**Brockton High School**
**Content: Math III**
**Week of: May 11 to May 15, 2020**

Greetings Math III Students! We hope you are safe and well with your families!
This assignment is for the week, use your time wisely. You do not have to complete this in one sitting. Here is the lesson plan for this week:

## Goals for this week

**Learning Objectives:**

Students will be able to:

1. Apply a formula for calculating the sum of consecutive numbers.
2. Identify a linear, exponential or quadratic function from an equation, graph or scenario.
3. Interpret linear models.
4. Identify x and y-intercept, domain and range of the graphs of functions.

*(Standard A-SSE)*

**Literacy Objectives:**

Students will be able to:

1. to create, interpret and explain a table, chart or graph
2. to compute, interpret and explain numbers
3. to convey one's thinking in complete sentences

*(https://www.bpsma.org/schools/brockton-high-school/about-us/mission-literacy-charts)*

**Carnegie Learning (use with Carnegie Resources provided below)**

(Log-in through Clever)

**Instructional Video Links: Please watch at least one of these videos to help guide you.**

**Module 2 Unit 1: Searching for Patterns**

- https://www.youtube.com/watch?v=IQ5a3zDK8fU
- https://www.youtube.com/watch?v=s_unH3o-PvM
- .https://www.khanacademy.org/math/pre-algebra/pre-algebra-math-reasoning/pre-algebra-number-patterns/v/math-patterns-example-1
- ttps://www.khanacademy.org/math/pre-algebra/pre-algebra-math-reasoning/pre-algebra-number-patterns/v/math-patterns-example-2
- https//www.youtube.com/watch?v=9Bu0Hkxw88g
- https://www.youtube.com/watch?v=CxEFOozrMSE

**Module 2 Unit 2: Graphs of Functions**

- https://youtu.be/Cn1aFaxRyeU
- https://youtu.be/mxBoni8N70Y
- https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:transform-quadratic-functions/v/shifting-and-scaling-parabolas

Feel free to also search for your own tutorial videos to guide you.

**Printable Resources for Module 2**: : optional resources

Multiple Representations of Functions Pages M1 31 to M1 45.

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**Key Terms**

- **Arithmetic sequence**: a sequence of numbers in which the difference between any two consecutive terms is a constant. The positive or negative difference is called the common difference.
- **Linear function**: a function that cab be written in the form f(x) = mx + b, where m and b are both real numbers.
- **Quadratic function**: a function that can be written in the form f(x) = a$x^2$ + bx + c, where *a*, *b* and *c* are real numbers and *a* is not equal to zero.
- **Exponential function**: a function of the form f(x) = a$b^x$, where a is any non-zero real number and b is any real number greater than zero and not equal to 1.
- **Intercept:** the point where the graph intercepts the x or y axis.
- **Minimum point:** of a graph or function is the ordered pair on the graph with the least value.
- **Maximum point:** of a graph or function is the ordered pair on the graph with the greatest value.
- **Domain:** set of all possible input values for a function.
- **Range:** set of all possible input values for a function.

**Practice Activities:**

On-Line:

All students now have access to an on-line program called **Mathia!**

- Mathia- If you are already in Mathia, please continue to work in the program.
- If you are new to Mathia: Please see the log-in information below and **begin working on Modules 1 and 2.** Please through units 1 and 2 for Module 2

**Extension Activities:**

Complete the **PRACTICE activity** on the Printable Resource form page M1 – 47 and send a copy to your teacher.

**Log-in Information**

1. Log-in to Clever
2. Under Math, click on MATHia
3. Username: 6-digit BHS school ID # @bpsma.org
   Password: Date of birth bps 1920
   Example: Student (Michael) with ID #:123456
   Date of birth: January 1st, 2000
   Username: 123456@bpsma.org
   Password: 01012000bps1920

**Additional Support**

Email:

- Please email your math teacher with specific questions.

