CHAPTER 3

Study Guide and Review

Study Guide

KeyConcepts

Transversals (Lessons 3-1 and 3-2)

- When a transversal intersects two lines, the following types of angles are formed: exterior, interior, consecutive interior, alternate interior, alternate exterior, and corresponding.
- If two parallel lines are cut by a transversal, then:
  - each pair of corresponding angles is congruent,
  - each pair of alternate interior angles is congruent,
  - each pair of consecutive interior angles is supplementary, and
  - each pair of alternate exterior angles is congruent.

Slope (Lessons 3-3 and 3-4)

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

Proving Lines Parallel (Lesson 3-5)

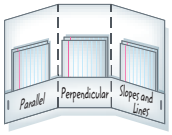
- If two lines in a plane are cut by a transversal so that any one of the following is true, then the two lines are parallel:
  - a pair of corresponding angles is congruent,
  - a pair of alternate exterior angles is congruent,
  - a pair of alternate interior angles is congruent, or
  - a pair of consecutive interior angles is supplementary.
- In a plane, if two lines are perpendicular to the same line, then they are parallel.

Distance (Lesson 3-6)

- 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.
- The distance between two parallel lines is the perpendicular distance between one of the lines and any point on the other line.

FOLDABLES StudyOrganizer

Be sure the Key Concepts are noted in your Foldable.



KeyVocabulary

alternate exterior angles (p. 174)

alternate interior angles (p. 174)

consecutive interior angles (p. 174)

corresponding angles (p. 174)

equidistant (p. 218)

parallel lines (p. 173)

parallel planes (p. 173)

point-slope form (p. 198)

rate of change (p. 189)

skew lines (p. 173)

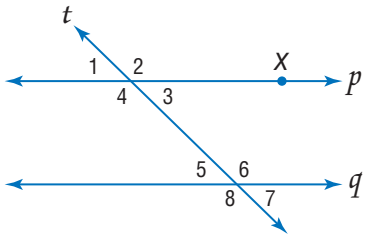
slope (p. 188)

slope-intercept form (p. 198)

transversal (p. 174)

VocabularyCheck

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

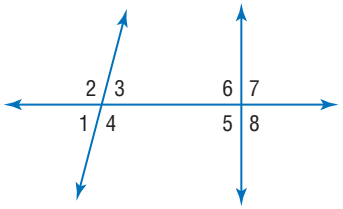


1. If $\angle 1 \cong \angle 5$, then lines p and q are skew lines.
2. Angles 4 and 6 are alternate interior angles.
3. Angles 1 and 7 are alternate exterior angles.
4. If lines p and q are parallel, then angles 3 and 6 are congruent.
5. The distance from point X to line q is the length of the segment perpendicular to line q from X.
6. Line t is called the transversal for lines p and q.
7. If $p \parallel q$, then $\angle 2$ and $\angle 8$ are supplementary.
8. Angles 4 and 8 are corresponding angles.

Lesson-by-Lesson Review

3-1 Parallel Lines and Transversals

Classify the relationship between each pair of angles as *alternate interior, alternate exterior, corresponding,* or *consecutive interior* angles.



9. ∠1 and ∠5

10. ∠4 and ∠6

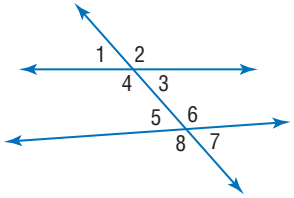
11. ∠2 and ∠8

12. ∠4 and ∠5

13. **BRIDGES** The Roebling Suspension Bridge extends over the Ohio River connecting Cincinnati, Ohio, to Covington, Kentucky. Describe the type of lines formed by the bridge and the river.

Example 1

Refer to the figure below. Classify the relationship between each pair of angles as *alternate interior, alternate exterior, corresponding,* or *consecutive interior* angles.



a. ∠3 and ∠6
consecutive interior

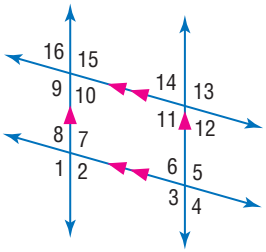
b. ∠2 and ∠6
corresponding

c. ∠1 and ∠7
alternate exterior

d. ∠3 and ∠5
alternate interior

3-2 Angles and Parallel Lines

In the figure, $m\angle 1 = 123$. Find the measure of each angle. Tell which postulate(s) or theorem(s) you used.



