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It's All About the Slope

Parallel and Perpendicular Lines on the Coordinate Plane

Vocabulary

Complete the sentence.

1. The point-slope form of the equation of the line that passes through (x_1, y_1) and has slope m is $y - y_1 = m(x - x_1)$.

Problem Set

Determine whether each pair of lines are parallel, perpendicular, or neither. Explain your reasoning.

1. line n: $y = -2x - 4$
   line m: $y = -2x + 8$
   Parallel. The slope of line n is -2, which is equal to the slope of line m, so the lines are parallel.

2. line p: $y = 3x + 5$
   line q: $y = \frac{1}{3}x + 5$
   Neither. The slope of line p is 3 and the slope of line q is $\frac{1}{3}$. The slopes of the lines are not equal, so the lines are not parallel. The product of the slopes is $3 \times \frac{1}{3} = 1 \neq -1$, so the lines are not perpendicular.

3. line r: $y = -5x + 12$
   line s: $y = \frac{1}{5}x - 6$
   Perpendicular. The slope of line r is -5 and the slope of line s is $\frac{1}{5}$. The product of the slopes is $-5 \times \frac{1}{5} = -1$, so the slopes are negative reciprocals and the lines are perpendicular.

4. line n: $y = 6x + 2$
   line m: $y = -6x - 2$
   Neither. The slope of line n is 6 and the slope of line m is -6. The slopes of the lines are not equal, so the lines are not parallel. The product of the slopes is $6 \times -6 = -36 \neq -1$, so the lines are not perpendicular.

5. line p: $y - x = 4$

line q: $2x + y = 8$

Neither. The equation for line p can be rewritten as $y = x + 4$, and the equation for line q can be rewritten as $y = -2x + 8$. The slope of line p is 1 and the slope of line q is -2. The slopes of the lines are not equal, so the lines are not parallel. The product of the slopes is $1 \times (-2) = -2 \neq -1$, so the lines are not perpendicular.

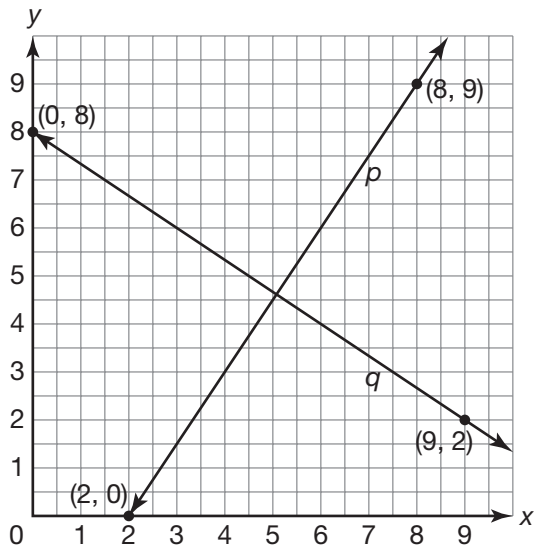
6. line r: $2y + x = 6$

line s: $3x + 6y = 12$

Parallel. The equation for line r can be rewritten as $y = -\frac{1}{2}x + 3$, and the equation for line s can be rewritten as $y = -\frac{1}{2}x + 2$. The slope of line r is $-\frac{1}{2}$, which is equal to the slope of line s, so the lines are parallel.

Determine whether the lines shown on each coordinate plane are parallel, perpendicular, or neither. Explain your reasoning.

7.



The lines are perpendicular. The slope of line p is $\frac{3}{2}$ and the slope of line q is $-\frac{2}{3}$. Because $\frac{3}{2}\left(-\frac{2}{3}\right) = -1$, the lines are perpendicular.

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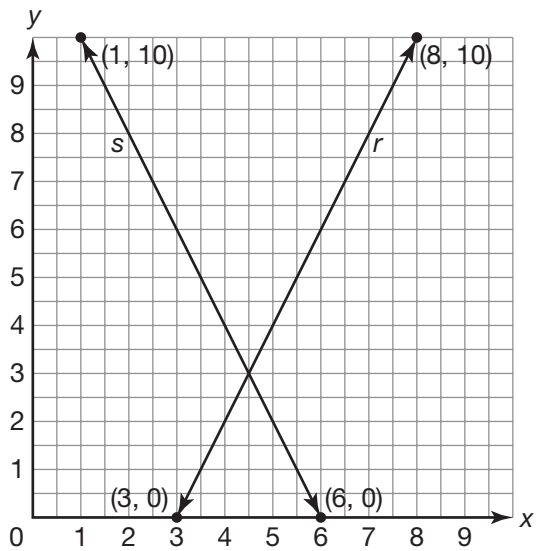
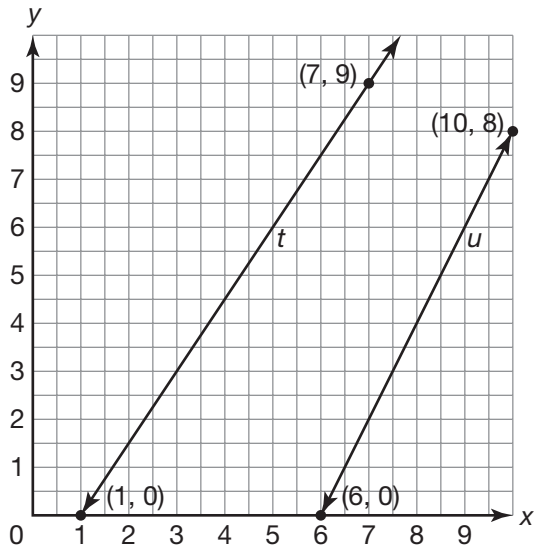
8.



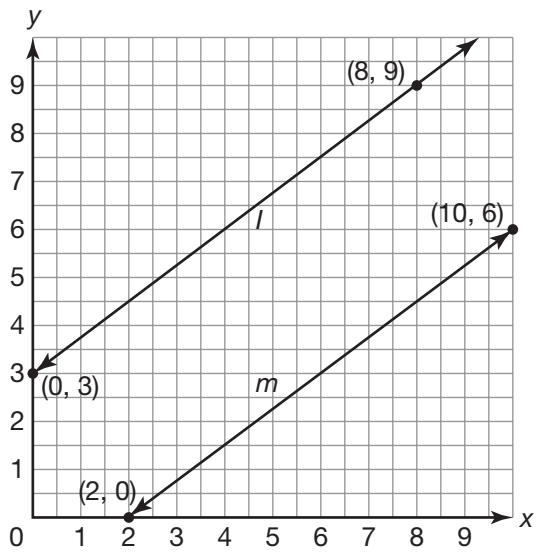
The lines are neither parallel or perpendicular. The slope of line *r* is 2, and the slope of line *s* is −2. The slopes are not equal, so the lines are not parallel. The slopes are not negative reciprocals, so the lines are not perpendicular.

