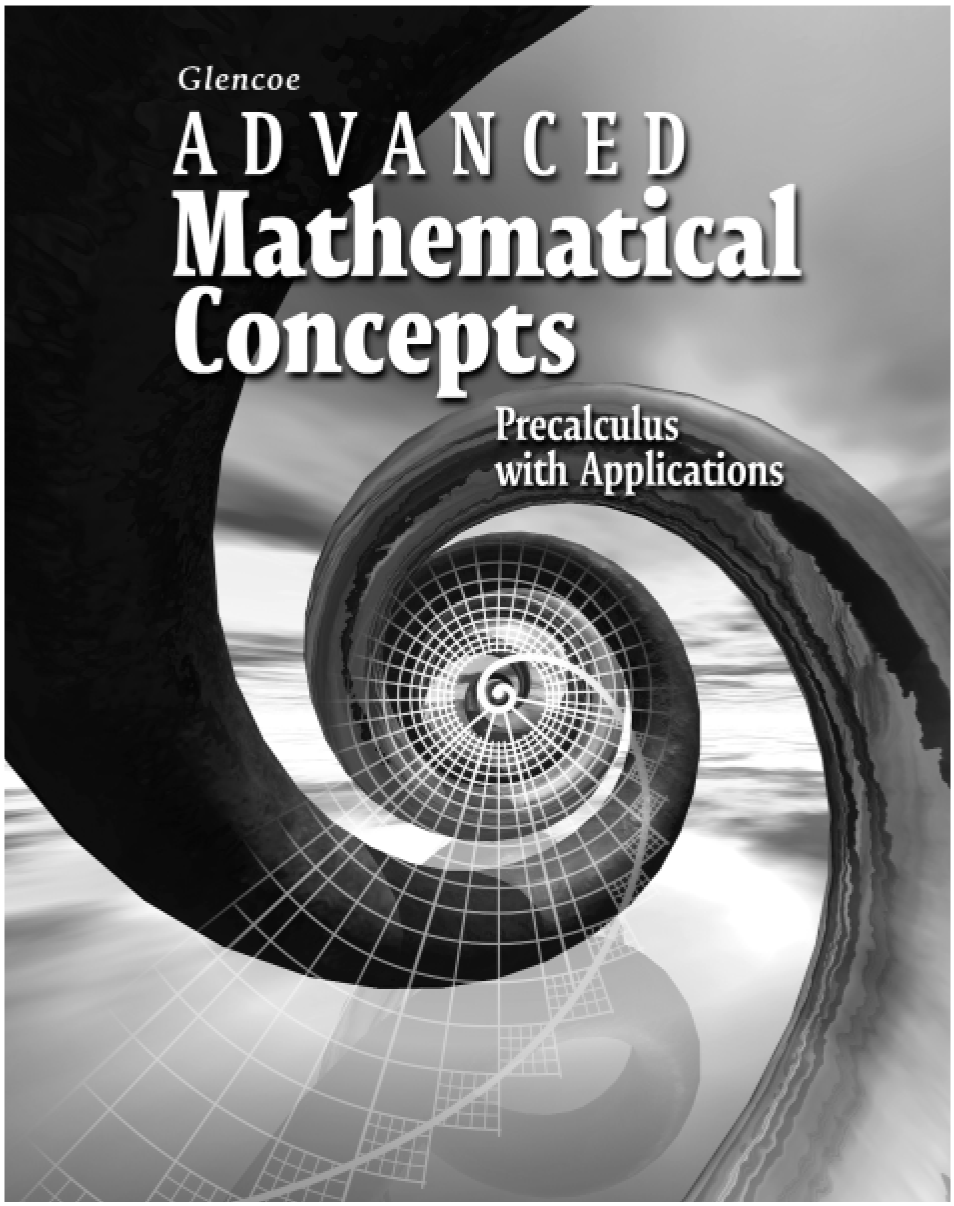
Chapter 1
Resource Masters



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StudentWorks™ This CD-ROM includes the entire Student Edition along with the Study Guide, Practice, and Enrichment masters.

TeacherWorks™ All of the materials found in this booklet are included for viewing and printing in the *Advanced Mathematical Concepts TeacherWorks* CD-ROM.

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Advanced Mathematical Concepts
Chapter 1 Resource Masters

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Contents

A Teacher's Guide to Using the Chapter 1 Resource Masters

The ***Fast File*** Chapter Resource system allows you to conveniently file the resources you use most often. The *Chapter 1 Resource Masters* include the core materials needed for Chapter 1. These materials include worksheets, extensions, and assessment options. The answers for these pages appear at the back of this booklet.

All of the materials found in this booklet are included for viewing and printing in the *Advanced Mathematical Concepts TeacherWorks* CD-ROM.

Vocabulary Builder Pages vii-x include a student study tool that presents the key vocabulary terms from the chapter. Students are to record definitions and/or examples for each term. You may suggest that students highlight or star the terms with which they are not familiar.

When to Use Give these pages to students before beginning Lesson 1-1. Remind them to add definitions and examples as they complete each lesson.

Study Guide There is one Study Guide master for each lesson.

When to Use Use these masters as reteaching activities for students who need additional reinforcement. These pages can also be used in conjunction with the Student Edition as an instructional tool for those students who have been absent.

Practice There is one master for each lesson. These problems more closely follow the structure of the Practice section of the Student Edition exercises. These exercises are of average difficulty.

When to Use These provide additional practice options or may be used as homework for second day teaching of the lesson.

Enrichment There is one master for each lesson. These activities may extend the concepts in the lesson, offer a historical or multicultural look at the concepts, or widen students' perspectives on the mathematics they are learning. These are not written exclusively for honors students, but are accessible for use with all levels of students.

When to Use These may be used as extra credit, short-term projects, or as activities for days when class periods are shortened.

Assessment Options

The assessment section of the *Chapter 1 Resources Masters* offers a wide range of assessment tools for intermediate and final assessment. The following lists describe each assessment master and its intended use.

Chapter Assessments

Chapter Tests

- *Forms 1A, 1B, and 1C* Form 1 tests contain multiple-choice questions. Form 1A is intended for use with honors-level students, Form 1B is intended for use with average-level students, and Form 1C is intended for use with basic-level students. These tests are similar in format to offer comparable testing situations.

- *Forms 2A, 2B, and 2C* Form 2 tests are composed of free-response questions. Form 2A is intended for use with honors-level students, Form 2B is intended for use with average-level students, and Form 2C is intended for use with basic-level students. These tests are similar in format to offer comparable testing situations.

  All of the above tests include a challenging Bonus question.

- The **Extended Response Assessment** includes performance assessment tasks that are suitable for all students. A scoring rubric is included for evaluation guidelines. Sample answers are provided for assessment.

Intermediate Assessment

- A **Mid-Chapter Test** provides an option to assess the first half of the chapter. It is composed of free-response questions.

- Four free-response **quizzes** are included to offer assessment at appropriate intervals in the chapter.

Continuing Assessment

- The **SAT and ACT Practice** offers continuing review of concepts in various formats, which may appear on standardized tests that they may encounter. This practice includes multiple-choice, quantitative-comparison, and grid-in questions. Bubble-in and grid-in answer sections are provided on the master.

- The **Cumulative Review** provides students an opportunity to reinforce and retain skills as they proceed through their study of advanced mathematics. It can also be used as a test. The master includes free-response questions.

Answers

- Page A1 is an answer sheet for the SAT and ACT Practice questions that appear in the Student Edition on page 65. Page A2 is an answer sheet for the SAT and ACT Practice master. These improve students' familiarity with the answer formats they may encounter in test taking.

- The answers for the lesson-by-lesson masters are provided as reduced pages with answers appearing in red.

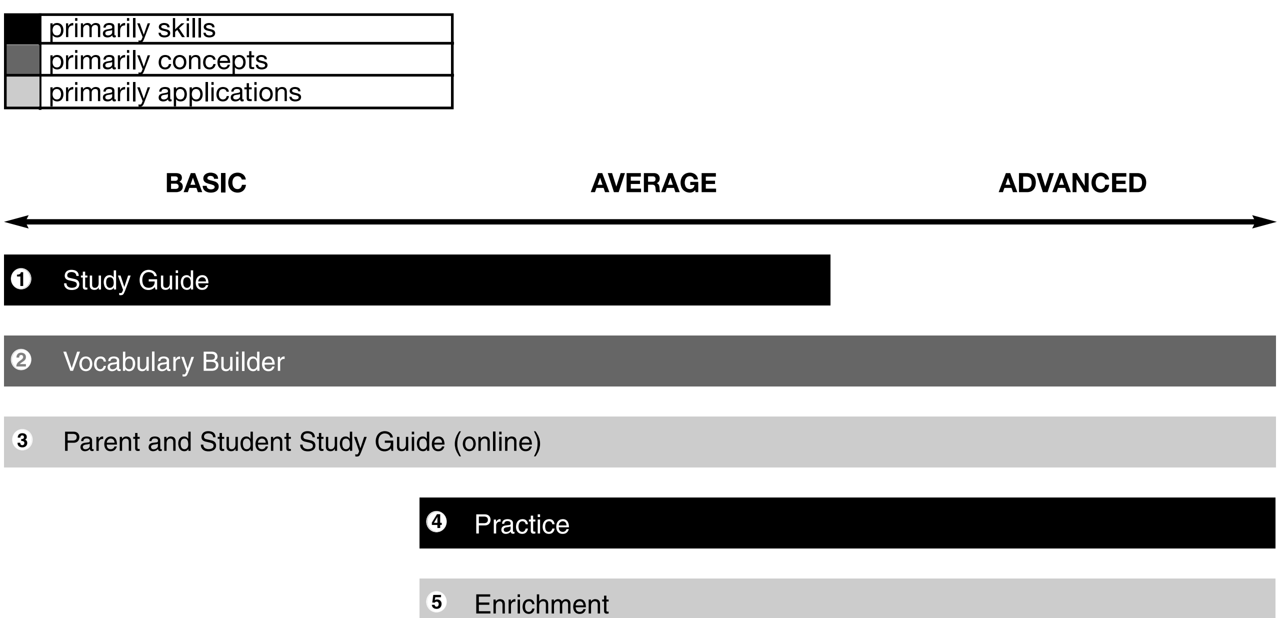
- Full-size answer keys are provided for the assessment options in this booklet.

Chapter 1 Leveled Worksheets

Glencoe's **leveled worksheets** are helpful for meeting the needs of every student in a variety of ways. These worksheets, many of which are found in the **FAST FILE Chapter Resource Masters**, are shown in the chart below.

- **Study Guide** masters provide worked-out examples as well as practice problems.
- Each chapter's **Vocabulary Builder** master provides students the opportunity to write out key concepts and definitions in their own words.
- **Practice** masters provide average-level problems for students who are moving at a regular pace.
- **Enrichment** masters offer students the opportunity to extend their learning.

Five Different Options to Meet the Needs of Every Student in a Variety of Ways



Chapter 1

NAME ______________________ DATE ______________ PERIOD _________

Reading to Learn Mathematics

Vocabulary Builder

This is an alphabetical list of the key vocabulary terms you will learn in Chapter 1. As you study the chapter, complete each term's definition or description. Remember to add the page number where you found the term.

Vocabulary Term	Found on Page	Definition/Description/Example
abscissa		
absolute value function		
best-fit line		
boundary		
coinciding lines		
composite		
composition of functions		
constant function		
correlation coefficient		
domain		

(continued on the next page)

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Reading to Learn Mathematics

Vocabulary Builder *(continued)*

Vocabulary Term	Found on Page	Definition/Description/Example
family of graphs		
function		
function notation		
goodness of fit		
greatest integer function		
half plane		
iterate		
iteration		
linear equation		
linear function		
linear inequality		

(continued on the next page)

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Reading to Learn Mathematics

Vocabulary Builder *(continued)*

Vocabulary Term	Found on Page	Definition/Description/Example
model		
ordinate		
parallel lines		
Pearson-product moment correlation		
perpendicular lines		
piecewise function		
point-slope form		
prediction equation		
range		
regression line		
relation		

(continued on the next page)

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Reading to Learn Mathematics

Vocabulary Builder (continued)

Vocabulary Term	Found on Page	Definition/Description/Example
scatter plot		
slope		
slope intercept form		
standard form		
step function		
vertical line test		
x-intercept		
y-intercept		
zero of a function		

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1-1

Study Guide

Relations and Functions

A **relation** is a set of ordered pairs. The set of first elements in the ordered pairs is the **domain**, while the set of second elements is the **range**.

Example 1 **State the domain and range of the following relation.**
{(5, 2), (30, 8), (15, 3), (17, 6), (14, 9)}
Domain: {5, 14, 15, 17, 30}
Range: {2, 3, 6, 8, 9}
You can also use a table, a graph, or a rule to represent a relation.

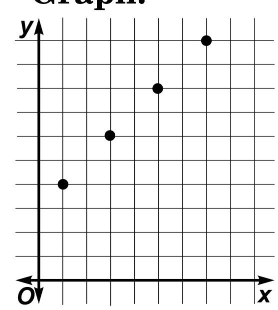
Example 2 **The domain of a relation is all odd positive integers less than 9. The range *y* of the relation is 3 more than *x*, where *x* is a member of the domain. Write the relation as a table of values and as an equation. Then graph the relation.**

Table:

x	y
1	4
3	6
5	8
7	10

Equation:
$y = x + 3$

Graph:



A **function** is a relation in which each element of the domain is paired with exactly one element in the range.

Example 3 **State the domain and range of each relation. Then state whether the relation is a function.**

a. {(−2, 1), (3, −1), (2, 0)}
The domain is {−2, 2, 3} and the range is {−1, 0, 1}. Each element of the domain is paired with exactly one element of the range, so this relation is a function.

b. {(3, −1), (3, −2), (9, 1)}
The domain is {3, 9}, and the range is {−2, −1, 1}. In the domain, 3 is paired with two elements in the range, −1 and −2. Therefore, this relation is not a function.

Example 4 **Evaluate each function for the given value.**

a. $\boldsymbol{f(-1)}$ **if** $\boldsymbol{f(x) = 2x^3 + 4x^2 - 5x}$
$f(-1) = 2(-1)^3 + 4(-1)^2 - 5(-1)$ $\quad x = -1$
$= -2 + 4 + 5$ or 7

b. $\boldsymbol{g(4)}$ **if** $\boldsymbol{g(x) = x^4 - 3x^2 + 4}$
$g(4) = (4)^4 - 3(4)^2 + 4$ $\quad x = 4$
$= 256 - 48 + 4$ or 212

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1-1

Practice

Relations and Functions

State the domain and range of each relation. Then state whether the relation is a function. Write yes or no.

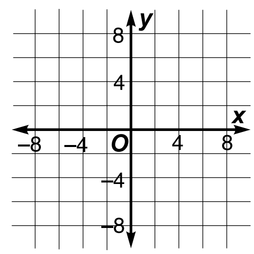
1. $\{(-1, 2), (3, 10), (-2, 20), (3, 11)\}$

2. $\{(0, 2), (13, 6), (2, 2), (3, 1)\}$

3. $\{(1, 4), (2, 8), (3, 24)\}$

4. $\{(-1, -2), (3, 54), (-2, -16), (3, 81)\}$

5. The domain of a relation is all even negative integers greater than -9. The range y of the relation is the set formed by adding 4 to the numbers in the domain. Write the relation as a table of values and as an equation. Then graph the relation.



Evaluate each function for the given value.

6. $f(-2)$ if $f(x) = 4x^3 + 6x^2 + 3x$

7. $f(3)$ if $f(x) = 5x^2 - 4x - 6$

8. $h(t)$ if $h(x) = 9x^9 - 4x^4 + 3x - 2$

9. $f(g + 1)$ if $f(x) = x^2 - 2x + 1$

10. ***Climate*** The table shows record high and low temperatures for selected states.

a. State the relation of the data as a set of ordered pairs.

b. State the domain and range of the relation.

c. Determine whether the relation is a function.

Record High and Low Temperatures (°F)

State	High	Low
Alabama	112	−27
Delaware	110	−17
Idaho	118	−60
Michigan	112	−51
New Mexico	122	−50
Wisconsin	114	−54

Source: National Climatic Data Center

1-1

Enrichment

Rates of Change

Between $x = a$ and $x = b$, the function $f(x)$ changes by $f(b) - f(a)$. The *average rate of change* of $f(x)$ between $x = a$ and $x = b$ is defined by the expression

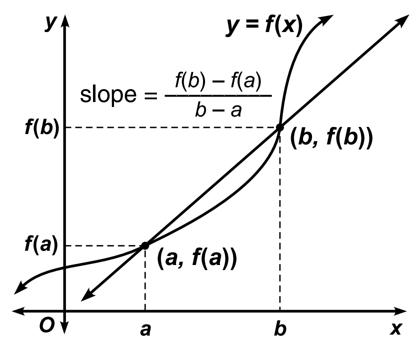
$$\frac{f(b) - f(a)}{(b - a)}.$$

Find the change and the average rate of change of f(x) in the given range.

1. $f(x) = 3x - 4$, from $x = 3$ to $x = 8$

2. $f(x) = x^2 + 6x - 10$, from $x = 2$ to $x = 4$

The average rate of change of a function $f(x)$ over an interval is the amount the function changes per unit change in x. As shown in the figure at the right, the average rate of change between $x = a$ and $x = b$ represents the slope of the line passing through the two points on the graph of f with abscissas a and b.



3. Which is larger, the average rate of change of $f(x) = x^2$ between 0 and 1 or between 4 and 5?

4. Which of these functions has the greatest average rate of change between 2 and 3: $f(x) = x$; $g(x) = x^2$; $h(x) = x^3$?

5. Find the average rate of change for the function $f(x) = x^2$ in each interval.
a. $a = 1$ to $b = 1.1$ **b.** $a = 1$ to $b = 1.01$ **c.** $a = 1$ to $b = 1.001$

d. What value does the average rate of change appear to be approaching as the value of b gets closer and closer to 1?

The value you found in Exercise **5d** is the *instantaneous rate of change* of the function. Instantaneous rate of change has enormous importance in calculus, the topic of Chapter 15.

6. Find the instantaneous rate of change of the function $f(x) = 3x^2$ as x approaches 3.

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1-2 Study Guide

Composition of Functions

Operations of Functions	Two functions can be added together, subtracted, multiplied, or divided to form a new function.

Example 1 **Given $f(x) = x^2 - x - 6$ and $g(x) = x + 2$, find each function.**

a. $(f + g)(x)$

$$\begin{aligned}(f + g)(x) &= f(x) + g(x)\\ &= x^2 - x - 6 + x + 2\\ &= x^2 - 4\end{aligned}$$

b. $(f - g)(x)$

$$\begin{aligned}(f - g)(x) &= f(x) - g(x)\\ &= x^2 - x - 6 - (x + 2)\\ &= x^2 - 2x - 8\end{aligned}$$

c. $(f \cdot g)(x)$

$$\begin{aligned}(f \cdot g)(x) &= f(x) \cdot g(x)\\ &= (x^2 - x - 6)(x + 2)\\ &= x^3 + x^2 - 8x - 12\end{aligned}$$

d. $\left(\frac{f}{g}\right)(x)$

$$\begin{aligned}\left(\frac{f}{g}\right)(x) &= \frac{f(x)}{g(x)}\\ &= \frac{x^2 - x - 6}{x + 2}\\ &= \frac{(x - 3)(x + 2)}{x + 2}\\ &= x - 3, x \neq -2\end{aligned}$$

Functions can also be combined by using **composition**. The function formed by composing two functions f and g is called the **composite** of f and g, and is denoted by $f \circ g$. $[f \circ g](x)$ is found by substituting $g(x)$ for x in $f(x)$.

