

*Important Concepts . . .*

# Preview Review



**Mathematics    Grade 9**  
**W2 - Lesson 6: Graphing Linear**  
**Relations**

## Important Concepts of Grade 9 Mathematics

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## Materials Required

Paper  
Pencil  
Calculator

## No Textbook Required

**This is a stand-alone course.**

## Mathematics Grade 9

### Version 6

### Preview/Review W2 - Lesson 6

ISBN: 978-1-927090-00-8

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# Preview/Review Concepts for Grade Nine Mathematics



***W2 – Lesson 6:***

***Graphing Linear Relations***

# OBJECTIVES

By the end of this lesson, you will be able to:

- Write a linear equation representing the pattern in a given table of values, and verify the equation by substituting values from the table.
- Describe the pattern found in a given graph.
- Graph a given linear relation, including horizontal and vertical lines.
- Match given equations of linear relations with their corresponding graphs.
- Solve a given problem by graphing a linear relation and analyzing the graph.

## GLOSSARY

**Algebraic equation:** A number sentence containing a variable and an = sign. For example:

$$3x + 4 = 7$$

or

$$2a = 6$$

**Algebraic expression:** Similar to an equation, but does not contain an = sign. For example:

$$3a + 2$$

or

$$2x + 37y + 7$$

**Linear equation:** An equation of the form  $y = ax + b$ . The graph forms a non-vertical and non-horizontal straight line when graphed.

**Linear relation:** Relationships between two variables (usually  $x$  and  $y$ ) that form a straight non-vertical and non-horizontal line when graphed.

**Ordered pair:** A related pair of values that correspond to a point on a graph; an ordered pair is written in the form  $(x, y)$ .

**Table of Values:** A series of numbers used to substitute one variable within an equation in order to determine the value of the other (unknown) variable.

## W1 – Lesson 6: Graphing Linear Relations

### Materials required:

- Paper, Pencil, and Calculator

### Part 1: Describing Relations Algebraically

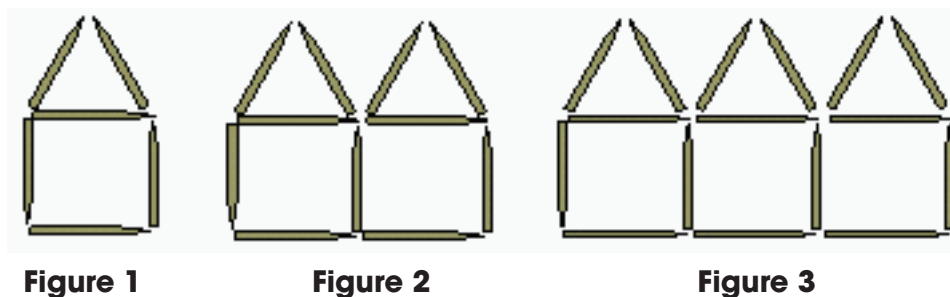
A linear relation is a relationship between two variables (usually  $x$  and  $y$ ) that form a straight non-vertical and non-horizontal line when it is graphed.

A linear relation looks like  $y = 3x + 1$ , where  $x$  is the input value and  $y$  is the output value.

Before graphing a linear relation, the ordered pairs corresponding to the given linear relation must be determined. Ordered pairs can be calculated by substituting a given value of  $x$  into the linear relation and evaluating the value of  $y$ .

### Example 1

1. Look at the following pattern. What would the next figure look like?



2. Complete the chart.

Figure	Number of Toothpicks
1	6
2	11
3	16
4	21
5	26

3. Describe the pattern rule.

There are several patterns in the above chart. One pattern is that the shape, or the “figure”, increases by **one** each time. Another pattern is that the number of toothpicks increases by **five** each time.

The **pattern rule** is the relationship between the figure number and the number of squares.

