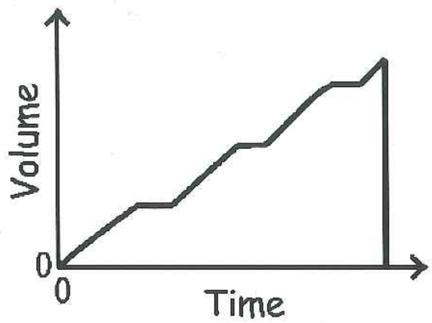
Algebra I
4-1: Using Graphs to Relate Two Quantities

Name ______________________
Date ____________ Class Period ______

Learning Target: Today you will be able to REPRESENT MATHEMATICAL RELATIONSHIPS USING GRAPHS

Question/Main Ideas:	Notes:
Example 1: Analyzing a Graph	The graph below shows the volume of air in a balloon as you blow it up, until it pops. What are the variables? Describe how the variables are related at various points on the graph.

Air in Balloon



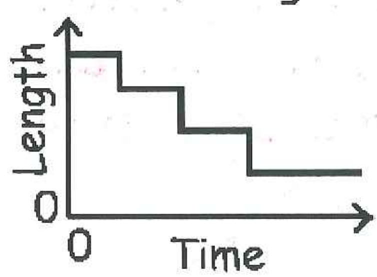
Variables: x - time
y - volume

- Volume increases when you blow
- Volume stays constant when you take a breath
- Balloon pops in middle of 4th blow. Volume instantly decreases to zero.

Question/Main Ideas:	Notes:
Now It's Your Turn	What are the variables in each graph? Describe how the variables are related at various points on the graph.

a.

Board Length

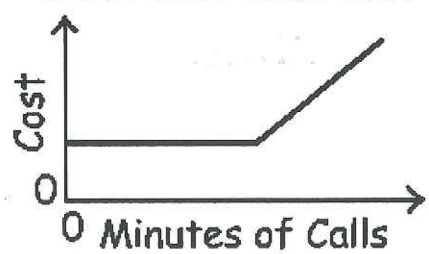


X - time
Y - length

- Length of the board stays constant until another piece is cut off

b.

