

SAMPLE

# COMMON CORE BASICS

Building Essential Test Readiness Skills  
for High School Equivalency Exams

**Mc  
Graw  
Hill**  
Education

## MATHEMATICS

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# To the Student

*Common Core Basics: Building Essential Test Readiness Skills, Mathematics* will help you learn or strengthen the skills you need when you take any Common Core State Standards-aligned mathematics test. Regardless of your background, you can use this book to learn and practice the mathematical and problem-solving skills that are most important.

Before beginning the lessons in this book, take the **Pretest**. This test will help you identify which skill areas you need to concentrate on most. Use the chart at the end of the Pretest to pinpoint the types of questions you have answered incorrectly and to determine which skills you need to work on. You may decide to concentrate on specific areas of study or to work through the entire book. It is highly recommended that you do work through the whole book to build a strong foundation in the core areas in which you will be tested.

*Common Core Basics: Building Essential Test Readiness Skills, Mathematics* is divided into twelve chapters:

- **Chapter 1: Whole Numbers** introduces place value, ordering and comparing numbers, operations on numbers, factoring, rounding, estimation, and solving real-world problems with whole numbers.
- **Chapter 2: Decimals** teaches decimal place value, operations with decimals, and solving real-world problems with decimals.
- **Chapter 3: Fractions** introduces operations with fractions and mixed numbers.
- **Chapter 4: Integers** explains integer concepts, including absolute value, integer operations, and the coordinate grid.
- **Chapter 5: Expressions and Equations** teaches writing and evaluating expressions, solving one- and two-step equations and inequalities, and identifying patterns.
- **Chapter 6: Linear Equations and Functions** introduces linear equations, graphing linear equations, functions, and scatter plots.
- **Chapter 7: Ratios, Proportions, and Percents** introduces ratios and rates, solving proportions, and solving percent problems.
- **Chapter 8: Exponents and Roots** teaches how to evaluate expressions with exponents, roots, and scientific notation.
- **Chapter 9: Data** introduces the measures of central tendency and range, graphs and line plots, and misleading graphs.
- **Chapter 10: Probability** explains counting methods and introduces probability and compound events.
- **Chapter 11: Measurement** teaches using customary units, metric units, and converting among units.
- **Chapter 12: Geometry** explores various geometric figures and solids, scale drawings and measurement, the Pythagorean Theorem, and finding perimeter, circumference, area, and the volume of cones and spheres.

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In addition, *Common Core Basics: Building Essential Test Readiness Skills, Mathematics* has a number of features designed to familiarize you with and prepare you for mathematics tests.

- The **Chapter Opener** provides an overview of the content and a goal-setting activity.
- **Lesson Objectives** state what you will be able to accomplish after completing the lesson.
- **Skills** list the Core Skills and Core Practice that are taught and applied to the lesson content.
- **Vocabulary** critical for understanding lesson content is listed at the start of every lesson. All bold words in the text can be found in the Glossary.
- The **Key Concept** summarizes the content that is the focus of the lesson.
- **Think About Math** questions check your understanding of the content throughout the lesson as you read.
- **Math Link** activities include tips and strategies related to the mathematics skills and practices.
- End-of-lesson **Vocabulary Review** checks your understanding of important lesson vocabulary, while the **Skill Review** checks your understanding of the content and skills presented in the lesson.
- **Skill Practice** exercises appear at the end of every lesson to help you apply your learning of content and skill fundamentals.
- The **Chapter Review** tests your understanding of the chapter content.
- **Check Your Understanding** charts allow you to check your knowledge of the skills you have practiced.
- The **Answer Key** explains the answers for questions in the book.
- The **Glossary** and **Index** contain lists of key terms found throughout the book and make it easy to review important skills and concepts.

After you have worked through the book, take the Posttest to see how well you have learned the skills presented in this book.

Good luck with your studies! Keep in mind that mathematics and problem-solving skills will help you succeed on any mathematics test and in other future tasks, whether at school, at home, or in the workplace.

# LESSON 1.7

# Problem Solving

## Lesson Objectives

### You will be able to

- Use the five-step approach to solve word problems
- Use various strategies to solve word problems
- Judge the reasonableness of answers

## Skills

- **Core Skill:** Build Lines of Reasoning
- **Core Practice:** Attend to Precision

## Vocabulary

irrelevant  
reasonable  
solution

**KEY CONCEPT:** Problem solving is an important part of the study of mathematics and an important part of everyday life.

