Chapter 9

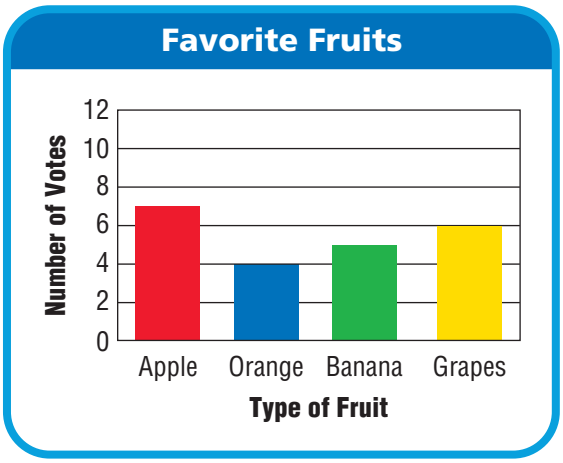
Algebra: Patterns and Graphing

Show What You Know

Check your understanding of important skills.

Name _____

Read and Use a Bar Graph Use the graph to answer the questions.



1. Which fruit received the most votes?

   _____

2. Which fruit received 5 votes? _____

3. There were _____ votes in all.

Extend Patterns Find the missing numbers. Then write a description for each pattern.

4. 0, 5, 10, 15, _____, _____, _____

   description: _____

5. 70, 60, 50, 40, _____, _____, _____

   description: _____

6. 12, 18, 24, 30, _____, _____, _____

   description: _____

7. 150, 200, 250, 300, _____, _____, _____

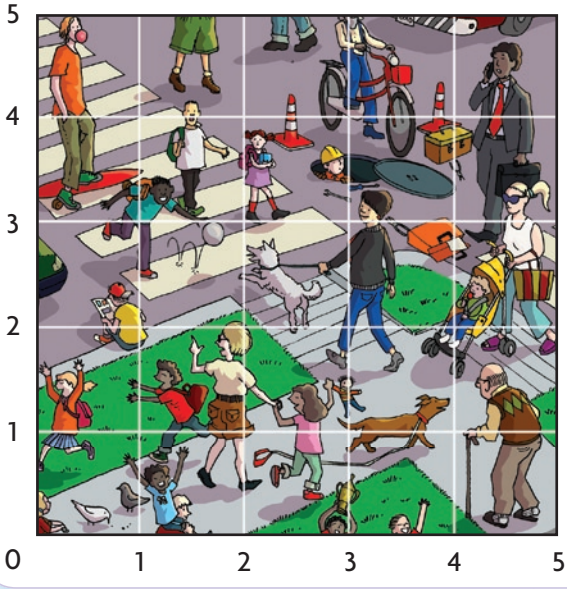
   description: _____

8. 200, 180, 160, 140, _____, _____, _____

   description: _____

Be a math detective by graphing and connecting the map coordinates to locate the secret documents in the lost briefcase.

(3, 3), (4, 2), (4, 4), (5, 3)



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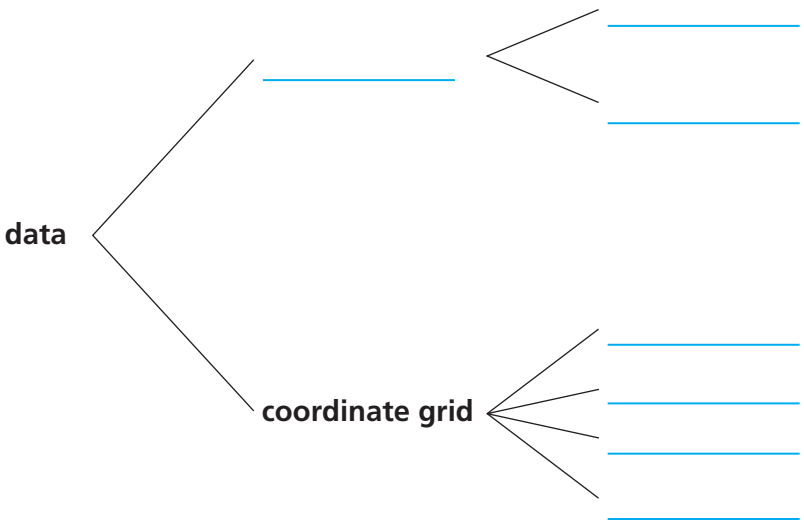
Vocabulary Builder

Visualize It

Use the checked words to complete the tree map.



Review Words

data

line plot

Preview Words

✓ interval

✓ line graph

✓ ordered pair

✓ origin

✓ scale

✓ x-axis

x-coordinate

✓ y-axis

y-coordinate

Understand Vocabulary

Complete the sentences using the preview words.

1. A graph that uses line segments to show how data changes over time is called a _____.

2. The pair of numbers used to locate points on a grid is an _____.

3. The point, (0, 0), also called the _____, is where the *x*-axis and the *y*-axis intersect.

4. On a coordinate grid, the horizontal number line is the _____ and the vertical number line is the _____.

5. The first number in an ordered pair is the _____ and the second number in an ordered pair is the _____.

6. The difference between the values on the scale of a graph is an _____.

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Name _____

Line Plots

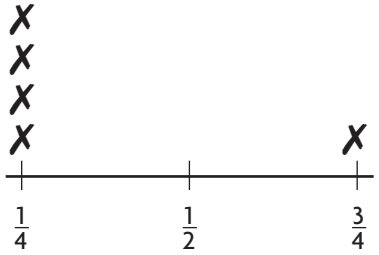
Essential Question How can a line plot help you find an average with data given in fractions?

UNLOCK the Problem REAL WORLD

Students have measured different amounts of water into beakers for an experiment. The amount of water in each beaker is listed below.

$\frac{1}{4}$ cup, $\frac{1}{4}$ cup, $\frac{1}{2}$ cup, $\frac{3}{4}$ cup, $\frac{1}{4}$ cup, $\frac{1}{4}$ cup,
$\frac{1}{4}$ cup, $\frac{1}{2}$ cup, $\frac{1}{4}$ cup, $\frac{3}{4}$ cup, $\frac{1}{4}$ cup, $\frac{3}{4}$ cup

If the total amount of water stayed the same, what would be the average amount of water in a beaker?



Water Used (in cups)

STEP 1 Count the number of cups for each amount. Draw an ✗ for the number of times each amount is recorded to complete the line plot.

$\frac{1}{4}$: _____ $\frac{1}{2}$: _____ $\frac{3}{4}$: _____

STEP 2 Find the total amount of water in all of the beakers that contain $\frac{1}{4}$ cup of water.

There are _____ beakers with $\frac{1}{4}$ cup of water. So, there are _____ fourths, or $\frac{\square}{\square}$, or $\square\frac{\square}{\square}$ cups.

STEP 3 Find the total amount of water in all of the beakers that contain $\frac{1}{2}$ cup of water.

There are _____ beakers with $\frac{1}{2}$ cup of water. So, there are _____ halves, or $\frac{\square}{\square}$, or 1 cup.

STEP 4 Find the total amount of water in all of the beakers that contain $\frac{3}{4}$ cup of water.

$3 \times \frac{3}{4} = \frac{\square}{\square}$, or $\square\frac{\square}{\square}$

STEP 5 Add to find the total amount of water in all of the beakers.

$1\frac{3}{4} + 1 + 2\frac{1}{4} =$ _____

STEP 6 Divide the sum you found in Step 5 by the number of beakers to find the average.

$5 \div 12 = \frac{\square}{\square}$

So, the average amount of water in a beaker is _____ cup.

Try This!

You can use the order of operations to find the average. Solve the problem as a series of expressions that use parentheses and brackets to separate them. Perform operations from inside the parentheses to the outer brackets.

$\left[\left(7 \times \frac{1}{4}\right) + \left(2 \times \frac{1}{2}\right) + \left(3 \times \frac{3}{4}\right)\right] \div 12$ Perform the operations inside the parentheses.

$\left[\frac{\square}{\square} + \square + \frac{\square}{\square}\right] \div 12$ Next, perform the operations in the brackets.

$\square \div 12$ Divide.

$\frac{\square}{\square}$ Write the expression as a fraction.

Example

Raine divides three 2-ounce bags of rice into smaller bags. The first bag is divided into bags weighing $\frac{1}{6}$-ounce each, the second bag is divided into bags weighing $\frac{1}{3}$-ounce each, and the third bag is divided into bags weighing $\frac{1}{2}$-ounce each.

Find the number of $\frac{1}{6}$-, $\frac{1}{3}$-, and $\frac{1}{2}$-ounce rice bags. Then graph the results on the line plot.

STEP 1 Write a title for your line plot. It should describe what you are counting.

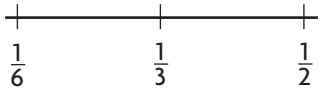
STEP 2 Label $\frac{1}{6}$, $\frac{1}{3}$, and $\frac{1}{2}$ on the line plot to show the different amounts into which the three 2-ounce bags of rice are divided.

STEP 3 Use division to find the number of $\frac{1}{6}$-ounce, $\frac{1}{3}$-ounce, and $\frac{1}{2}$-ounce bags that were made from the three original 2-ounce bags of rice.

$2 \div \frac{1}{6}$ $2 \times \square = \square$

$2 \div \frac{1}{3}$ $2 \times \square = \square$

$2 \div \frac{1}{2}$ $2 \times \square = \square$



STEP 4 Draw an ✗ above $\frac{1}{6}$, $\frac{1}{3}$, or $\frac{1}{2}$ to show the number of rice bags.

Math Talk MATHEMATICAL PRACTICES

Explain why there are more $\frac{1}{6}$-ounce rice bags than $\frac{1}{2}$-ounce rice bags.

