

**GLENCOE
MATHEMATICS**

Geometry

Chapter 3 Resource Masters

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Consumable Workbooks

Many of the worksheets contained in the Chapter Resource Masters booklets are available as consumable workbooks.

<i>Study Guide and Intervention Workbook</i>	0-07-860191-6
<i>Skills Practice Workbook</i>	0-07-860192-4
<i>Practice Workbook</i>	0-07-860193-2
<i>Reading to Learn Mathematics Workbook</i>	0-07-861061-3

ANSWERS FOR WORKBOOKS The answers for Chapter 3 of these workbooks can be found in the back of this Chapter Resource Masters booklet.



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Geometry
Chapter 3 Resource Masters

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Teacher's Guide to Using the Chapter 3 Resource Masters

The **Fast File** Chapter Resource system allows you to conveniently file the resources you use most often. The *Chapter 3 Resource Masters* includes the core materials needed for Chapter 3. 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 *Geometry TeacherWorks* CD-ROM.

Vocabulary Builder Pages vii–viii include a student study tool that presents up to twenty of 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 3-1. Encourage them to add these pages to their Geometry Study Notebook. Remind them to add definitions and examples as they complete each lesson.

Vocabulary Builder Pages ix–x include another student study tool that presents up to fourteen of the key theorems and postulates from the chapter. Students are to write each theorem or postulate in their own words, including illustrations if they choose to do so. You may suggest that students highlight or star the theorems or postulates with which they are not familiar.

WHEN TO USE Give these pages to students before beginning Lesson 3-1. Encourage them to add these pages to their Geometry Study Notebook. Remind them to update it as they complete each lesson.

Study Guide and Intervention

Each lesson in *Geometry* addresses two objectives. There is one Study Guide and Intervention master for each objective.

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 students who have been absent.

Skills Practice There is one master for each lesson. These provide computational practice at a basic level.

WHEN TO USE These masters can be used with students who have weaker mathematics backgrounds or need additional reinforcement.

Practice There is one master for each lesson. These problems more closely follow the structure of the Practice and Apply 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.

Reading to Learn Mathematics

One master is included for each lesson. The first section of each master asks questions about the opening paragraph of the lesson in the Student Edition. Additional questions ask students to interpret the context of and relationships among terms in the lesson. Finally, students are asked to summarize what they have learned using various representation techniques.

WHEN TO USE This master can be used as a study tool when presenting the lesson or as an informal reading assessment after presenting the lesson. It is also a helpful tool for ELL (English Language Learner) students.

Enrichment There is one extension master for each lesson. These activities may extend the concepts in the lesson, offer an 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 masters in the *Chapter 3 Resources Masters* offer a wide range of assessment tools for intermediate and final assessment. The following lists describe each assessment master and its intended use.

Chapter Assessment

CHAPTER TESTS

- *Form 1* contains multiple-choice questions and is intended for use with basic level students.
- *Forms 2A and 2B* contain multiple-choice questions aimed at the average level student. These tests are similar in format to offer comparable testing situations.
- *Forms 2C and 2D* are composed of free-response questions aimed at the average level student. These tests are similar in format to offer comparable testing situations. Grids with axes are provided for questions assessing graphing skills.
- *Form 3* is an advanced level test with free-response questions. Grids without axes are provided for questions assessing graphing skills.

All of the above tests include a free-response Bonus question.

- The **Open-Ended 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.

- A **Vocabulary Test**, suitable for all students, includes a list of the vocabulary words in the chapter and ten questions assessing students' knowledge of those terms. This can also be used in conjunction with one of the chapter tests or as a review worksheet.

Intermediate Assessment

- Four free-response **quizzes** are included to offer assessment at appropriate intervals in the chapter.
- A **Mid-Chapter Test** provides an option to assess the first half of the chapter. It is composed of both multiple-choice and free-response questions.

Continuing Assessment

- The **Cumulative Review** provides students an opportunity to reinforce and retain skills as they proceed through their study of Geometry. It can also be used as a test. This master includes free-response questions.
- The **Standardized Test Practice** offers continuing review of geometry concepts in various formats, which may appear on the standardized tests that they may encounter. This practice includes multiple-choice, grid-in, and short-response questions. Bubble-in and grid-in answer sections are provided on the master.

Answers

- Page A1 is an answer sheet for the Standardized Test Practice questions that appear in the Student Edition on pages 172–173. This improves 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 masters in this booklet.

3

Reading to Learn Mathematics***Vocabulary Builder***

This is an alphabetical list of the key vocabulary terms you will learn in Chapter 3. As you study the chapter, complete each term's definition or description. Remember to add the page number where you found the term. Add these pages to your Geometry Study Notebook to review vocabulary at the end of the chapter.

Vocabulary Term	Found on Page	Definition/Description/Example
alternate exterior angles		
alternate interior angles		
consecutive interior angles		
corresponding angles		
<u>equidistant</u> ee·kwuh·DIS·tuht		
<u>non-Euclidean geometry</u> yoo·KLID·ee·yuhn		
parallel lines		
parallel planes		

(continued on the next page)

3

Reading to Learn Mathematics**Vocabulary Builder** *(continued)*

Vocabulary Term	Found on Page	Definition/Description/Example
plane Euclidean geometry		
point-slope form		
rate of change		
skew lines		
slope		
slope-intercept form		
spherical geometry SFIR·uh·kuhl		
transversal		

3

Learning to Read Mathematics

Proof Builder

This is a list of key theorems and postulates you will learn in Chapter 3. As you study the chapter, write each theorem or postulate in your own words. Include illustrations as appropriate. Remember to include the page number where you found the theorem or postulate. Add this page to your Geometry Study Notebook so you can review the theorems and postulates at the end of the chapter.

Proof Builder

Theorem or Postulate	Found on Page	Description/Illustration/Abbreviation
Theorem 3.1 <i>Alternate Interior Angles Theorem</i>		
Theorem 3.2 <i>Consecutive Interior Angles Theorem</i>		
Theorem 3.3 <i>Alternate Exterior Angles Theorem</i>		
Theorem 3.4 <i>Perpendicular Transversal Theorem</i>		
Theorem 3.5		
Theorem 3.6		
Theorem 3.7		

(continued on the next page)

3

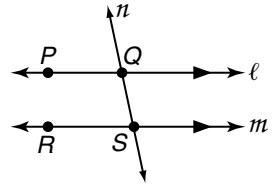
Learning to Read Mathematics***Proof Builder*** (continued)

Theorem or Postulate	Found on Page	Description/Illustration/Abbreviation
Theorem 3.8		
Theorem 3.9		
Postulate 3.1 <i>Corresponding Angles Postulate</i>		
Postulate 3.2		
Postulate 3.3		
Postulate 3.4		
Postulate 3.5 <i>Parallel Postulate</i>		

3-1 Study Guide and Intervention

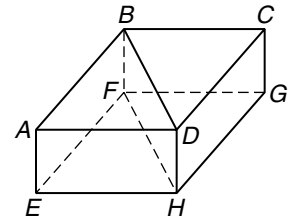
Parallel Lines and Transversals

Relationships Between Lines and Planes When two lines lie in the same plane and do not intersect, they are **parallel**. Lines that do not intersect and are not coplanar are **skew lines**. In the figure, ℓ is parallel to m , or $\ell \parallel m$. You can also write $\overline{PQ} \parallel \overline{RS}$. Similarly, if two planes do not intersect, they are **parallel planes**.



Example

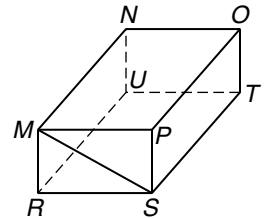
- Name all planes that are parallel to plane ABD .
plane EFH
- Name all segments that are parallel to \overline{CG} .
 \overline{BF} , \overline{DH} , and \overline{AE}
- Name all segments that are skew to \overline{EH} .
 \overline{BF} , \overline{CG} , \overline{BD} , \overline{CD} , and \overline{AB}



Exercises

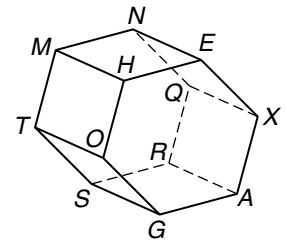
For Exercises 1–3, refer to the figure at the right.

- Name all planes that intersect plane OPT .
- Name all segments that are parallel to \overline{NU} .
- Name all segments that intersect \overline{MP} .



For Exercises 4–7, refer to the figure at the right.

- Name all segments parallel to \overline{QX} .
- Name all planes that intersect plane MHE .
- Name all segments parallel to \overline{QR} .
- Name all segments skew to \overline{AG} .

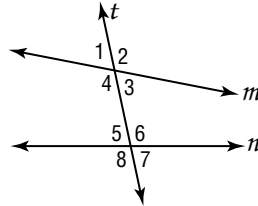


3-1 Study Guide and Intervention *(continued)*

Parallel Lines and Transversals

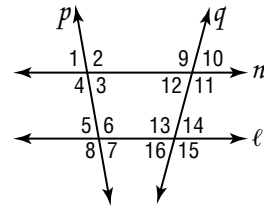
Angle Relationships A line that intersects two or more other lines in a plane is called a **transversal**. In the figure below, t is a transversal. Two lines and a transversal form eight angles. Some pairs of the angles have special names. The following chart lists the pairs of angles and their names.

Angle Pairs	Name
$\angle 3, \angle 4, \angle 5,$ and $\angle 6$	interior angles
$\angle 3$ and $\angle 5$; $\angle 4$ and $\angle 6$	alternate interior angles
$\angle 3$ and $\angle 6$; $\angle 4$ and $\angle 5$	consecutive interior angles
$\angle 1, \angle 2, \angle 7,$ and $\angle 8$	exterior angles
$\angle 1$ and $\angle 7$; $\angle 2$ and $\angle 8$	alternate exterior angles
$\angle 1$ and $\angle 5$; $\angle 2$ and $\angle 6$; $\angle 3$ and $\angle 7$; $\angle 4$ and $\angle 8$	corresponding angles



Example Identify each pair of angles as *alternate interior, alternate exterior, corresponding, or consecutive interior angles*.

- a. $\angle 10$ and $\angle 16$
alternate exterior angles
- b. $\angle 4$ and $\angle 12$
corresponding angles
- c. $\angle 12$ and $\angle 13$
consecutive interior angles
- d. $\angle 3$ and $\angle 9$
alternate interior angles



Exercises

Use the figure in the Example for Exercises 1–12.

Name the transversal that forms each pair of angles.

- 1. $\angle 9$ and $\angle 13$
- 2. $\angle 5$ and $\angle 14$
- 3. $\angle 4$ and $\angle 6$

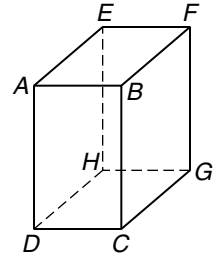
Identify each pair of angles as *alternate interior, alternate exterior, corresponding, or consecutive interior angles*.

- 4. $\angle 1$ and $\angle 5$
- 5. $\angle 6$ and $\angle 14$
- 6. $\angle 2$ and $\angle 8$
- 7. $\angle 3$ and $\angle 11$
- 8. $\angle 12$ and $\angle 3$
- 9. $\angle 4$ and $\angle 6$
- 10. $\angle 6$ and $\angle 16$
- 11. $\angle 11$ and $\angle 14$
- 12. $\angle 10$ and $\angle 16$

3-1 Skills Practice

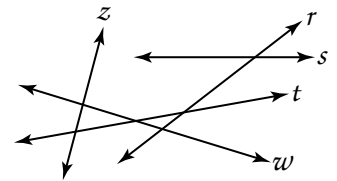
Parallel Lines and Transversals

For Exercises 1–4, refer to the figure at the right.



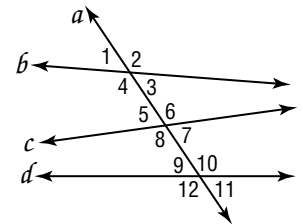
1. Name all planes that are parallel to plane DEH .
2. Name all segments that are parallel to \overline{AB} .
3. Name all segments that intersect \overline{GH} .
4. Name all segments that are skew to \overline{CD} .

Identify the sets of lines to which each given line is a transversal.



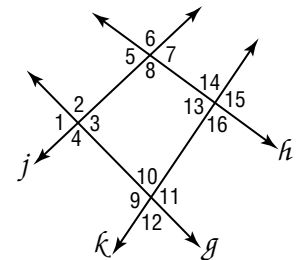
5. r
6. s
7. w

Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.



- | | |
|--------------------------------|--------------------------------|
| 8. $\angle 2$ and $\angle 8$ | 9. $\angle 3$ and $\angle 6$ |
| 10. $\angle 1$ and $\angle 9$ | 11. $\angle 3$ and $\angle 9$ |
| 12. $\angle 6$ and $\angle 12$ | 13. $\angle 7$ and $\angle 11$ |

Name the transversal that forms each pair of angles. Then identify the special name for the angle pair.

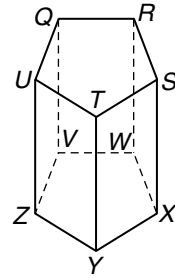


- | | |
|--------------------------------|---------------------------------|
| 14. $\angle 4$ and $\angle 10$ | 15. $\angle 2$ and $\angle 12$ |
| 16. $\angle 7$ and $\angle 3$ | 17. $\angle 13$ and $\angle 10$ |
| 18. $\angle 8$ and $\angle 14$ | 19. $\angle 6$ and $\angle 14$ |

3-1 Practice

Parallel Lines and Transversals

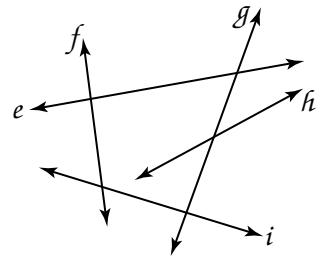
For Exercises 1–4, refer to the figure at the right.



1. Name all planes that intersect plane STX .
2. Name all segments that intersect \overline{QU} .
3. Name all segments that are parallel to \overline{XY} .
4. Name all segments that are skew to \overline{VW} .

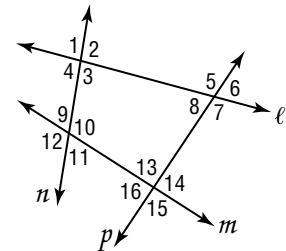
Identify the sets of lines to which each given line is a transversal.

5. e
6. h



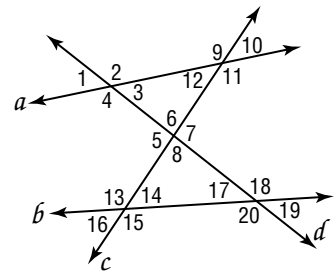
Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.

7. $\angle 9$ and $\angle 13$
8. $\angle 6$ and $\angle 16$
9. $\angle 3$ and $\angle 10$
10. $\angle 8$ and $\angle 14$



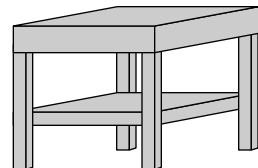
Name the transversal that forms each pair of angles. Then identify the special name for the angle pair.

11. $\angle 2$ and $\angle 12$
12. $\angle 6$ and $\angle 18$
13. $\angle 13$ and $\angle 19$
14. $\angle 11$ and $\angle 7$



FURNITURE For Exercises 15–16, refer to the drawing of the end table.

15. Find an example of parallel planes.
16. Find an example of parallel lines.



3-1

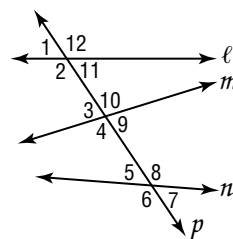
Reading to Learn Mathematics***Parallel Lines and Transversals*****Pre-Activity** How are parallel lines and planes used in architecture?

Read the introduction to Lesson 3-1 at the top of page 126 in your textbook.

- Give an example of parallel lines that can be found in your classroom.
- Give an example of parallel planes that can be found in your classroom.

Reading the Lesson

- Write a geometrical term that matches each definition.
 - two planes that do not intersect
 - lines that are not coplanar and do not intersect
 - two coplanar lines that do not intersect
 - a line that intersects two or more lines in a plane at different points
 - a pair of angles determined by two lines and a transversal consisting of an interior angle and an exterior angle that have different vertices and that lie on the same side of the transversal
- Refer to the figure at the right. Give the special name for each angle pair.
 - $\angle 3$ and $\angle 5$
 - $\angle 6$ and $\angle 12$
 - $\angle 4$ and $\angle 8$
 - $\angle 2$ and $\angle 3$
 - $\angle 8$ and $\angle 12$
 - $\angle 5$ and $\angle 9$
 - $\angle 4$ and $\angle 10$
 - $\angle 6$ and $\angle 7$

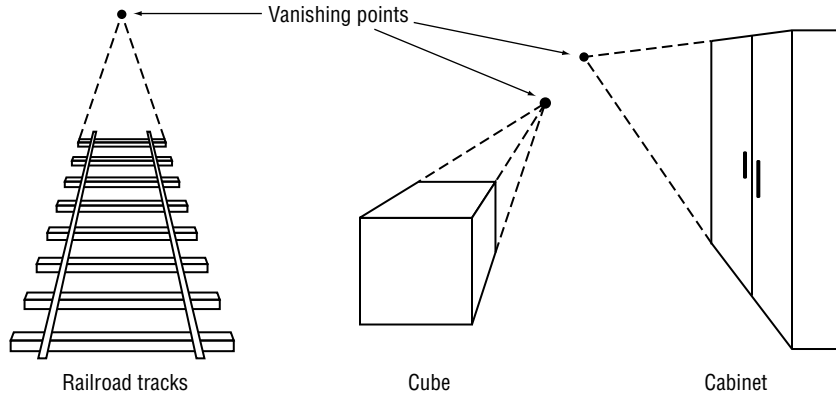
**Helping You Remember**

- A good way to remember new mathematical terms is to relate them to words that you use in everyday life. Many words start with the prefix *trans-*, which is a Latin root meaning *across*. List four English words that start with *trans-*. How can the meaning of this prefix help you remember the meaning of *transversal*?

3-1 Enrichment

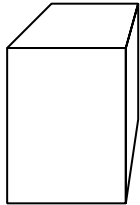
Perspective Drawings

To draw three-dimensional objects, artists make **perspective drawings** such as the ones shown. To indicate depth in a perspective drawing, some parallel lines are drawn as converging lines. The dotted lines in the figures below each extend to a **vanishing point**, or spot where parallel lines appear to meet.

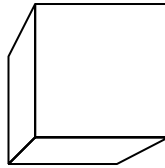


Draw lines to locate the vanishing point in each drawing of a box.

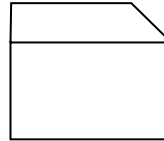
1.



2.

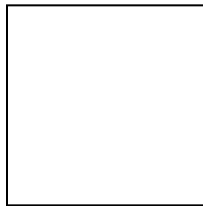
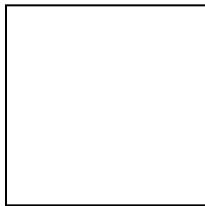


3.



4. The fronts of two cubes are shown below. Using point *P* as the vanishing point for both cubes, complete the perspective drawings of the cubes.

P



5. Find an example of a perspective drawing in a newspaper or magazine. Trace the drawing and locate a vanishing point.

3-2 Study Guide and Intervention

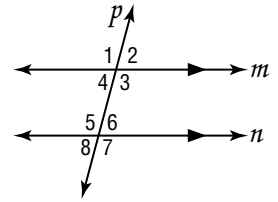
Angles and Parallel Lines

Parallel Lines and Angle Pairs When two parallel lines are cut by a transversal, the following pairs of angles are congruent.

- corresponding angles
- alternate interior angles
- alternate exterior angles

Also, consecutive interior angles are supplementary.

Example In the figure, $m\angle 2 = 75$. Find the measures of the remaining angles.

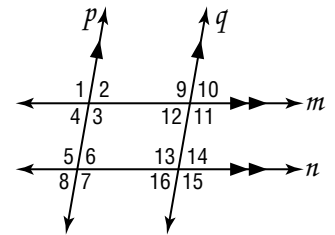


- $m\angle 1 = 105$ $\angle 1$ and $\angle 2$ form a linear pair.
- $m\angle 3 = 105$ $\angle 3$ and $\angle 2$ form a linear pair.
- $m\angle 4 = 75$ $\angle 4$ and $\angle 2$ are vertical angles.
- $m\angle 5 = 105$ $\angle 5$ and $\angle 3$ are alternate interior angles.
- $m\angle 6 = 75$ $\angle 6$ and $\angle 2$ are corresponding angles.
- $m\angle 7 = 105$ $\angle 7$ and $\angle 3$ are corresponding angles.
- $m\angle 8 = 75$ $\angle 8$ and $\angle 6$ are vertical angles.

Exercises

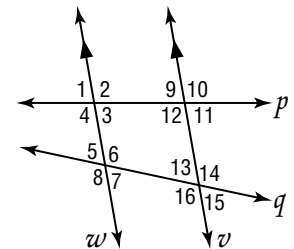
In the figure, $m\angle 3 = 102$. Find the measure of each angle.

- | | |
|----------------|----------------|
| 1. $\angle 5$ | 2. $\angle 6$ |
| 3. $\angle 11$ | 4. $\angle 7$ |
| 5. $\angle 15$ | 6. $\angle 14$ |



In the figure, $m\angle 9 = 80$ and $m\angle 5 = 68$. Find the measure of each angle.

- | | |
|----------------|-----------------|
| 7. $\angle 12$ | 8. $\angle 1$ |
| 9. $\angle 4$ | 10. $\angle 3$ |
| 11. $\angle 7$ | 12. $\angle 16$ |



3-2 Study Guide and Intervention *(continued)*

Angles and Parallel Lines

Algebra and Angle Measures Algebra can be used to find unknown values in angles formed by a transversal and parallel lines.

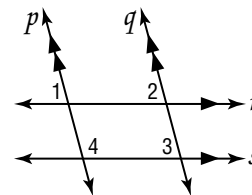
Example If $m\angle 1 = 3x + 15$, $m\angle 2 = 4x - 5$, $m\angle 3 = 5y$, and $m\angle 4 = 6z + 3$, find x and y .

$p \parallel q$, so $m\angle 1 = m\angle 2$
because they are corresponding angles.

$$\begin{aligned} 3x + 15 &= 4x - 5 \\ 3x + 15 - 3x &= 4x - 5 - 3x \\ 15 &= x - 5 \\ 15 + 5 &= x - 5 + 5 \\ 20 &= x \end{aligned}$$

$r \parallel s$, so $m\angle 2 = m\angle 3$
because they are corresponding angles.

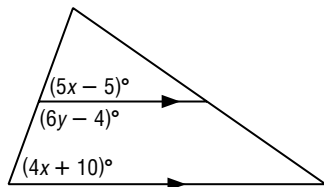
$$\begin{aligned} m\angle 2 &= m\angle 3 \\ 75 &= 5y \\ \frac{75}{5} &= \frac{5y}{5} \\ 15 &= y \end{aligned}$$



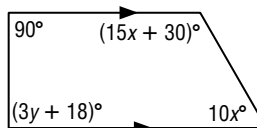
Exercises

Find x and y in each figure.

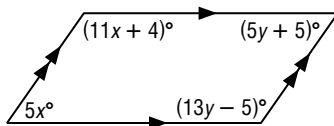
1.



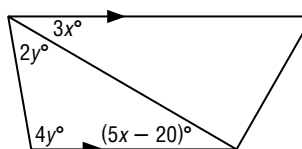
2.



3.

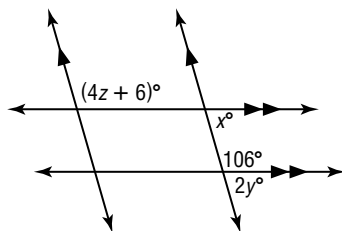


4.

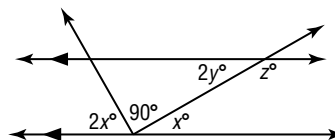


Find x , y , and z in each figure.

5.



6.

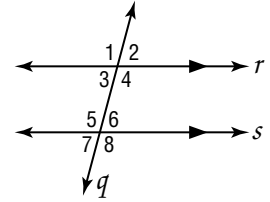


3-2 Skills Practice

Angles and Parallel Lines

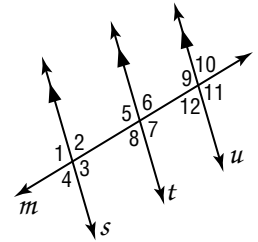
In the figure, $m\angle 2 = 70$. Find the measure of each angle.

- | | |
|---------------|---------------|
| 1. $\angle 3$ | 2. $\angle 5$ |
| 3. $\angle 8$ | 4. $\angle 1$ |
| 5. $\angle 4$ | 6. $\angle 6$ |



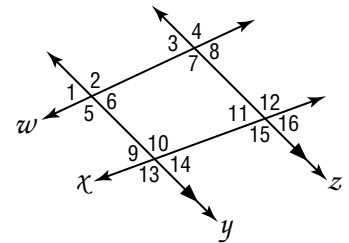
In the figure, $m\angle 7 = 100$. Find the measure of each angle.

- | | |
|----------------|-----------------|
| 7. $\angle 9$ | 8. $\angle 6$ |
| 9. $\angle 8$ | 10. $\angle 2$ |
| 11. $\angle 5$ | 12. $\angle 11$ |

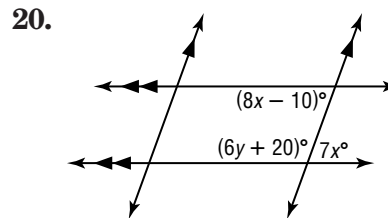
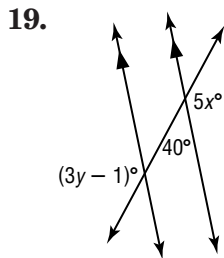


In the figure, $m\angle 3 = 75$ and $m\angle 10 = 115$. Find the measure of each angle.

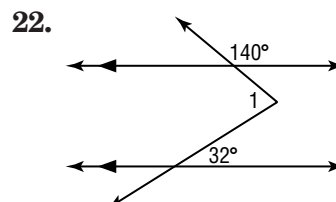
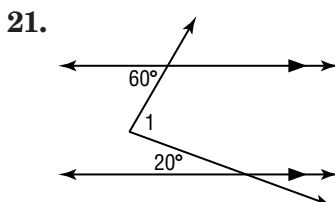
- | | |
|-----------------|-----------------|
| 13. $\angle 2$ | 14. $\angle 5$ |
| 15. $\angle 7$ | 16. $\angle 15$ |
| 17. $\angle 14$ | 18. $\angle 9$ |



Find x and y in each figure.



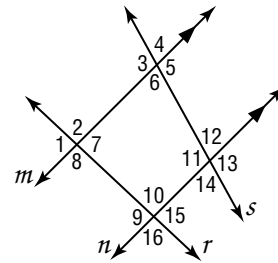
Find $m\angle 1$ in each figure.