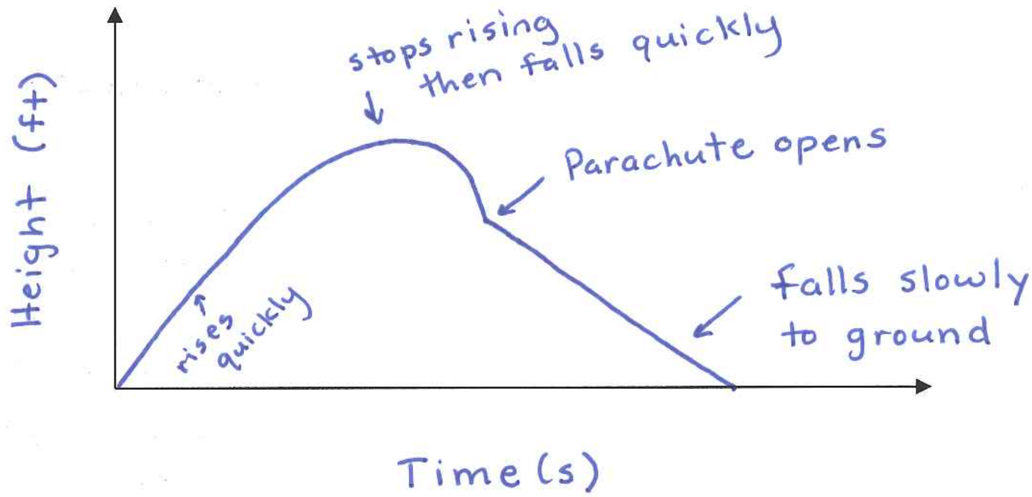
June Cell Phone Cost



X - minutes of calls
Y - cost

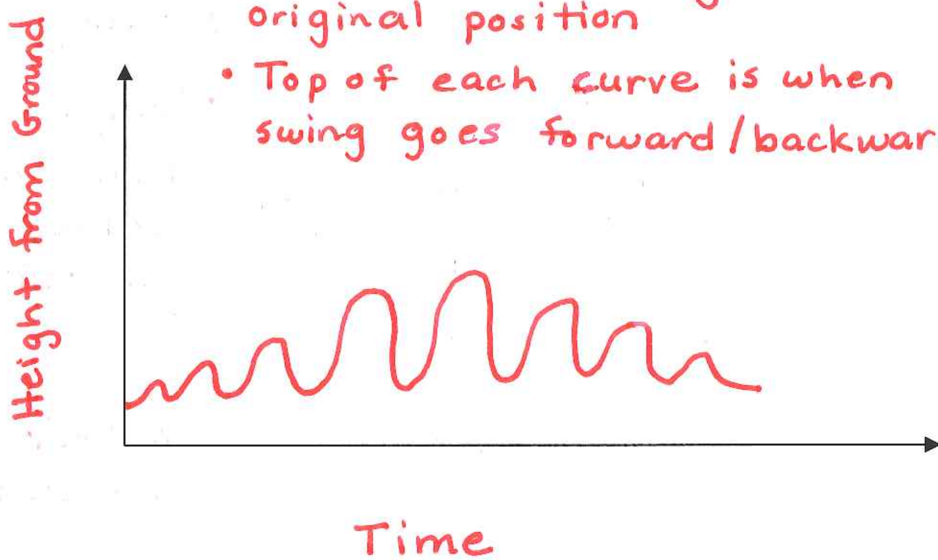
- Cost remains the same for a certain number of minutes then increases per minute after

Example 2: Sketching a Graph	A model rocket rises quickly and then slows to a stop as its fuel runs out. It begins to fall quickly until the parachute opens, after which it falls slowly back to earth. Draw a sketch of a graph that could represent the height of the rocket during its flight. Label each section.



Now It's Your Turn	Suppose you start to swing yourself on a playground swing. You move back and forth and swing higher in the air. Then you slowly swing to a stop. Draw a sketch of a graph that could represent how you height from the ground might change over time? Label each section.

- Bottom is when swing reaches original position
- Top of each curve is when swing goes forward / backward



Summary: ____

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Algebra I
4-2/4-3: Patterns, Linear and Nonlinear Functions

Name ____________________
Date ______________ Class Period _______

Learning Target: Today you will be able to IDENTIFY AND REPRESENT PATTERNS THAT DESCRIBE LINEAR AND NONLINEAR FUNCTIONS

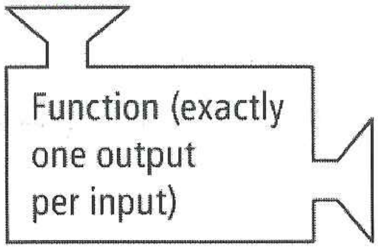
Question/Main Ideas:	Notes:

Definition: Function

A relationship that pairs each input value with exactly one output value.

The Function Machine

Input; x; indepedent variable



output; y; dependent variable

x	y
2	6
0	4
1	8
2	4

Inputs match

cannot have two diff. outputs for the same input

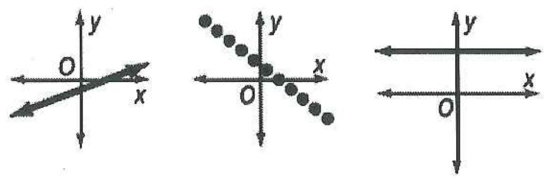
NOT a function

Linear Functions Versus Nonlinear Functions

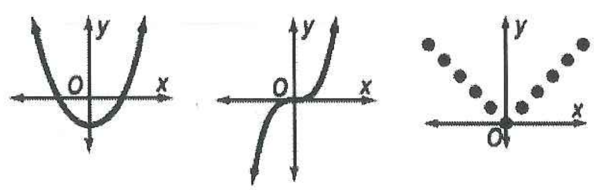
take note

Concept Summary Linear and Nonlinear Functions

Linear Function
A linear function is a function whose graph is a nonvertical line or part of a nonvertical line.



Nonlinear Function
A nonlinear function is a function whose graph is not a line or part of a line.



Exploring Tables

Look at the table below.

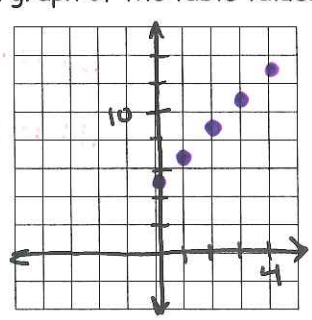
x	0	1	2	3	4
y	5	7	9	11	13

What is the pattern for...

The x-values: +1

The y-values: +2

Make a graph of the table values.



