


# 3-6 Organizer

**Pacing:** Traditional 1 day  
Block  $\frac{1}{2}$  day

**Objectives:** Graph lines and write their equations in slope-intercept and point-slope form. Classify lines as parallel, intersecting, or coinciding.

 **Technology Lab**  
In *Technology Lab Activities*

 **Online Edition**  
Tutorial Videos, Interactivity

 **Countdown to Testing Week 6**

**Power Presentations with PowerPoint®**


## Warm Up

Substitute the given values of  $m$ ,  $x$ , and  $y$  into the equation  $y = mx + b$  and solve for  $b$ .

- $m = 2$ ,  $x = 3$ , and  $y = 0$   
 $b = -6$
- $m = -1$ ,  $x = 5$ , and  $y = -4$   
 $b = 1$

Solve each equation for  $y$ .

- $y - 6x = 9$     $y = 6x + 9$
- $4x - 2y = 8$     $y = 2x - 4$

Also available on transparency 

## Math Humor

**Q:** What do two lines with the same slope do when it rains?

**A:** Coincide.

# 3-6

## Lines in the Coordinate Plane

### Objectives

Graph lines and write their equations in slope-intercept and point-slope form.

Classify lines as parallel, intersecting, or coinciding.

### Vocabulary

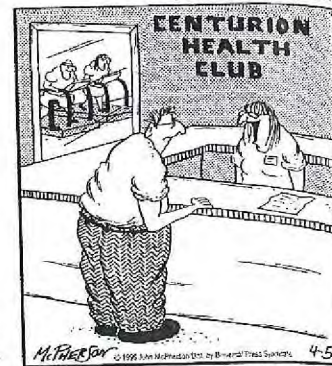
point-slope form  
slope-intercept form

### Why learn this?

The cost of some health club plans includes a one-time enrollment fee and a monthly fee. You can use the equations of lines to determine which plan is best for you. (See Example 4.)

The equation of a line can be written in many different forms. The *point-slope* and *slope-intercept* forms of a line are equivalent. Because the slope of a vertical line is undefined, these forms cannot be used to write the equation of a vertical line.

CLOSE TO HOME  
JOHN McPHERSON



"A one-year membership is \$10,000, but to encourage you to work out, we give you back \$25 every time you use the facility."

### Know It!

*Note*

### Forms of the Equation of a Line

FORM	EXAMPLE
The <b>point-slope form</b> of a line is $y - y_1 = m(x - x_1)$ , where $m$ is the slope and $(x_1, y_1)$ is a given point on the line.	$y - 3 = 2(x - 4)$ $m = 2$ , $(x_1, y_1) = (3, 4)$
The <b>slope-intercept form</b> of a line is $y = mx + b$ , where $m$ is the slope and $b$ is the $y$ -intercept.	$y = 3x + 6$ $m = 3$ , $b = 6$
The equation of a vertical line is $x = a$ , where $a$ is the $x$ -intercept.	$x = 5$
The equation of a horizontal line is $y = b$ , where $b$ is the $y$ -intercept.	$y = 2$

You will prove the slope-intercept form of a line in Exercise 48.

### PROOF

#### Point-Slope Form of a Line

**Given:** The slope of a line through points  $(x_1, y_1)$  and  $(x_2, y_2)$  is  $m = \frac{y_2 - y_1}{x_2 - x_1}$ .

**Prove:** The equation of the line through  $(x_1, y_1)$  with slope  $m$  is  $y - y_1 = m(x - x_1)$ .

**Proof:**

Let  $(x, y)$  be any point on the line.

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

*Slope formula*

$$m = \frac{y - y_1}{x - x_1}$$

*Substitute  $(x, y)$  for  $(x_2, y_2)$ .*

$$(x - x_1)m = (x - x_1)\frac{y - y_1}{x - x_1}$$

*Multiply both sides by  $(x - x_1)$ .*

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

*Simplify.*

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

*Sym. Prop. of =*

State Resources

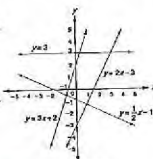
## 1 Introduce

### EXPLORATION

#### 3-6 Lines in the Coordinate Plane

Use the given lines to explore equations, slopes, and  $y$ -intercepts.

- Find the slope of each line. Record the slopes in the table.
- Find the  $y$ -intercept of each line. Record the  $y$ -intercepts in the table.



Equation	Slope	$y$ -intercept
$y = 3x + 2$		
$y = 2x - 3$		
$y = \frac{1}{2}x - 1$		
$y = 3$		

## Motivate

Show students the instructions for baking a cake from a packaged cake mix. Point out that the baking times are different at higher altitudes because the air pressure is less at higher elevations than at sea level. Tell students that the graph of a linear equation can be used to determine how long a cake should be baked at a particular altitude.

