Contents

Standards:

8.F.A.1

8.F.A.2

8.F.A.3

Module 5 Topic A

Functions

“I Can” Do Math (Functions)

I can understand, interpret and compare functions.

- 8.F.A.1 I can define a function as a rule, where for each input there is exactly one output.
- 8.F.A.1 I can show the relationship between inputs and outputs of a function by graphing them as ordered pairs on a coordinate grid.

- 8.F.A.2 I can determine the properties of a function given the inputs and outputs in a table.
- 8.F.A.2 I can compare the properties of two functions that are represented differently (equations, tables, graphs or given verbally).

- 8.F.A.3 I can explain why the equation y=mx+b represents a linear function and then find the slope and y-intercept in relation to the function.
- 8.F.A.3 I can give examples of relationships and create a table of values that can be defined as a non-linear function.

Keeping Track of My Learning

	1	2	3	4	5	6	7	8	9	10

M5A L2 Relations and Functions

Notebook p.86

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. (Function notation is not required in Grade 8.).

Learning Target: ____

____

Key Vocabulary

Key Idea

Relations and Mapping Diagrams

A **relation** pairs inputs with outputs. A relation can be represented by ordered pairs or a **mapping diagram**.

Ordered Pairs

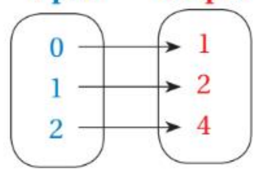
(0, 1)

(1, 2)

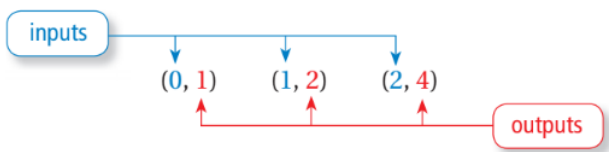
(2, 4)

Mapping Diagram

Input **Output**



Ordered pairs can be used to show **inputs** and **outputs**.

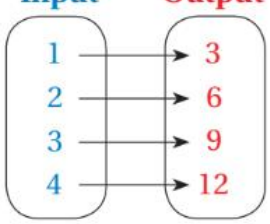


A relation that pairs each input with *exactly one* output is a **function**.

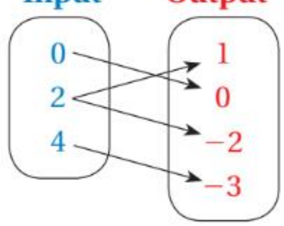
EXAMPLE 1 Listing Ordered Pairs of a Relation

List the ordered pairs shown in the mapping diagram.

a. **Input** **Output**



b. **Input** **Output**



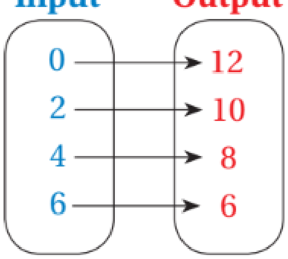
The ordered pairs are .

The ordered pairs are (0, 0), (2, 1), (2, −2), and (4, −3).

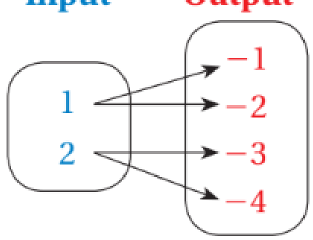
On Your Own

List the ordered pairs shown in the mapping diagram.

1. **Input** **Output**



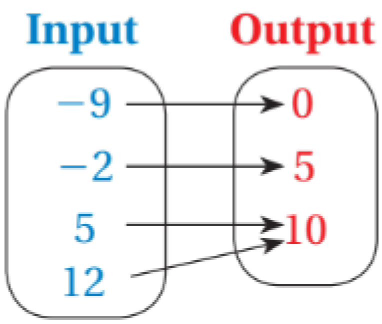
2. **Input** **Output**



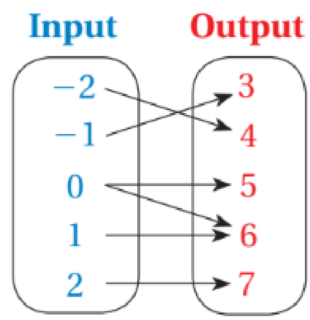
EXAMPLE 2 Determining Whether Relations Are Functions

Determine whether each relation is a function.

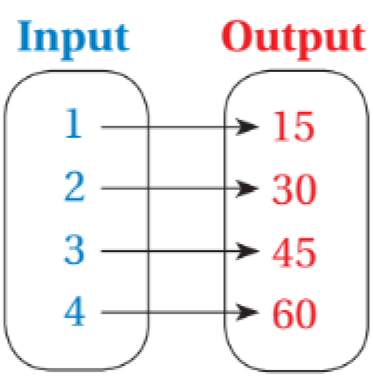
a.



b.



EXAMPLE 3 Describing a Mapping Diagram



Consider the mapping diagram at the left.

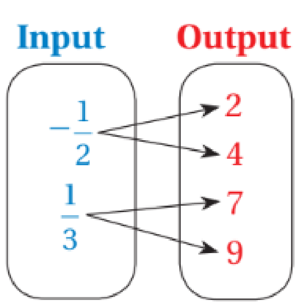
a. Determine whether the relation is a function.

b. Describe the pattern of inputs and outputs in the mapping diagram.

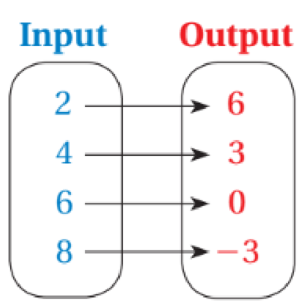
On Your Own

Determine whether the relation is a function.

3.



4.



5. Describe the pattern of inputs and outputs in the mapping diagram in On Your Own 4.

M5A L2 Relations and Functions CW

Date:

Partner A Name : ______________________________________ Partner B Name:_____________________________________

16. SCUBA DIVING The normal pressure at sea level is one atmosphere of pressure (1 ATM). As you dive below sea level, the pressure increases by 1 ATM for each 10 meters of depth.

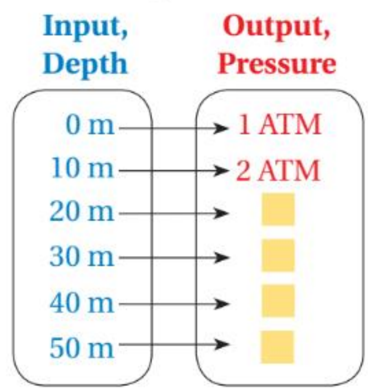
a. Complete the mapping diagram.

b. Is the relation a function? Explain.

c. List the ordered pairs. Then plot the ordered pairs in a coordinate plane.

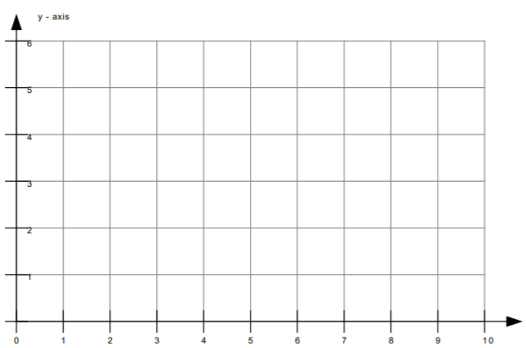
d. Compare the mapping diagram and graph. Which do you prefer? Why?

e. **RESEARCH** What are common depths for people who are just learning to scuba dive? What are common depths for experienced scuba divers?



b. ____

c.



d. ______________________________
____
____

e.______________________________
____
____

17. MOVIES A store sells previously viewed movies. The table shows the cost of buying 1, 2, 3, or 4 movies.

a. Use the table to draw a mapping diagram.

b. Is the relation a function? Explain.

c. Describe the pattern. How does the cost per movie change as you buy more movies?

Movies	Cost
1	$10
2	$18
3	$24
4	$28

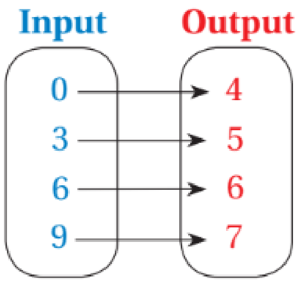
a.

b.____
____

c.____
____

Homework: Name:________________________ Cohort:_______

List the ordered pairs shown in the mapping diagram.

6.


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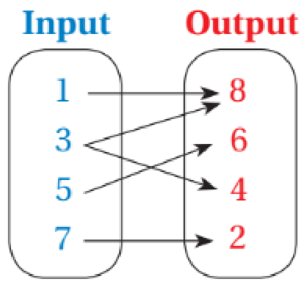

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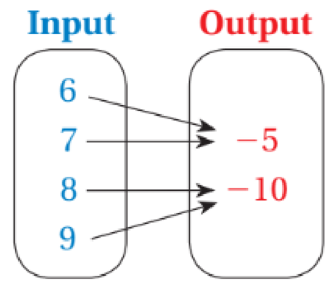
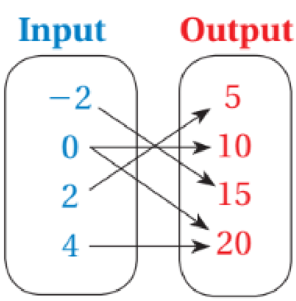


Determine whether the relation is a function.