Is the function linear or nonlinear? Linear

Look at the table below.

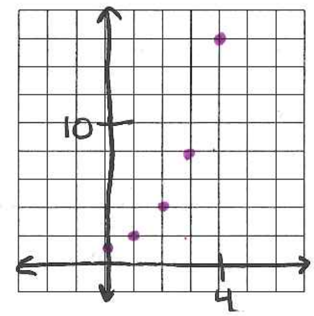
x	0	1	2	3	4
y	1	2	4	8	16

What is the pattern for…

The x-values: +1

The y-values: • 2

Make a graph of the table values.



Is the function linear or nonlinear? Nonlinear

Identifying Linear Tables

Both the x-values and the y-values go up or down at a constant rate (addition / subtraction)

Example 1: Linear or Nonlinear Tables

Tell whether the function is *linear* or *nonlinear*.

a.

x	0	1	2	3	4
y	-2	-3	-4	-5	-6

x : +1

y : -1

Linear

b.

x	0	1	2	3	4
y	1	4	9	16	25

x : +1

y : up odds

nonlinear

Now It's Your Turn

Tell whether the function is *linear* or *nonlinear*.

a.

x	0	1	2	3	4
y	13	9	5	1	-3

x : +1

y : -4

Linear

b.

x	0	1	2	3	4
y	1	4	16	64	256

x : +1

y : • 4

Nonlinear

c.

x	0	2	3	7	10
y	2	4	6	8	10

x : Not constant

y : +2

Nonlinear

d.

x	1	2	4	7	8
y	2	6	14	26	30

x : +1

y : +4

Linear

Need to fill in missing #s

Summary: ______________________________

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Algebra I
4-4: Graphing a Function Rule

Name ____________________
Date ____________ Class Period ________

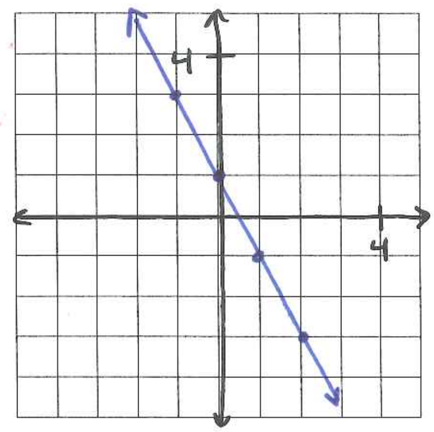
Learning Target: Today you will be able to GRAPH EQUATIONS THAT REPRESENT FUNCTIONS AND DECIDE WHETHER A GIVEN SCENARIO WOULD BE A CONTINUOUS OR DISCRETE GRAPH

Question/Main Ideas:	Notes:

Example 1: Graphing a Function Rule

What is the graph of the function rule $y = -2x + 1$?

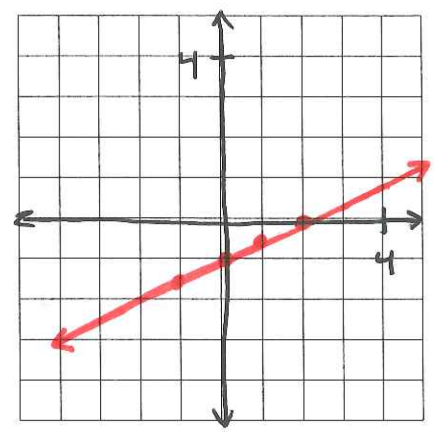
x	$y = -2x + 1$	y
-1	$-2(-1)+1$	3
0	$-2(0)+1$	1
1	$-2(1)+1$	-1
2	$-2(2)+1$	-3



Now It's Your Turn

What is the graph of the function rule $y = \frac{1}{2}x - 1$?

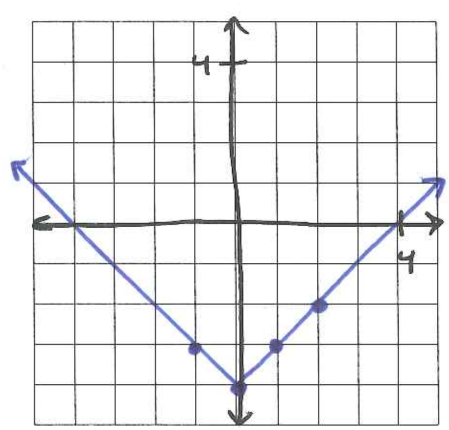
x	$y = \frac{1}{2}x - 1$	y
-1	$\frac{1}{2}(-1)-1$	-1.5
0	$\frac{1}{2}(0)-1$	-1
1	$\frac{1}{2}(1)-1$	-.5
2	$\frac{1}{2}(2)-1$	0



Example 2: Graphing Nonlinear Function Rules

What is the graph of the function rule $y = |x| - 4$?