Example 2 **Given $f(x) = 3x^2 + 2x - 1$ and $g(x) = 4x + 2$, find $[f \circ g](x)$ and $[g \circ f](x)$.**

$$\begin{aligned}[f \circ g](x) &= f(g(x))\\ &= f(4x + 2) && \textit{Substitute } 4x + 2 \textit{ for } g(x).\\ &= 3(4x + 2)^2 + 2(4x + 2) - 1 && \textit{Substitute } 4x + 2 \textit{ for } x \textit{ in } f(x).\\ &= 3(16x^2 + 16x + 4) + 8x + 4 - 1\\ &= 48x^2 + 56x + 15\end{aligned}$$

$$\begin{aligned}[g \circ f](x) &= g(f(x))\\ &= g(3x^2 + 2x - 1) && \textit{Substitute } 3x^2 + 2x - 1 \textit{ for } f(x).\\ &= 4(3x^2 + 2x - 1) + 2 && \textit{Substitute } 3x^2 + 2x - 1 \textit{ for } x \textit{ in } g(x).\\ &= 12x^2 + 8x - 2\end{aligned}$$

NAME ______________________________ DATE ________________ PERIOD ________

Practice

Composition of Functions

Given $f(x) = 2x^2 + 8$ and $g(x) = 5x - 6$, find each function.

1. $(f + g)(x)$

2. $(f - g)(x)$

3. $(f \cdot g)(x)$

4. $\left(\frac{f}{g}\right)(x)$

Find $[f \circ g](x)$ and $[g \circ f](x)$ for each $f(x)$ and $g(x)$.

5. $f(x) = x + 5$
$g(x) = x - 3$

6. $f(x) = 2x^3 - 3x^2 + 1$
$g(x) = 3x$

7. $f(x) = 2x^2 - 5x + 1$
$g(x) = 2x - 3$

8. $f(x) = 3x^2 - 2x + 5$
$g(x) = 2x - 1$

9. State the domain of $[f \circ g](x)$ for $f(x) = \sqrt{x - 2}$ and $g(x) = 3x$.

Find the first three iterates of each function using the given initial value.

10. $f(x) = 2x - 6$; $x_0 = 1$

11. $f(x) = x^2 - 1$; $x_0 = 2$

12. ***Fitness*** Tara has decided to start a walking program. Her initial walking time is 5 minutes. She plans to double her walking time and add 1 minute every 5 days. Provided that Tara achieves her goal, how many minutes will she be walking on days 21 through 25?

1-2

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Enrichment

Applying Composition of Functions

Because the area of a square A is explicitly determined by the length of a side of the square, the area can be expressed as a function of one variable, the length of a side s: $A = f(s) = s^2$. Physical quantities are often functions of numerous variables, each of which may itself be a function of several additional variables. A car's gas mileage, for example, is a function of the mass of the car, the type of gasoline being used, the condition of the engine, and many other factors, each of which is further dependent on other factors. Finding the value of such a quantity for specific values of the variables is often easiest by first finding a single function composed of all the functions and then substituting for the variables.

The *frequency* f of a pendulum is the number of complete swings the pendulum makes in 60 seconds. It is a function of the *period* p of the pendulum, the number of seconds the pendulum requires to make one complete swing: $f(p) = \frac{60}{p}$.

In turn, the period of a pendulum is a function of its length L in centimeters: $p(L) = 0.2\sqrt{L}$.

Finally, the length of a pendulum is a function of its length ℓ at 0° Celsius, the Celsius temperature C, and the *coefficient of expansion* e of the material of which the pendulum is made:
$L(\ell, C, e) = \ell(1 + eC)$.

1. a. Find and simplify $f(p(L(\ell, C, e)))$, an expression for the frequency of a brass pendulum, $e = 0.00002$, in terms of its length, in centimeters at 0°C, and the Celsius temperature.

b. Find the frequency, to the nearest tenth, of a brass pendulum at 300°C if the pendulum's length at 0°C is 15 centimeters.

2. The volume V of a spherical weather balloon with radius r is given by $V(r) = \frac{4}{3}\pi r^3$. The balloon is being inflated so that the radius increases at a constant rate $r(t) = \frac{1}{2}t + 2$, where r is in meters and t is the number of seconds since inflation began.

a. Find $V(r(t))$

b. Find the volume after 10 seconds of inflation. Use 3.14 for π.

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Study Guide

Graphing Linear Equations

You can graph a **linear equation** $Ax + By + C = 0$, where A and B are not both zero, by using the x- and y-intercepts. To find the x-intercept, let $y = 0$. To find the y-intercept, let $x = 0$.

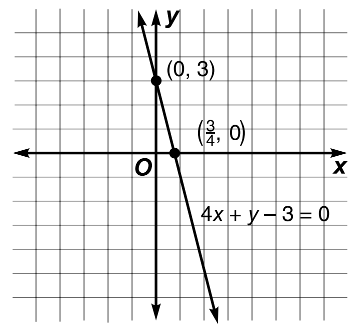
Example 1 **Graph $4x + y - 3 = 0$ using the x- and y-intercepts.**
Substitute 0 for y to find the x-intercept. Then substitute 0 for x to find the y-intercept.

x-intercept

$$4x + y - 3 = 0$$
$$4x + 0 - 3 = 0$$
$$4x - 3 = 0$$
$$4x = 3$$
$$x = \frac{3}{4}$$

y-intercept

$$4x + y - 3 = 0$$
$$4(0) + y - 3 = 0$$
$$y - 3 = 0$$
$$y = 3$$



The line crosses the x-axis at $\left(\frac{3}{4}, 0\right)$ and the y-axis at $(0, 3)$.

Graph the intercepts and draw the line that passes through them.

The **slope** of a nonvertical line is the ratio of the change in the y-coordinates of two points to the corresponding change in the x-coordinates of the same points. The slope of a line can be interpreted as the ratio of change in the y-coordinates to the change in the x-coordinates.

Slope	The slope m of a line through two points (x_1, y_1) and (x_2, y_2) is given by $m = \frac{y_2 - y_1}{x_2 - x_1}$.

Example 2 **Find the slope of the line passing through $A(-3, 5)$ and $B(6, 2)$.**

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{2 - 5}{6 - (-3)} \quad \textit{Let } x_1 = -3,\ y_1 = 5,\ x_2 = 6, \textit{ and } y_2 = 2.$$
$$= \frac{-3}{9} \text{ or } -\frac{1}{3}$$

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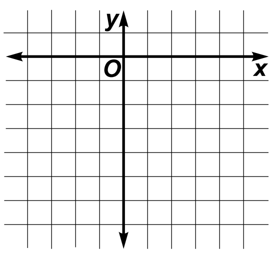
Practice

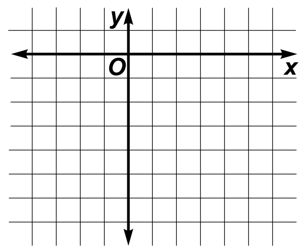
Graphing Linear Equations

Graph each equation using the x- and y-intercepts.

1. $2x - y - 6 = 0$

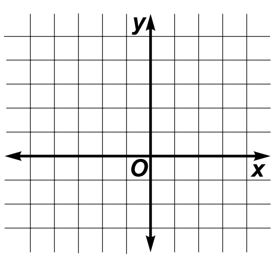


2. $4x + 2y + 8 = 0$

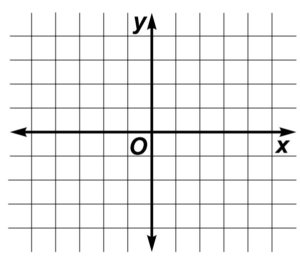


Graph each equation using the y-intercept and the slope.

3. $y = 5x - \frac{1}{2}$

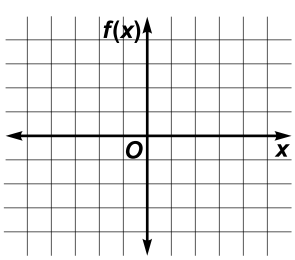


4. $y = \frac{1}{2}x$

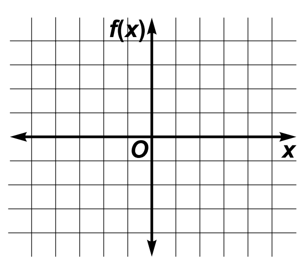


Find the zero of each function. Then graph the function.

5. $f(x) = 4x - 3$



6. $f(x) = 2x + 4$



7. ***Business*** In 1990, a two-bedroom apartment at Remington Square Apartments rented for $575 per month. In 1999, the same two-bedroom apartment rented for $850 per month. Assuming a constant rate of increase, what will a tenant pay for a two-bedroom apartment at Remington Square in the year 2000?

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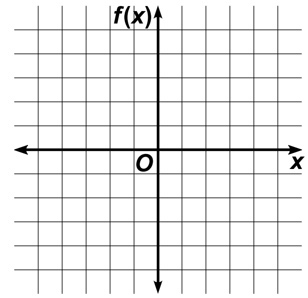
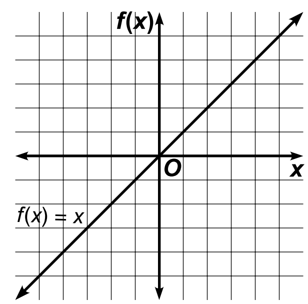
Enrichment

Inverses and Symmetry



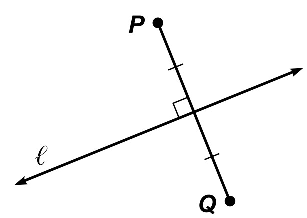
1. Use the coordinate axes at the right to graph the function $f(x) = x$ and the points $A(2, 4)$, $A'(4, 2)$, $B(-1, 3)$, $B'(3, -1)$, $C(0, -5)$, and $C'(-5, 0)$.

2. Describe the apparent relationship between the graph of the function $f(x) = x$ and any two points with interchanged abscissas and ordinates.



3. Graph the function $f(x) = 2x - 4$ and its inverse $f^{-1}(x)$ on the coordinate axes at the right.

4. Describe the apparent relationship between the graphs you have drawn and the graph of the function $f(x) = x$.



Recall from your earlier math courses that two points P and Q are said to be *symmetric* about line ℓ provided that P and Q are equidistant from ℓ and on a perpendicular through ℓ. The line ℓ is the *axis of symmetry* and P and Q are *images* of each other in ℓ. The image of the point $P(a, b)$ in the line $y = x$ is the point $Q(b, a)$.

5. Explain why the graphs of a function $f(x)$ and its inverse, $f^{-1}(x)$, are symmetric about the line $y = x$.

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Study Guide

Writing Linear Equations

The form in which you write an equation of a line depends on the information you are given. Given the slope and y-intercept, or given the slope and one point on the line, the **slope-intercept** form can be used to write the equation.

Example 1 Write an equation in slope-intercept form for each line described.

a. a slope of $\frac{2}{3}$ and a y-intercept of -5

Substitute $\frac{2}{3}$ for m and -5 for b in the general slope-intercept form.

$y = mx + b \quad \rightarrow \quad y = \frac{2}{3}x - 5.$

The slope-intercept form of the equation of the line is $y = \frac{2}{3}x - 5$.

b. a slope of 4 and passes through the point at $(-2, 3)$

Substitute the slope and coordinates of the point in the general slope-intercept form of a linear equation. Then solve for b.

$y = mx + b$

$3 = 4(-2) + b$ *Substitute −2 for x, 3 for y, and 4 for m.*

$11 = b$ *Add 8 to both sides of the equation.*

The y-intercept is 11. Thus, the equation for the line is $y = 4x + 11$.

When you know the coordinates of two points on a line, you can find the slope of the line. Then the equation of the line can be written using either the slope-intercept or the **point-slope** form, which is $y - y_1 = m(x - x_1)$.

Example 2 ***Sales*** **In 1998, the average weekly first-quarter sales at Vic's Hardware store were $9250. In 1999, the average weekly first-quarter sales were $10,100. Assuming a linear relationship, find the average quarterly rate of increase.**

(1, 9250) and (5, 10,100)   *Since there are two data points, identify the two coordinates to find the slope of the line. Coordinate 1 represents the first quarter of 1998 and coordinate 5 represents the first quarter of 1999.*

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{10{,}100 - 9250}{5 - 1} = \frac{850}{4} \text{ or } 212.5$$

Thus, for each quarter, the average sales increase was $212.50.

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1-4 Practice

Writing Linear Equations

Write an equation in slope-intercept form for each line described.

1. slope $= -4$, y-intercept $= 3$

2. slope $= 5$, passes through $A(-3, 2)$

3. slope $= -4$, passes through $B(3, 8)$

4. slope $= \frac{4}{3}$, passes through $C(-9, 4)$

5. slope $= 1$, passes through $D(-6, 6)$

6. slope $= -1$, passes through $E(3, -3)$

7. slope $= 3$, y-intercept $= \frac{3}{4}$

8. slope $= -2$, y-intercept $= -7$

9. slope $= -1$, passes through $F(-1, 7)$

10. slope $= 0$, passes through $G(3, 2)$

11. ***Aviation*** The number of active certified commercial pilots has been declining since 1980, as shown in the table.

a. Find a linear equation that can be used as a model to predict the number of active certified commercial pilots for any year. Assume a steady rate of decline.

b. Use the model to predict the number of pilots in the year 2003.

Number of Active Certified Pilots

Year	Total
1980	182,097
1985	155,929
1990	149,666
1993	143,014
1994	138,728
1995	133,980
1996	129,187

Source: U. S. Dept. of Transportation

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Enrichment

Finding Equations From Area

A right triangle in the first quadrant is bounded by the x-axis, the y-axis, and a line intersecting both axes. The point (1, 2) lies on the hypotenuse of the triangle. The area of the triangle is 4 square units.

Follow these instructions to find the equation of the line containing the hypotenuse. Let m represent the slope of the line.

1. Write the equation, in point-slope form, of the line containing the hypotenuse of the triangle.

2. Find the x-intercept and the y-intercept of the line.

3. Write the measures of the legs of the triangle.

4. Use your answers to Exercise 3 and the formula for the area of a triangle to write an expression for the area of the triangle in terms of the slope of the hypotenuse. Set the expression equal to 4, the area of the triangle, and solve for m .

5. Write the equation of the line, in point-slope form, containing the hypotenuse of the triangle.

6. Another right triangle in the first quadrant has an area of 4 square units. The point (2, 1) lies on the hypotenuse. Find the equation of the line, in point-slope form, containing the hypotenuse.

7. A line with negative slope passes through the point (6, 1). A triangle bounded by the line and the coordinate axes has an area of 16 square units. Find the slope of the line.

1-5

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Study Guide

Writing Equations of Parallel and Perpendicular Lines

- Two nonvertical lines in a plane are **parallel** if and only if their slopes are equal and they have no points in common.
- Graphs of two equations that represent the same line are said to **coincide**.
- Two nonvertical lines in a plane are **perpendicular** if and only if their slopes are negative reciprocals.

Example 1 **Determine whether the graphs of each pair of equations are *parallel*, *coinciding*, or *neither*.**

a. $2x - 3y = 5$, $6x - 9y = 21$ **b.** $12x + 6y = 18$, $4x = -2y + 6$

Write each pair of equations in slope-intercept form.

a. $2x - 3y = 5$ $\quad$ $6x - 9y = 21$

$y = \frac{2}{3}x - \frac{5}{3}$ $\quad$ $y = \frac{2}{3}x - \frac{7}{3}$

The lines have the same slope but different y-intercepts, so they are parallel.

b. $12x + 6y = 18$ $\quad$ $4x = -2y + 6$

$y = -2x + 3$ $\quad$ $y = -2x + 3$

The equations are identical, so the lines coincide.

Example 2 **Write the standard form of the equation of the line that passes through the point at (3, −4) and is parallel to the graph of $x + 3y - 4 = 0$.**

Any line parallel to the graph of $x + 3y - 4 = 0$ will have the same slope. So, find the slope of the graph of $x + 3y - 4 = 0$.

$$m = -\frac{A}{B}$$

$$= -\frac{1}{3} \quad A = 1, B = 3$$

Use the point-slope form to write the equation of the line.

$$y - y_1 = m(x - x_1)$$

$$y - (-4) = -\frac{1}{3}(x - 3) \quad x_1 = 3, y_1 = -4, m = -\frac{1}{3}$$

$$y + 4 = -\frac{1}{3}x + 1$$

$$3y + 12 = -x + 3 \quad \textit{Multiply each side by 3.}$$

$$x + 3y + 9 = 0 \quad \textit{Write in standard form.}$$

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Practice

Writing Equations of Parallel and Perpendicular Lines

Determine whether the graphs of each pair of equations are parallel, perpendicular, coinciding, or none of these.

1. $x + 3y = 18$
$3x + 9y = 12$

2. $2x - 4y = 8$
$x - 2y = 4$

3. $-3x + 2y = 6$
$2x + 3y = 12$

4. $x + y = 6$
$3x - y = 6$

5. $4x + 8y = 2$
$2x + 4y = 8$

6. $3x - y = 9$
$6x - 2y = 18$

Write the standard form of the equation of the line that is parallel to the graph of the given equation and that passes through the point with the given coordinates.

7. $2x + y - 5 = 0; (0, 4)$

8. $3x - y + 3 = 0; (-1, -2)$

9. $3x - 2y + 8 = 0; (2, 5)$

Write the standard form of the equation of the line that is perpendicular to the graph of the given equation and that passes through the point with the given coordinates.

10. $2x - y + 6 = 0; (0, -3)$

11. $2x - 5y - 6 = 0; (-4, 2)$

12. $3x + 4y - 13 = 0; (2, 7)$

13. ***Consumerism*** Marillia paid $180 for 3 video games and 4 books. Three months later she purchased 8 books and 6 video games. Her brother guessed that she spent $320. Assuming that the prices of video games and books did not change, is it possible that she spent $320 for the second set of purchases? Explain.

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Enrichment

Reading Mathematics: Question Assumptions

Students at the elementary level assume that the statements in their textbooks are complete and verifiably true. A lesson on the area of a triangle is assumed to contain everything there is to know about triangle area, and the conclusions reached in the lesson are rock-solid fact. The student's job is to "learn" what textbooks have to say. The better the student does this, the better his or her grade.

By now you probably realize that knowledge is open-ended and that much of what passes for fact—in math and science as well as in other areas— consists of theory or opinion to some degree.

At best, it offers the closest guess at the "truth" that is now possible. Rather than accept the statements of an author blindly, the educated person's job is to read them carefully, critically, and with an open mind, and to then make an independent judgment of their validity. The first task is to question the author's assumptions.

The following statements appear in the best-selling text Mathematics: Trust Me!. Describe the author's assumptions. What is the author trying to accomplish? What did he or she fail to mention? What is another way of looking at the issue?

1. "The study of trigonometry is critically important in today's world."

2. "We will look at the case where $x > 0$. The argument where $x \leq 0$ is similar."

3. "As you recall, the mean is an excellent method of describing a set of data."

4. "Sometimes it is necessary to estimate the solution."

5. "This expression can be written $\frac{1}{x}$."