14. ∠5

15. ∠14

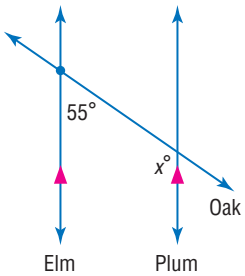
16. ∠16

17. ∠11

18. ∠4

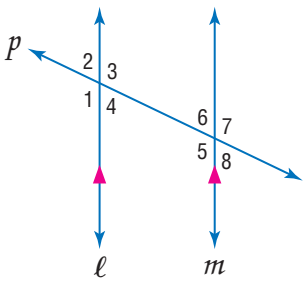
19. ∠6

20. **MAPS** The diagram shows the layout of Elm, Plum, and Oak streets. Find the value of x.



Example 2

ALGEBRA If $m\angle 5 = 7x - 5$ and $m\angle 4 = 2x + 23$, find x. Explain your reasoning.



$m\angle 4 + m\angle 5 = 180$	Def. of Supp. ∠s
$(2x + 23) + (7x - 5) = 180$	Substitution
$9x + 18 = 180$	Simplify.
$9x = 162$	Subtract.
$x = 18$	Divide.

Since lines ℓ and m are parallel, ∠4 and ∠5 are supplementary by the Consecutive Interior Angles Theorem.

3-3 Slopes of Lines

Determine whether $\overleftrightarrow{AB}$ and $\overleftrightarrow{XY}$ are *parallel, perpendicular,* or *neither.* Graph each line to verify your answer.

21. $A(5, 3)$, $B(8, 0)$, $X(-7, 2)$, $Y(1, 10)$

22. $A(-3, 9)$, $B(0, 7)$, $X(4, 13)$, $Y(-5, 7)$

23. $A(8, 1)$, $B(-2, 7)$, $X(-6, 2)$, $Y(-1, -1)$

Graph the line that satisfies each condition.

24. contains $(-3, 4)$ and is parallel to $\overleftrightarrow{AB}$ with $A(2, 5)$ and $B(9, 2)$

25. contains $(1, 3)$ and is perpendicular to $\overleftrightarrow{PQ}$ with $P(4, -6)$ and $Q(6, -1)$

26. AIRPLANES Two Oceanic Airlines planes are flying at the same altitude. Using satellite imagery, each plane's position can be mapped onto a coordinate plane. Flight 815 was mapped at (23, 17) and (5, 11) while Flight 44 was mapped at (3, 15) and (9, 17). Determine whether their paths are *parallel, perpendicular,* or *neither.*

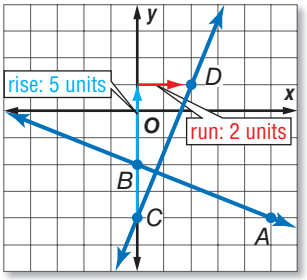
Example 3

Graph the line that contains $C(0, -4)$ and is perpendicular to $\overleftrightarrow{AB}$ with $A(5, -4)$ and $B(0, -2)$.

The slope of $\overleftrightarrow{AB}$ is $\frac{-2-(-4)}{0-5}$ or $-\frac{2}{5}$.

Since $-\frac{2}{5}\left(\frac{5}{2}\right) = -1$, the slope of the line perpendicular to $\overleftrightarrow{AB}$ through C is $\frac{5}{2}$.

To graph the line, start at C. Move up 5 units and then right 2 units. Label the point D and draw $\overleftrightarrow{CD}$.



3-4 Equations of Lines

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

27. $m = 2$, $(4, -9)$

28. $m = -\frac{3}{4}$, $(8, -1)$

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

29. m: 5, y-intercept: -3

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

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

31. $(-3, 12)$ and $(15, 0)$ **32.** $(-7, 2)$ and $(5, 8)$

33. WINDOW CLEANING Ace Window Cleaning Service charges \$50 for the service call and \$20 for each hour spent on the job. Write an equation in slope-intercept form that represents the total cost C in terms of the number of hours h.