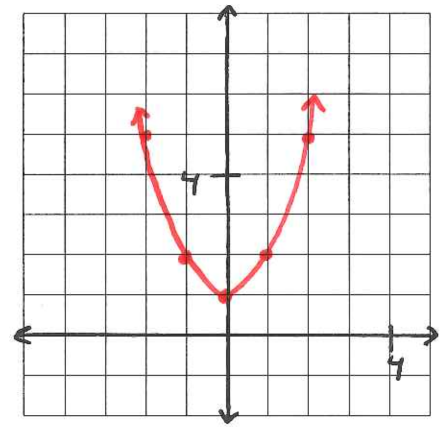
x	$y = \lvert x \rvert - 4$	y
-1	$\lvert -1 \rvert - 4$	-3
0	$\lvert 0 \rvert - 4$	-4
1	$\lvert 1 \rvert - 4$	-3
2	$\lvert 2 \rvert - 4$	-2



Now It's Your Turn

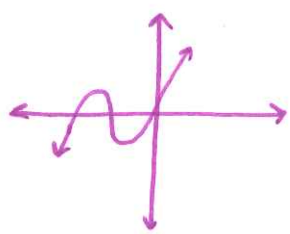
What is the graph of the function rule $y = x^2 + 1$?

x	$y = x^2 + 1$	y
-1	$(-1)^2+1$	2
0	$(0)^2+1$	1
1	$(1)^2+1$	2
2	$(2)^2+1$	5

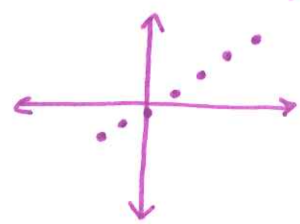


Definitions: Continuous Graph versus Discrete Graph

A **Continuous Graph** is a graph that is unbroken



A **Discrete Graph** is composed of distinct isolated points



Example 3: Identifying Continuous and Discrete Graphs

Based on the scenario, is the graph *continuous* or *discrete*? Justify your answer.

a. The amount of water in a wading pool, in gallons, depends on the amount of time t, in minutes, the wading pool has been filling, as related by the function w=3t.

Continuous – time and gallons can be decimals

b. The cost C for baseball tickets, in dollars, depends on the number n of tickets bought, as related by the function rule C = 16n.

Discrete – You cannot buy a partial ticket

Summary: ____________________

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Algebra I
4-6 Part 1: Formalizing Relations and Functions

Name ______________________
Date ____________ Class Period ______

Learning Target: Today you will be able to DETERMINE WHETHER A RELATION IS A FUNCTION

Question/Main Ideas:	Notes:

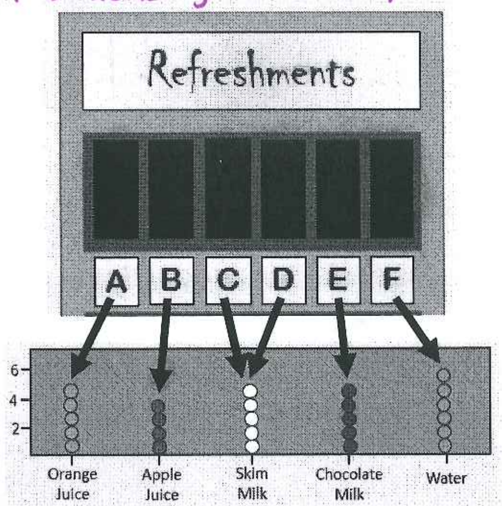
Definition: Function

A relationship that pairs each input value with exactly one output value.