9.


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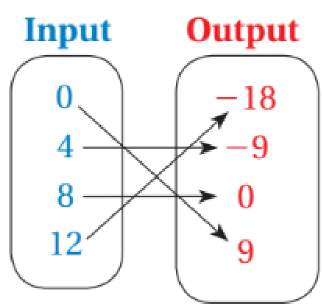
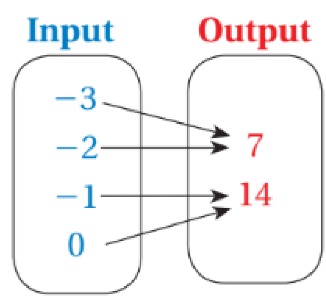


11.


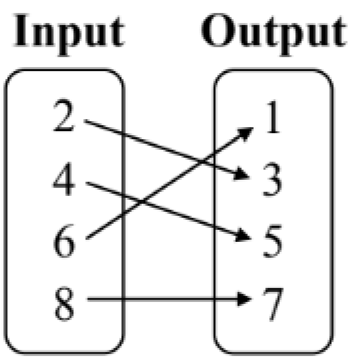
M5A L2 Relations and Functions Exit Ticket

Date:

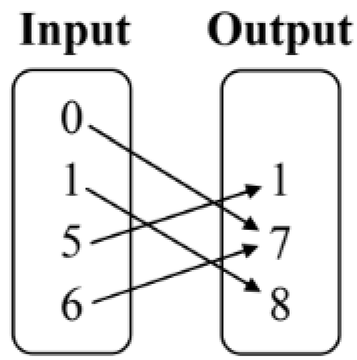
Name:_________________________ Cohort: _____

List the ordered pairs shown in the mapping diagram.

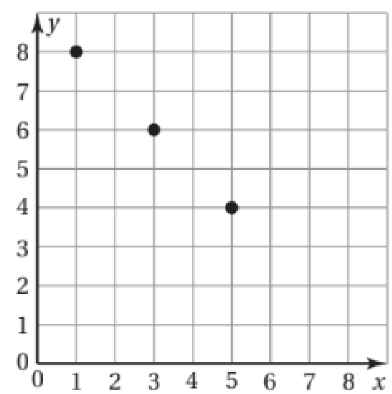
1.



2.



3. Draw a mapping diagram for the graph. Then describe the pattern of inputs and outputs.



4. The table shows the number of beads needed to make a bracelet. Use the table to draw a mapping diagram.

Bracelet Length (in.)	Number of Beads
6	12
7	14
8	16
9	18

M5A L3 Linear Functions and Proportionality

8.EE.C.8a Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

Learning Target: ____

____

Example 1

In the last lesson, we looked at several tables of values showing the inputs and outputs of functions. For instance, one table showed the costs of purchasing different numbers of bags of candy:

Bags of candy (x)	1	2	3	4	5	6	7	8
Cost in Dollars (y)	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00

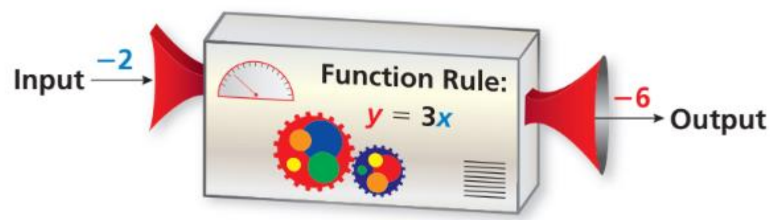
What do you think a *linear* function is?

____

____

____

A **function rule** is an equation that describes the relationship between inputs (independent variable) and outputs (dependent variable).



- **Do you think this is a *linear* function? Justify your answer.**

$\frac{10.00}{8} =$ _______; \$_______ *per each bag of candy*

$\frac{5.00}{4} =$ _______; \$_______ *per each bag of candy*

$\frac{2.50}{2} =$ _______; \$_______ *per each bag of candy*

_______________, this is a linear function because ____.

- **What rule or equation describes our cost function for bags of candy?**

____

The total cost of candy is a function of the number of bags purchased.

Example 2

Daniel A. walks at a constant speed of 8 miles every 2 hours. Describe a linear function for the number of miles he walks in x hours. What is a reasonable range of x-values for this function?

1. Average Speed (slope):

2. Function Rule (equation):

3. Limitation on x:

M5A L3 Linear Functions and Proportionality

Notebook p.89

Example 3

Veronica runs at a constant speed. The distance she runs is a function of the time she spends running. The function has the table of values shown below.

Time in minutes **(x)**	8	16	24	32
Distance run in miles **(y)**	1	2	3	4

1. Average Speed (slope):

2. Function Rule (equation):

3. Describe the function in terms of distance and time.

Example 4

Water flows from a faucet into a bathtub at the constant rate of 7 gallons of water pouring out every 2 minutes. The bathtub is initially empty, and its plug is in. Determine the rule that describes the volume of water in the tub as a function of time. If the tub can hold 50 gallons of water, how long will it take to fill the tub?

1. Rate of water flow (slope):

2. Function Rule (equation):

3. Answer the question:

Now assume that you are filling the same 50-gallon bathtub with water flowing in at the constant rate of 3.5 gallons per minute, but there were initially 8 gallons of water in the tub. Will it still take about 14 minutes to fill the tub?

Time in minutes **(x)**	0	3	6	9	12
Total volume in tub in gallons **()**					

M5A L3 Linear Functions and Proportionality CW

Date:

Partner A Name : ______________________________________ Partner B Name:_____________________________________

Exercise 1

Do: Partner A ; Assist Partner B

1. Hana claims she mows lawns at a constant rate. The table below shows the area of lawn she can mow over different time periods.

Number of minutes (x)	5	20	30	50
Area mowed in square feet (y)	36	144	216	360

a. Is the data presented consistent with the claim that the area mowed is a linear function of time?

To find the rate of change, we divide the Area by Minutes.

36/5 = ____________ **144/20 = ____________** **216/30 = ____________** **360/50 = ____________**

The rate of change is ___________________, therefore the data is ______________________.

b. Describe in words the function in terms of area mowed and time.

The ________________________________ is a function of ____.

c. At what rate does Hana mow lawns over a 5-minute period?

$\frac{36}{5} =$ ________ The rate is ____________ square feet per minute.

d. At what rate does Hana mow lawns over a 20-minute period?

The rate is ____________ square feet per minute.

e. At what rate does Hana mow lawns over a 30-minute period?

The rate is ____________ square feet per minute.

f. At what rate does Hana mow lawns over a 50-minute period?

The rate is ____________ square feet per minute.

g. Write the equation that describes the area mowed, y, in square feet, as a linear function of time, x, in minutes.

h. Describe any limitations on the possible values of x and y.

i. What number does the function assign to $x = 24$? That is, what area of lawn can be mowed in 24 minutes?

j. According to this work, how many minutes would it take to mow an area of 400 square feet?

Exercise 2

Do: Partner B ; Assist Partner A

2. A linear function has the table of values below. The information in the table shows the total volume of water, in gallons, that flows from a hose as a function of time, the number of minutes the hose has been running.

Time in minutes (x)	10	25	50	70
Total volume of water in gallons (y)	44	110	220	308

a. Describe the function in terms of volume and time.

The ______________________________ is a function of ____.

b. Write the rule for the volume of water in gallons, y, as a linear function of time, x, given in minutes.

c. What number does the function assign to 250? That is, how many gallons of water flow from the hose during a period of 250 minutes?

d. The average swimming pool holds about 17,300 gallons of water. Suppose such a pool has already been filled one quarter of its volume. Write an equation that describes the volume of water in the pool if, at time 0 minutes, we use the hose described above to start filling the pool.

e. Approximately how many hours will it take to finish filling the pool?

Homework **Name:**______________________________________ **Cohort:**_______

3. Recall that a linear function can be described by a rule in the form of $y = mx + b$, where m and b are constants. A particular linear function has the table of values below.

Input (x)	0	4	10	11	15	20	23
Output (y)	4	24	54	59			

a. What is the equation that describes the function?

b. Complete the table using the rule.

Name:_______________________________ Cohort:_____________

Exit Ticket

The information in the table shows the number of pages a student can read in a certain book as a function of time in minutes spent reading. Assume a constant rate of reading.

