Foundations of Algebra   Unit 5: Linear Functions   Notes

Understanding Function Notation

While visiting her grandmother, Fiona found markings on the inside of a closet door showing the heights of her mother, Julia, and Julia's brothers and sisters on their birthdays growing up. From the markings in the closet, Fiona wrote down her mother's height each year from ages 2 to 16. Her grandmother found the measurements at birth and one year by looking in her mother's baby book. The data is provided in the table below, with heights rounded to the nearest inch.

Indep.

Depend

Age (yrs.)	x	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Height (in.)	y	21	30	35	39	43	46	48	51	53	55	59	62	64	65	65	66	66

$h(x)$

1. Which variable is the independent variable, and which is the dependent variable? Explain your choice.

Indep: x = age (yrs)
Depend: y = height (in)
Julia's height is dependent on age

2. What is the value of $h(11)$? What does this mean in context?

x
$h(11) = 62$ At 11 years old, Julia was 62" tall.

3. When x is 3, what is the value of y? Express this fact using function notation.

$h(3) = 39$

4. Find an x such that $h(x) = 53$. What does your answer mean in context?

x = 8. Julia was 53" when she was 8 years old.

5. Find an x such that $h(x) = 65$. What does your answer mean in context?

x = 13, 14. Julia was 65" when she was 13 and 14 y.o.

6. Describe what happens to $h(x)$ as x increases from 0 to 16. What can you say about $h(x)$ for x greater than 16?

x: 0 → 16   Julia's height stays the
$h(x)$: increases   same at age 16+

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Day 3 – Creating Function Rules

Scenario: Consider the following situations...

- The number of hours worked and the money earned

$$\#\text{ of hrs work} \Rightarrow \$ \text{ earned}$$

$\bigcirc = \text{Indep. } (x)$
$\underline{\qquad} = \text{Depend. } (y)$

- Your grade on a test and the number of hours you studied

$$\#\text{ of hrs studied} \Rightarrow \text{grade on test}$$

- The number of people working on a particular job and the time it takes to complete a job

$$\#\text{ of people working} \Rightarrow \text{time to complete}$$

- The total cost of a pizza delivery and the number of pizzas ordered

$$\#\text{ of pizzas} \Rightarrow \text{total cost}$$

- The speed of a car and how far the driver pushes down on the gas pedal

$$\text{pushing on gas} \Rightarrow \text{speed of car}$$

There are two quantities changing in each situation. When one quantity depends on the other in a problem situation, it is said to be the **dependent quantity**. The quantity that the dependent quantity depends on is called the **independent quantity**. When you have a function, the input value that represents the independent quantity is considered the **independent variable** and the output value that represents the dependent quantity is considered the **dependent variable**.

$y = f(x)$

Independent Quantities/Variables	Dependent Quantities/Variables
Input values	Output values
Not changed by other quantities	Changes due to independent quantity
Located on x-axis	Located on y-axis

In the scenarios listed above, circle the independent quantity and underline the dependent quantity. Then name a variable to represent the independent and dependent quantities.

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Creating Function Rules from a Context

Creating functions is very similar to creating equations. You will want to define a variable, identify the changing value, and the constant value.   An algebraic expression that defines a function is a **function rule**.

Scenario: An art teacher has $500 for supplies and plans to spend $25 per week. $= \boxed{0} \cdot x$ $500 - 25x$

A. Name the independent and dependent quantities.

independent: $x = $ # of wks

dependent: $y = $ \$ remaining   output

B. Create a function rule that relates the independent and dependent quantities.

$$f(x) = 500 - 25x$$

C. How much money will be remaining after 4 weeks?   D. After 6 weeks?   E. After 8 weeks?

$$f(4) = 500 - 25(4)$$ $$f(6) = 500 - 25(6)$$ $$f(8) = 500 - 25(8)$$
$$f(4) = 500 - 100$$ $$f(6) = 500 - 150$$ $$f(8) = 500 - 200$$
$$f(4) = \underline{400}$$ $$f(6) = \boxed{350}$$ $$f(8) = \boxed{300}$$

F. How many weeks did it take to have $100 remaining?

$$100 = 500 - 25x$$
$$-500 \quad -500$$
$$-400 = -25x$$
$$-25 \qquad -25$$
$$\boxed{16 = x}$$