Office Hours:

- Here is a list of math teachers' office hours. Your teacher is available to help you during their scheduled office hours.
  https://brocktonpublicschools-my.sharepoint.com/:x:/g/personal/danielcorbett_bpsma_org/EWk_ij9UwjpPtRAHBUkEpS4B3vue-_IG8VYz0AwG9ovJjQ?e=4%3arkcL1r&at=9&CT=1588698277992&OR=OWA-NT&CID=8d0078f2-9a27-460f-e632-64578875ee60

3

# Samesies

## Comparing Multiple Representations of Functions

## Warm Up

Rewrite each expression as a different equivalent expression.

1. $7n(3n + 1)$
2. $x^2 - 25$
3. $(4w + 2)^2$

## Learning Goals

- Identify equivalent forms of functions in various representations.
- Model situations using tables, graphs, and equations.
- Use functions to make predictions.
- Determine whether two forms of a function are equivalent.

## Key Terms

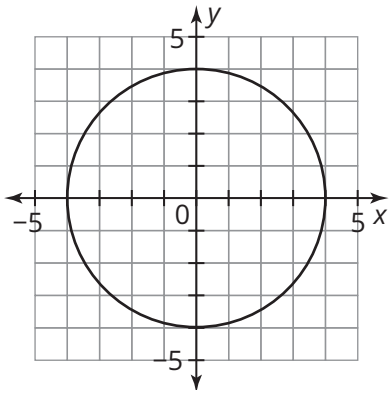
- relation
- function
- function notation

You have explored different representations of linear, exponential, and quadratic functions, either as a table, graph, equation, or scenario. How can you determine when different representations describe the same function?

# Odd One Out

Consider the relationships shown by each of the given representations.

**Relationship A**




**Relationship B**

| *x* | *y* |
|---|---|
| −6 | 5 |
| −4 | −3 |
| −2 | −3 |
| 0 | 5 |
| 2 | 21 |

**Relationship C**

$y = -\frac{3}{4}x + 8$

**Relationship D**

Zeke has one app on his phone when he buys it. He downloads a different number of apps each week. The total number of apps on his phone doubles each week until he has no more storage space.

**1. Choose the relationship that does not belong with the others and justify your choice.**

ACTIVITY
3.1

# Equivalent Representations

Understanding patterns not only gives insight into the world around you, it provides you with a powerful tool for predicting the future. Pictures, words, graphs, tables, and equations can describe the exact same pattern, but in different ways.

In the previous lesson, you used a visual model, graph, table, and context to describe the *relation* between the number of days that had passed and the total number of seniors that learned the results of the homecoming king election. In relations such as this one, there is only one output for each input. This type of relation is called a *function*. Functions can be represented algebraically using *function notation*.

A **relation** is a mapping between a set of input values and a set of output values. A **function** is a relation such that for each element of the domain there exists exactly one element in the range. In **function notation**, the function $f(x)$ is read as "$f$ of $x$" and indicates that $x$ is the input and $f(x)$ is the output.

**1. Cut out the relations provided at the end of the lesson. Analyze each relation and then create groups of equivalent relations. All relations have at least one match.**

**Provide a brief rationale for how you grouped each set of relations.**

**Remember:**

Equations can be written in different forms and still be equivalent.

2. **What strategies did you use to sort the representations into groups?**

3. **How do you know which relations are functions and which are not functions? Explain your reasoning in terms of the graph, table, and equation.**

**Think about:**

Is there more than one way to show that different representations are equivalent?

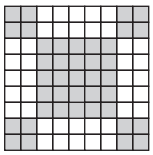
4. **Identify the function family associated with each grouping. How can you determine the function family from the graph, table, context, and the equation?**

ACTIVITY
# 3.2 Equivalent Functions

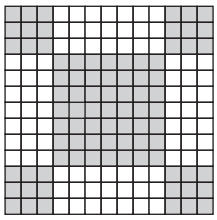
A ceramic tile company creates a new line of decorative kitchen and bathroom tiles. The company sells designs that are created from combinations of small gray and white square tiles. The designs follow the pattern shown.