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Study Guide

Modeling Real-World Data with Linear Functions

When real-world data are collected, the data graphed usually do not form a straight line. However, the graph may approximate a linear relationship.

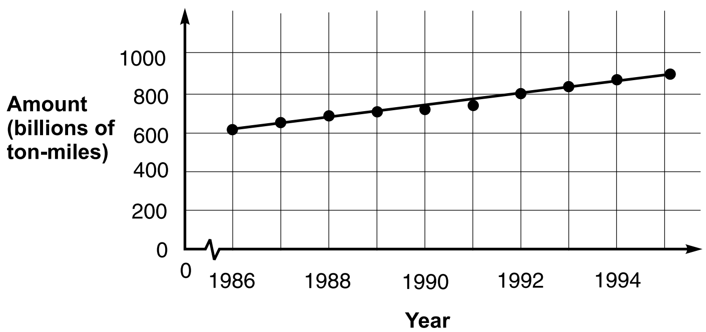
Example **The table shows the amount of freight hauled by trucks in the United States. Use the data to draw a line of best fit and to predict the amount of freight that will be carried by trucks in the year 2010.**

U.S. Truck Freight Traffic

Year	Amount (billions of ton-miles)
1986	632
1987	663
1988	700
1989	716
1990	735
1991	758
1992	815
1993	861
1994	908
1995	921

Source: *Transportation in America*

Graph the data on a scatter plot. Use the year as the independent variable and the ton-miles as the dependent variable. Draw a line of best fit, with some points on the line and others close to it.



Write a prediction equation for the data. Select two points that appear to represent the data. We chose (1990, 735) and (1993, 861).

Determine the slope of the line.

$$m = \frac{y_2 - y_1}{x_2 - x_1} \rightarrow \frac{861 - 735}{1993 - 1990} = \frac{126}{3} \text{ or } 42$$

Use one of the ordered pairs, such as (1990, 735), and the slope in the point-slope form of the equation.

$$y - y_1 = m(x - x_1)$$
$$y - 735 = 42(x - 1990)$$
$$y = 42x - 82{,}845$$

A prediction equation is $y = 42x - 82{,}845$. Substitute 2010 for x to estimate the average amount of freight a truck will haul in 2010.

$$y = 42x - 82{,}845$$
$$y = 42(2010) - 82{,}845$$
$$y = 1575$$

According to this prediction equation, trucks will haul 1575 billion ton-miles in 2010.

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Practice

Modeling Real-World Data with Linear Functions

Complete the following for each set of data.

a. ***Graph the data on a scatter plot.***

b. ***Use two ordered pairs to write the equation of a best-fit line.***

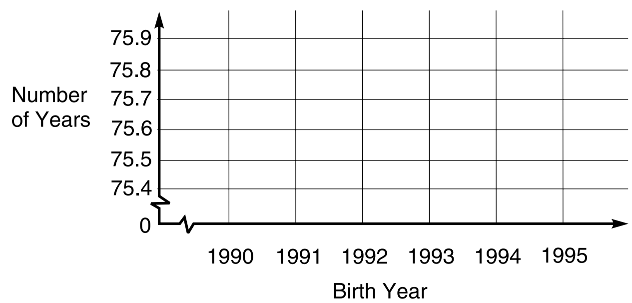
c. ***If the equation of the regression line shows a moderate or strong relationship, predict the missing value. Explain whether you think the prediction is reliable.***

1.

U. S. Life Expectancy	
Birth Year	**Number of Years**
1990	75.4
1991	75.5
1992	75.8
1993	75.5
1994	75.7
1995	75.8
2015	?

Source: National Center for Health Statistics

a.

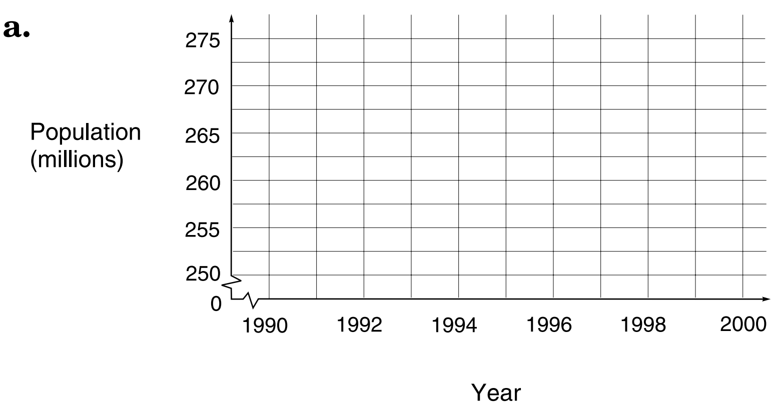


2.

Population Growth	
Year	**Population (millions)**
1991	252.1
1992	255.0
1993	257.7
1994	260.3
1995	262.8
1996	265.2
1997	267.7
1998	270.3
1999	272.9
2010	?

Source: U.S. Census Bureau

a.



1-6

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Enrichment

Significant Digits

All measurements are approximations. The **significant digits** of an approximate number are those which indicate the results of a measurement.

For example, the mass of an object, measured to the nearest gram, is 210 grams. The measurement $21\underline{0}$ g has 3 significant digits. The mass of the same object, measured to the nearest 100 g, is 200 g. The measurement 200 g has one significant digit.

Several identifying characteristics of significant digits are listed below, with examples.

1. Non-zero digits and zeros between significant digits are significant. For example, the measurement 9.071 m has 4 significant digits, 9, 0, 7, and 1.
2. Zeros at the end of a decimal fraction are significant. The measurement 0.050 mm has 2 significant digits, 5 and 0.
3. Underlined zeros in whole numbers are significant. The measurement $104{,}0\underline{0}0$ km has 5 significant digits, 1, 0, 4, 0, and 0.

In general, a computation involving multiplication or division of measurements *cannot* be more accurate than the least accurate measurement of the computation. Thus, the result of computation involving multiplication or division of measurements should be rounded to the number of significant digits in the least accurate measurement.

Example **The mass of 37 quarters is $21\underline{0}$ g. Find the mass of one quarter.**

mass of 1 quarter $= 21\underline{0}$ g ÷ 37 — *$21\underline{0}$ has 3 significant digits.*
$= 5.68$ g — *37 does not represent a measurement.*
Round the result to 3 significant digits.
Why?

Write the number of significant digits for each measurement.

1. 8314.20 m **2.** 30.70 cm **3.** 0.01 mm **4.** 0.0605 mg

5. $37\underline{0}{,}000$ km **6.** $370{,}0\underline{0}0$ km **7.** 9.7×10^4 g **8.** 3.20×10^{-2} g

Solve each problem. Round each result to the correct number of significant digits.

9. 23 m × 1.54 m **10.** $12{,}0\underline{0}0$ ft ÷ $52\underline{0}$ ft **11.** 2.5 cm × 25

12. 11.01 mm × 11 **13.** 908 yd ÷ 0.5 **14.** 38.6 m × 4.0 m

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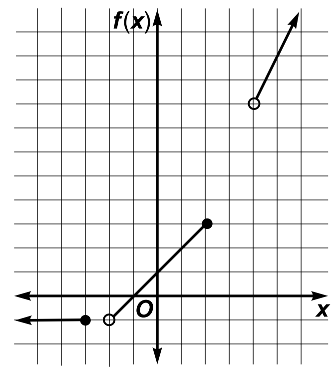
Study Guide

Piecewise Functions

Piecewise functions use different equations for different intervals of the domain. When graphing piecewise functions, the partial graphs over various intervals do not necessarily connect.

Example 1 **Graph** $f(x) = \begin{cases} -1 & \text{if } x \le -3 \\ 1 + x & \text{if } -2 < x \le 2 \\ 2x & \text{if } x > 4 \end{cases}$



First, graph the constant function $f(x) = -1$ for $x \le -3$. This graph is a horizontal line. Because the point at $(-3, -1)$ is included in the graph, draw a closed circle at that point.

Second, graph the function $f(x) = 1 + x$ for $-2 < x \le 2$. Because $x = -2$ is not included in this region of the domain, draw an open circle at $(-2, -1)$. The value of $x = 2$ is included in the domain, so draw a closed circle at $(2, 3)$ since for $f(x) = 1 + x$, $f(2) = 3$.

Third, graph the line $f(x) = 2x$ for $x > 4$. Draw an open circle at $(4, 8)$ since for $f(x) = 2x$, $f(4) = 8$.

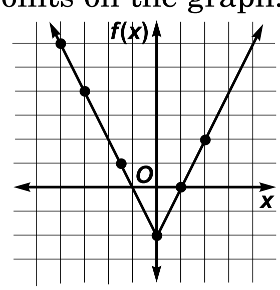
A piecewise function whose graph looks like a set of stairs is called a **step function**. One type of step function is the **greatest integer function**. The symbol $[\![x]\!]$ means *the greatest integer not greater than x*. The graphs of step functions are often used to model real-world problems such as fees for phone services and the cost of shipping an item of a given weight.

The **absolute value function** is another piecewise function. Consider $f(x) = |x|$. The absolute value of a number is always nonnegative.

Example 2 **Graph** $f(x) = 2|x| - 2$.

Use a table of values to determine points on the graph.

x	$2\|x\| - 2$	$(x, f(x))$
−4	$2\|-4\| - 2$	(−4, 6)
−3	$2\|-3\| - 2$	(−3, 4)
−1.5	$2\|-1.5\| - 2$	(−1.5, 1)
0	$2\|0\| - 2$	(0, −2)
1	$2\|1\| - 2$	(1, 0)
2	$2\|2\| - 2$	(2, 2)



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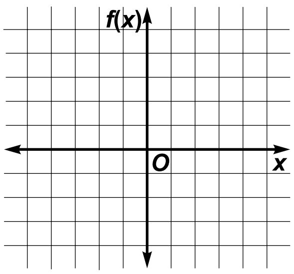
1-7 Practice

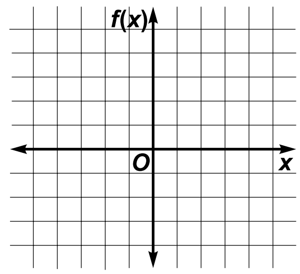
Piecewise Functions

Graph each function.

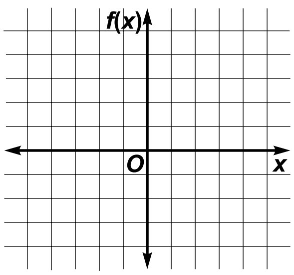
1. $f(x) = \begin{cases} 1 \text{ if } x \geq 2 \\ x \text{ if } -1 \leq x < 2 \\ -x - 3 \text{ if } x < -2 \end{cases}$



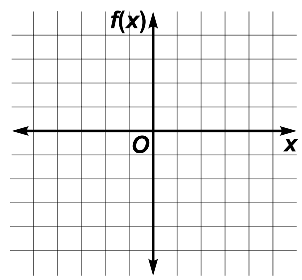
2. $f(x) = \begin{cases} -2 \text{ if } x \leq -1 \\ 1 + x \text{ if } -1 < x < 2 \\ 1 - x \text{ if } x > 2 \end{cases}$



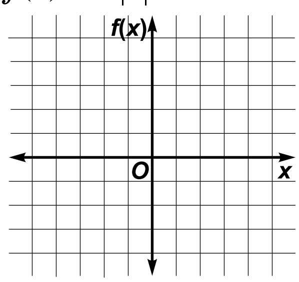
3. $f(x) = |x| - 3$



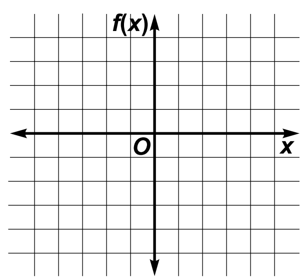
4. $f(x) = [\![x]\!] - 1$



5. $f(x) = 3|x| - 2$



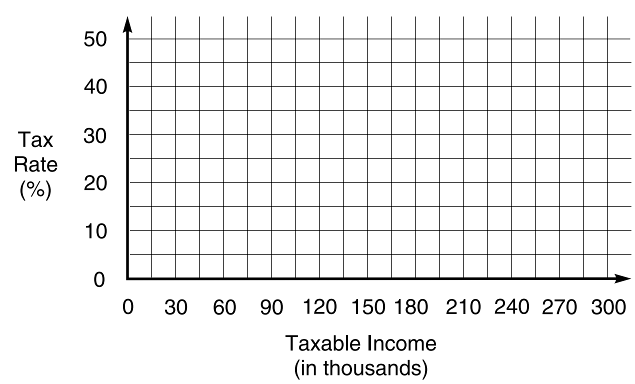
6. $f(x) = [\![2x + 1]\!]$



7. Graph the tax rates for the different incomes by using a step function.

Income Tax Rates for a Couple Filing Jointly	
Limits of Taxable Income	**Tax Rate**
$0 to $41,200	15%
$41,201 to $99,600	28%
$99,601 to $151,750	31%
$151,751 to $271,050	36%
$271,051 and up	39.6%

Source: Information Please Almanac



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Enrichment

Modus Ponens

A **syllogism** is a deductive argument in which a conclusion is inferred from two premises. Whether a syllogistic argument is valid or invalid is determined by its form. Consider the following syllogism.

Premise 1: If a line is perpendicular to line m, then the slope of that line is $-\frac{3}{5}$.
Premise 2: Line ℓ is perpendicular to line m.
Conclusion: $\therefore$ The slope of line ℓ is $-\frac{3}{5}$.

Any statement of the form, "if p, then q," such as the statement in premise 1, can be written symbolically as $p \rightarrow q$. We read this "p implies q."

The syllogism above is valid because the argument form,

Premise 1: $p \rightarrow q$
Premise 2: p
Conclusion: $\therefore q$

(This argument says that if p implies q is true and p is true, then q must be true.)

is a valid argument form.

The argument form above has the Latin name **modus ponens**, which means "a manner of affirming." Any *modus ponens* argument is a valid argument.

Decide whether each argument is a modus ponens argument.

1. If the graph of a relation passes the vertical line test, then the relation is a function. The graph of the relation $f(x)$ does not pass the vertical line test. Therefore, $f(x)$ is not a function.

2. If you know the Pythagorean Theorem, you will appreciate Shakespeare. You do know the Pythagorean Theorem. Therefore, you will appreciate Shakespeare.

3. If the base angles of a triangle are congruent, then the triangle is isosceles. The base angles of triangle ABC are congruent. Therefore, triangle ABC is isosceles.

4. When $x = -3$, $x^2 = 9$. Therefore, if $t = -3$, it follows that $t^2 = 9$.

5. Since $x > 10$, $x > 0$. It is true that $x > 0$. Therefore, $x > 10$.

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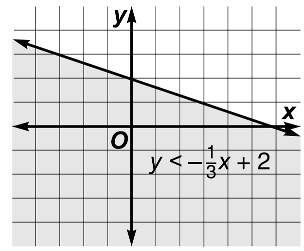
Study Guide

Graphing Linear Inequalities

The graph of $y = -\frac{1}{3}x + 2$ is a line that separates the coordinate plane into two regions, called **half planes**. The line described by $y = -\frac{1}{3}x + 2$ is called the **boundary** of each region. If the boundary is part of a graph, it is drawn as a solid line. A boundary that is not part of the graph is drawn as a dashed line.



The graph of $y > -\frac{1}{3}x + 2$ is the region above the line. The graph of $y < -\frac{1}{3}x + 2$ is the region below the line.

You can determine which half plane to shade by testing a point on either side of the boundary in the original inequality. If it is not on the boundary, (0, 0) is often an easy point to test. If the inequality is true for your test point, then shade the half plane that contains the test point. If the inequality is false for your test point, then shade the half plane that does not contain the test point.

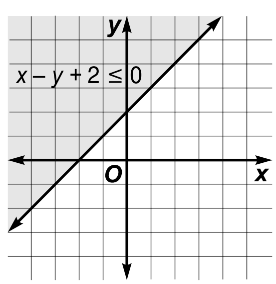
Example **Graph each inequality.**

a. $\boldsymbol{x - y + 2 \leq 0}$

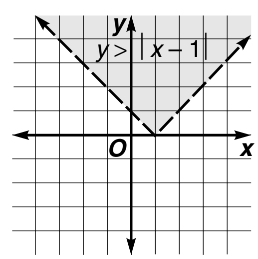
$$x - y + 2 \leq 0$$
$$-y \leq -x - 2$$
$$y \geq x + 2$$

Reverse the inequality when you divide or multiply by a negative.

The graph does include the boundary, so the line is solid. Testing (0, 0) in the inequality yields a false inequality, $0 \geq 2$. Shade the half plane that does not include (0, 0).



b. $\boldsymbol{y > |x - 1|}$



Graph the equation with a dashed boundary. Then test a point to determine which region is shaded. The test point (0, 0) yields the false inequality $0 > 1$, so shade the region that does not include (0, 0).

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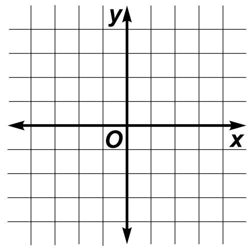
1-8

Practice

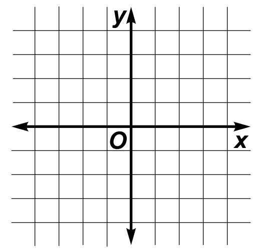
Graphing Linear Inequalities

Graph each inequality.

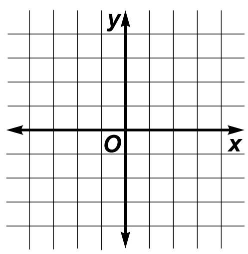
1. $x \geq -2$



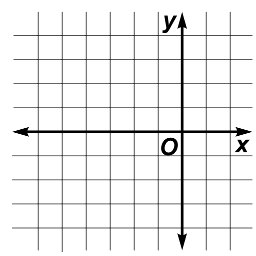
2. $y < -2x - 4$



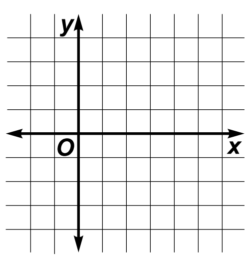
3. $y \geq 3x + 2$



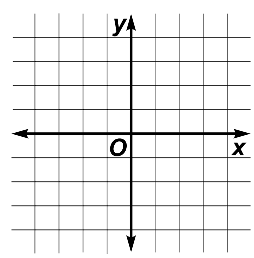
4. $y < |x + 3|$



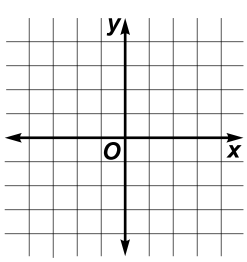
5. $y > |x - 2|$



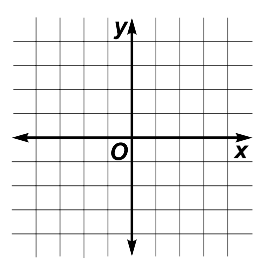
6. $y \leq -\frac{1}{2}x + 4$



7. $\frac{3}{4}x - 3 \leq y \leq \frac{4}{5}x + 4$



8. $-4 \leq x - 2y < 6$



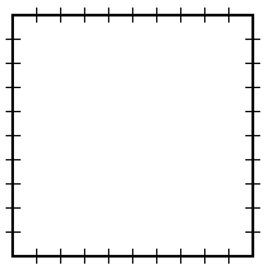
NAME ______________________ DATE ______________ PERIOD ________

Enrichment

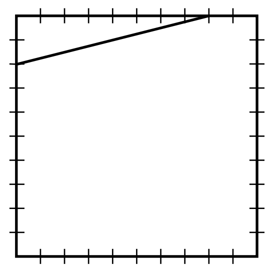
Line Designs: Art and Geometry

Iteration paths that spiral in toward an attractor or spiral out from a repeller create interesting designs. By inscribing polygons within polygons and using the techniques of line design, you can create your own interesting spiral designs that create an illusion of curves.