Use a calculator to solve each problem.

1.  $289 \times 97$
2.  $850 \times 381$
3.  $58,590 \div 62$
4.  $407 - 388$
5.  $2,894 + 19,073$
6.  $1,411 \times 3,879$
7.  $96 \div 4$
8.  $387 + 4,296$

## The Five-Step Approach

The following five-step approach can be used to find a **solution**, or an answer, for all types of word problems and help organize thinking.

- Step 1** Understand the question. After reading and rereading the problem carefully, decide what the problem asks you to find.
- Step 2** Decide what information is needed to solve the problem. Then determine what information is irrelevant to the question.
- Step 3** Choose the most appropriate operation or operations to solve the problem.
- Step 4** Solve the problem. Make sure the solution answers the question asked.
- Step 5** Check your answer by rereading the question to see if the answer is **reasonable**, that it makes sense.

### Example 1 Use the Five-Step Approach

Paulo works from 4 p.m. to 7 p.m., Monday through Friday. How many hours does he work each week?

- Step 1** Reread the problem for understanding. The problem asks for the number of hours Paulo works each week.
- Step 2** Decide what information is needed.  
Paulo works from 4 p.m. to 7 p.m. from Monday through Friday.
- Step 3** Choose the most appropriate operation or operations.  
Multiply 3 hours worked each day by 5 days per week.
- Step 4** Solve the problem.  
 $3 \times 5 = 15$ . So, Paulo works 15 hours each week.
- Step 5** Check your answer.  
If Paulo works three hours for five days a week, he works 15 hours each week. The answer is reasonable.

## IDENTIFY IRRELEVANT INFORMATION

Sometimes, a passage will include **irrelevant**, or unnecessary, information. There may be details or other information that can be ignored when reading a passage or problem. Learning to determine which information is irrelevant will help when reading problems.

Not all information given in a problem is necessary, or relevant, to finding the solution. In fact, in real-life situations, the most difficult part of using math is often looking at all the information available and deciding what is actually relevant to the problem. It is important to have a clear sense of what is being asked and which details will help to find the solution.

To find irrelevant information, ask: *How does this detail relate to the question that is being asked?*

Read the following problem, and identify the irrelevant information.

Sally is taking inventory of the glassware that her store sells. She has 15 cases of green glasses. They come 12 to a case and stand 8 inches tall. She also has 9 cases of blue glasses. They come 20 to a case. They are good for water and juice. If these are the only glasses Sally has in her store, how many glasses does she have in all?

The question asks how many total glasses Sally has. The size, color, and use for them are irrelevant information and can be ignored. The important information is 15 cases with 12 in a case and 9 cases with 20 in a case. Everything else in the problem is irrelevant information.

### Core Practice

#### Attend to Precision

Precision is important in mathematics, engineering, and sciences. One of the purposes of making multiple measurements or repeating experimental trials is to find precise answers, or answers that repeat the same value.

You may have heard someone say, "Measure twice, cut once," while undertaking a construction project. What is the purpose of measuring twice? And is twice enough?

When builders measure multiple times before they saw a length of wood, for example, they are attending to **precision**. If multiple measures result in the same value, builders can be confident that the value is precise.

In your notebook, describe a time you made multiple measurements or repeated the steps of an experiment to check mathematical values. Explain the value of precision in your work.

## Choose an Operation

Many times, the hardest part of solving a problem is deciding whether to add, subtract, multiply, or divide.

One way to determine which operation will be used is to focus on key words. Noticing these words will often provide a clue to determining the appropriate operation. Some key words or phrases are listed below.

Addition	Subtraction	Multiplication	Division
sum	difference	product	quotient
total	more...than	times	split
altogether	less...than	twice ( $\times 2$ )	divided by
increased by	minus	when finding	when given
when combining	decreased by	several of a	amount of many
different amounts	farther than	different amount	and finding one
	when comparing	when given part	when sharing,
	one amount to	and finding the	cutting, or
	another	whole	splitting

Compare the relevant numbers in the problem to the solution to determine if the correct operation was chosen.

### Example 2 Choose an Operation to Solve a Problem

Lamar rode his bicycle for 17 miles on Saturday. On Sunday, he rode 25 more miles. How many miles did Lamar ride altogether?