Design 1

Design 2



Design 3



**1. Analyze the tile designs. Describe all of the various patterns that you notice.**

**2. Numerically organize the pattern.**

| Design Number | 1 | 2 | 3 | 4 | 7 | 10 | |
|---|---|---|---|---|---|---|---|
| Number of White Tiles, $w(n)$ | | | | | | | |
| Number of Gray Tiles, $g(n)$ | | | | | | | |
| Total Number of Tiles, $t(n)$ | | | | | | | |

Don't worry about the last column for now. You will determine an expression for each type of tile later.

**3. What new patterns do you notice?**

4. **How many total tiles are in Design 7? How many of the tiles are white? How many are gray? Explain your reasoning.**

5. **A hotel would like to order the largest design possible. They have enough money in their budget to order a design made up of 1700 total gray and white tiles. Which design can they afford? How many tiles in the design will be white? How many will be gray? Explain your reasoning.**

6. **Complete the last column of the table in Question 2 by writing an expression to describe the number of white tiles, gray tiles, and total tiles for Design *n*.**

7. **Tonya and Alex came up with different expressions to represent the number of gray tiles in each pattern. Their expressions are shown.**

| Tonya | Alex |
|---|---|
| $4n^2 + (2n + 1)(2n + 1)$ | $(4n + 1)^2 - 4n(2n + 1)$ |

**Tonya claims that they are the same expression written different ways. Alex says, "One expression has addition and the other has subtraction. There is no way they are equivalent!"**

**Who is correct? Justify your reasoning using algebraic and graphical representations.**

You may have noticed several patterns in this sequence. An obvious pattern is that the sum of the white tiles and gray tiles is equal to the total number of tiles. This pattern is clear when analyzing the values in the table. However, adding $w(n)$ and $g(n)$ creates a brand new function that looks very different from the function $t(n)$.

## Worked Example

To prove that the sum of the white tiles and gray tiles is equal to the total number of tiles, you must show that the expressions are equivalent.

| $w(n) + g(n)$ | $t(n)$ |
|---|---|
| $4n(2n + 1) + (2n + 1)^2 + 4n^2$ | $(4n + 1)^2$ |
| $(8n^2 + 4n) + (4n^2 + 4n + 1) + 4n^2$ | $(4n + 1)(4n + 1)$ |
| $16n^2 + 8n + 1$ | $16n^2 + 8n + 1$ |

**8. Analyze the context, table, and expressions in this problem.**

**a. Identify the function family that describes the pattern for the number of white tiles. Explain your reasoning.**

**b. Identify the function family that describes the pattern for the number of gray tiles. Explain your reasoning.**

**c. When you add the functions that represent the number of white tiles and gray tiles, does the new function belong to the same function family? Explain your reasoning.**

There are many ways to prove something. Mathematical proofs consist of equations, written arguments, pictures, and flow charts. You should always use precise terminology to describe mathematically why you know something is true.

**9. Describe the relationship between the number of white tiles and gray tiles in each design. Prove that this relationship exists.**

**10. Analyze the tile patterns.**

**a. Prove that the number of white tiles is always an even number.**

**b. Prove that the total number of tiles is always an odd number.**

NOTES

# TALK the TALK

## Equal to the Task

1. **Use *always*, *sometimes*, or *never* to complete each statement. Explain your reasoning.**

   a. **Two functions are _____ equivalent if their algebraic representations are the same.**

   b. **Two functions are _____ equivalent if they produce the same output for a specific input value.**

   c. **Two functions are _____ equivalent if their graphical representations are the same.**

NOTES

**2. Determine whether each table of values is a function. If so, identify its function family.**

**a.**

| *x* | *y* |
|---|---|
| −5 | −13 |
| −4 | −12 |
| 0 | −8 |
| 1 | −7 |
| 5 | −3 |

