

Important Concepts . . .

Preview Review



Mathematics Grade 9 TEACHER KEY
**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

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Preview/Review Concepts for Grade Nine Mathematics

Teacher Key



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

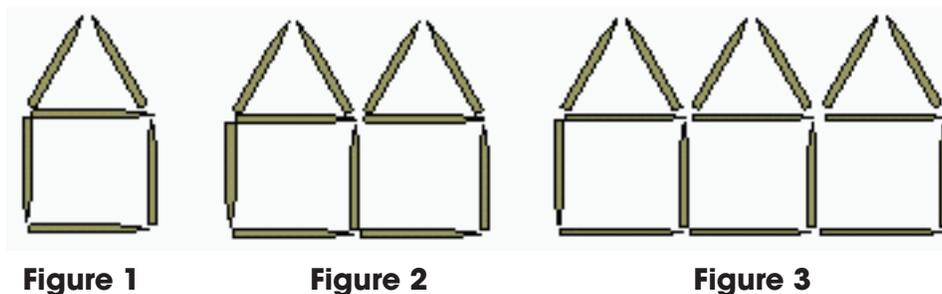
A linear relation is a relationship between two variables (usually x and y) that form a straight non-vertical and non-horizontal line when it is graphed.

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:

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

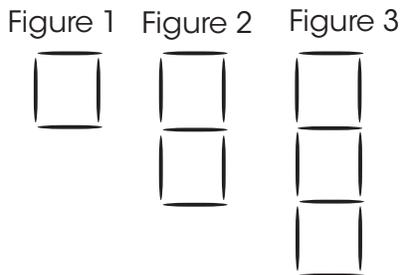
4. Describe what the 8th figure would look like.

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

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

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	16	12
6	19	14

- b. Write the pattern rule as an algebraic equation for the number of toothpicks in any figure.

$$y = 3x + 1$$

- c. Using your algebraic equation, calculate the number of tooth picks in the 21st figure.

$$\begin{aligned}
 y &= 3x + 1 \\
 y &= 3(21) + 1 \\
 &= 63 + 1 \\
 &= 64 \text{ toothpicks}
 \end{aligned}$$

- d. Write an algebraic equation for the perimeter of the figure number.

$$y = 2x + 2$$

- e. Using your algebraic equation, calculate the perimeter in the 32nd figure.

$$\begin{aligned}y &= 2x + 2 \\y &= 2(32) + 2 \\&= 64 + 2 \\&= 66\end{aligned}$$

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.

$3 + b$

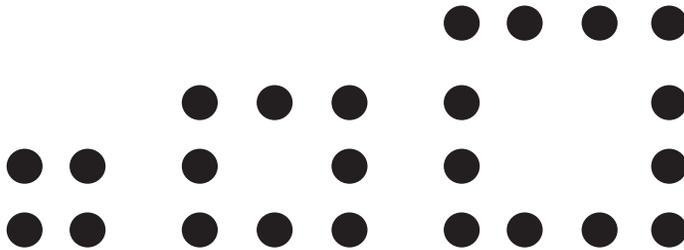
- What is the variable? The variable stands for the number of baseballs Dexter found after practice, in this case, b .
- What is the expression? ($3 + b$)
- Is 3 a numerical coefficient or constant? (It is a constant, because it increases or decreases the value of the expression.)

