

Analyze Patterns and Relationships



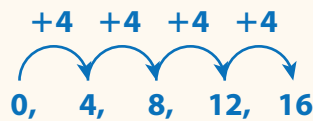
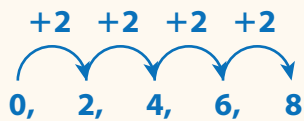
Dear Family,

This week your child is learning to analyze patterns and relationships.

Your child is learning ways to describe how two number patterns are related. He or she might see a problem like this:

At the school fair, a box of raisins costs \$2 and a box of nuts costs \$4. How does the cost of a given number of boxes of raisins compare to the cost of the same number of boxes of nuts for 0, 1, 2, 3, or 4 boxes?

A diagram shows the number patterns for the raisins and the nuts:



You can list the numbers, or **terms**, of the pattern in a table and form ordered pairs of **corresponding terms**.

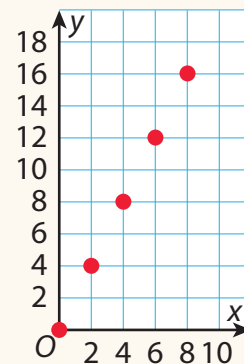
Look for a pattern. The second number in each ordered pair is twice the first number. For example, in the ordered pair (4, 8), $8 = 2 \times 4$.

Raisins, x	Nuts, y	Ordered Pair (x, y)
0	0	(0, 0)
2	4	(2, 4)
4	8	(4, 8)
6	12	(6, 12)
8	16	(8, 16)

Another way to see how the number patterns are related is to plot the ordered pairs on a graph.

The graph at the right shows a point for each ordered pair in the table. From point to point, the pattern is: move 2 to the right, move up 4.

Invite your child to share what he or she knows about analyzing number patterns and relationships by doing the following activity together.



ACTIVITY ANALYZING PATTERNS



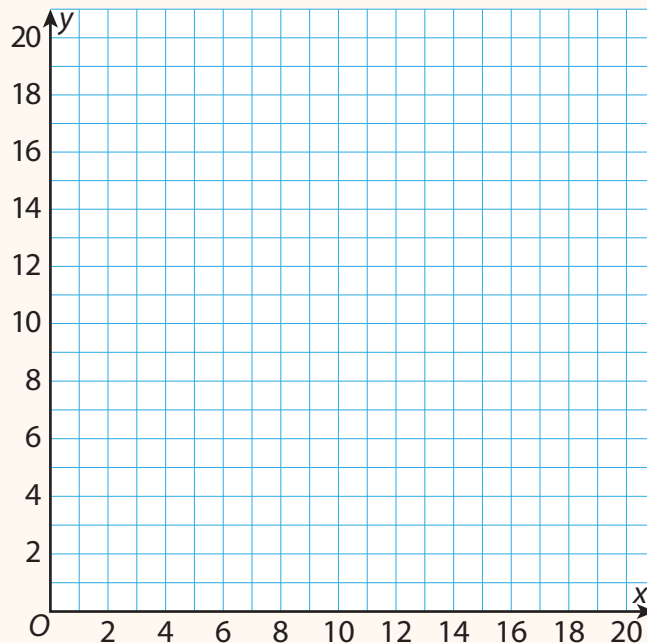
Do this activity with your child to analyze patterns and relationships.

Work with your child to show how the costs of two items are related.

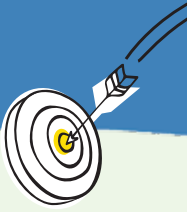
- Together with your child, find the cost of your child's two favorite snacks. Round each to the nearest dollar. (Example: A box of crackers costs \$2 and a carton of ice cream costs \$3.)
- In the table, write the cost of 0, 1, 2, 3, 4, and 5 containers of each snack.

Snack 1:, x	Snack 2:, y	Ordered Pair (x, y)

- Together, plot the ordered pairs on the coordinate plane at the right and describe the relationship between the costs of the snacks.