**b.**

| *x* | *y* |
|---|---|
| −2 | −2 |
| 0 | 0 |
| 1 | 4 |
| 3 | 18 |
| 5 | 40 |

**c.**

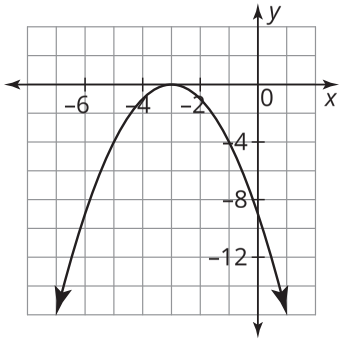
| *x* | *y* |
|---|---|
| 4 | 1 |
| 4 | 2 |
| 4 | 3 |
| 4 | 4 |
| 4 | 5 |

**3. Determine whether the functions in each pair are equivalent.**

**a.** $f(x) = (x + 4)^2 + 6$
$f(x) = x^2 + 8x + 22$

**b.** $f(x) = (x + 1)^2 + 2x^2$
$f(x) = (2x + 1)^2 - 2x(x + 1)$

**A.**




**B.**

$f(x) = x^2 + 2x + 5$

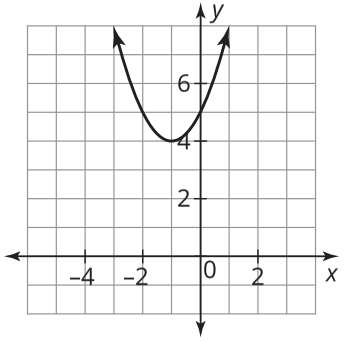
**C.**

| x | y |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | 6 |
| 4 | 8 |
| 5 | 10 |

**D.**

$f(x) = x^2 + 6x + 5$

**E.**




**F.**

$f(x) = -(x^2 + 6x + 9)$

**G.**

$f(x) = 2x$

**H.**

$f(x) = (x + 5)(x + 1)$

**I.**

$f(x) = -(x + 3)(x + 3)$

**J.**

A parabola with a line of symmetry at $x = -3$, a vertex that is a maximum value, and a graph that opens down.

**K.**

Louise heard a rumor. She tells the rumor to two people the next day. The two people that she told then tell two more people the following day, who each then go on to tell two more new people the rumor the following day.

**L.**

| *x* | *y* |
|---|---|
| −3 | 8 |
| −2 | 5 |
| −1 | 4 |
| 0 | 5 |
| 1 | 8 |

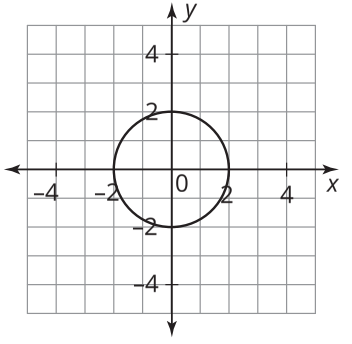
**M.**

| *x* | *y* |
|---|---|
| −4 | −1 |
| −3 | 0 |
| −2 | −1 |
| −1 | −4 |
| 0 | −9 |

