Classify each pair of angles as alternate interior angles, same-side interior angles, or corresponding angles.

1. 

2. 

3. 

4. 

5. 

6. 

Use the figure on the right to answer Exercises 7–9.

7. Name all pairs of corresponding angles formed by the transversal \( t \) and lines \( s \) and \( c \).

8. Name all pairs of alternate interior angles formed by the transversal \( t \) and lines \( s \) and \( c \).

9. Name all pairs of same-side interior angles formed by the transversal \( t \) and lines \( s \) and \( c \).

Find \( m\angle 1 \) and then \( m\angle 2 \). Justify each answer.

10. 

11. 

12. 

Algebra Find the value of \( x \). Then find the measure of each angle.

13. 

14. 

15. 

16. Developing Proof Supply the missing reasons in this two-column proof.

Given: \( a \parallel b \)
Prove: \( \angle 1 \cong \angle 3 \)

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( a \parallel b )</td>
<td>1. Given</td>
</tr>
<tr>
<td>2. ( \angle 1 \cong \angle 2 )</td>
<td>a. ?</td>
</tr>
<tr>
<td>3. ( \angle 2 \cong \angle 3 )</td>
<td>b. ?</td>
</tr>
<tr>
<td>4. ( \angle 1 \cong \angle 3 )</td>
<td>c. ?</td>
</tr>
</tbody>
</table>
Practice 3-2  Proving Lines Parallel

1. **Developing Proof** Complete the paragraph proof for the figure shown.

   Given: \( \angle RQT \) and \( \angle QTS \) are supplementary.
   \( \angle TSV \) and \( \angle SVU \) are supplementary.

   Prove: \( \overrightarrow{QR} \parallel \overrightarrow{UV} \)

   **Proof** Because \( \angle RQT \) and \( \angle QTS \) are supplementary, \( \angle RQT \) and
   \( \angle QTS \) are \( a. \) \( \angle \) angles. By the Same-Side Interior Angles Theorem,
   \( b. \) \( \angle \) \( \parallel \). Because \( \angle TSV \) and \( \angle SVU \) are supplementary, \( \angle TSV \)
   and \( \angle SVU \) are \( d. \) \( \angle \) angles. By the \( e. \) \( \angle \) Theorem, \( \overrightarrow{TS} \parallel \overrightarrow{UV} \).
   Because \( \overrightarrow{QR} \) and \( \overrightarrow{UV} \) both are parallel to \( f. \) \( \angle \), \( \overrightarrow{QR} \parallel \overrightarrow{UV} \) by
   Theorem \( g. \) \( \angle \).

Which lines or segments are parallel? Justify your answer with a theorem or postulate.

2. \[ \text{Diagram with lines and angles labeled} \]

3. \[ \text{Diagram with lines and angles labeled} \]

4. \[ \text{Diagram with angles labeled} \]

5. \[ \text{Diagram with lines and angles labeled} \]

6. \[ \text{Diagram with lines and angles labeled} \]

7. \[ \text{Diagram with lines and angles labeled} \]

**Algebra** Find the value of \( x \) for which \( a \parallel t \).

8. \[ \text{Diagram with angles and \( x \) labeled} \]

9. \[ \text{Diagram with angles and \( x \) labeled} \]

10. \[ \text{Diagram with angles and \( x \) labeled} \]

11. \[ \text{Diagram with angles and \( x \) labeled} \]

12. \[ \text{Diagram with angles and \( x \) labeled} \]

13. \[ \text{Diagram with angles and \( x \) labeled} \]
In a soon-to-be-built town, all streets will be designated either as avenues or as boulevards. The avenues will all be parallel to one another, the boulevards will all be parallel to one another, and in the middle of town, Center City Boulevard will intersect Founders Avenue at right angles. Which of the following statements must be true? Justify your answer in each case.

1. Every avenue will be perpendicular to every boulevard.
2. All city blocks will be the same size.
3. All city blocks will be rectangular.
4. All city blocks will be bordered by two avenues and two boulevards.
5. All city blocks will be bordered on one side by either Center City Boulevard or Founders Avenue.

$a, b, c, d$, and $e$ are distinct lines in the same plane. For each combination of relationships between $a$ and $b$, $b$ and $c$, $c$ and $d$, and $d$ and $e$, how are $a$ and $e$ related?

6. $a \parallel b, b \parallel c, c \perp d, d \parallel e$
7. $a \perp b, b \parallel c, c \parallel d, d \perp e$
8. $a \parallel b, b \parallel c, c \perp d, d \perp e$
9. $a \perp b, b \parallel c, c \perp d, d \parallel e$
10. $a \perp b, b \perp c, c \perp d, d \parallel e$
11. $a \perp b, b \perp c, c \parallel d, d \perp e$

12. Suppose you are given information about a sequence of lines, $\ell_1$ through $\ell_n$, in the following form:

$$\ell_1 \square \ell_2, \ell_2 \square \ell_3, \ell_3 \square \ell_4, \ldots, \ell_{n-2} \square \ell_{n-1}, \text{ and } \ell_{n-1} \square \ell_n,$$

where each $\square$ is either $\parallel$ or $\perp$. Now you are asked whether $\ell_1 \parallel \ell_n$ or $\ell_1 \perp \ell_n$. How can you decide by simply counting the number of $\perp$ statements in the given information?