Explore Analyzing Patterns and Relationships



Learning Target

- Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

SMP 1, 2, 3, 4, 5, 6, 7, 8

Previously you learned to identify and continue numerical patterns. Now you will describe the relationship between two patterns. Use what you know to try to solve the problem below.

Maria works at the snack stand at a basketball game. Each frozen yogurt costs \$3, and each sandwich costs \$6. Maria makes a list of the costs for buying 0, 1, 2, 3, 4, 5, or 6 frozen yogurts. She also makes a list of the costs for the same number of sandwiches.

- Show how Maria may have made her lists of costs.
- Write a sentence describing the rules used to make each list.



TRY IT



Math Toolkit

- counters
- base-ten blocks
- grid paper



DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: A model I used was . . . It helped me . . .

CONNECT IT

1 LOOK BACK

How did you find the costs of yogurts and the costs of sandwiches?

2 LOOK AHEAD

In the previous problem, each list of costs forms a numerical pattern. The numbers in a pattern are called **terms**. A rule tells you how to move from one term in a pattern to the next. You can generate two related patterns using two different rules.

- a. Maria also sells hot dogs for \$5 each and pizzas for \$10 each. Use the rules shown in the table to list the terms of two patterns.

Number of Items	Cost of Hot Dogs (\$) Rule: add 5	Cost of Pizzas (\$) Rule: add 10
0		
1		
2		
3		

- b. Terms that are in the same position in two related patterns are called **corresponding terms**. What are the corresponding terms for the cost of 3 items in the two patterns you wrote in the table in part a?

3 REFLECT

How do the corresponding terms in problem 2b compare? Is this true for all pairs of corresponding terms in the table?

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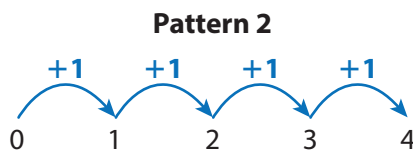
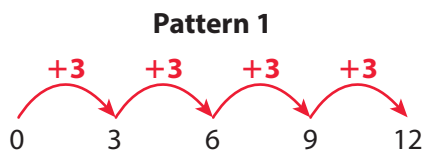


Prepare for Analyzing Patterns and Relationships

- 1 Think about what you know about patterns. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

<p>What Is It?</p>	<p>What I Know About It</p>	
<p>corresponding terms</p>		
<p>Examples</p>	<p>Examples</p>	<p>Examples</p>

- 2 Look at the patterns. What are the corresponding terms?





3 Solve the problem. Show your work.

Russell works at a gift shop. Each T-shirt costs \$15, and each snow globe costs \$5. Russell makes a list of the costs for buying 0, 1, 2, 3, 4, 5, or 6 T-shirts. He also makes a list of the costs for the same number of snow globes.

- Show how Russell may have made his list of the costs.
- Write a sentence describing the rules for each list.

Solution

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4 Check your answer. Show your work.

Develop Comparing Two Numerical Patterns

Read and try to solve the problem below.

In Level 1 of a video game, you earn 2 points for each monster you catch.

In Level 2, you earn 8 points for each ghost you catch.

Compare the number of points in Level 2 to the number of points in Level 1 if you catch 0, 1, 2, 3, 4, 5, or 6 monsters or ghosts.



TRY IT



Math Toolkit

- counters
- base-ten blocks
- grid paper



DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: I didn't think about . . .

Explore different ways to understand relationships between two numerical patterns.

In Level 1 of a video game, you earn 2 points for each monster you catch.
 In Level 2, you earn 8 points for each ghost you catch.
 Compare the number of points in Level 2 to the number of points in Level 1 if you catch 0, 1, 2, 3, 4, 5, or 6 monsters or ghosts.

