Every Graph Tells a Story

1

Independent and Dependent Variables

MATERIALS

Scissors
Tape

Lesson Overview

Students create scenarios to match numberless graphs in which the axes are labeled. They then cut out graphs and match them with the appropriate scenario. Students will then label the axes and analyze the graphs based on their prior knowledge, including ratio relationships and using inequality statements to represent constraints in problem situations. They determine how one quantity depends on another using scenarios, equations, and graphs. Students then identify independent and dependent quantities and represent those quantities using variables. They write an equation, complete a table of values, and create a graph to model the situation. Finally, students analyze two situations in which the independent and dependent quantities are reversed to understand that the question being asked often determines which is the independent quantity and which is the dependent quantity.

Grade 6
Expressions, Equations, and Relationships

(6) The student applies mathematical process standards to use multiple representations to describe algebraic relationships. The student is expected to:

(A) identify independent and dependent quantities from tables and graphs.

(B) write an equation that represents the relationship between independent and dependent quantities from a table.

(C) represent a given situation using verbal descriptions, tables, graphs, and equations in the form $y = kx$ or $y = x + b$.

ELPS

1.A, 1.D, 1.E, 1.G, 2.C, 2.D, 2.G, 2.H, 2.I, 3.A, 3.B, 3.C, 3.D, 3.F, 4.A, 4.B, 4.C, 4.G, 4.K, 5.E

Essential Ideas

- Graphical representations are used to solve problems.
- Graphs represent the relationships between independent and dependent quantities.
- When one quantity is determined by another in the problem situation, it is said the be the *dependent quantity.* The variable representing the dependent quantity is the *dependent variable.*

- When one quantity is not determined by another in the problem situation, it is said to be the *independent quantity.* The variable representing the independent quantity is the independent variable.
- The independent variable is located on the *x*-axis, and the dependent variable is located on the *y*-axis.
- When writing an equation, it can be helpful to isolate the dependent variable to more clearly see the relationship between quantities.

Lesson Structure and Pacing: 2 Days

Day 1

Engage

Getting Started: It's Not a Tall Tale!

Students are given two numberless graphs and they create a scenario to describe each graph. This prepares students to discuss independent and dependent quantities and variables and how quantities change in relation to each other.

Develop

Activity 1.1: Match and Analyze

Students match six graphs and scenarios. Some of the graphs have scale labels on the *x*- or *y*-axis, but none of the graphs have quantity labels. Students need to understand that all graphs are not lines and that quantities can vary in non-linear ways. This activity provides that foundation as students analyze the graphs in terms of unit rates and equivalent ratios. They also write inequality statements to describe constraints presented in problems.

Activity 1.2: Quantities That Change

The terms *independent quantity, dependent quantity, independent variable,* and *dependent variable* are defined. Students continue to analyze the scenarios from the previous activity. They name the varying quantities, determine which quantity is dependent on the other, and notice that in the equations provided, the dependent quantity is represented by the isolated variable.

Day 2

Activity 1.3: Total Price and Profit

Students consider a scenario in which a store makes 20% profit on the total price of all the items they sell. Students identify two quantities, identify the independent and dependent quantities, write an equation, and complete a table of values. The columns are labeled Independent Quantity and Dependent Quantity, which students then use to create a graph.

Activity 1.4: Profit and Total Price

Students consider the scenario from Activity 1.3 from a different perspective: the dependent variable in the previous problem has now become the independent variable, and vice versa. Students identify two quantities, identify the dependent and independent quantities, write an equation, complete a table of values, and create a graph.

Activity 1.5: The Question Matters

This activity compares the situations in Activities 1.3 and 1.4. Students should notice that the independent quantity is always associated with the *x*-axis of a graph, and the dependent quantity is always associated with the *y*-axis.

Demonstrate

Talk the Talk: Create Your Own Story

Students create a real-world situation to match a numberless graph. They then identify the independent and dependent quantities and the independent and dependent variables.

ENGAGE

Getting Started: It's Not a Tall Tale!

Facilitation Notes

In this activity, numberless graphs are given and students create a scenario to describe each graph. This activity provides the groundwork for studying independent and dependent quantities and variables and how quantities change in relation to each other. The formal introduction of these terms will be covered in another activity. The purpose at this time is to assess students' prior knowledge and supply context for numberless graphs.

Ask students to work with a partner or in groups to complete Questions 1 and 2. Emphasize to students the importance of the titles on each axis of the numberless graphs. Share responses as a class.

As students work, look for

- Confusion over which quantity is independent and which quantity is dependent.
- Interpretations of the graph as a result of switching the independent and dependent variable.
- Associating the height/depth of the water in the bathtub with the *y*-axis because it is a vertical direction.