Example 4

Write an equation of the line through (2, 5) and (6, 3) in slope-intercept form.

Step 1 Find the slope of the line through the points.

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

$$= \frac{3-5}{6-2}$$ $x_1 = 2$, $y_1 = 5$, $x_2 = 6$, and $y_2 = 3$

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

Step 2 Write an equation of the line.

$$y - y_1 = m(x - x_1)$$ Point-slope form

$$y - 5 = -\frac{1}{2}[x - (2)]$$ $m = -\frac{1}{2}$, $(x_1, y_1) = (2, 5)$

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

$$y = -\frac{1}{2}x + 6$$ Add 5 to each side.

3-5 Proving Lines Parallel

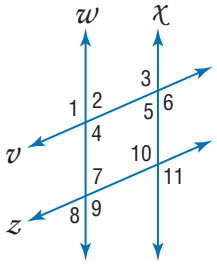
Given the following information, determine which lines, if any, are parallel. State the postulate or theorem that justifies your answer.

34. $\angle 7 \cong \angle 10$

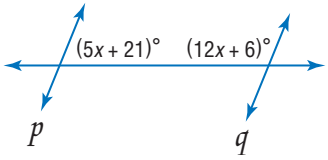
35. $\angle 2 \cong \angle 10$

36. $\angle 1 \cong \angle 3$

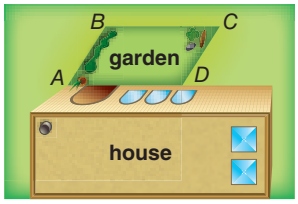
37. $\angle 3 \cong \angle 11$



38. Find x so that $p \parallel q$. Identify the postulate or theorem you used.

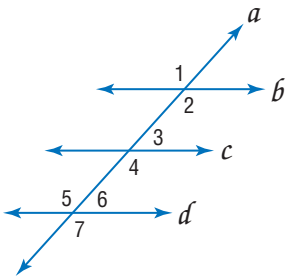


39. **LANDSCAPING** Find the measure needed for $m\angle ADC$ that will make $\overline{AB} \parallel \overline{CD}$ if $m\angle BAD = 45$.



Example 5

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



a. $\angle 1 \cong \angle 7$

$\angle 1$ and $\angle 7$ are alternate exterior angles of lines b and d.

Since $\angle 1 \cong \angle 7$, $b \parallel d$ by the Converse of the Alternate Exterior Angles Theorem.

b. $\angle 4 \cong \angle 5$

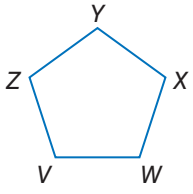
$\angle 4$ and $\angle 5$ are alternate interior angles of lines c and d.

Since $\angle 4 \cong \angle 5$, $c \parallel d$ by the Converse of the Alternate Interior Angles Theorem.

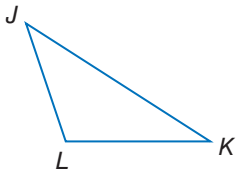
3-6 Perpendiculars and Distance

Copy each figure. Draw the segment that represents the distance indicated.

40. X to $\overline{VW}$



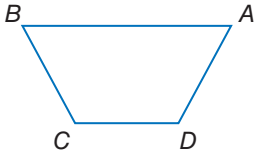
41. L to $\overline{JK}$



42. **HOME DÉCOR** Scott wants to hang two rows of framed pictures in parallel lines on his living room wall. He first spaces the nails on the wall in a line for the top row. Next, he hangs a weighted plumb line from each nail and measures an equal distance below each nail for the second row. Why does this ensure that the two rows of pictures will be parallel?

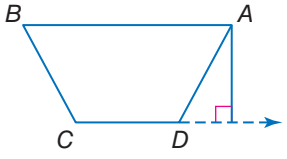
Example 6

Copy the figure. Draw the segment that represents the distance from point A to $\overline{CD}$.