- When pressing buttons (input) on a vending machine, you expect a certain product (output)

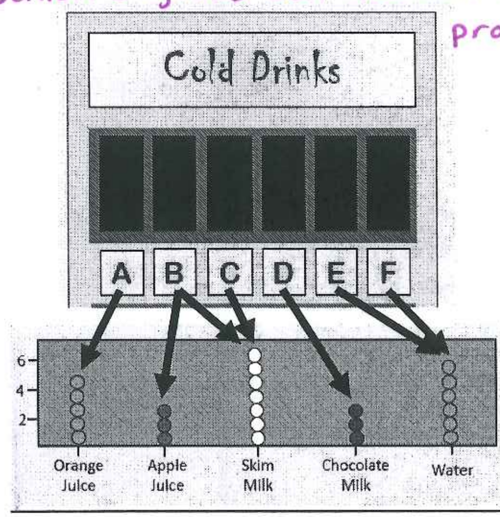
Function Example:

All buttons give one product



Non-Function Example:

Button B gives out two diff. products



Definitions: Domain and Range

Domain - all the possible input values (x).

Range - all the possible output values (y)

Example 1: Identifying Functions Using Mapping Diagrams

Identify the domain and range of each relation. Represent the relation with a mapping diagram. Is the relation a function?

a. {(-2, 0.5), (0, 2.5), (4, 6.5), (5, 2.5)}

Domain → Range

$-2 \to 0.5$
$0 \to 2.5$
$4 \to 6.5$
$5 \to 2.5$

Yes a Function

b. {(6, 5), (4, 3), (6, 4), (5, 8)}

Domain → Range

$4 \to 3$
$5 \to 8$
$6 \to 4$
$6 \to 5$

Not a function

Now It's Your Turn

Identify the domain and range of each relation. Represent the relation with a mapping diagram. Is the relation a function?

a. {(4.2, 1.5), (5, 2.2), (7, 4.8), (4.2, 0)}

Domain: 4.2, 5, 7

Range: 0, 1.5, 2.2, 4.8

No

b. {(-1, 1), (-2, 2), (4, -4), (7, -7)}

Domain: -2, -1, 4, 7

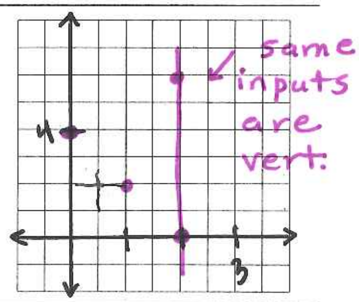
Range: -7, -4, 1, 2

Yes

Definition: Vertical Line Test

If any vertical line passes through more than one point on the graph, then it is not a function.

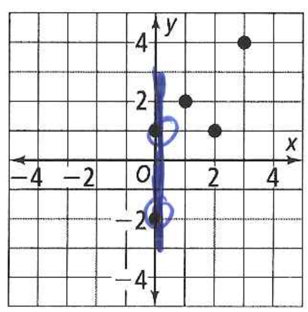
x	y
2	6
0	4
1	2
2	0



Example 2: Identifying Functions using the Vertical Line Test

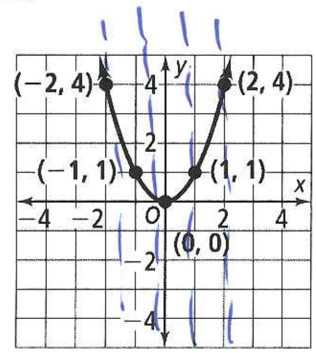
Is the relation a function? Use the vertical line test.

a.



Not a function

b.

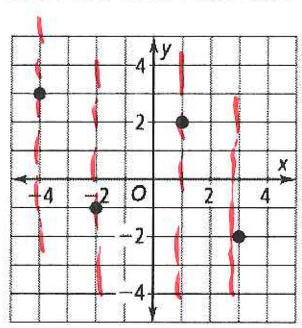


Yes a function

Now It's Your Turn

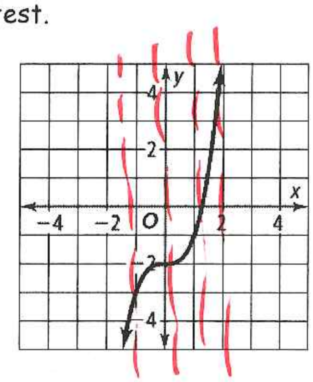
Is the relation a function? Use the vertical line test.

a.



Yes a function

b.



Yes a function

Summary: ____

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Algebra I
4-6 Part 2: Function Notation

Name ____________________
Date ____________ Class Period ______

Learning Target: Today you will be able to EVALUATE USING FUNCTION NOTATION

Question/Main Ideas:	Notes:
Concept: Comparing Function Notation	

Old Notation:

Evaluate y = 5x - 6 for x = 3.