- Step 1** Reread the problem to understand the question.  
The problem asks for the number of miles Lamar rode his bicycle on Saturday and Sunday combined.
- Step 2** Decide what information is needed.  
You need to find the total number of miles Lamar biked over the weekend.
- Step 3** Choose the most appropriate operation.  
The key word *altogether* gives the clue to add 17 and 25.
- Step 4** Solve the problem.  
 $17 + 25 = 42$   
Lamar rode a total of 42 miles over the weekend.
- Step 5** Check your answer. To check an addition problem, subtract one of the numbers in the problem from the answer. In this case, subtract 25 from 42. The answer is 17, the other number in the problem. The answer checks out.

### THINK ABOUT MATH



**Directions:** Solve the following word problem by using the five-step approach. Tell which operation you used.

Marcella bought shampoo for \$3, hair rinse for \$2, and a brush for \$2. She gave the clerk a 10-dollar bill. How much did the items cost altogether?



# Problem-Solving Strategies

## Draw a Picture

To solve a problem, you can sometimes draw a sketch or diagram to help you understand what is being asked.

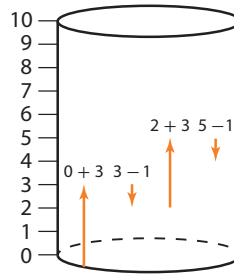
### Example 3 Draw a Picture to Solve a Problem

An empty water container is 10 meters tall. As it is being filled, the water level goes up 3 meters during the day, but because of a leak, it goes down 1 meter each night. How many days will it be before the water reaches the top of the container?

**Step 1** Understand the question. You want to figure out how many days it will take the container to fill.

**Step 2** Find the necessary information. Just writing the three numbers that are in the problem (10, 3, and 1) and using division will result in the wrong answer. Drawing a picture should show that subtraction should be used as well.

**Step 3** Choose an arithmetic operation or operations. Look at the picture and notice the lines go up 3 meters and then down 1 meter. This indicates that subtraction should be used to find the actual distance at which the water is going up each day and night. Then use division to find the number of days.



**Step 4** Solve the problem. Make sure to answer the question asked. One way (but not the only way) is to subtract 1 from 3 and then divide 10 by the result. So,  $10 \div (3 - 1) = 5$ .

It will take five days to fill the water container.

**Step 5** Check the answer. Divide 10 by 5 and get 2, which is the distance the water goes up each day and night. The answer is reasonable.

## 21st Century Skill Technology Connection

The Internet is a wonderful learning resource that can be an effective tool in your education, but not all "hits" when doing online searches are equal. A good rule of thumb is to rely on hits that take you to "organizations." You will be able to recognize organizations because they have ".org" in their domain names. Your math teacher can also recommend some good sites to go to.

As a class project, create a list of internet sites that could serve as reliable math-learning sources.

## MATH LINK



You do not have to be an artist to practice the "draw a picture" strategy. If you know what you are drawing and why, this method can be very useful.

## THINK ABOUT MATH



**Directions:** Explain which strategy you would use to solve the following word problems. Then solve the problem.

1. Susan has 32 onions she wants to sell. Each bag she has holds 7 onions. How many onions will Susan have left over after she sells the ones that have been placed in bags?
2. Five basketball players are in a circle. Each player throws the ball to every other player once. How many times is the ball thrown?

## Guess and Check

Another popular problem-solving strategy is called guess and check. This is a method people often use in everyday situations.

### Example 4 Guess and Check to Solve a Problem

Which two 2-digit numbers made from the digits 1, 2, 3, 4, and 5 give the largest sum when added together? No single digit may be used more than once.

**Step 1** Understand the question.

It asks which two 2-digit numbers give the largest sum when added together.

**Step 2** Find the necessary information.

Use only the digits 1, 2, 3, 4, and 5. No digit may be used more than once.

**Step 3** Choose an arithmetic operation.

Because the question asks for a sum, add the two 2-digit numbers.

**Step 4** Solve the problem.

First guess:            Second guess:

$$54 + 32 = 86 \quad 53 + 42 = 95$$

$$\text{Answer: } 53 + 42 = 95$$

**Step 5** Check the answer.

Test the first guess. Ask: Is 86 a reasonable sum? No, adding 5 and 3 in the tens place gives 80. By changing 3 to 4 and then adding 5 and 4 in the tens place, you get 90.