3-2 Practice

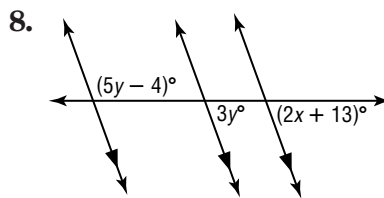
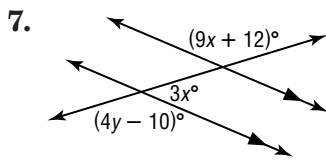
Angles and Parallel Lines

In the figure, $m\angle 2 = 92$ and $m\angle 12 = 74$. Find the measure of each angle.

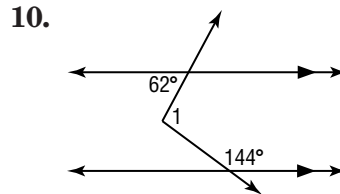
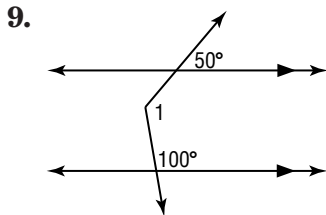


- | | |
|----------------|----------------|
| 1. $\angle 10$ | 2. $\angle 8$ |
| 3. $\angle 9$ | 4. $\angle 5$ |
| 5. $\angle 11$ | 6. $\angle 13$ |

Find x and y in each figure.



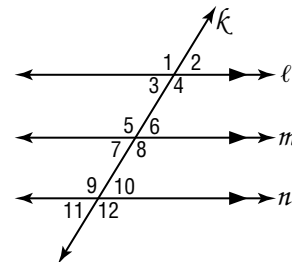
Find $m\angle 1$ in each figure.



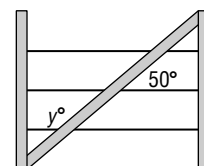
11. **PROOF** Write a paragraph proof of Theorem 3.3.

Given: $l \parallel m, m \parallel n$

Prove: $\angle 1 \cong \angle 12$



12. **FENCING** A diagonal brace strengthens the wire fence and prevents it from sagging. The brace makes a 50° angle with the wire as shown. Find y .



3-2

Reading to Learn Mathematics

*Angles and Parallel Lines***Pre-Activity** How can angles and lines be used in art?

Read the introduction to Lesson 3-2 at the top of page 133 in your textbook.

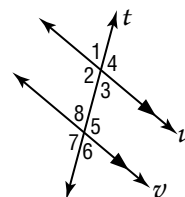
- Your textbook shows a painting that contains two parallel lines and a transversal. What is the name for $\angle 1$ and $\angle 2$?
- What is the relationship between these two angles?

Reading the Lesson

- Choose the correct word to complete each sentence.
 - If two parallel lines are cut by a transversal, then alternate exterior angles are _____ (congruent/complementary/supplementary).
 - If two parallel lines are cut by a transversal, then corresponding angles are _____ (congruent/complementary/supplementary).
 - If parallel lines are cut by a transversal, then consecutive interior angles are _____ (congruent/complementary/supplementary).
 - In a plane, if a line is perpendicular to one of two parallel lines, then it is _____ (parallel/perpendicular/skew) to the other.

Use the figure for Exercises 2 and 3.

- Name four pairs of vertical angles.
 - Name all angles that form a linear pair with $\angle 7$.
 - Name all angles that are congruent to $\angle 1$.
 - Name all angles that are congruent to $\angle 4$.
 - Name all angles that are supplementary to $\angle 3$.
 - Name all angles that are supplementary to $\angle 2$.
- Which conclusion(s) could you make about lines u and v if $m\angle 4 = m\angle 1$?
 - $t \parallel u$
 - $t \perp u$
 - $v \perp u$
 - $v \perp t$
 - $v \parallel t$

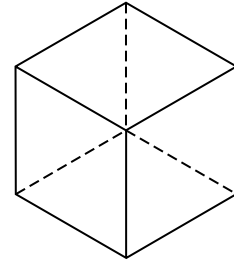
**Helping You Remember**

- How can you use an everyday meaning of the adjective *alternate* to help you remember the types of angle pairs for two lines and a transversal?

3-2 Enrichment

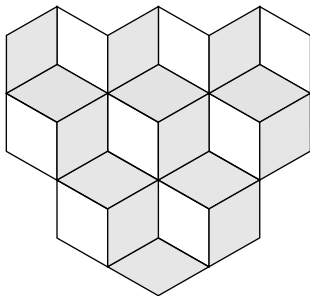
More Optical Illusions

In drawings, diagonal lines may create the illusion of depth. For example, the figure at the right can be thought of as picturing a flat figure or a cube. The optical illusions on this page involve depth perception.

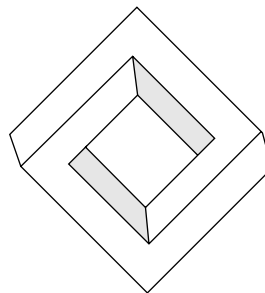


Answer each question.

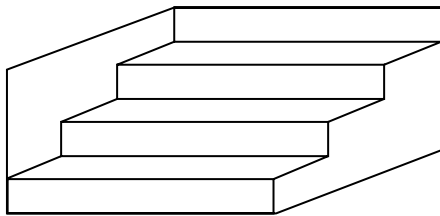
1. How many cubes do you see in the drawing?



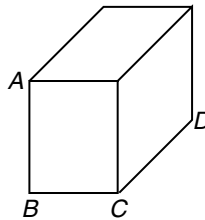
2. Can this figure show an actual object?



3. Does the drawing show a view from the top or the bottom of the stairs?

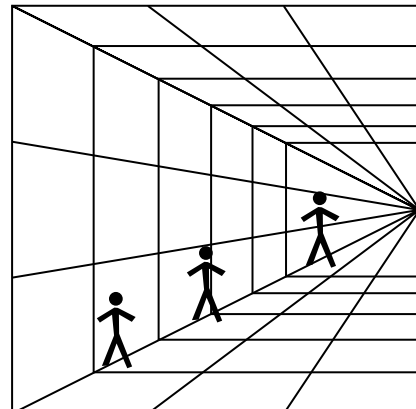


4. Which line segment is longer, \overline{AB} or \overline{CD} ? Measure to check your answer.



5. Which person in the drawing at the right appears to be tallest? Measure to check your answer.

6. Draw two more objects the same size on the figure at the right. Does one appear larger than the other?



3-3 Study Guide and Intervention

Slopes of Lines

Slope of a Line The slope m of a line containing two points with coordinates (x_1, y_1) and (x_2, y_2) is given by the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$, where $x_1 \neq x_2$.

Example Find the slope of each line.

For line p , let (x_1, y_1) be $(1, 2)$ and (x_2, y_2) be $(-2, -2)$.

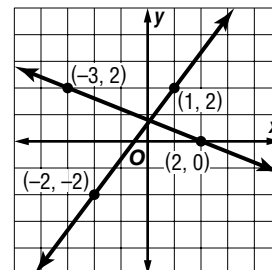
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{-2 - 2}{-2 - 1} \text{ or } \frac{4}{3}$$

For line q , let (x_1, y_1) be $(2, 0)$ and (x_2, y_2) be $(-3, 2)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{2 - 0}{-3 - 2} \text{ or } -\frac{2}{5}$$



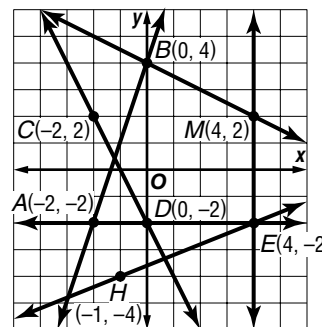
Exercises

Determine the slope of the line that contains the given points.

- | | |
|-------------------------|---------------------------|
| 1. $J(0, 0), K(-2, 8)$ | 2. $R(-2, -3), S(3, -5)$ |
| 3. $L(1, -2), N(-6, 3)$ | 4. $P(-1, 2), Q(-9, 6)$ |
| 5. $T(1, -2), U(6, -2)$ | 6. $V(-2, 10), W(-4, -3)$ |

Find the slope of each line.

- | | |
|---------------------|---------------------|
| 7. \overline{AB} | 8. \overline{CD} |
| 9. \overline{EM} | 10. \overline{AE} |
| 11. \overline{EH} | 12. \overline{BM} |



3-3 Study Guide and Intervention *(continued)***Slopes of Lines**

Parallel and Perpendicular Lines If you examine the slopes of pairs of parallel lines and the slopes of pairs of perpendicular lines, where neither line in each pair is vertical, you will discover the following properties.

Two lines have the same slope if and only if they are parallel.

Two lines are perpendicular if and only if the product of their slopes is -1 .

Example 1 Find the slope of a line parallel to the line containing $A(-3, 4)$ and $B(2, 5)$.

Find the slope of \overline{AB} . Use $(-3, 4)$ for (x_1, y_1) and use $(2, 5)$ for (x_2, y_2) .

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{5 - 4}{2 - (-3)} \text{ or } \frac{1}{5} \end{aligned}$$

The slope of any line parallel to \overline{AB} must be $\frac{1}{5}$.

Example 2 Find the slope of a line perpendicular to \overline{PQ} for $P(-2, -4)$ and $Q(4, 3)$.

Find the slope of \overline{PQ} . Use $(-2, -4)$ for (x_1, y_1) and use $(4, 3)$ for (x_2, y_2) .

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{3 - (-4)}{4 - (-2)} \text{ or } \frac{7}{6} \end{aligned}$$

Since $\frac{7}{6} \cdot \left(-\frac{6}{7}\right) = -1$, the slope of any line perpendicular to \overline{PQ} must be $-\frac{6}{7}$.

Exercises

Determine whether \overline{MN} and \overline{RS} are *parallel*, *perpendicular*, or *neither*.

1. $M(0, 3), N(2, 4), R(2, 1), S(8, 4)$

2. $M(-1, 3), N(0, 5), R(2, 1), S(6, -1)$

3. $M(-1, 3), N(4, 4), R(3, 1), S(-2, 2)$

4. $M(0, -3), N(-2, -7), R(2, 1), S(0, -3)$

5. $M(-2, 2), N(1, -3), R(-2, 1), S(3, 4)$

6. $M(0, 0), N(2, 4), R(2, 1), S(8, 4)$

Find the slope of \overline{MN} and the slope of any line perpendicular to \overline{MN} .

7. $M(2, -4), N(-2, -1)$

8. $M(1, 3), N(-1, 5)$

9. $M(4, -2), N(5, 3)$

10. $M(2, -3), N(-4, 1)$

3-3 Skills Practice

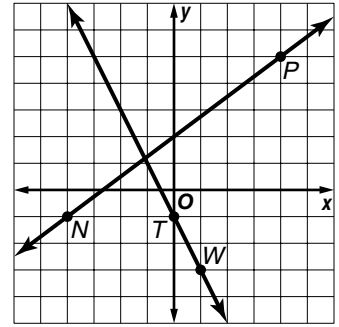
Slopes of Lines

Determine the slope of the line that contains the given points.

1. $S(-1, 2), W(0, 4)$
2. $G(-2, 5), H(1, -7)$
3. $C(0, 1), D(3, 3)$
4. $J(-5, -2), K(5, -4)$

Find the slope of each line.

5. \overleftrightarrow{NP}
6. \overleftrightarrow{TW}
7. a line parallel to \overleftrightarrow{TW}
8. a line perpendicular to \overleftrightarrow{NP}

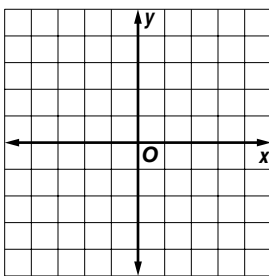


Determine whether \overleftrightarrow{AB} and \overleftrightarrow{MN} are *parallel*, *perpendicular*, or *neither*.

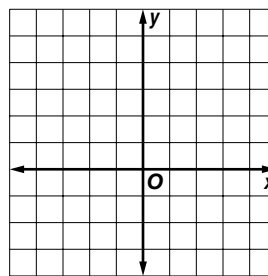
9. $A(0, 3), B(5, -7), M(-6, 7), N(-2, -1)$
10. $A(-1, 4), B(2, -5), M(-3, 2), N(3, 0)$
11. $A(-2, -7), B(4, 2), M(-2, 0), N(2, 6)$
12. $A(-4, -8), B(4, -6), M(-3, 5), N(-1, -3)$

Graph the line that satisfies each condition.

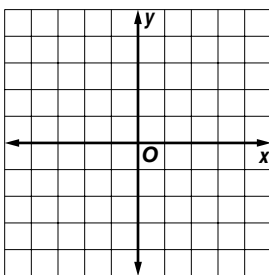
13. slope = 3, contains $A(0, 1)$



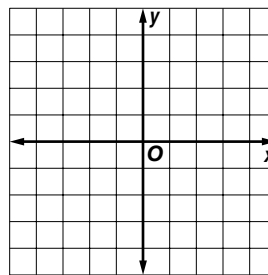
14. slope = $-\frac{3}{2}$, contains $R(-4, 5)$



15. contains $Y(3, 0)$, parallel to \overleftrightarrow{DJ} with $D(-3, 1)$ and $J(3, 3)$



16. contains $T(0, -2)$, perpendicular to \overleftrightarrow{CX} with $C(0, 3)$ and $X(2, -1)$



3-3 Practice

Slopes of Lines

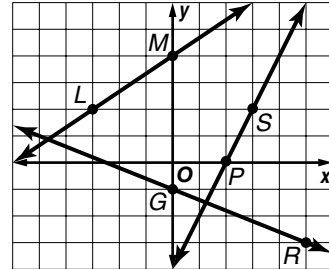
Determine the slope of the line that contains the given points.

1. $B(-4, 4), R(0, 2)$ 2. $I(-2, -9), P(2, 4)$

Find the slope of each line.

3. \overline{LM} 4. \overline{GR}

5. a line parallel to \overline{GR} 6. a line perpendicular to \overline{PS}

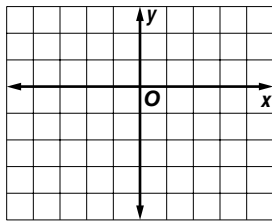


Determine whether \overline{KM} and \overline{ST} are *parallel, perpendicular, or neither*.

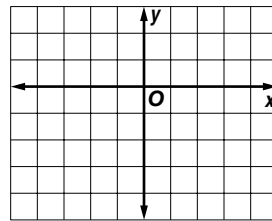
7. $K(-1, -8), M(1, 6), S(-2, -6), T(2, 10)$ 8. $K(-5, -2), M(5, 4), S(-3, 6), T(3, -4)$
9. $K(-4, 10), M(2, -8), S(1, 2), T(4, -7)$ 10. $K(-3, -7), M(3, -3), S(0, 4), T(6, -5)$

Graph the line that satisfies each condition.

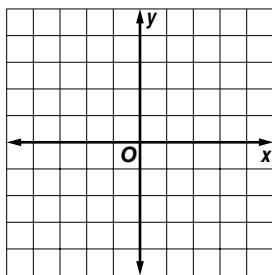
11. slope = $-\frac{1}{2}$, contains $U(2, -2)$



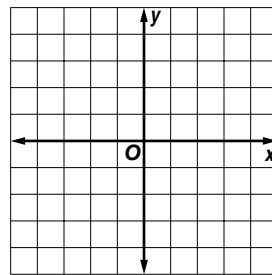
12. slope = $\frac{4}{3}$, contains $P(-3, -3)$



13. contains $B(-4, 2)$, parallel to \overline{FG} with $F(0, -3)$ and $G(4, -2)$



14. contains $Z(-3, 0)$, perpendicular to \overline{EK} with $E(-2, 4)$ and $K(2, -2)$



15. **PROFITS** After Take Two began renting DVDs at their video store, business soared. Between 2000 and 2003, profits increased at an average rate of \$12,000 per year. Total profits in 2003 were \$46,000. If profits continue to increase at the same rate, what will the total profit be in 2009?

3-3 Reading to Learn Mathematics

Slopes of Lines

Pre-Activity How is slope used in transportation?

Read the introduction to Lesson 3-3 at the top of page 139 in your textbook.

- If you are driving uphill on a road with a 4% grade, how many feet will the road rise for every 1000 horizontal feet traveled?
- If you are driving downhill on a road with a 7% grade, how many meters will the road fall for every 500 meters traveled?

Reading the Lesson

1. Which expressions can be used to represent the slope of the line containing points (x_1, y_1) and (x_2, y_2) ? Assume that no denominator is zero.

A. $\frac{\Delta y}{\Delta x}$

B. $\frac{\text{horizontal run}}{\text{vertical rise}}$

C. $\frac{y_2 - y_1}{x_2 - x_1}$

D. $\frac{\text{change in } x}{\text{change in } y}$

E. $\frac{y_2 - y_1}{x_1 - x_2}$

F. $\frac{y_1 - y_2}{x_1 - x_2}$

G. $\frac{x_2 - x_1}{y_2 - y_1}$

H. $\frac{y_2 - x_2}{y_1 - x_1}$

2. Match the description of a line from the first column with the description of its slope from the second column.

Type of Line

- a horizontal line
- a line that rises from left to right
- a vertical line
- a line that falls from left to right

Slope

- a negative number
- 0
- undefined
- a positive number

3. Find the slope of each line.

- a line parallel to a line with slope $\frac{3}{4}$
- a line perpendicular to the x -axis
- a line perpendicular to a line with slope 5
- a line parallel to the x -axis
- y -axis

Helping You Remember

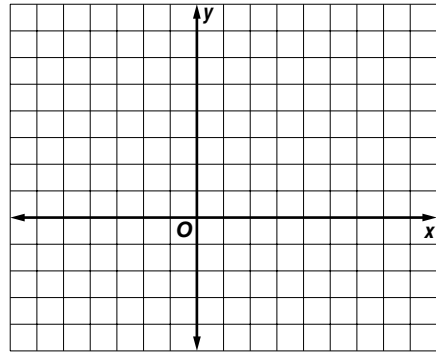
4. A good way to remember something is to explain it to someone else. Suppose your friend thinks that perpendicular lines (if neither line is vertical) have slopes that are reciprocals of each other. How could you explain to your friend that this is incorrect and give her a good way to remember the correct relationship?

3-3 Enrichment

Slopes and Polygons

In coordinate geometry, the slopes of two lines determine if the lines are parallel or perpendicular. This knowledge can be useful when working with polygons.

- The coordinates of the vertices of a triangle are $A(-6, 4)$, $B(8, 6)$, and $C(4, -4)$. Graph $\triangle ABC$.
- J , K , and L are midpoints of \overline{AB} , \overline{BC} , and \overline{AC} , respectively. Find the coordinates of J , K , and L . Draw $\triangle JKL$.



- Which segments appear to be parallel?
- Show that the segments named in Exercise 3 are parallel by finding the slopes of all six segments.

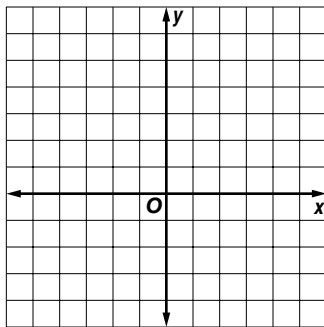
The coordinates of the vertices of right $\triangle PQR$ are given. Find the slope of each side of the triangle. Then name the hypotenuse.

- $P(5, 1)$ $Q(1, -1)$ $R(-2, 5)$
 slope of \overline{PQ} =
 slope of \overline{QR} =
 slope of \overline{PR} =
 hypotenuse:

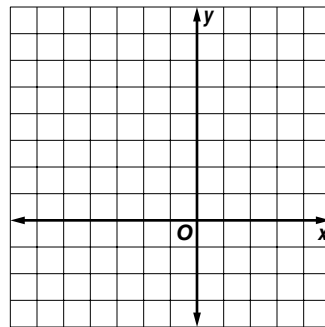
- $P(-2, -3)$ $Q(5, 1)$ $R(2, 3)$
 slope of \overline{PQ} =
 slope of \overline{QR} =
 slope of \overline{PR} =
 hypotenuse:

The coordinates of quadrilateral $PQRS$ are given. Graph quadrilateral $PQRS$ and find the slopes of the diagonals. State whether the diagonals are perpendicular.

- $P(-2, 6)$, $Q(4, 0)$, $R(1, -4)$, $S(-5, 2)$



- $P(0, 6)$, $Q(3, 0)$, $R(-4, -2)$, $S(-5, 4)$



3-4 Study Guide and Intervention

Equations of Lines

Write Equations of Lines You can write an equation of a line if you are given any of the following:

- the slope and the y -intercept,
- the slope and the coordinates of a point on the line, or
- the coordinates of two points on the line.

If m is the slope of a line, b is its y -intercept, and (x_1, y_1) is a point on the line, then:

- the **slope-intercept form** of the equation is $y = mx + b$,
- the **point-slope form** of the equation is $y - y_1 = m(x - x_1)$.

Example 1 Write an equation in slope-intercept form of the line with slope -2 and y -intercept 4 .

$$y = mx + b \quad \text{Slope-intercept form}$$

$$y = -2x + 4 \quad m = -2, b = 4$$

The slope-intercept form of the equation of the line is $y = -2x + 4$.

Example 2 Write an equation in point-slope form of the line with slope $-\frac{3}{4}$ that contains $(8, 1)$.

$$y - y_1 = m(x - x_1) \quad \text{Point-slope form}$$

$$y - 1 = -\frac{3}{4}(x - 8) \quad m = -\frac{3}{4}, (x_1, y_1) = (8, 1)$$

The point-slope form of the equation of the line is $y - 1 = -\frac{3}{4}(x - 8)$.

Exercises

Write an equation in slope-intercept form of the line having the given slope and y -intercept.

1. $m: 2, y$ -intercept: -3

2. $m: -\frac{1}{2}, y$ -intercept: 4

3. $m: \frac{1}{4}, y$ -intercept: 5

4. $m: 0, y$ -intercept: -2

5. $m: -\frac{5}{3}, y$ -intercept: $\frac{1}{3}$

6. $m: -3, y$ -intercept: -8

Write an equation in point-slope form of the line having the given slope that contains the given point.

7. $m = \frac{1}{2}, (3, -1)$

8. $m = -2, (4, -2)$

9. $m = -1, (-1, 3)$

10. $m = \frac{1}{4}, (-3, -2)$

11. $m = -\frac{5}{2}, (0, -3)$

12. $m = 0, (-2, 5)$

3-4 Study Guide and Intervention *(continued)***Equations of Lines**

Write Equations to Solve Problems Many real-world situations can be modeled using linear equations.

Example

Donna offers computer services to small companies in her city. She charges \$55 per month for maintaining a web site and \$45 per hour for each service call.

- a. Write an equation to represent the total monthly cost C for maintaining a web site and for h hours of service calls.

For each hour, the cost increases \$45. So the rate of change, or slope, is 45. The y -intercept is located where there are 0 hours, or \$55.

$$\begin{aligned} C &= mh + b \\ &= 45h + 55 \end{aligned}$$

- b. Donna may change her costs to represent them by the equation $C = 25h + 125$, where \$125 is the fixed monthly fee for a web site and the cost per hour is \$25. Compare her new plan to the old one if a company has $5\frac{1}{2}$ hours of service calls. Under which plan would Donna earn more?

First plan

For $5\frac{1}{2}$ hours of service Donna would earn

$$\begin{aligned} C &= 45h + 55 = 45\left(5\frac{1}{2}\right) + 55 \\ &= 247.5 + 55 \text{ or } \$302.50 \end{aligned}$$

Second Plan

For $5\frac{1}{2}$ hours of service Donna would earn

$$\begin{aligned} C &= 25h + 125 = 25(5.5) + 125 \\ &= 137.5 + 125 \text{ or } \$262.50 \end{aligned}$$

Donna would earn more with the first plan.

Exercises

For Exercises 1–4, use the following information.

Jerri's current satellite television service charges a flat rate of \$34.95 per month for the basic channels and an additional \$10 per month for each premium channel. A competing satellite television service charges a flat rate of \$39.99 per month for the basic channels and an additional \$8 per month for each premium channel.

- Write an equation in slope-intercept form that models the total monthly cost for each satellite service, where p is the number of premium channels.
- If Jerri wants to include three premium channels in her package, which service would be less, her current service or the competing service?
- A third satellite company charges a flat rate of \$69 for all channels, including the premium channels. If Jerri wants to add a fourth premium channel, which service would be least expensive?
- Write a description of how the fee for the number of premium channels is reflected in the equation.

3-4 Skills Practice**Equations of Lines**

Write an equation in slope-intercept form of the line having the given slope and y-intercept.

1. $m: -4$, y-intercept: 3

2. $m: 3$, y-intercept: -8

3. $m: \frac{3}{7}$, (0, 1)

4. $m: -\frac{2}{5}$, (0, -6)

Write equations in point-slope form and slope-intercept form of the line having the given slope and containing the given point.

5. $m: 2$, (5, 2)

6. $m: -3$, (2, -4)

7. $m: -\frac{1}{2}$, (-2 , 5)

8. $m: \frac{1}{3}$, (-3 , -8)

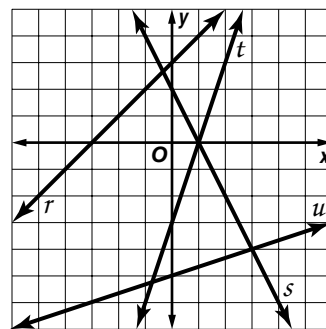
Write an equation in slope-intercept form for each line.

9. r

10. s

11. t

12. u

13. the line parallel to line r that contains (1, -1)14. the line perpendicular to line s that contains (0, 0)

Write an equation in slope-intercept form for the line that satisfies the given conditions.

15. $m = 6$, y-intercept = -2

16. $m = -\frac{5}{3}$, y-intercept = 0

17. $m = -1$, contains (0, -6)

18. $m = 4$, contains (2, 5)

19. contains (2, 0) and (0, 10)

20. x-intercept is -2 , y-intercept is -1

3-4 Practice**Equations of Lines**

Write an equation in slope-intercept form of the line having the given slope and y-intercept.

1. $m: \frac{2}{3}$, y-intercept: -10

2. $m: -\frac{7}{9}$, $(0, -\frac{1}{2})$

3. $m: 4.5$, $(0, 0.25)$

Write equations in point-slope form and slope-intercept form of the line having the given slope and containing the given point.

4. $m: \frac{3}{2}$, $(4, 6)$

5. $m: -\frac{6}{5}$, $(-5, -2)$

6. $m: 0.5$, $(7, -3)$

7. $m: -1.3$, $(-4, 4)$

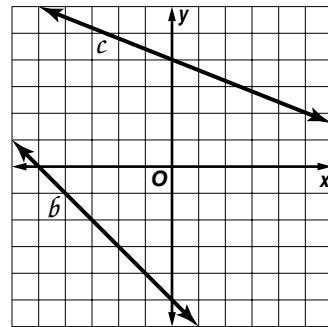
Write an equation in slope-intercept form for each line.

8. b

9. c

10. parallel to line b , contains $(3, -2)$

11. perpendicular to line c , contains $(-2, -4)$



Write an equation in slope-intercept form for the line that satisfies the given conditions.

12. $m = -\frac{4}{9}$, y-intercept = 2

13. $m = 3$, contains $(2, -3)$

14. x-intercept is -6 , y-intercept is 2

15. x-intercept is 2 , y-intercept is -5

16. passes through $(2, -4)$ and $(5, 8)$

17. contains $(-4, 2)$ and $(8, -1)$

18. COMMUNITY EDUCATION A local community center offers self-defense classes for teens. A \$25 enrollment fee covers supplies and materials and open classes cost \$10 each. Write an equation to represent the total cost of x self-defense classes at the community center.