Questions to ask

- Which happened faster, filling the bathtub or draining the bathtub? How do you know?
- What aspect of the graph tells you the water filled the tub faster than the water drained from the tub?
- What does the horizontal line mean in each graph?
- Did it take you longer to spend the money or save the money?
- What aspect of the graph tells you that spending the money happened faster than saving the money?

Summary

Numberless graphs can be used to describe relationships between independent and dependent quantities in the real world.

Activity 1.1
Match and Analyze

DEVELOP

Facilitation Notes

In this activity, students cut out and match six graphs to appropriate scenarios. This activity illustrates that all graphs are not lines and that quantities can vary in non-linear ways. Each graph will be analyzed in terms of unit rates and equivalent ratios. Inequality statements are written to describe constraints with respect to each situation.

Ask students to work with a partner or in groups to cut out the six scenarios and graphs, then complete Questions 1 and 2. Share responses as a class.

As students work, look for

- Discussions regarding discrete data versus continuous data without using those terms.
- The use of sample coordinates to fit the graph in terms of the situation.
- Attempts at creating a scale of sorts on the *y*-axis to make sense of the situation.

Questions to ask

- What aspect of the graph helped you determine the correct match for each scenario?
- How did you determine the two quantities in each scenario?
- How did you decide which quantity is labeled on each axis?
- Do any of the scenarios describe more than one graph?
- Do any of the graphs describe more than one scenario?
- Which scenarios describe a linear relationship?
- Which scenarios describe a non-linear relationship?
- In the Pool Party scenario, how can you tell how many cookies you had to start?

Ask a student to read the definitions following Question 2 aloud and complete Questions 3 and 4 as a class.

Questions to ask

- What is the difference between a discrete graph and a continuous graph?
- What are the graphical characteristics of equivalent ratios? (Note that although Graph F/Scenario 2 gives a unit rate, there is a starting value other than 0. Therefore, this graph does not display equivalent ratios.)

Have students work with a partner or in groups to complete Questions 5 through 7. Share responses as a class.

Questions to ask

- Should the graph of the Rainy Day scenario pass through the origin? Why or why not?
- Should the graph of the Toy Rocket scenario pass through the origin? Why or why not?
- Should the graph of the T-Shirt Sales scenario pass through the origin? Why or why not?

Misconception

In the Toy Rocket scenario, students may think the graph represents the path of the rocket; in actuality, the graph just represents the rocket's height at different times. To help students correct this misconception, toss a ball in the air for them to see that it comes directly back down; the ball's path is just vertical, but the graph shows the height at different times. A rocket may have limited horizontal motion, but the graph does not represent that horizontal motion.

Summary

Discrete and continuous graphs represent real-world situations. Writing inequality statements describes constraints in real-world situations.

Activity 1.2
Quantities That Change

Facilitation Notes

In this activity, the terms *independent quantity, dependent quantity, independent variable,* and *dependent variable* are defined. Students continue to analyze the scenarios from the previous activity. They name the varying quantities, determine which quantity is dependent on the other, and notice that in the equations provided, the dependent quantity is represented by the isolated variable.

Ask a student to read the introduction and definitions aloud. Have students work with a partner or in groups to complete Questions 1 through 3. Share responses as a class.

As students work, look for

- Switching the independent quantity with the dependent quantity.
- Switching the independent variable with the dependent variable.
- Representing the independent variable on the *y*-axis and the dependent variable on the *x*-axis.

Questions to ask

- What is the difference between the dependent quantity and the independent quantity?

- How did you determine which quantity was the independent quantity and which quantity was the dependent quantity?
- Does the number of cookies per teammate depend on the number of teammates, or does the number of teammates depend on the number of cookies per teammate?
- Does the amount of time the tank is draining depend on the amount of water in the tank, or does the amount of water in the tank depend on the amount of time the tank is draining?
- Is the dependent quantity represented by the isolated variable?
- Does the time depend on the amount of rain that has fallen, or does the amount of rain that has fallen depend on the time?
- Does the time depend on the height of the rocket, or does the height of the rocket depend on the time?
- Does the number of rentals depend on the total cost, or does the total cost depend on the number of rentals?
- Does the number of T-Shirts depend on the total cost, or does the total cost depend on the number of T-Shirts?

Differentiation strategies

To scaffold support with determining which is the dependent quantity and which is the independent quantity,

- Have students fill in the sentence: "_____ causes a change in _____." Although the choice of independent and dependent often depends on the question posed, this sentence can be a good first step.
- Make the connection with completing a table. Ask students what variable would make sense being in the *x*-column of the table and what variable would make sense being in the *y*-column of the table.

Summary

Dependent quantities and independent quantities are used in graphical representations of real-world situations to answer questions.