The number 90 is greater than 80.

## Vocabulary Review

**Directions:** Fill in the blank with the correct word.

**irrelevant      reasonable      solution**

1. To find the \_\_\_\_\_ to a word problem is to find the answer.
2. When using addition to solve a word problem, check that you have found a \_\_\_\_\_ sum.
3. Knowing what a question is asking makes it easy to find \_\_\_\_\_ information.

## Skill Review

**Directions:** Find the irrelevant information in the following problems. Solve the problem.

1. Manny spent \$3.15 for a 96-inch board of wood. How many 8-inch long pieces can he cut from the board?
2. Mrs. O'Rourke worked 28 hours this week. Mr. Martinez worked 32 hours, and Ms. Wong worked 41 hours. How many hours more did Ms. Wong work than Mrs. O'Rourke?
3. Carlos purchased 3 pounds of potatoes, 2 pounds of bananas, and 5 pounds of apples. He handed the clerk \$12.43. How many pounds total do his items weigh?
4. At a garage sale, Chaske sold 12 DVDs for \$3 each. He also sold his DVD player for \$20. How much money did he receive for his DVDs?

## Skill Practice

**Directions:** Choose the best answer to each question.

1. Which two 2-digit numbers made with the digits 5, 6, 7, and 8 give the largest sum when added together? No digit may be used more than once.
  - A.  $87 + 65$
  - B.  $86 + 75$
  - C.  $88 + 77$
  - D.  $85 + 67$
2. In May, Jack's rent will increase \$30. If he pays \$415 now, how much will his new rent cost each month?  
\_\_\_\_\_
3. Which operation is best to use to solve the following problem: Last year, 64,441,087 passengers flew through a major airport. The year before, there were 51,943,567 passengers. How many more passengers flew through it last year than the year before?
  - A. addition
  - B. subtraction
  - C. division
  - D. multiplication
4. Garbage service in the town of Kankakee costs \$156 for one year. What is the monthly charge for garbage collection?  
\_\_\_\_\_

# LESSON 6.5

# Functions

## Lesson Objectives

### You will be able to

- Identify a function
- Determine whether an equation represents a function

## Skills

- **Core Skill:** Build Lines of Reasoning
- **Core Skill:** Interpret Graphs and Functions

## Vocabulary

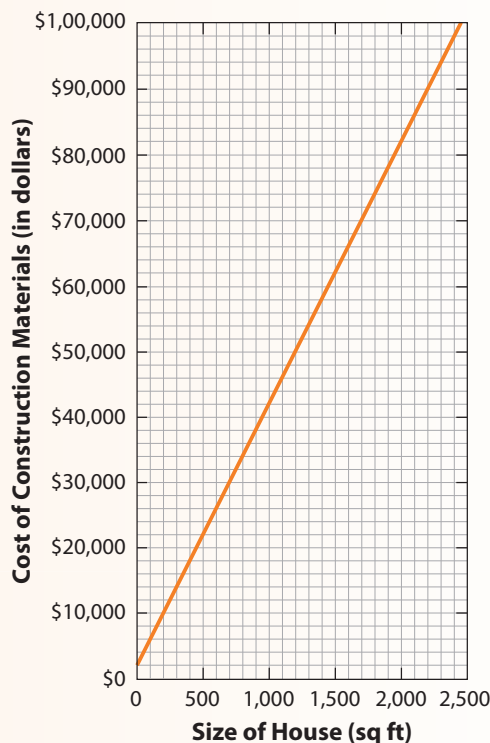
function  
input  
linear function  
nonlinear function  
output  
vertical line test

**KEY CONCEPT:** You can look at a function as a set of instructions that tells you what to do with the input, or values you put in. The result of the instructions is called the output. Functions are equations that provide only one output for each input.

*In a previous lesson, you learned about linear equations and some of the ways that they are used in different applications. For example, imagine you are a builder. You can use a linear equation to determine the cost of construction materials (in dollars) for any given size house (in square feet). The linear equation is*

$$y = 40x + 2,000$$

*where  $x$  is the size of the house (in square feet) and  $y$  is the cost of the construction materials. Examine the graph of this linear equation.*



## What Is a Function?

A **function** is a mathematical equation that has two variables, an **input** variable that goes into the equation and an **output** variable that results from the input. A rule to remember is that for each input, a function has only one output.