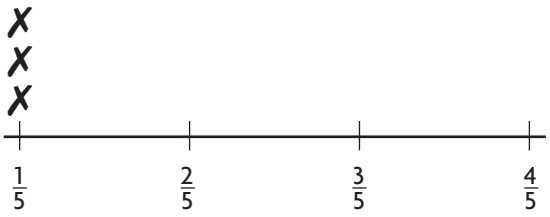
Name _____

Share and Show

Use the data to complete the line plot. Then answer the questions.

Lilly needs to buy beads for a necklace. The beads are sold by mass. She sketches a design to determine what beads are needed, and then writes down their sizes. The sizes are shown below.

$\frac{2}{5}$ g, $\frac{2}{5}$ g, $\frac{4}{5}$ g, $\frac{2}{5}$ g, $\frac{1}{5}$ g, $\frac{1}{5}$ g, $\frac{3}{5}$ g,
$\frac{4}{5}$ g, $\frac{1}{5}$ g, $\frac{2}{5}$ g, $\frac{3}{5}$ g, $\frac{3}{5}$ g, $\frac{2}{5}$ g



Mass of Beads (in grams)

1. What is the combined mass of the beads with a mass of $\frac{1}{5}$ gram?

Think: There are _____ Xs above $\frac{1}{5}$ on the line plot, so the combined mass of the beads is _____ fifths, or _____ gram.

2. What is the combined mass of all the beads with a mass of $\frac{2}{5}$ gram?

_____

3. What is the combined mass of all the beads on the necklace?

_____

4. What is the average weight of the beads on the necklace?

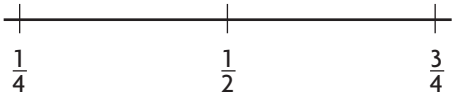
_____

On Your Own

Use the data to complete the line plot. Then answer the questions.

A breakfast chef used different amounts of milk when making pancakes, depending on the number of pancakes ordered. The results are shown below.

$\frac{1}{2}$ c, $\frac{1}{4}$ c, $\frac{1}{2}$ c, $\frac{3}{4}$ c, $\frac{1}{2}$ c, $\frac{3}{4}$ c, $\frac{1}{2}$ c, $\frac{1}{4}$ c, $\frac{1}{2}$ c, $\frac{1}{2}$ c



Milk in Pancake Orders (in cups)

5. How much milk combined is used in $\frac{1}{4}$-cup amounts? _____

6. How much milk combined is used in $\frac{1}{2}$-cup amounts? _____

7. How much milk combined is used in $\frac{3}{4}$-cup amounts? _____

8. How much milk is used in all the orders of pancakes? _____

9. What is the average amount of milk used for an order of pancakes? _____

10. H.O.T. **Describe** an amount you could add to the data that would make the average increase.

_____

UNLOCK the Problem REAL WORLD

11. For 10 straight days, Samantha measured the amount of food that her cat Dewey ate, recording the results, which are shown below. Graph the results on the line plot. What is the average amount of cat food that Dewey ate daily?

$\frac{1}{2}$ c, $\frac{3}{8}$ c, $\frac{5}{8}$ c, $\frac{1}{2}$ c, $\frac{5}{8}$ c, $\frac{1}{4}$ c, $\frac{3}{4}$ c, $\frac{1}{4}$ c, $\frac{1}{2}$ c, $\frac{5}{8}$ c

a. What do you need to know? _____

_____

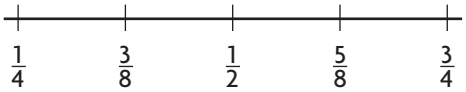
_____

b. How can you use a line plot to organize the information?

_____

_____

_____



Amount of Cat Food Eaten (in cups)

c. What steps could you use to find the average amount of food that Dewey ate daily?

_____

_____

_____

_____

_____

d. Fill in the blanks for the totals of each amount measured.

$\frac{1}{4}$ cup: _____

$\frac{3}{8}$ cup: _____

$\frac{1}{2}$ cup: _____

$\frac{5}{8}$ cup: _____

$\frac{3}{4}$ cup: _____

e. Find the total amount of cat food eaten over 10 days.

_____ + _____ + _____ + _____ +

_____ = _____

So, the average amount of food Dewey ate daily was _____.

12. **Test Prep** How many days did Dewey eat the least amount of cat food?

Ⓐ 1 day

Ⓑ 2 days

Ⓒ 3 days

Ⓓ 4 days

FOR MORE PRACTICE:
Standards Practice Book, pp. P183–P184

Name _____

Ordered Pairs

Essential Question How can you identify and plot points on a coordinate grid?

CONNECT Locating a point on a coordinate grid is similar to describing directions using North-South and West-East. The horizontal number line on the grid is the ***x*-axis**. The vertical number line on the grid is the ***y*-axis**.

Each point on the coordinate grid can be described by an **ordered pair** of numbers. The ***x*-coordinate**, the first number in the ordered pair, is the horizontal location, or the distance the point is from 0 in the direction of the *x*-axis. The ***y*-coordinate**, the second number in the ordered pair, is the vertical location, or the distance the point is from 0 in the direction of the *y*-axis.

(x, y)

x-coordinate — *y*-coordinate

The *x*-axis and the *y*-axis intersect at the point $(0, 0)$, called the **origin**.

UNLOCK the Problem REAL WORLD

Write the ordered pairs for the locations of the arena and the aquarium.

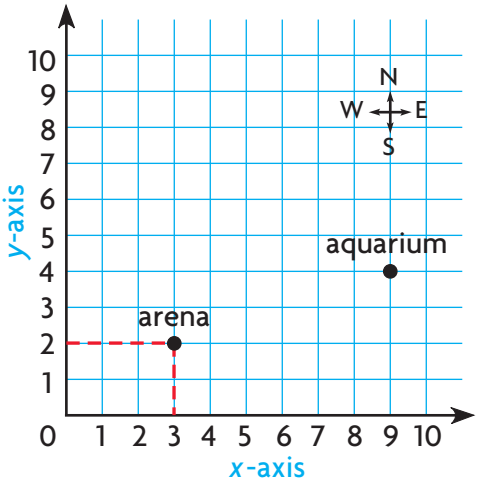
Locate the point for which you want to write an ordered pair.

Look below at the *x*-axis to identify the point's horizontal distance from 0, which is its *x*-coordinate.

Look to the left at the *y*-axis to identify the point's vertical distance from 0, which is its *y*-coordinate.

So, the ordered pair for the arena is $(3, 2)$ and the ordered pair for the aquarium

is (_____, _____).



- Describe the path you would take to get from the origin to the aquarium, using horizontal, then vertical movements.

_____

_____

Example 1 Use the graph.

A point on a coordinate grid can be labeled with an ordered pair, a letter, or both.

A **Plot the point (5, 7) and label it *J*.**

From the origin, move right 5 units and then up 7 units.

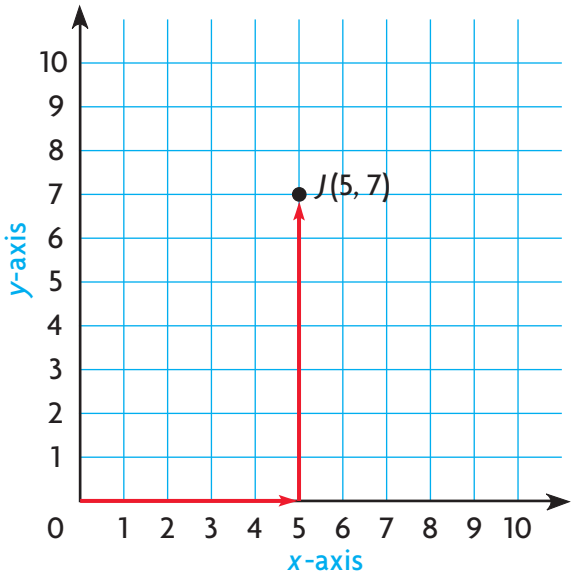
Plot and label the point.

B **Plot the point (8, 0) and label it *S*.**

From the origin, move right _____ units and

then up _____ units.

Plot and label the point.

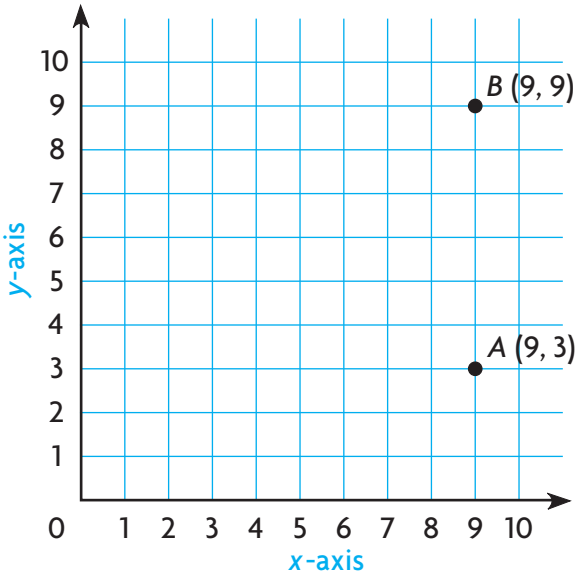


Example 2 Find the distance between two points.

You can find the distance between two points when the points are along the same horizontal or vertical line.

- Draw a line segment to connect point *A* and point *B*.
- Count vertical units between the two points.

There are _____ units between points *A* and *B*.



1. Points *A* and *B* form a vertical line segment and have the same *x*-coordinates. How can you use subtraction to find the distance between the points?

_____

_____

_____

_____

2. Graph the points (3, 2) and (5, 2). **Explain** how you can use subtraction to find the horizontal distance between these two points.

_____

_____

Name _____

Share and Show

MATH BOARD

Use Coordinate Grid A to write an ordered pair for the given point.