Time in minutes (x)	2	6	11	20
Total number of pages read in a certain book (y)	7	21	38.5	70

a. Write the equation that describes the total number of pages read, y, as a linear function of the number of minutes, x, spent reading.

b. How many pages can be read in 45 minutes?

c. A certain book has 396 pages. The student has already read $\frac{3}{8}$ of the pages and now picks up the book again at time $x = 0$ minutes. Write the equation that describes the total number of pages of the book read as a function of the number of minutes of further reading.

d. Approximately how much time, in minutes, will it take to finish reading the book?

M5A L4 More Examples of Functions

Notebook p.90

8.F.A.2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Learning Target: ____

____

- The word *discrete* in English means individually separate or distinct. If a function admits only individually separate input values (like whole number counts of candy bags, for example), then we say we have *a discrete function*. If a function admits, over a range of values, <u>any</u> input value within that range (all fractional values too, for example), then we have a function that is not discrete. Functions that describe motion, for example, are typically not discrete.

Example 1

Classify each of the functions described below as either discrete or not discrete.

a) The function that assigns to each whole number the cost of buying that many cans of beans in a particular grocery store.

b) The function that assigns to each time of day one Wednesday the temperature of Sammy's fever at that time.

c) The function that assigns to each real number its first digit.

d) The function that assigns to each day in the year 2015 my height at noon that day.

e) The function that assigns to each moment in the year 2015 my height at that moment.

f) The function that assigns to each color the first letter of the name of that color.

g) The function that assigns the number 23 to each and every real number between 20 and 30.6.

h) The function that assigns the word YES to every yes/no question.

i) The function that assigns to each height directly above the North Pole the temperature of the air at that height right at this very moment.

M5A L4 More Examples of Functions

Notebook p.91

Example 2

Water flows from a faucet into a bathtub at a constant rate of 7 gallons of water every 2 minutes. Regard the volume of water accumulated in the tub as a function of the number of minutes the faucet has be on. Is this function discrete or not discrete?

Example 3

You have just been served freshly made soup that is so hot that it cannot be eaten. You measure the temperature of the soup, and it is $210°\text{F}$. Since $212°\text{F}$ is boiling, there is no way it can safely be eaten yet. One minute after receiving the soup, the temperature has dropped to $203°\text{F}$. If you assume that the rate at which the soup cools is constant, write an equation that would describe the temperature of the soup over time.

- Curious whether or not you are correct in assuming the cooling rate of the soup is constant, you decide to measure the temperature of the soup each minute after its arrival to you. Here's the data you obtain:

Time	**Temperature in Fahrenheit**
after 2 minutes	196
after 3 minutes	190
after 4 minutes	184
after 5 minutes	178
after 6 minutes	173
after 7 minutes	168
after 8 minutes	163
after 9 minutes	158

M5A L4 More Examples of Functions Classwork

Date:

Partner A Name : ____ Partner B Name:______________________________________

Exercise 1

Do: Partner B ; Assist Partner A

1. At ASU Prep, each bus in its fleet of buses can transport 35 students. Let B be the function that assigns to each count of students the number of buses needed to transport that many students on a field trip.

When Xavier thought about matters, he drew the following table of values and wrote the formula $B = \frac{x}{35}$. Here x is the count of students, and B is the number of buses needed to transport that many students. He concluded that B is a linear function.

Number of students (x)	35	70	105	140
Number of buses (B)	1	2	3	4

Vinny looked at Xavier's work and saw no errors with his arithmetic. But he said that the function is not actually linear.

a. Vinny is right. Explain why B is not a linear function.

b. Is B a discrete function?

Do: Partner A ; Assist Partner B

2. A linear function has the table of values below. It gives the costs of purchasing certain numbers of movie tickets.

Number of tickets (x)	3	6	9	12
Total cost in dollars (y)	27.75	55.50	83.25	111.00

c. Write the linear function that represents the total cost, y, for x tickets purchased.

d. Is the function discrete? Explain.

e. What number does the function assign to 4? What do the question and your answer mean?

Do: Partner B ; Assist Partner A

3. A function produces the following table of values.

Input	**Output**
Banana	B
Cat	C
Flippant	F
Oops	O
Slushy	S

a. Make a guess as to the rule this function follows. Each input is a word from the English language.

b. Is this function discrete?

Homework ♥

1. The table shows the distances covered over certain counts of hours traveled by a driver driving a car at a constant speed.

Number of hours driven (x)	3	4	5	6
Total miles driven (y)	141	188	235	282

a. Write an equation that describes y, the number of miles covered, as a linear function of x, number of hours driven.

b. Are there any restrictions on the value x and y can adopt?

c. Is the function discrete?

d. What number does the function assign to 8? Explain what your answer means.

e. Use the function to determine how much time it would take to drive 500 miles.

M5A L4 More Examples of Functions Exit Ticket

Date: 12/10/2018

Name:____________________________________ Cohort:________________

Exit Ticket

The table below shows the costs of purchasing certain numbers of tablets. We can assume that the total cost is a linear function of the number of tablets purchased.

Number of tablets (x)	17	22	25
Total cost in dollars (y)	$10{,}183.00$	$13{,}178.00$	$14{,}975.00$

a. Write an equation that describes the total cost, y, as a linear function of the number, x, of tablets purchased.

b. Is the function discrete? Explain.

c. What number does the function assign to 7? Explain.

M5A L5 Graphs of Functions and Equations

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.

Learning Target: ____

____

1. The distance that Giselle can run is a function of the amount of time she spends running. Giselle runs 3 miles in 21 minutes. Assume she runs at a constant rate.

   a. **<u>Write an equation</u>** in two variables that represents her distance run, y, as a function of the time, x, she spends running.

   b. Use the equation you wrote in part (a) to determine **<u>how many miles</u>** Giselle can run in **<u>14 minutes.</u>**

   Giselle can run ________ miles in **14** minutes.

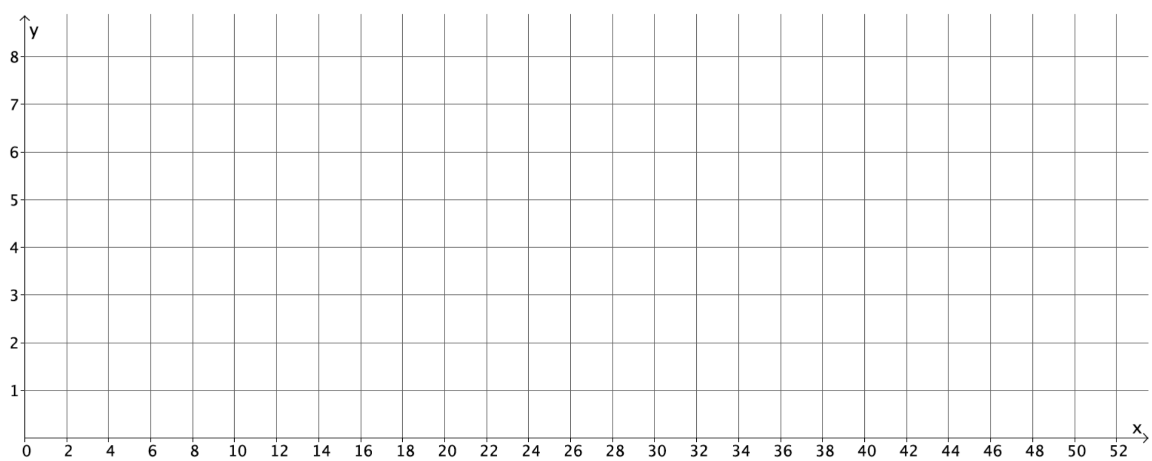
   c. Use the equation you wrote in part (a) to determine **<u>how many miles</u>** Giselle can run in **<u>28 minutes</u>**.

   Giselle can run ________ miles in 28 minutes.

   d. Use the equation you wrote in part (a) to determine **<u>how many miles</u>** Giselle can run in **<u>7 minutes</u>**.

   Giselle can run ________ miles in 7 minutes.

   e. For a given input x of the function, a time, the matching output of the function, y, is the distance Giselle ran in that time. Write the inputs and outputs from parts (b)–(d) as **<u>ordered pairs</u>**, and **<u>plot them as points on a coordinate plane</u>**.



f. What do you notice about the points you plotted?

g. Is the function discrete?

h. **Use the equation** you wrote in part (a) to determine **<u>how many miles Giselle can run in 36 minutes</u>**. Write your answer as an ordered pair, as you did in part (e), and include the point on the graph. Is the point in a place where you expected it to be? Explain.

i. Assume you used the rule that describes the function to determine how many miles Giselle can run for any given time and wrote each answer as an ordered pair. Where do you think these points would appear on the graph?

j. What do you think the graph of all the input/output pairs would look like? Explain.

I know the graph will be a ________ as we can find all of the points that represent ________________________________ of time too. We also know that Giselle runs at a ___________________ rate, so we would expect that as the __________ she spends ______________ increases, the _____________ she can run will increase at the same rate.

k. Connect the points you have graphed to make a line. Select a point on the graph that has integer coordinates. Verify that this point has an output that the function would assign to the input.