3-4 Reading to Learn Mathematics

Equations of Lines

Pre-Activity How can the equation of a line describe the cost of cellular telephone service?

Read the introduction to Lesson 3-4 at the top of page 145 in your textbook. If the rates for your cellular phone plan are described by the equation in your textbook, what will be the total charge (excluding taxes and fees) for a month in which you use 50 minutes of air time?

Reading the Lesson

1. Identify what each formula represents.

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

b. $m = \frac{y_2 - y_1}{x_2 - x_1}$

c. $y = mx + b$

2. Write the point-slope form of the equation for each line.

a. line with slope $-\frac{1}{2}$ containing $(-2, 5)$

b. line containing $(-4.5, -6.5)$ and parallel to a line with slope 0.5

3. Which one of the following correctly describes the y -intercept of a line?

A. the y -coordinate of the point where the line intersects the x -axis

B. the x -coordinate of the point where the line intersects the y -axis

C. the y -coordinate of the point where the line crosses the y -axis

D. the x -coordinate of the point where the line crosses the x -axis

E. the ratio of the change in y -coordinates to the change in x -coordinates

4. Find the slope and y -intercept of each line.

a. $y = 2x - 7$

b. $x + y = 8.5$

c. $2.4x - y = 4.8$

d. $y - 7 = x + 12$

e. $y + 5 = -2(x + 6)$

Helping You Remember

5. A good way to remember something new is to relate it to something you already know. How can the slope formula help you to remember the equation for the point-slope form of a line?

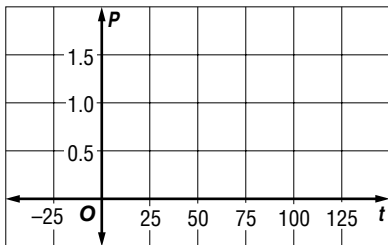
3-4 Enrichment

Absolute Zero

All matter is made up of atoms and molecules that are in constant motion. Temperature is one measure of this motion. Absolute zero is the theoretical temperature limit at which the motion of the molecules and atoms of a substance is the least possible.

Experiments with gaseous substances yield data that allow you to estimate just how cold absolute zero is. For any gas of a constant volume, the pressure, expressed in a unit called atmospheres, varies linearly as the temperature. That is, the pressure P and the temperature t are related by an equation of the form $P = mt + b$, where m and b are real numbers.

1. Sketch a graph for the data in the table.



t (in °C)	P (in atmospheres)
-25	0.91
0	1.00
25	1.09
100	1.36

2. Use the data and your graph to find values for m and b in the equation $P = mt + b$, which relates temperature to pressure.
3. Estimate absolute zero in degrees Celsius by setting P equal to 0 in the equation above and using the values m and b that you obtained in Exercise 2.

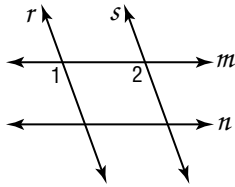
3-5 Study Guide and Intervention

Proving Lines Parallel

Identify Parallel Lines If two lines in a plane are cut by a transversal and certain conditions are met, then the lines must be parallel.

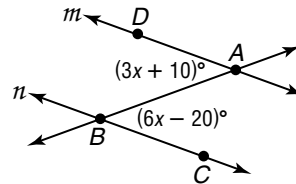
If	then
<ul style="list-style-type: none"> • corresponding angles are congruent, • alternate exterior angles are congruent, • consecutive interior angles are supplementary, • alternate interior angles are congruent, or • two lines are perpendicular to the same line, 	the lines are parallel.

Example 1 If $m\angle 1 = m\angle 2$, determine which lines, if any, are parallel.



Since $m\angle 1 = m\angle 2$, then $\angle 1 \cong \angle 2$. $\angle 1$ and $\angle 2$ are congruent corresponding angles, so $r \parallel s$.

Example 2 Find x and $m\angle ABC$ so that $m \parallel n$.



We can conclude that $m \parallel n$ if alternate interior angles are congruent.

$$m\angle DAB = m\angle CDA$$

$$3x + 10 = 6x - 20$$

$$10 = 3x - 20$$

$$30 = 3x$$

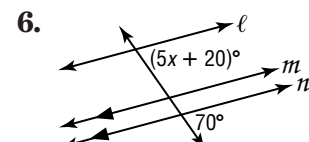
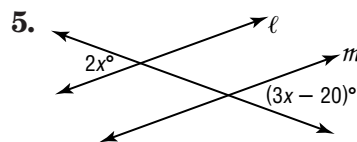
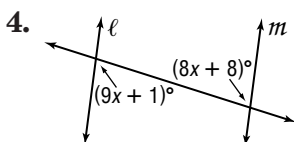
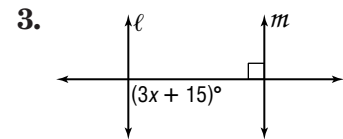
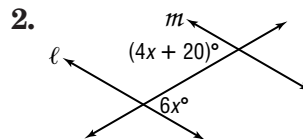
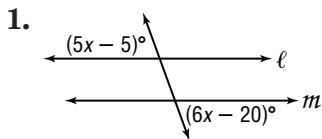
$$10 = x$$

$$m\angle ABC = 6x - 20$$

$$= 6(10) - 20 \text{ or } 40$$

Exercises

Find x so that $\ell \parallel m$.



3-5 Study Guide and Intervention *(continued)*

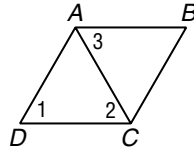
Proving Lines Parallel

Prove Lines Parallel You can prove that lines are parallel by using postulates and theorems about pairs of angles. You also can use slopes of lines to prove that two lines are parallel or perpendicular.

Example

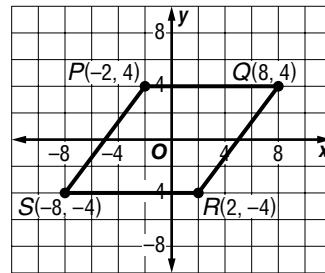
a Given: $\angle 1 \cong \angle 2, \angle 1 \cong \angle 3$

Prove: $\overline{AB} \parallel \overline{DC}$



Statements	Reasons
1. $\angle 1 \cong \angle 2$ $\angle 1 \cong \angle 3$	1. Given
2. $\angle 2 \cong \angle 3$	2. Transitive Property of \cong
3. $\overline{AB} \parallel \overline{DC}$	3. If alt. int. angles are \cong , then the lines are \parallel .

b. Which lines are parallel?
Which lines are perpendicular?



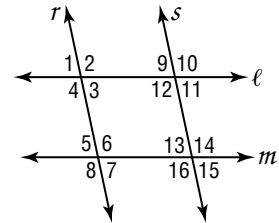
slope of $\overline{PQ} = 0$ slope of $\overline{SR} = 0$
 slope of $\overline{PS} = \frac{4}{3}$ slope of $\overline{QR} = \frac{4}{3}$
 slope of $\overline{PR} = -2$ slope of $\overline{SQ} = \frac{1}{2}$
 So $\overline{PQ} \parallel \overline{SR}$, $\overline{PS} \parallel \overline{QR}$, and $\overline{PR} \perp \overline{SQ}$.

Exercises

For Exercises 1–6, fill in the blanks.

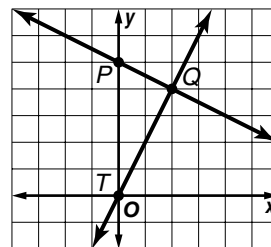
Given: $\angle 1 \cong \angle 5, \angle 15 \cong \angle 5$

Prove: $\ell \parallel m, r \parallel s$



Statements	Reasons
1. $\angle 15 \cong \angle 5$	1. _____
2. $\angle 13 \cong \angle 15$	2. _____
3. $\angle 5 \cong \angle 13$	3. _____
4. $r \parallel s$	4. _____
5. _____	5. Given
6. _____	6. If corr \sphericalangle s are \cong , then lines \parallel .

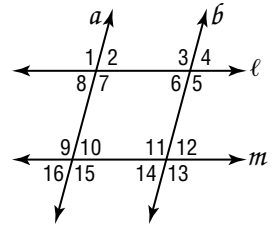
7. Determine whether $\overline{PQ} \perp \overline{TQ}$. Explain why or why not.



3-5 Skills Practice

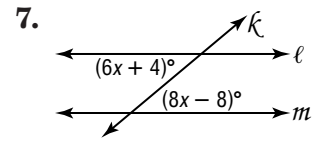
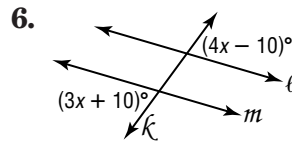
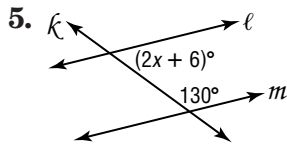
Proving Lines Parallel

Given the following information, determine which lines, if any, are parallel. State the postulate or theorem that justifies your answer.



1. $\angle 3 \cong \angle 7$
2. $\angle 9 \cong \angle 11$
3. $\angle 2 \cong \angle 16$
4. $m\angle 5 + m\angle 12 = 180$

Find x so that $\ell \parallel m$.



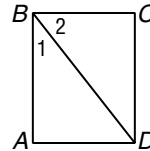
8. **PROOF** Provide a reason for each statement in the proof of Theorem 3.7.

Given: $\angle 1$ and $\angle 2$ are complementary.

$$\overline{BC} \perp \overline{CD}$$

Prove: $\overline{BA} \parallel \overline{CD}$

Proof:

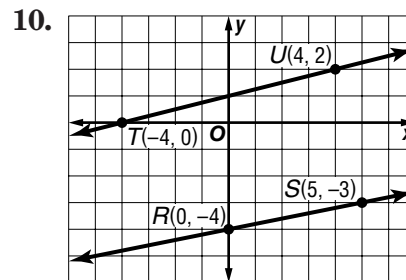
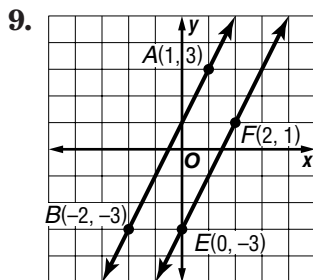


Statements

Reasons

1. $\overline{BC} \perp \overline{CD}$	1.
2. $m\angle ABC = m\angle 1 + m\angle 2$	2.
3. $\angle 1$ and $\angle 2$ are complementary.	3.
4. $m\angle 1 + m\angle 2 = 90$	4.
5. $m\angle ABC = 90$	5.
6. $\overline{BA} \perp \overline{BC}$	6.
7. $\overline{BA} \parallel \overline{CD}$	7.

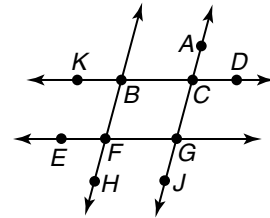
Determine whether each pair of lines is parallel. Explain why or why not.



3-5 Practice

Proving Lines Parallel

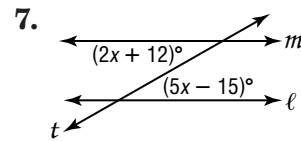
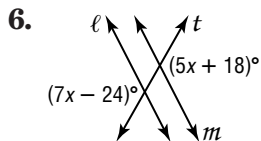
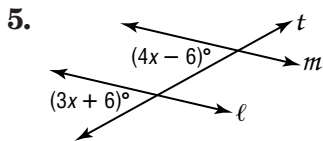
Given the following information, determine which lines, if any, are parallel. State the postulate or theorem that justifies your answer.



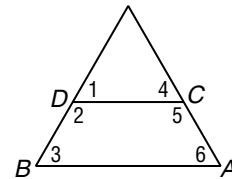
1. $m\angle BCG + m\angle FGC = 180$ 2. $\angle CBF \cong \angle GFH$

3. $\angle EFB \cong \angle FBC$ 4. $\angle ACD \cong \angle KBF$

Find x so that $\ell \parallel m$.



8. **PROOF** Write a two-column proof.
Given: $\angle 2$ and $\angle 3$ are supplementary.
Prove: $\overline{AB} \parallel \overline{CD}$



9. **LANDSCAPING** The head gardener at a botanical garden wants to plant rosebushes in parallel rows on either side of an existing footpath. How can the gardener ensure that the rows are parallel?

3-5

Reading to Learn Mathematics

Proving Lines Parallel

Pre-Activity How do you know that the sides of a parking space are parallel?

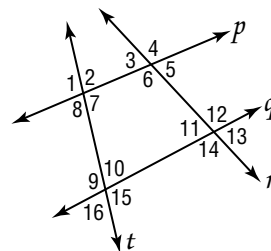
Read the introduction to Lesson 3-5 at the top of page 151 in your textbook.

How can the workers who are striping the parking spaces in a parking lot check to see if the sides of the spaces are parallel?

Reading the Lesson

- Choose the word or phrase that best completes each sentence.
 - If two coplanar lines are cut by a transversal so that corresponding angles are congruent, then the lines are _____ (parallel/perpendicular/skew).
 - In a plane, if two lines are perpendicular to the same line, then they are _____ (perpendicular/parallel/skew).
 - For a line and a point not on the line, there exists _____ (at least one/exactly one/at most one) line through the point that is parallel to the given line.
 - If two coplanar lines are cut by a transversal so that consecutive interior angles are _____ (complementary/supplementary/congruent), then the lines are parallel.
 - If two coplanar lines are cut by a transversal so that alternate interior angles are congruent, then the lines are _____ (perpendicular/parallel/skew).
- Which of the following conditions verify that $p \parallel q$?

A. $\angle 6 \cong \angle 12$	B. $\angle 2 \cong \angle 4$
C. $\angle 8 \cong \angle 16$	D. $\angle 11 \cong \angle 13$
E. $\angle 6$ and $\angle 7$ are supplementary.	F. $\angle 1 \cong \angle 15$
G. $\angle 7$ and $\angle 10$ are supplementary.	H. $\angle 4 \cong \angle 16$



Helping You Remember

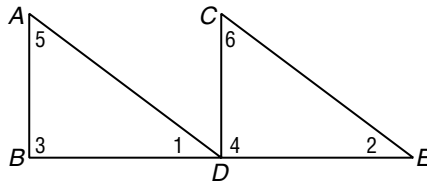
- A good way to remember something new is to draw a picture. How can a sketch help you to remember the Parallel Postulate?

3-5 Enrichment

Scrambled-Up Proof

The reasons necessary to complete the following proof are scrambled up below. To complete the proof, number the reasons to match the corresponding statements.

- Given: $\overline{CD} \perp \overline{BE}$
 $\overline{AB} \perp \overline{BE}$
 $\overline{AD} \cong \overline{CE}$
 $\overline{BD} \cong \overline{DE}$



Prove: $\overline{AD} \parallel \overline{CE}$

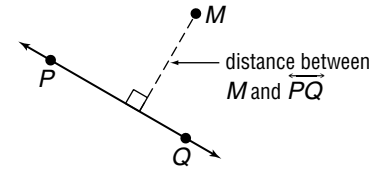
Proof:

Statements	Reasons
1. $\overline{CD} \perp \overline{BE}$	Definition of Right Triangle
2. $\overline{AB} \perp \overline{BE}$	Given
3. $\angle 3$ and $\angle 4$ are right angles.	Given
4. $\triangle ABD$ and $\triangle CDE$ are right triangles.	Definition of Perpendicular Lines
5. $\overline{AD} \cong \overline{CE}$	Given
6. $\overline{BD} \cong \overline{DE}$	CPCTC
7. $\triangle ABD \cong \triangle CDE$	In a plane, if two lines are cut by a transversal so that a pair of corresponding angles is congruent, then the lines are parallel. (Theorem 7-5)
8. $\angle 1 \cong \angle 2$	Given
9. $\overline{AD} \parallel \overline{CE}$	HL

3-6 Study Guide and Intervention

Perpendiculars and Distance

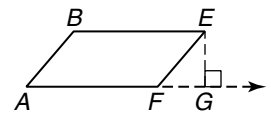
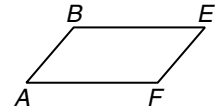
Distance From a Point to a Line When a point is not on a line, the distance from the point to the line is the length of the segment that contains the point and is perpendicular to the line.



Example Draw the segment that represents the distance from E to \overrightarrow{AF} .

Extend \overrightarrow{AF} . Draw $\overline{EG} \perp \overrightarrow{AF}$.

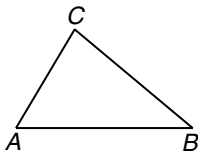
\overline{EG} represents the distance from E to \overrightarrow{AF} .



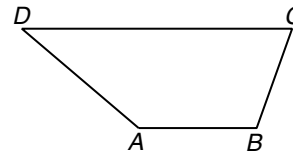
Exercises

Draw the segment that represents the distance indicated.

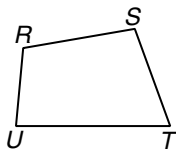
1. C to \overline{AB}



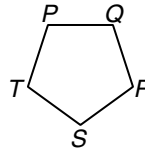
2. D to \overline{AB}



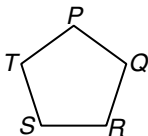
3. T to \overline{RS}



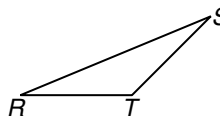
4. S to \overline{PQ}



5. S to \overline{QR}



6. S to \overline{RT}



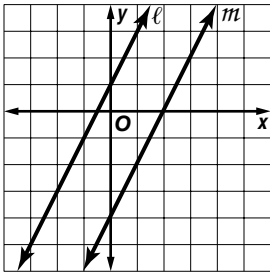
3-6 Study Guide and Intervention *(continued)*

Perpendiculars and Distance

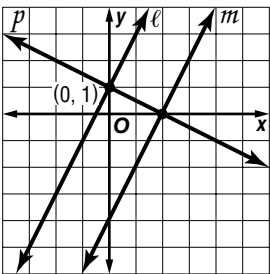
Distance Between Parallel Lines The distance between parallel lines is the length of a segment that has an endpoint on each line and is perpendicular to them. Parallel lines are everywhere **equidistant**, which means that all such perpendicular segments have the same length.

Example

Find the distance between the parallel lines ℓ and m whose equations are $y = 2x + 1$ and $y = 2x - 4$, respectively.



Draw a line p through $(0, 1)$ that is perpendicular to ℓ and m .



Line p has slope $-\frac{1}{2}$ and y -intercept 1. An equation of p is $y = -\frac{1}{2}x + 1$. The point of intersection for p and ℓ is $(0, 1)$.

To find the point of intersection of p and m , solve a system of equations.

$$\text{Line } m: y = 2x - 4$$

$$\text{Line } p: y = -\frac{1}{2}x + 1$$

Use substitution.

$$2x - 4 = -\frac{1}{2}x + 1$$

$$4x - 8 = -x + 2$$

$$5x = 10$$

$$x = 2$$

Substitute 2 for x to find the y -coordinate.

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

$$= -\frac{1}{2}(2) + 1 = -1 + 1 = 0$$

The point of intersection of p and m is $(2, 0)$.

Use the Distance Formula to find the distance between $(0, 1)$ and $(2, 0)$.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$= \sqrt{(2 - 0)^2 + (0 - 1)^2}$$

$$= \sqrt{5}$$

The distance between ℓ and m is $\sqrt{5}$ units.

Exercises

Find the distance between each pair of parallel lines.

1. $y = 8$
 $y = -3$

2. $y = x + 3$
 $y = x - 1$

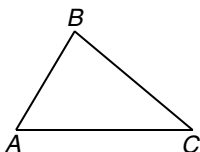
3. $y = -2x$
 $y = -2x - 5$

3-6 Skills Practice

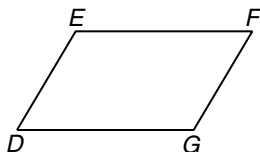
Perpendiculars and Distance

Draw the segment that represents the distance indicated.

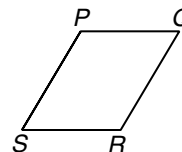
1. B to \overleftrightarrow{AC}



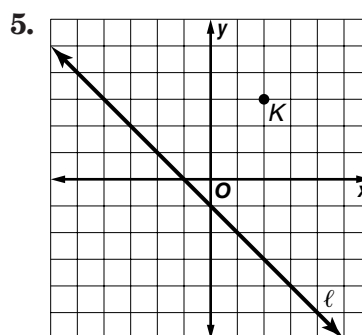
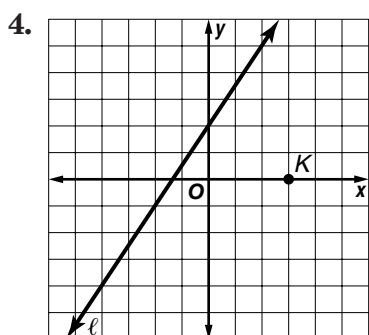
2. G to \overleftrightarrow{EF}



3. Q to \overleftrightarrow{SR}



Construct a line perpendicular to ℓ through K . Then find the distance from K to ℓ .



Find the distance between each pair of parallel lines.

6. $y = 7$
 $y = -1$

7. $x = -6$
 $x = 5$

8. $y = 3x$
 $y = 3x + 10$

9. $y = -5x$
 $y = -5x + 26$

10. $y = x + 9$
 $y = x + 3$

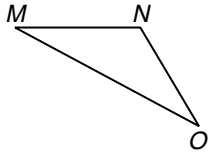
11. $y = -2x + 5$
 $y = -2x - 5$

3-6 Practice

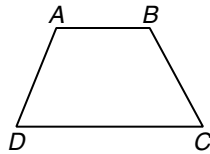
Perpendiculars and Distance

Draw the segment that represents the distance indicated.

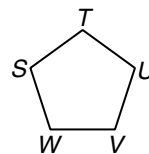
1. O to \overline{MN}



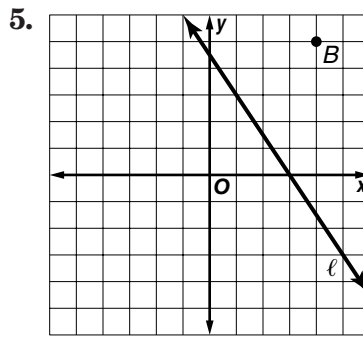
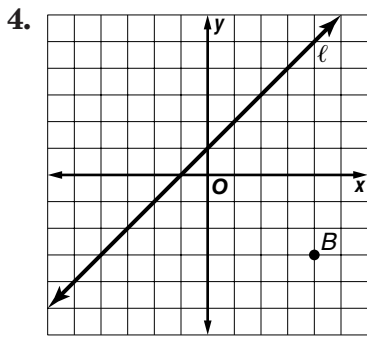
2. A to \overline{DC}



3. T to \overline{VU}



Construct a line perpendicular to ℓ through B . Then find the distance from B to ℓ .



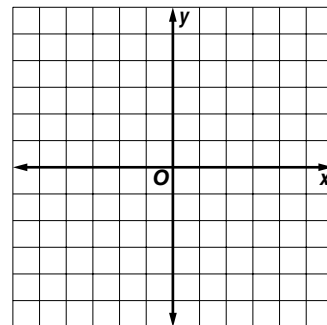
Find the distance between each pair of parallel lines.

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

7. $y = 2x + 7$
 $y = 2x - 3$

8. $y = 3x + 12$
 $y = 3x - 18$

9. Graph the line $y = -x + 1$. Construct a perpendicular segment through the point at $(-2, -3)$. Then find the distance from the point to the line.



10. **CANOEING** Bronson and a friend are going to carry a canoe across a flat field to the bank of a straight canal. Describe the shortest path they can use.

3-6 Reading to Learn Mathematics

Perpendiculars and Distance

Pre-Activity How does the distance between parallel lines relate to hanging new shelves?

Read the introduction to Lesson 3-6 at the top of page 159 in your textbook.

Name three examples of situations in home construction where it would be important to construct parallel lines.

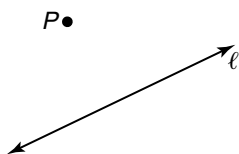
Reading the Lesson

1. Fill in the blank with a word or phrase to complete each sentence.

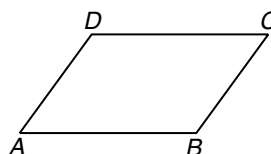
- The distance from a line to a point not on the line is the length of the segment _____ to the line from the point.
- Two coplanar lines are parallel if they are everywhere _____.
- In a plane, if two lines are both equidistant from a third line, then the two lines are _____ to each other.
- The distance between two parallel lines measured along a perpendicular to the two lines is always _____.
- To measure the distance between two parallel lines, measure the distance between one of the lines and any point on the _____.

2. On each figure, draw the segment that represents the distance indicated.

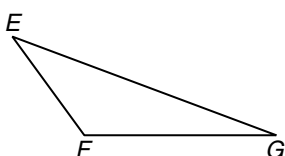
a. P to ℓ



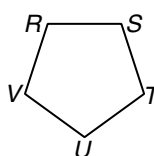
b. D to \overline{AB}



c. E to \overline{FG}



d. U to \overline{RV}



Helping You Remember

3. A good way to remember a new word is to relate it to words that use the same root. Use your dictionary to find the meaning of the Latin root *aequus*. List three words other than equal and equidistant that are derived from this root and give the meaning of each.

3-6 Enrichment

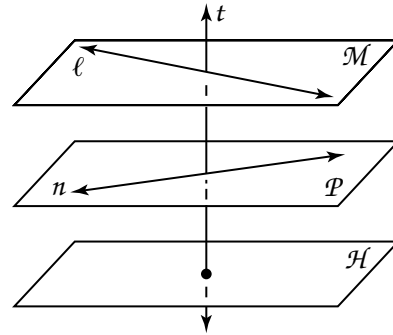
Parallelism in Space

In space geometry, the concept of parallelism must be extended to include two planes and a line and a plane.

Definition: Two planes are parallel if and only if they do not intersect.

Definition: A line and a plane are parallel if and only if they do not intersect.

Thus, in space, two lines can be intersecting, parallel, or skew while two planes or a line and a plane can only be intersecting or parallel. In the figure at the right, $t \perp \mathcal{M}$, $t \perp \mathcal{P}$, $\mathcal{P} \parallel \mathcal{H}$, and ℓ and n are skew.



The following five statements are theorems about parallel planes.

Theorem: Two planes perpendicular to the same line are parallel.

Theorem: Two planes parallel to the same plane are parallel.

Theorem: A line perpendicular to one of two parallel planes is perpendicular to the other.

Theorem: A plane perpendicular to one of two parallel planes is perpendicular to the other.

Theorem: If two parallel planes each intersect a third plane, then the two lines of intersection are parallel.

Use the figure given above for Exercises 1–10. State *yes* or *no* to tell whether the statement is true.

- | | | | | |
|--|-----------------------------|--|---------------------------------|---------------------------|
| 1. $\mathcal{M} \parallel \mathcal{P}$ | 2. $\ell \parallel n$ | 3. $\mathcal{M} \parallel \mathcal{H}$ | 4. $\ell \parallel \mathcal{P}$ | 5. $\ell \perp t$ |
| 6. $n \parallel \mathcal{H}$ | 7. $\ell \perp \mathcal{P}$ | 8. $t \parallel \mathcal{H}$ | 9. $\mathcal{M} \perp t$ | 10. $t \perp \mathcal{H}$ |

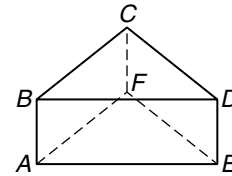
Make a small sketch to show that each statement is false.