9.



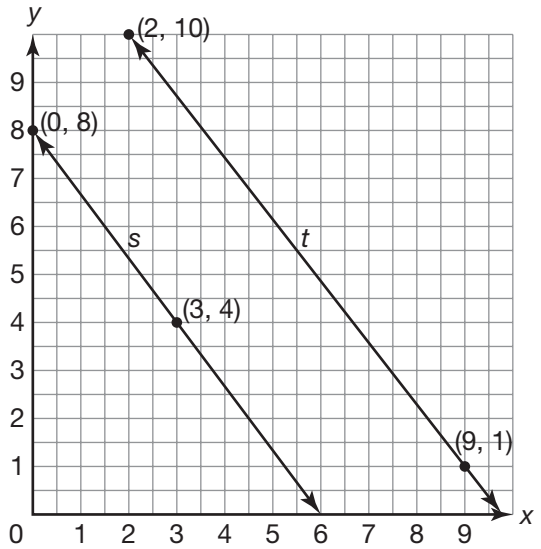
The lines are neither parallel or perpendicular. The slope of line *t* is $\frac{3}{2}$ and the slope of line *u* is 2. The slopes are not equal, so the lines are not parallel. The slopes are not negative reciprocals, so the lines are not perpendicular.

10.



The lines are parallel. The slope of line *l* is $\frac{3}{4}$ and the slope of line *m* is $\frac{3}{4}$. Because $\frac{3}{4} = \frac{3}{4}$, the lines are parallel.

11.



The lines are neither parallel or perpendicular. The slope of line *s* is $-\frac{4}{3}$ and the slope of line *t* is $-\frac{9}{7}$. The slopes are not equal, so the lines are not parallel. The slopes are not negative reciprocals, so the lines are not perpendicular.

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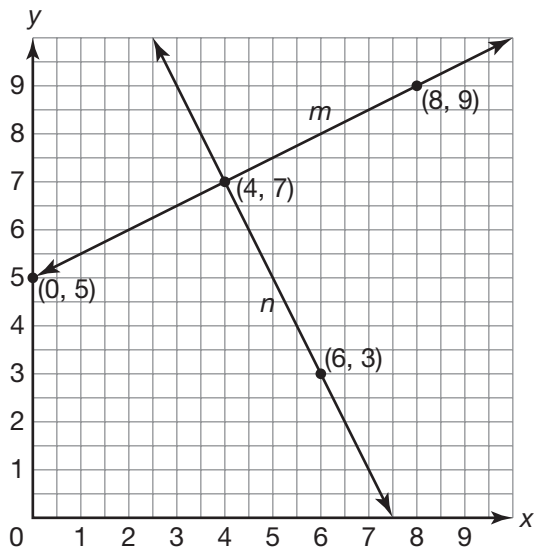
12.



The lines are perpendicular. The slope of line m is $\frac{1}{2}$ and the slope of line n is -2. Because $\frac{1}{2}(-2) = -1$, the lines are perpendicular.

Determine an equation for each parallel line described. Write your answer in both point-slope form and slope-intercept form.

13. What is the equation of a line parallel to $y = \frac{4}{5}x + 2$ that passes through (1, 2)?

Point-slope form: $(y - 2) = \frac{4}{5}(x - 1)$

Slope-intercept form:

$$y - 2 = \frac{4}{5}x - \frac{4}{5}$$
$$y = \frac{4}{5}x - \frac{4}{5} + 2$$
$$y = \frac{4}{5}x + \frac{6}{5}$$

14. What is the equation of a line parallel to $y = -5x + 3$ that passes through (3, 1)?

Point-slope form: $(y - 1) = -5(x - 3)$

Slope-intercept form:

$$y - 1 = -5x + 15$$
$$y = -5x + 15 + 1$$
$$y = -5x + 16$$

15. What is the equation of a line parallel to $y = 7x - 8$ that passes through $(5, -2)$?

Point-slope form: $(y + 2) = 7(x - 5)$

Slope-intercept form:

$y + 2 = 7x - 35$

$y = 7x - 35 - 2$

$y = 7x - 37$

16. What is the equation of a line parallel to $y = -\frac{1}{2}x + 6$ that passes through $(-4, 1)$?

Point-slope form:

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

Slope-intercept form:

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

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

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

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

17. What is the equation of a line parallel to $y = \frac{1}{3}x - 4$ that passes through $(9, 8)$?

Point-slope form: $(y - 8) = \frac{1}{3}(x - 9)$

Slope-intercept form:

$y - 8 = \frac{1}{3}x - 3$

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

$y = \frac{1}{3}x + 5$

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18. What is the equation of a line parallel to $y = -4x - 7$ that passes through $(2, -9)$?

Point-slope form: $(y + 9) = -4(x - 2)$

Slope-intercept form:

$y + 9 = -4x + 8$

$y = -4x + 8 - 9$

$y = -4x - 1$

Determine an equation for each perpendicular line described. Write your answer in both point-slope form and slope-intercept form.

19. What is the equation of a line perpendicular to $y = 2x - 6$ that passes through $(5, 4)$?

The slope of the new line must be $-\frac{1}{2}$.

Point-slope form: $(y - 4) = -\frac{1}{2}(x - 5)$

Slope-intercept form:

$y - 4 = -\frac{1}{2}x + \frac{5}{2}$

$y = -\frac{1}{2}x + \frac{5}{2} + 4$

$y = -\frac{1}{2}x + \frac{13}{2}$

20. What is the equation of a line perpendicular to $y = -3x + 4$ that passes through $(-1, 6)$?

The slope of the new line must be $\frac{1}{3}$.

Point-slope form: $(y - 6) = \frac{1}{3}(x + 1)$

Slope-intercept form:

$y - 6 = \frac{1}{3}x + \frac{1}{3}$

$y = \frac{1}{3}x + \frac{1}{3} + 6$

$y = \frac{1}{3}x + \frac{19}{3}$

21. What is the equation of a line perpendicular to $y = -\frac{2}{5}x - 1$ that passes through (2, −8)?

The slope of the new line must be $\frac{5}{2}$.

Point-slope form: $(y + 8) = \frac{5}{2}(x - 2)$

Slope-intercept form:

$$y + 8 = \frac{5}{2}x - 5$$
$$y = \frac{5}{2}x - 5 - 8$$
$$y = \frac{5}{2}x - 13$$

22. What is the equation of a line perpendicular to $y = \frac{3}{4}x + 12$ that passes through (12, 3)?

The slope of the new line must be $-\frac{4}{3}$.