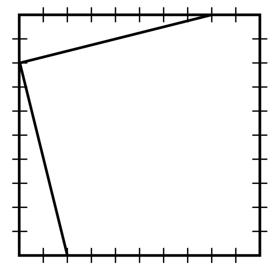
1. Mark off equal units on the sides of a square.



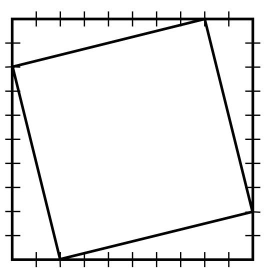
2. Connect two points that are equal distances from adjacent vertices.



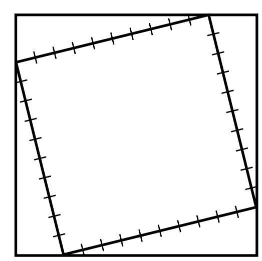
3. Draw the second (adjacent) side of the inscribed square.



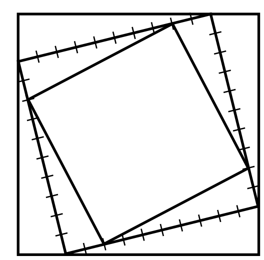
4. Draw the other two sides of the inscribed square



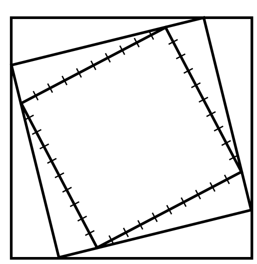
5. Repeat Step 1 for the inscribed square. (Use the same number of divisions).



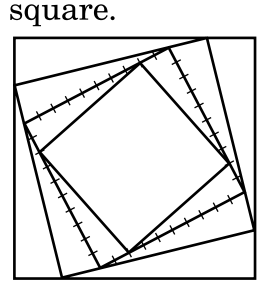
6. Repeat Steps 2, 3, and 4 for the inscribed square.



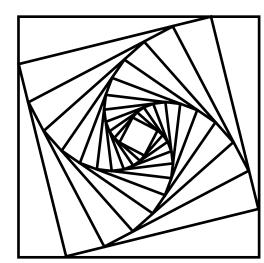
7. Repeat Step 1 for the new square.



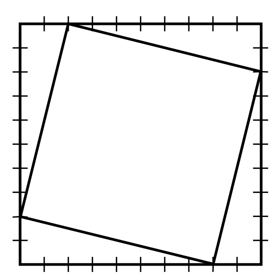
8. Repeat Steps 2, 3, and 4, for the third inscribed square.



9. Repeat the procedure as often as you wish.



10. Suppose your first inscribed square is a clockwise rotation like the one at the right. How will the design you create compare to the design created above, which used a counterclockwise rotation?



11. Create other spiral designs by inscribing triangles within triangles and pentagons within pentagons.

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Chapter 1

Chapter 1 Test, Form 1A

Write the letter for the correct answer in the blank at the right of each problem.

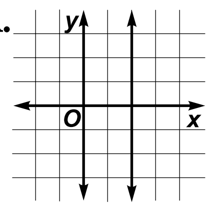
1. What are the domain and range of the relation $\{(-1, -2), (1, -2), (3, 1)\}$? Is the relation a function? Choose *yes* or *no*. **1.** ________

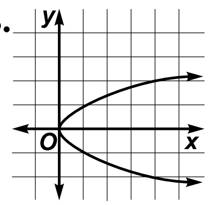
A. $D = \{-1, 1, 3\}; R = \{-2, 1\}$; yes **B.** $D = \{-2, 1\}; R = \{-1, 1, 3\}$; no
C. $D = \{-1, -2, 3\}; R = \{-1, 1\}$; no **D.** $D = \{-2, 1\}; R = \{-2, 1\}$; yes

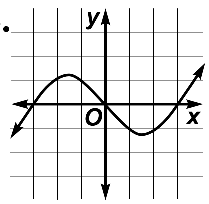
2. Given $f(x) = x^2 + 2x$, find $f(a - 3)$. **2.** ________

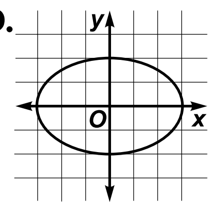
A. $a^2 - 4a + 3$ **B.** $a^2 + 2a - 15$ **C.** $a^2 + 8a + 3$ **D.** $a^2 - 4a + 6$

3. Which relation is a function? **3.** ________

A.


B.


C.


D.


4. If $f(x) = \frac{x}{x - 3}$ and $g(x) = 2x - 1$, find $(f - g)(x)$. **4.** ________

A. $\frac{-2x^2 + 8x - 3}{x - 3}$ **B.** $\frac{-2x^2 + 6x + 1}{x - 3}$ **C.** $\frac{-2x^2 + 5x - 3}{x - 3}$ **D.** $\frac{2x^2 + 6x + 3}{x - 3}$

5. If $f(x) = x^2 + 1$ and $g(x) = \frac{1}{x}$, find $[f \circ g](x)$. **5.** ________

A. $x + \frac{1}{x}$ **B.** $\frac{1}{x^2}$ **C.** $\frac{1}{x^2 + 1}$ **D.** $\frac{1}{x^2} + 1$

6. Find the zero of $f(x) = -\frac{2}{3}x - 12$. **6.** ________

A. -18 **B.** -12 **C.** 12 **D.** 18

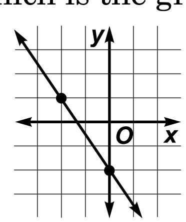
7. Which equation represents a line perpendicular to the graph of $x + 3y = 9$? **7.** ________

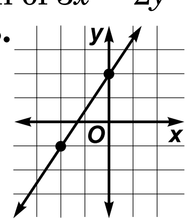
A. $y = -\frac{1}{3}x - 1$ **B.** $y = 3x - 1$ **C.** $y = -3x + 1$ **D.** $y = -\frac{1}{3}x + 1$

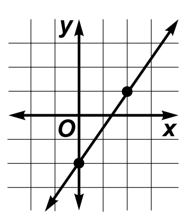
8. Find the slope and y-intercept of the graph $2x + 3y - 3 = 0$. **8.** ________

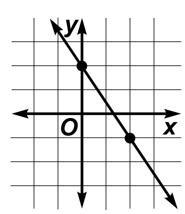
A. $m = \frac{2}{3}, b = -3$ **B.** $m = -\frac{2}{3}, b = \frac{3}{2}$
C. $m = 1, b = 2$ **D.** $m = -\frac{2}{3}, b = 1$

9. Which is the graph of $3x - 2y = 4$? **9.** ________

A.


B.


C.


D.


10. Line k passes through $A(-3, -5)$ and has a slope of $-\frac{1}{3}$. What is the standard form of the equation for line k? **10.** ________

A. $-x + 3y + 18 = 0$ **B.** $x + 3y + 12 = 0$
C. $x + 3y + 18 = 0$ **D.** $x + 3y - 18 = 0$

11. Write an equation in slope-intercept form for a line passing through $A(4, -3)$ and $B(10, 5)$. **11.** ________

A. $y = \frac{4}{3}x + \frac{25}{3}$ **B.** $y = -\frac{4}{3}x + \frac{7}{3}$ **C.** $y = \frac{4}{3}x - \frac{25}{3}$ **D.** $y = \frac{4}{3}x - \frac{10}{3}$

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Chapter 1 Test, Form 1A (continued)

12. Write an equation in slope-intercept form for a line with a slope of $\frac{1}{10}$ and a y-intercept of -2. **12.** ________

A. $y = 0.1x + 200$ **B.** $y = 0.1x + 2$
C. $y = 0.1x - 20$ **D.** $y = 0.1x - 2$

13. Write an equation in standard form for a line with an x-intercept of 2 and a y-intercept of 5. **13.** ________

A. $2x + 5y - 25 = 0$ **B.** $5x + 2y - 5 = 0$
C. $2x + 5y + 5 = 0$ **D.** $5x + 2y - 10 = 0$

14. Which of the following describes the graphs of $2x + 5y = 9$ and $10x = 4y + 18$? **14.** ________

A. parallel **B.** coinciding **C.** perpendicular **D.** none of these

15. Write the standard form of the equation of the line parallel to the graph of $2y - 6 = 0$ and passing through $B(4, -1)$. **15.** ________

A. $x - 4 = 0$ **B.** $x + 1 = 0$ **C.** $y + 1 = 0$ **D.** $y - 4 = 0$

16. Write an equation of the line perpendicular to the graph of $x - 2y - 6 = 0$ and passing through $A(-3, 2)$. **16.** ________

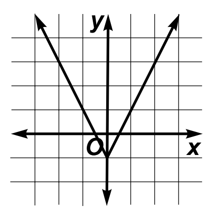
A. $2x + y + 4 = 0$ **B.** $x - y + 4 = 0$
C. $x - 2y + 7 = 0$ **D.** $2x + y - 8 = 0$

17. The table shows data for vehicles sold by a certain automobile dealer during a six-year period. Which equation best models the data in the table? **17.** ________

Year	1994	1995	1996	1997	1998	1999
Number of Vehicles Sold	720	710	800	840	905	945

A. $y = x + 945$ **B.** $y = 720$
C. $y = 45x - 89{,}010$ **D.** $y = -45x - 945$

18. Which function describes the graph? **18.** ________

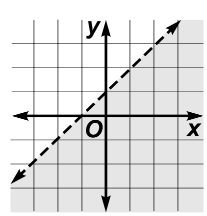


A. $f(x) = |x| - 1$ **B.** $f(x) = |2x| - 1$
C. $f(x) = |2x| + 1$ **D.** $f(x) = \frac{1}{2}|x| - 1$

19. The cost of renting a car is \$125 a day. Write a function for the situation where d represents the number of days. **19.** ________

A. $c(d) = 125d + \frac{125}{24}d$ **B.** $c(d) = 125[\![d + 1]\!]$
C. $c(d) = \begin{cases} 125d \text{ if } [\![d]\!] = d \\ 125[\![d + 1]\!] \text{ if } [\![d]\!] < d \end{cases}$ **D.** $c(d) = \begin{cases} 125d \text{ if } [\![d]\!] = d \\ 125[\![d - 1]\!] \text{ if } [\![d]\!] < d \end{cases}$

20. Which inequality describes the graph? **20.** ________



A. $y \leq x$ **B.** $x + 1 \geq y$
C. $2x + y \leq 0$ **D.** $x \leq 7$

Bonus Find the value of k such that $-\frac{2}{3}$ is a zero of the function $f(x) = \frac{4x + k}{7}$. **Bonus:** ________

A. $-\frac{14}{3}$ **B.** $-\frac{7}{6}$ **C.** $\frac{1}{6}$ **D.** $\frac{8}{3}$

NAME ______________________ DATE ______________ PERIOD ________

Chapter 1 Test, Form 1B

Write the letter for the correct answer in the blank at the right of each problem.

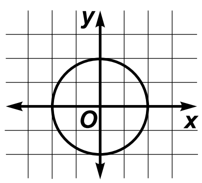
1. What are the domain and range of the relation {(4, −1), (4, 1), (3, 2)}? Is the relation a function? Choose *yes* or *no*. **1.** ________

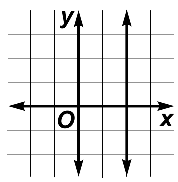
A. $D = \{-1, 1, 2\}; R = \{1, 2\}$; no **B.** $D = \{4, 3, 2\}; R = \{-1, 1\}$; yes
C. $D = \{4, 3\}; R = \{-1, 1, 2\}$; no **D.** $D = \{4, -1, 3, 2\}; R = \{1\}$; no

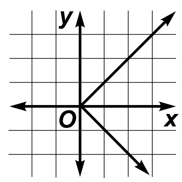
2. Given $f(x) = -x^2 + 2x$, find $f(-3)$. **2.** ________

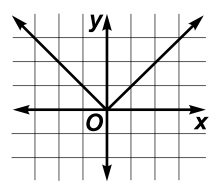
A. 3 **B.** −15 **C.** 15 **D.** −10

3. Which relation is a function? **3.** ________

A.


B.


C.


D.


4. If $f(x) = \frac{1}{x+2}$ and $g(x) = 3x$, find $(f - g)(x)$. **4.** ________

A. $\frac{-3x^2 - 6x + 1}{x + 2}$ **B.** $\frac{-3x^2 + 6x + 1}{x + 2}$ **C.** $\frac{-3x^2 - 6x - 1}{x + 2}$ **D.** $\frac{3x^2 + 6x + 1}{x + 2}$

5. If $f(x) = x^2 + 1$ and $g(x) = x + 2$, find $[f \circ g](x)$. **5.** ________

A. $x^2 + 4$ **B.** $x^2 + 5$ **C.** $x^2 + 4x + 4$ **D.** $x^2 + 4x + 5$

6. Find the zero of $f(x) = \frac{3}{4}x - 12$. **6.** ________

A. −12 **B.** −16 **C.** 9 **D.** 16

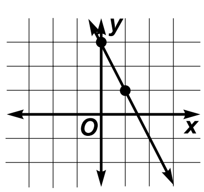
7. Which equation represents a line perpendicular to the graph of $2y - x = 2$? **7.** ________

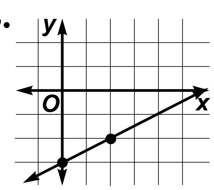
A. $y = \frac{1}{2}x - 2$ **B.** $y = -4x + 2$ **C.** $y = -2x + 1$ **D.** $y = -\frac{1}{2}x + 2$

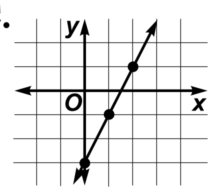
8. Find the slope and y-intercept of the graph of $5x - 3y + 6 = 0$. **8.** ________

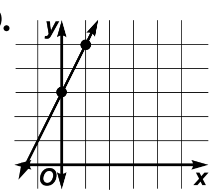
A. $m = \frac{1}{2}, b = 4$ **B.** $m = \frac{5}{3}, b = 2$
C. $m = \frac{3}{5}, b = 4$ **D.** $m = 2, b = \frac{1}{2}$

9. Which is the graph of $4x - 2y = 6$? **9.** ________

A.


B.


C.


D.


10. Write an equation in standard form for a line with a slope of $\frac{1}{2}$ and passing through $A(1, 2)$. **10.** ________

A. $x - 2y - 3 = 0$ **B.** $x - 2y + 3 = 0$
C. $-x + 2y + 3 = 0$ **D.** $-x - 2y + 3 = 0$

11. Which is an equation for the line passing through $B(0, 3)$ and $C(-3, 4)$? **11.** ________

A. $x - 3y - 9 = 0$ **B.** $3x - y - 3 = 0$
C. $3x + y - 3 = 0$ **D.** $x + 3y - 9 = 0$

NAME ________________________________ DATE ______________ PERIOD ________

Chapter 1 Test, Form 1B (continued)

12. Write an equation in slope-intercept form for the line passing through $A(-2, 1)$ and having a slope of 0.5. **12.** ________

A. $y = 0.5x + 2$ **B.** $y = 0.5x$ **C.** $y = 0.5x + 3$ **D.** $y = 0.5x + 1$

13. Write an equation in standard form for a line with an x-intercept of 3 and a y-intercept of 6. **13.** ________

A. $2y + x - 6 = 0$ **B.** $y + 2x - 6 = 0$
C. $y + 2x - 3 = 0$ **D.** $2y + x + 3 = 0$

14. Which describes the graphs of $2x - 3y = 9$ and $4x = 6y + 18$? **14.** ________

A. parallel **B.** coinciding **C.** perpendicular **D.** none of these

15. Write the standard form of an equation of the line parallel to the graph of $x - 2y - 6 = 0$ and passing through $A(-3, 2)$. **15.** ________

A. $x + 2y - 1 = 0$ **B.** $x - 2y - 1 = 0$
C. $x - 2y + 7 = 0$ **D.** $x + 2y + 7 = 0$

16. Write an equation of the line perpendicular to the graph of $2y - 6 = 0$ and passing through $C(4, -1)$. **16.** ________

A. $x - 4 = 0$ **B.** $x + 1 = 0$ **C.** $y + 1 = 0$ **D.** $y - 4 = 0$

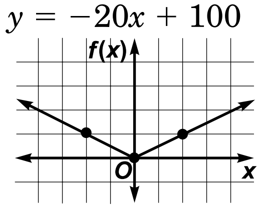
17. A laboratory test exposes 100 weeds to a certain herbicide. Which equation best models the data in the table? **17.** ________

Week	0	1	2	3	4	5
Number of Weeds Remaining	100	82	64	39	24	0

A. $y = 100$ **B.** $y = x + 100$ **C.** $y = 20x + 5$ **D.** $y = -20x + 100$

18. Which function describes the graph? **18.** ________

A. $f(x) = |x|$ **B.** $f(x) = |2x|$
C. $f(x) = |x - 2|$ **D.** $f(x) = \frac{1}{2}|x|$



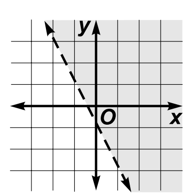
19. The cost of renting a washer and dryer is \$30 for the first month, \$55 for two months, and \$20 per month for more than two months, up to one year. Write a function for the situation where m represents the number of months. **19.** ________

A. $c(m) = \begin{cases} 30 \text{ if } 0 < m \le 1 \\ 55 \text{ if } 1 < m \le 2 \\ 20m \text{ if } 2 < m \le 12 \end{cases}$ **B.** $c(m) = \begin{cases} 30 \text{ if } 0 < m < 1 \\ 55 \text{ if } 1 \le m < 2 \\ 20m \text{ if } 2 \le m \end{cases}$

C. $c(m) = 20m + 30$ **D.** $c(m) = 30(m + 1) + 55(m + 2) + 20(m + 3)$

20. Which inequality describes the graph? **20.** ________

A. $y > -2x$
B. $-\frac{1}{2}x - 1 < y$
C. $y > -2x - 1$
D. $y < -2x - 1$



Bonus For what value of k will the graph of $2x + ky = 6$ be perpendicular to the graph of $6x - 4y = 12$? **Bonus:** ________

A. $-\frac{4}{3}$ **B.** $\frac{4}{3}$ **C.** -3 **D.** 3

NAME ______________________ DATE ____________ PERIOD ________

Chapter 1 Test, Form 1C

Write the letter for the correct answer in the blank at the right of each problem.