The distance from a line to a point not on the line is the length of the segment perpendicular to the line that passes through the point.

Extend $\overline{CD}$ and draw the segment perpendicular to $\overline{CD}$ from A.

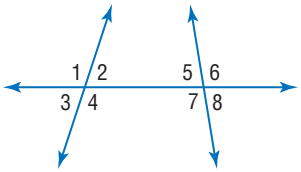


CHAPTER 3

Practice Test

Classify the relationship between each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.

1. $\angle 6$ and $\angle 3$
2. $\angle 4$ and $\angle 7$
3. $\angle 5$ and $\angle 4$

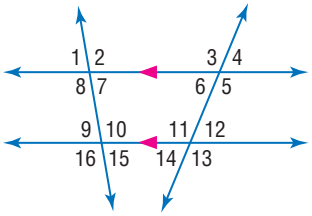


Determine the slope of the line that contains the given points.

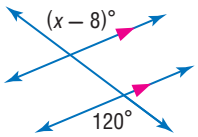
4. $G(8, 1)$, $H(8, -6)$
5. $A(0, 6)$, $B(4, 0)$
6. $E(6, 3)$, $F(-6, 3)$
7. $E(5, 4)$, $F(8, 1)$

In the figure, $m\angle 8 = 96$ and $m\angle 12 = 42$. Find the measure of each angle. Tell which postulate(s) or theorem(s) you used.

8. $\angle 9$
9. $\angle 11$
10. $\angle 6$



11. Find the value of x in the figure below.



12. **FITNESS** You would like to join a fitness center. Fit-N-Trim charges \$80 per month. Fit-For-Life charges a one-time membership fee of \$75 and \$55 per month.
    - **a.** Write and graph two equations in slope-intercept form to represent the cost y to attend each fitness center for x months.
    - **b.** Are the lines you graphed in part **a** parallel? Explain why or why not.
    - **c.** Which fitness center offers the better rate? Explain.

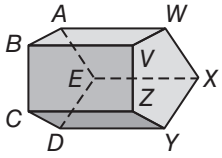
Write an equation in slope-intercept form for each line described.

13. passes through $(-8, 1)$, perpendicular to $y = 2x - 17$
14. passes through $(0, 7)$, parallel to $y = 4x - 19$
15. passes through $(-12, 3)$, perpendicular to $y = -\frac{2}{3}x - 11$

Find the distance between each pair of parallel lines with the given equations.

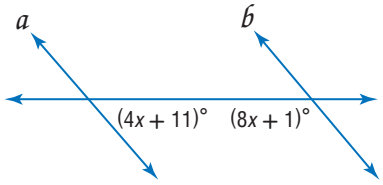
16. $y = x - 11$
    $y = x - 7$
17. $y = -2x + 1$
    $y = -2x + 16$

18. **MULTIPLE CHOICE** Which segment is skew to $\overline{CD}$?



A $\overline{ZY}$
B $\overline{AB}$
C $\overline{DE}$
D $\overline{VZ}$

19. Find x so that $a \parallel b$. Identify the postulate or theorem you used.

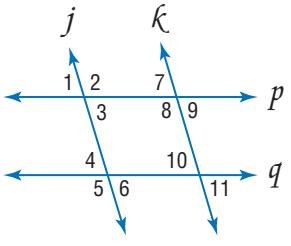


COORDINATE GEOMETRY **Find the distance from P to ℓ.**

20. Line ℓ contains points $(-4, 2)$ and $(3, -5)$. Point P has coordinates $(1, 2)$.
21. Line ℓ contains points $(6, 5)$ and $(2, 3)$. Point P has coordinates $(2, 6)$.

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

22. $\angle 4 \cong \angle 10$
23. $\angle 9 \cong \angle 6$
24. $\angle 7 \cong \angle 11$



25. **JOBS** Hailey works at a gift shop. She is paid \$10 per hour plus a 15% commission on merchandise she sells. Write an equation in slope-intercept form that represents her earnings in a week if she sold \$550 worth of merchandise.