- | | |
|---|--|
| 11. If two lines are parallel to the same plane, then the lines are parallel. | 12. If two planes are parallel, then any line in one plane is parallel to any line in the other plane. |
| 13. If two lines are parallel, then any plane containing one of the lines is parallel to any plane containing the other line. | 14. If two lines are parallel, then any plane containing one of the lines is parallel to the other line. |

3 Chapter 3 Test, Form 1

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

For Questions 1–3, refer to the figure at the right.



1. Identify the plane parallel to plane BCD .

A. plane ABE	B. plane ABF	1. _____
C. plane AEF	D. plane DEF	

2. Identify a segment parallel to \overline{CD} .

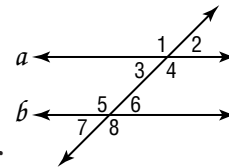
A. \overline{AB}	B. \overline{AE}	C. \overline{BC}	D. \overline{EF}	2. _____
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3. Which segment is skew to \overline{DE} ?

A. \overline{AB}	B. \overline{BC}	C. \overline{BD}	D. \overline{CD}	3. _____
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For Questions 4–7, refer to the figure at the right.

Identify the special name for each angle pair.



4. $\angle 1$ and $\angle 8$

A. alternate exterior	B. alternate interior	4. _____
C. consecutive interior	D. corresponding	

5. $\angle 3$ and $\angle 7$

A. alternate exterior	B. alternate interior	5. _____
C. consecutive interior	D. corresponding	

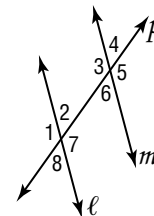
6. Given $a \parallel b$ and $m\angle 2 = 65$, find $m\angle 6$.

A. 25	B. 65	C. 115	D. 140	6. _____
-------	-------	--------	--------	----------

7. Given $a \parallel b$ and $m\angle 3 = 5x + 10$ and $m\angle 5 = 3x + 10$, find x .

A. 110	B. 70	C. 20	D. 2.5	7. _____
--------	-------	-------	--------	----------

For Questions 8–10, refer to the figure at the right.



8. Which angle relationship justifies that $\ell \parallel m$?

A. $\angle 1 \cong \angle 7$	B. $\angle 3 \cong \angle 4$	8. _____
C. $\angle 4 \cong \angle 5$	D. $\angle 6 \cong \angle 8$	

9. If $m\angle 2 = 6x + 8$ and $m\angle 6 = 8x - 6$, find x so that $\ell \parallel m$.

A. -7	B. 1	C. 7	D. 14	9. _____
-------	------	------	-------	----------

10. Given $m\angle 6 + m\angle 7 = 180$, which postulate or theorem justifies that $\ell \parallel m$?

A. Consecutive Interior Angles Theorem B. Corresponding Angles Postulate C. Alternate Exterior Angles Theorem D. Alternate Interior Angles Theorem	10. _____
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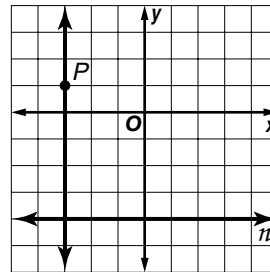
3 Chapter 3 Test, Form 1 *(continued)*

For Questions 11–12, determine the slope of the line that contains the given points.

11. $A(0, 5), B(5, 0)$ 11. _____
 A. -1 B. 0 C. 1 D. 5
12. $F(-2, -4), G(1, 2)$ 12. _____
 A. -2 B. $-\frac{1}{2}$ C. $\frac{1}{2}$ D. 2
13. What is the slope of a line parallel to the line containing $(-6, 1)$ and $(3, -2)$? 13. _____
 A. -3 B. $-\frac{1}{3}$ C. $\frac{1}{3}$ D. 3
14. Find the slope of the line perpendicular to the line containing $(0, 0)$ and $(-1, 4)$. 14. _____
 A. $-\frac{1}{4}$ B. -4 C. $\frac{1}{4}$ D. 4
15. Which is an equation of the line with slope 4 and a y -intercept -3 ? 15. _____
 A. $y = -3x + 4$ B. $y = -3x + \frac{3}{4}$ C. $y = 4x - 3$ D. $y = 4x - \frac{3}{4}$
16. Which is an equation of the line with slope 2 that contains $(3, 1)$? 16. _____
 A. $y - 1 = 2(x - 3)$ B. $y + 1 = 2(x + 3)$
 C. $y - 3 = 2(x - 1)$ D. $y - 3 = (x - 2)$
17. Yoga lessons cost \$5 per lesson if Kylie enrolls in the health club for a fee of \$120 per year. Suppose Kylie joins the health club. Which equation represents the yearly cost C of ℓ yoga lessons? 17. _____
 A. $C = 5\ell$ B. $C = 5\ell + 120$
 C. $C = 5\ell - 120$ D. $C = 5(\ell + 120)$

18. What is the distance from P to n shown in the figure? 18. _____

- A. -3
 B. 1
 C. 4
 D. 5



For Questions 19–20, find the distance between each pair of parallel lines.

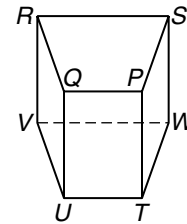
19. $y = 4$ and $y = 6$ 19. _____
 A. 2 B. 4 C. 6 D. 10
20. $y = x$ and $y = x + 2$ 20. _____
 A. 1 B. 1.5 C. $\sqrt{2}$ D. 2

Bonus What is the slope of a line perpendicular to $y = -2$? **B:** _____

3 Chapter 3 Test, Form 2A

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

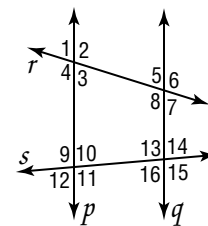
For Questions 1 and 2, refer to the figure at the right.



1. Identify the plane parallel to plane PQT .
 - A. plane PQS
 - B. plane PTS
 - C. plane RSV
 - D. plane TUW
2. Which segment is skew to \overline{RV} ?
 - A. \overline{RS}
 - B. \overline{RQ}
 - C. \overline{SW}
 - D. \overline{SP}

1. _____
2. _____

For Questions 3–10, refer to the figure at the right.



Identify the special name for each angle pair.

3. $\angle 3$ and $\angle 10$
 - A. alternate exterior
 - B. alternate interior
 - C. consecutive interior
 - D. corresponding
4. $\angle 9$ and $\angle 13$
 - A. alternate exterior
 - B. alternate interior
 - C. consecutive interior
 - D. corresponding
5. Given $p \parallel q$ and $m\angle 3 = 75$, find $m\angle 5$.
 - A. 15
 - B. 75
 - C. 105
 - D. 120
6. Given $p \parallel q$ and $m\angle 10 = 3x - 7$ and $m\angle 13 = 4x - 9$, find x .
 - A. -2
 - B. 2
 - C. 16
 - D. 28
7. Given $\angle 1 \cong \angle 5$, which postulate or theorem justifies that $p \parallel q$?
 - A. Corresponding Angles Postulate
 - B. Consecutive Interior Angles Theorem
 - C. Alternate Exterior Angles Theorem
 - D. Alternate Interior Angles Theorem
8. If $\angle 12 \cong \angle 14$, which postulate or theorem justifies that $p \parallel q$?
 - A. Corresponding Angles Postulate
 - B. Consecutive Interior Angles Theorem
 - C. Alternate Exterior Angles Theorem
 - D. Alternate Interior Angles Theorem
9. If $p \parallel q$ by the Consecutive Interior Angles Theorem, which angle pair must be supplementary?
 - A. $\angle 3$ and $\angle 10$
 - B. $\angle 3$ and $\angle 8$
 - C. $\angle 8$ and $\angle 13$
 - D. $\angle 15$ and $\angle 16$
10. If $m\angle 4 = 7x - 20$ and $m\angle 8 = 5x + 18$, find x so that $p \parallel q$.
 - A. -19
 - B. -1
 - C. 1
 - D. 19

3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

3 Chapter 3 Test, Form 2A *(continued)*

Determine the slope of the line that contains the given points.

11. $P(-6, 3), Q(12, 9)$ 11. _____

- A. -3 B. $-\frac{1}{3}$ C. $\frac{1}{3}$ D. 3

12. $M(-8, 14), N(2, -11)$ 12. _____

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

13. What is the slope of a line parallel to the line containing $(-6, -6)$ and $(9, 14)$? 13. _____

- A. $\frac{3}{4}$ B. $\frac{4}{3}$ C. $\frac{10}{3}$ D. undefined

14. Find the slope of a line perpendicular to the line containing $(-8, 10)$ and $(0, 9)$. 14. _____

- A. -8 B. $-\frac{1}{8}$ C. $\frac{1}{8}$ D. 8

15. Which is an equation of the line with slope $\frac{1}{2}$ that contains $(-4, 7)$? 15. _____

- A. $y - 7 = \frac{1}{2}(x + 4)$ B. $y - 7 = \frac{1}{2}(x - 4)$
 C. $y - 7 = -4x + \frac{1}{2}$ D. $y + 7 = \frac{1}{2}(x + 4)$

16. Which is an equation of the line with x -intercept 2 and y -intercept 12? 16. _____

- A. $y = -6x + 12$ B. $y = 2x + 12$ C. $y = 6x + 12$ D. $y = 12x + 2$

17. Which is an equation of the line containing $(1, -3)$ and $(7, 15)$? 17. _____

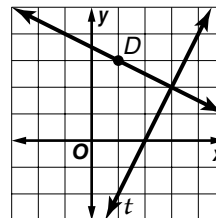
- A. $y = -3x + 8$ B. $y = 3x$ C. $y = 3x - 6$ D. $y = 3x - 10$

18. Mr. Perugia gives 4 points per question for q questions on English quizzes plus 5 points for a bonus question. Which equation represents the total score T a student can receive on a quiz? 18. _____

- A. $T + 5 = 4q$ B. $T = 4q + 5$ C. $T = 4(q + 5)$ D. $4T = q + 5$

19. What is the distance from D to t shown in the figure? 19. _____

- A. 2
 B. 3
 C. 5
 D. $\sqrt{5}$



20. What is the distance between parallel lines whose equations are $y = 2x + 7$ and $y = 2x - 3$? 20. _____

- A. $\sqrt{2}$ B. $\sqrt{5}$ C. $2\sqrt{5}$ D. $4\sqrt{2}$

Bonus Suppose Ian reads at the rate of 15 pages an hour. Write an equation to represent the number of pages y Ian will still need to read after reading x hours in a 285-page novel. How long will it take Ian to read the entire novel? B: _____

3 Chapter 3 Test, Form 2B

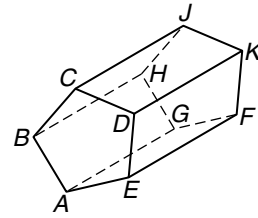
Write the letter for the correct answer in the blank at the right of each question.

For Questions 1 and 2, refer to the figure at the right.

- Identify the plane parallel to plane ACE .

A. plane ABG	B. plane BCH
C. plane EFK	D. plane GJF
- Which segment is skew to \overline{JK} ?

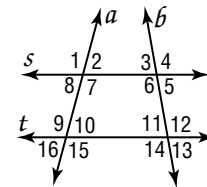
A. \overline{AB}	B. \overline{CD}
C. \overline{JH}	D. \overline{GF}



1. _____
2. _____

For Questions 3–10, refer to the figure at the right.

Identify the special name for each angle pair.



- $\angle 1$ and $\angle 5$

A. alternate exterior	B. alternate interior
C. consecutive interior	D. corresponding
- $\angle 10$ and $\angle 14$

A. alternate exterior	B. alternate interior
C. consecutive interior	D. corresponding
- Given $s \parallel t$ and $m\angle 7 = 84$, find $m\angle 10$.

A. 6	B. 84	C. 96	D. 104
------	-------	-------	--------
- Given $s \parallel t$ and $m\angle 1 = 8x - 4$ and $m\angle 15 = 6x + 24$, find x .

A. -10	B. 14	C. 20	D. 28
--------	-------	-------	-------
- Given $\angle 6 \cong \angle 12$, which postulate or theorem justifies that $s \parallel t$?

A. Corresponding Angles Postulate	B. Consecutive Interior Angles Theorem
C. Alternate Exterior Angles Theorem	D. Alternate Interior Angles Theorem
- If $\angle 8 \cong \angle 16$, which postulate or theorem justifies that $s \parallel t$?

A. Corresponding Angles Postulate	B. Consecutive Interior Angles Theorem
C. Alternate Exterior Angles Theorem	D. Alternate Interior Angles Theorem
- If $s \parallel t$ by the Alternate Exterior Angles Theorem, which angle pair must be congruent?

A. $\angle 1$ and $\angle 7$	B. $\angle 1$ and $\angle 5$	C. $\angle 1$ and $\angle 15$	D. $\angle 1$ and $\angle 13$
------------------------------	------------------------------	-------------------------------	-------------------------------
- If $m\angle 6 = 10x - 6$ and $m\angle 11 = 4x + 18$, find x so that $s \parallel t$.

A. 2	B. 4	C. 12	D. 32
------	------	-------	-------

3 Chapter 3 Test, Form 2B *(continued)*

Determine the slope of the line that contains the given points.

11. $C(1, -7), D(5, 13)$ 11. _____

- A. -5 B. $-\frac{1}{5}$ C. $\frac{1}{5}$ D. 5

12. $Y(-7, -4), Z(5, 2)$ 12. _____

- A. -1 B. $\frac{1}{2}$ C. 1 D. 2

13. What is the slope of a line parallel to the line containing $(2, 5)$ and $(6, -11)$? 13. _____

- A. -13 B. -4 C. $-\frac{1}{4}$ D. 4

14. Find the slope of a line perpendicular to the line containing $(-2, -9)$ and $(8, 6)$. 14. _____

- A. $-\frac{2}{3}$ B. $\frac{2}{5}$ C. $\frac{2}{3}$ D. $\frac{3}{2}$

15. Which is an equation of the line with slope of $-\frac{3}{5}$ that contains $(5, -5)$? 15. _____

- A. $y - 5 = -\frac{3}{5}(x + 5)$ B. $y - 5 = -\frac{3}{5}(x - 5)$
 C. $y + 5 = -\frac{3}{5}(x - 5)$ D. $y + 5 = -\frac{3}{5}x - 5$

16. Which is an equation of the line with x -intercept 18 and a y -intercept 3 ? 16. _____

- A. $y = -\frac{1}{6}x + 3$ B. $y = \frac{1}{6}x + 3$ C. $y = 3x + 18$ D. $y = 6x + 3$

17. Which is an equation of the line containing $(-3, 13)$ and $(6, -5)$? 17. _____

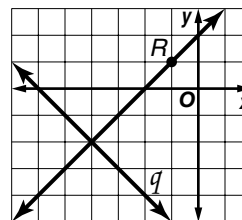
- A. $y = 2x - 7$ B. $y = -2x + 12$ C. $y = -2x + 17$ D. $y = -2x + 7$

18. Mrs. Ekeledo writes computer manuals. She charges \$125 to review writing specifications plus \$50 per hour h to write the manual. Which equation represents the total fee F that Mrs. Ekeledo earns for writing each computer manual? 18. _____

- A. $F = 50(h + 125)$ B. $F = 50h + 125$
 C. $F + 125 = 50h$ D. $50F = h + 125$

19. What is the distance from R to q shown in the figure? 19. _____

- A. $\sqrt{3}$
 B. 3
 C. $3\sqrt{2}$
 D. $\sqrt{8}$



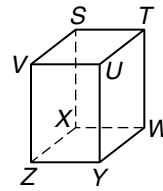
20. What is the distance between parallel lines whose equations are $y = -x + 2$ and $y = -x + 8$? 20. _____

- A. $3\sqrt{2}$ B. $2\sqrt{17}$ C. 10 D. $2\sqrt{29}$

Bonus Suppose line a is perpendicular to line b and line b is parallel to line c . What is the relationship between line a and line c ? B: _____

3 Chapter 3 Test, Form 2C

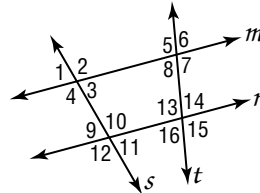
For Questions 1 and 2, refer to the figure.



1. Identify the intersection of plane SVX and plane STU .
2. Name a segment skew to \overline{WY} .

1. _____
2. _____

For Questions 3–5, identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior angles*.



3. $\angle 2$ and $\angle 12$
4. $\angle 3$ and $\angle 5$
5. $\angle 7$ and $\angle 15$
6. Given $m \parallel n$ and $m\angle 8 = 86$, find $m\angle 13$.
7. Find x and y given $m \parallel n$, $m\angle 4 = 6x - 5$, $m\angle 10 = 5x + 8$, and $m\angle 9 = 3y - 10$.

3. _____
4. _____
5. _____
6. _____
7. _____

Determine the slope of the line that contains the given points.

8. $V(-10, -4)$, $W(5, 5)$
9. $A(-2, 9)$, $C(2, -15)$
10. $G(-6, 14)$, $L(-3, 9)$

8. _____
9. _____
10. _____

For Questions 11–13, determine whether \overleftrightarrow{CS} and \overleftrightarrow{KP} are *parallel*, *perpendicular*, or *neither*.

11. $C(1, -12)$, $S(5, 4)$, $K(1, 9)$, $P(6, -6)$
12. $C(-5, 6)$, $S(-3, 2)$, $K(-2, 10)$, $P(1, 4)$
13. $C(-6, -7)$, $S(-3, -5)$, $K(3, 3)$, $P(9, 7)$

11. _____
12. _____
13. _____

14. Printer's Ink charges \$1.18 per page p to copy a report plus \$12 to bind it. Write an equation that represents the total cost C to copy and bind a report. What would be the cost to copy and bind a 50-page report?

14. _____

3 Chapter 3 Test, Form 2C *(continued)*

Write an equation in slope-intercept form for the line that satisfies the given conditions.

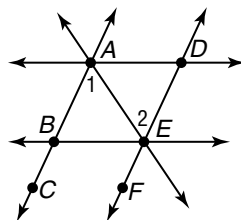
15. $m = -9$, y -intercept = 3 15. _____

16. $m = 3$, contains $(-1, 5)$ 16. _____

17. x -intercept is 3, y -intercept is -1 17. _____

18. contains $(-7, 9)$ and $(6, -4)$ 18. _____

For Questions 19–21, given the following information, determine which lines, if any are parallel. State the postulate or theorem that justifies your answer.

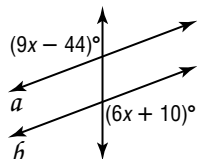


19. $\angle 1 \cong \angle 2$ 19. _____

20. $\angle DAB \cong \angle EBC$ 20. _____

21. $m\angle ADE + m\angle BED = 180$ 21. _____

22. Find x so that $a \parallel b$. 22. _____

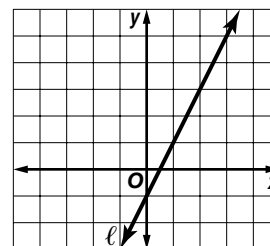


For Questions 23 and 24, find the distance between each pair of parallel lines.

23. $y = x - 6$ and $y = x + 8$ 23. _____

24. $y = -2x + 10$ and $y = -2x - 5$ 24. _____

25. Construct a line perpendicular to ℓ through $B(-2, 5)$. Then find the distance from B to ℓ . 25. _____



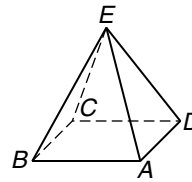
Bonus Draw and label a figure you could use to prove the theorem *If two lines in a plane are cut by a transversal so that a pair of consecutive interior angles is supplementary, then the lines are parallel.* State the given and the statement to be proved.

B: _____

3 Chapter 3 Test, Form 2D

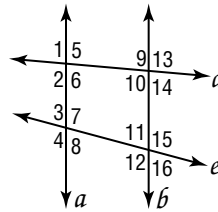
For Questions 1 and 2, refer to the figure.

1. Identify the intersection of plane ABD and plane CDE .
2. Name a segment skew to \overline{BC} .



1. _____
2. _____

Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.



3. $\angle 5$ and $\angle 13$
4. $\angle 7$ and $\angle 12$
5. $\angle 9$ and $\angle 16$
6. Given $a \parallel b$ and $m\angle 6 = 89$, find $m\angle 10$.
7. Find x and y given $a \parallel b$, $m\angle 8 = 4x + 10$, $m\angle 12 = 7x - 17$, and $m\angle 11 = 3y$.

3. _____
4. _____
5. _____
6. _____
7. _____

Determine the slope of the line that contains the given points.

8. $P(-5, 11), R(5, 7)$
9. $B(7, -1), G(14, 0)$
10. $U(-6, 9), V(-3, 8)$

8. _____
9. _____
10. _____

For Questions 11–13, determine whether \overrightarrow{BT} and \overrightarrow{MV} are *parallel*, *perpendicular*, or *neither*.

11. $B(1, -4), T(5, 12), M(-8, 3), V(-4, 2)$
12. $B(-5, -7), T(10, 17), M(-5, -10), V(5, 6)$
13. $B(3, -5), T(5, -1), M(-2, 6), V(4, 3)$
14. A job hotline service charges \$25 plus a 4% commission c on the first month of earnings if it finds work for a client. Write an equation that represents the total cost T to find a job through the hotline. What is the cost if a client earns \$1500 the first month?

11. _____
12. _____
13. _____
14. _____

3 Chapter 3 Test, Form 2D *(continued)*

Write an equation in slope-intercept form for the line that satisfies the given conditions.

- 15. $m = 7$, y -intercept = -8 15. _____
- 16. $m = -4$, contains $(-4, 8)$ 16. _____
- 17. x -intercept is -5 , y -intercept is 2 17. _____
- 18. containing $(2, 5)$ and $(7, -5)$ 18. _____

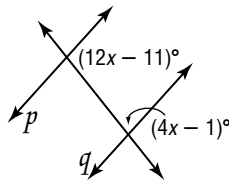
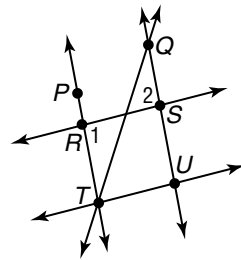
Given the following information, determine which lines, if any, are parallel. State the postulate or theorem that justifies your answer.

19. $\angle QSR \cong \angle SUT$

20. $\angle 1 \cong \angle 2$

21. $m\angle RTU + m\angle TUS = 180$

22. Find x so that $p \parallel q$.



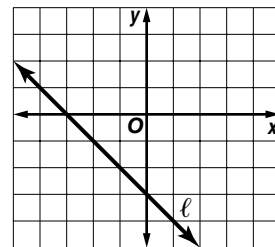
- 19. _____
- 20. _____
- 21. _____
- 22. _____

Find the distance between each pair of parallel lines.

23. $y = 3x - 1$ and $y = 3x - 11$

24. $y = -5x$ and $y = -5x + 26$

25. Construct a line perpendicular to ℓ through $Q(2, 3)$. Then find the distance from Q to ℓ .



- 23. _____
- 24. _____
- 25. _____

Bonus Draw and label a figure you could use to prove the theorem *If two lines in a plane are cut by a transversal so that a pair of alternate interior angles is congruent, then the lines are parallel.* State the given and the statement to be proved.

B: _____

3 Chapter 3 Test, Form 3

1. Draw a triangular prism and label the parallel planes ABC and DEF .

1. _____

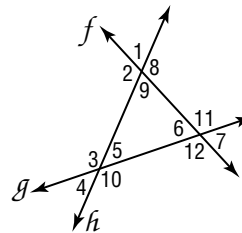
2. Identify two planes in your triangular prism that intersect. Name their intersection.

2. _____

3. Name two lines in your triangular prism that are skew.

3. _____

Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior angles*.



4. $\angle 9$ and $\angle 12$

4. _____

5. $\angle 2$ and $\angle 3$

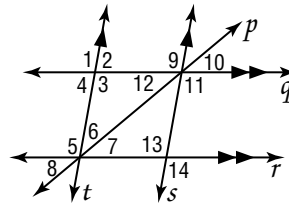
5. _____

6. $\angle 4$ and $\angle 11$

6. _____

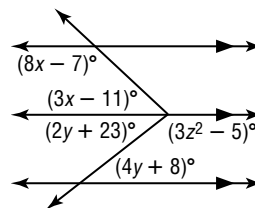
7. If $m\angle 9 = 110$ and $m\angle 8 = 30$, find $m\angle 6$.

7. _____



8. Find x , y , and z in the figure.

8. _____



Determine the slope of the line that contains the given points.

9. $D(-6, -7), F(12, 23)$

9. _____

10. $V(-2, -0.25), U(4, -2.5)$

10. _____

Determine whether \overleftrightarrow{QV} and \overleftrightarrow{RM} are *parallel*, *perpendicular*, or *neither*.

11. $Q(-3, -8), V(5, 12), R(-2.5, 1), M(-5, 2)$

11. _____

12. $Q(-2, 4.5), V(4, 9), R(-4, -12), M(10, -1.5)$

12. _____

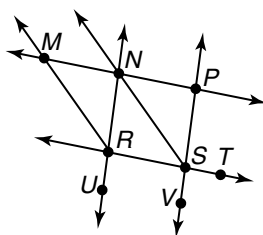
3 Chapter 3 Test, Form 3 *(continued)*

13. Write an equation of the line that is parallel to $y = \frac{8}{5}x - 12$ and contains $(-6, -10)$. 13. _____

14. Write an equation of the line that is perpendicular to $3x - 4y = 9$ and contains $(-4, -5)$. 14. _____

15. A car rental company charges \$30 per day plus \$0.28 per mile m for each mile over 100 miles to rent a car. Mr. Benitez rented a car for 5 days and drove 255 miles. Write an equation that represents the total cost C to rent a car for 5 days. What was Mr. Benitez's total cost? 15. _____

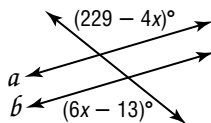
Given the following information, determine which lines, if any are parallel. State the postulate or theorem that justifies your answer.



16. $\angle RNS \cong \angle PSN$ 16. _____

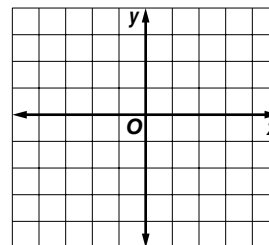
17. $m\angle MRS + m\angle RSN = 180$ 17. _____

18. Find x so that $a \parallel b$. 18. _____



19. Find the distance between parallel lines whose equations are $y = -\frac{1}{4}x + 2$ and $y = -\frac{1}{4}x - \frac{9}{4}$. 19. _____

20. Graph line m whose equation is $-6x - 3y = 9$. Construct a perpendicular line through $P(3, 1)$. Then find the distance from P to m . 20. _____

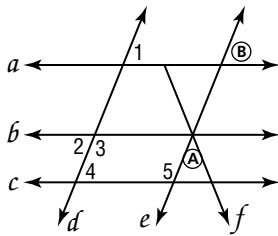


Bonus Suppose line p is perpendicular to line s and line q is perpendicular to line s . Are lines p and q parallel under all circumstances? Draw a figure to illustrate your answer. **B:** _____

3 Chapter 3 Open-Ended Assessment

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

- 1. TOWN PLANNING** The lines in the diagram represent the intersection of streets near Todd's home. \textcircled{A} represents the location of Todd's home, and \textcircled{B} represents the location of a library. 1, 2, 3, 4, and 5 represent the angles formed at street intersections.