Activity 1.3

Total Price and Profit

Facilitation Notes

In this activity, a store makes 20% profit on the total price of all the items they sell. Students identify two quantities, identify the independent and dependent quantities, write an equation, and

complete a table of values in which the columns are labeled Independent Quantity and Dependent Quantity. The table of values is used to create a graph.

Select a student to read the scenario aloud. Ensure that students understand what profit is. Have students work with a partner or in groups to complete Questions 1 and 2. Share responses as a class.

Questions to ask

- Is the total price of the items changing?
- Is the profit changing?
- Does the total price of the items depend on the profit or does the profit depend on the total cost of the items?

Misconception

Some students may say that the profit depends upon the number of items being sold. While this is correct, that is not enough information to determine the profit. We need to know the total price of the items to determine the profit.

Have students work with a partner or in groups to complete Questions 3 through 8. Have students pairs or groups compare their tables and graphs with another pair or group before sharing as a class.

Questions to ask

- How is 20% represented as a fraction?
- How is 20% represented as a decimal?
- Does the equation $p = 0.2t$ represent the situation, or does the equation $t = 0.2p$ represent the situation? How can you tell?
- In the table of values, which quantity is typically associated with the x-value on a graph?
- In the table of values, which quantity is typically associated with the y-value on a graph?
- Can any number be used to replace the variables in the equation? Why or why not?
- What does the x-value of each point represent in the problem situation?
- What does the y-value of each point represent in the problem situation?
- How many points are on the graph?
- What do you notice about the location of the points on the graph? Do you see a pattern?
- Do the points on the graph look linear?
- Could another point be located between each of the two points on the graph? Explain.

Summary

Multiple representations such as words, equations, tables, and graphs are used to solve real-world situations.

Activity 1.4
Profit and Total Price

Facilitation Notes

In this activity, students consider the scenario from the previous activity but from a different perspective. The dependent variable in the previous problem has now become the independent variable, and vice versa. Students identify two quantities, identify the dependent and independent quantities, write an equation, complete a table of values, and create a graph.

Ask a student to read the introduction aloud and then complete Questions 1 and 2 as a class.

Questions to ask

- How is this situation different than the last activity?
- Is the total price of the items changing?
- Is the profit changing?
- Does the total price of the items depend on the profit, or does the profit depend on the cost of the item?

Have students work with a partner or in groups to complete Questions 3 through 8. As a class, discuss how the equation, table, and graph compare to the equation, table, and graph in the previous activity.

Questions to ask

- Does the equation $p = \frac{t}{0.2}$ represent the situation or does the equation $t = \frac{p}{0.2}$ represent the situation?
- How can you tell from your equation which value will be larger, t or p?
- In the table of values, which quantity is typically associated with the x-value on a graph?
- In the table of values, which quantity is typically associated with the y-value on a graph?
- Can any number be used to replace the variables in the equation? Why or why not?
- What does the x-value of each point represent in the problem situation?
- What does the y-value of each point represent in the problem situation?

- How many points are on the graph?
- What do you notice about the location of the points on the graph? Do you see a pattern?
- Do the points on the graph look linear?
- Could another point be located between each of the two points on the graph? Explain.

Summary

Multiple representations such as words, equations, tables, and graphs are used to solve real-world situations.

Activity 1.5
The Question Matters

Facilitation Notes

In this activity, the situations from the previous two activities are compared. Students should notice that the independent quantity is always associated with the *x*-axis of a graph, and the dependent quantity is always associated with the *y*-axis.

Ask students work with a partner or in groups to complete Questions 1 through 5. Share responses as a class.

Questions to ask

- How can you show that the equations are the same?
- Why do you suppose the equations are the same?
- Are the equations solved for the same variable or different variables?
- What effect did switching the dependent and independent quantities and variables have on the graph of each situation?
- Can you think of a scenario where time would be the dependent quantity and variable?
- Can you think of a scenario where time would be the independent quantity and variable?
- Can you think of a scenario where money would be the dependent quantity and variable?
- Can you think of a scenario where money would be the independent quantity and variable?
- Are both graphs continuous?
- Can you think of a scenario where the graph is discrete?

Differentiation strategy

To scaffold support with realizing that the two equations are the same, make the connection using the concept of fact families.

Have a student read the scenario following Question 5 aloud. Then ask students work with a partner or in groups to complete Questions 6 and 7. Share responses as a class.

Questions to ask

- Does the number of gallons of gas depend on the number of miles traveled, or does the number of miles traveled depend on the number of gallons of gas?
- Does $d = 41g$ represent the situation, or does $g = 41d$ represent the situation?
- How is the situation in Question 7 different than the situation in Question 6?
- Does $g = \frac{d}{41}$ represent the situation, or does $d = \frac{g}{41}$ represent the situation?