1. C _____
2. D _____
3. E _____
4. F _____

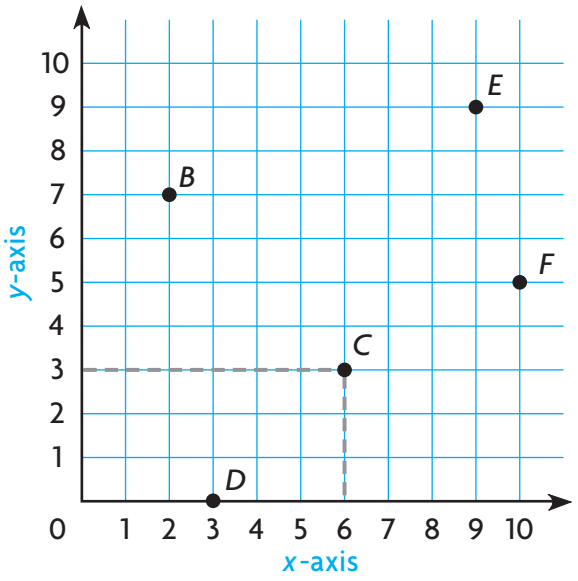
Plot and label the points on Coordinate Grid A.

5. $M(0, 9)$
6. $H(8, 6)$
7. $K(10, 4)$
8. $T(4, 5)$
9. $W(5, 10)$
10. $R(1, 3)$

Math Talk MATHEMATICAL PRACTICES

Describe how to find the distance between point R and point C.

Coordinate Grid A



On Your Own

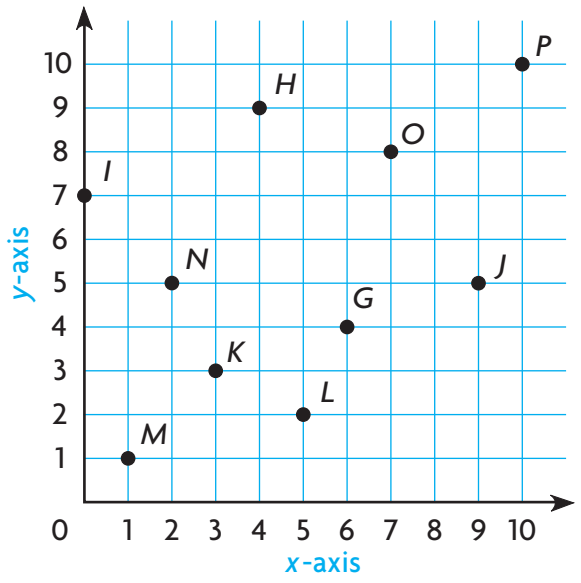
Use Coordinate Grid B to write an ordered pair for the given point.

11. G _____
12. H _____
13. I _____
14. J _____
15. K _____
16. L _____
17. M _____
18. N _____
19. O _____
20. P _____

Plot and label the points on Coordinate Grid B.

21. $W(8, 2)$
22. $E(0, 4)$
23. $X(2, 9)$
24. $B(3, 4)$
25. $R(4, 0)$
26. $F(7, 6)$
27. $T(5, 7)$
28. $A(7, 1)$
29. $S(10, 8)$
30. $Y(1, 6)$
31. $Q(3, 8)$
32. $V(3, 1)$

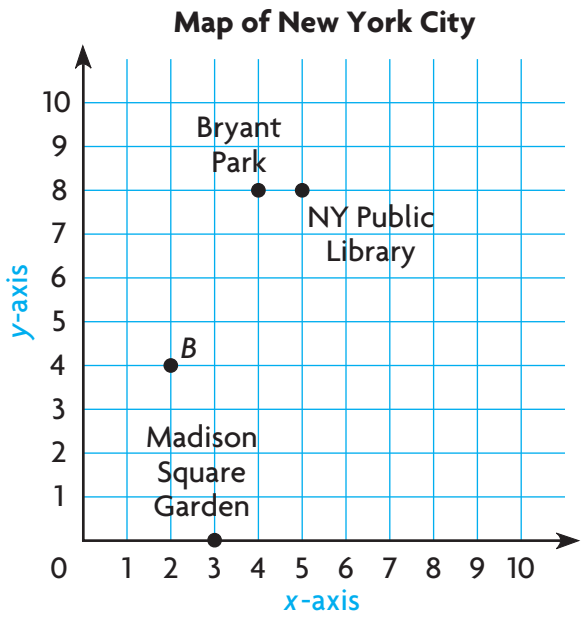
Coordinate Grid B



Problem Solving REAL WORLD

Nathan and his friends are planning a trip to New York City. Use the map for 33–38. Each unit represents 1 city block.

33. What ordered pair gives the location of Bryant Park?



34. H.O.T. **What's the Error?** Nathan says that Madison Square Garden is located at (0, 3) on the map. Is his ordered pair correct? **Explain**.

35. The Empire State Building is located 5 blocks right and 1 block up from (0, 0). Write the ordered pair for this location. Plot and label a point for the Empire State Building.

36. H.O.T. Paulo walks from point *B* to Bryant Park. Raul walks from point *B* to Madison Square Garden. If they only walk along the grid lines, who walks farther? **Explain**.

37. Write Math **Explain** how to find the distance between Bryant Park and a hot dog stand at the point (4, 2).

38. **Test Prep** Use the map above. Suppose a pizzeria is located at point *B*. What ordered pair describes this point?

Ⓐ (4, 2) Ⓑ (3, 4) Ⓒ (2, 4) Ⓓ (4, 4)

Name _____

Graph Data

Essential Question How can you use a coordinate grid to display data collected in an experiment?

Investigate

Materials ■ paper cup ■ water ■ Fahrenheit thermometer ■ ice cubes ■ stopwatch

When data is collected, it can be organized in a table.

A. Fill the paper cup more than halfway with room-temperature water.

B. Place the Fahrenheit thermometer in the water and find its beginning temperature before adding any ice. Record this temperature in the table at 0 seconds.

C. Place three cubes of ice in the water and start the stopwatch. Find the temperature every 10 seconds for 60 seconds. Record the temperatures in the table.

Water Temperature

Time (in seconds)	Temperature (in °F)
0	
10	
20	
30	
40	
50	
60	

Draw Conclusions

1. **Explain** why you would record the beginning temperature at 0 seconds.

2. **Describe** what happens to the temperature of the water in 60 seconds, during the experiment.

3. H.O.T. **Analyze** your observations of the temperature of the water during the 60 seconds, and explain what you think would happen to the temperature if the experiment continued for 60 seconds longer.

Make Connections

You can use a coordinate grid to graph and analyze the data you collected in the experiment.

STEP 1 Write the related pairs of data as ordered pairs.

(0, _____) (40, _____)

(10, _____) (50, _____)

(20, _____) (60, _____)

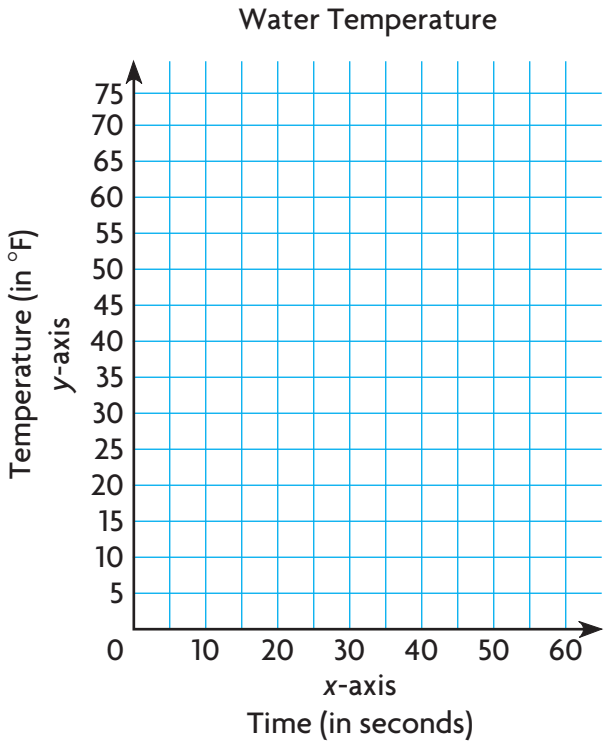
(30, _____)

STEP 2 Construct a coordinate grid and write a title for it. Label each axis.

STEP 3 Plot a point for each ordered pair.

MATHEMATICAL PRACTICES

Math Talk What is the ordered pair that you recorded for the data at 10 seconds? **Explain** what each coordinate represents.



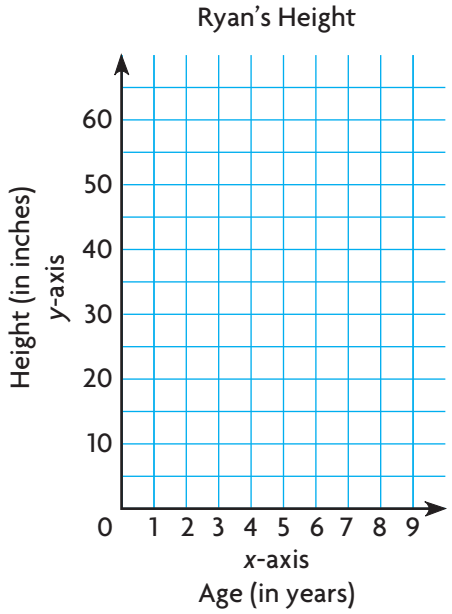
Name _____

Share and Show MATH BOARD

Graph the data on the coordinate grid.

1.