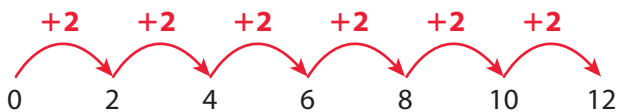


PICTURE IT

You can use a diagram to show the terms of each pattern.

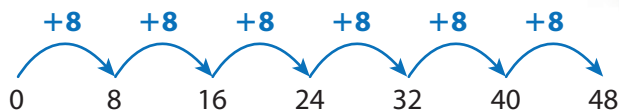
Level 1

Each monster caught earns **2 points**.



Level 2

Each ghost caught earns **8 points**.



MODEL IT

You can use a table to list the terms of each pattern.

Number Caught	Points in Level 1	Points in Level 2
0	0	0
1	2	8
2		
3		
4		
5		
6		

The total number of points in Level 1 increases by 2 for each monster caught.
 The total number of points in Level 2 increases by 8 for each ghost caught.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to identify relationships between two numerical patterns.

- 1 Look at **Picture It** on the previous page. Describe how the total number of points changes with each monster or ghost caught in Level 1 and Level 2.
Level 1 rule:
- Level 2 rule:**
- 2 Complete the table on the previous page.
- 3 Use the table to describe the relationship between the corresponding terms of the patterns.
- 4 Suppose the game has a third level. You get 10 points for each giant caught in Level 3. Explain how you could use the table to show how the points for catching a given number of monsters in Level 1 compares to catching the same number of giants in Level 3.

5 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for representing patterns and identifying relationships between corresponding terms? Explain.

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APPLY IT

Use what you just learned to solve these problems.

- 6 School magnets cost \$4, and shirts cost \$24. Write a pattern for the costs of 0–5 magnets and a second pattern for the costs of 0–5 shirts. How do the corresponding terms of the two patterns compare?

Solution

- 7 Tom and Ehrin write number patterns. Tom uses the rule “add 3” and starts at 12. Ehrin uses the rule “subtract 4” and starts at 26. Write the first five terms of their patterns. What number appears as a term in both patterns? Show your work.

Solution

- 8 The Lakeview Feed Store posts prices for two different types of grass seed by the square foot.

Number of Square Feet	0	1	2	3	4	5
Grass Seed A (\$)	0	4	6	8	10	12
Grass Seed B (\$)	0	8	12	16	20	24

Which sentences correctly compare the cost of a number of square feet of Grass Seed A and the cost of the same number of square feet of Grass Seed B?

- Ⓐ The cost of Grass Seed A is one-half the cost of Grass Seed B.
- Ⓑ The cost of Grass Seed A is two times the cost of Grass Seed B.
- Ⓒ The cost of Grass Seed B is one-half the cost of Grass Seed A.
- Ⓓ The cost of Grass Seed B is two times the cost of Grass Seed A.
- Ⓔ The cost of Grass Seed A is always two dollars less than the cost of Grass Seed B.

Practice Comparing Two Numerical Patterns

Study the Example showing one way to identify relationships between two numerical patterns. Then solve problems 1–6.



EXAMPLE

The school store sells laces and decals in the school colors. Laces cost \$1 each, and decals cost \$5 each. Find the cost of laces and the cost of decals for selling 0, 1, 2, 3, 4, and 5 of each item.

Use a table to show the two patterns.

The pattern for the cost of laces follows the rule “add 1.”

0, 1, 2, 3, 4, 5

The pattern for the cost of decals follows the rule “add 5.”

0, 5, 10, 15, 20, 25

Number of Items	Cost of Laces (\$)	Cost of Decals (\$)
0	0	0
1	1	5
2	2	10
3	3	15
4	4	20
5	5	25

1 Look at the Example. What is the cost for 6 decals? Explain how you got your answer.

2 Look at the Example. How are the terms in the pattern for the cost of decals related to the corresponding terms in the pattern for the cost of laces?

- 3 Suppose school bookmarks cost \$3 each. Complete the table to show how the terms in this pattern compare to the corresponding terms in the pattern for the cost of laces.