G. How long did it take to spend all the money? $0
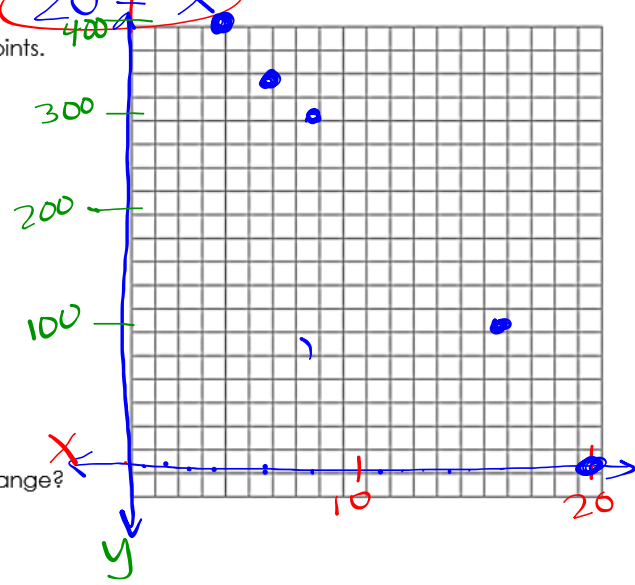
$$0 = 500 - 25x$$
$$-500 \quad -500$$
$$-500 = -25x$$
$$-25 \qquad -25$$
$$\boxed{20 = x}$$

H. Create an input-output table and then graph your points.

X	Y
4	400
6	350
8	300
16	100
20	0

I. What is a reasonable domain? What's a reasonable range?

domain: $x: \{0 \longrightarrow 20\}$

range: $y: \{0 \longrightarrow 500\}$

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Creating Function Rules

Ex. Create a function rule for the tables below:

A.

x	1	2	3	4
y	-1	0	1	2

-2 -2 -2 -2

$$y = x - 2$$
$$f(x) = x - 2$$

B.

Time Worked (h) x	1	2	3	4
Amount Earned ($) y	5	10	15	20

·5 ·5 ·5 ·5

$$y = x \cdot 5 = 5x$$
$$f(x) = 5x$$

C. {(1, 3), (2, 6), (3, 9), (4, 12)}

$$\frac{x}{y}$$

1 → 3 ·3
2 → 6 ·3
3 → 9 ·3
4 → 12 ·3

$$y = 3x$$
$$f(x) = 3x$$

D. {(1, -6), (2, -5), (3, -4), (4, -3)}

$$\frac{x}{y}$$

1 → -6 -7
2 → -5 -7
3 → -4 -7
4 → -3 -7

$$y = x - 7$$
$$f(x) = x - 7$$

E. A hot air balloon cruising at 1000 feet begins to ascend. It ascends at a rate of 200 feet per minute. Create a function f to represent the height of the balloon for *m* minutes. How many minutes does it take to reach 1400 feet?

$$f(m) = 1000 + 200m$$

Ind: m = # of min
Dep: f(m) = total height

$$1400 = 1000 + 200m$$

$$\frac{-1000 \quad -1000}{400 = 200m}$$

$$\frac{400}{200} = \frac{200m}{200}$$

$$2 = m$$

F. A fish tank filled with 12 gallons of water is drained. The water drains at a rate of 1.5 gallons per minute. Create a function f to represent the number of gallons remaining after *m* minutes. How long does it take for the tank to have 3 gallons remaining?

$$f(m) = 12 - 1.5m$$

Ind: m = # of min
Dep: f(m) = gal remain

$$3 = 12 - 1.5m$$

$$\frac{-12 \quad -12}{-9 = -1.5m}$$

$$\frac{-9}{-1.5} = \frac{-1.5m}{-1.5}$$

$$m = 6 \text{ min}$$

Ex. Create a function rule for each person
Maya runs 7 miles per week and increases her distance by 1 mile each week. Matthew runs 4 miles per week and increases his distance by 2 miles each week.

a. Maya's Function Rule:

$$f(w) = 7 + 1w$$

b. Matthew's Function Rule:

$$f(w) = 4 + 2w$$

c. Who has run farther after 4 weeks?

Maya
$$f(4) = 7 + 1(4)$$
$$f(4) = 11 \text{ miles}$$

Matt
$$f(4) = 4 + 2(4)$$
$$f(4) = 12 \text{ miles}$$