Ryan's Height					
Age (in years)	1	2	3	4	5
Height (in inches)	30	35	38	41	44



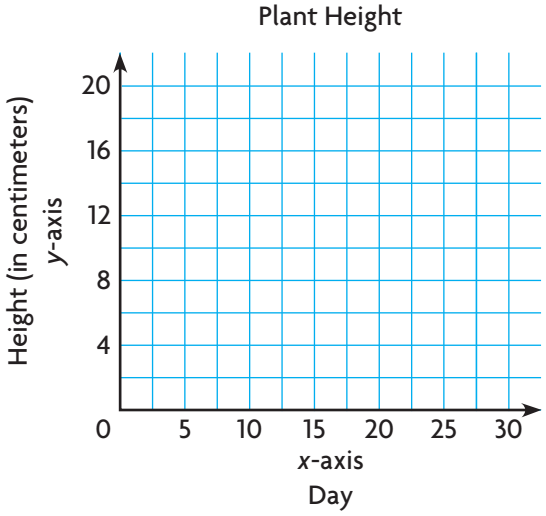
a. Write the ordered pairs for each point.

b. What does the ordered pair (3, 38) tell you about Ryan's age and height?

c. Why would the point (6, 42) be nonsense?

2.

Plant Height						
Day	5	10	15	20	25	30
Height (in cm)	1	3	8	12	16	19



a. Write the ordered pairs for each point.

b. How would the ordered pairs be different if the heights of the plants were measured every 6 days for 30 days instead of every 5 days?

Problem Solving REAL WORLD

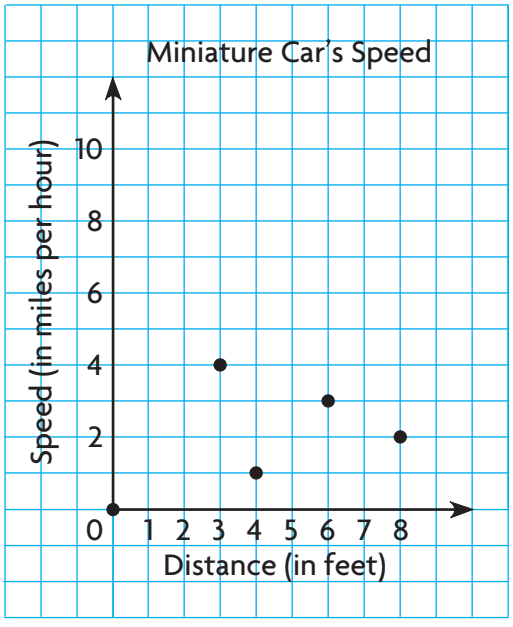
H.O.T. What's the Error?

3. Mary places a miniature car onto a track with launchers. The speed of the car is recorded every foot. Some of the data is shown in the table. Mary graphs the data on the coordinate grid below.

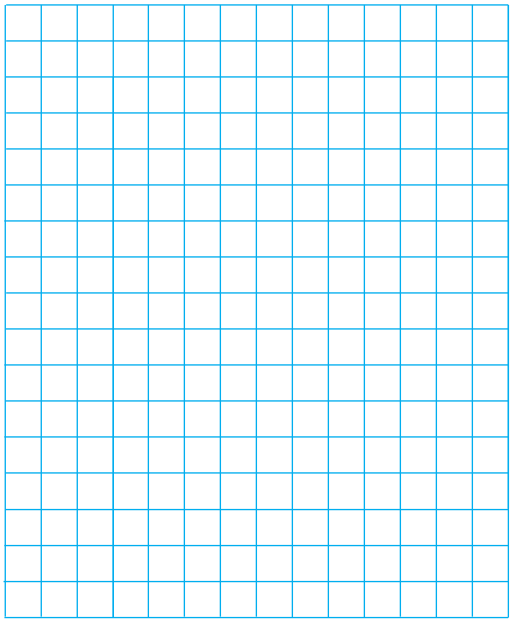
Miniature Car's Speed

Distance (in feet)	Speed (in miles per hour)
0	0
1	4
2	8
3	6
4	3

Look at Mary's graphed data. Find her error.



Graph the data and correct the error.



- Describe the error Mary made.

FOR MORE PRACTICE:
Standards Practice Book, pp. P187–P188

Name _____

Line Graphs

Essential Question How can you use a line graph to display and analyze real-world data?

UNLOCK the Problem REAL WORLD

A **line graph** is a graph that uses line segments to show how data changes over time. The series of numbers placed at fixed distances that label the graph are the graph's **scale**. The **intervals**, or difference between the values on the scale, should be equal.

Graph the data. Use the graph to determine the times between which the greatest temperature change occurred.

Recorded Temperatures							
Time (A.M.)	1:00	2:00	3:00	4:00	5:00	6:00	7:00
Temperature (in °F)	51	49	47	44	45	44	46

- Write related number pairs of data as ordered pairs.

(1:00, 51) (_____, _____)

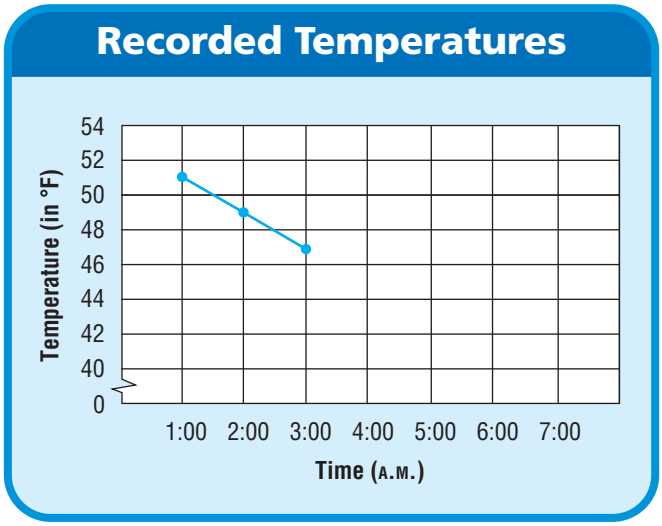
(_____, _____) (_____, _____)

(_____, _____) (_____, _____)

(_____, _____)

STEP 1 For the vertical axis, choose a scale and an interval that are appropriate for the data. You can show a break in the scale between 0 and 40, since there are no temperatures between 0°F and 44°F.

STEP 2 For the horizontal axis, write the times of day. Write a title for the graph and name each axis. Then graph the ordered pairs. Complete the graph by connecting the points with line segments.



Look at each line segment in the graph. Find the line segment that shows the greatest change in temperature between two consecutive points.

The greatest temperature change occurred between _____ and _____.

Try This! Jill used a rain gauge to collect data on the total rainfall during 6 days at her home in Miami. She read the amount of rain collected in the rain gauge each day and did not pour it out. Her data is shown in the table. Make a line graph to display Jill's data.

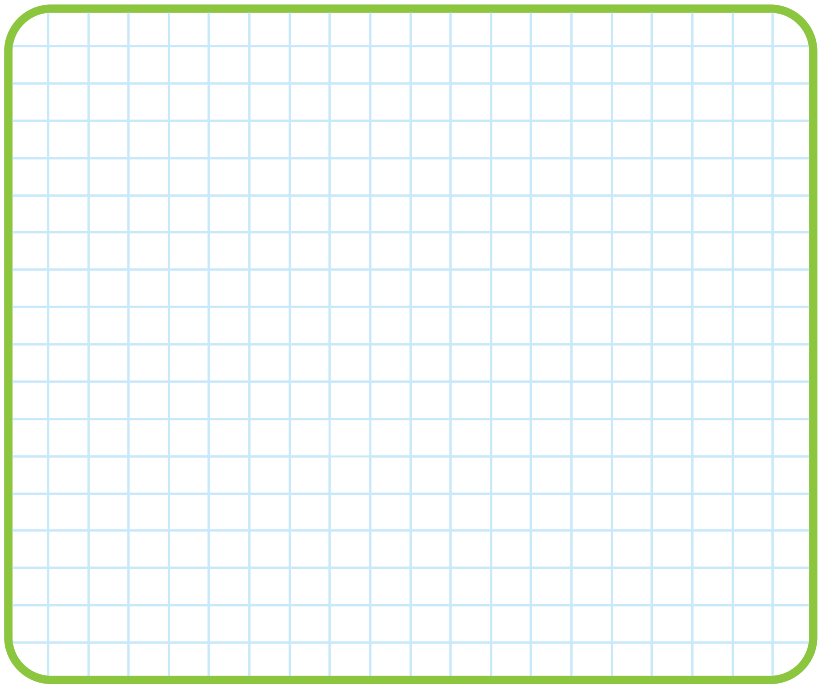
STEP 1 Write related pairs of data as ordered pairs.

(Mon, 2) (____, ____) (____, ____)

(____, ____) (____, ____) (____, ____)

STEP 2 Choose a scale and an interval for the data.

STEP 3 Label the horizontal and vertical axes. Write a title for the graph. Graph the ordered pairs. Connect the points with line segments.



Rainfall Collected

Day	Rainfall (in inches)
Mon	2
Tue	2
Wed	3
Thu	6
Fri	8
Sat	9

MATHEMATICAL PRACTICES

Math Talk **Explain** how you could use the graph to identify the two readings between which it did not rain.

Use the graph to answer the questions.

1. On which day was the total rainfall recorded the greatest?

_____

2. On which day did Jill record the greatest increase in rainfall collected from the previous day?

_____

Name _____

Share and Show

Use the table at the right for 1–3.