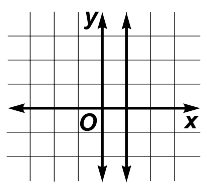
1. What are the domain and range of the relation {(2, 2), (4, 2), (6, 2)}? Is the relation a function? Choose *yes* or *no*. **1.** ________

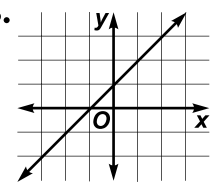
A. $D = \{2\}; R = \{2, 4, 6\}$; yes **B.** $D = \{2\}; R = \{2, 4, 6\}$; no
C. $D = \{2, 4, 6\}; R = \{2\}$; no **D.** $D = \{2, 4, 6\}; R = \{2\}$; yes

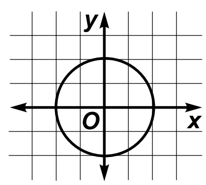
2. Given $f(x) = x^2 - 2x$, find $f(4)$. **2.** ________

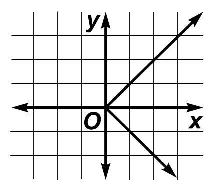
A. 0 **B.** −8 **C.** 8 **D.** 24

3. Which relation is a function? **3.** ________

A. 

B. 

C. 

D. 

4. If $f(x) = x - 3$ and $g(x) = 2x - 4$, find $(f + g)(x)$. **4.** ________

A. $3x - 7$ **B.** $-x - 7$ **C.** $-x + 1$ **D.** $3x + 1$

5. If $f(x) = x^2 + 1$ and $g(x) = 2x$, find $[f \circ g](x)$. **5.** ________

A. $2x^2 + 2$ **B.** $2x^2 + 1$ **C.** $x^2 + 4x + 4$ **D.** $4x^2 + 1$

6. Find the zero of $f(x) = 5x - 2$. **6.** ________

A. $\frac{2}{5}$ **B.** −2 **C.** 2 **D.** $-\frac{2}{5}$

7. Which equation represents a line perpendicular to the graph of $2x + y = 2$? **7.** ________

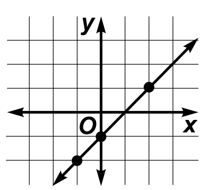
A. $y = -\frac{1}{2}x - 2$ **B.** $y = 2x - 2$ **C.** $y = -2x + 2$ **D.** $y = \frac{1}{2}x + 2$

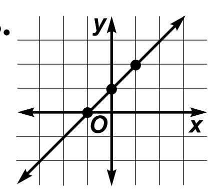
8. Find the slope and y-intercept of the graph of $3x - 2y + 8 = 0$. **8.** ________

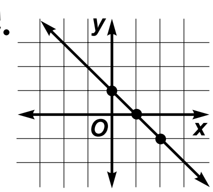
A. $m = \frac{3}{8}, b = 4$ **B.** $m = \frac{5}{3}, b = 2$

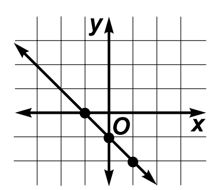
C. $m = \frac{3}{2}, b = 4$ **D.** $m = 2, b = \frac{1}{2}$

9. Which is the graph of $x - y = 1$? **9.** ________

A. 

B. 

C. 

D. 

10. Write an equation in standard form for a line with a slope of −1 passing through $C(2, 1)$. **10.** ________

A. $x + y + 3 = 0$ **B.** $x + y - 3 = 0$
C. $-x + y - 3 = 0$ **D.** $x - y + 3 = 0$

11. Write an equation in standard form for a line passing through $A(-2, 3)$ and $B(3, 4)$. **11.** ________

A. $5x - y - 17 = 0$ **B.** $x - y - 1 = 0$
C. $x - 5y - 19 = 0$ **D.** $x - 5y + 17 = 0$

NAME ______________________ DATE ____________ PERIOD ________

Chapter 1 Test, Form 1C (continued)

12. Write an equation in slope-intercept form for a line with a slope of 2 and a y-intercept of 1. **12.** ________

A. $y = -2x + 1$ **B.** $y = 2x + 2$ **C.** $y = \frac{1}{2}x + 3$ **D.** $y = 2x + 1$

13. Write an equation in standard form for a line with a slope of 2 and a y-intercept of 3. **13.** ________

A. $2x - y + 3 = 0$ **B.** $\frac{1}{2}x + y - 3 = 0$

C. $2x + y - 3 = 0$ **D.** $-2x + y + 3 = 0$

14. Which of the following describes the graphs of $2x - 3y = 9$ and $6x - 9y = 18$? **14.** ________

A. parallel **B.** coinciding

C. perpendicular **D.** none of these

15. Write the standard form of the equation of the line parallel to the graph of $x - 2y - 6 = 0$ and passing through $C(0, 1)$. **15.** ________

A. $x + 2y + 2 = 0$ **B.** $x - 2y + 2 = 0$

C. $2x - y + 2 = 0$ **D.** $2x + y + 2 = 0$

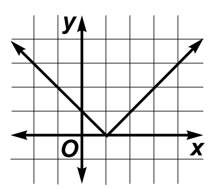
16. Write an equation of the line perpendicular to the graph of $x = 3$ and passing through $D(4, -1)$. **16.** ________

A. $x - 4 = 0$ **B.** $x + 1 = 0$ **C.** $y + 1 = 0$ **D.** $y - 4 = 0$

17. What does the correlation value r for a regression line describe about the data? **17.** ________

A. It describes the accuracy of the data.
B. It describes the domain of the data.
C. It describes how closely the data fit the line.
D. It describes the range of the data.

18. Which function describes the graph? **18.** ________



A. $f(x) = |x + 1|$ **B.** $f(x) = |x - 1|$

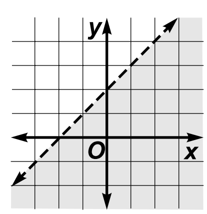
C. $f(x) = |x| - 1$ **D.** $f(x) = |x| + 1$

19. A canoe rental shop on Lake Carmine charges \$10 for one hour or less or \$25 for the day. Write a function for the situation where t represents time in hours. **19.** ________

A. $c(t) = \begin{cases} 10 \text{ if } t = 1 \\ 25 \text{ if } 1 < t \end{cases}$ **B.** $c(t) = \begin{cases} 10 \text{ if } 0 < t \leq 1 \\ 25 \text{ if } 1 < t \leq 24 \end{cases}$

C. $c(t) = 10t$ **D.** $c(t) = 25 - 10t$

20. Which inequality describes the graph? **20.** ________



A. $y - x < 2$
B. $2x - 1 \leq y$
C. $x - y \geq 2$
D. $y \leq x + 2$

Bonus For what value of k will the graph of $6x + ky = 6$ be perpendicular to the graph of $2x - 6y = 12$? **Bonus:** ________

A. $\frac{1}{2}$ **B.** 4 **C.** 2 **D.** 5

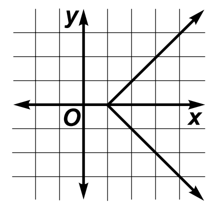
NAME ____________________ DATE ______________ PERIOD ________

Chapter 1 Test, Form 2A

1. State the domain and range of the relation $\{(-2, -1), (0, 0), (1, 0), (2, 1), (-1, 2)\}$. Then state whether the relation is a function. Write *yes* or *no*. **1.** ______________

2. If $f(x) = 2x^2 - x$, find $f(x + h)$. **2.** ______________

3. State the domain and range of the relation whose graph is shown. Then state whether the relation is a function. Write *yes* or *no*. **3.** ______________



Given $f(x) = x - 3$ and $g(x) = \frac{1}{x^2 - 9}$, find each function.

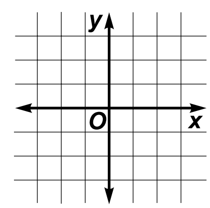
4. $(f \cdot g)(x)$ **4.** ______________

5. $[g \circ f](x)$ **5.** ______________

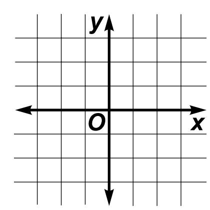
6. Find the zero of $f(x) = 4x + \frac{2}{3}$. **6.** ______________

Graph each equation.

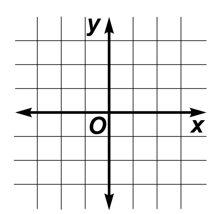
7. $4y + 8 = 0$ **7.**



8. $y = -\frac{1}{3}x + 2$ **8.**



9. $3x - 2y - 2 = 0$ **9.**



10. ***Depreciation*** A car that sold for $18,600 new in 1993 is valued at $6000 in 1999. Find the slope of the line through the points at (1993, 18,600) and (1999, 6000). What does this slope represent? **10.** ______________

NAME ______________________ DATE ______________ PERIOD ________

Chapter 1 Test, Form 2A (continued)

11. Write an equation in slope-intercept form for a line that passes through the point $C(-2, 3)$ and has a slope of $\frac{2}{3}$. **11.** ______________

12. Write an equation in standard form for a line passing through $A(2, 1)$ and $B(-4, 3)$. **12.** ______________

13. Determine whether the graphs of $4x - y + 2 = 0$ and $2y = 8x + 4$ are *parallel, coinciding, perpendicular,* or *none of these.* **13.** ______________

14. Write the slope-intercept form of the equation of the line that passes through $C(2, -3)$ and is parallel to the graph of $3x - 2y - 6 = 0$. **14.** ______________

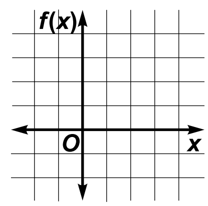
15. Write the standard form of the equation of the line that passes through $C(3, 4)$ and is perpendicular to the line that passes through $E(4, 1)$ and $F(-2, 4)$. **15.** ______________

16. The table displays data for a toy store's sales of a specific toy over a six-month period. Write the prediction equation in slope-intercept form for the best-fit line. Use the points (1, 47) and (6, 32). **16.** ______________

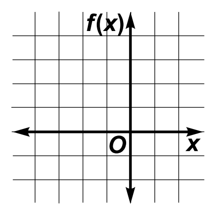
Month	1	2	3	4	5	6
Number of Toys Sold	47	42	43	38	37	32

Graph each function.

17. $f(x) = 2|x - 1| - 2$ **17.**

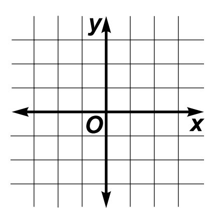


18. $f(x) = \begin{cases} x + 3 \text{ if } x < 0 \\ 2x \text{ if } x \geq 0 \end{cases}$ **18.**

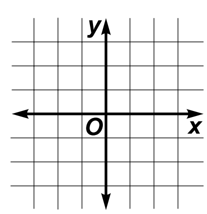


Graph each inequality.

19. $-2 \leq x - 2y \leq 4$ **19.**



20. $y < -|x + 1| + 2$ **20.**



Bonus If $f(x) = \sqrt{x + 2}$ and $(f \circ g)(x) = |x|$, find $g(x)$. **Bonus:** ______________

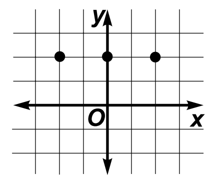
NAME ______________________ DATE ______________ PERIOD _________

Chapter 1 Test, Form 2B

1. State the domain and range of the relation {(−3, 1), (−1, 0), (0, 4), (−1, 5)}. Then state whether the relation is a function. Write *yes* or *no*. **1.** ______________

2. If $f(x) = 3x^2 - 4$, find $f(a - 2)$. **2.** ______________

3. State the relation shown in the graph as a set of ordered pairs. Then state whether the relation is a function. Write *yes* or *no*. **3.** ______________



Given $f(x) = x^2 + 4$ and $g(x) = \frac{1}{x-2}$, find each function.

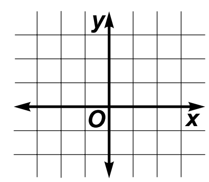
4. $\frac{f(x)}{g(x)}$ **4.** ______________

5. $(g \circ f)(x)$ **5.** ______________

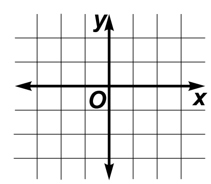
6. Find the zero of $f(x) = -\frac{2}{3}x - 8$. **6.** ______________

Graph each equation.

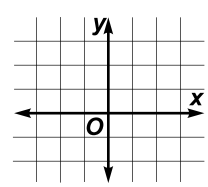
7. $x + 2 = 0$ **7.**



8. $y = 3x - 2$ **8.**



9. $2x + 3y - 6 = 0$ **9.**



10. ***Retail*** The cost of a typical mountain bike was \$330 in 1994 and \$550 in 1999. Find the slope of the line through the points at (1994, 330) and (1999, 550). What does this slope represent? **10.** ______________

NAME ______________________ DATE ____________ PERIOD ________

Chapter 1 Test, Form 2B (continued)

11. Write an equation in slope-intercept form for a line that passes through the point $A(4, 1)$ and has a slope of $-\frac{1}{2}$. **11.** ________________

12. Write an equation in standard form for a line with an x-intercept of -3 and a y-intercept of 4. **12.** ________________

13. Determine whether the graphs of $3x - 2y - 5 = 0$ and $y = -\frac{2}{3}x + 4$ are *parallel*, *coinciding*, *perpendicular*, or *none of these*. **13.** ________________

14. Write the slope-intercept form of the equation of the line that passes through $A(-6, 5)$ and is parallel to the line $x - 3y + 6 = 0$. **14.** ________________

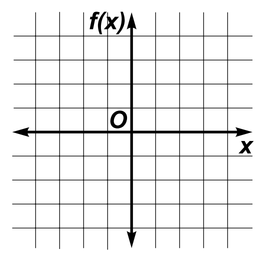
15. Write the standard form of the equation of the line that passes through $B(-2, 3)$ and is perpendicular to the graph of $2y + 6 = 0$. **15.** ________________

16. A laboratory tests a new fertilizer by applying it to 100 seeds. Write a prediction equation in slope-intercept form for the best-fit line. Use the points (1, 8) and (6, 98). **16.** ________________

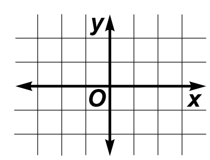
Week	1	2	3	4	5	6
Number of Sprouts	8	20	42	61	85	98

Graph each function.

17. $f(x) = -2|x|$ **17.**

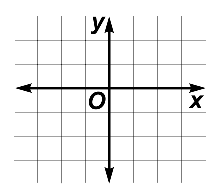


18. $f(x) = [\![x - 1]\!]$ **18.**

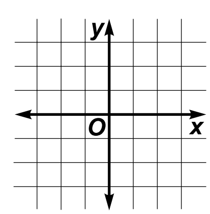


Graph each inequality.

19. $x + 1 > y$ **19.**



20. $y \leq |2x| - 1$ **20.**



Bonus If $f(x) = \sqrt{x + 2}$ and $(g \circ f)(x) = x - 1$, find $g(x)$. **Bonus:** ________________

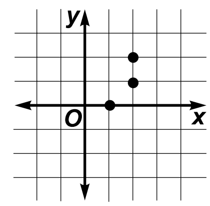
NAME ______________________ DATE ______________ PERIOD ________

Chapter 1 Test, Form 2C

1. State the domain and range of the relation {(−1, 0), (0, 2), (2, 3), (0, 4)}. Then state whether the relation is a function. Write *yes* or *no*. **1.** ______________

2. If $f(x) = 2x^2 - 1$, find $f(3)$. **2.** ______________

3. State the relation shown in the graph as a set of ordered pairs. Then state whether the relation is a function. Write *yes* or *no*. **3.** ______________



Given f(x) = x − 3 and g(x) = x², find each function.

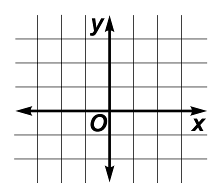
4. $(g - f)(x)$ **4.** ______________

5. $[f \circ g](x)$ **5.** ______________

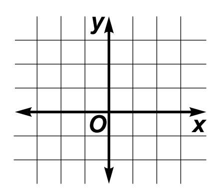
6. Find the zero of $f(x) = 4x - 5$. **6.** ______________

Graph each equation.

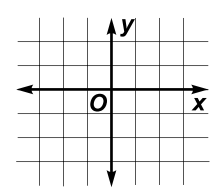
7. $y = x + 1$ **7.**



8. $y - 2x = 2$ **8.**



9. $2y + 4x = 1$ **9.**



10. ***Appreciation*** An old coin had a value of \$840 in 1991 and \$1160 in 1999. Find the slope of the line through the points at (1991, 840) and (1999, 1160). What does this slope represent? **10.** ______________

NAME ______________________ DATE ______________ PERIOD ________

Chapter 1 Test, Form 2C (continued)

11. Write an equation in slope-intercept form for a line that passes through the point $A(0, 5)$ and has a slope of $\frac{1}{2}$. **11.** ______________

12. Write an equation in standard form for a line passing through $B(2, 4)$ and $C(3, 8)$. **12.** ______________

13. Determine whether the graphs of $x + 2y - 2 = 0$ and $-3x - 6y - 5 = 0$ are *parallel, coinciding, perpendicular,* or *none of these.* **13.** ______________

14. Write the slope-intercept form of the equation of the line that passes through $D(-2, 3)$ and is parallel to the graph of $2y - 4 = 0$. **14.** ______________

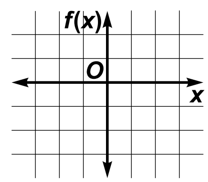
15. Write the standard form of the equation of the line that passes through $E(2, -2)$ and is perpendicular to the graph of $y = 2x + 3$. **15.** ______________

16. The table shows the average price of a new home in a certain area over a six-year period. Write the prediction equation in slope-intercept form for the best-fit line. Use the points (1994, 102) and (1999, 125). **16.** ______________

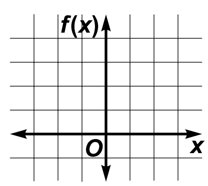
Year	1994	1995	1996	1997	1998	1999
Price (Thousands of Dollars)	102	105	115	114	119	125

Graph each function.

17. $f(x) = -|x|$ **17.**

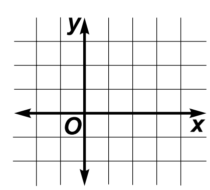


18. $f(x) = \begin{cases} 2 \text{ if } x < 0 \\ x \text{ if } x \geq 0 \end{cases}$ **18.**

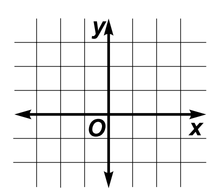


Graph each inequality.

19. $y > 3x - 1$ **19.**



20. $y \leq |x| + 1$ **20.**



Bonus What value of k in the equation $2x - ky - 2 = 0$ would result in a slope of $\frac{1}{3}$? **Bonus:** ______________

Chapter 1

NAME ______________ DATE ______________ PERIOD ______________

Chapter 1 Open-Ended Assessment

Instructions: Demonstrate your knowledge by giving a clear, concise solution to each problem. Be sure to include all relevant drawings and justify your answer. You may show your solution in more than one way or investigate beyond the requirements of the problem.

1. a. The graphs of the equations $y - 2x = 3$, $2y + x = 11$, and $2y - 4x = 8$ form three sides of a parallelogram. Complete the parallelogram by writing an equation for the graph that forms the fourth side. Justify your choice.

b. Explain how to determine whether the parallelogram is a rectangle. Is it a rectangle? Justify your answer.

c. Graph the equations on the same coordinate axes. Is the graph consistent with your conclusion?