You can think of a function as a set of instructions that tells you how to take the input and use it to calculate the output. Mathematicians often describe a function as a “black box,” like the one in the drawing below. Think of it as a computer that takes in the input value, follows the instructions on what to do with the input value, and produces an output value. In the drawing, the input is labeled  $x$  and the output is labeled  $y$ .





## Is It a Function?

Remember that the definition of a function states that for each input, there is only one output. This definition will help you determine whether or not an equation represents a function.

At the beginning of this lesson, we looked at a linear equation that related the size of a house to the cost of the construction materials required to build it:

$$y = 40x + 2000$$

where  $x$  is the size of the house (in square feet) and  $y$  is the cost of the construction materials. If you select a value for the size of the house, you can calculate the cost of the materials. Say the value of  $x = 1,500$  square feet. Now you can calculate the value of  $y$ .

$$y = (40 \times 1500) + 2000 = 60,000 + 2,000 = 62,000$$

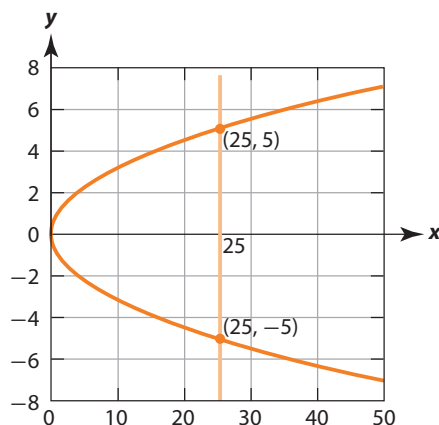
So, the cost of the construction materials to build a 1,500 square foot house is \$62,000. The equation provides only one possible answer for each size of house. This is also evident from the graph of the linear equation. If you select any value of  $x$ , there is only one possible value of  $y$ . So, for each input, or house size, there is only one output, or cost of materials. Therefore, the linear equation  $y = 40x + 2,000$  is a function.

Now, consider the following equation

$$y = \sqrt{x}$$

If  $x = 25$ , then the value of  $y$  is 5, since  $5 \times 5 = 25$ . But the value of  $y$  could also be  $-5$ , since  $-5 \times -5 = 25$ . So, for this equation, there are two possible answers. In other words, for any input  $x$ , there are two possible values for the output,  $y$ . This violates the definition of a function, which states that there is only one output for each input. Therefore, this equation is **not** a function.

Look at the graph of this equation, which shows the two values of  $y$  when  $x = 25$ . Note that because these points have the same  $x$  coordinate, they lie on the same vertical line.



### Core Skill Build Lines of Reasoning

You have already worked with functions, without realizing it. A linear equation is an example of a function. For example, in a previous lesson, you calculated the temperature in degrees Fahrenheit when given the temperature in degrees Celsius. The linear equation for this function is

$$F = 1.8C + 32$$

The variable  $C$ , the temperature in degrees Celsius, is the input. This is the value that we know. The variable  $F$ , the temperature in degrees Fahrenheit is the output. This is the value that we want to calculate.

Return to the idea of a function as a “black box” or computer. Imagine that when you type in the temperature in degrees Celsius, the computer displays the temperature in degrees Fahrenheit. Let’s call this computer a “temperature converter.”



What “instructions” does the temperature converter follow? Use the linear equation  $F = 1.8C + 32$  to write the instructions.

## WORKPLACE CONNECTION

### Computer Programming Input, Output Values

In addition to numerous applications in science and mathematics, the concept of a function is very important in computer programming. Computer scientists use the concept of a function when specifying input and output values for a computer program.

For example, a computer programmer writes a program for teachers. The program converts numerical grades (input values) into letter grades (output values). Without knowing the specific programming that makes the program work, a teacher is able to type in any numerical value and receive an equivalent letter grade. So, the computer program works like a “black box,” in that it accepts any input from the user and delivers an output.

You can do a **vertical line test** to determine if an equation is a function. Examine the line of the graph in the figure on the previous page. Then, observe the vertical line  $x = 25$ . Notice that it intersects the graph of the equation at two points. This indicates that there are two output values, 5 and  $-5$ , for one input value, 25. Because the vertical line crosses the graph at more than one point, the equation is not a function. It violates the definition of a function that there can be only one output for each input.