Point-slope form: $(y - 3) = -\frac{4}{3}(x - 12)$

Slope-intercept form:

$$y - 3 = -\frac{4}{3}x + 16$$
$$y = -\frac{4}{3}x + 16 + 3$$
$$y = -\frac{4}{3}x + 19$$

23. What is the equation of a line perpendicular to $y = 6x - 5$ that passes through (6, −3)?

The slope of the new line must be $-\frac{1}{6}$.

Point-slope form: $(y + 3) = -\frac{1}{6}(x - 6)$

Slope-intercept form:

$$y + 3 = -\frac{1}{6}x + 1$$
$$y = -\frac{1}{6}x + 1 - 3$$
$$y = -\frac{1}{6}x - 2$$

24. What is the equation of a line perpendicular to $y = \frac{5}{2}x - 1$ that passes through (−1, −4)?

The slope of the new line must be $-\frac{2}{5}$.

Point-slope form: $(y + 4) = -\frac{2}{5}(x + 1)$

Slope-intercept form:

$$y + 4 = -\frac{2}{5}x - \frac{2}{5}$$
$$y = -\frac{2}{5}x - \frac{2}{5} - 4$$
$$y = -\frac{2}{5}x - \frac{22}{5}$$

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Determine the equation of a vertical line that passes through each given point.

25. (−2, 1)
$x = -2$

26. (3, 15)
$x = 3$

27. (9, −7)
$x = 9$

28. (−11, −8)
$x = -11$

29. (−5, −10)
$x = -5$

30. (0, −4)
$x = 0$

Determine the equation of a horizontal line that passes through each given point.

31. (4, 7)
$y = 7$

32. (−6, 5)
$y = 5$

33. (−8, −3)
$y = -3$

34. (2, −9)
$y = -9$

35. (−7, 8)
$y = 8$

36. (6, −2)
$y = -2$

Calculate the distance from each given point to the given line.

37. Point: (0, 4); Line: $f(x) = 2x - 3$

Write the equation for the line perpendicular to the given line that goes through the given point.

Since the slope of f is 2, the slope of the perpendicular segment is $-\frac{1}{2}$.

$y = mx + b$

$4 = -\frac{1}{2}(0) + b$

$4 = b$

The equation of the line containing the perpendicular segment is $y = -\frac{1}{2}x + 4$.

Calculate the point of intersection of the segment and the line $f(x) = 2x - 3$.

$-\frac{1}{2}x + 4 = 2x - 3$

$-x + 8 = 4x - 6$

$-5x = -14$

$x = \frac{-14}{-5} = 2.8$

$y = -\frac{1}{2}(2.8) + 4 = 2.6$

The point of intersection is (2.8, 2.6).

Calculate the distance.

$d = \sqrt{(0 - 2.8)^2 + (4 - 2.6)^2}$

$d = \sqrt{(-2.8)^2 + (1.4)^2}$

$d = \sqrt{7.84 + 1.96}$

$d = \sqrt{9.8} \approx 3.13$

The distance from the point (0, 4) to the line $f(x) = 2x - 3$ is approximately 3.13 units.

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38. Point: $(-1, 3)$; Line: $f(x) = -\frac{1}{2}x - 4$

Write the equation for the line perpendicular to the given line that goes through the given point.

Since the slope of f is $-\frac{1}{2}$, the slope of the perpendicular segment is 2.

$y = mx + b$

$3 = 2(-1) + b$

$5 = b$

The equation of the line containing the perpendicular segment is $y = 2x + 5$.

Calculate the point of intersection of the segment and the line $f(x) = -\frac{1}{2}x - 4$.

$2x + 5 = -\frac{1}{2}x - 4$

$4x + 10 = -x - 8$

$5x = -18$

$x = -\frac{18}{5} = -3.6$

$y = 2(-3.6) + 5 = -2.2$

The point of intersection is $(-3.6, -2.2)$.

Calculate the distance.

$d = \sqrt{[-1 - (-3.6)]^2 + [3 - (-2.2)]^2}$

$d = \sqrt{(2.6)^2 + (5.2)^2}$

$d = \sqrt{6.76 + 27.04}$

$d = \sqrt{33.8} \approx 5.81$

The distance from the point $(-1, 3)$ to the line $f(x) = -\frac{1}{2}x - 4$ is approximately 5.81 units.

39. Point: $(-2, 5)$; Line: $f(x) = \frac{2}{3}x - \frac{1}{6}$

Write the equation for the line perpendicular to the given line that goes through the given point.

Since the slope of f is $\frac{2}{3}$, the slope of the perpendicular segment is $-\frac{3}{2}$.

$y = mx + b$

$5 = -\frac{3}{2}(-2) + b$

$2 = b$

The equation of the line containing the perpendicular segment is $y = -\frac{3}{2}x + 2$.

Calculate the point of intersection of the segment and the line $f(x) = \frac{2}{3}x - \frac{1}{6}$.

$-\frac{3}{2}x + 2 = \frac{2}{3}x - \frac{1}{6}$

$-9x + 12 = 4x - 1$

$-13x = -13$

$x = 1$

$y = -\frac{3}{2}(1) + 2 = 0.5$

The point of intersection is $(1, 0.5)$.

Calculate the distance.

$d = \sqrt{(-2 - 1)^2 + (5 - 0.5)^2}$

$d = \sqrt{(-3)^2 + (4.5)^2}$

$d = \sqrt{9 + 20.25}$

$d = \sqrt{29.25} \approx 5.41$

The distance from the point $(-2, 5)$ to the line $f(x) = \frac{2}{3}x - \frac{1}{6}$ is approximately 5.41 units.

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40. Point: $(-1, -2)$; Line: $f(x) = -4x + 11$

Write the equation for the line perpendicular to the given line that goes through the given point.

Since the slope of f is -4, the slope of the perpendicular segment is $\frac{1}{4}$.

$y = mx + b$

$-2 = \frac{1}{4}(-1) + b$

$-\frac{7}{4} = b$

The equation of the line containing the perpendicular segment is $y = \frac{1}{4}x - \frac{7}{4}$.

Calculate the point of intersection of the segment and the line $f(x) = -4x + 11$.

$\frac{1}{4}x - \frac{7}{4} = -4x + 11$

$x - 7 = -16x + 44$

$17x = 51$

$x = 3$

$y = \frac{1}{4}(3) - \frac{7}{4} = -1$

The point of intersection is $(3, -1)$.

Calculate the distance.