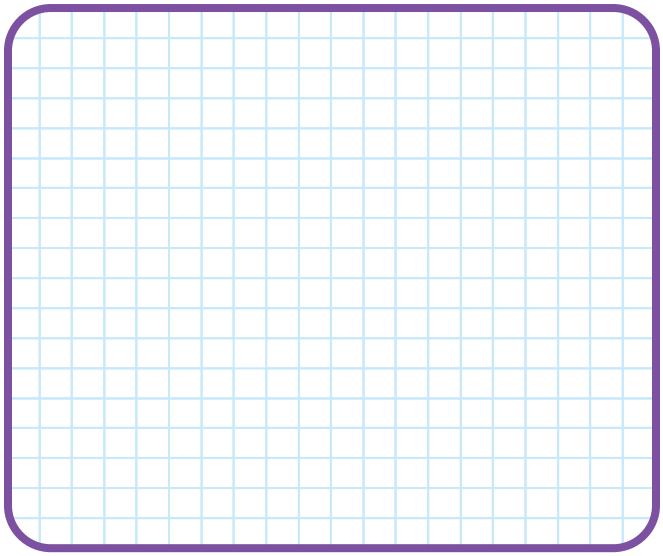
Average Monthly Temperature in Tupelo, Mississippi					
Month	Jan	Feb	Mar	Apr	May
Temperature (in °F)	40	44	54	62	70

1. What scale and intervals would be appropriate to make a graph of the data?

2. Write the related pairs as ordered pairs.

3. Make a line graph of the data.

4. Use the graph to determine between which two months the least change in average temperature occurs.



On Your Own

Use the table at the right for 5–7.

Plant Height				
Month	1	2	3	4
Height (in inches)	20	25	29	32

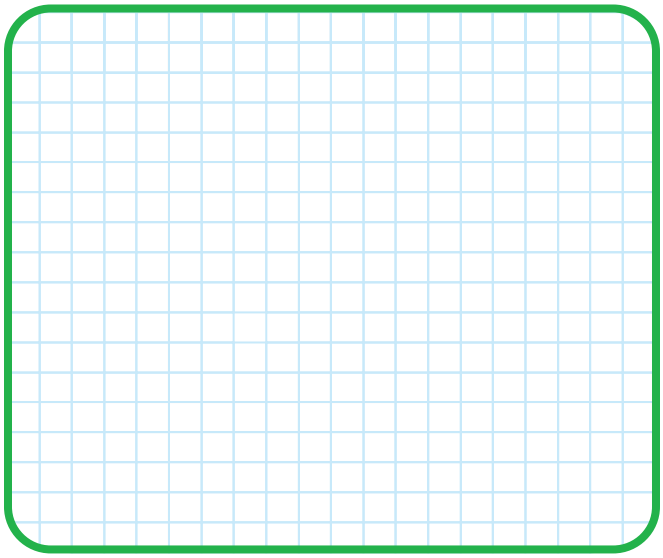
5. Write the related number pairs for the plant height as ordered pairs.

6. What scale and intervals would be appropriate to make a graph of the data?

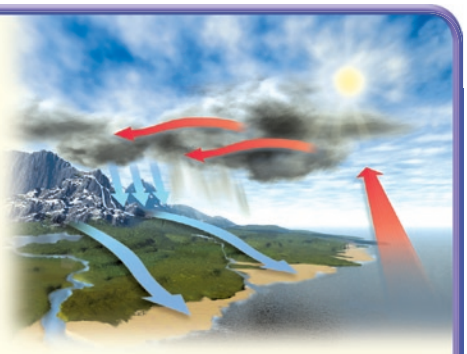
7. Make a line graph of the data.

8. Use the graph to find the difference in height between Month 1 and Month 2.

9. H.O.T. Use the graph to estimate the height at $1\frac{1}{2}$ months.



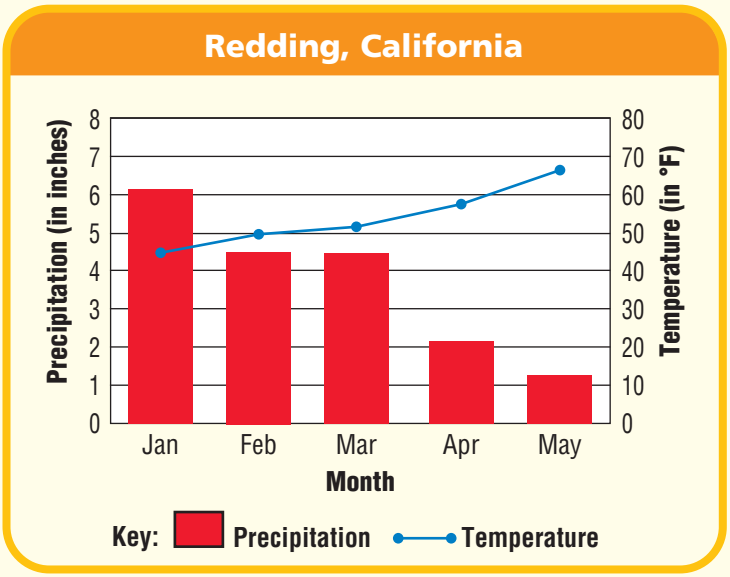
Connect to Science



Evaporation changes water on Earth's surface into water vapor. Water vapor condenses in the atmosphere and returns to the surface as precipitation. This process is called the water cycle. The ocean is an important part of this cycle. It influences the average temperature and precipitation of a place.

The overlay graph below uses two vertical scales to show monthly average precipitation and temperatures for Redding, California.

Use the graph for 10–13.



10. About how much precipitation falls in Redding, California, in February?

_____

11. What is the average temperature for Redding, California, in February?

_____

12. **Explain** how the overlay graph helps you relate precipitation and temperature for each month.

_____

_____

13. Write Math **Describe** how the average temperature changes in the first 5 months of the year.

_____

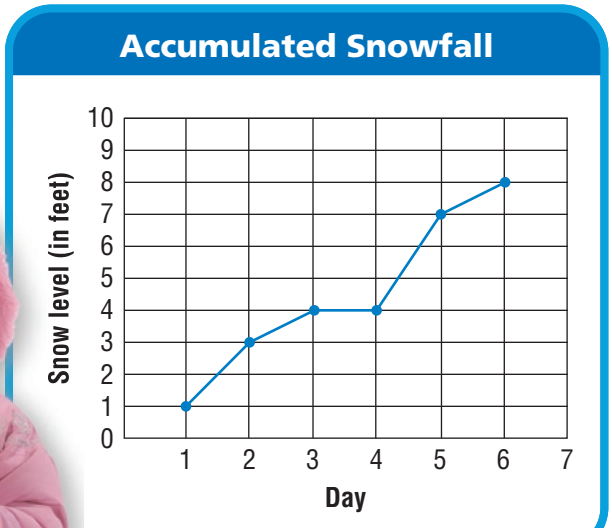
14. **Test Prep** Which day had an increase of 3 feet of snow from the previous day?

Ⓐ Day 2

Ⓑ Day 3

Ⓒ Day 5

Ⓓ Day 6



FOR MORE PRACTICE:
Standards Practice Book, pp. P189–P190

Name _____

Mid-Chapter Checkpoint

Vocabulary

Choose the best term from the box.

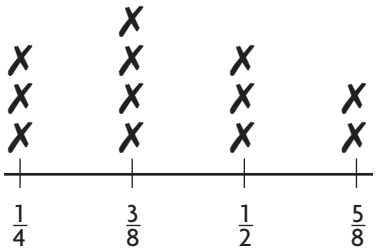
Vocabulary
line graph
line plot
x-axis
y-axis

1. The _____ is the horizontal number line on the coordinate grid. (p. 373)

2. A _____ is a graph that uses line segments to show how data changes over time. (p. 381)

Check Concepts

Use the line plot at the right for 3–5.



Weights of Kittens in the Animal Shelter (lb)

3. How many kittens weigh at least $\frac{3}{8}$ of a pound?

_____

4. What is the combined weight of all the kittens?

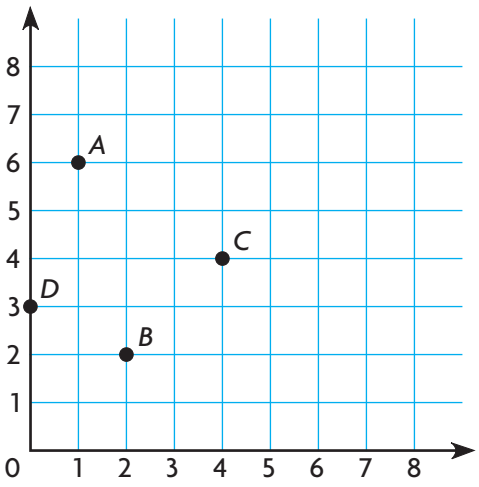
_____

5. What is the average weight of the kittens in the shelter?

_____

Use the coordinate grid at the right for 6–13.

Write an ordered pair for the given point.



6. *A* _____ 7. *B* _____

8. *C* _____ 9. *D* _____

Plot and label the point on the coordinate grid.

10. *E* (6, 2) 11. *F* (5, 0)

12. *G* (3, 4) 13. *H* (3, 1)

Fill in the bubble completely to show your answer.

14. The ordered pair $(0, 7)$ is:

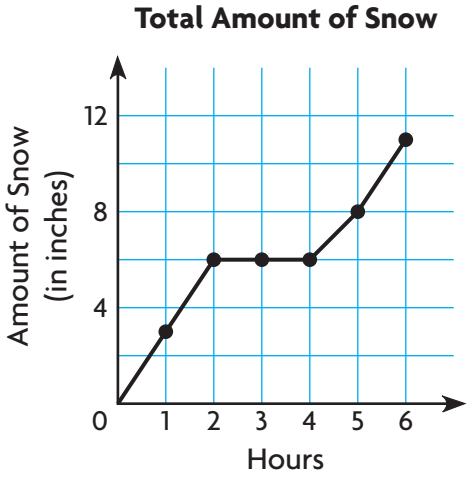
Ⓐ at the origin

Ⓑ on the *x*-axis

Ⓒ on the *y*-axis

Ⓓ 7 units from the *y*-axis

15. The graph below shows the amount of snowfall in a 6-hour period.



Based on the graph, which statement best describes the amount of snow that fell during that time period?