2. a. Write a function $f(x)$.

b. If $g(x) = 2x^2 - 1$, does $(f + g)(x) = (g + f)(x)$? Justify your answer.

c. Does $(f - g)(x) = (g - f)(x)$? Justify your answer.

d. Does $(f \cdot g)(x) = (g \cdot f)(x)$? Justify your answer.

e. Does $\left(\frac{f}{g}\right)(x) = \left(\frac{g}{f}\right)(x)$?

f. What can you conclude about the commutativity of adding, subtracting, multiplying, or dividing two functions?

3. Write a word problem that uses the composition of two functions. Give an example of the composition and solve. What does the answer mean? Use the domain and range in your explanation.

NAME ______________________ DATE ____________ PERIOD ________

Chapter 1 Mid-Chapter Test (Lessons 1-1 through 1-4)

1. State the domain and range of the relation $\{(-3, 0), (0, -2), (1, 1), (0, 3)\}$. Then state whether the relation is a function. Write *yes* or *no*. **1.** ________________

2. Find $f(-2)$ for $f(x) = 3x^2 - 1$. **2.** ________________

3. If $f(x) = 2(x - 1)^2 + 3x$, find $f(a + 1)$. **3.** ________________

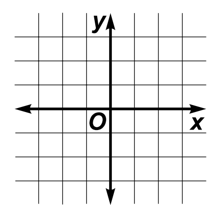
Given $f(x) = 2x - 1$ and $g(x) = \frac{1}{2x^2}$, find each function.

4. $\left(\frac{f}{g}\right)(x)$ **4.** ________________

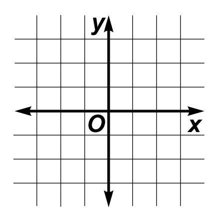
5. $[f \circ g](x)$ **5.** ________________

Graph each equation.

6. $x - 2y = 4$ **6.**



7. $x = -3y + 6$ **7.**



8. Find the zero of $f(x) = 2x - 5$. **8.** ________________

9. Write an equation in standard form for a line passing through $A(-1, 2)$ and $B(3, 8)$. **9.** ________________

10. ***Sales*** The initial cost of a new model of calculator was \$120. After the calculator had been on the market for two years, its price dropped to \$86. Let x represent the number of years the calculator has been on the market, and let y represent the selling price. Write an equation that models the selling price of the calculator after any given number of years. **10.** ________________

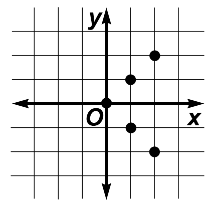
Chapter 1

NAME ______________________ DATE ______________ PERIOD ________

Chapter 1, Quiz A (Lessons 1-1 and 1-2)

1. State the domain and range of the relation $\{(2, 3), (3, 3), (4, -2), (5, -3)\}$. Then state whether the relation is a function. Write *yes* or *no*. **1.** ______________

2. State the relation shown in the graph as a set of ordered pairs. Then state whether the graph represents a function. Write *yes* or *no*. **2.** ______________



3. Evaluate $f(-2)$ if $f(x) = 3x^2 - 2x$. **3.** ______________

Given $f(x) = 2x - 3$ and $g(x) = 4x^2$, find each function.

4. $(f \cdot g)(x)$ **4.** ______________

5. $[f \circ g](x)$ **5.** ______________

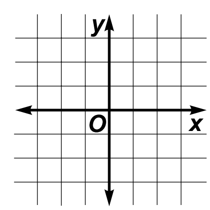
Chapter 1

NAME ______________________ DATE ______________ PERIOD ________

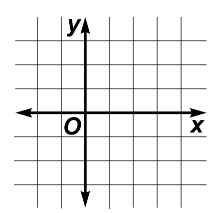
Chapter 1, Quiz B (Lessons 1-3 and 1-4)

Graph each equation.

1. $y = -\frac{3}{2}x + 1$ **1.**



2. $4x - 3y = 6$ **2.**



3. Find the zero of the function $f(x) = 3x - 2$. **3.** ______________

4. Write an equation in slope-intercept form for the line that passes through $A(9, -2)$ and has a slope of $-\frac{2}{3}$. **4.** ______________

5. Write an equation in standard form for the line that passes through $B(-2, -2)$ and $C(4, 1)$. **5.** ______________

Chapter 1

NAME ______________________ DATE ____________ PERIOD ________

Chapter 1, Quiz C (Lessons 1-5 and 1-6)

Determine whether the graphs of each pair of equations are parallel, coinciding, perpendicular, or none of these.

1. $3x - y = 7$
$2y = 6x + 4$ **1.** ______________

2. $y = \frac{1}{3}x - 1$
$x + 3y = 11$ **2.** ______________

3. Write an equation in standard form for the line that passes through $A(-2, 4)$ and is parallel to the graph of $2x - y - 5 = 0$. **3.** ______________

4. Write an equation in slope-intercept form for the line that passes through $B(3, 1)$ and is perpendicular to the line through $C(-1, 1)$ and $D(1, 7)$. **4.** ______________

5. ***Demographics*** The table shows data for the 10-year growth rate of the world population. Predict the growth rate for the year 2010. Use the points (1960, 22.0) and (2000, 12.6). **5.** ______________

Year	1960	1970	1980	1990	2000	2010
Ten-year Growth Rate (%)	22.0	20.2	18.5	15.2	12.6	?

Source: *U.S. Bureau of the Census*

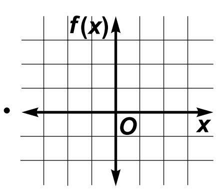
Chapter 1

NAME ______________________ DATE ____________ PERIOD ________

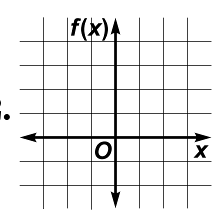
Chapter 1, Quiz D (Lessons 1-7 and 1-8)

Graph each function.

1. $f(x) = [\![x]\!] + 1$

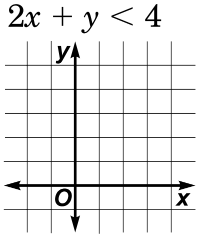
1. 

2. $f(x) = \begin{cases} x + 3 \text{ if } x < 0 \\ 3x - 1 \text{ if } x \geq 0 \end{cases}$

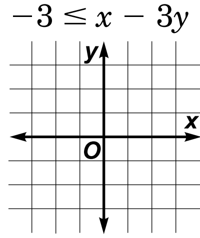
2. 

Graph each inequality.

3. $2x + y < 4$



4. $-3 \leq x - 3y \leq 6$



NAME ______________________ DATE ______________ PERIOD ________

Chapter 1 SAT and ACT Practice

After working each problem, record the correct answer on the answer sheet provided or use your own paper.

Multiple Choice

1. If $9 \times 9 \times 9 = 3 \times 3 \times t$, then $t =$
A 3
B 9
C 27
D 81
E 243

2. If $11! = 39{,}916{,}800$, then $\frac{12!}{4!} =$
A 9,979,200
B 19,958,400
C 39,916,800
D 79,833,600
E 119,750,000

3. $(-3)^3 + (16)^{\frac{1}{2}} + (-1)^5 =$
A $-\frac{7}{2}$
B -24
C -28
D 32
E -20

4. Which number is a factor of $15 \times 26 \times 77$?
A 4
B 9
C 36
D 55
E None of these

5. To dilute a concentrated liquid fabric softener, the directions state to mix 3 cups of water with 1 cup of concentrated liquid. How many gallons of water will you need to make 6 gallons of diluted fabric softener?
A $1\frac{1}{2}$ gallons **B** 3 gallons
C $2\frac{1}{2}$ gallons **D** 4 gallons
E $4\frac{1}{2}$ gallons

6. If a number between 1 and 2 is squared, the result is a number between
A 0 and 1
B 2 and 3
C 2 and 4
D 1 and 4
E None of these

7. Seventy-five percent of 32 is what percent of 18?
A $1\frac{1}{3}\%$
B $13\frac{1}{3}\%$
C $17\frac{7}{9}\%$
D 75%
E $133\frac{1}{3}\%$

8. $\frac{2}{3} + \frac{5}{6} - \frac{1}{12} + \frac{7}{8} =$
A $\frac{13}{5}$ **B** $\frac{59}{24}$
C $\frac{55}{24}$ **D** $\frac{31}{24}$
E $\frac{25}{12}$

9. If 9 and 15 each divide M without a remainder, what is the value of M?
A 30
B 45
C 90
D 135
E It cannot be determined from the information given.

10. $14^5 \div 32 =$
A $\frac{5^{14}}{32}$
B 196
C 14^3
D 7^5
E 5^7

Chapter 1 SAT and ACT Practice (continued)

11. A long-distance telephone call costs \$1.25 a minute for the first 2 minutes and \$0.50 for each minute thereafter. At these rates, how much will a 12-minute telephone call cost?

A \$6.25
B \$6.75
C \$7.25
D \$7.50
E \$8.50

12. After $\frac{3\frac{1}{6}}{2\frac{3}{4}}$ has been simplified to a single fraction in lowest terms, what is the denominator?

A 33
B 6
C 12
D 4
E 11

13. Which of the following expresses the prime factorization of 24?

A $1 \times 2 \times 2 \times 3$
B $2 \times 2 \times 2 \times 3$
C $2 \times 2 \times 3 \times 4$
D $1 \times 2 \times 2 \times 3 \times 3$
E $1 \times 2 \times 2 \times 2 \times 3$

14. $-|-4| + (-7) - |2| + |-6| - (-3) =$

A -10
B -4
C -2
D -14
E 22

15. Which of the following statements is true?

A $5 + 3 \times 4 - 6 = 26$
B $2 + 3 - 1 - 2 - 4 - 3 = 1$
C $3 - (5 - 2) \times 6 + 5(6 - 4) = -5$
D $2 \times (5 - 1) + 3 + 2 \times (4 - 1) = 19$
E $(6 - 2^2) \times 5 + 3 - 2 \times (4 + 1) = -33$

16. At last night's basketball game, Ryan scored 16 points, Geoff scored 11 points, and Bruce scored 9 points. Together they scored $\frac{3}{7}$ of their team's points. What was their team's final score?

A 108
B 96
C 36
D 77
E 84

17–18. Quantitative Comparison

A if the quantity in Column A is greater
B if the quantity in Column B is greater
C if the two quantities are equal
D if the relationship cannot be determined from the information given

$$0 < y < 1$$

	Column A	Column B
17.	y^4	y^5
18.	0.01%	10^{-4}

19. Grid-In What is the sum of the positive odd factors of 36?

20. Grid-In Write $\frac{a}{b}$ as a decimal number if $a = \frac{3}{2}$ and $b = \frac{5}{4}$.

Chapter 1

NAME ______________ DATE ______________ PERIOD ______

Chapter 1 Cumulative Review

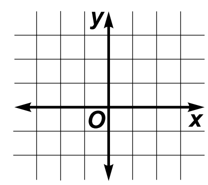
1. Given that x is an integer and $-1 \le x \le 2$, state the relation represented by $y = -4x + 1$ by listing a set of ordered pairs. Then state whether the relation is a function. Write *yes* or *no.* *(Lesson 1-1)* **1.** ______________

2. If $f(x) = x^2 - 5x$, find $f(-3)$. *(Lesson 1-1)* **2.** ______________

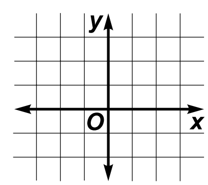
3. If $f(x) = \frac{1}{x - 4}$ and $g(x) = x^2 + 2$, find $[f \circ g](x)$. *(Lesson 1-2)* **3.** ______________

Graph each equation.

4. $x - 2y - 2 = 0$ *(Lesson 1-3)* **4.**



5. $x - 2 = 0$ *(Lesson 1-3)* **5.**



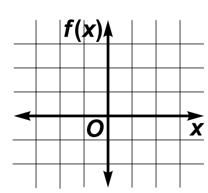
6. Write an equation in standard form for the line that passes through $A(-2, 0)$ and $B(4, 3)$. *(Lesson 1-4)* **6.** ______________

7. Write an equation in slope-intercept form for the line perpendicular to the graph of $y = -\frac{1}{3}x + 1$ and passing through $C(2, 1)$. *(Lesson 1-5)* **7.** ______________

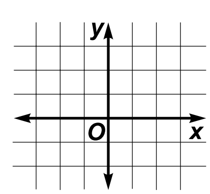
8. The table shows the number of students in Anne Smith's Karate School over a six-year period. Write the prediction equation in slope-intercept form for the best-fit line. Use the points (1994, 10) and (1999, 35). *(Lesson 1-6)* **8.** ______________

Year	1994	1995	1996	1997	1998	1999
Number of Students	10	15	20	25	30	35

9. Graph the function $f(x) = \begin{cases} -2x \text{ if } x \le 0 \\ 1 \text{ if } x > 0 \end{cases}$. *(Lesson 1-7)* **9.**



10. Graph the inequality $y \le |x| + 1$. *(Lesson 1-8)* **10.**



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NAME ______________________________ DATE _______________ PERIOD ________

SAT and ACT Practice Answer Sheet

(10 Questions)

1 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

2 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

3 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

4 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

5 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

6 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

7 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

8 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

9 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

10

	/	/	
.	.	.	.
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

NAME ______________________ DATE ____________ PERIOD _______

SAT and ACT Practice Answer Sheet

(20 Questions)

1 (A) (B) (C) (D) (E)

2 (A) (B) (C) (D) (E)

3 (A) (B) (C) (D) (E)

4 (A) (B) (C) (D) (E)

5 (A) (B) (C) (D) (E)

6 (A) (B) (C) (D) (E)

7 (A) (B) (C) (D) (E)

8 (A) (B) (C) (D) (E)

9 (A) (B) (C) (D) (E)

10 (A) (B) (C) (D) (E)

11 (A) (B) (C) (D) (E)

12 (A) (B) (C) (D) (E)

13 (A) (B) (C) (D) (E)

14 (A) (B) (C) (D) (E)

15 (A) (B) (C) (D) (E)

16 (A) (B) (C) (D) (E)

17 (A) (B) (C) (D) (E)

18 (A) (B) (C) (D) (E)

19

	/	/	
.	.	.	.
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

20

	/	/	
.	.	.	.
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

NAME ______________ DATE __________ PERIOD ________

1-1

Practice

Relations and Functions

State the domain and range of each relation. Then state whether the relation is a function. Write yes or no.

1. $\{(-1, 2), (3, 10), (-2, 20), (3, 11)\}$
D = {−2, −1, 3}, R = {2, 10, 11, 20}; no

2. $\{(0, 2), (13, 6), (2, 2), (3, 1)\}$
D = {0, 2, 3, 13}, R = {1, 2, 6}; yes

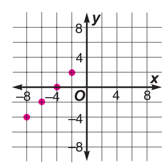
3. $\{(1, 4), (2, 8), (3, 24)\}$
D = {1, 2, 3}, R = {4, 8, 24}; yes

4. $\{(-1, -2), (3, 54), (-2, -16), (3, 81)\}$
D = {−2, −1, 3}, R = {−16, −2, 54, 81}; no

5. The domain of a relation is all even negative integers greater than −9. The range y of the relation is the set formed by adding 4 to the numbers in the domain. Write the relation as a table of values and as an equation. Then graph the relation.

y = x + 4

x	y
−2	2
−4	0
−6	−2
−8	−4



Evaluate each function for the given value.

6. $f(-2)$ if $f(x) = 4x^3 + 6x^2 + 3x$
−14

7. $f(3)$ if $f(x) = 5x^2 - 4x - 6$
27

8. $h(t)$ if $h(x) = 9x^9 - 4x^4 + 3x - 2$
$9t^9 - 4t^4 + 3t - 2$

9. $f(g + 1)$ if $f(x) = x^2 - 2x + 1$
g^2

10. ***Climate*** The table shows record high and low temperatures for selected states.

Record High and Low Temperatures (°F)		
State	High	Low
Alabama	112	−27
Delaware	110	−17
Idaho	118	−60
Michigan	112	−51
New Mexico	122	−50
Wisconsin	114	−54

Source: National Climatic Data Center

a. State the relation of the data as a set of ordered pairs.
{(112, −27), (110, −17), (118, −60), (112, −51), (122, −50), (114, −54)}

b. State the domain and range of the relation.
D = {110, 112, 114, 118, 122}
R = {−60, −54, −51, −50, −27, −17}

c. Determine whether the relation is a function.
no

NAME ______________ DATE __________ PERIOD ________

1-1

Enrichment

Rates of Change

Between $x = a$ and $x = b$, the function $f(x)$ changes by $f(b) - f(a)$. The *average rate of change* of $f(x)$ between $x = a$ and $x = b$ is defined by the expression

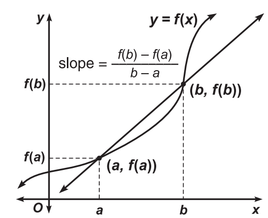
$$\frac{f(b) - f(a)}{(b - a)}.$$

Find the change and the average rate of change of f(x) in the given range.

1. $f(x) = 3x - 4$, from $x = 3$ to $x = 8$
change: 15; average rate of change: 3

2. $f(x) = x^2 + 6x - 10$, from $x = 2$ to $x = 4$
change: 24; average rate of change: 12

The average rate of change of a function $f(x)$ over an interval is the amount the function changes per unit change in x. As shown in the figure at the right, the average rate of change between $x = a$ and $x = b$ represents the slope of the line passing through the two points on the graph of f with abscissas a and b.



3. Which is larger, the average rate of change of $f(x) = x^2$ between 0 and 1 or between 4 and 5?
between 4 and 5

4. Which of these functions has the greatest average rate of change between 2 and 3: $f(x) = x$; $g(x) = x^2$; $h(x) = x^3$?
$h(x)$

5. Find the average rate of change for the function $f(x) = x^2$ in each interval.

a. $a = 1$ to $b = 1.1$ **2.1**
b. $a = 1$ to $b = 1.01$ **2.01**
c. $a = 1$ to $b = 1.001$ **2.001**

d. What value does the average rate of change appear to be approaching as the value of b gets closer and closer to 1? **2**

The value you found in Exercise **5d** is the *instantaneous rate of change* of the function. Instantaneous rate of change has enormous importance in calculus, the topic of Chapter 15.

6. Find the instantaneous rate of change of the function $f(x) = 3x^2$ as x approaches 3. **18**

NAME ______________ DATE ________ PERIOD ______

1-2 Practice

Composition of Functions

Given $f(x) = 2x^2 + 8$ and $g(x) = 5x - 6$, find each function.

1. $(f + g)(x)$
$2x^2 + 5x + 2$

2. $(f - g)(x)$
$2x^2 - 5x + 14$

3. $(f \cdot g)(x)$
$10x^3 - 12x^2 + 40x - 48$

4. $\left(\frac{f}{g}\right)(x)$
$\frac{2x^2 + 8}{5x - 6}, x \neq \frac{6}{5}$

Find $[f \circ g](x)$ and $[g \circ f](x)$ for each $f(x)$ and $g(x)$.

5. $f(x) = x + 5$
$g(x) = x - 3$
$x + 2, x + 2$

6. $f(x) = 2x^3 - 3x^2 + 1$
$g(x) = 3x$
$54x^3 - 27x^2 + 1, 6x^3 - 9x^2 + 3$

7. $f(x) = 2x^2 - 5x + 1$
$g(x) = 2x - 3$
$8x^2 - 34x + 34, 4x^2 - 10x - 1$

8. $f(x) = 3x^2 - 2x + 5$
$g(x) = 2x - 1$
$12x^2 - 16x + 10, 6x^2 - 4x + 9$

9. State the domain of $[f \circ g](x)$ for $f(x) = \sqrt{x - 2}$ and $g(x) = 3x$.
$x \geq \frac{2}{3}$

Find the first three iterates of each function using the given initial value.