$d = \sqrt{(-1 - 3)^2 + [-2 - (-1)]^2}$

$d = \sqrt{(-4)^2 + (-1)^2}$

$d = \sqrt{16 + 1}$

$d = \sqrt{17} \approx 4.12$

The distance from the point $(-1, -2)$ to the line $f(x) = -4x + 11$ is approximately 4.12 units.

17

41. Point: (3, −1); Line: $f(x) = \frac{1}{3}x - 6$

Write the equation for the line perpendicular to the given line that goes through the given point.

Since the slope of f is $\frac{1}{3}$, the slope of the perpendicular segment is −3.

$y = mx + b$

$-1 = -3(3) + b$

$8 = b$

The equation of the line containing the perpendicular segment is $y = -3x + 8$.

Calculate the point of intersection of the segment and the line $f(x) = \frac{1}{3}x - 6$.

$-3x + 8 = \frac{1}{3}x - 6$

$-9x + 24 = x - 18$

$-10x = -42$

$x = 4.2$

$y = -3(4.2) + 8 = -4.6$

The point of intersection is (4.2, −4.6).

Calculate the distance.

$d = \sqrt{(3 - 4.2)^2 + [-1 - (-4.6)]^2}$

$d = \sqrt{(-1.2)^2 + (3.6)^2}$

$d = \sqrt{1.44 + 12.96}$

$d = \sqrt{14.4} \approx 3.79$

The distance from the point (3, −1) to the line $f(x) = \frac{1}{3}x - 6$ is approximately 3.79 units.

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42. Point: $(-4, -2)$; Line: $f(x) = -\frac{1}{2}x + 4$

Write the equation for the line perpendicular to the given line that goes through the given point.

Since the slope of f is $-\frac{1}{2}$, the slope of the perpendicular segment is 2.

$y = mx + b$

$-2 = 2(-4) + b$

$6 = b$

The equation of the line containing the perpendicular segment is $y = 2x + 6$.

Calculate the point of intersection of the segment and the line $f(x) = -\frac{1}{2}x + 4$.

$2x + 6 = -\frac{1}{2}x + 4$

$4x + 12 = -x + 8$

$5x = -4$

$x = -0.8$

$y = 2(-0.8) + 6 = 4.4$

The point of intersection is $(-0.8, 4.4)$.

Calculate the distance.

$d = \sqrt{[-4 - (-0.8)]^2 + (-2 - 4.4)^2}$

$d = \sqrt{(-3.2)^2 + (-6.4)^2}$

$d = \sqrt{10.24 + 40.96}$

$d = \sqrt{51.2} \approx 7.16$

The distance from the point $(-4, -2)$ to the line $f(x) = -\frac{1}{2}x + 4$ is approximately 7.16 units.

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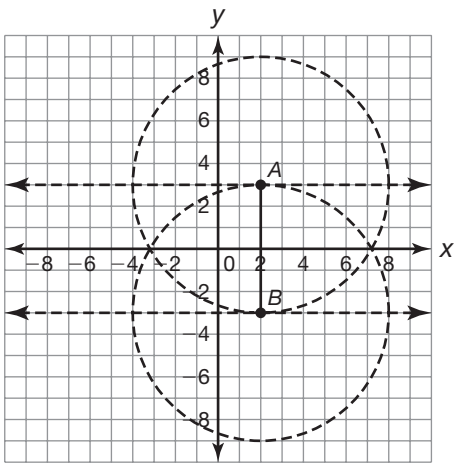
Hey, I Know That Triangle!

Classifying Triangles on the Coordinate Plane

Problem Set

Determine the location of point *C* such that triangle *ABC* has each given characteristic. The graph shows line segment *AB* and circles *A* and *B*.



1. Triangle *ABC* is a right triangle.

Point *C* can have an infinite number of locations as long as the location satisfies one of the following conditions:

- Point *C* could be located anywhere on line $y = 3$ except where $x = 2$.
- Point *C* could be located anywhere on line $y = -3$ except where $x = 2$.

2. Triangle *ABC* is an acute triangle.

Point *C* can have an infinite number of locations as long as the location satisfies one of the following conditions:

- Point *C* could be located anywhere on circle *A* between the *y*-values of 3 and −3 except where $x = 2$.
- Point *C* could be located anywhere on circle *B* between the *y*-values of 3 and −3 except where $x = 2$.

3. Triangle *ABC* is an obtuse triangle.

Point *C* can have an infinite number of locations as long as the location satisfies one of the following conditions:

- Point *C* could be located anywhere on circle *A* between the *y*-values of 3 and 9 except where $x = 2$.
- Point *C* could be located anywhere on circle *B* between the *y*-values of -3 and -9 except where $x = 2$.

4. Triangle *ABC* is an equilateral triangle.

Point *C* can have two possible locations. Circle *A* and circle *B* intersect at two locations. Either point of intersection is a possible location for point *C*.

5. Triangle *ABC* is an isosceles triangle.

Point *C* can have an infinite number of locations as long as the location satisfies one of the following conditions:

- Point *C* could be located anywhere on line $y = 0$ except where $x = 2$.
- Point *C* could be located anywhere on circle *A* except where $x = 2$.
- Point *C* could be located anywhere on circle *B* except where $x = 2$.

6. Triangle *ABC* is a scalene triangle.

Point *C* can have an infinite number of locations as long as the location does not:

- Create an equilateral triangle at the two intersection points of circle *A* and circle *B*.
- Create an isosceles triangle by being located:

  anywhere on line $y = 0$.

  anywhere on circle *A*.

  anywhere on circle *B*.

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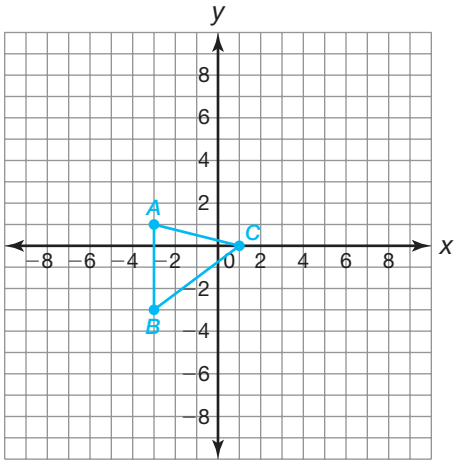
Graph triangle *ABC* using each set of given points. Determine if triangle *ABC* is scalene, isosceles, or equilateral.