Summary

The wording of the scenario is key when defining which quantity and variable is independent and which quantity and variable is dependent.

Talk the Talk: Create Your Own Story

DEMONSTRATE

Facilitation Notes

In this activity, students create a real-world situation to match a numberless graph. Then they identify the independent and dependent quantities and the independent and dependent variables.

Ask students work with a partner or in groups to complete Questions 1 through 4. Share responses as a class.

Questions to ask

- Where is the independent quantity on your graph located?
- Did anyone use something different than "time" to describe the independent quantity?
- Where is the dependent quantity on your graph located?
- Is the scenario you created represented by a continuous graph or a discrete graph?
- Does your scenario make sense at point (0, 0)?

- Does your scenario make sense in the first quadrant only, or does it extend into other quadrants?
- What does the flat part of the graph represent in your scenario?
- Does your situation make sense beyond the edge of the graph?
- What type of scale was used on the axes?
- Is the same scale used on both axes?
- What are the units associated with your scenario?
- Is this the graph of equivalent ratios? How do you know?

Summary

A real-world situation can be created for a numberless graph, and the graph can be used to answer relevant questions.

1 Every Graph Tells a Story

Independent and Dependent Variables

WARM UP

Write an inequality for each verbal statement.

1. x is less than 5.
2. 4 times g is no more than 9.
3. y is at least 2 more than x.
4. 3 less than the product of 4 and some number is greater than another number.

LEARNING GOALS

- Interpret information about a situation from a graphical representation.
- Distinguish between graphs that are discrete or continuous.
- Identify the graphs of situations.
- Identify and use variables to define independent and dependent quantities in real-world problems.
- Write an equation to express a quantity that is the dependent variable in terms of another quantity, the independent variable.

KEY TERMS

- discrete graph
- continuous graph
- dependent quantity
- independent quantity
- independent variable
- dependent variable

Throughout this course, you have analyzed quantities in a variety of ways. Often, the equation you write to represent variable quantities depends on the question you are answering. How do you tell what variable quantity is the focus of a mathematical question?

Warm Up Answers

1. $x < 5$
2. $4g \leq 9$
3. $y \geq 2 + x$
4. $4x - 3 > y$

LESSON 1: Every Graph Tells a Story • 763

Answers

Sample answers.

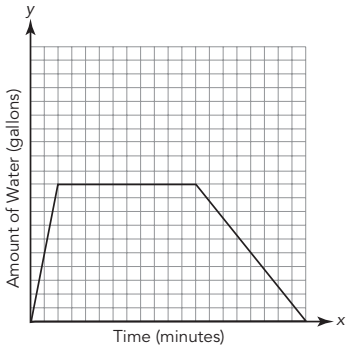
1. I filled up the bathtub and then took a bath, so the water level remained the same. After I was finished with my bath, I drained the water out of the tub.
2. I had money in my bank account. I started to take the same amount of money out each week, and then I stopped. I let the money sit in my bank account for a few weeks. Then, I started depositing money in my bank account each week.

Getting Started

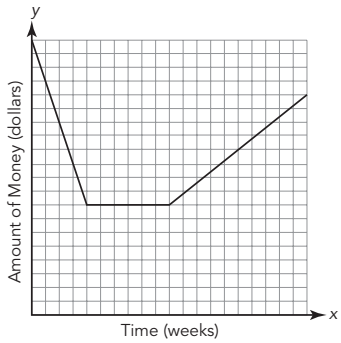
It's Not a Tall Tale!

Write a story to describe the situation represented by each graph.

1. The Water Level in the Bathtub



2. Money in Your Bank Account



ELL Tip

Help English Language Learners build stories by listing observations about the graphs. Ask the following questions:

- How are the *x*-axes labeled on each graph? (Time)
- How are the *y*-axes labeled on each graph? (Amount)
- What do you think it means when a graph goes up or down from left to right? (increase or decrease in amount)
- What about when a graph goes flat? (no change in amount)
- Have students ask their own questions about the graphs. Encourage responses from fellow students, listening for correct interpretations.

ACTIVITY
1.1

Match and Analyze

In this activity, you will match a specific graph to a real-world problem situation.

Cut out the graphs and scenarios located at the end of the lesson.

1. **Tape each graph in the box with the appropriate scenario. Label the axes with appropriate quantities and units.**

2. **How did you determine which graph matched which scenario?**

Even though only certain points make sense in the situation, you can draw a line to represent the shape of discrete data.

Answers

1. See table below.
2. Answers will vary.

1.