The pattern rule can be written as an algebraic equation:

$$y = 5x + 1 \text{ (the number of toothpicks equals 5 times the figure number plus one)}$$

4. Describe what the 8<sup>th</sup> figure would look like.

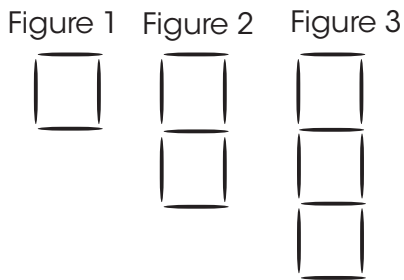
Since the pattern rule (written as an algebraic equation) is:

$$y = 5x + 1$$

$$\begin{aligned} y &= 5(8) + 1 \text{ (substitute the } x \text{ for 8)} \\ &= 41 \text{ toothpicks} \end{aligned}$$

## Practice Questions

1. Study the toothpick pattern. The first diagram is a square.



- a. Complete the table of values.

Figure	Number of Toothpicks	Perimeter
1	4	4
2	7	6
3	10	8
4	13	10
5		12
6		14

- b. Write the pattern rule as an algebraic equation for the number of toothpicks in any figure.
- c. Using your algebraic equation, calculate the number of tooth picks in the 21st figure.

- d. Write an algebraic equation for the perimeter of the figure number.
- e. Using your algebraic equation, calculate the perimeter in the 32<sup>nd</sup> figure.



## Part 2: Graphing Linear Patterns

Consider the following problem: Dexter has three baseballs. After practice, he found several more baseballs. Write an expression using a variable. Before writing the expression, remember the following terms.

**Variable:** a letter that represents an unknown number...for example,  $x$ ,  $y$ ,  $n$ , etc. Usually these are lower case letters. Upper case letters usually represent something . . . for example  $A$  = area,  $P$  = perimeter,  $C$  = circumference, etc.

**Expression:** a variable in combination with an operation(s) and numbers.

For example:

$x + 5$ ,  $5h$ , etc.

**Value:** a known or calculated amount

**Constant:** a number without a variable ( $7$ ,  $-2.07$ ,  $\frac{1}{2}$ )

**Numerical coefficient:** a number that multiplies a variable ( $3x$ ,  $-4y$ ,  $-0.5n^2$ )

Write an expression that represents the number of balls that Dexter found.

$3 + b$

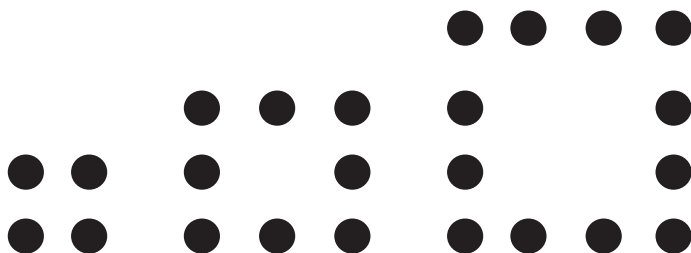
- What is the variable? The variable stands for the number of baseballs Dexter found after practice, in this case,  $b$ .
- What is the expression? ( $3 + b$ )
- Is 3 a numerical coefficient or constant? (It is a constant, because it increases or decreases the value of the expression.)

Linear relations can be graphed.

1. Look at the linear expression.
2. Create a table of values.
3. Substitute values into the expression.
4. The substituted value is the  $x$  value.
5. The result of the substitution is the  $y$  value.
6. Graph the expression.

## Example 1

- Look at the following pattern.



- Create a chart that records the pattern

Figure ( $x$ )	1	2	3	4	5	6
Number of Dots ( $y$ )	4	8	12	16	20	24

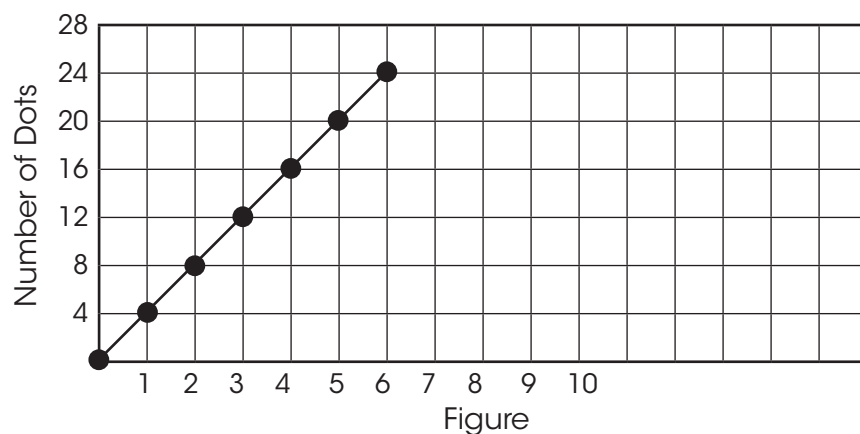
- Write the equation that describes the chart.

$$y = 4x$$

- How many dots would be in the 15th figure?