**N.**

$y = 2^x$

**O.**



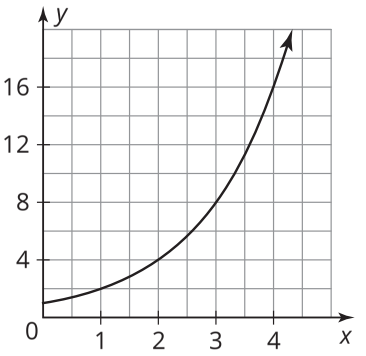

**P.**

$y = (x + 3)^2 - 4$

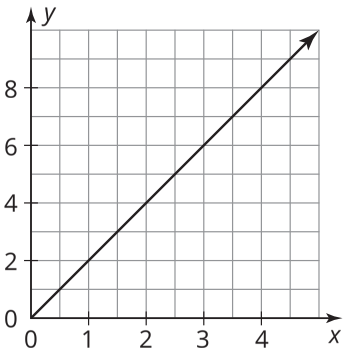
**Q.**

| *x* | *y* |
|---|---|
| 0 | 1 |
| 1 | 2 |
| 2 | 4 |
| 3 | 8 |
| 4 | 16 |

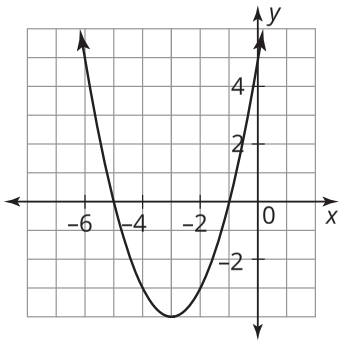
**R.**




**S.**




**T.**




**U.**

Erika is worried that her secret got out. On the first day, she and her best friend were the only people who knew about the secret. But each day, two new people hear about the secret.

**V.**

$x^2 + y^2 = 4$

**W.**

| *x* | *y* |
|---|---|
| −5 | 0 |
| −4 | −3 |
| 0 | 5 |
| 1 | 12 |
| 2 | 21 |

**X.**

| *x* | *y* |
|---|---|
| −1 | 1.73 |
| −1 | −1.73 |
| 0 | 2 |
| 0 | −2 |
| 1 | 1.73 |
| 1 | −1.73 |

# Assignment

## Write

Define each term in your own words.

1. relation
2. function
3. function notation

## Remember

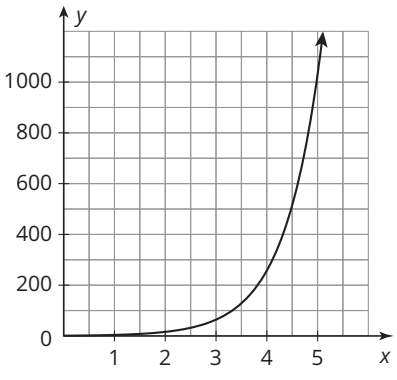
Relationships between quantities can be represented in graphs, tables, equations, and contexts. Two functions are equivalent if their algebraic or graphical representations are the same.

## Practice

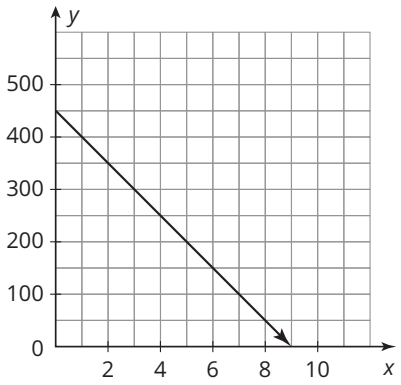
1. Consider the three scenarios given. Match each with the corresponding function, graph, and table.
   a. Juanita is driving home from her vacation spot at a constant rate. Which function, graph, and table represent her distance from home as a function of the number of hours she has traveled? Explain your reasoning.
   b. A mechanic drops a wrench from a flying helicopter. Which function, graph, and table represent the height of the wrench above the ground as a function of the time since it was dropped? Explain your reasoning.
   c. Scientists watch as a single cell divides into 4 cells over the course of an hour. During the next hour, each of the 4 new cells divides into 4 cells and the process continues. Which function, graph, and table represent the total number of cells as a function of time? Explain your reasoning.

$f(x) = -16x^2 + 1900$ $g(x) = 4^x$ $h(x) = -50x + 450$

**Graph 1**




**Graph 2**




**Graph 3**

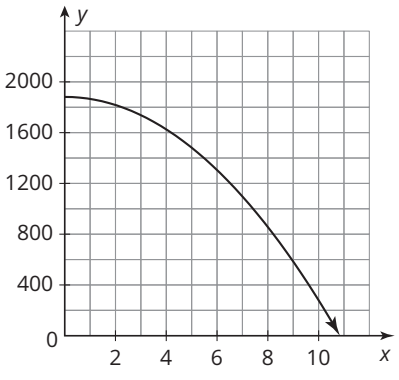



**Table 1**

| *x* | *y* |
|---|---|
| 0 | 1 |
| 1 | 4 |
| 2 | 16 |
| 3 | 64 |
| 4 | 256 |

**Table 2**

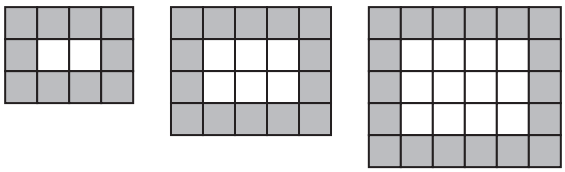
| *x* | *y* |
|---|---|
| 0 | 1900 |
| 2 | 1836 |
| 4 | 1644 |
| 6 | 1324 |
| 8 | 876 |