10. $f(x) = 2x - 6$; $x_0 = 1$
$-4, -14, -34$

11. $f(x) = x^2 - 1$; $x_0 = 2$
$3, 8, 63$

12. ***Fitness*** Tara has decided to start a walking program. Her initial walking time is 5 minutes. She plans to double her walking time and add 1 minute every 5 days. Provided that Tara achieves her goal, how many minutes will she be walking on days 21 through 25? **95 minutes or 1 hour 35 minutes**

NAME ______________ DATE ________ PERIOD ______

1-2 Enrichment

Applying Composition of Functions

Because the area of a square A is explicitly determined by the length of a side of the square, the area can be expressed as a function of one variable, the length of a side s: $A = f(s) = s^2$. Physical quantities are often functions of numerous variables, each of which may itself be a function of several additional variables. A car's gas mileage, for example, is a function of the mass of the car, the type of gasoline being used, the condition of the engine, and many other factors, each of which is further dependent on other factors. Finding the value of such a quantity for specific values of the variables is often easiest by first finding a single function composed of all the functions and then substituting for the variables.

The *frequency* f of a pendulum is the number of complete swings the pendulum makes in 60 seconds. It is a function of the *period* p of the pendulum, the number of seconds the pendulum requires to make one complete swing: $f(p) = \frac{60}{p}$.

In turn, the period of a pendulum is a function of its length L in centimeters: $p(L) = 0.2\sqrt{L}$.

Finally, the length of a pendulum is a function of its length ℓ at 0° Celsius, the Celsius temperature C, and the *coefficient of expansion* e of the material of which the pendulum is made:
$L(\ell, C, e) = \ell(1 + eC)$.

1. a. Find and simplify $f(p(L(\ell, C, e)))$, an expression for the frequency of a brass pendulum, $e = 0.00002$, in terms of its length, in centimeters at 0°C, and the Celsius temperature.
$f(p(L(\ell, C, e))) = \frac{300\sqrt{\ell(1 + 0.00002C)}}{\ell(1 + 0.00002C)}$

b. Find the frequency, to the nearest tenth, of a brass pendulum at 300°C if the pendulum's length at 0°C is 15 centimeters.
77.2 swings per minute

2. The volume V of a spherical weather balloon with radius r is given by $V(r) = \frac{4}{3}\pi r^3$. The balloon is being inflated so that the radius increases at a constant rate $r(t) = \frac{1}{2}t + 2$, where r is in meters and t is the number of seconds since inflation began.

a. Find $V(r(t))$
$V(r(t)) = \frac{\pi t^3}{6} + 2\pi t^2 + 8\pi t + \frac{32}{3}\pi$

b. Find the volume after 10 seconds of inflation. Use 3.14 for π. **1436.8 m^3**

1-3

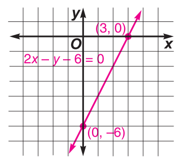
NAME ______________ DATE ______________ PERIOD ________

Practice

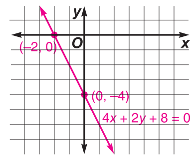
Graphing Linear Equations

Graph each equation using the x- and y-intercepts.

1. $2x - y - 6 = 0$

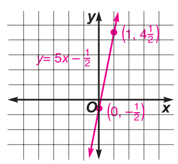


2. $4x + 2y + 8 = 0$

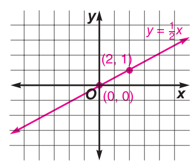


Graph each equation using the y-intercept and the slope.

3. $y = 5x - \frac{1}{2}$

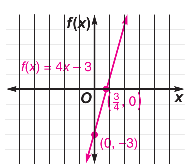


4. $y = \frac{1}{2}x$

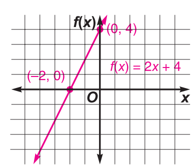


Find the zero of each function. Then graph the function.

5. $f(x) = 4x - 3$ $\frac{3}{4}$



6. $f(x) = 2x + 4$ **−2**



7. *Business* In 1990, a two-bedroom apartment at Remington Square Apartments rented for \$575 per month. In 1999, the same two-bedroom apartment rented for \$850 per month. Assuming a constant rate of increase, what will a tenant pay for a two-bedroom apartment at Remington Square in the year 2000? **about \$881**

1-3

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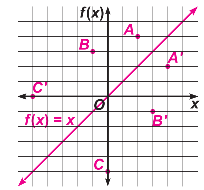
Enrichment

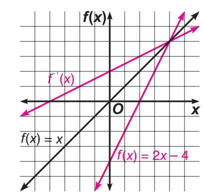
Inverses and Symmetry

1. Use the coordinate axes at the right to graph the function $f(x) = x$ and the points $A(2, 4)$, $A'(4, 2)$, $B(-1, 3)$, $B'(3, -1)$, $C(0, -5)$, and $C'(-5, 0)$.



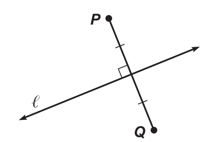
2. Describe the apparent relationship between the graph of the function $f(x) = x$ and any two points with interchanged abscissas and ordinates.
Sample answers: The points are mirror images of each other in the graph of $f(x) = x$; the points are symmetric to each other with respect to the graph of $f(x) = x$; the points are the same distance from but on opposite sides of the graph of $f(x) = x$.

3. Graph the function $f(x) = 2x - 4$ and its inverse $f^{-1}(x)$ on the coordinate axes at the right.



4. Describe the apparent relationship between the graphs you have drawn and the graph of the function $f(x) = x$.
Sample answers: They are mirror images of each other in the graph of $f(x) = x$; they intersect $f(x) = x$ at the same point and at the same angle.

Recall from your earlier math courses that two points P and Q are said to be *symmetric* about line ℓ provided that P and Q are equidistant from ℓ and on a perpendicular through ℓ. The line ℓ is the *axis of symmetry* and P and Q are *images* of each other in ℓ. The image of the point $P(a, b)$ in the line $y = x$ is the point $Q(b, a)$.



5. Explain why the graphs of a function $f(x)$ and its inverse, $f^{-1}(x)$, are symmetric about the line $y = x$.
The graph of $f^{-1}(x)$ consists of ordered pairs formed by interchanging the coordinates of the ordered pairs of $f(x)$. Therefore, each point $P(a, b)$ in $f(x)$ has an image $Q(b, a)$ in $f^{-1}(x)$ that is symmetric with it about the line $y = x$.

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1-4 Practice

Writing Linear Equations

Write an equation in slope-intercept form for each line described.

1. slope = −4, y-intercept = 3
$y = -4x + 3$

2. slope = 5, passes through $A(-3, 2)$
$y = 5x + 17$

3. slope = −4, passes through $B(3, 8)$
$y = -4x + 20$

4. slope = $\frac{4}{3}$, passes through $C(-9, 4)$
$y = \frac{4}{3}x + 16$

5. slope = 1, passes through $D(-6, 6)$
$y = x + 12$

6. slope = −1, passes through $E(3, -3)$
$y = -x$

7. slope = 3, y-intercept = $\frac{3}{4}$
$y = 3x + \frac{3}{4}$

8. slope = −2, y-intercept = −7
$y = -2x - 7$

9. slope = −1, passes through $F(-1, 7)$
$y = -x + 6$

10. slope = 0, passes through $G(3, 2)$
$y = 2$

11. ***Aviation*** The number of active certified commercial pilots has been declining since 1980, as shown in the table.

Number of Active Certified Pilots	
Year	Total
1980	182,097
1985	155,929
1990	149,666
1993	143,014
1994	138,728
1995	133,980
1996	129,187

Source: U. S. Dept. of Transportation

a. Find a linear equation that can be used as a model to predict the number of active certified commercial pilots for any year. Assume a steady rate of decline.
Sample answer using (1985, 155,929) and (1995, 133,980): $y = -2195x + 4{,}513{,}004$

b. Use the model to predict the number of pilots in the year 2003. **Sample prediction: 116,419**

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1-4 Enrichment

Finding Equations From Area

A right triangle in the first quadrant is bounded by the x-axis, the y-axis, and a line intersecting both axes. The point (1, 2) lies on the hypotenuse of the triangle. The area of the triangle is 4 square units.

Follow these instructions to find the equation of the line containing the hypotenuse. Let m represent the slope of the line.

1. Write the equation, in point-slope form, of the line containing the hypotenuse of the triangle.
$y - 2 = m(x - 1)$

2. Find the x-intercept and the y-intercept of the line.
x−intercept: $\frac{m-2}{m}$ y−intercept: $2 - m$

3. Write the measures of the legs of the triangle.
$\frac{m-2}{m}$ and $2 - m$

4. Use your answers to Exercise 3 and the formula for the area of a triangle to write an expression for the area of the triangle in terms of the slope of the hypotenuse. Set the expression equal to 4, the area of the triangle, and solve for m .
$m = -2$

5. Write the equation of the line, in point-slope form, containing the hypotenuse of the triangle.
$y - 2 = -2(x - 1)$

6. Another right triangle in the first quadrant has an area of 4 square units. The point (2, 1) lies on the hypotenuse. Find the equation of the line, in point-slope form, containing the hypotenuse.
$y - 1 = -\frac{1}{2}(x - 2)$

7. A line with negative slope passes through the point (6, 1). A triangle bounded by the line and the coordinate axes has an area of 16 square units. Find the slope of the line.
$m = -\frac{1}{2}$ or $m = -\frac{1}{18}$

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1-5

Practice

Writing Equations of Parallel and Perpendicular Lines

Determine whether the graphs of each pair of equations are parallel, perpendicular, coinciding, or none of these.

1. $x + 3y = 18$, $3x + 9y = 12$ **parallel**

2. $2x - 4y = 8$, $x - 2y = 4$ **coinciding**

3. $-3x + 2y = 6$, $2x + 3y = 12$ **perpendicular**

4. $x + y = 6$, $3x - y = 6$ **none of these**

5. $4x + 8y = 2$, $2x + 4y = 8$ **parallel**

6. $3x - y = 9$, $6x - 2y = 18$ **coinciding**

Write the standard form of the equation of the line that is parallel to the graph of the given equation and that passes through the point with the given coordinates.

7. $2x + y - 5 = 0$; $(0, 4)$ **$2x + y - 4 = 0$**

8. $3x - y + 3 = 0$; $(-1, -2)$ **$3x - y + 1 = 0$**

9. $3x - 2y + 8 = 0$; $(2, 5)$ **$3x - 2y + 4 = 0$**

Write the standard form of the equation of the line that is perpendicular to the graph of the given equation and that passes through the point with the given coordinates.

10. $2x - y + 6 = 0$; $(0, -3)$ **$x + 2y + 6 = 0$**

11. $2x - 5y - 6 = 0$; $(-4, 2)$ **$5x + 2y + 16 = 0$**

12. $3x + 4y - 13 = 0$; $(2, 7)$ **$4x - 3y + 13 = 0$**

13. ***Consumerism*** Marillia paid $180 for 3 video games and 4 books. Three months later she purchased 8 books and 6 video games. Her brother guessed that she spent $320. Assuming that the prices of video games and books did not change, is it possible that she spent $320 for the second set of purchases? Explain.
No; the lines that represent the situation are parallel.

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1-5

Enrichment

Reading Mathematics: Question Assumptions

Students at the elementary level assume that the statements in their textbooks are complete and verifiably true. A lesson on the area of a triangle is assumed to contain everything there is to know about triangle area, and the conclusions reached in the lesson are rock-solid fact. The student's job is to "learn" what textbooks have to say. The better the student does this, the better his or her grade.

By now you probably realize that knowledge is open-ended and that much of what passes for fact—in math and science as well as in other areas— consists of theory or opinion to some degree.

At best, it offers the closest guess at the "truth" that is now possible. Rather than accept the statements of an author blindly, the educated person's job is to read them carefully, critically, and with an open mind, and to then make an independent judgment of their validity. The first task is to question the author's assumptions.

Answers will vary. Sample answers are given.

The following statements appear in the best-selling text Mathematics: Trust Me!. Describe the author's assumptions. What is the author trying to accomplish? What did he or she fail to mention? What is another way of looking at the issue?

1. "The study of trigonometry is critically important in today's world."
That's an opinion. Critically important to whom? The author should back this statement up. It sounds like the author is trying to justify including this topic in the book.

2. "We will look at the case where $x > 0$. The argument where $x \leq 0$ is similar." **Is it? I would like to hear the argument. Perhaps it gets into some sticky issues or raises some interesting points. The author assumes that I am not interested, but I am.**

3. "As you recall, the mean is an excellent method of describing a set of data." **I do not recall that. Where and when was that established? What does "excellent" mean? Perhaps at certain times the mean is excellent but there are times when it is not.**

4. "Sometimes it is necessary to estimate the solution."
When is it necessary? Why is it necessary? It sounds as though the author is trying to avoid saying that there are no good methods for solving this problem, or that there are some methods but the author thinks I am not capable of understanding them.

5. "This expression can be written $\frac{1}{x}$."
How is it done? Why is the author writing the expression in this form rather than another?

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1-6

Practice

Modeling Real-World Data with Linear Functions

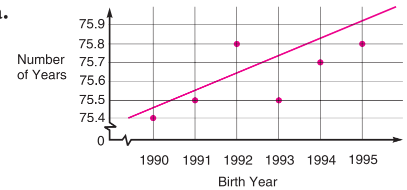
Complete the following for each set of data.
a. Graph the data on a scatter plot.
b. Use two ordered pairs to write the equation of a best-fit line.
c. If the equation of the regression line shows a moderate or strong relationship, predict the missing value. Explain whether you think the prediction is reliable.

1.

U. S. Life Expectancy	
Birth Year	Number of Years
1990	75.4
1991	75.5
1992	75.8
1993	75.5
1994	75.7
1995	75.8
2015	?

Source: National Center for Health Statistics

a.



b. Sample answer using (1991, 75.5) and (1994, 75.7): $y = 0.07x - 63.9$

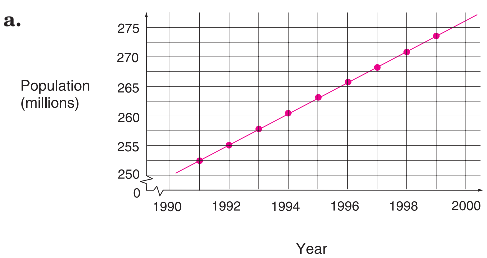
c. Prediction: 77.2; the prediction is not very reliable because many points are off the line.

2.

Population Growth	
Year	Population (millions)
1991	252.1
1992	255.0
1993	257.7
1994	260.3
1995	262.8
1996	265.2
1997	267.7
1998	270.3
1999	272.9
2010	?

Source: U.S. Census Bureau

a.



b. Sample answer using (1993, 257.7) and (1997, 267.7): $y = 2.5x - 4724.8$

c. Prediction: 300.2; the prediction is reliable because the line passes through most of the points.

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1-6

Enrichment

Significant Digits

All measurements are approximations. The **significant digits** of an approximate number are those which indicate the results of a measurement.

For example, the mass of an object, measured to the nearest gram, is 210 grams. The measurement $21\underline{0}$ g has 3 significant digits. The mass of the same object, measured to the nearest 100 g, is 200 g. The measurement 200 g has one significant digit.

Several identifying characteristics of significant digits are listed below, with examples.

1. Non-zero digits and zeros between significant digits are significant. For example, the measurement 9.071 m has 4 significant digits, 9, 0, 7, and 1.
2. Zeros at the end of a decimal fraction are significant. The measurement 0.050 mm has 2 significant digits, 5 and 0.
3. Underlined zeros in whole numbers are significant. The measurement $104{,}0\underline{0}0$ km has 5 significant digits, 1, 0, 4, 0, and 0.

In general, a computation involving multiplication or division of measurements *cannot* be more accurate than the least accurate measurement of the computation. Thus, the result of computation involving multiplication or division of measurements should be rounded to the number of significant digits in the least accurate measurement.

Example **The mass of 37 quarters is $21\underline{0}$ g. Find the mass of one quarter.**

mass of 1 quarter $= 21\underline{0}$ g ÷ 37   *$21\underline{0}$ has 3 significant digits.*
$= 5.68$ g   *37 does not represent a measurement.*
Round the result to 3 significant digits.
Why?

Write the number of significant digits for each measurement.

1. 8314.20 m **6**
2. 30.70 cm **4**
3. 0.01 mm **1**
4. 0.0605 mg **3**
5. $37\underline{0},000$ km **3**
6. $370{,}0\underline{0}0$ km **5**
7. 9.7×10^4 g **2**
8. 3.20×10^{-2} g **3**

Solve each problem. Round each result to the correct number of significant digits.

9. 23 m × 1.54 m **35 m²**
10. $12{,}0\underline{0}0$ ft ÷ $52\underline{0}$ ft **23.1**
11. 2.5 cm × 25 **63 cm**
12. 11.01 mm × 11 **121.1 mm**
13. 908 yd ÷ 0.5 **1,820 yd**
14. 38.6 m × 4.0 m **150 m²**

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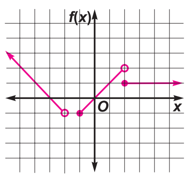
1-7

Practice

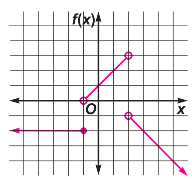
Piecewise Functions

Graph each function.

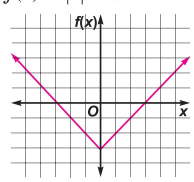
1. $f(x) = \begin{cases} 1 \text{ if } x \geq 2 \\ x \text{ if } -1 \leq x < 2 \\ -x - 3 \text{ if } x < -2 \end{cases}$



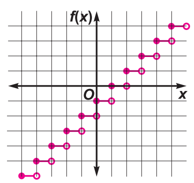
2. $f(x) = \begin{cases} -2 \text{ if } x \leq -1 \\ 1 + x \text{ if } -1 < x < 2 \\ 1 - x \text{ if } x > 2 \end{cases}$



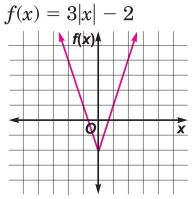
3. $f(x) = |x| - 3$



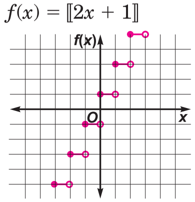
4. $f(x) = [\![x]\!] - 1$



5. $f(x) = 3|x| - 2$



6. $f(x) = [\![2x + 1]\!]$

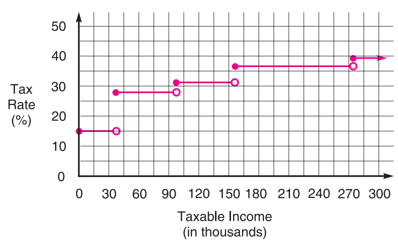


7. Graph the tax rates for the different incomes by using a step function.

Income Tax Rates for a Couple Filing Jointly

Limits of Taxable Income	Tax Rate
$0 to $41,200	15%
$41,201 to $99,600	28%
$99,601 to $151,750	31%
$151,751 to $271,050	36%
$271,051 and up	39.6%

Source: Information Please Almanac



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1-7

Enrichment

Modus Ponens

A **syllogism** is a deductive argument in which a conclusion is inferred from two premises. Whether a syllogistic argument is valid or invalid is determined by its form. Consider the following syllogism.