## Function Categories

Functions can be classified into two broad categories—linear functions and nonlinear functions. You have been working with linear functions throughout this chapter. A **linear function** has the form

$$y = mx + b$$

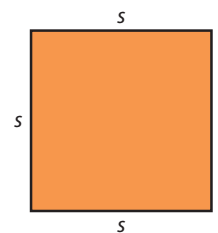
where  $m$  is the slope of the line and  $b$  is the  $y$ -intercept.

If a function does not have this form, then it is a **nonlinear function**. Let's look at two examples to illustrate the difference between linear and nonlinear functions.

### Perimeter of a Square

The perimeter of a square is the sum of the lengths of all its sides. The equation that represents the perimeter,  $P$ , is

$$P = s + s + s + s$$
$$P = 4s$$



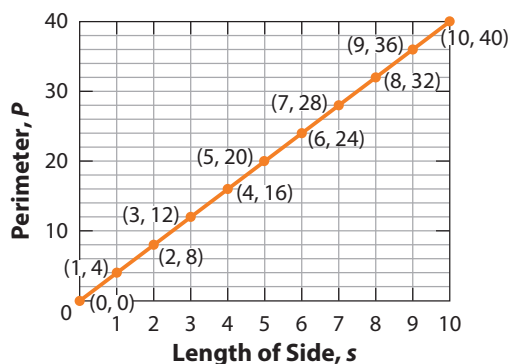
where  $s$  is the length of each side. Because it has the form  $y = mx + b$ , this equation represents a linear function.

$$y = mx + b$$

$\swarrow$   $\searrow$

$$P = 4s$$

The slope is 4 and the  $y$ -intercept is 0. Look at the graph of this function. Note that all of the points lie on a straight line, thus confirming that the formula for finding perimeter,  $P = 4s$ , is a linear function.



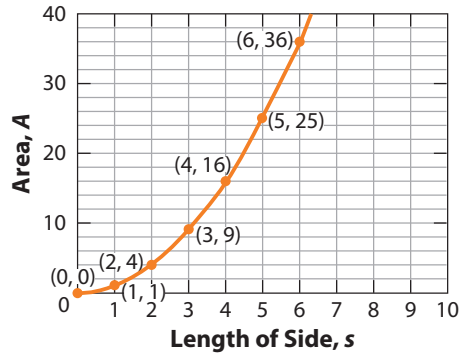
## Area of a Square

The area of a square is the product of the length of two of its sides. The equation that represents the area,  $A$ , is

$$A = s \times s$$

$$A = s^2$$

You can graph this function, as you see. Note that the points do not lie on a straight line. Thus the equation  $A = s^2$  is a nonlinear function. More specifically, it is a quadratic function.



### Core Skill

#### Interpret Graphs and Functions

When you are asked to graph a function or interpret the graph of a function, it is always helpful to look at its equation, if it is available. You can look at the form of the function to determine whether it is linear or nonlinear. Remember, if the function has the form

$$y = mx + b$$

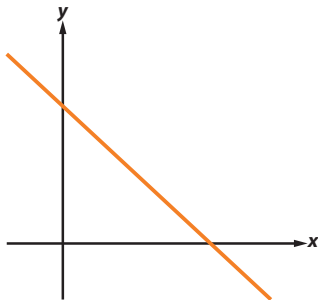
then the function is linear—if it does not have that form, then the function is nonlinear.