7. *A* (−3, 1), *B* (−3, −3), *C* (1, 0)



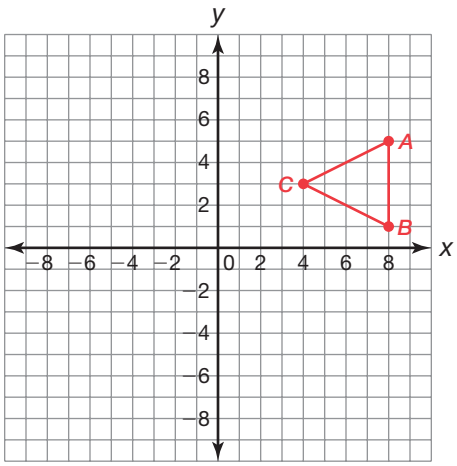
$AB = 1 - (-3)$
$= 4$

$BC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(1 - (-3))^2 + (0 - (-3))^2}$
$= \sqrt{(4)^2 + (3)^2}$
$= \sqrt{16 + 9}$
$= \sqrt{25}$
$= 5$

$AC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(-3 - 1)^2 + (1 - 0)^2}$
$= \sqrt{(-4)^2 + (1)^2}$
$= \sqrt{16 + 1}$
$= \sqrt{17}$

Triangle *ABC* is scalene because all of the side lengths are different.

8. *A*(8, 5), *B*(8, 1), *C*(4, 3)



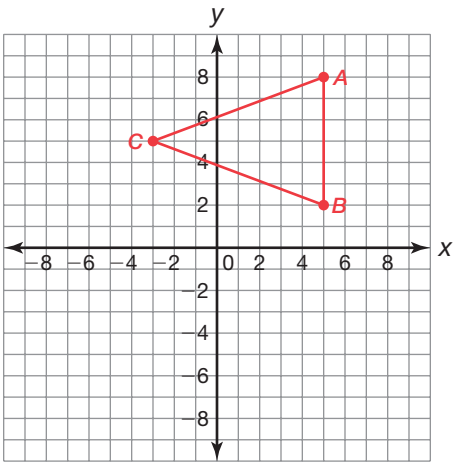
$AB = 5 - 1$
$= 4$

$AC = \sqrt{(8 - 4)^2 + (5 - 3)^2}$
$= \sqrt{16 + 4}$
$= \sqrt{20}$

$BC = \sqrt{(8 - 4)^2 + (1 - 3)^2}$
$= \sqrt{16 + 4}$
$= \sqrt{20}$

Triangle *ABC* is isosceles because segments *AC* and *BC* are congruent.

9. A (5, 8), B (5, 2), C (−3, 5)



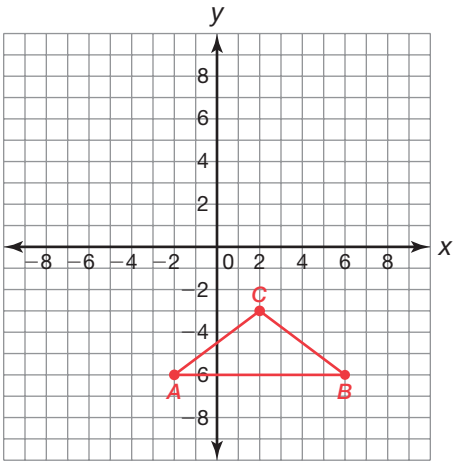
$AB = 6$

$AC = \sqrt{(5 - (-3))^2 + (8 - 5)^2}$
$= \sqrt{64 + 9}$
$= \sqrt{73}$

$BC = \sqrt{(5 - (-3))^2 + (2 - 5)^2}$
$= \sqrt{64 + 9}$
$= \sqrt{73}$

Triangle ABC is isosceles because segments AC and BC are congruent.

10. A (−2, −6), B (6, −6), C (2, −3)



$AB = 8$

$AC = \sqrt{(-2 - 2)^2 + (-6 - (-3))^2}$
$= \sqrt{16 + 9}$
$= \sqrt{25}$
$= 5$

$BC = \sqrt{(6 - 2)^2 + (-6 - (-3))^2}$
$= \sqrt{16 + 9}$
$= \sqrt{25}$
$= 5$

Triangle ABC is isosceles because segments AC and BC are congruent.

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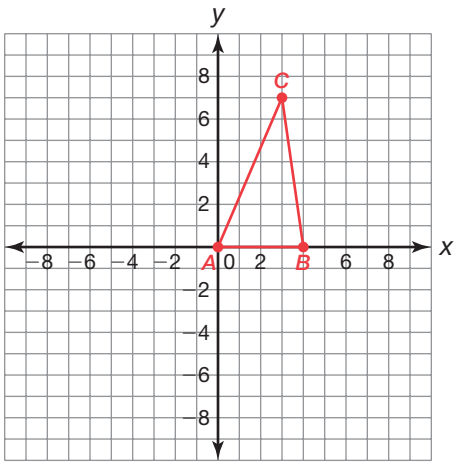
11. *A* (0, 0), *B* (4, 0), *C* (3, 7)



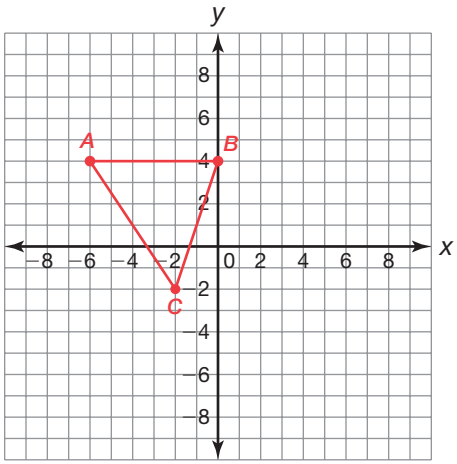
$AB = 4$

$AC = \sqrt{(0 - 3)^2 + (0 - 7)^2}$
$= \sqrt{9 + 49}$
$= \sqrt{58}$

$BC = \sqrt{(4 - 3)^2 + (0 - 7)^2}$
$= \sqrt{1 + 49}$
$= \sqrt{50}$

Triangle *ABC* is scalene because all of the side lengths are different.

12. *A* (−6, 4), *B* (0, 4), *C* (−2, −2)



$AB = 6$

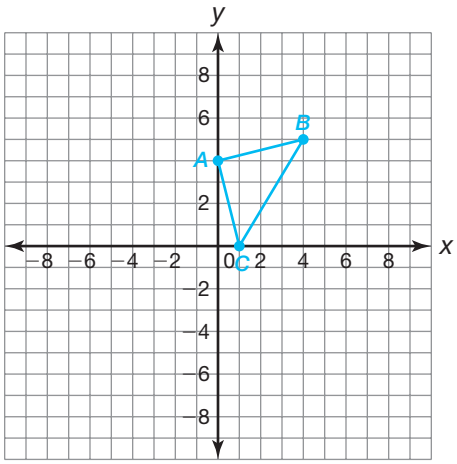
$AC = \sqrt{(-2 - (-6))^2 + (-2 - 4)^2}$
$= \sqrt{16 + 36}$
$= \sqrt{52}$

$BC = \sqrt{(-2 - 0)^2 + (-2 - 4)^2}$
$= \sqrt{4 + 36}$
$= \sqrt{40}$

Triangle *ABC* is scalene because all of the side lengths are different.