**Table 3**

| *x* | *y* |
|---|---|
| 0 | 450 |
| 2 | 350 |
| 4 | 250 |
| 6 | 150 |
| 8 | 50 |

2. Ingrid makes quilts in designs that follow a specific pattern. The first three designs are shown. In the designs, the white blocks represent blocks containing pictures while the gray blocks represent border blocks of a single color.

Design 1 Design 2 Design 3



a. Analyze the quilt designs. Describe as many patterns as you can.
b. Write the function $p(n)$ to represent the number of picture blocks in Design $n$.
c. Write the function $b(n)$ to represent the number of border blocks in Design $n$.
d. The total number of blocks in Design $n$ can be represented by the function $t(n) = (n + 2)(n + 3)$. Use the functions you wrote to show that $t(n) = p(n) + b(n)$.
e. An art museum hires Ingrid to make one of her quilt designs to display pictures of each of their 90 paintings in 90 individual picture blocks. Which design does the art museum choose? How many total blocks are in the design?

## Stretch

1. The figures shown represent a visual pattern of tiles.

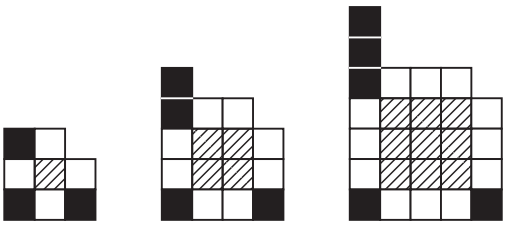


Figure 1 Figure 2 Figure 3

a. Write the function $b(n)$ to represent the number of black blocks in Figure $n$.
b. Write the function $w(n)$ to represent the number of white blocks in Figure $n$.
c. Write the function $s(n)$ to represent the number of striped blocks in Figure $n$.
d. The total number of blocks in Design $n$ can be represented by the function $t(n) = \left(n + \frac{5}{2}\right)^2 - \frac{17}{4}$. Use the functions you wrote to show that $t(n) = b(n) + w(n) + s(n)$.

## Review

1. A video game consists of a figure made of squares that resembles a snake. The figure gets longer in each minute of the game. The first three figures are shown.

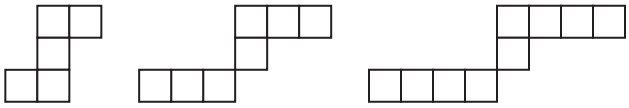


Figure 1 Figure 2 Figure 3

   a. Create a table to display the number of squares in each of the first 6 figures.
   b. Describe the pattern as linear, exponential, quadratic, or none of these. Explain your reasoning.

2. The figures shown represent a visual pattern of tiles.

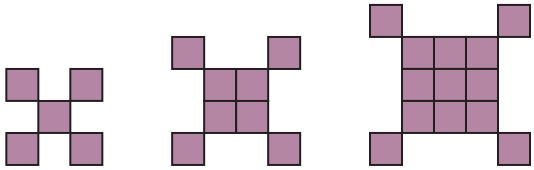


Figure 1 Figure 2 Figure 3

   a. Create a table to display the number of squares in each of the first 6 figures.
   b. Create a graph of the data points in your table on the coordinate plane shown. Draw a smooth curve to connect the points.
   c. Describe the pattern as linear, exponential, quadratic, or none of these. Explain your reasoning.

3. Solve the equation $-5\frac{1}{2} + 12y = \frac{1}{2}(7 - 8y)$.