13. Critical Thinking Theorem 3-10 says that in a plane, if two lines are perpendicular to the same line, then they are parallel to each other. What are some ways to prove this without using the concept of corresponding angles?

14. Critical Thinking In three dimensions, is it possible for lines $\ell_1$, $\ell_2$ and $\ell_3$ all to intersect at one point in such a way that $\ell_1$ and $\ell_2$ are each perpendicular to $\ell_3$ but $\ell_1$ and $\ell_2$ are neither parallel nor perpendicular to one another? Explain why or why not, using a sketch if necessary.
Practice 3-4

Parallel Lines and the Triangle Angle-Sum Theorem

Find the value of each variable.

1. \[
\begin{align*}
65^\circ & \quad 60^\circ \\
& \quad x^\circ
\end{align*}
\]

2. \[
\begin{align*}
30^\circ & \quad 39^\circ \\
& \quad y^\circ
\end{align*}
\]

3. \[
\begin{align*}
75^\circ & \quad 68^\circ \\
& \quad n^\circ
\end{align*}
\]

4. \[
\begin{align*}
93^\circ & \quad 36^\circ \\
& \quad m^\circ
\end{align*}
\]

5. \[
\begin{align*}
61^\circ & \quad 79^\circ \\
& \quad x^\circ
\end{align*}
\]

6. \[
\begin{align*}
46^\circ & \\
& \quad p^\circ
\end{align*}
\]

7. \[
\begin{align*}
55^\circ & \quad 10^\circ \\
& \quad x^\circ
\end{align*}
\]

8. \[
\begin{align*}
28^\circ & \quad 53^\circ \\
& \quad z^\circ
\end{align*}
\]

9. \[
\begin{align*}
25^\circ & \quad 56^\circ \\
& \quad w^\circ
\end{align*}
\]

10. \[
\begin{align*}
140^\circ & \\
& \quad 10^\circ
\end{align*}
\]

11. \[
\begin{align*}
120^\circ & \\
& \quad 2^\circ
\end{align*}
\]

12. \[
\begin{align*}
70^\circ & \quad 72^\circ \\
& \quad 86^\circ
\end{align*}
\]

13. \[
\begin{align*}
69.7^\circ & \quad 126.8^\circ \\
& \quad 2^\circ
\end{align*}
\]

14. \[
\begin{align*}
46^\circ & \\
& \quad 3^\circ
\end{align*}
\]

15. \[
\begin{align*}
38^\circ & \quad 31^\circ \\
& \quad 116^\circ
\end{align*}
\]

16. The sides of a triangle are 10 cm, 8 cm, and 10 cm. Classify the triangle.

17. The angles of a triangle are 44°, 110°, and 26°. Classify the triangle.

Use a protractor and a centimeter ruler to measure the angles and the sides of each triangle. Classify each triangle by its angles and sides.

18. \[
\quad
\]

19. \[
\quad
\]

20. \[
\quad
\]
Practice 3-5

The Polygon Angle-Sum Theorems

Find the values of the variables for each polygon. Each is a regular polygon.

1. \( y^\circ \)
2. \( n^\circ \)
3. \( a^\circ \)

Find the missing angle measures.

4. \( \angle EAB = 91^\circ \)
5. \( \angle GKH = 124^\circ \)
6. \( \angle LNP = 48^\circ \)

For a regular 12-sided polygon, find each of the following.

10. the measure of an exterior angle
11. the measure of an interior angle

The measure of an interior angle of a regular polygon is given. Find the number of sides.

12. 120
13. 108
14. 135

Identify each item in Exercises 15–18 in the figure.

15. quadrilateral
16. exterior angle
17. pair of supplementary angles
18. pentagon
19. A regular polygon has an exterior angle of measure 18. How many sides does the polygon have?
Practice 3-6

Write an equation of the line with the given slope that contains the given point.

1. \( F(3, -6), \) slope \( \frac{1}{3} \)
2. \( Q(5, 2), \) slope \(-2\)
3. \( A(3, 3), \) slope \(7\)
4. \( B(-4, -1), \) slope \(-\frac{1}{2}\)
5. \( L(-3, -2), \) slope \( \frac{1}{6} \)
6. \( R(15, 10), \) slope \( \frac{4}{5} \)
7. \( D(1, -9), \) slope \(4\)
8. \( W(0, 6), \) slope \(-1\)

Graph each line using slope-intercept form.

9. \( 2y = 8x - 2 \)
10. \( 2y = \frac{1}{2}x - 10 \)
11. \( 3x + 9y = 18 \)
12. \(-x + y = -1\)
13. \( y + 7 = 2x \)
14. \( 4x - 2y = 6 \)
15. \( 5 - y = \frac{3}{4}x \)
16. \( \frac{1}{3}x = \frac{1}{2}y - 1 \)

Graph each line.