Explorations and answers are provided in the



$$y - 1 = 3(x - 2) \quad \text{Substitute 3 for } m, 2 \text{ for } x_1, \text{ and 1 for } y_1.$$

**B** the line through  $(0, 4)$  and  $(-1, 2)$  in slope-intercept form

$$m = \frac{2 - 4}{-1 - 0} = \frac{-2}{-1} = 2 \quad \text{Find the slope.}$$

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

$$4 = 2(0) + b \quad \text{Substitute 2 for } m, 0 \text{ for } x, \text{ and 4 for } y \text{ to find } b.$$

$$4 = b \quad \text{Simplify.}$$

$$y = 2x + 4 \quad \text{Write in slope-intercept form using } m = 2 \text{ and } b = 4.$$

**C** the line with  $x$ -intercept 2 and  $y$ -intercept 3 in point-slope form

$$m = \frac{3 - 0}{0 - 2} = -\frac{3}{2} \quad \text{Use the points } (2, 0) \text{ and } (0, 3) \text{ to find the slope.}$$

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

$$y - 0 = -\frac{3}{2}(x - 2) \quad \text{Substitute } -\frac{3}{2} \text{ for } m, 2 \text{ for } x_1, \text{ and } 0 \text{ for } y_1.$$

$$y = -\frac{3}{2}(x - 2) \quad \text{Simplify.}$$

**CHECK IT OUT!** Write the equation of each line in the given form.  $y \neq 6$

1a. the line with slope 0 through  $(4, 6)$  in slope-intercept form

1b. the line through  $(-3, 2)$  and  $(1, 2)$  in point-slope form  
 $y - 2 = 0$

## EXAMPLE 2 Graphing Lines

$x^2y$  Algebra

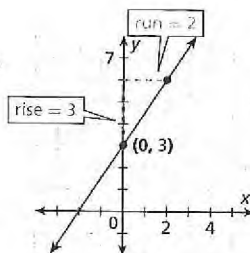
Graph each line.

**A**  $y = \frac{3}{2}x + 3$

The equation is given in slope-intercept form, with a slope of  $\frac{3}{2}$  and a  $y$ -intercept of 3.

Plot the point  $(0, 3)$  and then rise 3 and run 2 to find another point.

Draw the line containing the two points.

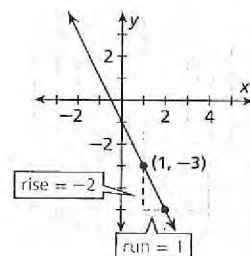


**B**  $y + 3 = -2(x - 1)$

The equation is given in point-slope form, with a slope of  $-2 = \frac{-2}{1}$  through the point  $(1, -3)$ .

Plot the point  $(1, -3)$  and then rise  $-2$  and run 1 to find another point.

Draw the line containing the two points.



substituting a negative coordinate into the point-slope form of an equation. Remind students that subtracting  $y$  is equivalent to adding the opposite of  $y$ .

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## Additional Examples

### Example 1

Write the equation of each line in the given form.

**A.** the line with slope 6 through  $(3, -4)$  in point-slope form  
 $y + 4 = 6(x - 3)$

**B.** the line through  $(-1, 0)$  and  $(1, 2)$  in slope-intercept form  
 $y = x + 1$

**C.** the line with  $x$ -intercept 3 and  $y$ -intercept  $-5$  in point-slope form  
 $y = \frac{5}{3}(x - 3)$

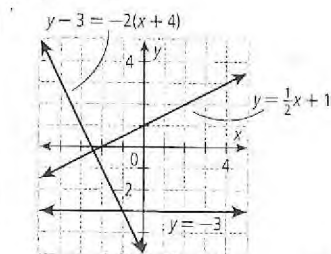
### Example 2

Graph each line.

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

**B.**  $y - 3 = -2(x + 4)$

**C.**  $y = -3$



Also available on transparency



## INTERVENTION Questioning Strategies

### EXAMPLE 1

- In **Example 1B**, how do you find the  $y$ -intercept  $b$  after you find the slope?
- How do you use the intercepts to find the slope in **Example 1C**?

### EXAMPLE 2

- Describe how you graph each line.

## Teach

### Guided Instruction

Before writing equations of lines, discuss the meaning of the points  $(x_1, y_1)$  and  $(x_2, y_2)$ . As you work through the lesson, write the equations of parallel, intersecting, and coinciding lines to their graphs.



## Reaching All Learners Through Curriculum Integration

Give groups of students a thermometer showing Fahrenheit and Celsius temperatures. Ask them to write two ordered pairs ( $^{\circ}\text{F}$ ,  $^{\circ}\text{C}$ ) that relate the boiling and freezing temperatures in Fahrenheit to the corresponding temperatures in Celsius. Then have them write the slope-intercept form of the equation of the line through the two points.