Number of Items	Cost of Laces (\$)	Cost of Bookmarks (\$)
0	0	0
1	1	3
2	2	
3	3	
4	4	
5	5	

- 4 Look at problem 3. How do the corresponding terms of the two patterns compare?
- 5 Look at problem 3. What is the rule for finding the cost of bookmarks?
- 6 Look at problem 3. If the table was continued, which two values could be corresponding terms for laces and bookmarks?
- (A) 8 and 21
 - (B) 10 and 30
 - (C) 12 and 36
 - (D) 15 and 60
 - (E) 16 and 24
 - (F) 20 and 60

Vocabulary

term a number in a pattern.

corresponding terms terms that have the same position in two related patterns.

Develop Using a Graph to Compare Patterns

Read and try to solve the problem below.

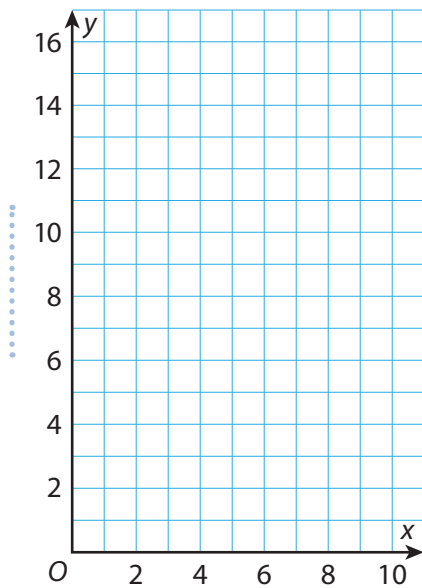
The scouts are making model vehicles. They have a choice of making a model plane or a model boat.

- The materials for each plane cost \$2.
- The materials for each boat cost \$4.

Write two patterns to show the costs for making 0 to 4 of each type of vehicle. Graph points in the coordinate plane to show a relationship between corresponding terms of the patterns.



TRY IT



Math Toolkit

- grid paper
- base-ten blocks



DISCUSS IT

Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I knew ... so I ...



Explore ways to understand corresponding terms of patterns.

The scouts are making model vehicles.

They have a choice of making a model plane or a model boat.

- The materials for each plane cost \$2.
- The materials for each boat cost \$4.

Write two patterns to show the costs for making 0 to 4 of each type of vehicle. Graph points in the coordinate plane to show a relationship between corresponding terms of the patterns.

MODEL IT

You can use a table to list the terms of the patterns.

List the cost of materials for 0, 1, 2, 3, and 4 planes and boats in a table. Then write the corresponding costs as ordered pairs.

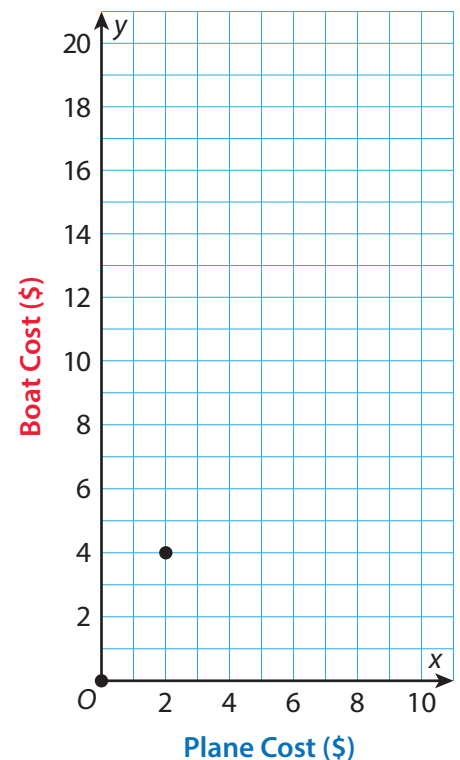
Number Made	Cost of Planes (\$), x	Cost of Boats (\$), y	Ordered Pair (x, y)
0	0	0	(0, 0)
1	2	4	(2, 4)
2	4	8	(4, 8)
3	6	12	(6, 12)
4	8	16	(8, 16)

MODEL IT

You can use a graph to model the relationship between corresponding terms.