Graph triangle *ABC* using each set of given points. Determine if triangle *ABC* is a right triangle, an acute triangle, or an obtuse triangle.

13. *A* (0, 4), *B* (4, 5), *C* (1, 0)



Slope of line segment *AB*:

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 4}{4 - 0} = \frac{1}{4}$$

Slope of line segment *BC*:

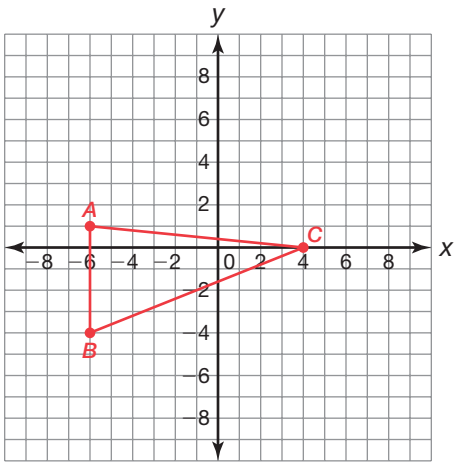
$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 5}{1 - 4} = \frac{-5}{-3} = \frac{5}{3}$$

Slope of line segment *AC*:

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 4}{1 - 0} = \frac{-4}{1} = -4$$

Triangle *ABC* is a right triangle because segments *AB* and *AC* have negative reciprocal slopes.

14. *A* (−6, 1), *B* (−6, −4), *C* (4, 0)



Slope of line segment *AB*:

Line segment *AB* is a vertical line. The slope is undefined.

Slope of line segment *BC*:

$$m = \frac{0 - (-4)}{4 - (-6)} = \frac{2}{5}$$

Slope of line segment *AC*:

$$m = \frac{0 - 1}{4 - (-6)} = -\frac{1}{10}$$

Triangle *ABC* is an acute triangle.

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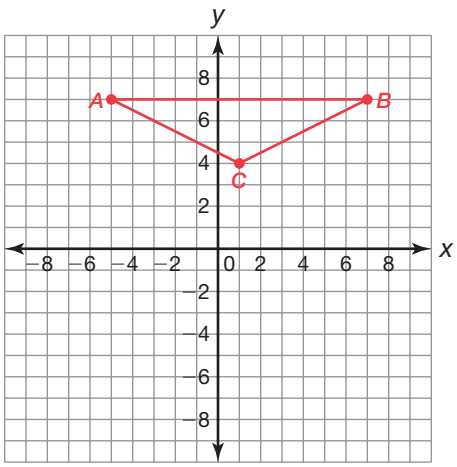
15. $A\ (-5, 7)$, $B\ (7, 7)$, $C\ (1, 4)$



Triangle *ABC* is an obtuse triangle.

Slope of line segment *AB*:

Line segment *AB* is a horizontal line. The slope is 0.

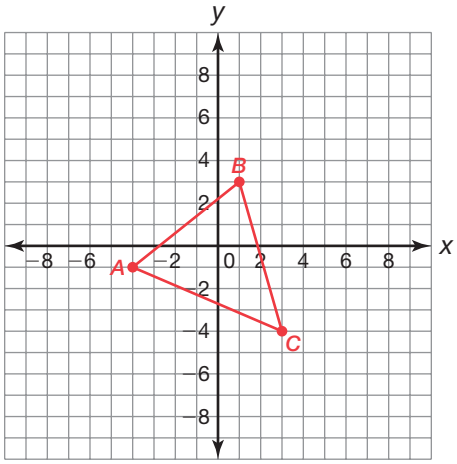
Slope of line segment *AC*:

$$m = \frac{4 - 7}{1 - (-5)}$$
$$= -\frac{1}{2}$$

Slope of line segment *BC*:

$$m = \frac{4 - 7}{1 - 7}$$
$$= \frac{1}{2}$$

16. $A\ (-4, -1)$, $B\ (1, 3)$, $C\ (3, -4)$



Triangle *ABC* is an acute triangle.

Slope of line segment *AB*:

$$m = \frac{3 - (-1)}{1 - (-4)}$$
$$= \frac{4}{5}$$

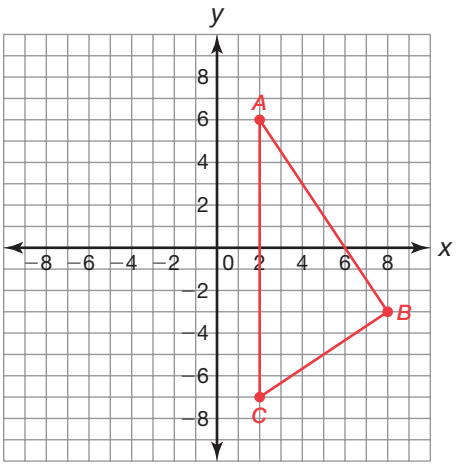
Slope of line segment *AC*:

$$m = \frac{-4 - (-1)}{3 - (-4)}$$
$$= -\frac{3}{7}$$

Slope of line segment *BC*:

$$m = \frac{-4 - 3}{3 - 1}$$
$$= -\frac{7}{2}$$

17. A (2, 6), B (8, −3), C (2, −7)



Slope of line segment AB:

$$m = \frac{-3 - 6}{8 - 2} = -\frac{3}{2}$$

Slope of line segment BC:

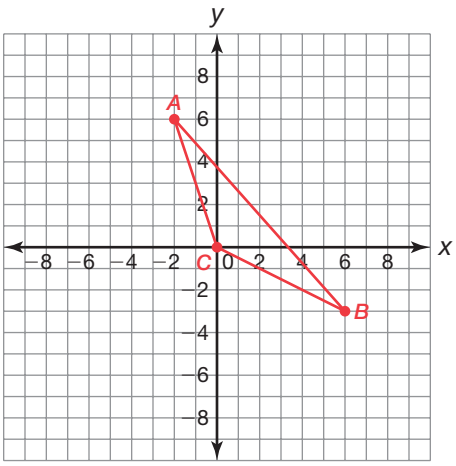
$$m = \frac{-7 - (-3)}{2 - 8} = \frac{2}{3}$$

Slope of line segment AC:

Line segment AC is a vertical line. The slope is undefined.

Triangle ABC is a right triangle because segments AB and BC have negative reciprocal slopes.