17. \( y = 5x + 4 \)
18. \( y = \frac{1}{2}x - 3 \)
19. \( x = -2 \)
20. \( y = -2x \)
21. \( y = -5 \)
22. \( y = x \)
23. \( y = \frac{-2}{3}x + 2 \)
24. \( x = 2.5 \)

Write an equation of the line containing the given points.

25. \( A(2, 7), B(3, 4) \)
26. \( P(-1, 3), Q(0, 4) \)
27. \( S(10, 2), T(2, -2) \)
28. \( D(7, -4), E(-5, 2) \)
29. \( G(-2, 0), H(3, 10) \)
30. \( B(3, 5), C(-6, 2) \)
31. \( X(-1, -1), Y(4, -2) \)
32. \( M(8, -3), N(7, 3) \)

Write equations for (a) the horizontal line and (b) the vertical line that contain the given point.

33. \( Z(2, -11) \)
34. \( D(0, 2) \)
35. \( R(-4, -4) \)
36. \( F(-1, 8) \)

Graph each line using intercepts.

37. \( 3x - y = 12 \)
38. \( 2x + 4y = -4 \)
39. \( \frac{1}{2}x + \frac{1}{2}y = 3 \)
40. \( 12x - 3y = -6 \)
41. \( 2x - 2y = 8 \)
42. \( \frac{1}{4}x + 2y = 2 \)
43. \( -6x + 1.5y = 18 \)
44. \( 0.2x + 0.3y = 1.8 \)

45. Hourly Wages The equation \( P = 3.90 + 0.10x \) represents the hourly pay \( P \) a worker receives for loading \( x \) number of boxes onto a truck.
   a. What is the slope of the line represented by the given equation?
   b. What does the slope represent in this situation?
   c. What is the \( y \)-intercept of the line?
   d. What does the \( y \)-intercept represent in this situation?

46. Inclines The Blackberrys’ driveway is difficult to get up in the winter ice and snow because of its slope. What is the equation of the line that represents the Blackberrys’ driveway?
Practice 3-7
Slopes of Parallel and Perpendicular Lines

Are the lines parallel, perpendicular, or neither? Explain.

1. \( y = 3x - 2 \)
   \( y = \frac{1}{3}x + 2 \)
2. \( y = \frac{1}{2}x + 1 \)
   \(-4y = 8x + 3 \)
3. \( \frac{2}{5}x + y = 4 \)
   \( y = -\frac{2}{3}x + 8 \)
4. \(-x - y = -1 \)
   \( y + x = 7 \)
5. \( y = 2 \)
   \( x = 0 \)
6. \( 3x + 6y = 30 \)
   \( 4y + 2x = 9 \)
7. \( y = x \)
   \( 8y - x = 8 \)
8. \( \frac{1}{3}x + \frac{1}{2}y = 1 \)
   \( \frac{3}{4}y + \frac{1}{2}x = 1 \)

Are lines \( l_1 \) and \( l_2 \) parallel, perpendicular, or neither? Explain.

9. \( \)
10. \( \)
11. \( \)
12. \( \)
13. \( \)
14. \( \)

Write an equation for the line perpendicular to \( \overline{XY} \) that contains point \( Z \).

15. \( \overline{XY} : 3x + 2y = -6, Z(3, 2) \)
16. \( \overline{XY} : y = \frac{3}{4}x + 22, Z(12, 8) \)
17. \( \overline{XY} : -x + y = 0, Z(-2, -1) \)

Write an equation for the line parallel to \( \overline{XY} \) that contains point \( Z \).

18. \( \overline{XY} : 6x - 10y + 5 = 0, Z(-5, 3) \)
19. \( \overline{XY} : y = -1, Z(0, 0) \)
20. \( \overline{XY} : x = \frac{1}{2}y + 1, Z(1, -2) \)

21. **Aviation** Two planes are flying side by side at the same altitude. It is important that their paths do not intersect. One plane is flying along the path given by the line \( 4x - 2y = 10 \). What is the slope-intercept form of the line that must be the path of another plane passing through the point \( L(-1, -2) \) so that the planes do not collide? Graph the paths of the two planes.
Practice 3-8

Constructing Parallel and Perpendicular Lines

Construct a line perpendicular to line \( l \) through point \( Q \).

1. \( Q \)
2. \( Q \)
3. \( Q \)

Construct a line perpendicular to line \( l \) at point \( T \).

4. \( T \)
5. \( T \)
6. \( T \)

Construct a line parallel to line \( l \) and through point \( K \).

7. \( K \)
8. \( K \)
9. \( K \)

For Exercises 10–15, use the segments at the right.

10. Construct a quadrilateral with one pair of parallel sides of lengths \( a \) and \( b \).

11. Construct a quadrilateral with one pair of parallel sides of lengths \( b \) and \( c \).

12. Construct a square with side lengths of \( b \).

13. Construct a right triangle with leg lengths of \( a \) and \( c \).

14. Construct a right triangle with leg lengths of \( b \) and \( c \).

15. Construct an isosceles right triangle with leg lengths of \( a \).