The coordinate plane shows the relationship between the cost of planes and cost of boats.

The first two ordered pairs from the table above are shown on the coordinate plane.



CONNECT IT

Now you will use the problem from the previous page to help you understand how to use a graph to show relationships between corresponding terms of patterns.

- 1 Look at the table in the first **Model It**. What does the ordered pair (4, 8) represent?

- 2 How do the corresponding terms in the ordered pair (4, 8) compare? Is this relationship true of all corresponding terms in the table?

- 3 The first two ordered pairs in the table are graphed in the coordinate plane in the second **Model It**. Plot the other three ordered pairs from the table on the graph.

- 4 Connect the points on the graph in the second **Model It**. Explain what you see.

- 5 Describe how to move along grid lines from one point to the next point to the right on your graph in the second **Model It**. How does your description relate to the rules for the patterns?

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for how to use a graph to show relationships between corresponding terms of patterns. Explain.

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APPLY IT

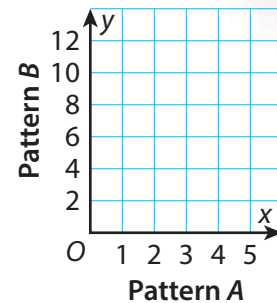
Use what you just learned to solve these problems.

- 7 Consider the two patterns below. Start each pattern with 0.

Pattern A: add 1

Pattern B: add 3

Write five ordered pairs made up of corresponding terms from the two patterns. Plot the points in the coordinate plane to the right. Describe the relationship between the two patterns. Show your work.

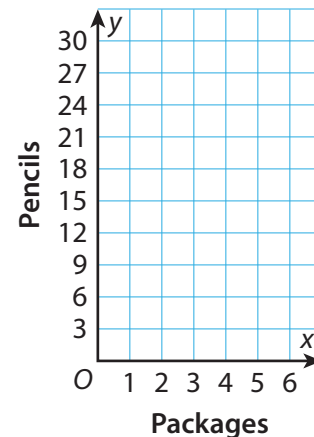


- 8 In the school store, pencils are sold in packages of 6. Write five ordered pairs made up of corresponding terms of these two patterns, based on selling 0 to 4 packages of pencils.

Pattern A: number of packages sold

Pattern B: number of pencils sold

Plot the points in the coordinate plane. Describe the relationship between the coordinates of the ordered pairs. Show your work.



- 9 Madeline and Javier graphed ordered pairs using the terms from the patterns they made. Madeline made the number pattern 0, 1, 3, 5, 7, 9. Javier made a number pattern with terms that were three times the corresponding terms in Madeline's pattern. Which list shows the ordered pairs Madeline and Javier graphed?

- (A) (0, 0) (1, 3) (3, 9) (5, 15) (7, 21) (9, 27)
- (B) (0, 0) (1, 3) (3, 5) (5, 7) (7, 9) (9, 11)
- (C) (0, 0) (1, 3) (3, 12) (5, 20) (7, 28) (9, 36)
- (D) (0, 0) (3, 1) (9, 3) (15, 5) (7, 21) (9, 27)

Practice Using a Graph to Compare Patterns

Study the Example comparing two patterns on a graph. Then solve problems 1–6.

EXAMPLE

Luke compared a pattern with the rule “add 2” to a pattern with the rule “add 6.”

He started at 0 and wrote the first three numbers of each pattern.

Add 2: **0, 2, 4**

Add 6: **0, 6, 12**

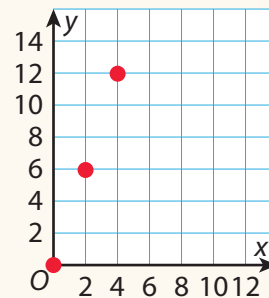
He wrote three ordered pairs.