18. A (−2, 6), B (6, −3), C (0, 0)



Slope of line segment AB:

$$m = \frac{-3 - 6}{6 - (-2)} = -\frac{9}{8}$$

Slope of line segment BC:

$$m = \frac{0 - (-3)}{0 - 6} = -\frac{1}{2}$$

Slope of line segment AC:

$$m = \frac{0 - 6}{0 - (-2)} = -3$$

Triangle ABC is an obtuse triangle.

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And I Know That Quadrilateral Too!

Classifying Quadrilaterals on the Coordinate Plane

Problem Set

Determine the distance between the two points.

1. $A(-2, 5)$ $B(3, 2)$

$AB = \sqrt{(-2 - 3)^2 + (5 - 2)^2}$
$= \sqrt{(-5)^2 + 3^2}$
$= \sqrt{25 + 9}$
$= \sqrt{34}$

2. $C(-3, -1)$ $D(4, 0)$

$CD = \sqrt{(-3 - 4)^2 + (-1 - 0)^2}$
$= \sqrt{(-7)^2 + (-1)^2}$
$= \sqrt{49 + 1}$
$= \sqrt{50}$

3. $R(5, 1)$ $S(-6, 4)$

$RS = \sqrt{(5 - (-6))^2 + (1 - 4)^2}$
$= \sqrt{(11)^2 + (-3)^2}$
$= \sqrt{121 + 9}$
$= \sqrt{130}$

4. $T(-1, 0)$ $W(-5, -1)$

$TW = \sqrt{(-1 - (-5))^2 + (0 - (-1))^2}$
$= \sqrt{4^2 + 1^2}$
$= \sqrt{16 + 1}$
$= \sqrt{17}$

5. $M(0, 0)$ $N(5, 1)$

$MN = \sqrt{(0 - 5)^2 + (0 - 1)^2}$
$= \sqrt{(-5)^2 + (-1)^2}$
$= \sqrt{25 + 1}$
$= \sqrt{26}$

6. $P(0, -8)$ $Q(2, 6)$

$PQ = \sqrt{(0 - 2)^2 + (-8 - 6)^2}$
$= \sqrt{(-2)^2 + (-14)^2}$
$= \sqrt{4 + 196}$
$= \sqrt{200}$

Determine the slope of $\overline{AB}$ and $\overline{CD}$. Then state if the segments are *parallel, perpendicular* or *neither*. Explain your reasoning.

7. $A(-4, 2)$, $B(4, 4)$, $C(0, 0)$, $D(4, 1)$

Slope of $\overline{AB}$

$m = \frac{4 - 2}{4 - (-4)}$
$= \frac{2}{8}$
$= \frac{1}{4}$

Slope of $\overline{CD}$

$m = \frac{1 - 0}{4 - 0}$
$= \frac{1}{4}$

The slopes of the segments are the same. The segments are parallel.

8. $A(-1, -3)$, $B(1, 2)$, $C(-1, 7)$, $D(5, 1)$

Slope of $\overline{AB}$

$$m = \frac{2 - (-3)}{1 - (-1)} = \frac{5}{2}$$

Slope of $\overline{CD}$

$$m = \frac{1 - 7}{5 - (-1)} = \frac{6}{-6} = -1$$

The slopes of the segments are neither the same nor negative reciprocals. The segments are neither parallel nor perpendicular.

9. $A(-2, 1)$, $B(0, -4)$, $C(-5, -4)$, $D(0, -2)$

Slope of $\overline{AB}$

$$m = \frac{-4 - 1}{0 - (-2)} = \frac{-5}{2} = -\frac{5}{2}$$

Slope of $\overline{CD}$

$$m = \frac{-2 - (-4)}{0 - (-5)} = \frac{2}{5}$$

The slopes of the segments are negative reciprocals. The segments are perpendicular.

10. $A(-2, -1)$, $B(10, 2)$, $C(3, 6)$, $D(5, -2)$

Slope of $\overline{AB}$

$$m = \frac{2 - (-1)}{10 - (-2)} = \frac{3}{12} = \frac{1}{4}$$

Slope of $\overline{CD}$

$$m = \frac{-2 - 6}{5 - 3} = \frac{-8}{2} = -4$$

The slopes of the segments are negative reciprocals. The segments are perpendicular.

11. $A(1, 2)$, $B(-1, -6)$, $C(0, -5)$, $D(2, 3)$

Slope of $\overline{AB}$

$$m = \frac{-6 - 2}{-1 - 1} = \frac{-8}{-2} = 4$$

Slope of $\overline{CD}$

$$m = \frac{3 - (-5)}{3 - 0} = \frac{8}{2} = 4$$

The slopes of the segments are the same. The segments are parallel.

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12. $A(-3, 0)$, $B(1, 2)$, $C(1, 2)$, $D(3, -2)$

Slope of $\overline{AB}$

$m = \frac{2 - 0}{1 - (-3)}$

$= \frac{2}{4}$

$= \frac{1}{2}$

Slope of $\overline{CD}$

$m = \frac{-2 - 2}{3 - 1}$

$= \frac{-4}{2}$

$= -2$

The slopes are negative reciprocals. The segments are perpendicular.

Determine the equation of the line with the given slope and passing through the given point.

13. $m = \frac{2}{3}$ passing through (9, 1)

$(y - 1) = \frac{2}{3}(x - 9)$

$y - 1 = \frac{2}{3}x - 6$

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

14. $m = -\frac{1}{4}$ passing through $(-4, 2)$

$(y - 2) = -\frac{1}{4}(x - (-4))$

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

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

15. $m = 0$ passing through (3, 5)

$(y - 5) = 0(x - 3)$

$y - 5 = 0$

$y = 5$

16. $m = \frac{3}{5}$ passing through $(-8, 2)$

$(y - 2) = \frac{3}{5}(x - (-8))$

$y - 2 = \frac{3}{5}x + \frac{24}{5}$

$y = \frac{3}{5}x + \frac{34}{5}$

17. $m = -5$ passing through $(6, -3)$

$(y - (-3)) = -5(x - 6)$

$y + 3 = -5x + 30$

$y = -5x + 27$

18. $m = \frac{6}{5}$ passing through $(0, -10)$

$(y - (-10)) = \frac{6}{5}(x - 0)$

$y + 10 = \frac{6}{5}x$

$y = \frac{6}{5}x - 10$

Determine the coordinates of point D, the solution to the system of linear equations.

19. $y = -\frac{3}{2}x + 8$ and $y = -x + 10$

$-\frac{3}{2}x + 8 = -x + 10$

$-\frac{3}{2}x = -x + 2$

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

$x = -4$

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

$y = -\frac{3}{2}(-4) + 8$

$y = 6 + 8$

$y = 14$

The coordinates of point D are $(-4, 14)$.