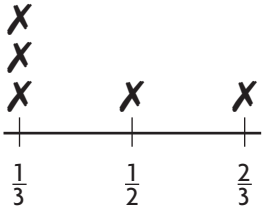
Ⓐ The greatest amount of snow fell between hour 1 and hour 2.

Ⓑ The greatest amount of snow fell between hour 5 and hour 6.

Ⓒ The least amount of snow fell between hour 2 and hour 4.

Ⓓ The least amount of snow fell between hour 4 and hour 5.

16. Joy recorded the distances she walked each day for five days. How far did she walk in 5 days?



Distance Walked Each Day (in miles)

Ⓐ $1\frac{1}{3}$ miles

Ⓑ $1\frac{2}{3}$ miles

Ⓒ 2 miles

Ⓓ $2\frac{1}{6}$ miles

Name _____

Numerical Patterns

Essential Question How can you identify a relationship between two numerical patterns?

UNLOCK the Problem REAL WORLD

On the first week of school, Joel purchases 2 movies and 6 songs from his favorite media website. If he purchases the same number of movies and songs each week, how does the number of songs purchased compare to the number of movies purchased from one week to the next?

- How many movies does Joel purchase each week?

  _____

- How many songs does Joel purchase each week?

  _____

STEP 1 Use the two rules given in the problem to generate the first 4 terms in the sequence for the number of movies and the sequence for number of songs.

- The sequence for the number of movies each week is:

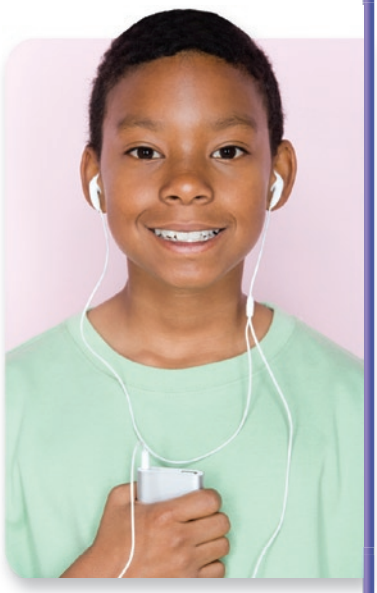
+2 +2 +2

2, ☐, ☐, ☐, . . .

- The sequence for the number of songs each week is:

+6 +6 +6

6, ☐, ☐, ☐, . . .



STEP 2 Write number pairs that relate the number of movies to the number of songs.

Week 1: 2, 6 Week 2: _____

Week 3: _____ Week 4: _____

STEP 3 For each number pair, compare the number of movies to the number of songs. Write a rule to describe this relationship.

Think: For each related number pair, the second number is _____ times as great as the first number.

Rule: _____

So, from one week to the next, the number of songs Joel purchased is _____ times as many as the number of movies purchased.

Example

When Alice completes each level in her favorite video game, she wins 3 extra lives and 6 gold coins. What rule can you write to relate the number of gold coins to the number of extra lives she has won at any level? How many extra lives will Alice have won after she completes 8 levels?

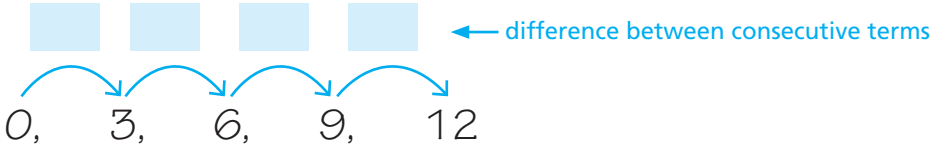
Add _____.

Add _____.

Level	0	1	2	3	4	8
Extra Lives	0	3	6	9	12	
Gold Coins	0	6	12	18	24	48

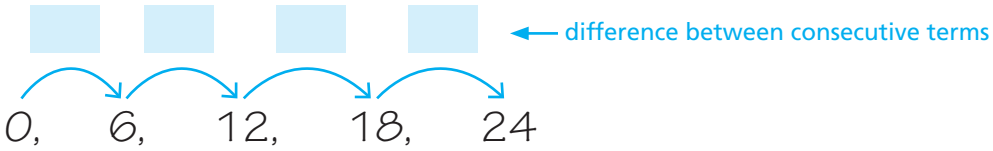
Multiply by _____ or divide by _____.

STEP 1 To the left of the table, complete the rule for how you could find the number of extra lives won from one level to the next.



From one level to the next, Alice wins _____ more extra lives.

STEP 2 To the left of the table, complete the rule for how you could find the number of gold coins won from one level to the next.



From one level to the next, Alice wins _____ more gold coins.

STEP 3 Write number pairs that relate the number of gold coins to the number of extra lives won at each level.

Level 1: 6, 3 Level 2: _____

Level 3: _____ Level 4: _____

STEP 4 Complete the rule to the right of the table that describes how the number pairs are related. Use your rule to find the number of extra lives at level 8.

Think: For each level, the number of extra lives is _____ as great as the number of gold coins.

Rule: _____

So, after 8 levels, Alice will have won _____ extra lives.

MATHEMATICAL PRACTICES

Math Talk **Explain** how your rule would change if you were relating extra lives to gold coins instead of gold coins to extra lives.

Name _____

Share and Show

Use the given rules to complete each sequence. Then, complete the rule that describes how nickels are related to dimes.

1.

	Number of coins	1	2	3	4	5
Add 5.	Nickels (¢)	5	10	15	20	
Add 10.	Dimes (¢)	10	20	30	40	

Multiply by _____.

Complete the rule that describes how one sequence is related to the other. Use the rule to find the unknown term.

2. Multiply the number of books by _____ to find the amount spent.

Day	1	2	3	4	8
Number of Books	3	6	9	12	24
Amount Spent ($)	12	24	36	48	

3. Divide the weight of the bag by _____ to find the number of marbles.

Bags	1	2	3	4	12
Number of Marbles	10	20	30	40	
Weight of Bag (grams)	30	60	90	120	360

On Your Own

Complete the rule that describes how one sequence is related to the other. Use the rule to find the unknown term.

4. Multiply the number of eggs by _____ to find the number of muffins.

Batches	1	2	3	4	9
Number of Eggs	2	4	6	8	18
Muffins	12	24	36	48	

5. Divide the number of meters by _____ to find the number of laps.

Runners	1	2	3	4
Number of Laps	4	8	12	
Number of Meters	1,600	3,200	4,800	6,400

6. H.O.T. Suppose the number of eggs used in Exercise 4 is changed to 3 eggs for each batch of 12 muffins, and 48 eggs are used. How many batches and how many muffins will be made?

_____

Problem Solving REAL WORLD

SHOW YOUR WORK

7. Emily has a road map with a key that shows an inch on the map equals 5 miles of actual distance. If a distance measured on the map is 12 inches, what is the actual distance? Write the rule you used to find the actual distance.

8. To make a shade of lavender paint, Jon mixes 4 ounces of red tint and 28 ounces of blue tint into one gallon of white paint. If 20 gallons of white paint and 80 ounces of red tint are used, how much blue tint should be added? Write a rule that you can use to find the amount of blue tint needed.

9. H.O.T. In the cafeteria, tables are arranged in groups of 4, with each table seating 8 students. How many students can sit at 10 groups of tables? Write the rule you used to find the number of students.

10. **Test Prep** What is the unknown number in Sequence 2 in the chart? What rule could you write that relates Sequence 1 to Sequence 2?

Sequence Number	1	2	3	5	7
Sequence 1	5	10	15	25	35
Sequence 2	15	30	45	75	?

Ⓐ 70; Multiply by 2.

Ⓑ 100; Add 25.

Ⓒ 105; Multiply by 3.

Ⓓ 150; Add 150.

FOR MORE PRACTICE:
Standards Practice Book, pp. P191–P192

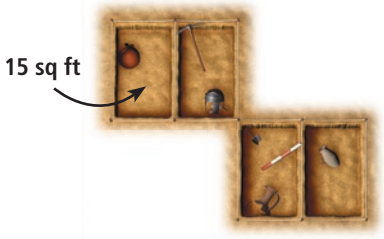
Name _____

Problem Solving • Find a Rule

Essential Question How can you use the strategy *solve a simpler problem* to help you solve a problem with patterns?

UNLOCK the Problem REAL WORLD

On an archaeological dig, Gabriel separates his dig site into sections with areas of 15 square feet each. There are 3 archaeological members digging in every section. What is the area of the dig site if 21 members are digging at one time?



Read the Problem

What do I need to find?

I need to find the

_____

_____

_____.

What information do I need to use?

I can use the area of each section, which is

_____, that

there are _____ members in each section, and that there are 21 members digging.

How will I use the information?

I will use the information to search for patterns to solve

a _____ problem.

Solve the Problem

	Sections	1	2	3	4	5	6	7
Add 3.	Number of Members	3	6	9	12	15	18	21
Add 15.	Area (in square feet)	15	30	45	60	75	90	

Multiply by _____.

Multiply by _____.

So, the area of the dig site if 21 members are digging is _____ square feet.

Possible Rules:

- Multiply the number of sections by _____ to find the number of members.
- Multiply the number of members by _____ to find the total area. Complete the table.

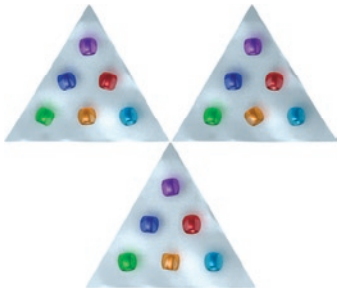
MATHEMATICAL PRACTICES

Math Talk **Explain** how you can use division to find the number of members if you know the dig site area is 135 square feet.