Scenario	Graph	Horizontal Axis	Vertical Axis
Pool Party	B	Number of Teammates Who Attend the Pool Party	Number of Cookies For Each Teammate
Fish Tank	F	Amount of Time Draining (minutes)	Amount of Water in Tank (gallons)
Rainy Day	D	Time Since I Left Home (hours)	Amount of Rain (inches)
Toy Rocket	A	Time Since Launch (seconds)	Height of the Rocket (feet)
DVD and Game Rentals	E	Number of Rentals	Total Cost (dollars)
T-shirt Sales	C	Number of T-Shirts	Total Cost (dollars)

Answers

3. Discrete graphs: B, C, E; The independent quantity in each graph is an object measured by counting numbers, e.g., teammates, T-shirts, and rentals. Continuous graphs: A, D, F; The independent quantity in each graph is time and time can be represented by any rational number.
4. Graph E shows equivalent ratios. The scenario states a unit rate. I can multiply by the unit rate to determine the total cost.

5a. The unit rate for the first part of the graph is 0.375 inch per hour. The unit rate for the downpour is $\frac{3}{3} = 1$ inch per hour.

5b. $t > 11$

NOTES

A **discrete graph** is a graph of isolated points. Often, the coordinates of those points are counting numbers. A **continuous graph** is a graph with no breaks in it. Each point on a continuous graph, even those with fractional numbers as coordinates, represents a solution to the graphed scenario.

3. Which graphs are discrete graphs and which are continuous graphs? How does the scenario inform you that the graph will display discrete points or be continuous?

4. Which graph(s) represent equivalent ratios? How does the scenario inform you that the graph(s) will display equivalent ratios?

5. Consider the graph in the Rainy Day scenario. Assume that 2 hours after you left home, 1.5 inches of rain had fallen.

a. Explain how the graph illustrates that the rain fell faster later in the day than at the beginning of the day.

b. Write an inequality statement in terms of the time, *t*, to represent when the rain stopped for the day.

ELL Tip

The word *discrete* comes from the Latin term *discretus*, meaning "separate." Explain to students that a discrete graph has "separate points," or points that are isolated and unconnected. Have students look up the homophone *discreet*, and discuss what this might have to do with being "separate" or "isolated."

6. **Consider the graph in the Toy Rocket scenario. The rocket reaches a maximum height of 256 feet.**

   a. **Describe the shape of the graph.**

   b. **Write an inequality statement in terms of the time, *t*, to represent when the rocket was rising into the air.**

7. **Consider the graph of the T-shirt Sales scenario. Suppose there is a minimum order total of $100 when you are ordering the T-shirts. Write an inequality statement for the number of shirts, *n*, that must be ordered to meet the minimum order requirement.**

Be sure to keep your graphs and scenarios. You will use them in the next activity.

Answers

6a. The graph is not a straight line or made up of straight lines. It is a curve that goes up, reaches a highest point, and then returns to the *x*-axis. It has an upside-down U shape.

6b. $t < 8$

7. $n \geq 12$

Answers

1a. The two quantities are the number of teammates who attend the pool party and the number of cookies for each teammate.

1b. The number of cookies for each teammate depends on the number of teammates who attend the pool party.

1c. Let *n* represent the number of teammates attending the pool party; this is the independent variable. Let *c* represent the number of cookies for each teammate; this is the dependent variable.

2a. The two quantities are the amount of time the tank is draining and the amount of water in the tank.

2b. The amount of time is the independent quantity and the amount of water is the dependent quantity.

ACTIVITY 1.2

Quantities That Change

When one quantity is determined by another in a real-world problem situation, it is said to be the **dependent quantity**. The quantity that is not determined by another is called the **independent quantity**. The variable that represents the independent quantity is called the **independent variable**, and the variable that represents the dependent quantity is called the **dependent variable**.

Consider the scenarios from the previous activity.

1. Use the Pool Party scenario to answer each question.

a. What two quantities are changing in this situation?

b. Which quantity depends on, or is determined by, the other?

c. Define variables for each quantity and label them appropriately as the independent and dependent variables.

2. Use the Fish Tank scenario to answer each question.

a. What two quantities are changing in this situation?

b. Which quantity is the independent quantity and which is the dependent quantity?

ELL Tip

Have students engage in a Think-Pair-Share activity using the prefix *in-*. Students should think about the meaning of the prefix, and then pair up to discuss their answers. During the time in pairs, students should engage in a free discussion about the meaning of *independent* and *dependent* in relation to one another.

c. The equation that represents the fish scenario is $w = 200 - 10t$. What do the variables w and t represent in this equation?

d. What do you notice about which variable is isolated in the equation?

3. Identify the independent quantity and the dependent quantity in each of the four remaining scenarios.

a. Rainy Day

Independent Quantity:

Dependent Quantity:

b. Toy Rocket

Independent Quantity:

Dependent Quantity:

c. DVD and Game Rentals

Independent Quantity:

Dependent Quantity:

d. T-shirt Sales

Independent Quantity:

Dependent Quantity:

Answers

2c. The variable w represents the amount of water in the tank. The variable t represents the amount of time the tank has been draining.