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

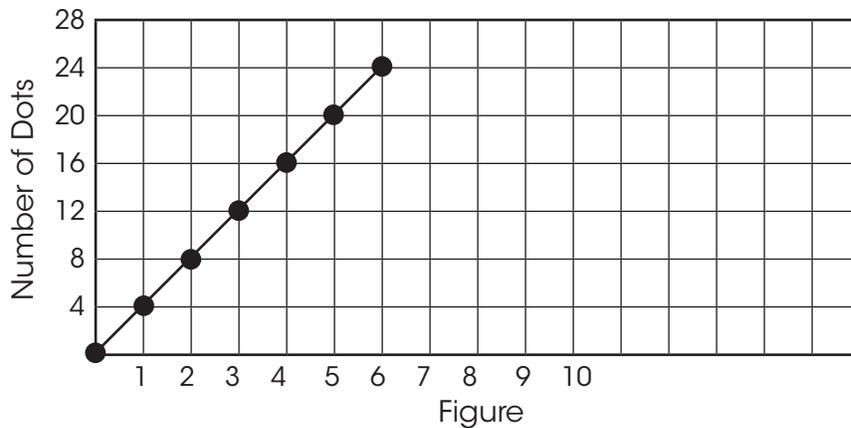
- Write the equation that describes the chart.

$$y = 4x$$

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

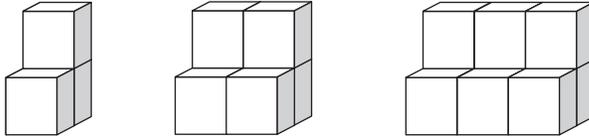
$$y = 4x, \text{ therefore } y = 4(15) = 60 \text{ dots in the 15th figure}$$

- Graph the expression.



Practice Questions

1. Look at the following 3D pattern.



2. Create a chart that records the pattern.

Figure	1	2	3	4	5	6
Number of Horizontal Layers (x)	1	2	3	4	5	6
Number of Cubes (y)	3	6	9	12	15	18

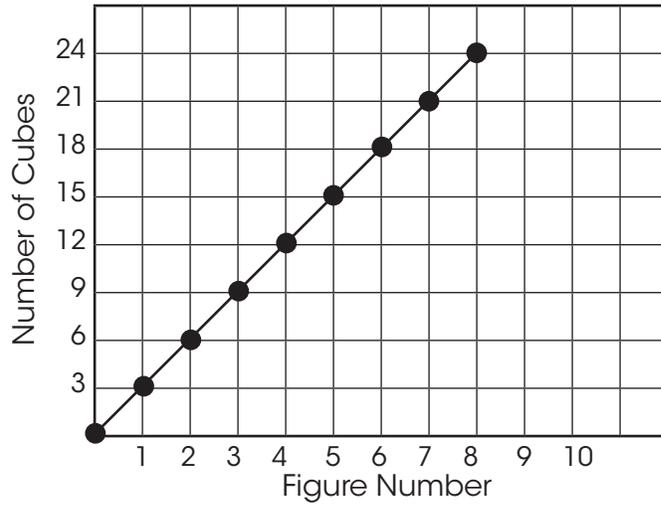
3. Write an equation to describe the pattern.

$$y = 3x$$

4. How many cubes would be in the 20th layer?

$$\begin{aligned}
 y &= 3x \\
 y &= 3(20) \\
 &= 60 \text{ cubes}
 \end{aligned}$$

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

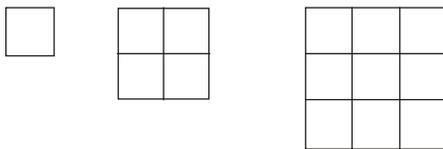


Part 3: Solving Linear Relations Graphically

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:

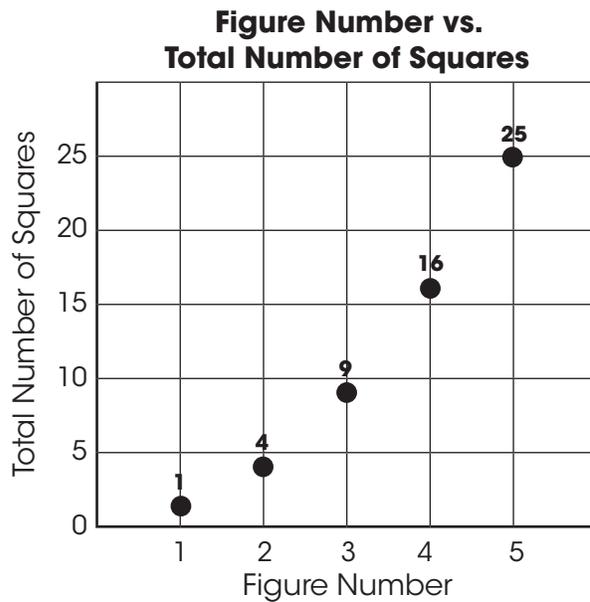
- How many linking cubes are needed for a figure that is 9 cubes high?
_____ (Answer below)
- How many linking cubes are needed for a figure that is 13 cubes high?
_____ (Answer below)
- How many squares would be in the 20th figure?
_____ (Answer below)