Try Another Problem

Casey is making a design with triangles and beads for a costume. In his design, each pattern unit adds 3 triangles and 18 beads. If Casey uses 72 triangles in his design, how many times does he repeat the pattern unit? How many beads does Casey use?

Use the graphic organizer below to solve the problem.



Read the Problem

What do I need to find?	What information do I need to use?	How will I use the information?

Solve the Problem

So, Casey repeats the pattern unit _____ times and

uses _____ beads.

- What rule could you use to find an unknown number of beads if you know the related number of triangles?

_____

_____

Name _____

Share and Show MATH BOARD

1. Max builds rail fences. For one style of fence, each section uses 3 vertical fence posts and 6 horizontal rails. How many posts and rails does he need for a fence that will be 9 sections long?

1 Section

2 Sections

3 Sections

First, think about what the problem is asking and what you know. As each section of fence is added, how does the number of posts and the number of rails change?

Next, make a table and look for a pattern. Use what you know about 1, 2, and 3 sections. Write a rule for the number of posts and rails needed for 9 sections of fence.

Number of Sections	1	2	3	9
Number of Posts	3	6	9	
Number of Rails	6	12	18	

Possible rule for posts: _____

Possible rule for rails: _____

Finally, use the rule to solve the problem.

2. H.O.T. **What if** another style of rail fencing has 6 rails between each pair of posts? How many rails are needed for 9 sections of this fence?

Number of Sections	1	2	3	9
Number of Posts	3	6	9	
Number of Rails	12	24	36	

Possible rule: _____

3. Leslie is buying a coat on layaway for $135. She will pay $15 each week until the coat is paid for. How much will she have left to pay after 8 weeks?

Number of Weeks	1	2	3	8
Amount paid ($)	15	30	45	

On Your Own

Choose a STRATEGY

- Act It Out
- Draw a Diagram
- Make a Table
- Solve a Simpler Problem
- Work Backward
- Guess, Check, and Revise

4. Jane works as a limousine driver. She earns $50 for every 2 hours that she works. How much does Jane earn in one week if she works 40 hours per week? Write a rule and complete the table.

Possible rule: _____

Hours Worked	2	4	6	40
Jane's Pay ($)	50	100	150	

5. H.O.T. Rosa joins a paperback book club. Members pay $8 to buy 2 tokens, and can trade 2 tokens for 4 paperback books. Rosa buys 30 tokens and trades them for 60 paperback books. How much money does she spend? Write a rule and complete the table.

Tokens	2	4	6	8	30
Cost ($)	8	16	24	32	
Books	4	8	12	16	60

Possible rule: _____

_____

_____

6. H.O.T. Paul is taking a taxicab to a museum. The taxi driver charges a $3 fee plus $2 for each mile traveled. How much does the ride to the museum cost if it is 8 miles away?

_____

7. **Test Prep** Which expression could describe the next figure in the pattern, Figure 4?

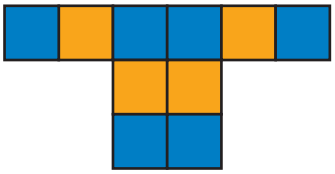
Figure 1

2 squares

Figure 2

6 squares

Figure 3



10 squares

Ⓐ 2×5

Ⓑ $2 + 4 + 4$

Ⓒ $2 + 4 + 4 + 4$

Ⓓ 16

Name _____

Graph and Analyze Relationships

Essential Question How can you write and graph ordered pairs on a coordinate grid using two numerical patterns?

UNLOCK the Problem REAL WORLD

Sasha is making hot cocoa for a party. For each mug of cocoa, he uses 3 tablespoons of cocoa mix and 6 fluid ounces of hot water. If Sasha uses an entire 18-tablespoon container of cocoa mix, how many fluid ounces of water will he use?

- How many tablespoons of cocoa mix does Sasha add for each mug of cocoa?

_____

- How many fluid ounces of water does Sasha add for each mug of cocoa?

_____

STEP 1 Use the two given rules in the problem to generate the first four terms for the number of tablespoons of cocoa mix and the number of fluid ounces of water.

Cocoa Mix (tbsp)	3				18
Water (fl oz)	6				

STEP 2 Write the number pairs as ordered pairs, relating the number of tablespoons of cocoa mix to the number of fluid ounces of water.

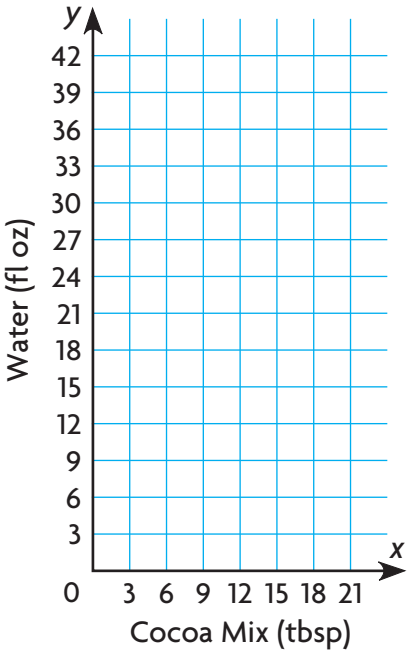
(3, 6) _____ _____ _____

STEP 3 Graph and label the ordered pairs. Then write a rule to describe how the number pairs are related.

- What rule can you write that relates the amount of cocoa mix to water?

_____

So, Sasha will use _____ fluid ounces of water if he uses the entire container of cocoa mix.



- Write the final number pair as an ordered pair. Then graph and label it. Starting at the origin, connect the points with straight line segments. What do the connected points form? **Explain** why this is formed.

_____

_____

_____

Example

Jon is customizing an audio sound system. He needs to buy $3\frac{1}{2}$ feet of cable wire, but it is sold in inches. He knows there are 12 inches in 1 foot. How many inches of wire will he need?

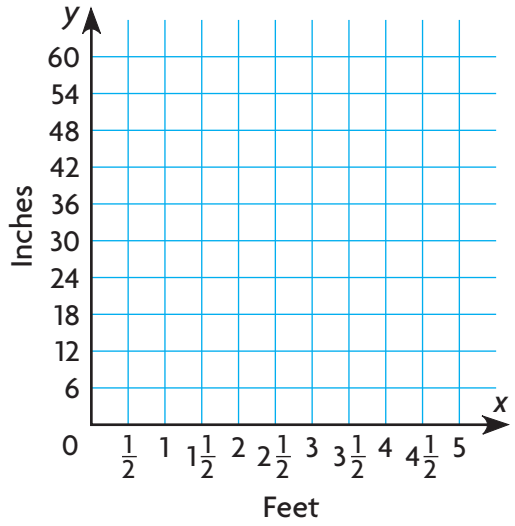
Feet	1	2	3	4
Inches	12			

Rule: Multiply the number of feet by _____.

STEP 1 Write the number pairs as ordered pairs, relating the number of feet to the number of inches.

_____ _____ _____ _____

STEP 2 Graph the ordered pairs. Connect the points from the origin with straight line segments.



STEP 3 Use the graph to find the number of inches in $3\frac{1}{2}$ feet.

Think: $3\frac{1}{2}$ is between the whole numbers _____ and _____.

Locate $3\frac{1}{2}$ on the *x*-axis.

STEP 4 Draw a vertical line from $3\frac{1}{2}$ on the *x*-axis to the line that connects the ordered pairs. Then graph that point.

To find how many inches equal $3\frac{1}{2}$ feet, draw a horizontal line from that point left to the *y*-axis. What is the ordered pair for the point?

_____

So, Jon needs to buy _____ inches of cable wire.

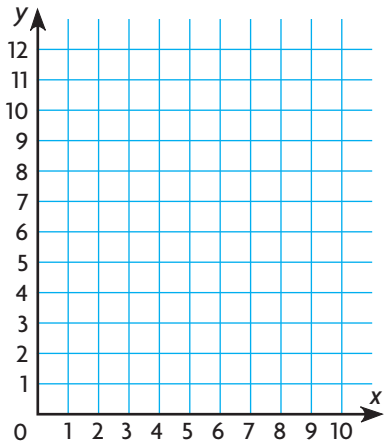
Name _____

Share and Show

Graph and label the related number pairs as ordered pairs. Then complete and use the rule to find the unknown term.

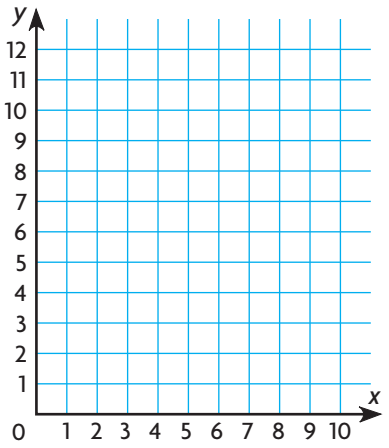
1. Multiply the number of tablespoons by _____ to find its weight in ounces.

Butter (tbsp)	1	2	3	4	5
Weight (oz)	2	4	6	8	



2. Multiply the number of hours by _____ to find the distance in miles.

Time (hr)	1	2	3	4
Distance walked (mi)	3	6	9	

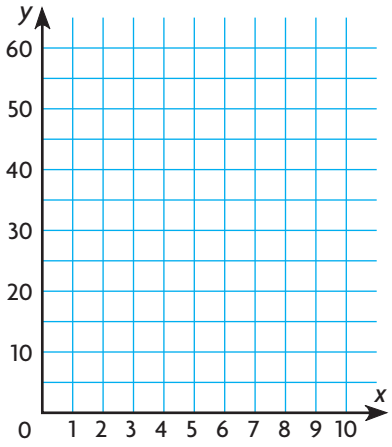


On Your Own

Graph and label the related number pairs as ordered pairs. Then complete and use the rule to find the unknown term.