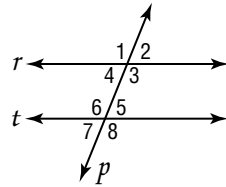
- Suppose you want to determine whether the streets represented by lines a , b , and c are parallel. What information would you need? Explain your reasoning.
 - Suppose the streets represented by lines d and e are parallel. If the measure of $\angle 5$ is 112, find the measure of $\angle 4$. Explain how you determined the measure.
 - If $m\angle 1 = 3x - 7$ and $m\angle 4 = 2x + 20$, find x so that lines a and c are parallel. Explain how you arrived at your answer and describe why these measures allow you to determine that a and c are parallel.
 - Todd wants to go from the library to his home. If the streets represented by lines a and b are parallel, how could Todd determine the shortest distance between \textcircled{B} and street b on which he lives? Give an explanation and illustrate your answer on a sketch of the above diagram.
- 2.** Draw a line ℓ on a coordinate grid so that the line contains $(-3, -1)$ and $(2, 4)$.
- Write an equation of the line in slope-intercept form. Provide an explanation for each of the steps.
 - If you construct a line parallel to ℓ , what is the slope of the line? How do you know? Construct a line parallel to ℓ that contains $(1, 5)$.
 - Find the distance between the two lines. Explain how you determined the distance.

3 Chapter 3 Vocabulary Test/Review

alternate exterior angles	equidistant	plane Euclidean geometry	slope
alternate interior angles	non-Euclidean geometry	point-slope form	slope-intercept form
consecutive interior angles	parallel lines	rate of change	spherical geometry
corresponding angles	parallel planes	skew lines	transversal

Write whether each statement is *true* or *false*. If false, replace the underlined word or number to make a true sentence.

For Questions 1–4, refer to the figure.



1. $\angle 4$ and $\angle 5$ are corresponding angles. 1. _____
2. According to the Parallel Postulate, line r is parallel to line t given $\angle 3 \cong \angle 8$. 2. _____
3. Given $r \parallel t$, then consecutive interior angles $\angle 4$ and $\angle 6$ are supplementary. 3. _____
4. Line p is a transversal since it intersects one or more lines in a plane at different points. 4. _____
5. When a linear equation is written in the form $y = mx + b$, m is the slope of the line and b is the y -intercept. 5. _____
6. Interior angles are located between the lines cut by a transversal. 6. _____
7. If two lines do not intersect and are everywhere equidistant, the lines are skew. 7. _____
8. The Perpendicular Transversal Theorem states that in a plane, if a line is perpendicular to one of two parallel lines, then it is parallel to the other. 8. _____
9. The equation $y + 6 = -\frac{5}{8}(x - 2)$ is in point-slope form. 9. _____
10. The ratio of the rise to the run of a line is called its slope-intercept form. 10. _____

In your own words—

11. Describe what is meant by *rate of change*. 11. _____

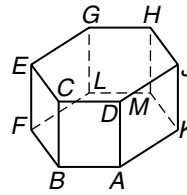
3 Chapter 3 Quiz

(Lessons 3-1 and 3-2)

SCORE _____

For Questions 1 and 2, refer to the figure.

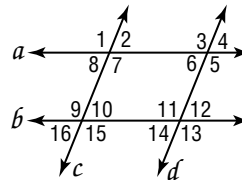
- Which plane is parallel to plane EGH ?
- Name the intersection of plane ABC and plane EFB .



- _____
- _____

For Questions 3-8, refer to the figure.

Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior angles*.

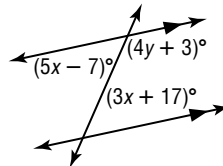


- $\angle 2$ and $\angle 10$
- $\angle 1$ and $\angle 5$
- $\angle 6$ and $\angle 12$
- $\angle 14$ and $\angle 15$

- _____
- _____
- _____
- _____

Given $a \parallel b$ and $m\angle 7 = 94$, find the measure of the following angles.

- $\angle 10$
- $\angle 9$
- Find x and y in the figure.

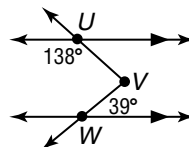


- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

10. STANDARDIZED TEST PRACTICE

What is $m\angle UVW$?

- A. 39 B. 42
C. 81 D. 138



3 Chapter 3 Quiz

(Lesson 3-3)

SCORE _____

Determine the slope of the line that contains the given points.

- $E(-5, 6), Z(4, -3)$
- $Y(-1, -12), P(3, 8)$
- $B(-2, 7), N(8, -8)$
- $R(-5, -7), Q(5, -5)$

- _____
- _____
- _____
- _____

Determine whether \overline{DC} and \overline{NM} are *parallel*, *perpendicular*, or *neither*.

- $D(-4, -11), C(2, 7), N(-6, -1), M(3, -4)$

- _____
- _____

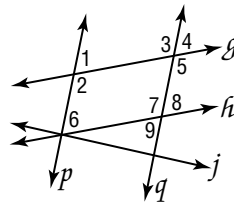
3 Chapter 3 Quiz

(Lessons 3-4 and 3-5)

SCORE _____

1. Write an equation in point-slope form of the line with slope $-\frac{1}{3}$ that contains (3, 8). 1. _____
2. Write an equation in slope-intercept form of the line with slope $\frac{5}{3}$ and y-intercept of -2 . 2. _____
3. Write an equation in slope-intercept form of the line that contains $(-1, 7)$ and $(3, -9)$. 3. _____
4. A bottled water company charges \$8 per month for a water cooler and \$5 per bottle b of water. Write an equation that represents the total cost C for monthly water service. 4. _____

Given the following information, determine which lines, if any, are parallel. State the postulate or theorem that justifies your answer.

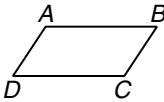
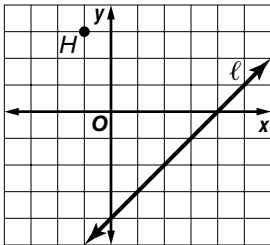


5. $\angle 1 \cong \angle 6$ 5. _____
6. $\angle 2 \cong \angle 3$ 6. _____
7. $\angle 4 \cong \angle 9$ 7. _____
8. $m\angle 7 + m\angle 6 = 180$ 8. _____
9. Given $g \parallel h$ and $m\angle 8 = 64$, find $m\angle 5$. 9. _____
10. If $m\angle 2 = 5x - 17$ and $m\angle 7 = 3x + 35$, find x so that $p \parallel q$. 10. _____

3 Chapter 3 Quiz

(Lesson 3-6)

SCORE _____

1. Draw the segment that represents the distance from B to \overleftrightarrow{DC} . 1. 
2. Construct a line perpendicular to ℓ through $H(-1, 3)$. Then find the distance from H to ℓ . 2. 

Find the distance between each pair of parallel lines.

3. $y = -8$ 3. _____
 $y = 4$
4. $y = -x - 9$ 4. _____
 $y = -x - 7$

3 Chapter 3 Mid-Chapter Test

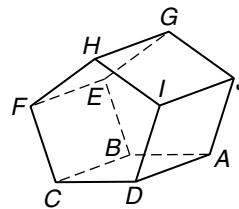
(Lessons 3-1 through 3-3)

SCORE _____

Assessments

Part I Write the letter for the correct answer in the blank at the right of each question.

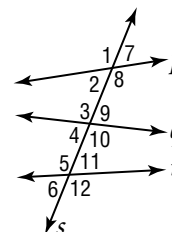
For Questions 1 and 2, refer to the figure.



1. Which segment is skew to \overline{IJ} ?
 A. \overline{GH} B. \overline{AJ}
 C. \overline{HI} D. \overline{AB}
2. Which plane is parallel to plane CDF ?
 A. BEF B. HIJ
 C. ABE D. ABC

1. _____
 2. _____

For Questions 3-5, refer to the figure. Identify the special name for each angle pair.

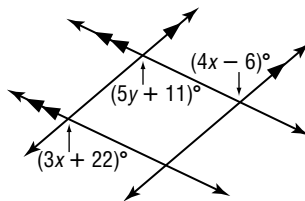


3. $\angle 2$ and $\angle 4$
 A. alternate exterior B. alternate interior
 C. corresponding D. consecutive interior
4. $\angle 3$ and $\angle 12$
 A. alternate exterior B. alternate interior
 C. corresponding D. consecutive interior
5. Given $p \parallel r$ and $m\angle 8 = 119$, find $m\angle 11$.
 A. 29 B. 61 C. 119 D. 151

3. _____
 4. _____
 5. _____

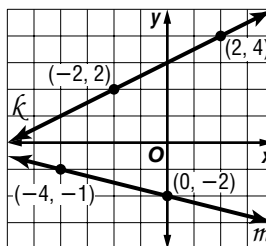
Part II

6. Find x and y in the figure.



6. _____

For Questions 7 and 8, refer to the graph. Find the slope of each line.



7. k 7. _____
8. m 8. _____

Determine whether \overline{AB} and \overline{DF} are parallel, perpendicular, or neither.

9. $A(-2, -11), B(6, 5), D(-7, -10), F(2, 8)$ 9. _____
10. $A(-1, 6), B(2, -9), D(-10, -1), F(5, 2)$ 10. _____

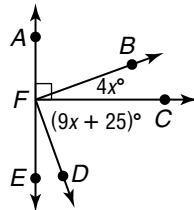
3 Chapter 3 Cumulative Review

SCORE _____

(Chapters 1-3)

1. Find y and BC if B is between A and C , $AB = 6y$, $BC = 12y$, and $AC = 42$. (Lesson 1-2) 1. _____
2. What are the coordinates of D if $E(-2, 2)$ is the midpoint of \overline{DF} , and F has coordinates $(3, 5)$? (Lesson 1-3) 2. _____

For Questions 3 and 4, use the figure at the right. \overrightarrow{FA} and \overrightarrow{FE} are opposite rays.



3. Classify $\angle AFB$. (Lesson 1-4) 3. _____
4. Find x and $\angle BFC$ so that \overline{BF} and \overline{FD} are perpendicular. (Lesson 1-5) 4. _____
5. Determine whether the conjecture is *true* or *false*. Give a counterexample for a false conjecture. (Lesson 2-1) 5. _____
Given: $\ell \parallel m$
Conjecture: The slopes of lines ℓ and m are equal.

6. Identify the hypothesis and conclusion of the statement 6. _____
If $m\angle 1 + m\angle 2 = 180$, then $\angle 1$ and $\angle 2$ are supplementary.
 (Lesson 2-3)

7. Determine whether statement (3) follows from statements (1) and (2) by the Law of Detachment or by the Law of Syllogism. Write invalid if neither law applies. (Lesson 2-4) 7. _____
 (1) If you swim, you must use earplugs.
 (2) Roy swims.
 (3) Roy must use earplugs.

8. Determine whether the statement *If $p \parallel q$ and $r \perp p$, then $r \perp q$ is always, sometimes, or never true.* (Lesson 2-5) 8. _____

9. If $F(-1, 6)$, $G(5, 3)$, $J(2, -4)$, and $K(6, -6)$, are \overline{FG} and \overline{JK} parallel, perpendicular, or neither? (Lesson 3-3) 9. _____

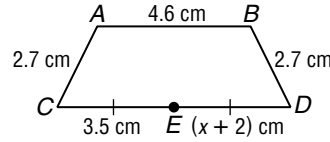
10. Write an equation for a line in point-slope form with a slope of 4 that contains the point at $(2, 8)$. (Lesson 3-4) 10. _____

11. Find the distance from $A(-1, 5)$ to the line whose equation is $4x - 5y = 12$. (Lesson 3-6) 11. _____

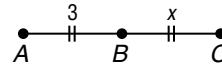
Part 1: Multiple Choice

Instructions: Fill in the appropriate oval for the best answer.

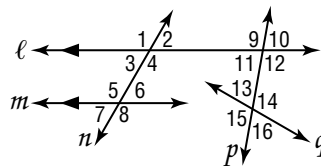
For Questions 1–4, use the figure.



1. Points A , B , and D _____. (Lesson 1-1)
 - A. are collinear.
 - B. are coplanar.
 - C. lie on \overline{AD}
 - D. contain C .
2. Which segments are congruent? (Lesson 1-2)
 - E. \overline{AB} and \overline{ED}
 - F. \overline{AC} and \overline{ED}
 - G. \overline{AC} and \overline{BD}
 - H. \overline{AB} and \overline{BD}
3. Find x . (Lesson 1-2)
 - A. 1
 - B. 1.5
 - C. 2
 - D. 2.7
4. Classify $\angle C$. (Lesson 1-4)
 - E. right angle
 - F. acute angle
 - G. obtuse angle
 - H. straight angle
5. Which statement has the same truth value as $3 = 5$? (Lesson 2-2)
 - A. $3 = x$
 - B. $AB = 3$
 - C. $AB = BC$
 - D. $BC = 3 + x$
6. The Law of Syllogism says that $[(p \rightarrow q) \wedge (q \rightarrow r)] \rightarrow$ _____. (Lesson 2-4)
 - E. q
 - F. r
 - G. $p \rightarrow q$
 - H. $p \rightarrow r$
7. State the property that justifies the statement *If $a + b = 25$ and $b = c$, then $a + c = 25$.* (Lesson 2-6)
 - A. Reflexive Property
 - B. Symmetric Property
 - C. Transitive Property
 - D. Substitution Property



For Questions 8–10, use the figure.



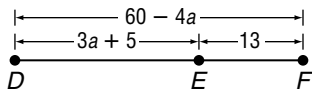
8. What type of angles are $\angle 3$ and $\angle 10$? (Lesson 3-1)
 - E. alternate interior angles
 - F. alternate exterior angles
 - G. corresponding angles
 - H. consecutive interior angles
9. State the transversal that forms $\angle 11$ and $\angle 13$. (Lesson 3-1)
 - A. ℓ
 - B. m
 - C. p
 - D. q
10. If $m\angle 1 = 120$, find $m\angle 8$. (Lesson 3-2)
 - E. 60
 - F. 110
 - G. 120
 - H. 140

3 Standardized Test Practice *(continued)*

Part 2: Grid In

Instructions: Enter your answer by writing each digit of the answer in a column box and then shading in the appropriate oval that corresponds to that entry.

11. Find DE . (Lesson 1-2)



11.

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

12.

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

12. The measure of the complement of $\angle A$ is 185 less than two times the measure of the supplement of $\angle A$. Find $m\angle A$. (Lesson 1-5)

13. The table below shows the number of each type of question that will be on four quarterly history tests. If Monique prefers the ratio of multiple choice questions to essay questions to be 4:1, which test will she prefer? (Lesson 2-4)

Test	Number of Essay Questions	Number of Multiple Choice Questions
1	4	26
2	8	22
3	6	24
4	5	25

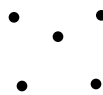
13.

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

Part 3: Short Response

Instructions: Show your work or explain in words how you found your answer.

14. Determine the number of line segments that can be drawn connecting this arrangement of points. (Lesson 2-5)



14. _____

15. The distance between $D(-2, -2)$ and $E(a, -2)$ is 7. Find a . (Lesson 1-3)

15. _____

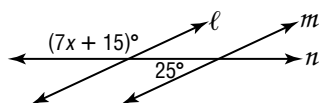
16. The line that is perpendicular to $y = -x$ and contains the point at $(2, 4)$ is $y = x + \underline{\hspace{1cm}}$. (Lesson 3-4)

16. _____

17. Find the slope of a line parallel to $3y - 6x = 9$. (Lesson 3-4)

17. _____

18. Find x so that $\ell \parallel m$. (Lesson 3-5)



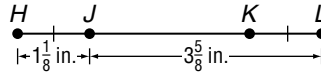
18. _____

3 Unit 1 Review

(Chapter 1–3)

SCORE _____

1. Find JK . What is the precision for this measurement?

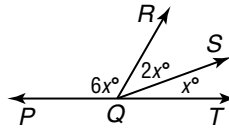


1. _____

2. Find the distance between $S(5, -7)$ and $T(13, -9)$. Then find the coordinates of the midpoint of \overline{ST} .

2. _____

3. In the figure, \overline{QP} and \overline{QT} are opposite rays. Find $m\angle PQR$, $m\angle RQS$, and $m\angle SQT$. Then classify each angle as *right*, *acute*, or *obtuse*.

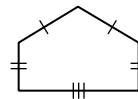


3. _____

4. Find the measures of two complementary angles if the difference in the measures is 16.

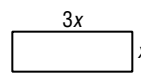
4. _____

5. Name the polygon by its number of sides. Then classify it as *convex* or *concave* and *regular* or *irregular*.



5. _____

6. Lou is roping a boundary for an event at a local carnival. She has 144 feet of rope, and the event supervisor has instructed her to rope an area that is three times as long as it is wide. Find the length of each roped side.



6. _____

7. Make a conjecture about the next letter in the sequence.
L M N P Q R T ...

7. _____

8. Construct a truth table for $\sim p \wedge q$.

8. _____

9. Identify the hypothesis and conclusion of the statement. *In a plane, if lines ℓ and m are equidistant from line p , then $\ell \parallel m$.*

9. _____

10. Cailyn knows that if two angles are vertical, they are congruent. She also knows that if two angles are congruent, then they have the same measure. She is given vertical angles 1 and 2, and she concludes that $m\angle 1 = m\angle 2$. What law of reasoning does she use?

10. _____

11. Determine whether the following statement is *always*, *sometimes*, or *never* true. *Points X , Y , and Z determine two lines.*

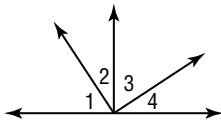
11. _____

3 Unit 1 Review *(continued)*

For Questions 12–16, complete the proof.

Given: $\angle 1$ and $\angle 2$ are complementary.
 $\angle 3$ and $\angle 4$ are complementary.
 $\angle 1 \cong \angle 3$

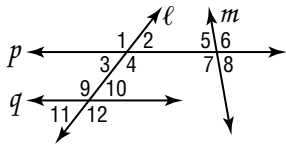
Prove: $\angle 3$ and $\angle 2$ are complementary.



Statements	Reasons
1. $\angle 1$ and $\angle 2$ are complementary. $\angle 3$ and $\angle 4$ are complementary. $\angle 1 \cong \angle 3$	1. (Question 12)
2. $\angle 2 \cong \angle 4$	2. (Question 13)
3. $m\angle 2 = m\angle 4$	3. (Question 14)
4. $m\angle 3 + m\angle 4 = 90$	4. (Question 15)
5. $m\angle 3 + m\angle 2 = 90$	5. (Question 16)
6. $\angle 3$ and $\angle 2$ are complementary	6. Def. of comp. \sphericalangle

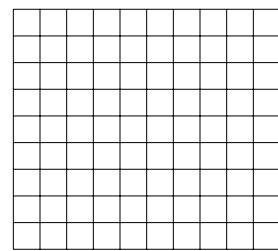
12. _____
13. _____
14. _____
15. _____
16. _____

For Questions 17 and 18, refer to the figure.

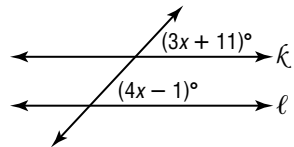


17. Name the transversal that forms $\angle 3$ and $\angle 6$. Then identify the special name for the angle pair.
18. If $p \parallel q$, $m\angle 1 = 5b + 23$, and $m\angle 11 = 2b + 10$, find $m\angle 2$, $m\angle 4$, $m\angle 10$, and $m\angle 12$.
19. Determine whether \overline{QR} and \overline{ST} are *parallel*, *perpendicular*, or *neither* for $Q(-4, -4)$, $R(5, 2)$, $S(4, -5)$, and $T(0, 1)$.
20. Graph the line that contains $C(3, -1)$ and has a slope of -2 . Then write an equation for the line in slope-intercept form.

17. _____
18. _____
19. _____
20. _____



21. Find x so that $k \parallel \ell$.



22. Find the distance between two lines that have equations $y = 3x + 1$ and $y = 3x - 19$.

21. _____
22. _____

3

Standardized Test Practice

Student Record Sheet (Use with pages 172–173 of the Student Edition.)

Part 1 Multiple Choice

Select the best answer from the choices given and fill in the corresponding oval.

- | | | | | | |
|---|-----------------|---|-----------------|---|-----------------|
| 1 | (A) (B) (C) (D) | 4 | (A) (B) (C) (D) | 7 | (A) (B) (C) (D) |
| 2 | (A) (B) (C) (D) | 5 | (A) (B) (C) (D) | 8 | (A) (B) (C) (D) |
| 3 | (A) (B) (C) (D) | 6 | (A) (B) (C) (D) | 9 | (A) (B) (C) (D) |

Part 2 Short Response/Grid In

Solve the problem and write your answer in the blank.

For Questions 11, 12, and 13, also enter your answer by writing each number or symbol in a box. Then fill in the corresponding oval for that number or symbol.

10 _____

11 _____ (grid in)

12 _____ (grid in)

13 _____ (grid in)

11

	/	/	
.	.	.	.
0	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

12

	/	/	
.	.	.	.
0	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

13

	/	/	
.	.	.	.
0	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

Part 3 Open-Ended

Record your answers for Questions 14–15 on the back of this paper.

NAME _____

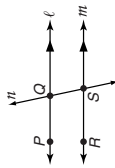
DATE _____

PERIOD _____

3-1 Study Guide and Intervention

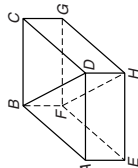
Parallel Lines and Transversals

Relationships Between Lines and Planes When two lines lie in the same plane and do not intersect, they are **parallel**. Lines that do not intersect and are not coplanar are **skew lines**. In the figure, ℓ is parallel to m , or $\ell \parallel m$. You can also write $PQ \parallel RS$. Similarly, if two planes do not intersect, they are **parallel planes**.



Example

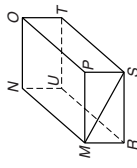
- Name all planes that are parallel to plane ABD .
plane EFH
- Name all segments that are parallel to \overline{CG} .
 \overline{BF} , \overline{DH} , and \overline{AE}
- Name all segments that are skew to \overline{EH} .
 \overline{BF} , \overline{CG} , \overline{BD} , \overline{CD} , and \overline{AB}



Exercises

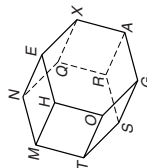
For Exercises 1–3, refer to the figure at the right.

- Name all planes that intersect plane OPT .
 MNO , MPS , NOT , RST
- Name all segments that are parallel to \overline{NU} .
 \overline{OT} , \overline{PS} , \overline{MR}
- Name all segments that intersect \overline{MP} .
 \overline{MR} , \overline{MN} , \overline{MS} , \overline{PS} , \overline{PO}



For Exercises 4–7, refer to the figure at the right.

- Name all segments parallel to \overline{QX} .
 \overline{RA} , \overline{SG} , \overline{TO} , \overline{MH} , \overline{NE}
- Name all planes that intersect plane MHE .
 MHO , NEX , HEX , MNQ , SGO , RAX
- Name all segments parallel to \overline{QR} .
 \overline{AX} , \overline{HO} , \overline{MT}
- Name all segments skew to \overline{AG} .
 \overline{ST} , \overline{TM} , \overline{NG} , \overline{QR} , \overline{TO} , \overline{MH} , \overline{NE} , \overline{QX}



NAME _____

DATE _____

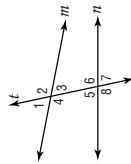
PERIOD _____

3-1 Study Guide and Intervention

Parallel Lines and Transversals

Angle Relationships A line that intersects two or more other lines in a plane is called a **transversal**. In the figure below, ℓ is a transversal. Two lines and a transversal form eight angles. Some pairs of the angles have special names. The following chart lists the pairs of angles and their names.

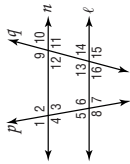
Angle Pairs	Name
$\angle 3$, $\angle 4$, $\angle 5$, and $\angle 6$	interior angles
$\angle 3$ and $\angle 5$; $\angle 4$ and $\angle 6$	alternate interior angles
$\angle 3$ and $\angle 6$; $\angle 4$ and $\angle 5$	consecutive interior angles
$\angle 1$, $\angle 2$, $\angle 7$, and $\angle 8$	exterior angles
$\angle 1$ and $\angle 7$; $\angle 2$ and $\angle 8$	alternate exterior angles
$\angle 1$ and $\angle 5$; $\angle 2$ and $\angle 6$; $\angle 3$ and $\angle 7$; $\angle 4$ and $\angle 8$	corresponding angles



Example

Identify each pair of angles as **alternate interior**, **alternate exterior**, **corresponding**, or **consecutive interior** angles.

- $\angle 10$ and $\angle 16$
alternate exterior angles
- $\angle 4$ and $\angle 12$
corresponding angles
- $\angle 3$ and $\angle 9$
consecutive interior angles



Exercises

Use the figure in the Example for Exercises 1–12.

Name the transversal that forms each pair of angles.

- $\angle 9$ and $\angle 13$ **q**
- $\angle 5$ and $\angle 14$ **ℓ**
- $\angle 4$ and $\angle 6$ **p**

Identify each pair of angles as **alternate interior**, **alternate exterior**, **corresponding**, or **consecutive interior** angles.

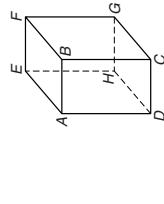
- $\angle 1$ and $\angle 5$
corresponding
- $\angle 6$ and $\angle 8$
alt. exterior
- $\angle 3$ and $\angle 11$
corresponding
- $\angle 12$ and $\angle 3$
consecutive interior
- $\angle 6$ and $\angle 14$
corresponding
- $\angle 2$ and $\angle 8$
alt. exterior
- $\angle 4$ and $\angle 6$
alt. interior
- $\angle 11$ and $\angle 14$
consecutive interior
- $\angle 10$ and $\angle 16$
alt. interior
- $\angle 3$ and $\angle 9$
consecutive interior
- $\angle 10$ and $\angle 16$
alt. exterior

NAME _____ DATE _____ PERIOD _____

3-1 Skills Practice

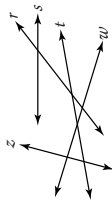
Parallel Lines and Transversals

For Exercises 1–4, refer to the figure at the right.



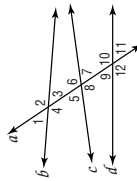
- Name all planes that are parallel to plane DEH . **plane FBG**
- Name all segments that are parallel to \overline{AB} . **\overline{CD} , \overline{EF} , \overline{GH}**
- Name all segments that intersect \overline{GH} . **\overline{CG} , \overline{DH} , \overline{EH} , \overline{FG}**
- Name all segments that are skew to \overline{CD} . **\overline{AE} , \overline{BF} , \overline{EH} , \overline{FG}**

Identify the sets of lines to which each given line is a transversal.