(0, 0) **(2, 6)** **(4, 12)**

Then he plotted the ordered pairs in the coordinate plane.

The first number in each ordered pair shows the location along the x -axis.

The second number in each ordered pair shows the location along the y -axis.



- 1 Look at the ordered pairs in the Example. Describe the relationship between corresponding terms of the two patterns.
- 2 Suppose you connect the points on the graph in the Example. What would the graph look like?

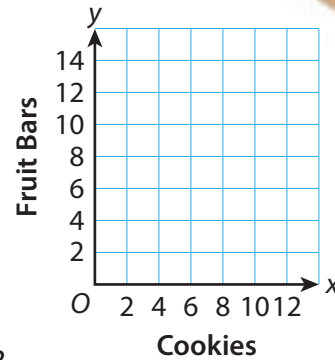
At a bake sale, cookies are sold in packages of 4 cookies each. Fruit bars are sold in packages of 2 fruit bars each.

- 3 Complete the table comparing the number of cookies and fruit bars sold for 0, 1, 2, and 3 packages.

Number of Packages	Number of Cookies, x	Number of Fruit Bars, y	Ordered Pair (x, y)
0	0	0	$(0, 0)$
1	4	2	$(4, 2)$
2			
3			



- 4 Use the coordinate plane at the right to graph the ordered pairs from the table in problem 3. What directions would you give someone to get from one point to the next point to the right on the graph?

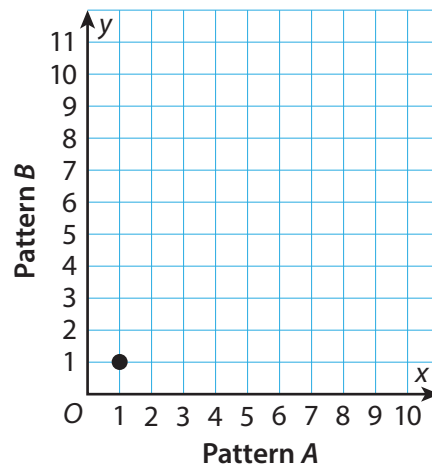


- 5 How do your directions relate to the rules for the patterns?

- 6 Graph the next two points in the coordinate plane following these rules:

Pattern A: Start at 1. Multiply by 3. Subtract 1.

Pattern B: Start at 1. Multiply by 4. Subtract 1.



Refine Analyzing Patterns and Relationships

Study the Example below. Then solve problems 1–8.

EXAMPLE

Look at the following two number patterns.

Pattern A: 6, 5, 4, 3, 2, 1, 0

Pattern B: 24, 20, 16, 12, 8, 4, 0

What is the relationship between corresponding terms in the two patterns?

Look at how you could show your work using ordered pairs.

The first number is a term from Pattern A.

The second number is the corresponding term from Pattern B.

Ordered pairs: (6, 24), (5, 20), (4, 16), (3, 12), (2, 8), (1, 4), (0, 0)

Solution

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The student wrote ordered pairs to identify a relationship between corresponding terms.



PAIR/SHARE

How are these patterns different from other patterns in this lesson?

APPLY IT

- One pattern starts at 0 and has the rule “add 8.” Another pattern starts at 0 and has the rule “add 4.” Write each pattern of numbers. How do the corresponding terms in the patterns compare? Show your work.

Solution

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How can you generate the patterns?

PAIR/SHARE

Does it matter how many terms you write for each pattern?

- 2 Identify the pattern in each column of the table. Complete the x - and y -columns of the table. Use those columns to write ordered pairs in the last column. Describe the relationship between corresponding terms in the patterns. Show your work.

x	y	Ordered Pair (x, y)
4	1	
8	2	
12	3	

Solution

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- 3 The ordered pairs (2, 12), (3, 18), and (4, 24) are formed by corresponding terms in two patterns. How do the terms of the pattern of y -coordinates compare to the corresponding terms of the pattern of x -coordinates?
- (A) 10 more
 - (B) 2 times as much
 - (C) $\frac{1}{6}$ times as much
 - (D) 6 times as much

Mike chose (C) as the correct answer. How did he get that answer?