### THINK ABOUT MATH

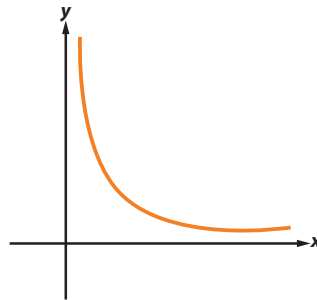


**Directions:** Label each graph as a Function or Not a Function.

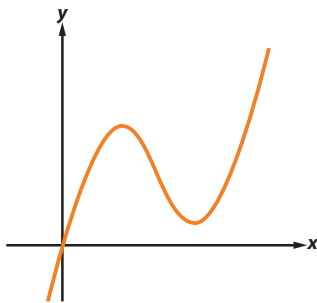
A. \_\_\_\_\_



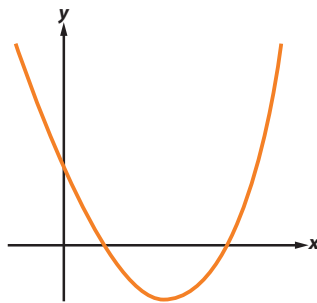
C. \_\_\_\_\_



B. \_\_\_\_\_



D. \_\_\_\_\_



## MATH LINK



The circumference of a circle,  $C$ , is given by the equation  $C = 2\pi r$ , and the area of a circle,  $A$ , is given by the equation  $A = \pi r^2$ . Explain how you can determine whether each of these functions is linear or nonlinear, without performing any calculations or plotting their graphs.

Hint: You can compare each of these equations with the form of a linear function. Remember that the equation of a linear function is  $y = mx + b$ , where  $y$  is the dependent variable and  $x$  is the independent variable. If you can rewrite one or both of the equations in the form  $y = mx + b$ , it is a linear function. If you cannot rewrite one or either of the equations in the form  $y = mx + b$ , it is not a linear function.

## Vocabulary Review

**Directions:** Use the following terms to complete each sentence. Note that some terms may be used in more than one sentence.

**function input linear function nonlinear function output vertical line test**

1. An equation is a \_\_\_\_\_ if there is only one \_\_\_\_\_ for each \_\_\_\_\_.
2. A \_\_\_\_\_ has the form  $y = mx + b$ .
3. The points of a \_\_\_\_\_ are not all on a straight line.
4. A \_\_\_\_\_ can help determine whether the graph of an equation is a \_\_\_\_\_ or not.

## Skill Review

**Directions:** Circle the best answer to each question.

1. You can think of a function as a
  - A. point on a line
  - B. set of instructions
  - C. set of geometric shapes
  - D. collection of mathematical questions
2. The vertical line test helps you determine whether
  - A. a function is linear or nonlinear
  - B. a graph represents a function
  - C. a function is a "black box"
  - D. an equation is graphed correctly

**Directions:** Read the problem. Then follow the directions.

3. Imagine you are programming a computer. Write the step-by-step "instructions" for the following nonlinear function. Include the words *input* and *output* in your instructions.

$$y = x^2 + 2x + 1$$

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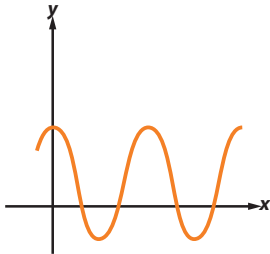


## Skill Practice

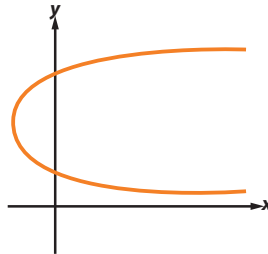
**Directions:** Read the problem. Then follow the directions.

1. Label each graph of an equation as a Linear Function or a Nonlinear Function.

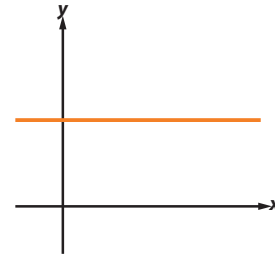
A. \_\_\_\_\_



B. \_\_\_\_\_



C. \_\_\_\_\_



2. The potential energy (PE) of an object is related to its vertical position. In other words, it is related to the object's height above the ground. The potential energy (in kilojoules) of an object is given by the equation

$$PE = \frac{mgh}{1000}$$

where  $m$  is the mass of the object,  $g$  is a constant related to gravity, or 9.8, and  $h$  is the height above the ground.

Use the data in the table to calculate the PE of someone with a mass of 90 kg traveling upward in an elevator 10 meters at a time.

Mass (in kg)	$g$	Height (in m)	PE (in kj)
90	9.8	0	
90	9.8	10	
90	9.8	20	
90	9.8	30	
90	9.8	40	
90	9.8	50	

3. Draw a graph to plot the PE values you calculated in the previous problem.

4. Does the graph that you drew represent a function? If so, is it linear or nonlinear? Explain each of your answers.

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- Guidance for supporting higher order reasoning and thinking skills
- 21<sup>st</sup> Century skill instruction tied to workplace and real-life tasks
- Vocabulary instruction on Tier 2, Tier 3, and key test-taking words
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