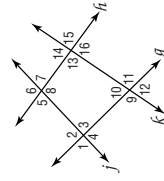
- r and s and t , s and w , s and z , t and w , t and z , w and z
- s and t and r and w , r and z , t and z , w and z
- w and s , r and t , r and z , s and t , s and z , t and z

Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.



- $\angle 2$ and $\angle 8$
alternate exterior
- $\angle 1$ and $\angle 9$
corresponding
- $\angle 6$ and $\angle 12$
alternate exterior

Name the transversal that forms each pair of angles. Then identify the special name for the angle pair.



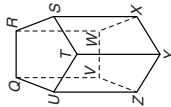
- $\angle 4$ and $\angle 10$
 g ; alternate interior
- $\angle 7$ and $\angle 3$
 j ; corresponding
- $\angle 8$ and $\angle 14$
 h ; alternate interior

NAME _____ DATE _____ PERIOD _____

3-1 Practice (Average)

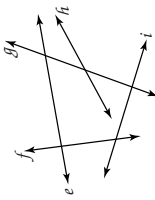
Parallel Lines and Transversals

For Exercises 1–4, refer to the figure at the right.



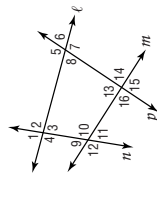
- Name all planes that intersect plane STX .
 TUY , RSW , STU , VWX , QUV , QVW
- Name all segments that intersect \overline{QU} . **\overline{QR} , \overline{QV} , \overline{TU} , \overline{UZ}**
- Name all segments that are parallel to \overline{XY} . **\overline{ST}**
- Name all segments that are skew to \overline{VW} . **\overline{QU} , \overline{RS} , \overline{ST} , \overline{SX} , \overline{TU} , \overline{TY} , \overline{UZ}**

Identify the sets of lines to which each given line is a transversal.



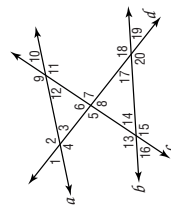
- e
 f and g , f and h , f and i , g and h , g and i , h and i
- h
 e and f , e and g , e and h , f and i , g and i

Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.



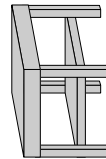
- $\angle 9$ and $\angle 13$
corresponding
- $\angle 3$ and $\angle 10$
consecutive interior
- $\angle 6$ and $\angle 16$
alternate exterior
- $\angle 8$ and $\angle 14$
alternate interior

Name the transversal that forms each pair of angles. Then identify the special name for the angle pair.



- $\angle 2$ and $\angle 12$
 d ; alternate interior
- $\angle 6$ and $\angle 18$
 d ; corresponding
- $\angle 13$ and $\angle 19$
 b ; alternate exterior
- $\angle 11$ and $\angle 7$
 c ; consecutive interior

FURNITURE For Exercises 15–16, refer to the drawing of the end table.



- Find an example of parallel planes. **Sample answer: the top of the table and the bottom shelf**
- Find an example of parallel lines. **Sample answer: the table legs**

NAME _____

DATE _____

PERIOD _____

3-1

Reading to Learn Mathematics

Parallel Lines and Transversals

Pre-Activity How are parallel lines and planes used in architecture?

Read the introduction to Lesson 3-1 at the top of page 126 in your textbook.

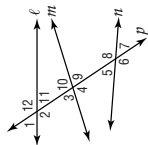
- Give an example of parallel lines that can be found in your classroom.
Sample answers: edges of floor along opposite walls; vertical edges of a door
- Give an example of parallel planes that can be found in your classroom.
Sample answers: ceiling and floor; opposite walls

Reading the Lesson

- Write a geometrical term that matches each definition.
 - two planes that do not intersect **parallel planes**
 - lines that are not coplanar and do not intersect **skew lines**
 - two coplanar lines that do not intersect **parallel lines**
 - a line that intersects two or more lines in a plane at different points **transversal**
 - a pair of angles determined by two lines and a transversal consisting of an interior angle and an exterior angle that have different vertices and that lie on the same side of the transversal **corresponding angles**

- Refer to the figure at the right. Give the special name for each angle pair:

- $\angle 3$ and $\angle 5$ **corresponding angles**
- $\angle 6$ and $\angle 12$ **alternate exterior angles**
- $\angle 4$ and $\angle 8$ **alternate interior angles**
- $\angle 2$ and $\angle 3$ **consecutive interior angles**
- $\angle 8$ and $\angle 12$ **corresponding angles**
- $\angle 5$ and $\angle 9$ **alternate interior angles**
- $\angle 4$ and $\angle 10$ **vertical angles**
- $\angle 6$ and $\angle 7$ **linear pair**



Helping You Remember

- A good way to remember new mathematical terms is to relate them to words that you use in everyday life. Many words start with the prefix *trans*, which is a Latin root meaning *across*. List four English words that start with *trans*. How can the meaning of this prefix help you remember the meaning of *transversal*?
Sample answer: Translate, transfer, transport, transcontinental; a transversal is a line that goes across two or more other lines.

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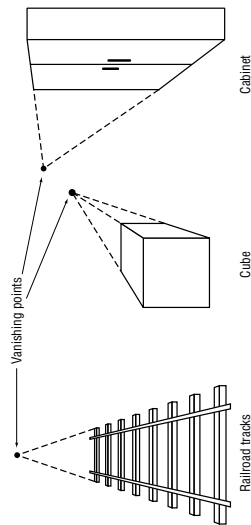
PERIOD _____

3-1

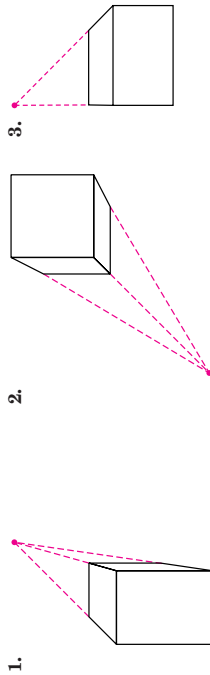
Enrichment

Perspective Drawings

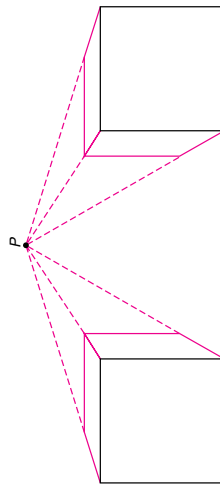
To draw three-dimensional objects, artists make **perspective drawings** such as the ones shown. To indicate depth in a perspective drawing, some parallel lines are drawn as converging lines. The dotted lines in the figures below each extend to a **vanishing point**, or spot where parallel lines appear to meet.



Draw lines to locate the vanishing point in each drawing of a box.



- The fronts of two cubes are shown below. Using point P as the vanishing point for both cubes, complete the perspective drawings of the cubes.



- Find an example of a perspective drawing in a newspaper or magazine. Trace the drawing and locate a vanishing point. **See students' work.**

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3-2 Study Guide and Intervention

Angles and Parallel Lines

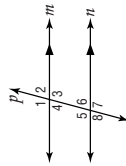
Parallel Lines and Angle Pairs When two parallel lines are cut by a transversal, the following pairs of angles are congruent.

- corresponding angles
- alternate interior angles
- alternate exterior angles

Also, consecutive interior angles are supplementary.

Example In the figure, $m\angle 2 = 75$. Find the measures of the remaining angles.

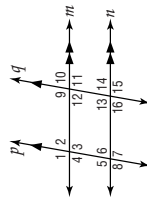
- $m\angle 1 = 105$ $\angle 1$ and $\angle 2$ form a linear pair.
 $m\angle 3 = 105$ $\angle 3$ and $\angle 2$ form a linear pair.
 $m\angle 4 = 75$ $\angle 4$ and $\angle 2$ are vertical angles.
 $m\angle 5 = 105$ $\angle 5$ and $\angle 3$ are alternate interior angles.
 $m\angle 6 = 75$ $\angle 6$ and $\angle 2$ are corresponding angles.
 $m\angle 7 = 105$ $\angle 7$ and $\angle 3$ are corresponding angles.
 $m\angle 8 = 75$ $\angle 8$ and $\angle 6$ are vertical angles.



Exercises

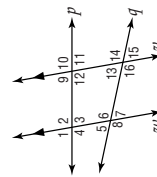
In the figure, $m\angle 3 = 102$. Find the measure of each angle.

- $\angle 5$ **102**
- $\angle 6$ **78**
- $\angle 11$ **102**
- $\angle 7$ **102**
- $\angle 15$ **102**
- $\angle 14$ **78**



In the figure, $m\angle 9 = 80$ and $m\angle 5 = 68$. Find the measure of each angle.

- $\angle 12$ **100**
- $\angle 1$ **80**
- $\angle 4$ **100**
- $\angle 3$ **80**
- $\angle 7$ **68**
- $\angle 16$ **112**



3-2 Study Guide and Intervention

Angles and Parallel Lines

Algebra and Angle Measures Algebra can be used to find unknown values in angles formed by a transversal and parallel lines.

Example If $m\angle 1 = 3x + 15$, $m\angle 2 = 4x - 5$, $m\angle 3 = 5y$, and $m\angle 4 = 6z + 3$, find x and y .

$p \parallel q$, so $m\angle 1 = m\angle 2$ because they are corresponding angles.

$$3x + 15 = 4x - 5$$

$$3x + 15 - 3x = 4x - 5 - 3x$$

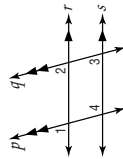
$$15 = x - 5$$

$$15 + 5 = x - 5 + 5$$

$$20 = x$$

$m\angle 2 = m\angle 3$

$$\frac{75}{5} = \frac{5y}{5}$$

$$15 = y$$


Exercises

Find x and y in each figure.

- $x = 15$; $y = 19$
- $x = 6$; $y = 24$
- $x = 11$; $y = 10$
- $x = 10$; $y = 25$

Find x , y , and z in each figure.

- $x = 74$; $y = 37$; $z = 25$
- $x = 30$; $y = 15$; $z = 150$

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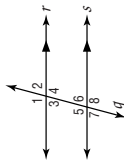
PERIOD _____

3-2 Skills Practice

Angles and Parallel Lines

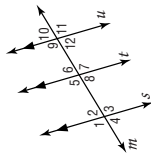
In the figure, $m\angle 2 = 70$. Find the measure of each angle.

1. $\angle 3$ **70**
2. $\angle 5$ **110**
3. $\angle 8$ **110**
4. $\angle 1$ **110**
5. $\angle 4$ **110**
6. $\angle 6$ **70**



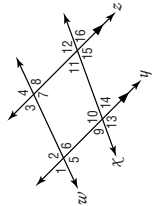
In the figure, $m\angle 7 = 100$. Find the measure of each angle.

7. $\angle 9$ **100**
8. $\angle 6$ **80**
9. $\angle 8$ **80**
10. $\angle 2$ **80**
11. $\angle 5$ **100**
12. $\angle 11$ **100**

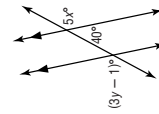


In the figure, $m\angle 3 = 75$ and $m\angle 10 = 115$. Find the measure of each angle.

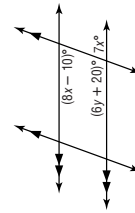
13. $\angle 2$ **105**
14. $\angle 5$ **105**
15. $\angle 7$ **105**
16. $\angle 15$ **115**
17. $\angle 14$ **65**
18. $\angle 9$ **65**



Find x and y in each figure.

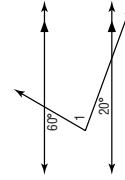


19. $x = 28, y = 47$

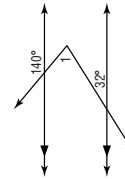


20. $x = 10, y = 15$

Find $m\angle 1$ in each figure.



21. **80**



22. **72**

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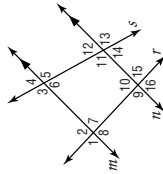
PERIOD _____

3-2 Practice (Average)

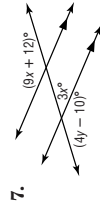
Angles and Parallel Lines

In the figure, $m\angle 2 = 92$ and $m\angle 12 = 74$. Find the measure of each angle.

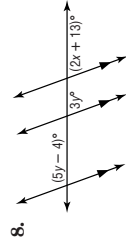
1. $\angle 10$ **92**
2. $\angle 8$ **92**
3. $\angle 9$ **88**
4. $\angle 5$ **106**
5. $\angle 11$ **106**
6. $\angle 13$ **106**



Find x and y in each figure.

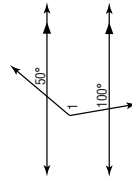


7. $x = 14, y = 37$

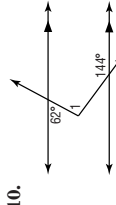


8. $x = 28, y = 23$

Find $m\angle 1$ in each figure.



9. **130**



10. **98**

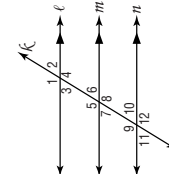
11. **PROOF** Write a paragraph proof of Theorem 3.3.

Given: $\ell \parallel m, m \parallel n$

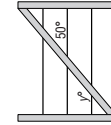
Prove: $\angle 1 \cong \angle 12$

Sample proof:

It is given that $\ell \parallel m$, so $\angle 1 \cong \angle 8$ by the Alternate Exterior Angles Theorem. Since it is given that $m \parallel n$, $\angle 8 \cong \angle 12$ by the Corresponding Angles Postulate. Therefore, $\angle 1 \cong \angle 12$, since congruence of angles is transitive.



12. **FENCING** A diagonal brace strengthens the wire fence and prevents it from sagging. The brace makes a 50° angle with the wire as shown. Find y . **130**



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Glencoe Geometry

3-2 Reading to Learn Mathematics

Angles and Parallel Lines

Pre-Activity How can angles and lines be used in art?

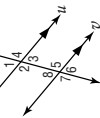
Read the introduction to Lesson 3-2 at the top of page 133 in your textbook.

- Your textbook shows a painting that contains two parallel lines and a transversal. What is the name for $\angle 1$ and $\angle 2$? **corresponding angles**
- What is the relationship between these two angles? **They are congruent.**

Reading the Lesson

- Choose the correct word to complete each sentence.
 - If two parallel lines are cut by a transversal, then alternate exterior angles are **congruent** (congruent/complementary/supplementary).
 - If two parallel lines are cut by a transversal, then corresponding angles are **congruent** (congruent/complementary/supplementary).
 - If parallel lines are cut by a transversal, then consecutive interior angles are **supplementary** (congruent/complementary/supplementary).
 - In a plane, if a line is perpendicular to one of two parallel lines, then it is **perpendicular** (parallel/perpendicular/skew) to the other.

Use the figure for Exercises 2 and 3.



- Name four pairs of vertical angles.
 $\angle 1$ and $\angle 3$, $\angle 2$ and $\angle 4$, $\angle 5$ and $\angle 7$, $\angle 6$ and $\angle 8$
- Name all angles that form a linear pair with $\angle 7$. **$\angle 6$, $\angle 8$**
- Name all angles that are congruent to $\angle 1$. **$\angle 3$, $\angle 6$, $\angle 8$**
- Name all angles that are congruent to $\angle 4$. **$\angle 2$, $\angle 5$, $\angle 7$**
- Name all angles that are supplementary to $\angle 3$. **$\angle 2$, $\angle 4$, $\angle 5$, $\angle 7$**
- Name all angles that are supplementary to $\angle 2$. **$\angle 1$, $\angle 3$, $\angle 6$, $\angle 8$**
- Which conclusion(s) could you make about lines u and v if $m\angle 4 = m\angle 1$? **B, D**
 A. $t \parallel u$ B. $t \perp u$ C. $v \perp u$ D. $v \perp t$ E. $v \parallel t$

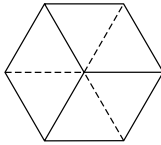
Helping You Remember

- How can you use an everyday meaning of the adjective *alternate* to help you remember the types of angle pairs for two lines and a transversal?
Sample answer: One meaning of alternate is "obtained by switching back and forth from one thing to another." The angle pairs in this lesson all use angles with different vertices, and those whose names contain the adjective alternate can be located in a figure by switching from one side of the transversal to the other. The pairs whose names do not include the word alternate are found on the same side of the transversal.

3-2 Enrichment

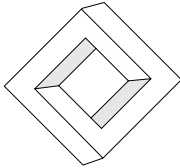
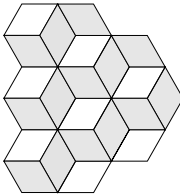
More Optical Illusions

In drawings, diagonal lines may create the illusion of depth. For example, the figure at the right can be thought of as picturing a flat figure or a cube. The optical illusions on this page involve depth perception.

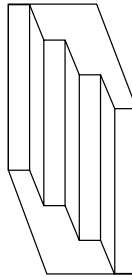


Answer each question.

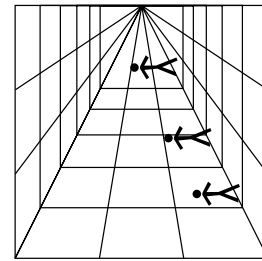
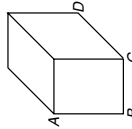
- How many cubes do you see in the drawing? **5 or 6**
- Can this figure show an actual object? **no**



- Does the drawing show a view from the top or the bottom of the stairs?
Answers may vary.



- Which line segment is longer, \overline{AB} or \overline{CD} ? Measure to check your answer.
 \overline{AB}



- Which person in the drawing at the right appears to be tallest? Measure to check your answer.
The person at the right appears tallest, but all are the same size.
- Draw two more objects the same size on the figure at the right. Does one appear larger than the other?
Answers will vary.

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3-3 Study Guide and Intervention

Slopes of Lines

Slope of a Line The slope m of a line containing two points with coordinates (x_1, y_1) and (x_2, y_2) is given by the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$, where $x_1 \neq x_2$.

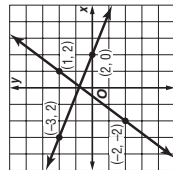
Example Find the slope of each line.

For line p , let (x_1, y_1) be $(1, 2)$ and (x_2, y_2) be $(-2, -2)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 2}{-2 - 1} \text{ or } \frac{4}{-3}$$

For line q , let (x_1, y_1) be $(2, 0)$ and (x_2, y_2) be $(-3, 2)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 0}{-3 - 2} \text{ or } -\frac{2}{5}$$



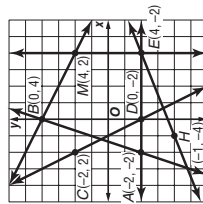
Exercises

Determine the slope of the line that contains the given points.

- $J(0, 0), K(-2, 8)$ **-4**
- $R(-2, -3), S(3, -5)$ **$-\frac{2}{5}$**
- $L(1, -2), N(-6, 3)$ **$-\frac{5}{7}$**
- $P(-1, 2), Q(-9, 6)$ **$-\frac{1}{2}$**
- $T(1, -2), U(6, -2)$ **0**
- $V(-2, 10), W(-4, -3)$ **$\frac{13}{2}$**

Find the slope of each line.

- \overline{AB} **3**
- \overline{CD} **-2**
- \overline{EM} **undefined**
- \overline{AE} **0**
- \overline{EH} **$\frac{2}{5}$**
- \overline{BM} **$-\frac{1}{2}$**



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3-3 Study Guide and Intervention

Slopes of Lines

Parallel and Perpendicular Lines If you examine the slopes of pairs of parallel lines and the slopes of pairs of perpendicular lines, where neither line in each pair is vertical, you will discover the following properties.

Two lines have the same slope if and only if they are parallel.

Two lines are perpendicular if and only if the product of their slopes is -1 .

Example 1 Find the slope of a line parallel to the line containing $A(-3, 4)$ and $B(2, 5)$.

Find the slope of \overline{AB} . Use $(-3, 4)$ for (x_1, y_1) and use $(2, 5)$ for (x_2, y_2) .

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 4}{2 - (-3)} \text{ or } \frac{1}{5}$$

The slope of any line parallel to \overline{AB} must be $\frac{1}{5}$.

Example 2 Find the slope of a line perpendicular to \overline{PQ} for $P(-2, -4)$ and $Q(4, 3)$.

Find the slope of \overline{PQ} . Use $(-2, -4)$ for (x_1, y_1) and use $(4, 3)$ for (x_2, y_2) .

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - (-4)}{4 - (-2)} \text{ or } \frac{7}{6}$$

Since $\frac{7}{6} \cdot \left(-\frac{6}{7}\right) = -1$, the slope of any line perpendicular to \overline{PQ} must be $-\frac{6}{7}$.

Exercises

Determine whether \overline{MN} and \overline{RS} are **parallel**, **perpendicular**, or **neither**.

- $M(0, 3), N(2, 4), R(2, 1), S(8, 4)$ **parallel**
- $M(-1, 3), N(0, 5), R(2, 1), S(6, -1)$ **perpendicular**
- $M(-1, 3), N(4, 4), R(3, 1), S(-2, 2)$ **neither**
- $M(0, -3), N(-2, -7), R(2, 1), S(0, -3)$ **parallel**
- $M(-2, 2), N(1, -3), R(-2, 1), S(3, 4)$ **perpendicular**
- $M(0, 0), N(2, 4), R(2, 1), S(8, 4)$ **neither**

Find the slope of \overline{MN} and the slope of any line perpendicular to \overline{MN} .

- $M(2, -4), N(-2, -1)$ **$-\frac{3}{4}$; 4**
- $M(1, 3), N(-1, 5)$ **-1 ; 1**
- $M(4, -2), N(5, 3)$ **5 ; $-\frac{1}{5}$**
- $M(2, -3), N(-4, 1)$ **$-\frac{2}{3}$; 3**

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3-3 Skills Practice

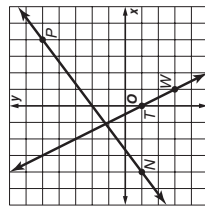
Slopes of Lines

Determine the slope of the line that contains the given points.

- $S(-1, 2), W(0, 4)$ **2**
- $G(-2, 5), H(1, -7)$ **-4**
- $C(0, 1), D(3, 3)$ **$\frac{2}{3}$**
- $J(-5, -2), K(5, -4)$ **$-\frac{1}{5}$**

Find the slope of each line.

- \overline{NP} **$\frac{3}{4}$**
- \overline{TW} **-2**
- a line parallel to \overline{TW} **$-\frac{4}{3}$**

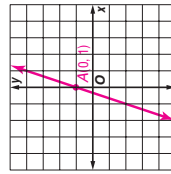


Determine whether \overline{AB} and \overline{MN} are **parallel**, **perpendicular**, or **neither**.

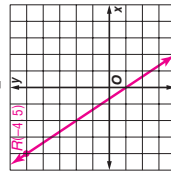
- $A(0, 3), B(5, -7), M(-6, 7), N(-2, -1)$ **neither**
- $A(-1, 4), B(2, -5), M(-3, 2), N(3, 0)$ **perpendicular**
- $A(-4, -8), B(4, -6), M(-3, 5), N(-1, -3)$ **perpendicular**

Graph the line that satisfies each condition.

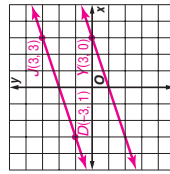
- slope = 3, contains $A(0, 1)$



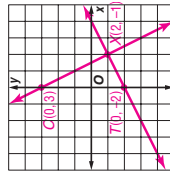
- slope = $-\frac{3}{2}$, contains $R(-4, 5)$



- contains $Y(3, 0)$, parallel to \overline{DJ} with $D(-3, 1)$ and $J(3, 3)$



- contains $T(0, -2)$, perpendicular to \overline{CX} with $C(0, 3)$ and $X(2, -1)$



3-3 Practice (Average)

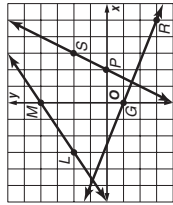
Slopes of Lines

Determine the slope of the line that contains the given points.

- $B(-4, 4), R(0, 2)$ **$-\frac{1}{2}$**
- $I(-2, -9), P(2, 4)$ **$\frac{13}{4}$**

Find the slope of each line.

- \overline{LM} **$\frac{3}{2}$**
- \overline{GR} **$-\frac{2}{5}$**
- a line parallel to \overline{GR} **$-\frac{2}{5}$**
- a line perpendicular to \overline{PS} **$-\frac{1}{-2}$**

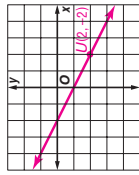


Determine whether \overline{KM} and \overline{ST} are **parallel**, **perpendicular**, or **neither**.

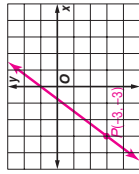
- $K(-1, -8), M(1, 6), S(-2, -6), T(2, 10)$ **neither**
- $K(-5, -2), M(5, 4), S(-3, 6), T(3, -4)$ **perpendicular**
- $K(-4, 10), M(2, -8), S(1, 2), T(4, -7)$ **parallel**
- $K(-3, -7), M(3, -3), S(0, 4), T(6, -5)$ **perpendicular**

Graph the line that satisfies each condition.

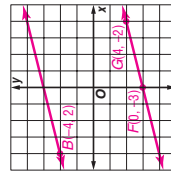
- slope = $-\frac{1}{2}$, contains $U(2, -2)$



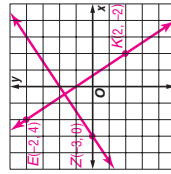
- slope = $\frac{4}{3}$, contains $P(-3, -3)$



- contains $B(-4, 2)$, parallel to \overline{FG} with $F(0, -3)$ and $G(4, -2)$



- contains $Z(-3, 0)$, perpendicular to \overline{EK} with $E(-2, 4)$ and $K(2, -2)$



15. PROFITS After Take Two began renting DVDs at their video store, business soared. Between 2000 and 2003, profits increased at an average rate of \$12,000 per year. Total profits in 2003 were \$46,000. If profits continue to increase at the same rate, what will the total profit be in 2009? **\$118,000**

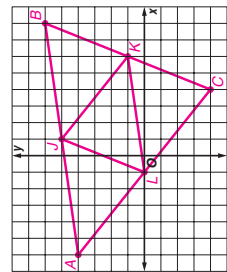
Lesson 3-3

NAME _____ DATE _____ PERIOD _____

3-3 Enrichment

Slopes and Polygons

In coordinate geometry, the slopes of two lines determine if the lines are parallel or perpendicular. This knowledge can be useful when working with polygons.



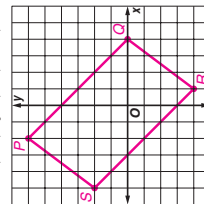
- The coordinates of the vertices of a triangle are $A(-6, 4)$, $B(8, 6)$, and $C(4, -4)$. Graph $\triangle ABC$.
- J , K , and L are midpoints of \overline{AB} , \overline{BC} , and \overline{AC} , respectively. Find the coordinates of J , K , and L . Draw $\triangle JKL$.
 $J(1, 5)$, $K(6, 1)$, $L(-1, 0)$
- Which segments appear to be parallel?
 \overline{AB} and \overline{LK} ; \overline{BC} and \overline{JL} ; \overline{AC} and \overline{JK}
- Show that the segments named in Exercise 3 are parallel by finding the slopes of all six segments.
 \overline{AB} : $\frac{1}{7}$; \overline{LK} : $\frac{1}{7}$; \overline{BC} : $\frac{5}{2}$; \overline{JL} : $\frac{5}{2}$; \overline{AC} : $-\frac{4}{5}$; \overline{JK} : $-\frac{4}{5}$

The coordinates of the vertices of right $\triangle PQR$ are given. Find the slope of each side of the triangle. Then name the hypotenuse.