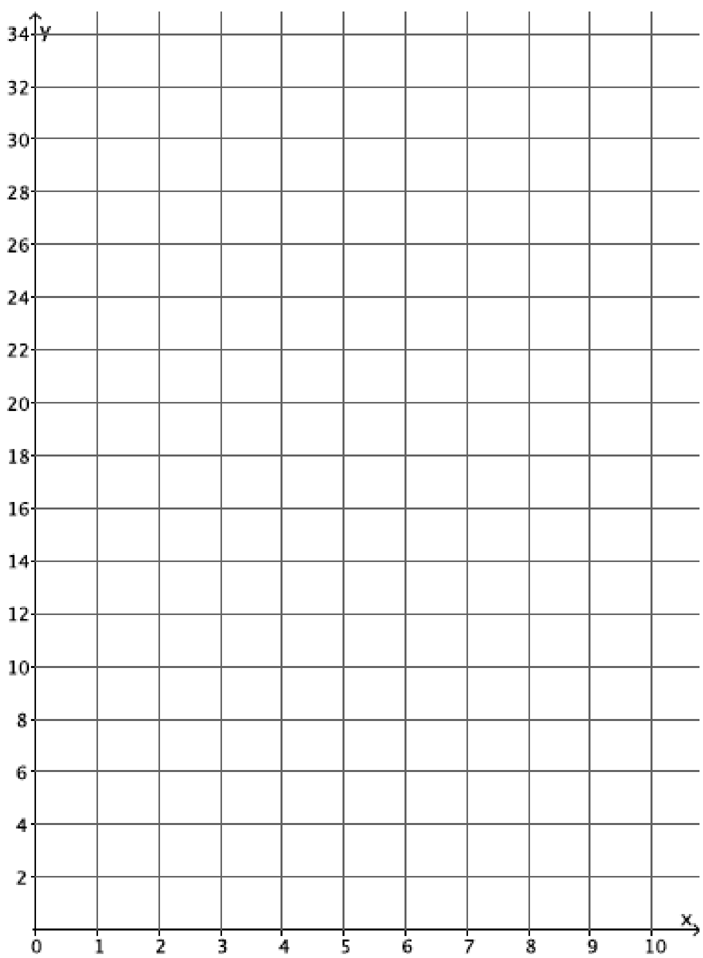
l. Sketch the graph of the equation $y = \frac{1}{7}x$ using the same coordinate plane in part (e). What do you notice about the graph of all the input/output pairs that describes Giselle's constant rate of running and the graph of the equation $y = \frac{1}{7}x$?

2. The number of devices a particular manufacturing company can produce is a function of the number of hours spent making the devices. On average, 4 devices are produced each hour. Assume that devices are produced at a constant rate.

   a. Write an equation in two variables that describes the number of devices, y, as a function of the time the company spends making the devices, x.

   b. Use the equation you wrote in part (a) to determine how many devices are produced in 8 hours.

   c. Use the equation you wrote in part (a) to determine how many devices are produced in 6 hours.



   d. Use the equation you wrote in part (a) to determine how many devices are produced in 4 hours.

   e. The input of the function, x, is time, and the output of the function, y, is the number of devices produced. Write the inputs and outputs from parts (b)–(d) as ordered pairs, and plot them as points on a coordinate plane.

f. What shape does the graph of the points appear to take?

g. Is the function discrete?

h. Use the equation you wrote in part (a) to determine how many devices are produced in 1.5 hours. Write your answer as an ordered pair, as you did in part (e), and include the point on the graph. Is the point in a place where you expected it to be? Explain.

i. Assume you used the equation that describes the function to determine how many devices are produced for any given time and wrote each answer as an ordered pair. Where do you think these points would appear on the graph?

j. What do you think the graph of all possible input/output pairs will look like? Explain.

I think the graph of this function will be a _________. Since the rate is continuous, we can find all of the points that represent fractional intervals of time. We also know that devices are _______________________________________, so we would expect that as the __________ spent producing devices increases, the number of devices produced would increase at the same rate.

k. Connect the points you have graphed to make a line. Select a point on the graph that has integer coordinates. Verify that this point has an output that the function would assign to the input.

l. Sketch the graph of the equation $y = 4x$ using the same coordinate plane in part (e). What do you notice about the graph of the input/out pairs that describes the company's constant rate of producing devices and the graph of the equation $y = 4x$?

M5A L5 Graphs of Functions and Equations Classwork

12/11/2018

Partner A Name : ______________________________________ Partner B Name:_____________________________________

Exercise 1

Do: Partner A and B then compare your answers.

1. The distance that Scott walks is a function of the time he spends walking. Scott can walk $\frac{1}{2}$ mile every 8 minutes. Assume he walks at a constant rate.

   a. Predict the shape of the graph of the function. Explain.

   ____

   b. Write an equation to represent the distance that Scott can walk in miles, y, in x minutes.

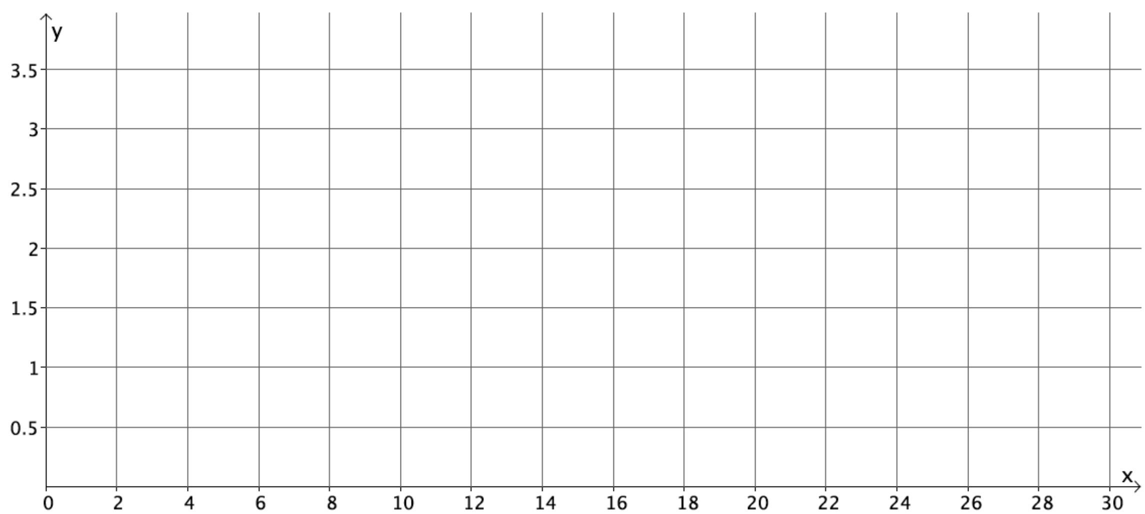
   ____

   c. Use the equation you wrote in part (b) to **determine how many miles** Scott can walk in **<u>24 minutes.</u>**

   d. Use the equation you wrote in part (b) to **determine how many miles** Scott can walk in **<u>12 minutes</u>**.

   e. Use the equation you wrote in part (b) to **determine how many miles** Scott can walk in **<u>16 minutes</u>**.

   f. Write your inputs and corresponding outputs as ordered pairs, and then plot them on a coordinate plane.



   g. What shape does the graph of the points appear to take? Does it match your prediction?

   ____

   h. Connect the points to make a line. What is the equation of the line?

   ____

M5A L5 Graphs of Functions and Equations Exit Ticket 12/11/2018

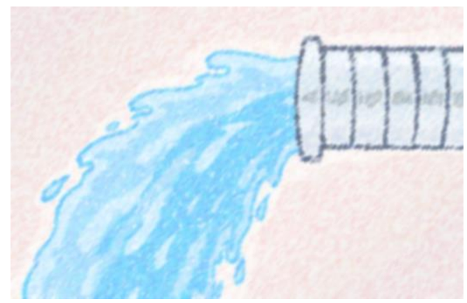
Name:__________________________________ Cohort:______________

Exit Ticket

Water flows from a hose at a constant rate of 11 gallons every 4 minutes. The total amount of water that flows from the hose is a function of the number of minutes you are observing the hose.

a. Write an equation in two variables that describes the amount of water, y, in gallons, that flows from the hose as a function of the number of minutes, x, you observe it.

b. Use the equation you wrote in part (a) to determine the amount of water that flows from the hose during an 8-minute period, a 4-minute period, and a 2-minute period.