2d. The dependent variable is isolated in the equation.

3a. Independent Quantity: Time Since I Left Home
Dependent Quantity: Amount of Rain

3b. Independent Quantity: Time Since Launch
Dependent Quantity: Height of the Rocket

3c. Independent Quantity: Number of Rentals
Dependent Quantity: Total Cost

3d. Independent Quantity: Number of T-Shirts
Dependent Quantity: Total Cost

Answers

1. The two quantities that are changing are the total price of the items and the profit.
2. The profit depends on the total price of the items.
3. $p = 0.2t$
4. The t is the independent variable and the p is the dependent variable.

ACTIVITY 1.3

Total Price and Profit

Profit is the extra money for selling items, over and above the cost of producing the items.

A store makes 20% profit on the total price of all the items they sell.

Analyze the situation.

1. Name the two quantities that are changing.

2. Describe which value depends on, or is determined by, the other.

Let t represent the total price of all items sold in dollars, and let p represent the profit in dollars.

3. Write an equation to represent the relationship between these variables.

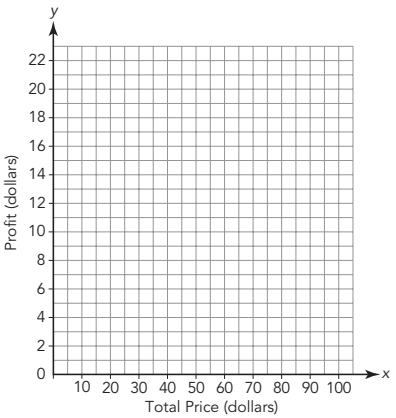
4. Identify the independent and dependent variables in this situation.

770 • TOPIC 3: Graphing Quantitative Relationships

5. Complete the table.

	Independent Quantity	Dependent Quantity
Quantity Name		
Unit of Measure		
Variable		
	25.00	
	49.95	
	99.95	

6. Use the table to complete the graph.



7. Is this a discrete graph or a continuous graph? Explain.

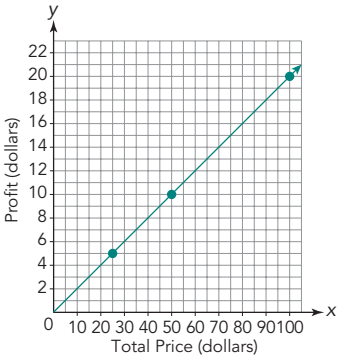
8. On which axis is the independent variable? On which axis is the dependent variable?

Answers

5.

	Independent Quantity	Dependent Quantity
Quantity Name	Total Price	Profit
Unit of Measure	dollars	dollars
Variable	t	p
	25.00	5.00
	49.95	9.99
	99.95	19.99

6.



7. This is a continuous graph; profit (money) is continuous.

8. The independent variable is on the x-axis. The dependent variable is on the y-axis.

Answers

1. The two quantities that are changing are the total cost of the items and the profit desired.
2. The total cost of the items depends on the profit desired.
3. $t = \frac{p}{0.2}$
4. The p is the independent variable and the t is the dependent variable.

ACTIVITY 1.4

Profit and Total Price

Let's think about the problem situation in a different way.

Suppose you are operating this store and you know how much profit you make on each item.

1. Name the two quantities that are changing.

2. Describe which value depends on, or is determined by, the other.

Let p represent the profit in dollars, and let t represent the total price of all items sold in dollars.

3. Write an equation to represent the relationship between these variables.

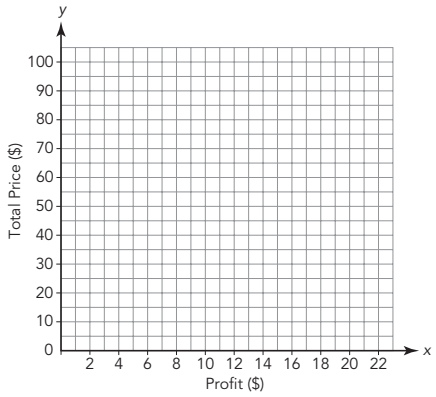
4. Identify the independent and dependent variables in this situation.

772 • TOPIC 3: Graphing Quantitative Relationships

5. **Complete the table.**

	Independent Quantity	Dependent Quantity
Quantity Name		
Unit of Measure		
Variable		
	7.50	
	10.00	
	19.99	

6. **Use the table to complete the graph.**



7. **Is this a discrete graph or a continuous graph? Explain.**

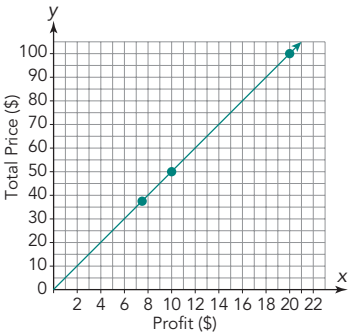
8. **On which axis is the independent variable? On which axis is the dependent variable?**

Answers

5.