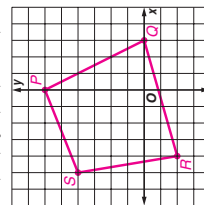
- $P(5, 1)$, $Q(1, -1)$, $R(-2, 5)$
slope of $\overline{PQ} = \frac{1}{2}$
slope of $\overline{QR} = -2$
slope of $\overline{PR} = -\frac{4}{7}$
hypotenuse: \overline{PR}
- $P(-2, -3)$, $Q(5, 1)$, $R(2, 3)$
slope of $\overline{PQ} = \frac{4}{7}$
slope of $\overline{QR} = -\frac{2}{3}$
slope of $\overline{PR} = \frac{3}{2}$
hypotenuse: \overline{PQ}

The coordinates of quadrilateral $PQRS$ are given. Graph quadrilateral $PQRS$ and find the slopes of the diagonals. State whether the diagonals are perpendicular.

- $P(-2, 6)$, $Q(4, 0)$, $R(1, -4)$, $S(-5, 2)$
- $P(0, 6)$, $Q(3, 0)$, $R(-4, -2)$, $S(-5, 4)$



\overline{PR} : $-\frac{10}{3}$; \overline{SQ} : $-\frac{2}{9}$; no



\overline{PR} : 2; \overline{SQ} : $-\frac{1}{2}$; yes

NAME _____ DATE _____ PERIOD _____

3-3 Reading to Learn Mathematics

Slopes of Lines

Pre-Activity How is slope used in transportation?

Read the introduction to Lesson 3-3 at the top of page 139 in your textbook.

- If you are driving uphill on a road with a 4% grade, how many feet will the road rise for every 1000 horizontal feet traveled? **40 ft**
- If you are driving downhill on a road with a 7% grade, how many meters will the road fall for every 500 meters traveled? **35 m**

Reading the Lesson

- Which expressions can be used to represent the slope of the line containing points (x_1, y_1) and (x_2, y_2) ? Assume that no denominator is zero. **A, C, F**

- A.** $\frac{\Delta y}{\Delta x}$ **B.** $\frac{\text{horizontal run}}{\text{vertical rise}}$ **C.** $\frac{y_2 - y_1}{x_2 - x_1}$ **D.** $\frac{\text{change in } x}{\text{change in } y}$
E. $\frac{y_2 - y_1}{x_1 - x_2}$ **F.** $\frac{y_1 - y_2}{x_1 - x_2}$ **G.** $\frac{y_2 - x_1}{y_2 - y_1}$ **H.** $\frac{y_2 - x_2}{y_1 - x_1}$

- Match the description of a line from the first column with the description of its slope from the second column.

Type of Line

- a horizontal line **ii**
- a line that rises from left to right **iv**
- a vertical line **iii**
- a line that falls from left to right **i**

Slope

- a negative number
- 0
- undefined
- a positive number

- Find the slope of each line.

- a line parallel to a line with slope $\frac{3}{4}$ **undefined slope**
- a line perpendicular to the x -axis **undefined slope**
- a line perpendicular to a line with slope $5 - \frac{1}{5}$
- a line parallel to the x -axis **0**
- y -axis **undefined slope**

Helping You Remember

- A good way to remember something is to explain it to someone else. Suppose your friend thinks that perpendicular lines (if neither line is vertical) have slopes that are reciprocals of each other. How could you explain to your friend that this is incorrect and give her a good way to remember the correct relationship?

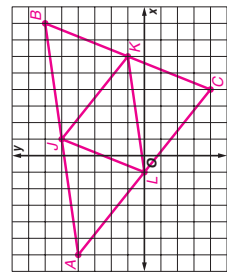
Sample answer: In order for two lines (neither one vertical) to meet at right angles, one must go upward from left to right and the other must go downward, so their slopes must have opposite signs. Reciprocals have the same sign. The product of the slopes must be -1 , not 1. Remember: The slopes are opposite reciprocals.

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3-3 Enrichment

Slopes and Polygons

In coordinate geometry, the slopes of two lines determine if the lines are parallel or perpendicular. This knowledge can be useful when working with polygons.



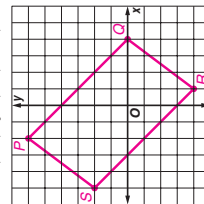
- The coordinates of the vertices of a triangle are $A(-6, 4)$, $B(8, 6)$, and $C(4, -4)$. Graph $\triangle ABC$.
- J , K , and L are midpoints of \overline{AB} , \overline{BC} , and \overline{AC} , respectively. Find the coordinates of J , K , and L . Draw $\triangle JKL$.
 $J(1, 5)$, $K(6, 1)$, $L(-1, 0)$
- Which segments appear to be parallel?
 \overline{AB} and \overline{LK} ; \overline{BC} and \overline{JL} ; \overline{AC} and \overline{JK}
- Show that the segments named in Exercise 3 are parallel by finding the slopes of all six segments.
 \overline{AB} : $\frac{1}{7}$; \overline{LK} : $\frac{1}{7}$; \overline{BC} : $\frac{5}{2}$; \overline{JL} : $\frac{5}{2}$; \overline{AC} : $-\frac{4}{5}$; \overline{JK} : $-\frac{4}{5}$

The coordinates of the vertices of right $\triangle PQR$ are given. Find the slope of each side of the triangle. Then name the hypotenuse.

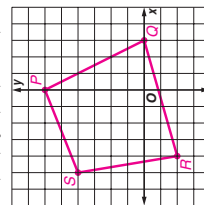
- $P(5, 1)$, $Q(1, -1)$, $R(-2, 5)$
slope of $\overline{PQ} = \frac{1}{2}$
slope of $\overline{QR} = -2$
slope of $\overline{PR} = -\frac{4}{7}$
hypotenuse: \overline{PR}
- $P(-2, -3)$, $Q(5, 1)$, $R(2, 3)$
slope of $\overline{PQ} = \frac{4}{7}$
slope of $\overline{QR} = -\frac{2}{3}$
slope of $\overline{PR} = \frac{3}{2}$
hypotenuse: \overline{PQ}

The coordinates of quadrilateral $PQRS$ are given. Graph quadrilateral $PQRS$ and find the slopes of the diagonals. State whether the diagonals are perpendicular.

- $P(-2, 6)$, $Q(4, 0)$, $R(1, -4)$, $S(-5, 2)$
- $P(0, 6)$, $Q(3, 0)$, $R(-4, -2)$, $S(-5, 4)$



\overline{PR} : $-\frac{10}{3}$; \overline{SQ} : $-\frac{2}{9}$; no



\overline{PR} : 2; \overline{SQ} : $-\frac{1}{2}$; yes

3-4 Study Guide and Intervention

Equations of Lines

Write Equations of Lines You can write an equation of a line if you are given any of the following:

- the slope and the y -intercept,
- the slope and the coordinates of a point on the line, or
- the coordinates of two points on the line.

If m is the slope of a line, b is its y -intercept, and (x_1, y_1) is a point on the line, then:

- the **slope-intercept form** of the equation is $y = mx + b$,
- the **point-slope form** of the equation is $y - y_1 = m(x - x_1)$.

Example 1 Write an equation in slope-intercept form of the line with slope -2 and y -intercept 4 .

$$y = mx + b$$

$$y = -2x + 4 \quad m = -2, b = 4$$

The slope-intercept form of the equation of the line is $y = -2x + 4$.

Example 2 Write an equation in point-slope form of the line with slope $-\frac{3}{4}$ that contains $(8, 1)$.

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

$$y - 1 = -\frac{3}{4}(x - 8) \quad m = -\frac{3}{4}, (x_1, y_1) = (8, 1)$$

The point-slope form of the equation of the line is $y - 1 = -\frac{3}{4}(x - 8)$.

Exercises

Write an equation in slope-intercept form of the line having the given slope and y -intercept.

- $m = 2, y$ -intercept: -3
 $y = 2x - 3$
- $m = -\frac{1}{2}, y$ -intercept: 4
 $y = -\frac{1}{2}x + 4$
- $m = \frac{1}{4}, y$ -intercept: 5
 $y = \frac{1}{4}x + 5$
- $m = -\frac{5}{3}, y$ -intercept: $\frac{1}{3}$
 $y = -\frac{5}{3}x + \frac{1}{3}$
- $m = -3, y$ -intercept: -8
 $y = -3x - 8$

Write an equation in point-slope form of the line having the given slope that contains the given point.

- $m = \frac{1}{2}, (3, -1)$
 $y + 1 = \frac{1}{2}(x - 3)$
- $m = -1, (-1, 3)$
 $y - 3 = -(x + 1)$
- $m = -\frac{5}{2}, (0, -3)$
 $y + 3 = -\frac{5}{2}x$
- $m = -2, (4, -2)$
 $y + 2 = -2(x - 4)$
- $m = \frac{1}{4}, (-3, -2)$
 $y + 2 = \frac{1}{4}(x + 3)$
- $m = 0, (-2, 5)$
 $y - 5 = 0$

3-4 Study Guide and Intervention

Equations of Lines

Write Equations to Solve Problems Many real-world situations can be modeled using linear equations.

Example Donna offers computer services to small companies in her city. She charges \$55 per month for maintaining a web site and \$45 per hour for each service call.

- a. Write an equation to represent the total monthly cost C for maintaining a web site and for h hours of service calls.

For each hour, the cost increases \$45. So the rate of change, or slope, is 45. The y -intercept is located where there are 0 hours, or \$55.

$$C = mh + b$$

$$= 45h + 55$$

- b. Donna may change her costs to represent them by the equation $C = 25h + 125$, where \$125 is the fixed monthly fee for a web site and the cost per hour is \$25. Compare her new plan to the old one if a company has $5\frac{1}{2}$ hours of service calls. Under which plan would Donna earn more?

First plan

$$\text{For } 5\frac{1}{2} \text{ hours of service Donna would earn}$$

$$C = 45h + 55 = 45\left(5\frac{1}{2}\right) + 55$$

$$= 247.5 + 55 \text{ or } \$302.50$$

Second Plan

$$\text{For } 5\frac{1}{2} \text{ hours of service Donna would earn}$$

$$C = 25h + 125 = 25(5.5) + 125$$

$$= 137.5 + 125 \text{ or } \$262.50$$

Donna would earn more with the first plan.

Exercises

For Exercises 1–4, use the following information.

Jerri's current satellite television service charges a flat rate of \$34.95 per month for the basic channels and an additional \$10 per month for each premium channel. A competing satellite television service charges a flat rate of \$39.99 per month for the basic channels and an additional \$8 per month for each premium channel.

- Write an equation in slope-intercept form that models the total monthly cost for each satellite service, where p is the number of premium channels.
- If Jerri wants to include three premium channels in her packages, which service would be less, her current service or the competing service?

Current service: $C = 10p + 34.95$

Competing service: $C = 8p + 39.99$

- A third satellite company charges a flat rate of \$69 for all channels, including the premium channels. If Jerri wants to add a fourth premium channel, which service would be least expensive?
the third company
- Write a description of how the fee for the number of premium channels is reflected in the equation. **The fee for the number of premium channels represents the rate of change, or slope, of the equation.**

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3-4

Skills Practice
Equations of Lines

Write an equation in slope-intercept form of the line having the given slope and y-intercept.

1. $m: -4, y\text{-intercept: } 3$
 $y = -4x + 3$

3. $m: \frac{3}{7}, (0, 1)$
 $y = \frac{3}{7}x + 1$

2. $m: 3, y\text{-intercept: } -8$
 $y = 3x - 8$

4. $m: -\frac{2}{5}, (0, -6)$
 $y = -\frac{2}{5}x - 6$

Write equations in point-slope form and slope-intercept form of the line having the given slope and containing the given point.

5. $m: 2, (5, 2)$
 $y - 2 = 2(x - 5), y = 2x - 8$

6. $m: -3, (2, -4)$
 $y + 4 = -3(x - 2), y = -3x + 2$

7. $m: -\frac{1}{2}, (-2, 5)$
 $y - 5 = -\frac{1}{2}(x + 2), y = -\frac{1}{2}x + 4$

8. $m: \frac{1}{3}, (-3, -8)$
 $y + 8 = \frac{1}{3}(x + 3), y = \frac{1}{3}x - 7$

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

9. r $y = x + 3$

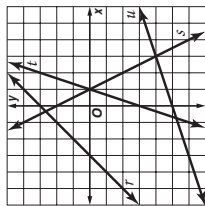
10. s $y = -2x + 2$

11. t $y = 3x - 3$

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

13. the line parallel to line r that contains $(1, -1)$ $y = x - 2$

14. the line perpendicular to line s that contains $(0, 0)$ $y = \frac{1}{2}x$



Write an equation in slope-intercept form for the line that satisfies the given conditions.

15. $m = 6, y\text{-intercept} = -2$
 $y = 6x - 2$

16. $m = -\frac{5}{3}, y\text{-intercept} = 0$
 $y = -\frac{5}{3}x$

17. $m = -1, \text{contains } (0, -6)$
 $y = -x - 6$

18. $m = 4, \text{contains } (2, 5)$
 $y = 4x - 3$

19. contains $(2, 0)$ and $(0, 10)$
 $y = -5x + 10$

20. x-intercept is $-2, y\text{-intercept is } -1$
 $y = -\frac{1}{2}x - 1$

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3-4

Practice (Average)
Equations of Lines

Write an equation in slope-intercept form of the line having the given slope and y-intercept.

1. $m: \frac{2}{3}, y\text{-intercept: } -10$
 $y = \frac{2}{3}x - 10$

2. $m: -\frac{7}{9}, (0, -\frac{1}{2})$
 $y = -\frac{7}{9}x - \frac{1}{2}$

3. $m: 4.5, (0, 0.25)$
 $y = 4.5x + 0.25$

Write equations in point-slope form and slope-intercept form of the line having the given slope and containing the given point.

4. $m: \frac{3}{2}, (4, 6)$
 $y - 6 = \frac{3}{2}(x - 4), y = \frac{3}{2}x$

5. $m: -\frac{6}{5}, (-5, -2)$
 $y + 2 = -\frac{6}{5}(x + 5), y = -\frac{6}{5}x - 8$

6. $m: 0.5, (7, -3)$
 $y + 3 = 0.5(x - 7), y = 0.5x - 6.5$

7. $m: -1.3, (-4, 4)$
 $y - 4 = -1.3(x + 4), y = -1.3x - 1.2$

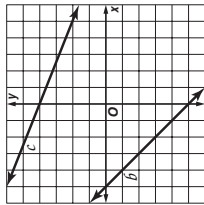
Write an equation in slope-intercept form for each line.

8. b $y = -x - 5$

9. c $y = -\frac{2}{5}x + 4$

10. parallel to line b , contains $(3, -2)$ $y = -x + 1$

11. perpendicular to line c , contains $(-2, -4)$ $y = \frac{5}{2}x + 1$



Write an equation in slope-intercept form for the line that satisfies the given conditions.

12. $m = \frac{4}{9}, y\text{-intercept} = 2$
 $y = -\frac{4}{9}x + 2$

13. $m = 3, \text{contains } (2, -3)$
 $y = 3x - 9$

14. x-intercept is $-6, y\text{-intercept is } 2$
 $y = \frac{1}{3}x + 2$

15. x-intercept is $2, y\text{-intercept is } -5$
 $y = \frac{5}{2}x - 5$

16. passes through $(2, -4)$ and $(5, 8)$
 $y = 4x - 12$

17. contains $(-4, 2)$ and $(8, -1)$
 $y = -\frac{1}{4}x + 1$

18. **COMMUNITY EDUCATION** A local community center offers self-defense classes for teens. A \$25 enrollment fee covers supplies and materials and open classes cost \$10 each. Write an equation to represent the total cost of x self-defense classes at the community center. $C = 10x + 25$

3-4 Reading to Learn Mathematics

Equations of Lines

Pre-Activity How can the equation of a line describe the cost of cellular telephone service?

Read the introduction to Lesson 3-4 at the top of page 145 in your textbook. If the rates for your cellular phone plan are described by the equation in your textbook, what will be the total charge (excluding taxes and fees) for a month in which you use 50 minutes of air time? **\$23.45**

Reading the Lesson

- Identify what each formula represents.
 - $y - y_1 = m(x - x_1)$ **point-slope form of an equation**
 - $m = \frac{y_2 - y_1}{x_2 - x_1}$ **slope of a line**
 - $y = mx + b$ **slope-intercept form of an equation**
- Write the point-slope form of the equation for each line.
 - line with slope $-\frac{1}{2}$ containing $(-2, 5)$ **$y - 5 = -\frac{1}{2}(x + 2)$**
 - line containing $(-4.5, -6.5)$ and parallel to a line with slope 0.5 **$y + 6.5 = 0.5(x + 4.5)$**
- Which one of the following correctly describes the y -intercept of a line? **C**
 - the y -coordinate of the point where the line intersects the x -axis
 - the x -coordinate of the point where the line intersects the y -axis
 - the y -coordinate of the point where the line crosses the y -axis
 - the x -coordinate of the point where the line crosses the x -axis
 - the ratio of the change in y -coordinates to the change in x -coordinates
- Find the slope and y -intercept of each line.
 - $y = 2x - 7$ **slope = 2; y -intercept = -7**
 - $x + y = 8.5$ **slope = -1; y -intercept = 8.5**
 - $2.4x - y = 4.8$ **slope = 2.4; y -intercept = -4.8**
 - $y - 7 = x + 12$ **slope = 1; y -intercept = 19**
 - $y + 5 = -2(x + 6)$ **slope = -2; y -intercept = -17**

Helping You Remember

- A good way to remember something new is to relate it to something you already know. How can the slope formula help you to remember the equation for the point-slope form of a line? **Sample answer: The slope of a line through (x, y) and (x_1, y_1) is given by $\frac{y - y_1}{x - x_1} = m$. Multiply each side of the slope formula by $x_2 - x_1$. The result will be the point-slope form.**

3-4 Enrichment

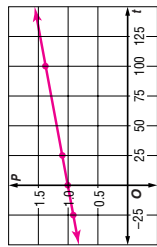
Absolute Zero

All matter is made up of atoms and molecules that are in constant motion. Temperature is one measure of this motion. Absolute zero is the theoretical temperature limit at which the motion of the molecules and atoms of a substance is the least possible.

Experiments with gaseous substances yield data that allow you to estimate just how cold absolute zero is. For any gas of a constant volume, the pressure, expressed in a unit called atmospheres, varies linearly as the temperature. That is, the pressure P and the temperature t are related by an equation of the form $P = mt + b$, where m and b are real numbers.

1. Sketch a graph for the data in the table.

t (in °C)	P (in atmospheres)
-25	0.91
0	1.00
25	1.09
100	1.36



2. Use the data and your graph to find values for m and b in the equation $P = mt + b$, which relates temperature to pressure.

$m = 0.0036, b = 1.00$

3. Estimate absolute zero in degrees Celsius by setting P equal to 0 in the equation above and using the values m and b that you obtained in Exercise 2.

about -278°C (The actual value is slightly higher.)

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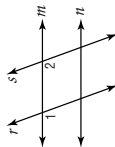
3-5 Study Guide and Intervention

Proving Lines Parallel

Identify Parallel Lines If two lines in a plane are cut by a transversal and certain conditions are met, then the lines must be parallel.

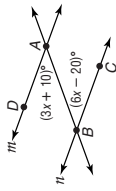
If	then
<ul style="list-style-type: none"> • corresponding angles are congruent, • alternate exterior angles are congruent, • consecutive interior angles are supplementary, • alternate interior angles are congruent, or • two lines are perpendicular to the same line, 	the lines are parallel.

Example 1 If $m\angle 1 = m\angle 2$, determine which lines, if any, are parallel.



Since $m\angle 1 = m\angle 2$, then $\angle 1 \cong \angle 2$. $\angle 1$ and $\angle 2$ are congruent corresponding angles, so $r \parallel s$.

Example 2 Find x and $m\angle ABC$ so that $m \parallel n$.



We can conclude that $m \parallel n$ if alternate interior angles are congruent.

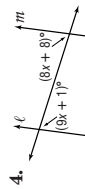
$$\begin{aligned}
 m\angle DAB &= m\angle CDA \\
 3x + 10 &= 6x - 20 \\
 10 &= 3x - 20 \\
 30 &= 3x \\
 10 &= x \\
 m\angle ABC &= 6x - 20 \\
 &= 6(10) - 20 \text{ or } 40
 \end{aligned}$$

Exercises

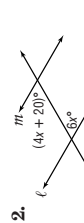
Find x so that $\ell \parallel m$.



15



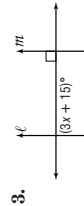
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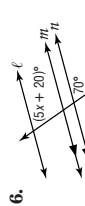
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20



25



10

NAME _____

DATE _____

PERIOD _____

3-5 Study Guide and Intervention

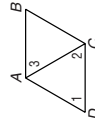
Proving Lines Parallel

Prove Lines Parallel You can prove that lines are parallel by using postulates and theorems about pairs of angles. You also can use slopes of lines to prove that two lines are parallel or perpendicular.

Example

a. Given: $\angle 1 \cong \angle 2$, $\angle 1 \cong \angle 3$

Prove: $\overline{AB} \parallel \overline{DC}$



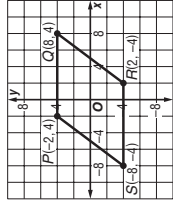
Statements

- $\angle 1 \cong \angle 2$
- $\angle 1 \cong \angle 3$
- $\angle 2 \cong \angle 3$
- $\overline{AB} \parallel \overline{DC}$

Reasons

- Given
- Transitive Property of \cong
- If alt. int. angles are \cong , then the lines are \parallel .

b. Which lines are parallel? Which lines are perpendicular?



slope of $\overline{PQ} = 0$ slope of $\overline{SR} = 0$
 slope of $\overline{PR} = \frac{4}{3}$ slope of $\overline{QR} = \frac{4}{3}$
 slope of $\overline{PR} = -2$ slope of $\overline{SQ} = \frac{1}{2}$
 So $\overline{PQ} \parallel \overline{SR}$, $\overline{PS} \parallel \overline{QR}$, and $\overline{PR} \perp \overline{SQ}$.

Exercises

For Exercises 1–6, fill in the blanks.

Given: $\angle 1 \cong \angle 5$, $\angle 15 \cong \angle 5$

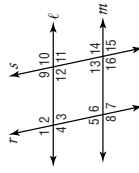
Prove: $\ell \parallel m$, $r \parallel s$

Statements

- $\angle 15 \cong \angle 5$
- $\angle 13 \cong \angle 15$
- $\angle 5 \cong \angle 13$
- $r \parallel s$
- $\angle 1 \cong \angle 5$
- $\ell \parallel m$

Reasons

- Given
- Vertical \angle s are \cong .
- Transitive Property of \cong
- If corr. \angle s are \cong , then lines \parallel .
- Given
- If corr. \angle s are \cong , then lines \parallel .



Lesson 3-5

15

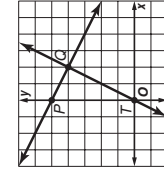
10

25

7

20

10



7. Determine whether $\overline{PQ} \perp \overline{TR}$. Explain why or why not.

slope of $\overline{PQ} = -\frac{1}{2}$; slope of $\overline{TR} = 2$
 $(-\frac{1}{2}) \cdot 2 = -1$, so $\overline{PQ} \perp \overline{TR}$.

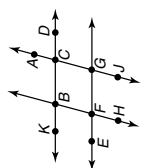
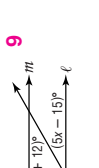
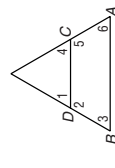
NAME _____ DATE _____ PERIOD _____

3-5 Practice (Average)

Proving Lines Parallel

Given the following information, determine which lines, if any, are parallel. State the postulate or theorem that justifies your answer.

- $m\angle BCG + m\angle FGC = 180$
 $\overline{BD} \parallel \overline{EG}$; **cons. int. \angle**
 $2. \angle CBF \cong \angle GFH$
 $\overline{BD} \parallel \overline{EG}$; **corr. \angle**
- $\angle EPB \cong \angle FBC$
 $\overline{BD} \parallel \overline{EG}$; **alt. int. \angle**
- $\angle ACD \cong \angle KBF$
 $\overline{AJ} \parallel \overline{BH}$; **alt. ext. \angle**

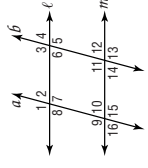
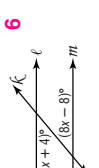
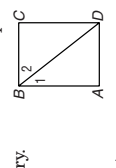
NAME _____ DATE _____ PERIOD _____

3-5 Skills Practice

Proving Lines Parallel

Given the following information, determine which lines, if any, are parallel. State the postulate or theorem that justifies your answer.

- $\angle 3 \cong \angle 7$
 $a \parallel b$; **alt. int. \angle**
- $\angle 9 \cong \angle 11$
 $a \parallel b$; **corr. \angle**
- $m\angle 5 + m\angle 12 = 180$
 $\ell \parallel m$; **cons. int. \angle**

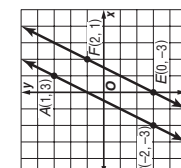
Find x so that $\ell \parallel m$.

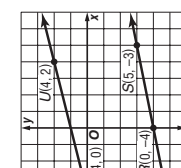
- $\ell \parallel m$; **alt. int. \angle**
- $\ell \parallel m$; **corr. \angle**
- $m\angle 5 + m\angle 12 = 180$
 $\ell \parallel m$; **cons. int. \angle**
- $m\angle 1 + m\angle 2 = 180$
 $\ell \parallel m$; **cons. int. \angle**

8. **PROOF** Provide a reason for each statement in the proof of Theorem 3.7.
 Given: $\angle 1$ and $\angle 2$ are complementary.
 Prove: $\overline{BA} \perp \overline{CD}$

Statements	Reasons
1. $\overline{BC} \perp \overline{CD}$	1. Given
2. $m\angle ABC = m\angle 1 + m\angle 2$	2. Angle Addition Postulate
3. $\angle 1$ and $\angle 2$ are complementary.	3. Given
4. $m\angle 1 + m\angle 2 = 90$	4. Definition of complementary angles
5. $m\angle ABC = 90$	5. Transitive Property of Equality
6. $\overline{BA} \perp \overline{BC}$	6. Definition of perpendicular
7. $\overline{BA} \perp \overline{CD}$	7. If 2 lines are \perp to the same line, then lines are \parallel.

Determine whether each pair of lines is parallel. Explain why or why not.

- 

Yes; the slopes are the same.
- 

No; the slopes are not the same.

3-5

Reading to Learn Mathematics

Proving Lines Parallel

Pre-Activity How do you know that the sides of a parking space are parallel?

Read the introduction to Lesson 3-5 at the top of page 151 in your textbook.