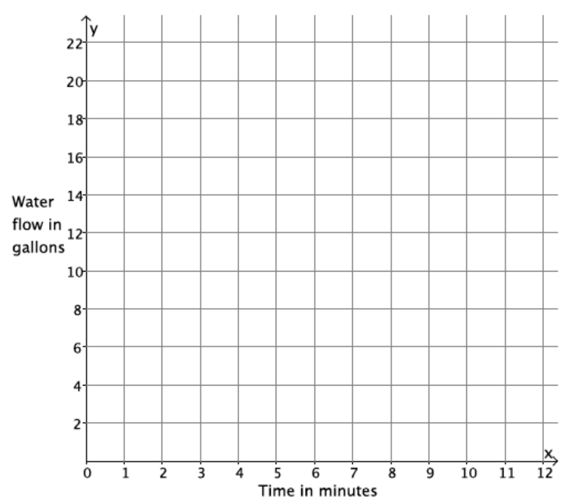


In 8 minutes, _______ gallons of water flow out of the hose.

In 4 minutes, ________ gallons of water flow out of the hose.

In 2 minutes, ________ gallons of water flow out of the hose.

c. An input of the function, x, is time in minutes, and the output of the function, y, is the amount of water that flows out of the hose in gallons. Write the inputs and outputs from part (b) as ordered pairs, and plot them as points on the coordinate plane.



M5A L6 Graphs of Linear Functions and Rate of Change

Notebook p.96

8.F.A.2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)

Learning Target: ____

____

A function is said to be linear if the rule defining the function can be described by a linear equation.

Functions 1, 2, and 3 have table-values as shown. Which of these functions appear to be linear? Justify your answers.

Input	Output
2	5
4	7
5	8
8	11

Input	Output
2	4
3	9
4	16
5	25

Input	Output
0	-3
1	1
2	6
3	9

- Suppose a function can be described by an ______________________ in the form of ___________________ .

- The graph of a linear equation is a line, and so the graph of this function will be a line. How do we compute the slope of the graph of a line?

To compute slope, we find the ___________________ in y-values compared to the _______________ in x-values. We use the following formula:

- And what is the slope of the line associated with this data? Using the first two rows of the table we get:

- Does the claim that the function is linear seem reasonable?

_____________, the ________________________ between each pair of inputs and outputs does seem to be _________________.

M5A L6 Graphs of Linear Functions and Rate of Change

Notebook p.97

A function assigns the inputs shown the corresponding outputs given in the table below.

Input	Output
1	2
2	-1
4	-7
6	-13

a. Do you suspect the function is **linear?** Compute the **rate of change** of this data for **at least three pairs** of inputs and their corresponding outputs.

b. **What equation** seems to describe the function?

c. As you did not **verify** that the rate of change is constant across all input/output pairs, check that the equation you found in part (a) does indeed produce the correct output for each of the four inputs 1, 2, 4, and 6.

d. What will the graph of the function look like? Explain.

Lesson Summary

If the rate of change for pairs of inputs and corresponding outputs for a function is the same for all pairs (constant), then the function is a linear function. It can thus be described by a linear equation $y = mx + b$.

The graph of a linear function will be a set of points contained in a line. If the linear function is discrete, then its graph will be a set of distinct collinear points. If the linear function is not discrete, then its graph will be a full straight line or a portion of the line (as appropriate for the context of the problem).

M5A L6 Graphs of Linear Functions and Rate of Change Classwork

Date:

Partner A Name : ______________________________________ Partner B Name:_____________________________________

Exercise 1

Do: Partner A ; Assist Partner B

1. A function assigns to the inputs given the corresponding outputs shown in the table below.

Input	Output
3	9
9	17
12	21
15	25

a. Does the function appear to be linear? Check at least three pairs of inputs and their corresponding outputs.

b. Find a linear equation that describes the function.

c. What will the graph of the function look like? Explain.

Exercise 2
Do: Partner B ; Assist Partner A

2. A function assigns to the inputs given the corresponding outputs shown in the table below.

Input	Output
-1	2
0	0
1	2
2	8
3	18

a. Is the function a linear function? Check at least three pairs of inputs and their outputs.

b. What equation describes the function?

M5A L6 Graphs of Linear Functions and Rate of Change Exit Ticket Date:

Name:____________________________________ Cohort:________________

Exit Ticket

1. Gabby claims that a function with the table of inputs and outputs below is a linear function. Is she correct? Explain.

Input	Output
-3	-25
2	10
5	31
8	54

2. A function assigns the inputs and corresponding outputs shown in the table to the right.

   a. Does the function appear to be linear? Check at least three pairs of inputs and their corresponding outputs.

Input	Output
-2	3
8	-2
10	-3
20	-8

   b. Can you write a linear equation that describes the function?

   c. What will the graph of the function look like? Explain.

M5A L7 Comparing Linear Functions and Graphs

Notebook p.98

8.F.A.2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Learning Target: ____
____

Each of Exercises 1–4 provides information about two functions. Use that information given to help you compare the two functions and answer the questions about them.

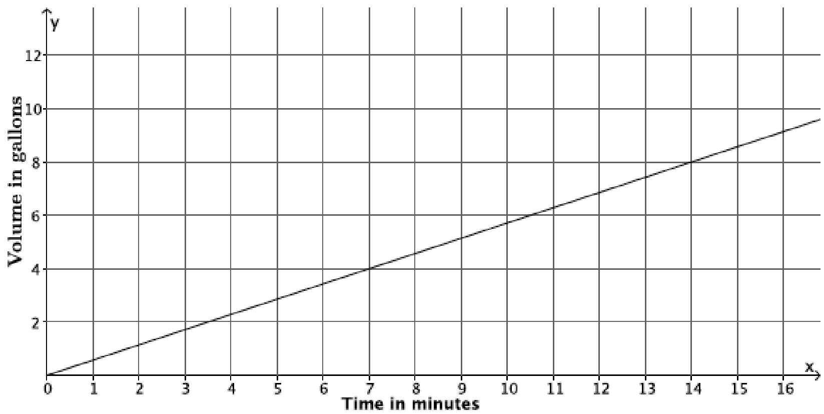
1. Julian and Julius each drive from City A to City B, a distance of 147 miles. They take the same route and drive at constant speeds. Julian begins driving at 1:40 p.m. and arrives at City B at 4:15 p.m. Julius's trip from City A to City B can be described with the equation $y = 64x$, where y is the distance traveled in miles and x is the time in minutes spent traveling. Who gets from City A to City B faster?

2. You have recently begun researching phone billing plans. Phone Company A charges a flat rate of $75 a month. A flat rate means that your bill will be $75 each month with no additional costs. The billing plan for Phone Company B is a linear function of the number of texts that you send that month. That is, the total cost of the bill changes each month depending on how many texts you send. The table below represents some inputs and the corresponding outputs that the function assigns.

Input (number of texts)		**Output (cost of bill in dollars)**
50		50
150		60
200		65
500		95

At what number of texts would the bill from each phone plan be the same? At what number of texts is Phone Company A the better choice? At what number of texts is Phone Company B the better choice?

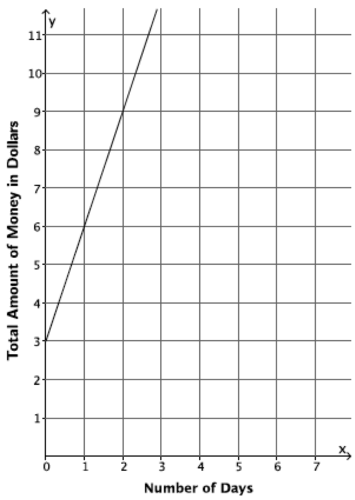
3. The function that gives the volume of water, y, that flows from Faucet A in gallons during x minutes is a linear function with the graph shown. Faucet B's water flow can be described by the equation $y = \frac{5}{6}x$, where y is the volume of water in gallons that flows from the faucet during x minutes. Assume the flow of water from each faucet is constant. Which faucet has a faster rate of flow of water? Each faucet is being used to fill a tub with a volume of 50 gallons. How long will it take each faucet to fill its tub? How do you know?



Suppose the tub being filled by Faucet A already had 15 gallons of water in it, and the tub being filled by Faucet B started empty. If now both faucets are turned on at the same time, which faucet will fill its tub fastest?

4. Two people, Adam and Bianca, are competing to see who can save the most money in one month. Use the table and the graph below to determine who will save the most money at the end of the month. State how much money each person had at the start of the competition. (Assume each is following a linear function in his or her saving habit.)

Adam's Savings:



Bianca's Savings:

Input (Number of Days)	**Output (Total amount of money in dollars)**
5	17
8	26
12	38
20	62

Summary:

We know that functions can be expressed as equations, graphs, tables, and using verbal descriptions. Regardless of the way that a function is expressed, we can compare it with other functions.