	Independent Quantity	Dependent Quantity
Quantity Name	Profit	Total Price
Unit of Measure	dollars	dollars
Variable	p	t
	7.50	37.50
	10.00	50.00
	19.99	99.95

6.



7. This is a continuous graph; profit (money) is continuous.

8. The independent variable is on the x-axis. The dependent variable is on the y-axis.

Answers

1. Total Price and Profit: The profit depends on the total price of the items. $p = 0.2t$
   Profit and Total Price: The total price depends on the profit desired. $t = \frac{p}{0.2}$
2. The equations are the same, but they are solved for different variables.
3. The independent and dependent quantities were switched. This also changes which variable to solve for in the equation.
4. Whether a variable is independent or dependent depends on the situation and the question being asked.

ACTIVITY 1.5

The Question Matters

The situations in the previous activities, *Total Price and Profit* and *Profit and Total Price*, are similar but presented in two different ways.

1. Complete each summary statement.

Total Price and Profit	Profit and Total Price
The _____ depends on the _____.	The _____ depends on the _____.
Equation:	Equation:

2. What do you notice about the two equations?

3. How does examining this same situation from different perspectives affect the independent and dependent variables?

4. What can you conclude about the designation of a variable as independent or dependent?

774 • TOPIC 3: Graphing Quantitative Relationships

NOTES

5. Compare the two graphs in the activities *Total Price and Profit* and *Profit and Total Price.*

a. How are they similar and how are they different?

b. What do you notice about the independent and dependent variables?

Consider another scenario.

Dawson purchased a diesel-powered car that averages 41 miles per gallon.

6. Suppose Dawson is interested in how far the car travels on a given amount of gas.

a. Identify the independent and dependent quantities.

b. Define variables for each quantity and identify which is the independent variable and which is the dependent variable.

c. Write an equation to represent the relationship between the two variables.

Answers

5a. Sample answer. The graphs were labeled differently depending on how you defined the independent and dependent quantities. They are similar because they both show a relationship between total price and profit.

5b. The independent quantities were always graphed on the x-axis, and the dependent quantities were always graphed on the y-axis.

6a. The independent quantity is the amount of gas, and the dependent quantity is the number of miles traveled.

6b. Let d represent the distance traveled; this is the dependent quantity. Let g represent the number of gallons of gas; this is the independent quantity.

6c. $d = 41g$

Answers

7a. Now, d represents the independent quantity and g represents the dependent quantity.

7b. $g = \frac{d}{41}$

8. The graphs would be labeled differently depending on which of the two variables was the independent and which was the dependent. The independent variables are graphed on the horizontal axis and the dependent variables are graphed on the vertical axis. Both are unit rates, so they both represent equivalent ratios. Both would be straight lines, starting at the origin.

NOTES

7. Suppose, instead, that Dawson runs out of gas on a regular basis. He is interested in how many gallons of gas he has used if he knows how many miles he has driven. Use the same variables you defined in Question 6.

a. Identify which variable represents the independent quantity and which variable represents the dependent quantity.

b. Write an equation to represent the relationship between the two variables.

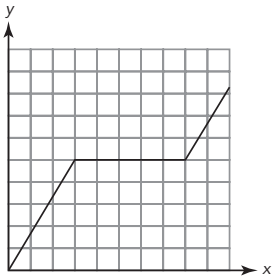
8. How would you expect the graphs of the two situations to be similar? How would they be different?

776 • TOPIC 3: Graphing Quantitative Relationships

TALK the TALK

Create Your Own Story

1. **Create a real-world situation to match the given graph.**



2. **Identify the independent and dependent quantities in your scenario.**

NOTES

Answers

Sample answers.

1. The graph describes my walk home from school. I walked at a steady rate away from school for 15 minutes. Then, I stopped at my friend's house for 25 minutes. Then, I walked the rest of the way home, at the same rate I started.
2. The quantities that change are time in minutes and distance from school. The independent quantity is the time, and the dependent quantity is the distance from school.

Answers

Sample answers.

3. The label for the *x*-axis is time, in minutes, with each interval 5 minutes. The label for the *y*-axis is distance from school in yards.
4. How far from school was I at different times along my walk home from school?