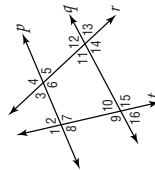
How can the workers who are striping the parking spaces in a parking lot check to see if the sides of the spaces are parallel? **Sample answer: Use a T-square or other device for forming right angles to lay out perpendicular segments cut from string or rope connecting the two sides of a parking space at both ends and in the middle. Measure the three perpendicular segments. If they are all the same length, the sides of the parking space are parallel.**

Reading the Lesson

- Choose the word or phrase that best completes each sentence.
 - If two coplanar lines are cut by a transversal so that corresponding angles are congruent, then the lines are **parallel** (parallel/perpendicular/skew).
 - In a plane, if two lines are perpendicular to the same line, then they are **parallel** (perpendicular/parallel/skew).
 - For a line and a point not on the line, there exists **exactly one** (at least one/exactly one/at most one) line through the point that is parallel to the given line.
 - If two coplanar lines are cut by a transversal so that consecutive interior angles are **supplementary** (complementary/supplementary/congruent), then the lines are parallel.
 - If two coplanar lines are cut by a transversal so that alternate interior angles are congruent, then the lines are **parallel** (perpendicular/parallel/skew).

2. Which of the following conditions verify that $p \parallel q$? **A, C, F, G**

- A.** $\angle 6 \cong \angle 12$ **B.** $\angle 2 \cong \angle 4$
C. $\angle 8 \cong \angle 16$ **D.** $\angle 11 \cong \angle 13$
E. $\angle 6$ and $\angle 7$ are supplementary. **F.** $\angle 1 \cong \angle 15$
G. $\angle 7$ and $\angle 10$ are supplementary. **H.** $\angle 4 \cong \angle 16$



Helping You Remember

- A good way to remember something new is to draw a picture. How can a sketch help you to remember the Parallel Postulate?

Sample answer: Draw a line with a ruler or straightedge and choose a point not on the line. Try to draw lines through the point that are parallel to the line you originally drew. You will see that there is exactly one way to do this.

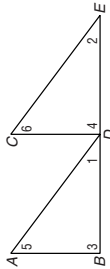
3-5

Enrichment

Scrambled-Up Proof

The reasons necessary to complete the following proof are scrambled up below. To complete the proof, number the reasons to match the corresponding statements.

Given: $\overline{CD} \perp \overline{BE}$
 $\overline{AB} \perp \overline{BE}$
 $\overline{AD} \cong \overline{CE}$
 $\overline{BD} \cong \overline{DE}$



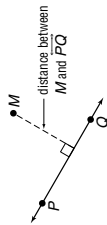
Prove: $\overline{AD} \parallel \overline{CE}$

Proof:

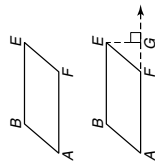
Statements	Reasons
1. $\overline{CD} \perp \overline{BE}$	Definition of Right Triangle 4
2. $\overline{AB} \perp \overline{BE}$	Given 1
3. $\angle 3$ and $\angle 4$ are right angles.	Given 2
4. $\triangle ABD$ and $\triangle CDE$ are right triangles.	Definition of Perpendicular Lines 3
5. $\overline{AD} \cong \overline{CE}$	Given 5
6. $\overline{BD} \cong \overline{DE}$	CPCTC 8
7. $\triangle ABD \cong \triangle CDE$	In a plane, if two lines are cut by a transversal so that a pair of corresponding angles is congruent, then the lines are parallel. (Theorem 7-5) 9
8. $\angle 1 \cong \angle 2$	Given 6
9. $\overline{AD} \parallel \overline{CE}$	HL 7

3-6 Study Guide and Intervention
Perpendiculars and Distance

Distance From a Point to a Line When a point is not on a line, the distance from the point to the line is the length of the segment that contains the point and is perpendicular to the line.



Example Draw the segment that represents the distance from E to \overleftrightarrow{AF} .
Extend \overleftrightarrow{AF} . Draw $\overline{EG} \perp \overleftrightarrow{AF}$.
 \overline{EG} represents the distance from E to \overleftrightarrow{AF} .



Exercises

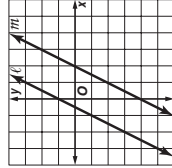
Draw the segment that represents the distance indicated.

1. C to \overleftrightarrow{AB}
2. D to \overleftrightarrow{AB}
3. T to \overleftrightarrow{RS}
4. S to \overleftrightarrow{PQ}
5. S to \overleftrightarrow{QR}
6. S to \overleftrightarrow{RT}

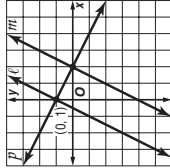
3-6 Study Guide and Intervention
Perpendiculars and Distance

Distance Between Parallel Lines The distance between parallel lines is the length of a segment that has an endpoint on each line and is perpendicular to them. Parallel lines are everywhere **equidistant**, which means that all such perpendicular segments have the same length.

Example Find the distance between the parallel lines ℓ and m whose equations are $y = 2x + 1$ and $y = 2x - 4$, respectively.



Draw a line p through $(0, 1)$ that is perpendicular to ℓ and m .



Line p has slope $-\frac{1}{2}$ and y -intercept 1. An equation of p is $y = -\frac{1}{2}x + 1$. The point of intersection for p and ℓ is $(0, 1)$.

To find the point of intersection of p and m , solve a system of equations.

Line m : $y = 2x - 4$
Line p : $y = -\frac{1}{2}x + 1$

Use substitution.

$$2x - 4 = -\frac{1}{2}x + 1$$

$$4x - 8 = -x + 2$$

$$5x = 10$$

$$x = 2$$

Substitute 2 for x to find the y -coordinate.

$$y = -\frac{1}{2}(2) + 1$$

$$= -\frac{1}{2}(2) + 1 = -1 + 1 = 0$$

The point of intersection of p and m is $(2, 0)$.

Use the Distance Formula to find the distance between $(0, 1)$ and $(2, 0)$.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$= \sqrt{(2 - 0)^2 + (0 - 1)^2}$$

$$= \sqrt{5}$$

The distance between ℓ and m is $\sqrt{5}$ units.

Exercises

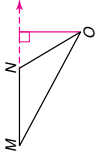
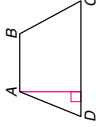

Find the distance between each pair of parallel lines.

1. $y = 8$
 $y = x - 3$
11
2. $y = x + 3$
 $y = x - 1$
 $\sqrt{8}$
3. $y = -2x$
 $y = -2x - 5$
 $\sqrt{5}$

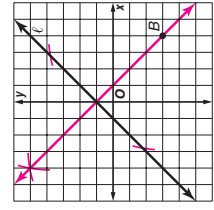
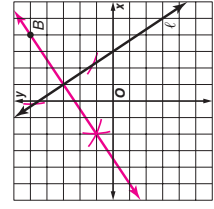
NAME _____ DATE _____ PERIOD _____

3-6 Practice (Average)
Perpendiculars and Distance

Draw the segment that represents the distance indicated.

1. O to \overline{MN} 
2. A to \overline{DC} 
3. T to \overline{VU} 

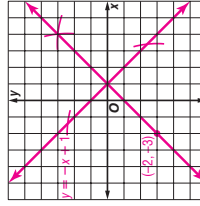
Construct a line perpendicular to ℓ through B . Then find the distance from B to ℓ .

4.  $4\sqrt{2}$
5.  $\sqrt{13}$

Find the distance between each pair of parallel lines.

6. $y = -x$
 $y = -x - 4$ $2\sqrt{2}$
7. $y = 2x + 7$
 $y = 2x - 3$ $2\sqrt{5}$
8. $y = 3x + 12$
 $y = 3x - 18$ $3\sqrt{10}$

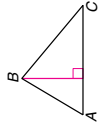
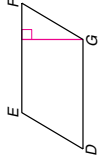
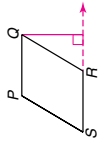
9. Graph the line $y = -x + 1$. Construct a perpendicular segment through the point at $(-2, -3)$. Then find the distance from the point to the line. $3\sqrt{2}$



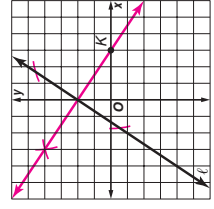
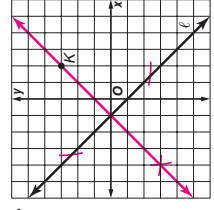
NAME _____ DATE _____ PERIOD _____

3-6 Skills Practice
Perpendiculars and Distance

Draw the segment that represents the distance indicated.

1. B to \overline{AC} 
2. G to \overline{EF} 
3. Q to \overline{SR} 

Construct a line perpendicular to ℓ through K . Then find the distance from K to ℓ .

4.  $\sqrt{13}$
5.  $3\sqrt{2}$

Find the distance between each pair of parallel lines.

6. $y = 7$
 $y = -1$ 8
7. $x = -6$
 $x = 5$ 11
8. $y = 3x$
 $y = 3x + 10$ $\sqrt{10}$
9. $y = -5x$
 $y = -5x + 26$ $\sqrt{26}$
10. $y = x + 9$
 $y = x + 3$ $3\sqrt{2}$
11. $y = -2x + 5$
 $y = -2x - 5$ $2\sqrt{5}$

10. **CANOING** Bronson and a friend are going to carry a canoe across a flat field to the bank of a straight canal. Describe the shortest path they can use.

Sample answer: The shortest path would be a perpendicular segment from where they are to the bank of the canal.

3-6 Reading to Learn Mathematics

Perpendiculars and Distance

Pre-Activity How does the distance between parallel lines relate to hanging new shelves?

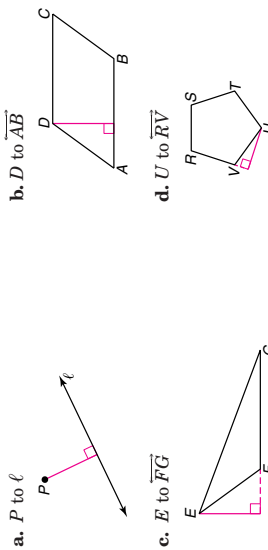
Read the introduction to Lesson 3-6 at the top of page 159 in your textbook. Name three examples of situations in home construction where it would be important to construct parallel lines.

Sample answer: opposite walls of a room, planks of hardwood flooring, tops and bottoms of cabinets

Reading the Lesson

- Fill in the blank with a word or phrase to complete each sentence.
 - The distance from a line to a point not on the line is the length of the segment **perpendicular** to the line from the point.
 - Two coplanar lines are parallel if they are everywhere **equidistant**.
 - In a plane, if two lines are both equidistant from a third line, then the two lines are **parallel** to each other.
 - The distance between two parallel lines measured along a perpendicular to the two lines is always **the same**.
 - To measure the distance between two parallel lines, measure the distance between one of the lines and any point on the **other line**.

2. On each figure, draw the segment that represents the distance indicated.



Helping You Remember

3. A good way to remember a new word is to relate it to words that use the same root. Use your dictionary to find the meaning of the Latin root *aequus*. List three words other than equal and equidistant that are derived from this root and give the meaning of each.

Sample answer: *Aequus* means even, fair, or equal. *Equinox* means one of the two times of year when day and night are of equal length. *Equity* means being just or fair. *Equivalent* means being equal in value or meaning.

3-6 Enrichment

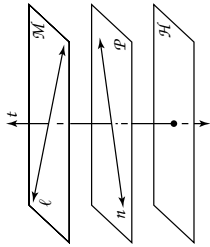
Parallelism in Space

In space geometry, the concept of parallelism must be extended to include two planes and a line and a plane.

Definition: Two planes are parallel if and only if they do not intersect.

Definition: A line and a plane are parallel if and only if they do not intersect.

Thus, in space, two lines can be intersecting, parallel, or skew while two planes or a line and a plane can only be intersecting or parallel. In the figure at the right, $t \perp M$, $t \perp P$, $P \parallel H$, and ℓ and n are skew.



The following five statements are theorems about parallel planes.

- Theorem:** Two planes perpendicular to the same line are parallel.
Theorem: Two planes parallel to the same plane are parallel.
Theorem: A line perpendicular to one of two parallel planes is perpendicular to the other.
Theorem: A plane perpendicular to one of two parallel planes is perpendicular to the other.
Theorem: If two parallel planes each intersect a third plane, then the two lines of intersection are parallel.

Use the figure given above for Exercises 1–10. State yes or no to tell whether the statement is true.

- $M \parallel P$ **yes**
- $\ell \parallel n$ **no**
- $M \parallel H$ **yes**
- $\ell \parallel P$ **yes**
- $\ell \perp t$ **yes**
- $n \parallel H$ **yes**
- $\ell \perp P$ **no**
- $t \parallel H$ **no**
- $M \perp t$ **yes**
- $t \perp H$ **yes**

Make a small sketch to show that each statement is false.

- If two lines are parallel to the same plane, then the lines are parallel.
- If two planes are parallel, then any line in one plane is parallel to any line in the other plane.



- If two lines are parallel, then any plane containing one of the lines is parallel to any plane containing the other line.



- If two lines are parallel, then any plane containing one of the lines is parallel to the other line.



Chapter 3 Assessment Answer Key

Form 1
Page 161

1. C

2. D

3. B

4. A

5. D

6. B

7. C

8. D

9. C

10. A

Page 162

11. A

12. D

13. B

14. C

15. C

16. A

17. B

18. D

19. A

20. C

B: undefined

Form 2A
Page 163

1. C

2. D

3. C

4. D

5. B

6. D

7. A

8. C

9. B

10. D

(continued on the next page)

Chapter 3 Assessment Answer Key

Form 2A (continued)
Page 164

11. C

12. A

13. B

14. D

15. A

16. A

17. C

18. B

19. D

20. C

B: **Sample answer:**
$$y = \frac{285 - 15x}{19h}$$

Form 2B
Page 165

1. D

2. A

3. A

4. B

5. C

6. B

7. D

8. A

9. C

10. C

Page 166

11. D

12. B

13. B

14. A

15. C

16. A

17. D

18. B

19. C

20. A

B: $a \perp c$

Chapter 3 Assessment Answer Key

Form 2C

Page 167

Page 168

1. \overline{SV}

2. Sample answer:
 \overline{VZ}

3. alternate exterior

4. alternate interior

5. corresponding

6. 94

7. $x = 13, y = 39$

8. $\frac{3}{5}$

9. -6

10. $-\frac{5}{3}$

11. neither

12. parallel

13. parallel

14. $C = 1.18p + 12;$
\$71

15. $y = -9x + 3$

16. $y = 3x + 8$

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

18. $y = -x + 2$

19. $\overline{AC} \parallel \overline{DF}$; alt. int. \sphericalangle s

20. $\overline{AD} \parallel \overline{BE}$; corr. \sphericalangle s

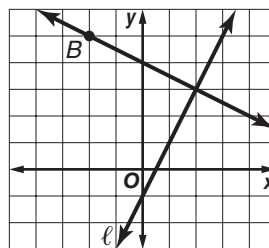
21. $\overline{AD} \parallel \overline{BE}$; cons. int. \sphericalangle s

22. 18

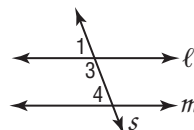
23. $\sqrt{98}$ or $7\sqrt{2}$

24. $\sqrt{45}$ or $3\sqrt{5}$

25. $\sqrt{20}$ or $2\sqrt{5}$



B: Sample answer:
Given: $\sphericalangle 3$ and $\sphericalangle 4$
are supplementary
Prove: $l \parallel m$



Chapter 3 Assessment Answer Key

Form 2D
Page 169

Page 170

1. \overleftrightarrow{CD}

2. Sample answer:
 \overline{AE}

3. corresponding

4. alternate interior

5. alternate exterior

6. 91

7. $x = 17; y = 26$

8. $-\frac{2}{5}$

9. $\frac{1}{7}$

10. $-\frac{1}{3}$

11. perpendicular

12. parallel

13. perpendicular

14. $T = 0.04c + 25;$
\$85

15. $y = 7x - 8$

16. $y = -4x - 8$

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

18. $y = -2x + 9$

19. $\overline{RS} \parallel \overline{TU}; \text{corr. } \sphericalangle$

20. $\overline{PT} \parallel \overline{QU}; \text{alt. int. } \sphericalangle$

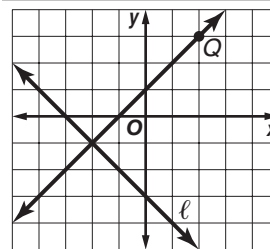
21. $\overline{PT} \parallel \overline{QU}; \text{cons. int. } \sphericalangle$

22. 12

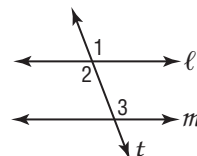
23. $\sqrt{10}$

24. $\sqrt{26}$

25. $\sqrt{32}$ or $4\sqrt{2}$



B: Sample answer:
Given: $\angle 2 \cong \angle 3$
Prove: $l \parallel m$



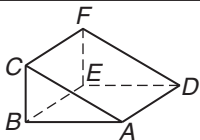
Answers

Chapter 3 Assessment Answer Key

Form 3

Page 171

1. Sample answer:



2. Sample answer:

Plane ABC
intersects plane
 BCE at \overleftrightarrow{BC} .

3. Sample answer: \overleftrightarrow{AD}
is skew to \overleftrightarrow{EF} .

4. corresponding

5. consecutive interior

6. alternate exterior

7. 40

8. $x = 18, y = 7.5,$
and $z = \pm 7$

9. $\frac{5}{3}$

10. $-\frac{3}{8}$

11. perpendicular

12. parallel

Page 172

13. $y + 10 = \frac{8}{5}(x + 6)$

or $y = \frac{8}{5}x - \frac{2}{5}$

14. $y = -\frac{4}{3}x - \frac{31}{3}$

15. $C = 0.28(m - 100)$
+ 150; \$193.40

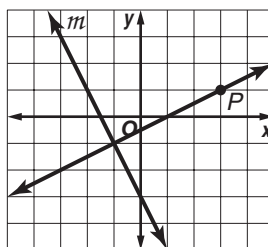
16. $\overleftrightarrow{NU} \parallel \overleftrightarrow{PV}$; alt. int. \sphericalangle

17. $\overleftrightarrow{MR} \parallel \overleftrightarrow{NS}$; cons. int. \sphericalangle

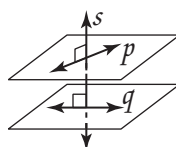
18. 24.2

19. $\sqrt{17}$

20. $\sqrt{20}$ or $2\sqrt{5}$



B: Sample answer: No, if
line p and line q lie in
different planes, the
lines could be skew
and not parallel.



Chapter 3 Assessment Answer Key

Page 173, Open-Ended Assessment Scoring Rubric

Score	General Description	Specific Criteria
4	Superior A correct solution that is supported by well-developed, accurate explanations	<ul style="list-style-type: none"> Shows thorough understanding of <i>using the relationships between lines and their properties, proving lines parallel, identifying and determining angle relationships, finding slope, and graphing parallel and perpendicular lines.</i> Uses appropriate strategies to solve problems. Computations are correct. Written explanations are exemplary. Graphs and figures are accurate and appropriate. Goes beyond requirements of some or all problems.
3	Satisfactory A generally correct solution, but may contain minor flaws in reasoning or computation	<ul style="list-style-type: none"> Shows an understanding of <i>using the relationships between lines and their properties, proving lines parallel, identifying and determining angle relationships, finding slope, and graphing parallel and perpendicular lines.</i> Uses appropriate strategies to solve problems. Computations are mostly correct. Written explanations are effective. Graphs and figures are mostly accurate and appropriate. Satisfies all requirements of problems.
2	Nearly Satisfactory A partially correct interpretation and/or solution to the problem	<ul style="list-style-type: none"> Shows a partial understanding of <i>using the relationships between lines and their properties, proving lines parallel, identifying and determining angle relationships, finding slope, and graphing parallel and perpendicular lines.</i> May not use appropriate strategies to solve problems. Computations are mostly correct. Written explanations are satisfactory. Graphs and figures are mostly accurate. Satisfies the requirements of most of the problems.
1	Nearly Unsatisfactory A correct solution with no supporting evidence or explanation	<ul style="list-style-type: none"> Final computation is correct. No written explanations or work is shown to substantiate the final computation. Graphs and figures may be accurate but lack detail or explanation. Satisfies minimal requirements of some of the problems.
0	Unsatisfactory An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given	<ul style="list-style-type: none"> Shows little or no understanding of <i>using the relationships between lines and their properties, proving lines parallel, identifying and determining angle relationships, finding slope, and graphing parallel and perpendicular lines.</i> Does not use appropriate strategies to solve problems. Computations are incorrect. Written explanations are unsatisfactory. Graphs and figures are inaccurate or inappropriate. Does not satisfy requirements of problems. No answer may be given.

Chapter 3 Assessment Answer Key

Page 173, Open-Ended Assessment Sample Answers

In addition to the scoring rubric found on page A25, the following sample answers may be used as guidance in evaluating open-ended assessment items.

1a. If you know the measure of one or more angles formed by the intersections of the streets, you can determine congruence of angles. If certain angles are congruent, the streets are parallel. For instance, lines a , b , and c are cut by transversal d . If you know the measure of $\angle 1$ and it is congruent to $\angle 2$, then the streets represented by a and b are parallel by the Alternate Exterior Angles Theorem. If $\angle 2$ is congruent to $\angle 4$, b and c are parallel by the Alternate Interior Angles Theorem.

b. $m\angle 4 = 68$. Given lines d and e are parallel, $\angle 5$ and $\angle 4$ are consecutive interior angles. Since consecutive interior angles are supplementary, $180 - m\angle 5$ will give the measure of 4: $180 - 112 = 68$.

c. $x = 27$; $\angle 1$ and $\angle 4$ are corresponding angles. If lines a and c are parallel, then $\angle 1 \cong \angle 4$. Therefore, $m\angle 1 = m\angle 4$. Substitute the measures for the angles and solve for x and then verify that the angles are congruent. Since $m\angle 1 = 3x - 7$ or 74 and $m\angle 4 = 2x + 20$ or 74; $\angle 1 \cong \angle 4$ and lines a and c are parallel.

d. Student should draw a line through \textcircled{B} perpendicular to line b . The perpendicular line segment should include a right angle symbol. To find the shortest distance from the library to his street, Todd could measure this perpendicular segment since a perpendicular line segment from any point to a line is the shortest distance between the point and the line.

2a. The student first draws the line, then writes the equation $y = x + 2$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} && \text{Use the slope formula to find the slope} \\ &= \frac{4 + 1}{2 + 3} && \text{of the line.} \\ &= \frac{5}{5} \text{ or } 1 && \text{Substitute coordinates into the formula.} \end{aligned}$$

Then use one of the pair of coordinates to write the equation in point-slope form.

$$\begin{aligned} y - y_1 &= m(x - x_1) && \text{Point-slope form} \\ y + 1 &= 1(x + 3) && \text{Substitute } (-3, -1). \\ y &= x + 3 - 1 && \text{Simplify and subtract 1 from} \\ & && \text{each side.} \\ y &= x + 2 \end{aligned}$$

b. The slope of a line parallel to $y = x + 2$ is 1, since parallel lines have the same slope.

c. $\sqrt{2}$; the student should draw a line perpendicular to the two lines, and then use the points of intersections and the Distance Formula to find the distance.

Chapter 3 Assessment Answer Key

Vocabulary Test/Review Page 174

1. false; alternate interior angles
2. false; Corr. \angle Postulate
3. true
4. false; two
5. true
6. true
7. false; parallel
8. false; perpendicular
9. true
10. false; slope
11. Sample answer:
Rate of change describes how a quantity is changing over time.

Quiz 1 Page 175

- Sample answer:
1. plane ABM
 2. \overrightarrow{BC}
 3. corresponding
 4. alternate interior
 5. alternate exterior
 6. consecutive interior
 7. 86
 8. 94
 9. $x = 12, y = 31$
 10. C

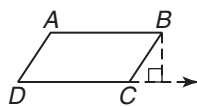
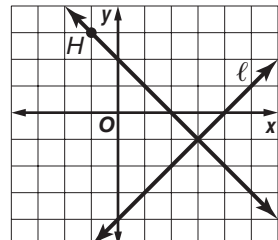
Quiz 2 Page 175

1. -1
2. 5
3. $-\frac{3}{2}$
4. $\frac{1}{5}$
5. perpendicular

Quiz 3 Page 176

1. $y - 8 = -\frac{1}{3}(x - 3)$
2. $y = \frac{5}{3}x - 2$
3. $y = -4x + 3$
4. $C = 5b + 8$
5. $g \parallel h$; corr. \angle s
6. $p \parallel q$; alt. int. \angle s
7. $g \parallel h$; alt. ext. \angle s
8. $p \parallel q$; cons. int. \angle s
9. 116
10. 26

Quiz 4 Page 176

1. 
 2. $\sqrt{32}$ or $4\sqrt{2}$
- 
3. 12
 4. $\sqrt{2}$

Chapter 3 Assessment Answer Key

Mid-Chapter Test

Page 177

Part I

1. D

2. C

3. C

4. A

5. B

Part II

6. $x = 28, y = 19$

7. $\frac{1}{2}$

8. $-\frac{1}{4}$

9. parallel

10. perpendicular

Cumulative Review

Page 178

1. 7; 84

2. $(-7, -1)$

3. acute

4. 5; 20

5. true

6. H: $m\angle 1 + m\angle 2 = 180$; C: $\angle 1$ and $\angle 2$ are supplementary

7. Law of Detachment

8. always

9. parallel

10. $y - 8 = 4(x - 2)$

11. $\sqrt{41}$ or ≈ 6.4

Chapter 3 Assessment Answer Key

Standardized Test Practice

Page 179

Page 180

1. (A) (B) (C) (D)

2. (E) (F) (G) (H)

3. (A) (B) (C) (D)

4. (E) (F) (G) (H)

5. (A) (B) (C) (D)

6. (E) (F) (G) (H)

7. (A) (B) (C) (D)

8. (E) (F) (G) (H)

9. (A) (B) (C) (D)

10. (E) (F) (G) (H)

11.

2	3		
.	/	/	.
	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

12.

8	5		
.	/	/	.
	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

13.

3			
.	/	/	.
	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

14. 10

15. 5 or -9

16. 2

17. 2

18. 20

Chapter 3 Assessment Answer Key

Unit 1 Test/Review

Page 181

1. $2\frac{1}{2}$ in.; $\frac{1}{4}$ in.

2. $\sqrt{68}$ or about
8.25; (9, -8)

3. $m\angle PQR = 120$,
obtuse;
 $m\angle RQS = 40$, acute;
 $m\angle SQT = 20$, acute

4. 53 and 37

5. pentagon,
convex, irregular

6. 54 ft long by
18 ft wide

7. U

8.

p	q	$\sim p$	$\sim p \wedge q$
T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

9. hypothesis: in a
plane, lines ℓ and
 m are equidistant
from line p ;
conclusion: $\ell \parallel m$

10. Law of Syllogism

11. sometimes

Page 182

12. Given

13. Angles comp. to
 $\cong \angle$ s are \cong .

14. Def. of $\cong \angle$ s

15. Def. of comp. \angle s

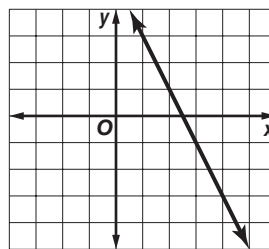
16. Substitution

17. p ; alternate
exterior angles

18. $m\angle 2 = 52$, $m\angle 4 =$
128, $m\angle 10 = 52$,
 $m\angle 12 = 128$

19. perpendicular

20. $y = -2x + 5$



21. 12

22. $\sqrt{40}$ or about
6.32 units