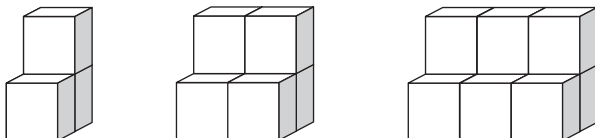
$$y = 4x, \text{ therefore } y = 4(15) = 60 \text{ dots in the 15th figure}$$

- Graph the expression.



## Practice Questions

- Look at the following 3D pattern.

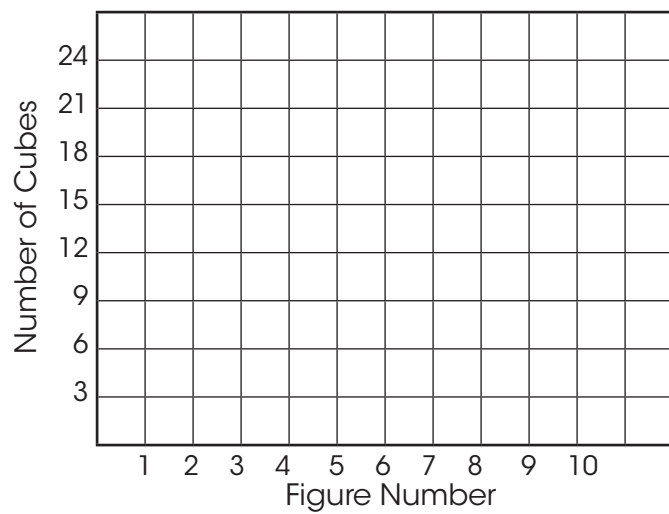


- Create a chart that records the pattern.

Figure						
Number of Horizontal Layers ( $x$ )						
Number of Cubes ( $y$ )						

- Write an equation to describe the pattern.
- How many cubes would be in the 20<sup>th</sup> layer?

5. Graph the rule that relates the number of cubes to the figure number.

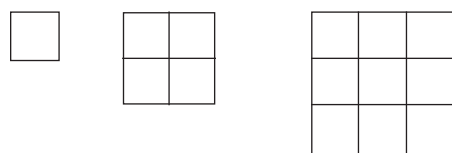


### Part 3: Solving Linear Relations Graphically

Consider the following tables of values.

Figure (x)	Squares (y)
1	1
2	4
3	9
4	
5	

Draw what this pattern could look like:



Relate the figure number to the total number of squares within the figure:

Total Number of Squares =  $n \times n$  or figure number times itself

Using your equation, determine:

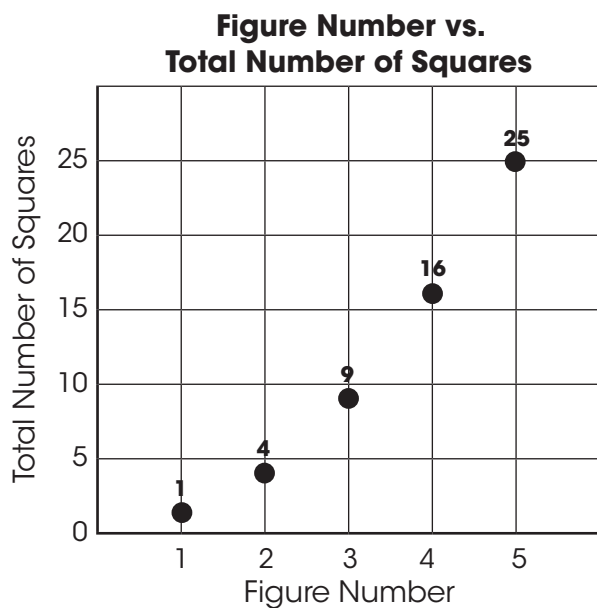
- How many linking cubes are needed for a figure that is 9 cubes high?  
\_\_\_\_\_ (Answer below)
- How many linking cubes are needed for a figure that is 13 cubes high?  
\_\_\_\_\_ (Answer below)
- How many squares would be in the 20<sup>th</sup> figure?  
\_\_\_\_\_ (Answer below)