$y = 5(3) - 6$
$y = 15 - 6$
$y = 9$

Function Notation:

If f(x) = 5x – 6, what is f(3)?

$f(3) = 5(3) - 6$
$f(3) = 15 - 6$
$f(3) = 9$

Old Notation:

Evaluate y = 5x – 6 for y = 14.

$14 = 5x - 6$
$+6 \quad +6$
$\frac{20}{5} = \frac{5x}{5}$
$4 = x$

Function Notation:

If f(x) = 5x – 6 and f(x) = 14, what is x?

$14 = 5x - 6$
$+6 \quad +6$
$\frac{20}{5} = \frac{5x}{5}$
$4 = x$

Definition: Function Notation

A new format used to label functions.

- $y = 5x - 6 \longrightarrow f(x) = 5x - 6$
- $x = 3 \longrightarrow f(3)$
- $y = 14 \longrightarrow f(x) = 14$

Example 1: Using Function Notation

Use the function f(x) = 2x - 11 and g(x) = -x^2 + 1 to find the value of each expression.

a. f(2) + g(-3)

$f(2) = 2(2) - 11$
$= 4 - 11$
$= -7$

$g(-3) = -(-3)^2 + 1$
$= -9 + 1$
$= -8$

$-7 + -8$
$\boxed{-15}$

b. f(3) - 3 · g(4)

$f(3) = 2(3) - 11$
$= 6 - 11$
$= -5$

$g(4) = -(4)^2 + 1$
$= -16 + 1$
$= -15$

$-5 - 3 \cdot (-15)$
$-5 + 45$
$\boxed{40}$

Now It's Your Turn

Use the function $f(x) = -7x + 15$ and $g(x) = x^3 - 1$ to find the value of each expression.

a. $g(2) + f(-1)$

$g(2) = (2)^3 - 1$
$= 8 - 1$
$= 7$

$f(-1) = -7(-1) + 15$
$= 7 + 15$
$= 22$

$7 + 22$
$\boxed{29}$

b. $f(g(3))$

$g(3) = (3)^3 - 1$
$= 27 - 1$
$= 26$

$f(26) = -7(26) + 15$
$= -182 + 15 = \boxed{-167}$

Example 2: Finding the Range of a Function

The domain of $f(x) = -1.5x + 4$ is $\{1, 2, 3, 4\}$. What is the range?

$f(1) = -1.5(1) + 4 = 2.5$
$f(2) = -1.5(2) + 4 = 1$
$f(3) = -1.5(3) + 4 = -0.5$
$f(4) = -1.5(4) + 4 = -2$

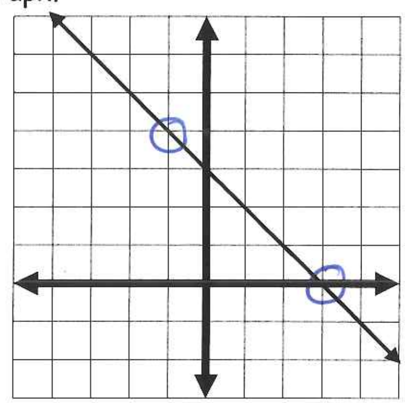
Range: $\{-2, -0.5, 1, 2.5\}$

Example 3: Evaluating Function Graphs

Evaluate for the function represented by the following graph.

$f(3) =$ 0

If $f(x) = 4$, then $x =$ -1

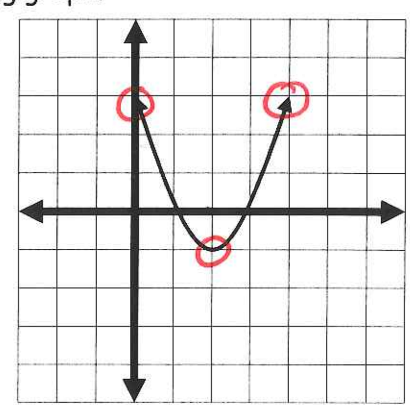


Now It's Your Turn

Evaluate for the function represented by the following graph.