What is the rule for each pattern?



PAIR/SHARE

Find the difference between the numbers in each ordered pair. Do you see another pattern?

What rule works for all the ordered pairs?

PAIR/SHARE

Does Mike's answer make sense?

- 4 Look at the patterns below. Choose *True* or *False* for each statement.

Pattern A: 3, 6, 9, 12, 15, 18, ...

Pattern B: 18, 36, 54, 72, 90, 108, ...

	True	False
The rule for Pattern A is "multiply by 2."	(A)	(B)
The rule for Pattern B is "add 18."	(C)	(D)
Each term in Pattern A is 6 times the corresponding term in Pattern B.	(E)	(F)
Each term in Pattern B is 3 times the corresponding term in Pattern A.	(G)	(H)

- 5 Cindy and Dawn make these number patterns.

Cindy's rule: Start at 4. Multiply by 2.

Dawn's rule: Start at 28. Subtract 4.

Write the first five terms of their patterns. Are there two corresponding terms that are the same? Explain. Show your work.

Solution

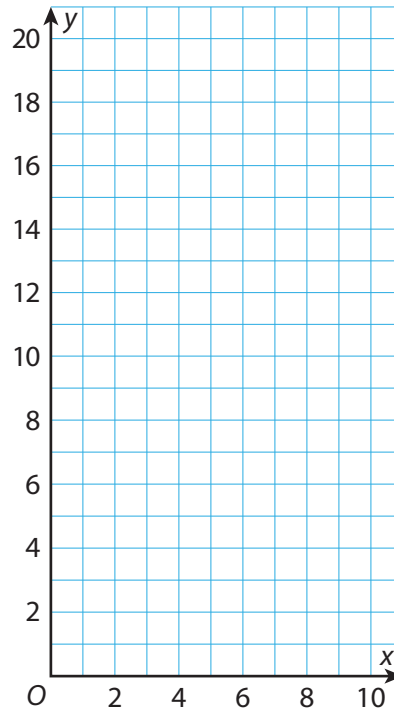
- 6 The table shows the terms of a pattern of x -coordinates and a pattern of y -coordinates. What two rules were used to make the patterns?

x-coordinate	0	1	2	3	4
y-coordinate	0	5	10	15	20

- (A) Add 4, Add 5
 (B) Add 1, Add 5
 (C) Add 1, Add 4
 (D) Add 4, Add 8

7 Part A Use the rules “add 2” and “add 5” to make two patterns that each begin with 0. Use the patterns to complete the table.

Add 2, x	Add 5, y	Ordered Pair (x, y)

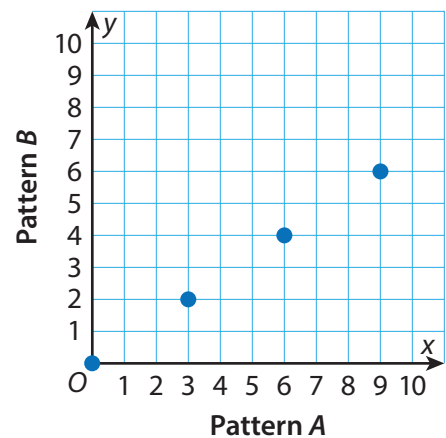


Part B Graph the ordered pairs and connect the points. What do you see?

Part C Describe the relationship between the corresponding terms of the patterns.

8 MATH JOURNAL

Use the graph of corresponding terms of Pattern A and Pattern B. Write the first 5 terms of each pattern. Explain how you found the terms.



SELF CHECK Go back to the Unit 5 Opener and see what you can check off.