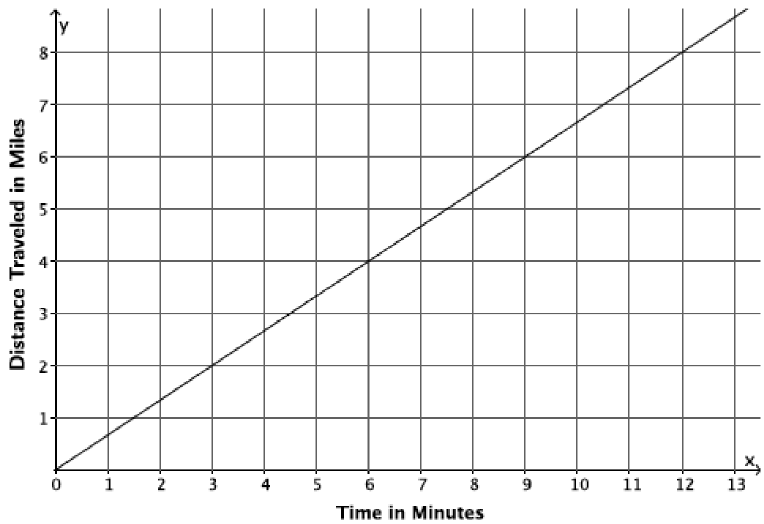
M5A L7 Comparing Linear Functions and Graphs Classwork W21 12/17/2018

Partner A Name : ______________________________________ Partner B Name:_____________________________________

Exercise 1
Do: Partner A and Partner B.

1. The graph below represents the distance in miles, y, Car A travels in x minutes. The table represents the distance in miles, y, Car B travels in x minutes. It is moving at a constant rate. Which car is traveling at a greater speed? How do you know?

Car A:



Car B:

Time in minutes (x)	**Distance in miles** (y)
15	12.5
30	25
45	37.5

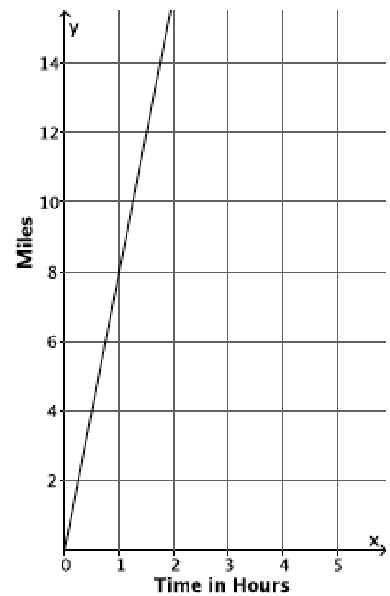
M5A L7 Comparing Linear Functions and Graphs Exit Ticket W21 12/17/2018

Name:___________________________________ Cohort:_______________

Exit Ticket

Brothers Paul and Pete walk 2 miles to school from home. Paul can walk to school in 24 minutes. Pete has slept in again and needs to run to school. Paul walks at a constant rate, and Pete runs at a constant rate. The graph of the function that represents Pete's run is shown below.

a. Which brother is moving at a greater rate? Explain how you know.



b. If Pete leaves 5 minutes after Paul, will he catch up to Paul before they get to school?

M5A L8 Graphs of Simple Nonlinear Functions

Notebook p.

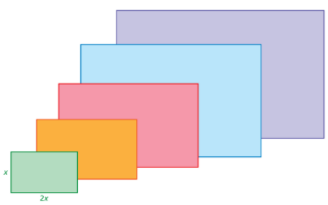
8.F.A.3: Interpret the equation y = mx + b as defining a linear function whose graph is a straight line; give examples of functions that are not linear.

Learning Target: ____

____

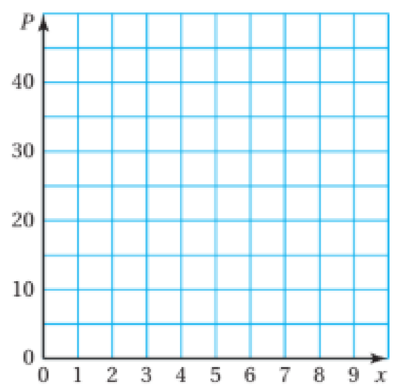
1 ACTIVITY: Finding Patterns for Similar Figures

Complete each table for the sequence of similar rectangles. Graph the data in each table. Decide whether each pattern is linear or nonlinear.



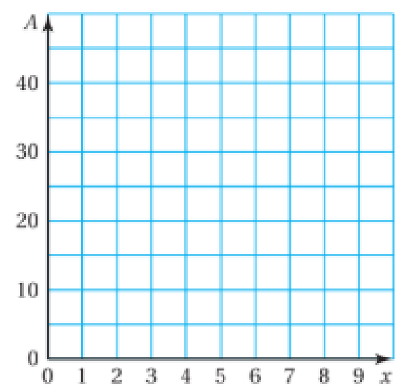
a. Perimeters of similar rectangles

x	1	2	3	4	5
P					



b. Areas of similar rectangles

x	1	2	3	4	5
A					



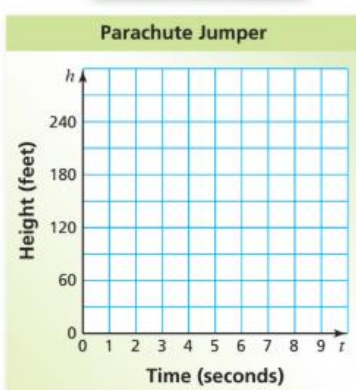
2 ACTIVITY: Comparing Linear and Nonlinear Functions

Each table shows the height h (in feet) of a falling object at t seconds.

1. Graph the data in each table.
2. Decide whether each graph is linear or nonlinear.
3. Compare the two falling objects. Which one has an increasing speed?

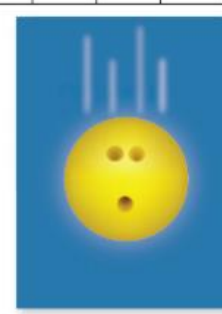
a. Falling parachute jumper

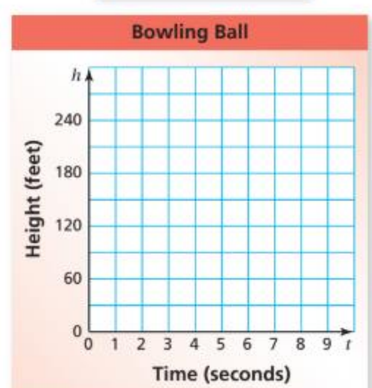
t	0	1	2	3	4
h	300	285	270	255	240



b. Falling bowling ball

t	0	1	2	3	4
h	300	284	236	156	44





M5A L8 Graphs of Simple Nonlinear Functions

Notebook p.

The graph of a linear function shows a constant rate of change. A nonlinear function does not have a ________________________________. So, its graph is not a line.

1 Identifying Functions from Tables

Does the table represent a *linear* or *nonlinear* function? Explain.

a.

x	3	6	9	12
y	40	32	24	16

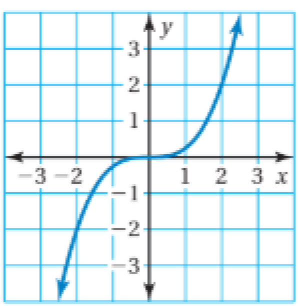
b.

x	1	3	5	7
y	2	11	33	88

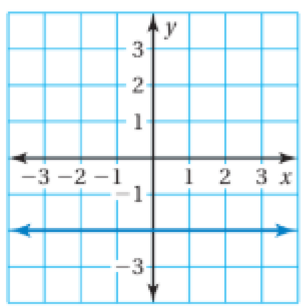
2 Identifying Functions from Graphs

Does the graph represent a *linear* or *nonlinear* function? Explain.

a.



b.



On Your Own

Does the table or graph represent a *linear* or *nonlinear* function? Explain.

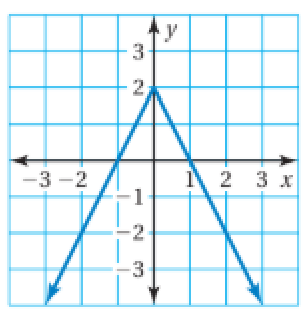
1.

x	*y*
0	25
7	20
14	15
21	10

2.

x	*y*
2	8
4	4
6	0
8	−4

3.



M5A L8 Graphs of Simple Nonlinear Functions Classwork   Date:

Partner A Name : ______________________________________   Partner B Name:_____________________________________

A: DO odd number questions, ASSIST even number questions.

B: DO even number questions, ASSIST odd number questions.

Graph the data in the table. Decide whether the graph is *linear* or *nonlinear*.

3.

x	0	1	2	3
y	4	8	12	16

4.

x	1	2	3	4
y	1	2	6	24

5.

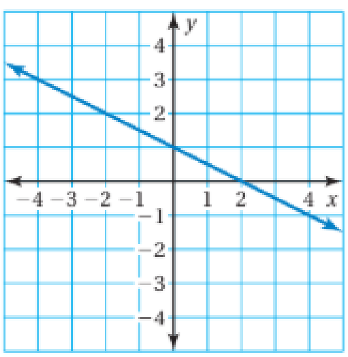
x	6	5	4	3
y	21	15	10	6

6.