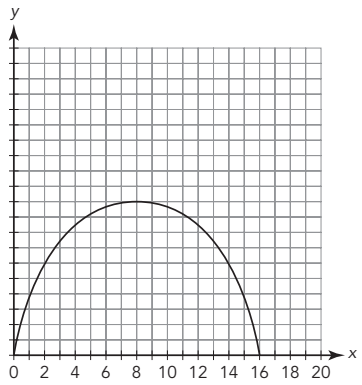
NOTES

3. Label the *x*-axis and *y*-axis to reflect your scenario.

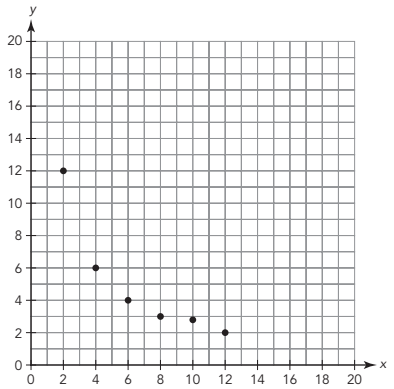
4. What real-world question could be answered using the graph based on your scenario?

778 • TOPIC 3: Graphing Quantitative Relationships

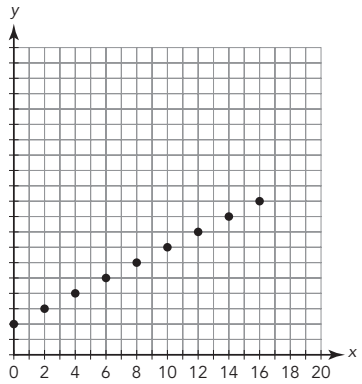
A



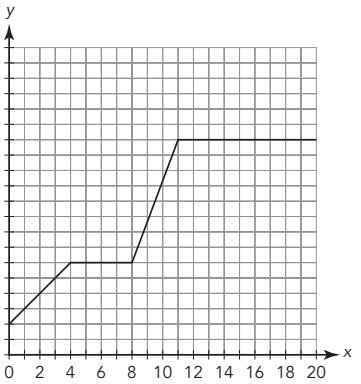
B



C



D



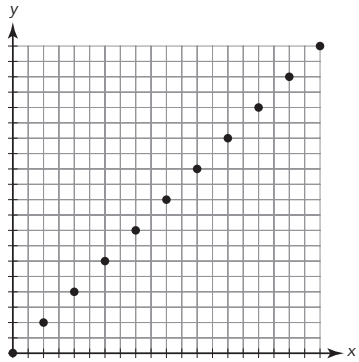
LESSON 1: Every Graph Tells a Story • 779

Why is this page blank?

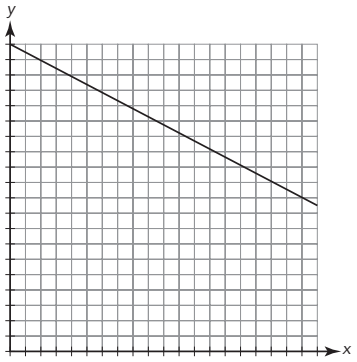
So you can cut out the graphs on the other side.

780 • TOPIC 3: Graphing Quantitative Relationships

E



F



Pool Party

You have cookies for your team pool party, but you don't know how many of your teammates will show up.
How many cookies will each teammate receive if everyone receives the same number of cookies?

LESSON 1: Every Graph Tells a Story • 781

Why is this page blank?

So you can cut out the graphs and scenarios on the other side.

782 • TOPIC 3: Graphing Quantitative Relationships

Fish Tank

You are draining a 200-gallon fish tank at a rate of 10 gallons per minute. How much water remains in the tank at a specific time?

Rainy Day

When you left home, the rain was falling at a steady rate. Then, it stopped raining for a few hours before a sudden downpour. Finally, it stopped raining. How many inches of rain had fallen at different points of the day?

LESSON 1: Every Graph Tells a Story • 783

Why is this page blank?

So you can cut out the scenarios on the other side.

784 • TOPIC 3: Graphing Quantitative Relationships

Toy Rocket

You launch a toy rocket into the air from the ground and observe its height through its entire flight. How many feet high was the rocket at a specific time after launch?

DVD and Game Rentals

The video kiosk charges $2.00 for DVD and game rentals. How many DVDs and games can you rent for different amounts of money?

LESSON 1: Every Graph Tells a Story • 785

Why is this page blank?

So you can cut out the scenarios on the other side.

786 • TOPIC 3: Graphing Quantitative Relationships

T-shirt Sales

You buy T-shirts to sell for your school. There is a $25 design charge plus the cost per T-shirt. What is the total cost for different numbers of T-shirts?

LESSON 1: Every Graph Tells a Story • 787

Why is this page blank?

So you can cut out the scenario on the other side.

788 • TOPIC 3: Graphing Quantitative Relationships