$f(2) =$ -1

If $f(x) = 3$, then $x =$ 0, 4



Summary: ______________________________

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Algebra I
4-6 Part 3: Formalizing Relations and Functions

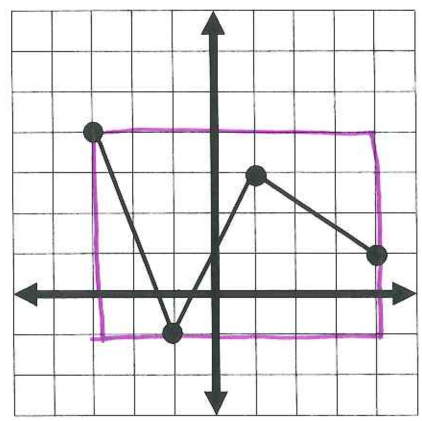
Name ______________________________
Date ______________ Class Period ________

Learning Target: Today you will be able to FIND THE DOMAIN AND RANGE OF A FUNCTION

Question/Main Ideas:	Notes:
Definition: Domain	All the possible input values (x)
Definition: Range	All the possible output values (y)

Exploring Domain and Range of a Graph

Look at the graph. Draw the smallest box possible that contains the entire function. Your box can go through points on the graph.



Fill in the blanks with appropriate number.

The left side (wall) is at x = -3

The right side (wall) is at x = 4

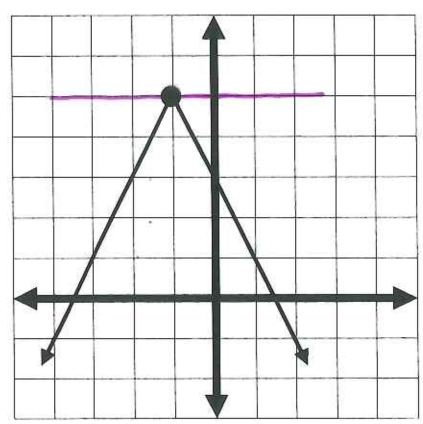
Domain: $-3 \leq x \leq 4$

The top (ceiling) is at y = 4

The bottom (floor) is at y = -1

Range: $-1 \leq y \leq 4$

Look at the graph. Draw the smallest box possible that contains the entire function. Your box can go through points on the graph.



Fill in the blanks with appropriate number.

The left side (wall) is at x = N/A

The right side (wall) is at x = N/A

Domain: all real #s ($\mathbb{R}$)

The top (ceiling) is at y = 5

The bottom (floor) is at y = N/A

Range: $y \leq 5$

Cannot draw walls or floor

Look at the graph. Draw the smallest box possible that contains the entire function. Your box can go through points on the graph.

Fill in the blanks with appropriate number.