*Answers*

a. 81      b. 169      c. 400

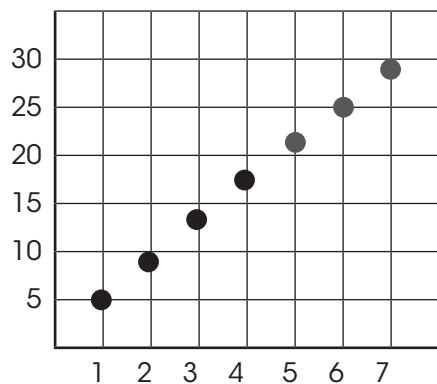
Next, graph the design. Follow the steps:

- Recall the  $x$  (horizontal) and  $y$  (vertical) axis.
- Title each axis. Call the  $x$ -axis “Figure Number” and the  $y$ -axis “Total Number of Squares”
- Choose a scale for each axis. (For example, count by 1’s or count by 2’s)
- Plot each point from the chart.



**Example 1**

1. Complete the table of values that represents this graph.



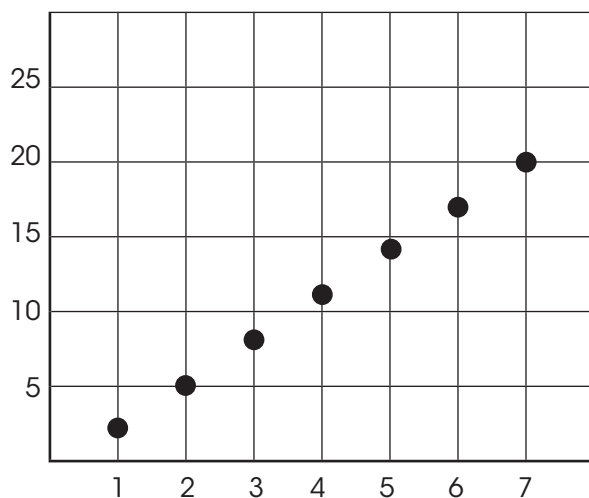
<b>x</b>	1	2	3	4	5	6	7
<b>y</b>	5	9	13	17	<b>21</b>	<b>25</b>	<b>29</b>

2. Write an equation to describe the table of values.

$$y = 4x + 1$$

## Practice Questions

1. Complete the table of values that represents this graph.



x	1	2	3	4	5	6	7
y							

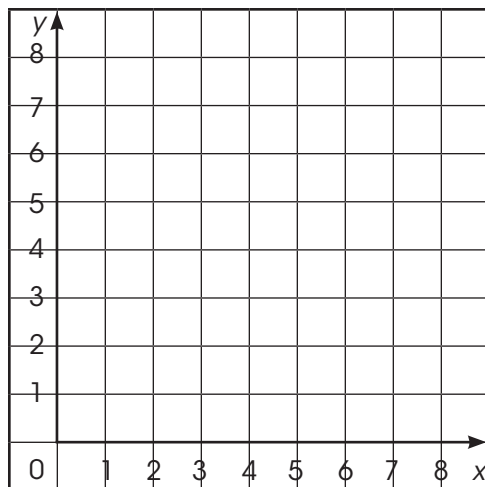
Note: The values for the missing plots can be determined by drawing a line connecting the dots.