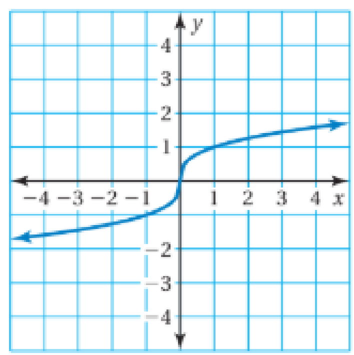
x	−1	0	1	2
y	−7	−3	1	5

Does the table or graph represent a *linear* or *nonlinear* function? Explain.

7.



8.



9.

x	5	11	17	23
y	7	11	15	19

10.

x	−3	−1	1	3
y	9	1	1	9

11. **VOLUME** The table shows the volume V (in cubic feet) of a cube with an edge length of x feet. Does the table represent a linear or nonlinear function? Explain.

Edge Length, x	1	2	3	4	5	6	7	8
Volume, V	1	8	27	64	125	216	343	512

M5A L8 Graphs of Simple Nonlinear Functions Classwork

Date:

Partner A Name : ______________________________________ Partner B Name:_____________________________________

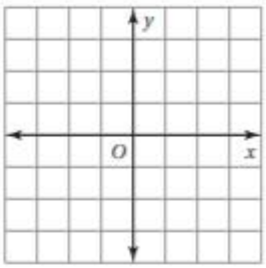
A: DO odd number questions, ASSIST even number questions.

B: DO even number questions, ASSIST odd number questions.

Graph the data in the table. Decide whether the graph is *linear* or *nonlinear*.

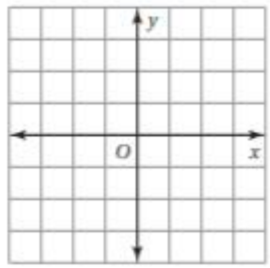
1.

x	–2	0	2	4
y	4	0	4	16



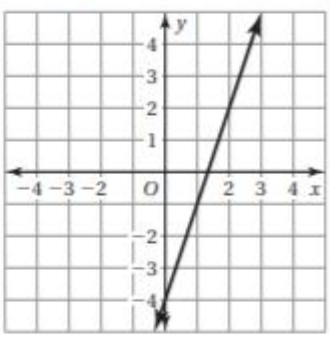
2.

x	–1	0	1	2
y	–1	1	3	5

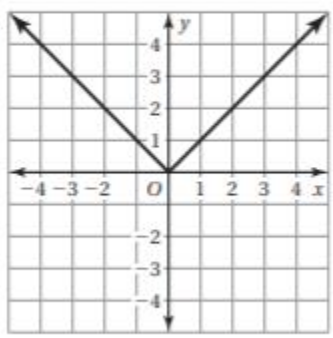


Does the graph represent a *linear* or nonlinear *function*? Explain.

3.



4.



5. The table shows the area of a square with side length x inches. Does the table represent a linear or nonlinear function? Explain.

Side Length, x	1	2	3	4
Area, A	1	4	9	16

Name:

Minute 25

1. 50% of 200 =

2. A number divided by –3 is –5. What is the number? __________

3. Original price: \$10 New price: \$7 Circle: Discount or Mark Up

4. To find sales tax, multiply the cost of an item by 0.05.

Circle: True or False

5. Circle the answers that are equal to 8%.

a. 8 **b.** 0.08 **c.** $\frac{4}{50}$ **d.** $\frac{8}{10}$

6. Emily puts \$100 in the bank and earns 4% interest per year.
How much interest will she earn in one year? __________

7. Which answer does not belong?

a. 0.1 **b.** 10% **c.** $\frac{1}{10}$ **d.** 0.001

8. Circle which answer is greater: 10% of 500 or 20% of 400

9. $4(\sqrt{100}) =$

10. $6^{-2} =$

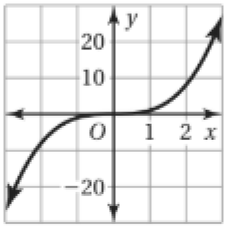
Bonus! Grampy Wolf has 7 coins in his pocket worth 65 cents.
How many quarters, dimes, and nickels does he have? __________

M5A L8 Graphs of Simple Nonlinear Functions Exit Ticket Date:

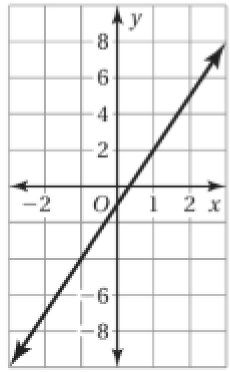
Name:_____________________________________ Cohort:________________

Does the table or graph represent a *linear* or *nonlinear* function? Explain.

3.



4.



5.

x	3	5	7	9
y	5	3	0	3

6.

x	4	7	10	13
y	–2	0	2	4

M5A L9 Graphs of Simple Nonlinear Functions

Notebook p.

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.

Learning Target: ____

____

3 Identifying a Nonlinear Function

Which equation represents a *nonlinear* function?

Ⓐ $y = 4.7$

Ⓑ $y = \pi x$

Ⓒ $y = \frac{4}{x}$

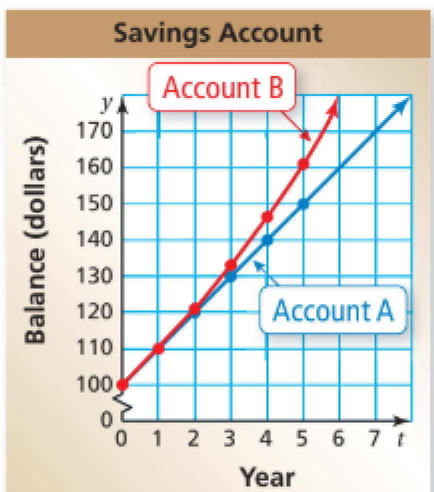
Ⓓ $y = 4(x - 1)$

If you can rewrite the equations in slope-intercept form, they are linear functions.

4 Real-Life Application

Account A earns simple interest. Account B earns compound interest. The table shows the balances for 5 years. Graph the data and compare the graphs.

Year, t	Account A Balance	Account B Balance
0	$100	$100
1	$110	$110
2	$120	$121
3	$130	$133.10
4	$140	$146.41
5	$150	$161.05



On Your Own

Does the equation represent a *linear* or *nonlinear* function? Explain.

4. $y = x + 5$

5. $y = \frac{4x}{3}$

6. $y = 1 - x^2$

M5A L9 Graphs of Simple Nonlinear Functions Classwork Date:

Partner A Name : ______________________________________ Partner B Name:_____________________________________

A: DO odd number questions, ASSIST even number questions.

B: DO even number questions, ASSIST odd number questions.

Does the equation represent a *linear* or *nonlinear* function? Explain.

3 **12.** $2x + 3y = 7$ **13.** $y + x = 4x + 5$ **14.** $y = \frac{8}{x^2}$

15. LIGHT The frequency y (in terahertz) of a light wave is a function of its wavelength x (in nanometers). Does the table represent a linear or nonlinear function? Explain.

Color	Red	Yellow	Green	Blue	Violet
Wavelength, x	660	595	530	465	400
Frequency, y	454	504	566	645	749

16. MODELING The table shows the cost y (in dollars) of x pounds of sunflower seeds.

Pounds, x	Cost, y
2	2.80
3	?
4	5.60

a. What is the missing y-value that makes the table represent a linear function?

b. Write a linear function that represents the cost y of x pounds of seeds. Interpret the slope.

c. Does the function have a maximum value? Explain your reasoning.

17. TREES Tree A is 5 feet tall and grows at a rate of 1.5 feet per year. The table shows the height h (in feet) of Tree B after x years.

Years, x	Height, h
0	5
1	11
4	17
9	23

a. Does the table represent a linear or nonlinear function? Explain.

b. Which tree is taller after 10 years? Explain.

18. Number Sense The ordered pairs represent a function.

$(0, -1), (1, 0), (2, 3), (3, 8)$, and $(4, 15)$

a. Graph the ordered pairs and describe the pattern. Is the function linear or nonlinear?

b. Write an equation that represents the function.

M5A L9 Graphs of Simple Nonlinear Functions Classwork Date:

Partner A Name : ____________________________________ Partner B Name:___________________________________

A: DO odd number questions, ASSIST even number questions.

B: DO even number questions, ASSIST odd number questions.

12.	13.	14.
15.	16a.	16b.
16c.	17a.	17b.
18a.	18b.	

