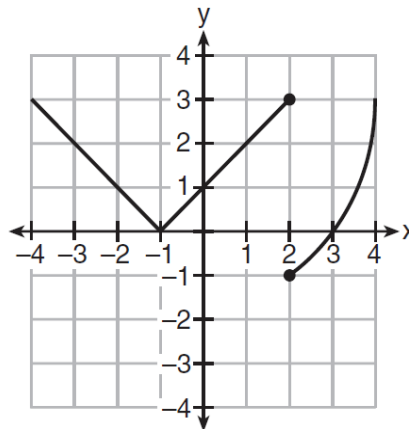
| | | | | |
|-------------|---|---|---|---|
| x | 3 | 5 | 7 | 9 |
| f(x) | 2 | 4 | 2 | 4 |

d.

| | | | | |
|-------------|---|----|----|---|
| x | 0 | 1 | -1 | 0 |
| f(x) | 0 | -1 | 0 | 1 |

3. The function f has a domain of $\{1, 3, 5, 7\}$ and a range of $\{2, 4, 6\}$. Could f be represented by $\{(1, 2), (3, 4), (5, 6), (7, 2)\}$? Justify your answer.

4. Marcel claims that the graph below represents a function.



State whether Marcel is correct. Justify your answer.

F.IF.A.1: Define Functions Answer Section

1. ANS: B

Strategy: Determine if each of the for views are functions, then select from the answer choices. A function is a relation that assigns exactly one value of the dependent variable to each value of the independent variable.

I *is not* a function because when $x = 2$, y can equal both 6 and -6.

II *is* a function because there are no values of x that have more than one value of y .

III *is not* a function because it fails the vertical line test, which means there are values of x that have more than one value of y .

IV *is* a function because it is a straight line that is not vertical.

Answer choice b is the correct answer.

PTS: 2 REF: 081511ai NAT: F.IF.A.1 TOP: Defining Functions

2. ANS: C

Strategy: Eliminate wrong answers. A function is a relation that assigns exactly one value of the dependent variable to each value of the independent variable.

Answer choice a *is not* a function because there are two values of y when $x = 2$.

Answer choice b *is not* a function because there are two values of y when $x = 0$.

Answer choice c *is* a function because only one value of y is paired with each value of x .

Answer choice d *is not* a function because there are two values of y when $x = 0$.

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PTS: 2 REF: 061504ai NAT: F.IF.A.1 TOP: Defining Functions

3. ANS:

Yes, because every element of the domain is assigned one unique element in the range.

Strategy: Determine if any value of x has more than one associated value of y . A function has one and only one value of y for every value of x .

PTS: 2 REF: 061430ai NAT: F.IF.A.1 TOP: Defining Functions

4. ANS:

Marcel is not correct, because the relation does not pass the vertical line test. If you draw the vertical line $x = 2$, there will be more than one value of y . A function can have one and only one value of y for every value of x .

PTS: 2 REF: 011626ai NAT: F.IF.A.1 TOP: Defining Functions

KEY: graphs

Homework - Write the Math Assignment

START Write your name, date, topic of lesson, and class on your paper.
 NAME: Mohammed Chen
 DATE: December 18, 2015
 LESSON: Missing Number in the Average
 CLASS: Z

PART 1a. Copy **the problem** from the lesson and underline/highlight key words.
 PART 1b. State your understanding of **what the problem is asking**.
 PART 1c. **Answer** the problem.
 PART 1d. Explanation of **strategy** with all work shown.

PART 2a. Create **a new problem** that addresses the same math idea.
 PART 2b. State your understanding of **what the new problem is asking**.
 PART 2c. **Answer** the new problem.
 PART 2d. Explanation of **strategy** used in solving the new problem with all work shown.

Clearly label each of the eight parts.

Grading Rubric

Each homework writing assignment is graded using a four point rubric, as follows:

| | |
|---------------------------------|--|
| Part 1. The Original Problem | Up to 2 points will be awarded for: a) correctly restating the original problem; b) explicitly stating what the original problem is asking; c) answering the original problem correctly; and d) explaining the math. |
| Part 2. My New Problem | Up to 2 points will be awarded for: a) creating a new problem similar to the original problem; b) explicitly stating what the new problem is asking; c) answering the new problem correctly; and d) explaining the math. |

This assignment/activity is designed to incorporate elements of [Polya's four step universal algorithm](#) for problem solving with the idea that writing is thinking. Polya's four steps for solving any problem are:

1. Read and understand the problem.
2. Develop a strategy for solving the problem.
3. Execute the strategy.
4. Check the answer for reasonableness.

EXEMPLAR OF A WRITING THE MATH ASSIGNMENT

Part 1a. The Problem

TOP Electronics is a small business with five employees. The mean (average) weekly salary for the five employees is \$360. If the weekly salaries of four of the employees are \$340, \$340, \$345, and \$425, what is the salary of the fifth employee?

Part 1b. What is the problem asking?

Find the salary of the fifth employee.

Part 1c. Answer

The salary of the fifth employee is \$350 per week.

Part 1d. Explanation of Strategy

The arithmetic mean or average can be represented algebraically as:

$$\bar{X} = \frac{x_1 + x_2 + \dots + x_n}{n}$$

I put information from the problem into the formula. The problem says there are 5 employees, so $n = 5$. The problem also gives the mean (average) salary and the salaries of 4 of the employees. These numbers can be substituted into the formula as follows:

$$360 = \frac{340 + 340 + 345 + 425 + x_5}{5}$$

$$1800 = 340 + 340 + 345 + 425 + x_5$$

$$1800 = 1450 + x_5$$

$$1800 - 1450 = x_5$$

$$350 = x_5$$

$$\text{Check: } 360 = \frac{340 + 340 + 345 + 425 + 350}{5} = \frac{1800}{5} = 360$$

Part 2a. A New Problem

Joseph took five math exams this grading period and his average score on all of the exams is 88. He remembers that he received test scores of 78, 87, 94, and 96 on four of the examinations, but he has lost one examination and cannot remember what he scored on it. What was Joseph's score on the missing exam?

Part 2b. What is the new problem asking?

Find Joseph's score on the missing exam.

Part 2c. Answer to New Problem

Joseph received a score of 85 on the missing examination.

Part 2d. Explanation of Strategy

I substitute information from the problem into the formula for the arithmetic mean, as follows:

$$88 = \frac{78 + 87 + 94 + 96 + x_5}{5}$$

$$440 = 355 + x_5$$

$$85 = x_5$$

$$88 = \frac{78 + 87 + 94 + 96 + 85}{5} = \frac{440}{5} = 88$$

The answer makes sense.