Premise 1: If a line is perpendicular to line m, then the slope of that line is $-\frac{3}{5}$.
Premise 2: Line ℓ is perpendicular to line m.
Conclusion: $\therefore$ The slope of line ℓ is $-\frac{3}{5}$.

Any statement of the form, "if p, then q," such as the statement in premise 1, can be written symbolically as $p \rightarrow q$. We read this "p implies q."

The syllogism above is valid because the argument form,

Premise 1: $p \rightarrow q$ (This argument says that if p implies q
Premise 2: p is true and p is true, then q must
Conclusion: $\therefore q$ be true.)

is a valid argument form.

The argument form above has the Latin name **modus ponens**, which means "a manner of affirming." Any *modus ponens* argument is a valid argument.

Decide whether each argument is a modus ponens argument.

1. If the graph of a relation passes the vertical line test, then the relation is a function. The graph of the relation $f(x)$ does not pass the vertical line test. Therefore, $f(x)$ is not a function.
no

2. If you know the Pythagorean Theorem, you will appreciate Shakespeare. You do know the Pythagorean Theorem. Therefore, you will appreciate Shakespeare.
yes

3. If the base angles of a triangle are congruent, then the triangle is isosceles. The base angles of triangle ABC are congruent. Therefore, triangle ABC is isosceles.
yes

4. When $x = -3$, $x^2 = 9$. Therefore, if $t = -3$, it follows that $t^2 = 9$.
yes

5. Since $x > 10$, $x > 0$. It is true that $x > 0$. Therefore, $x > 10$.
no

1-8

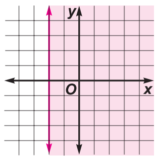
NAME ______________ DATE ________ PERIOD ______

Practice

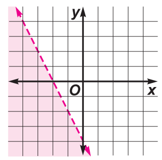
Graphing Linear Inequalities

Graph each inequality.

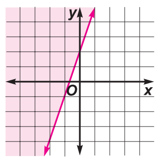
1. $x \geq -2$



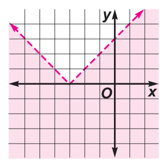
2. $y < -2x - 4$



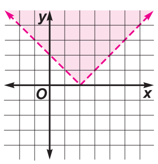
3. $y \geq 3x + 2$



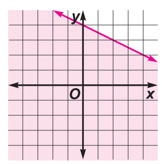
4. $y < |x + 3|$



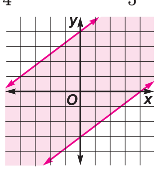
5. $y > |x - 2|$



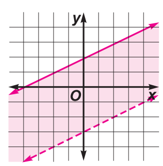
6. $y \leq -\frac{1}{2}x + 4$



7. $\frac{3}{4}x - 3 \leq y \leq \frac{4}{5}x + 4$



8. $-4 \leq x - 2y < 6$



1-8

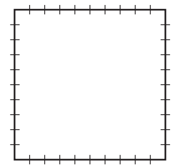
NAME ______________ DATE ________ PERIOD ______

Enrichment

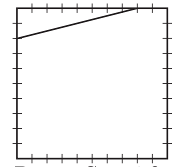
Line Designs: Art and Geometry

Iteration paths that spiral in toward an attractor or spiral out from a repeller create interesting designs. By inscribing polygons within polygons and using the techniques of line design, you can create your own interesting spiral designs that create an illusion of curves.

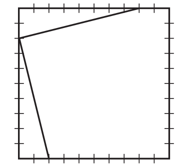
1. Mark off equal units on the sides of a square.



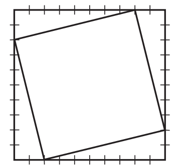
2. Connect two points that are equal distances from adjacent vertices.



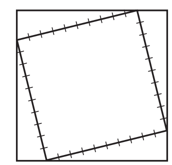
3. Draw the second (adjacent) side of the inscribed square.



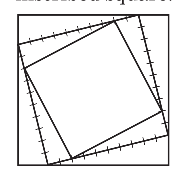
4. Draw the other two sides of the inscribed square



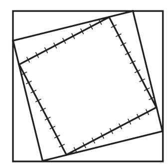
5. Repeat Step 1 for the inscribed square. (Use the same number of divisions).



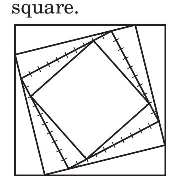
6. Repeat Steps 2, 3, and 4 for the inscribed square.



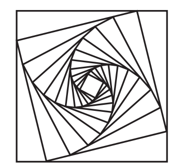
7. Repeat Step 1 for the new square.



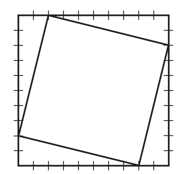
8. Repeat Steps 2, 3, and 4, for the third inscribed square.



9. Repeat the procedure as often as you wish.



10. Suppose your first inscribed square is a clockwise rotation like the one at the right. How will the design you create compare to the design created above, which used a counterclockwise rotation? **One design is the mirror reflection of the other.**



11. Create other spiral designs by inscribing triangles within triangles and pentagons within pentagons. **See students' work.**

Chapter 1 Answer Key

Form 1A

Page 25

1. A
2. A
3. C
4. A
5. D
6. A
7. B
8. D
9. C
10. C
11. C

Page 26

12. D
13. D
14. C
15. C
16. A
17. C
18. B
19. C
20. B

Bonus: D

Form 1B

Page 27

1. C
2. B
3. D
4. A
5. D
6. D
7. C
8. B
9. C
10. B
11. D

Page 28

12. A
13. B
14. B
15. C
16. A
17. D
18. D
19. A
20. C

Bonus: D

Chapter 1 Answer Key

Form 1C

Page 29

1. D
2. C
3. B
4. A
5. D
6. A
7. D
8. C
9. A
10. B
11. D

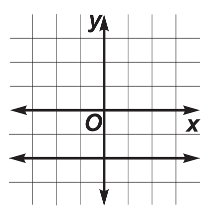
Page 30

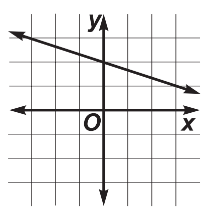
12. D
13. A
14. A
15. B
16. C
17. C
18. B
19. B
20. A

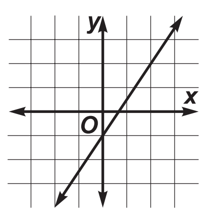
Bonus: C

Form 2A

Page 31

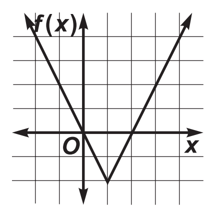
1. $D = \{-2, -1, 0, 1, 2\}$, $R = \{-1, 0, 1, 2\}$; yes
2. $2x^2 + 4xh + 2h^2 - x - h$
3. $D = \{x \mid x \geq 1\}$, $R =$ all reals; no
4. $\frac{1}{x + 3}$, $x \neq \pm 3$
5. $\frac{1}{x^2 - 6x}$
6. $-\frac{1}{6}$
7. 

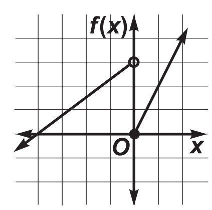
8. 

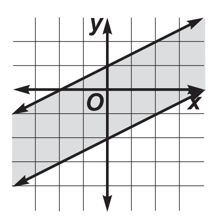
9. 

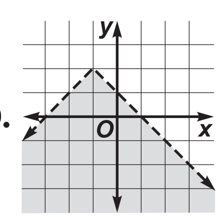
10. $m = -2100$; average annual rate of change in car's value

Page 32

11. $y = \frac{2}{3}x + \frac{13}{3}$
12. $x + 3y - 5 = 0$
13. coinciding
14. $y = \frac{3}{2}x - 6$
15. $2x - y - 2 = 0$
16. $y = -3x + 50$
17. 

18. 

19. 

20. 

Chapter 1 Answer Key

Form 2B

Page 33

1. $D = \{-3, -1, 0\}$, $R = \{0, 1, 4, 5\}$; no

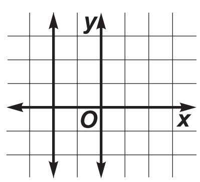
2. $3a^2 - 12a + 8$

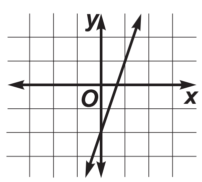
3. $\{(-2, 2), (0, 2), (2, 2)\}$; yes

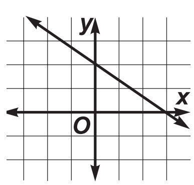
4. $x^3 - 2x^2 + 4x - 8$

5. $\frac{1}{x^2 + 2}$

6. -12

7. 

8. 

9. 

10. 44; average annual rate of increase in the bike's cost

Page 34

11. $y = -\frac{1}{2}x + 3$

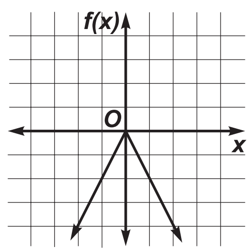
12. $4x - 3y + 12 = 0$

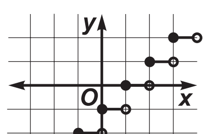
13. perpendicular

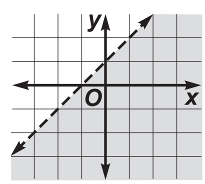
14. $y = \frac{1}{3}x + 7$

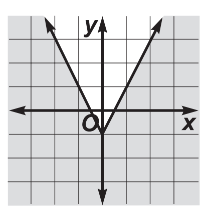
15. $x + 2 = 0$

16. $y = 18x - 10$

17. 

18. 

19. 

20. 

Bonus: $x^2 - 3$

Form 2C

Page 35

1. $D = \{-1, 0, 2\}$; $R = \{0, 2, 3, 4\}$; no

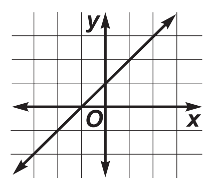
2. 17

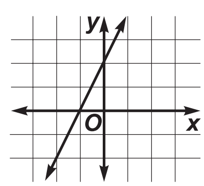
3. $\{(1, 0), (2, 1), (2, 2)\}$; no

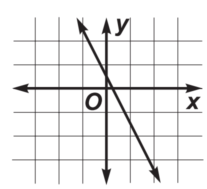
4. $x^2 - x + 3$

5. $x^2 - 3$

6. $\frac{5}{4}$

7. 

8. 

9. 

10. 40; average annual rate of increase in the coin's value

Page 36

11. $y = \frac{1}{2}x + 5$

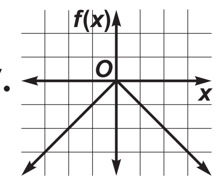
12. $4x - y - 4 = 0$

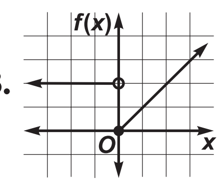
13. parallel

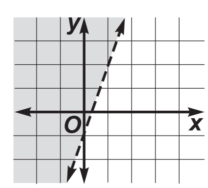
14. $y = 3$

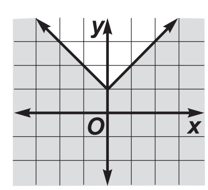
15. $x + 2y + 2 = 0$

16. $y = \frac{23}{5}x - \frac{45,352}{5}$

17. 

18. 

19. 

20. 

Bonus: 6

Chapter 1 Answer Key

CHAPTER 1 SCORING RUBRIC

Level	Specific Criteria
3 Superior	• Shows thorough understanding of the concepts *equations of parallel and perpendicular lines* and *adding, subtracting, multiplying, dividing, and composing functions.* • Uses appropriate strategies to solve problems. • Computations are correct. • Written explanations are exemplary. • Word problem concerning composition of functions is appropriate and makes sense. • Goes beyond requirements of some or all problems.
2 Satisfactory, with Minor Flaws	• Shows understanding of the concepts *equations of parallel and perpendicular lines* and *adding, subtracting, multiplying, dividing, and composing functions.* • Uses appropriate strategies to solve problems. • Computations are mostly correct. • Written explanations are effective. • Word problem concerning composition of functions is appropriate and makes sense. • Satisfies all requirements of problems.
1 Nearly Satisfactory, with Serious Flaws	• Shows understanding of most of the concepts *equations of parallel and perpendicular lines* and *adding, subtracting, multiplying, dividing, and composing functions.* • May not use appropriate strategies to solve problems. • Computations are mostly correct. • Written explanations are satisfactory. • Word problem concerning composition of functions is mostly appropriate and sensible. • Satisfies most requirements of problems.
0 Unsatisfactory	• Shows little or no understanding of the concepts *equations of parallel and perpendicular lines* and *adding, subtracting, multiplying, dividing, and composing functions.* • May not use appropriate strategies to solve problems. • Computations are incorrect. • Written explanations are not satisfactory. • Word problem concerning composition of functions is not appropriate or sensible. • Does not satisfy requirements of problems.

Chapter 1 Answer Key

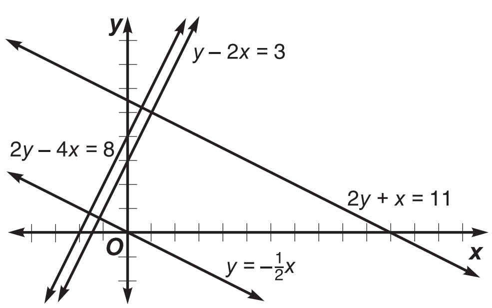
Open-Ended Assessment

Page 37

1a. The fourth side must have the same slope as $2y + x = 11$, but it must have a different y-intercept. The slope-intercept form of $2y + x = 11$ is $y = -\frac{1}{2}x + \frac{11}{2}$. Let the equation of the fourth side be $y = -\frac{1}{2}x$.

1b. If one angle is a right angle, the parallelogram is a rectangle. The slope-intercept form of $y - 2x = 3$ is $y = 2x + 3$. The slopes of $y = -\frac{1}{2}x$ and $y = 2x + 3$ are negative reciprocals of each other. Hence, the lines are perpendicular, and the parallelogram is a rectangle.

1c.



Yes, the points of intersection are the vertices of a rectangle.

2a. $f(x) = x - 4$

2b. $(f + g)(x) = x - 4 + 2x^2 - 1$
$= 2x^2 + x - 5$

$(g + f)(x) = 2x^2 - 1 + x - 4$
$= 2x^2 + x - 5$
$= (f + g)(x)$

2c. $(f - g)(x) = x - 4 - (2x^2 - 1)$
$= -2x^2 + x - 3$

$(g - f)(x) = 2x^2 - 1 - (x - 4)$
$= 2x^2 - x + 3$
$\neq (f - g)(x)$

2d. $(f \cdot g)(x) = (x - 4)(2x^2 - 1)$
$= 2x^3 - x - 8x^2 + 4$
$= 2x^3 - 8x^2 - x + 4$

$(g \cdot f)(x) = (2x^2 - 1)(x - 4)$
$= 2x^3 - 8x^2 - x + 4$
$= (f \cdot g)(x)$

2e. $(f \div g)(x) = \frac{x - 4}{2x^2 - 1}$

$(g \div f)(x) = \frac{2x^2 - 1}{x - 4}$

$\neq (f \div g)(x)$

2f. Addition and multiplication of functions are commutative, but subtraction and division are not.

3. Sample answer: Jeanette bought an electric wok that was originally priced at \$38. The department store advertised an immediate rebate of \$5 as well as a 25% discount on small appliances. What was the final price of the wok? Let x represent the original price of the wok, $r(x)$ represent the price after the rebate, and $d(x)$ the price after the discount. $r(d(x)) =$ \$23.50 and $d(r(x)) =$ \$24.75. The domain of each composition is \$38, however, the range of the composition differs with the order of the composition.

Chapter 1 Answer Key

Mid-Chapter Test
Page 38

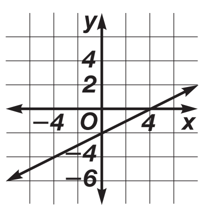
1. $D = \{-3, 0, 1\}$, $R = \{-2, 0, 1, 3\}$, no

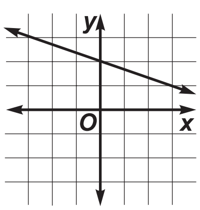
2. 11

3. $2a^2 + 3a + 3$

4. $4x^3 - 2x^2$

5. $\frac{1}{x^2} - 1$

6. 

7. 

8. $\frac{5}{2}$

9. $3x - 2y + 7 = 0$

10. $y = -17x + 120$

Quiz A
Page 39

1. $D = \{2, 3, 4, 5\}$, $R = \{-3, -2, 3\}$; yes

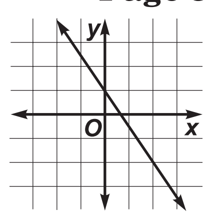
2. $\{(0, 0), (1,1), (1, -1), (2, 2), (2, -2)\}$; no

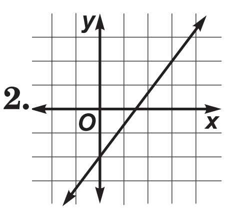
3. 16

4. $8x^3 - 12x^2$

5. $8x^2 - 3$

Quiz B
Page 39

1. 

2. 

3. $x = \frac{2}{3}$

4. $y = -\frac{2}{3}x + 4$

5. $x - 2y - 2 = 0$

Quiz C
Page 40

1. parallel

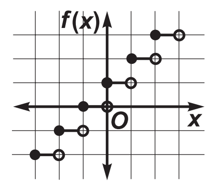
2. none of these

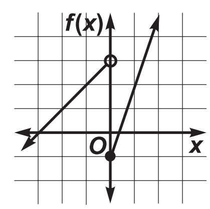
3. $2x - y + 8 = 0$

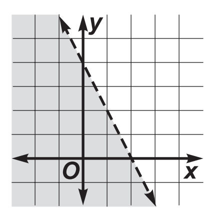
4. $y = -\frac{1}{3}x + 2$

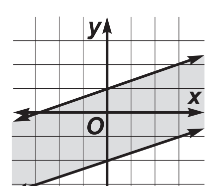
5. 10.3%

Quiz D
Page 40

1. 

2. 

3. 

4. 

Chapter 1 Answer Key

SAT/ACT Practice

Page 41

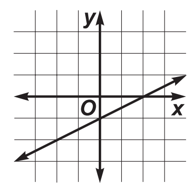
1. D
2. B
3. B
4. D
5. E
6. D
7. E
8. C
9. E
10. D

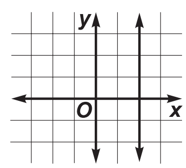
Page 42

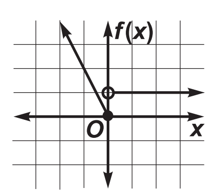
11. D
12. A
13. B
14. B
15. C
16. E
17. A
18. C
19. 13
20. 1.2

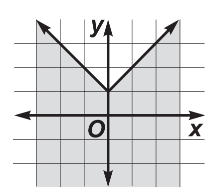
Cumulative Review

Page 43

1. {(−1, 5), (0, 1), (1, −3), (2, −7)}; yes
2. 24
3. $\frac{1}{x^2 - 2}$
4. 

5. 

6. $x - 2y + 2 = 0$
7. $y = 3x - 5$
8. $y = 5x - 9960$
9. 

10. 

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