The left side (wall) is at x = N/A

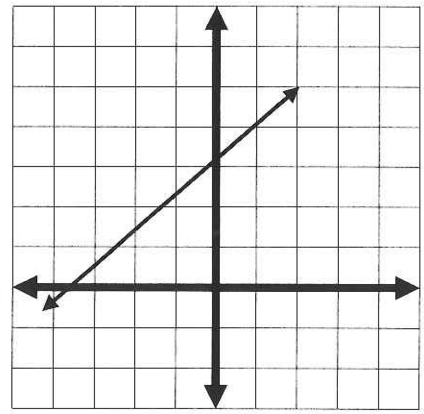
The right side (wall) is at x = N/A

Domain: $\mathbb{R}$

The top (ceiling) is at y = N/A

The bottom (floor) is at y = N/A

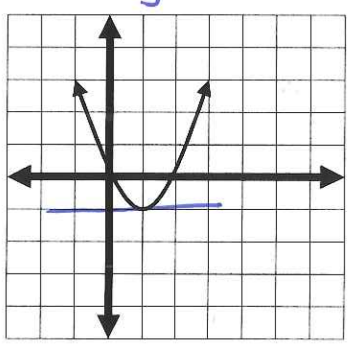
Range: $\mathbb{R}$



Example 1: Finding Domain and Range of a Graph

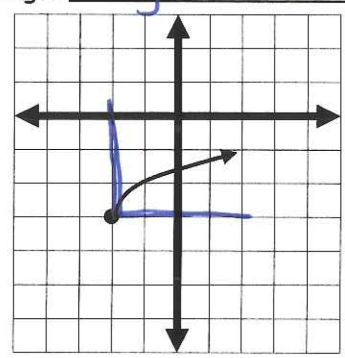
a. Domain: $\mathbb{R}$

Range: $y \geq -1$



b. Domain: $x \geq -2$

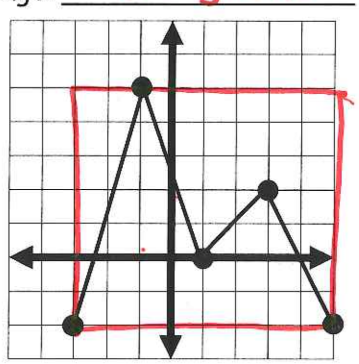
Range: $y \geq -3$



Now It's Your Turn

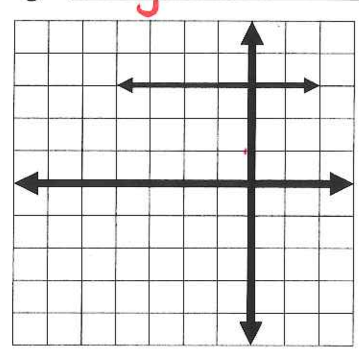
a. Domain: $-3 \leq x \leq 5$

Range: $-2 \leq y \leq 5$



b. Domain: $\mathbb{R}$

Range: $y = 3$



Summary: ______________________________

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Algebra I
4-7: Sequences and Functions

Name ______________________
Date ____________ Class Period ______

Learning Target: Today you will be able to IDENTIFY AND EXTEND PATTERNS IN SEQUENCES AND REPRESENT ARITHMETIC SEQUENCES USING FUNCTION NOTATION

Question/Main Ideas:	Notes:
Definitions: Sequence	An ordered list of numbers that often form a pattern
Definitions: Term of a Sequence	Each number in the list is called a term of a sequence
Example 1: Extending Sequences	Describe a pattern in each sequence. What are the next two terms of each sequence? a. 5, 8, 11, 14, ... +3 17, 20 b. 2.5, 5. 10, 20, ... • 2 40, 80
Now It's Your Turn	Describe a pattern in each sequence. What are the next two terms of each sequence? a. 2, -4, 8, -16, ... • -2 32, -64 b. 1, 4, 9, 16, ... Perfect Squares 25, 36
Definitions: Arithmetic Sequence and Common Difference	Arithmetic Sequence – when the difference between each term is constant. The amout being added or subtracted is called the common difference.
Example 2: Identifying an Arithmetic Sequence	Tell whether the sequence if arithmetic. If it is, what is the common difference? a. 3, 8, 13, 18, ... Yes; +5 b. 6, 9, 12, 16, ... +3 +3 +4 Not Arithmetic

Now It's Your Turn

Tell whether the sequence if arithmetic. If it is, what is the common difference?

a. 8, 15, 22, 30, ...

+7 +8 +8

Not Arithmetic

b. 10, 4, -2, -8, ...

Yes; −6

Sequences as a Function

Think of the term # as the input and each term as the output. Ex: 7, 11, 15, 19... becomes

Term #	1	2	3	4	→ n
Term	7	11	15	19	→ A(n)

$A(1) = 7$

$A(2) = 7+4$

$A(3) = 7+4+4$

$A(4) = 7+4+4+4$

$A(n) = 7+4+4+4 \ldots +4$

Rule for an Arithmetic Sequence

$$\underbrace{A(n)}_{n\text{th term}} = \underbrace{A(1)}_{1\text{st term}} + (\underbrace{n}_{\text{term }\#}-1)\underbrace{d}_{\text{common difference}}$$

Example 3: Writing a Rule for an Arithmetic Sequence

Tell whether the sequence is arithmetic. If the sequence is arithmetic, write a function rule to represent it. Then use your rule to find the 20th, 34th, and 41st terms.

3, 9, 15, 21, ...

+6 +6 +6

Yes; d = +6

$A(n) = 3 + (n-1)6$

$A(n) = 3 + 6n - 6$

$A(n) = 6n - 3$

$6(20) - 3 = 117$

$6(34) - 3 = 201$

$6(41) - 3 = 243$

Now It's Your Turn

Tell whether the sequence is arithmetic. If the sequence is arithmetic, write a function rule to represent it. Then use your rule to find the 18th, 22nd, and 31st terms.

3.6, 4.1, 4.6, 5.1, ...

+.5 +.5 +.5

Yes; d = .5

$A(n) = 3.6 + (n-1)0.5$

$A(n) = 3.6 + 0.5n - 0.5$

$A(n) = 0.5n + 3.1$

$0.5(18) + 3.1 = 12.1$

$0.5(22) + 3.1 = 14.1$

$0.5(31) + 3.1 = 18.6$

Summary: ______________________________

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