NAME:

MINUTE 26

1. $\frac{3}{4} \cdot \frac{3}{5} =$

2. $10.05 = 10\frac{1}{2}$ Circle: True or False

3. Circle the answer that is greater: 20% of 400 or 25% of 500

4. Order from least to greatest: $\frac{1}{5}$, $\frac{1}{10}$, 25%, 0.05. ______________________________

5. $-\frac{3}{4} = \frac{-3}{4}$ Circle: True or False

6. $\left(\frac{-2}{3}\right)\left(\frac{2}{3}\right) =$

7. The reciprocal of $\frac{3}{11}$ is __________.

8. Reduce: $\frac{-8}{24} =$

9. Find the mean temperature in Eagletown for the past 5 days. __________

Mon.	Tues.	Wed.	Thurs.	Fri.
60°	80°	65°	75°	70°

10. Write $\frac{9}{2}$ as a mixed number. __________

M5A L9 Graphs of Simple Nonlinear Functions Exit Ticket Date:

Name:____ Cohort:_________________

7. The table shows the profit P (in dollars) of selling x pairs of flip flops. Does the table represent a *linear* or *nonlinear* function? Explain.

Flip Flops, *x*	1	2	3	4	5
Profit, *P*	4	8	12	16	20

8. The table shows the commission y (in dollars) of selling x cell phone plans.

Cell Phone Plans, *x*	1	2	3	4
Commission, *y*	100	150	250	400

a. Does the table represent a *linear* or *nonlinear* function? Explain.

b. Based on the pattern in the table, what is the commission of selling 5 cell phone plans?

9. The formula for the volume V of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.

Does this formula represent a *linear* or *nonlinear* function? Explain.

M5A L10 Analyzing and Sketching Graphs

Notebook p.

8.F.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.

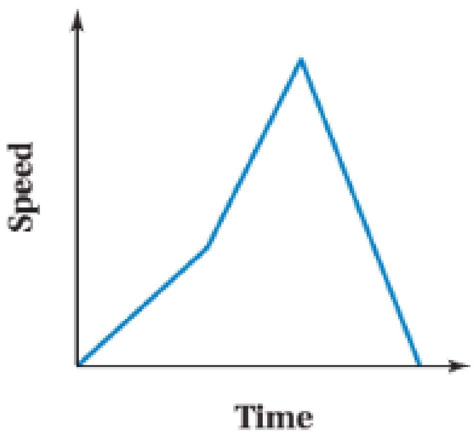
Learning Target: ____

____

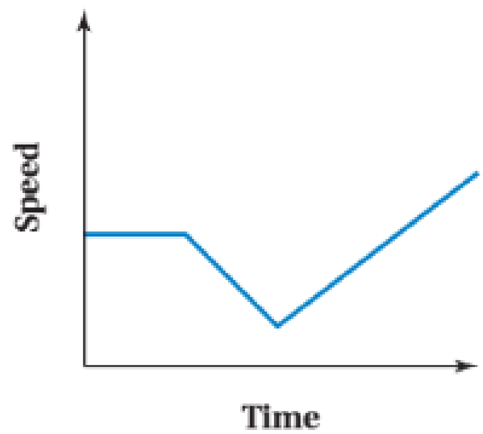
2 ACTIVITY: Matching Situations to Graphs

Work with a partner. You are riding your bike. Match each situation with the appropriate graph. Explain your reasoning.

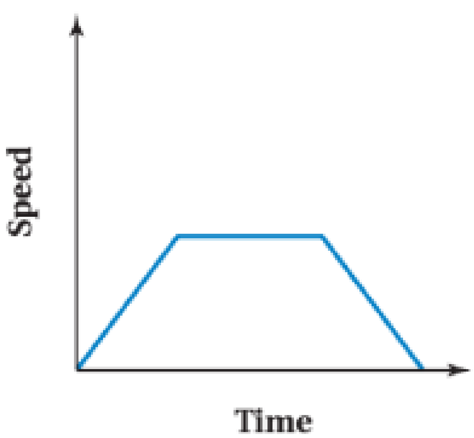
A.



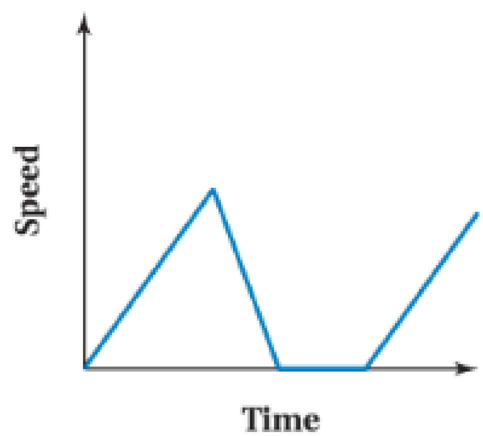
B.



C.



D.



a. You gradually increase your speed, then ride at a constant speed along a bike path. You then slow down until you reach your friend's house.

b. You gradually increase your speed, then go down a hill. You then quickly come to a stop at an intersection.

c. You gradually increase your speed, then stop at a store for a couple of minutes. You then continue to ride, gradually increasing your speed.

d. You ride at a constant speed, then go up a hill. Once on top of the hill, you gradually increase your speed.

M5A L10 Analyzing and Sketching Graphs

Notebook p.

2 Sketching Graphs

Sketch a graph that represents each situation.

A stopped subway train gains speed at a constant rate until it reaches its maximum speed. It travels at this speed for a while, and then slows down at a constant rate until coming to a stop at the next station.

Words	Graph
A stopped subway train gains speed at a constant rate . . .	increasing line segment starting at the origin
until it reaches its maximum speed. It travels at this speed for a while, . . .	horizontal line segment
and then slows down at a constant rate until coming to a stop at the next station.	decreasing line segment ending at the horizontal axis

As television size increases, the price increases at an increasing rate.

Step 1: Draw the axes. Label the vertical axis "Price" and the horizontal axis "TV size."

Step 2: Sketch the graph.

The price *increases at an increasing rate*. So, the graph is nonlinear and becomes steeper and steeper as the TV size increases.

On Your Own

Sketch a graph that represents the situation.

2. A fully charged battery loses its charge at a constant rate until it has no charge left. You plug it in and recharge it fully. Then it loses its charge at a constant rate until it has no charge left.

3. As the available quantity of a product increases, the price decreases at a decreasing rate.

M5A L10 Analyzing and Sketching Graphs Classwork

Date:

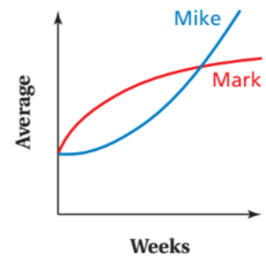
Partner A Name : ___________________________________ Partner B Name:__________________________________

A: DO odd number questions, ASSIST even number questions.
B: DO even number questions, ASSIST odd number questions.

14. REASONING The graph shows two bowlers' averages during a bowling season.

a. Describe each bowler's performance.

b. Who had a greater average most of the season? Who had a greater average at the end of the season?



a.____

____

____

____

b.____

Sketch a graph that represents the situation.

15. The value of a car depreciates. The value decreases quickly at first and then more slowly.

16. The distance from the ground changes as your friend swings on a swing.

17. The value of a rare coin increases at an increasing rate.

18. You are typing at a constant rate. You pause to think about your next paragraph, and then you resume typing at the same constant rate.

NAME:

MINUTE 27

1. $\frac{3}{8} \cdot \frac{4}{5} =$

2. $10.75 = 10\frac{3}{4}$ Circle: True or False

3. Order from least to greatest: $\frac{1}{8}$, 0.78, 15%, $\frac{1}{20}$. ____________________________

4. $-\frac{3}{4} = \frac{(-3)}{4}$ Circle: True or False

5. The reciprocal of $\frac{1}{20}$ is __________.

6. Reduce: $\frac{-8}{40} =$

7. $\frac{5}{11} \cdot \frac{-11}{6} =$

8. Write $10\frac{3}{4}$ as an improper fraction. __________

9. Circle the answer that is greater: 25% of 400 or 20% of 1,000

10. Which of these are prime numbers? *Circle all that apply.*

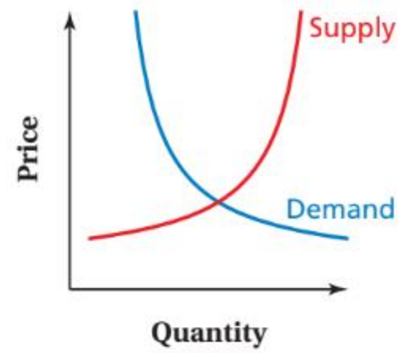
5 7 12 8 11 2 20 45

M5A L10 Analyzing and Sketching Graphs Exit Ticket

Date:

Name:___________________________________ Cohort:_______________

19. Economics You can use a *supply and demand model* to understand how the price of a product changes in a market. The *supply curve* of a particular product represents the quantity suppliers will produce at various prices. The *demand curve* for the product represents the quantity consumers are willing to buy at various prices.



a. Describe and interpret each curve.

b. Which part of the graph represents a surplus? a shortage? Explain your reasoning.

c. The curves intersect at the *equilibrium point*, which is where the quantity produced equals the quantity demanded. Suppose that demand for a product suddenly increases, causing the entire demand curve to shift to the right. What happens to the equilibrium point?