Answers

- a. 81 b. 169 c. 400

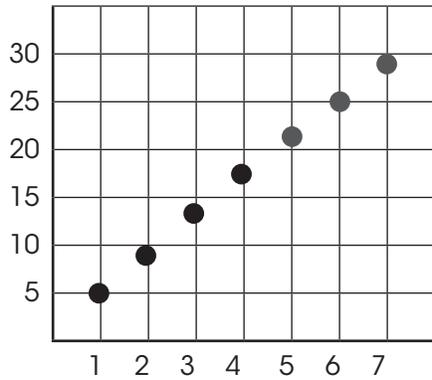
Next, graph the design. Follow the steps:

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



Example 1

- Complete the table of values that represents this graph.



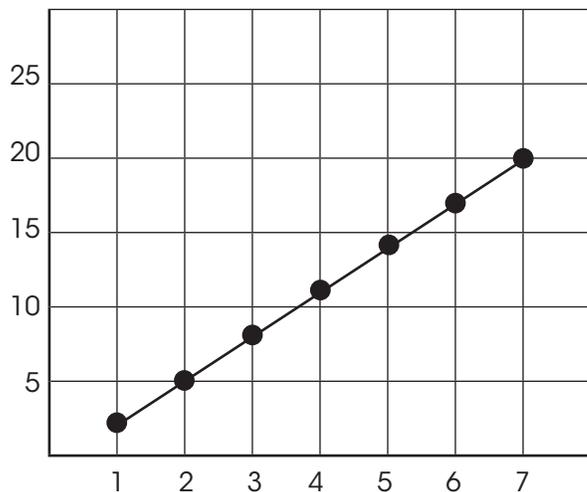
x	1	2	3	4	5	6	7
y	5	9	13	17	21	25	29

- 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	2	5	8	11	14	17	20

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

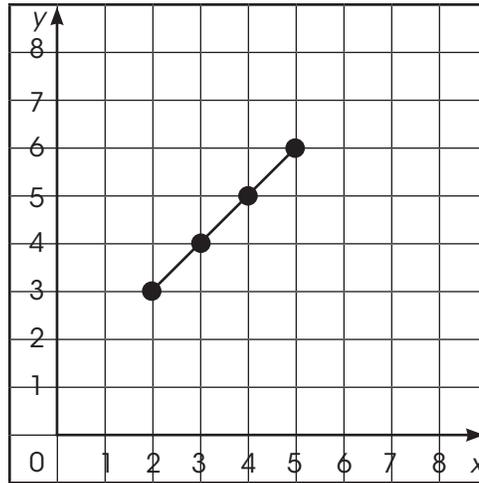
2. Write an equation to describe the table of values.