2. Write an equation to describe the table of values.



3. Draw a graph to represent this table of values. Write an equation to represent the table of values.

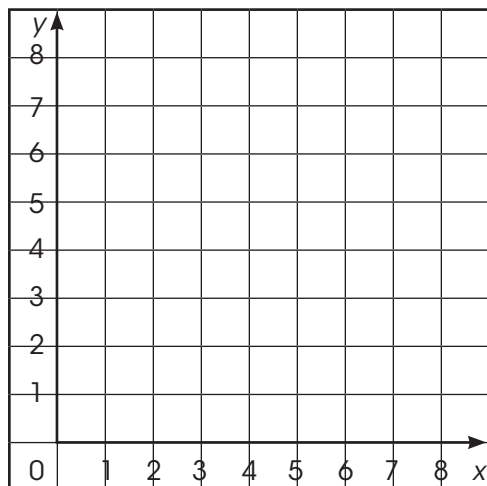
<b>x</b>	<b>y</b>
2	3
3	4
4	5
5	6



## Lesson 6 Assignment

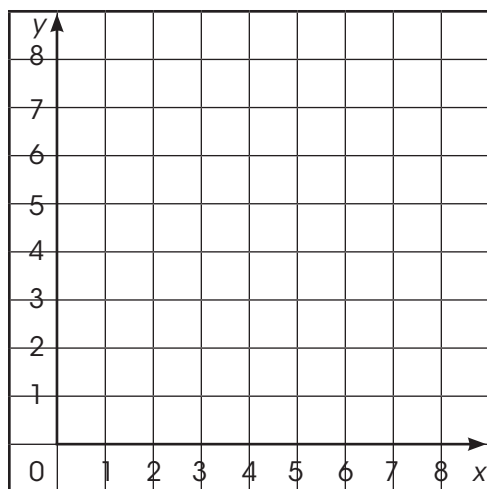
1. Complete the following table of values and draw a graph using the values in the table.

$x$	$2x-1$
1	
2	
3	
4	



2. Complete the following table of values and draw a graph using the values in the table.

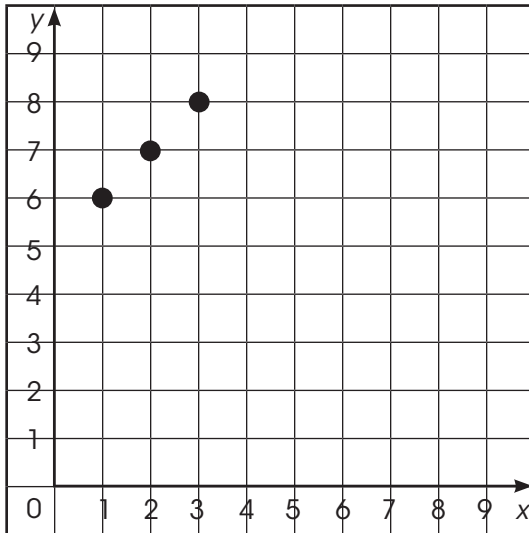
$x$	$3x-6$
2	
3	
4	
5	



3. Write a table of values that represents the linear relation  $y = 3x$ .

$x$	$3x$
2	
3	
4	

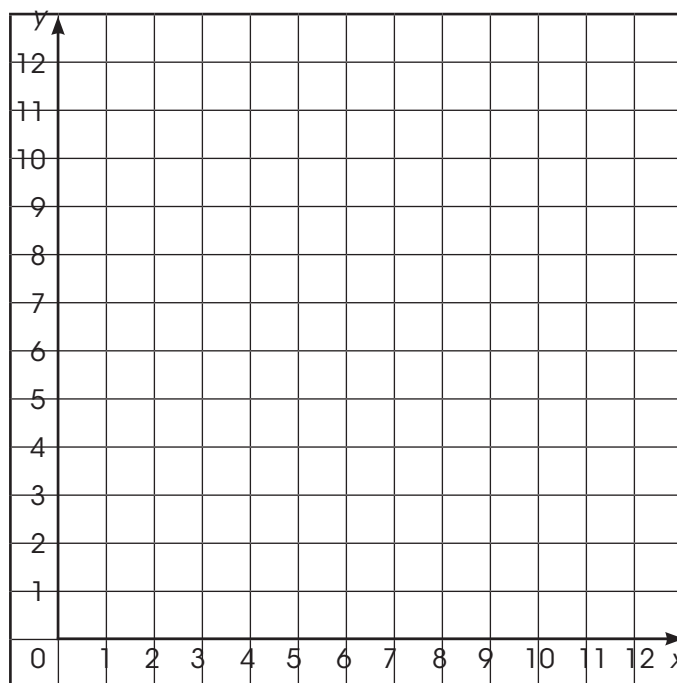
4. Write a linear relation that represents the graph.



5. Using the graph, determine the value of  $x$  when  $y = 6$ .

6. Graph a linear relation goes with this table of values.

$x$	$y$
1	2
2	5
3	8
4	11



7. Create a table of values that represents the linear relation  $y = 2x - 1$ .

<b>x</b>	<b>y</b>
11	
12	
13	