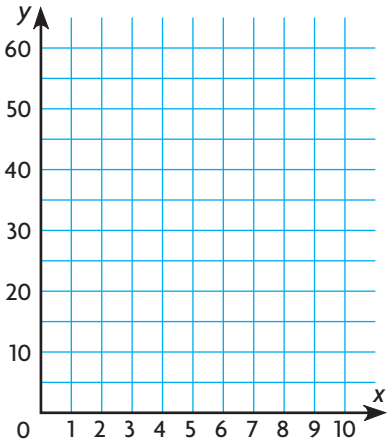
3. Multiply the number of inches by _____ to find the distance in miles.

Map (in.)	2	4	6	8	10
Miles	10	20	30	40	



4. Multiply the number of centiliters by _____ to find the equivalent number of milliliters.

Centiliters	1	2	3	4	5
Milliliters	10	20	30	40	



Problem Solving REAL WORLD

H.O.T. Sense or Nonsense?

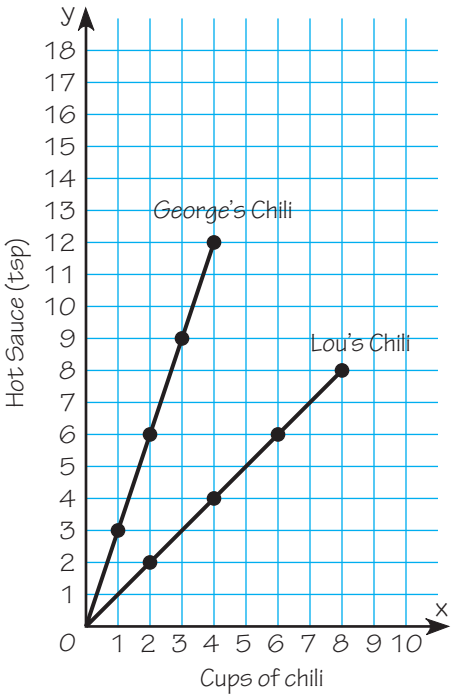
5. Elsa solved the following problem.

Lou and George are making chili for the Annual Firefighter's Ball. Lou uses 2 teaspoons of hot sauce for every 2 cups of chili that he makes, and George uses 3 teaspoons of the same hot sauce for every cup of chili in his recipe. Who has the hotter chili, George or Lou?

Write the related number pairs as ordered pairs and then graph them. Use the graph to compare who has the hotter chili, George or Lou.

Lou's chili (cups)	2	4	6	8
Hot sauce (tsp)	2	4	6	8

George's chili (cups)	1	2	3	4
Hot sauce (tsp)	3	6	9	12



Lou's chili: $(2, 2), (4, 4), (6, 6), (8, 8)$

George's chili: $(1, 3), (2, 6), (3, 9), (4, 12)$

Elsa said that George's chili was hotter than Lou's, because the graph showed that the amount of hot sauce in George's chili was always 3 times as great as the amount of hot sauce in Lou's chili. Does Elsa's answer make sense, or is it nonsense? **Explain**.

FOR MORE PRACTICE:
Standards Practice Book, pp. P195-P196

Name _____

Chapter Review/Test

Vocabulary

Choose the best term from the box.

Vocabulary
line graph
line plot
origin
x-coordinate
y-coordinate

1. The _____ is the point where the *x*-axis and *y*-axis meet. Its _____ is 0, and its _____ is 0. (p. 373)

2. A _____ uses line segments to show how data changes over time. (p. 381)

Check Concepts

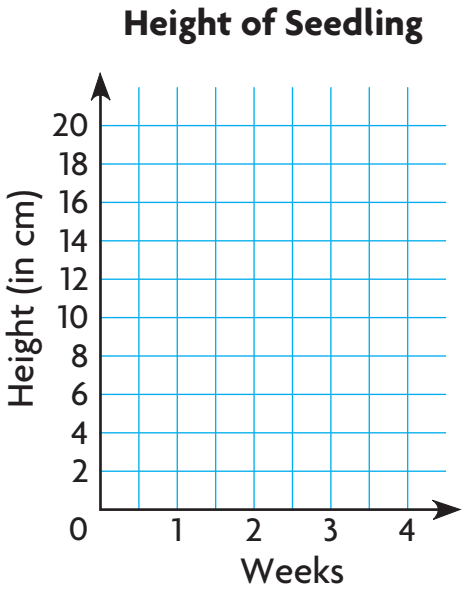
Use the table for 3–4.

Height of Seedling				
Weeks	1	2	3	4
Height (in cm)	2	6	14	16

3. Write related number pairs of data as ordered pairs.

_____

4. Make a line graph of the data.



Complete the rule that describes how one sequence is related to the other. Use the rule to find the unknown term.

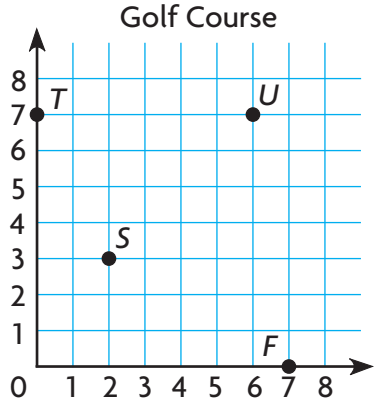
5. Multiply the number of eggs by _____ to find the number of cupcakes.

Batches	1	2	3	4	6
Number of Eggs	3	6	9	12	
Number of Cupcakes	18	36	54	72	

GO Online Assessment Options Chapter Test

Fill in the bubble completely to show your answer.

6. The letters on the coordinate grid represent the locations of the first four holes on a golf course.



Which ordered pair describes the location of the hole labeled *T*?

Ⓐ (0, 7)

Ⓑ (1, 7)

Ⓒ (7, 0)

Ⓓ (7, 1)

Use the line plot at the right for 7–8.

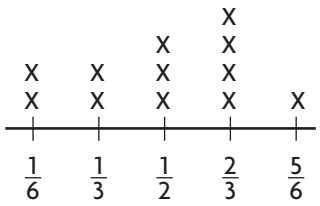
7. What is the average of the data in the line plot?

Ⓐ $\frac{1}{2}$ pound

Ⓑ 1 pound

Ⓒ 6 pounds

Ⓓ $6\frac{3}{4}$ pounds



Weights of Bags of Rice (in oz)

8. How many bags of rice weigh at least $\frac{1}{2}$ pound?

Ⓐ 2

Ⓑ 3

Ⓒ 5

Ⓓ 8

Name _____

Fill in the bubble completely to show your answer.

Use the table for 9–10.

Week	1	2	3	4	10
Tori's savings	$20	$40	$60	$80	$200
Martin's savings	$5	$10	$15	$20	$50

9. Compare Tori's and Martin's savings. Which of the following statements is true?

Ⓐ Tori saves 4 times as much per week as Martin.

Ⓑ Tori will always have exactly $15 more in savings than Martin has.

Ⓒ Tori will save 15 times as much as Martin will.

Ⓓ On week 5, Martin will have $30 and Tori will have $90.

10. What rule could you use to find Tori's savings after 10 weeks?

Ⓐ Add 10 from one week to the next.

Ⓑ Multiply the week by 2.

Ⓒ Multiply Martin's savings by 4.

Ⓓ Divide Martin's savings by 4.

11. In an ordered pair, the *x*-coordinate represents the number of hexagons and the *y*-coordinate represents the total number of sides. If the x-coordinate is 7, what is the *y*-coordinate?

Ⓐ 6

Ⓑ 7

Ⓒ 13

Ⓓ 42

12. Point A is 2 units to the right and 4 units up from the origin. What ordered pair describes point A?

Ⓐ (2, 0)

Ⓑ (2, 4)

Ⓒ (4, 2)

Ⓓ (0, 4)

Constructed Response

13. Mr. Stevens drives 110 miles in 2 hours, 165 miles in 3 hours, and 220 miles in 4 hours. How many miles will he drive in 5 hours?

_____

Explain how the number of hours he drives is related to the number of miles he drives.

_____

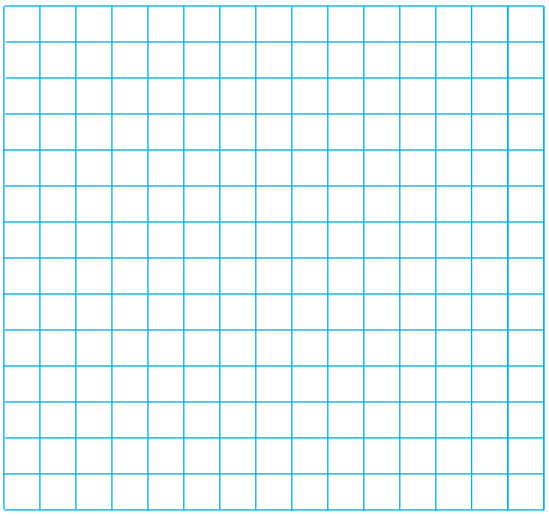
_____

Performance Task

14. Tim opens the freezer door and measures the temperature of the air inside. He continues to measure the temperature every 2 minutes, as the door stays open, and records the data in the table.

Open Freezer Temperatures						
Time (in minutes)	0	2	4	6	8	10
Temperature (in °F)	0	6	12	14	16	18

A On the grid below, make a line graph showing the data in the table.



B Use the graph to estimate the temperature at 7 minutes.

Estimate: _____

C Write a question that can be answered by making a prediction. Then answer your question and explain how you made your prediction.

_____

_____

_____