$$y = 3x - 1$$

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

x	y
2	3
3	4
4	5
5	6

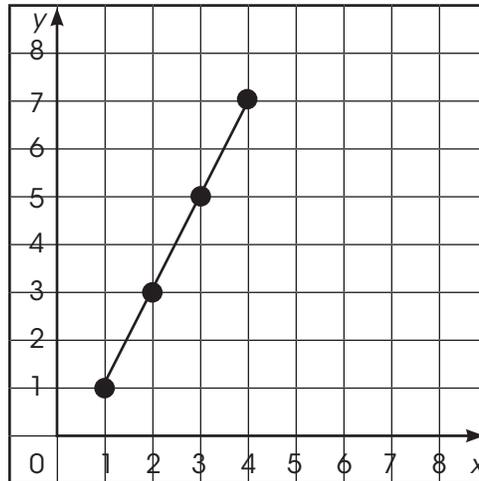
$y = x + 1$



Lesson 6 Assignment

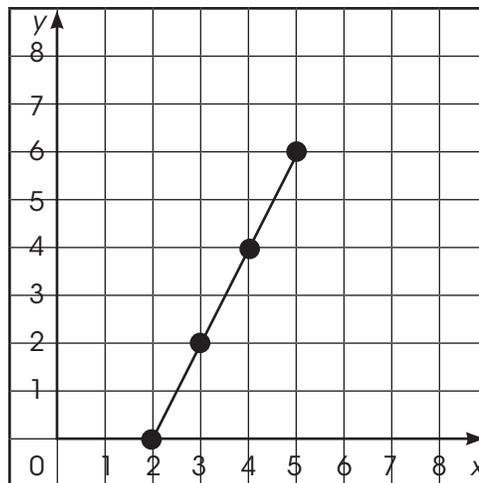
- Complete the following table of values and draw a graph using the values in the table.

x	2x-1
1	1
2	3
3	5
4	7



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

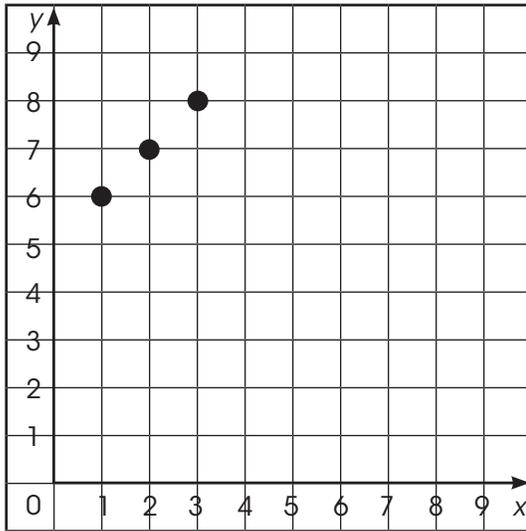
x	3x-6
2	0
3	2
4	4
5	6



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

x	3x
2	6
3	9
4	12

4. Write a linear relation that represents the graph.



$y = x + 5$

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

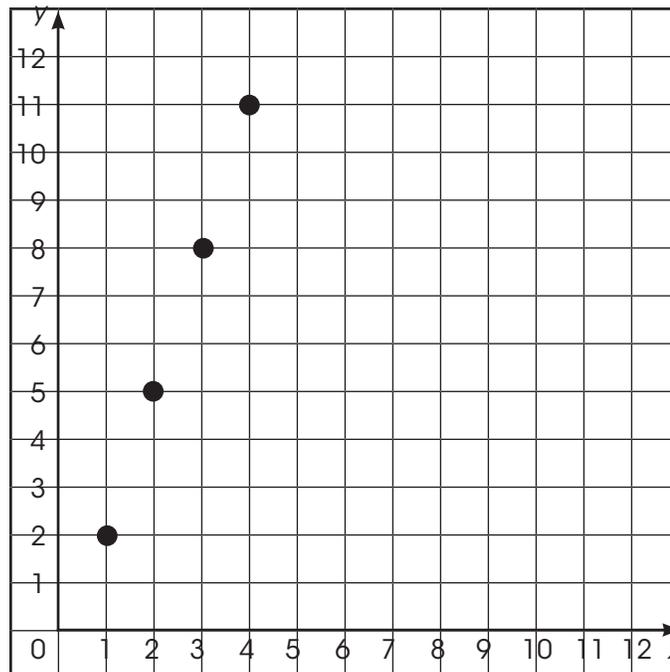
$y = x + 5$

$6 = x + 5$

$x = 1$

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 $y = 2x - 1$.

x	y
11	21
12	23
13	25