20. $y = \frac{3}{2}x - 2$ and $y = -2x + 5$

$-\frac{3}{2}x - 2 = -2x + 5$

$\frac{3}{2}x = -2x + 7$

$\frac{7}{2}x = 7$

$x = 2$

$y = \frac{3}{2}x - 2$

$y = \frac{3}{2}(2) - 2$

$y = 3 - 2$

$y = 1$

The coordinates of point D are $(2, 1)$.

21. $y = 4x - 2$ and $y = -\frac{3}{2}x + \frac{7}{2}$

$4x - 2 = -\frac{3}{2}x + \frac{7}{2}$

$4x = -\frac{3}{2}x + \frac{11}{2}$

$\frac{11}{2}x = \frac{11}{2}$

$x = 1$

$y = 4x - 2$

$y = 4(1) - 2$

$y = 4 - 2$

$y = 2$

The coordinates of point D are $(1, 2)$.

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22. $y = -2x + 5$ and $y = \frac{3}{2}x - 2$

$-2x + 5 = \frac{3}{2}x - 2$

$-2x = \frac{3}{2}x - 7$

$-\frac{7}{2}x = -7$

$x = 2$

$y = -2x + 5$

$y = -2(2) + 5$

$y = -4 + 5$

$y = 1$

The coordinates of point *D* are (2, 1).

23. $y = \frac{5}{3}x + 2$ and $y = x - 4$

$\frac{5}{3}x + 2 = x - 4$

$\frac{5}{3}x = x - 6$

$\frac{2}{3}x = -6$

$x = -9$

$y = \frac{5}{3}x + 2$

$y = \frac{5}{3}(-9) + 2$

$y = -15 + 2$

$y = -13$

The coordinates of point *D* are (−9, −13).

24. $y = -\frac{1}{5}x + \frac{4}{5}$ and $y = \frac{3}{7}x + \frac{10}{7}$

$-\frac{1}{5}x + \frac{4}{5} = \frac{3}{7}x + \frac{10}{7}$

$-\frac{1}{5}x = \frac{3}{7}x + \frac{22}{35}$

$-\frac{22}{35}x = \frac{22}{35}$

$x = -1$

$y = -\frac{1}{5}x + \frac{4}{5}$

$y = -\frac{1}{5}(-1) + \frac{4}{5}$

$y = \frac{1}{5} + \frac{4}{5}$

$y = 1$

The coordinates of point *D* are (−1, 1).

Use the given information to determine if quadrilateral *ABCD* can best be described as a trapezoid, a rhombus, a rectangle, a square, or none of these. Explain your reasoning.

25. Side lengths: $AB = \sqrt{20}$, $BC = \sqrt{45}$, $CD = \sqrt{20}$, $DA = \sqrt{45}$

Slope of $\overline{AB}$ is -2 Slope of $\overline{BC}$ is $\frac{1}{2}$

Slope of $\overline{CD}$ is -2 Slope of $\overline{DA}$ is $\frac{1}{2}$

The slopes of the line segments have a negative reciprocal relationship. This means the line segments are perpendicular which means the angles must be right angles. Also, the opposite sides have the same slope, so I know the opposite sides are parallel. Finally, opposite sides are congruent. Quadrilateral *ABCD* can best be described as a rectangle.

26. Side lengths: $AB = \sqrt{13}$, $BC = \sqrt{13}$, $CD = \sqrt{13}$, $DA = \sqrt{13}$

Slope of $\overline{AB}$ is $-\frac{3}{2}$ Slope of $\overline{BC}$ is 1

Slope of $\overline{CD}$ is $-\frac{3}{2}$ Slope of $\overline{DA}$ is 1

The slopes of the line segments do not have a negative reciprocal relationship. This means the line segments are not perpendicular which means the angles are not right angles. Also, the opposite sides have the same slope, so I know the opposite sides are parallel. Finally, all four sides are congruent. Quadrilateral *ABCD* can best be described as a rhombus.

27. Side lengths: $AB = \sqrt{13}$, $BC = \sqrt{17}$, $CD = \sqrt{52}$, $DA = \sqrt{10}$

Slope of $\overline{AB}$ is $\frac{2}{3}$ Slope of $\overline{BC}$ is $-\frac{1}{4}$

Slope of $\overline{CD}$ is $\frac{2}{3}$ Slope of $\overline{DA}$ is -3

The slopes of the line segments do not have a negative reciprocal relationship. This means the line segments are not perpendicular which means the angles are not right angles. Also, only one pair of opposite sides have the same slope, so I know only one pair of opposite sides are parallel. Quadrilateral *ABCD* can best be described as a trapezoid.

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28. Side lengths: $AB = \sqrt{8}$, $BC = \sqrt{32}$, $CD = \sqrt{8}$, $DA = \sqrt{32}$

Slope of $\overline{AB}$ is -1 Slope of $\overline{BC}$ is 1

Slope of $\overline{CD}$ is -1 Slope of $\overline{DA}$ is 1

The slopes of the line segments have a negative reciprocal relationship. This means the line segments are perpendicular which means the angles are right angles. Also, opposite sides have the same slope, so I know opposite sides are parallel. Finally, opposite sides have the same length. Quadrilateral *ABCD* can best be described as a rectangle.

29. Side lengths: $AB = \sqrt{14}$, $BC = \sqrt{14}$, $CD = \sqrt{14}$, $DA = \sqrt{14}$

Slope of $\overline{AB}$ is $\frac{1}{8}$ Slope of $\overline{BC}$ is -8

Slope of $\overline{CD}$ is $\frac{1}{8}$ Slope of $\overline{DA}$ is -8

The slopes of the line segments have a negative reciprocal relationship. This means the line segments are perpendicular which means the angles are right angles. Also, opposite sides have the same slope, so I know opposite sides are parallel. Finally, all four sides are equal in length. Quadrilateral *ABCD* can best be described as a square.

30. Side lengths: $AB = \sqrt{17}$, $BC = \sqrt{26}$, $CD = \sqrt{50}$, $DA = \sqrt{34}$

Slope of $\overline{AB}$ is 4 Slope of $\overline{BC}$ is $\frac{1}{5}$

Slope of $\overline{CD}$ is $\frac{1}{7}$ Slope of $\overline{DA}$ is $\frac{4}{5}$

The slopes of the line segments do not have a negative reciprocal relationship. This means the line segments are not perpendicular which means the angles are not right angles. Also, opposite sides do not have the same slope, so I know opposite sides are not parallel. Quadrilateral *ABCD* is not a trapezoid, rectangle, rhombus, nor a square.