ENGLISH LANGUAGE LEARNERS



### Additional Examples

#### Example 3

Determine whether the lines are parallel, intersect, or coincide.

$$y = 3x + 7, y = -3x - 4$$

intersect

$$y = -\frac{1}{3}x + 5, 6y = -2x + 12$$

parallel

$$2y - 4x = 16,$$

$$y - 10 = 2(x - 1) \text{ coincide}$$

available on transparency



### Intervention Questioning Strategies

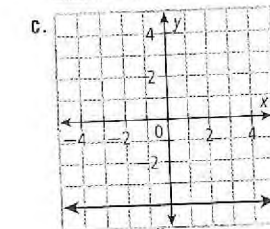
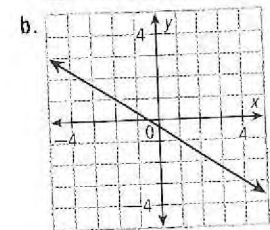
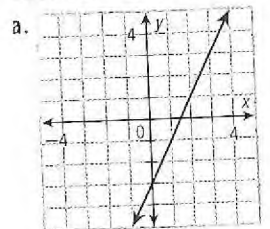
#### Example 3

How can you tell that two lines are parallel?

How is it helpful to solve equations for  $y$ ?

How can lines that have different equations be coinciding lines?

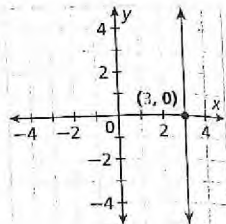
### Answers to Check It Out!



Graph the line.

**C**  $x = 3$

The equation is given in the form for a vertical line with an  $x$ -intercept of 3. The equation tells you that the  $x$ -coordinate of every point on the line is 3. Draw the vertical line through  $(3, 0)$ .



Graph each line.

2a.  $y = 2x - 3$

2b.  $y - 1 = -\frac{2}{3}(x + 2)$

2c.  $y = -4$

A system of two linear equations in two variables represents two lines. The lines can be parallel, intersecting, or coinciding. Lines that coincide are the same line, but the equations may be written in different forms.

### Know It!

Note

### Pairs of Lines

Parallel Lines	Intersecting Lines	Coinciding Lines
$y = 5x + 8$	$y = 2x - 5$	$y = 2x - 4$
$y = 5x - 4$	$y = 4x + 3$	$y = 2x - 4$
Same slope different $y$ -intercept	Different slopes	Same slope same $y$ -intercept

### Example 3 Classifying Pairs of Lines

Determine whether the lines are parallel, intersect, or coincide.

**A**  $y = 2x + 3, y = 2x - 1$

Both lines have a slope of 2, and the  $y$ -intercepts are different. So the lines are parallel.

**B**  $y = 3x - 5, 6x - 2y = 10$

Solve the second equation for  $y$  to find the slope-intercept form.

$$6x - 2y = 10$$

$$-2y = -6x + 10$$

$$y = 3x - 5$$

Both lines have a slope of 3 and a  $y$ -intercept of  $-5$ , so they coincide.

**C**  $3x + 2y = 7, 3y = 4x + 7$

Solve both equations for  $y$  to find the slope-intercept form.

$$3x + 2y = 7$$

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

$$y = -\frac{3}{2}x + \frac{7}{2} \quad \text{The slope is } -\frac{3}{2}$$

$$3y = 4x + 7$$

$$y = \frac{4}{3}x + \frac{7}{3} \quad \text{The slope is } \frac{4}{3}$$

The lines have different slopes, so they intersect.



3. Determine whether the lines  $3x + 5y = 2$  and  $3x + 6 = -5y$  are parallel, intersect, or coincide. **parallel**



**Math Background** An equation of the form  $Ax + By = C$  can be written in slope-intercept form as

$y = \frac{-A}{B}x + \frac{C}{B}$ . So a quick way to check whether lines have the same slope is to find  $\frac{-A}{B}$  for both lines. If the slopes are the same, then find  $\frac{C}{B}$  to see if the lines coincide.



total costs be the same?

Monthly Fee	\$35	\$55
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**1 Understand the Problem**

The answer is the number of months after which the costs of the two plans would be the same. Plan A costs \$140 for enrollment and \$35 per month. Plan B costs \$60 for enrollment and \$55 per month.

**2 Make a Plan**

Write an equation for each plan, and then graph the equations. The solution is the intersection of the two lines. Find the intersection by solving the system of equations.

**3 Solve**

Plan A:  $y = 35x + 140$

Plan B:  $y = 55x + 60$

$$0 = -20x + 80$$

*Subtract the second equation from the first.*

$x = 4$  *Solve for x.*

$y = 35(4) + 140 = 280$  *Substitute 4 for x in the first equation.*

The lines cross at (4, 280). Both plans cost \$280 after 4 months.



**4 Look Back**

Check your answer for each plan in the original problem. For 4 months, plan A costs \$140 plus  $\$35(4) = \$140 + \$140 = \$280$ . Plan B costs  $\$60 + \$55(4) = \$60 + \$220 = \$280$ , so the plans cost the same.



Use the information above to answer the following.

4. **What if...?** Suppose the rate for Plan B was also \$35 per month. What would be true about the lines that represent the cost of each plan? The lines would be  $\parallel$ .

to subtract 60 from 140, resulting in  $y = -20x + 200$ . Suggest that they align the equations vertically and change the sign of each term in the bottom equation, or suggest that students solve  $35x + 140 = 55x + 60$  instead.

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**Additional Examples**

**Example 4**

Erica is trying to decide between two car rental plans. For how many miles will the plans cost the same?

	Plan A	Plan B
Initial Fee	\$100.00	\$85.00
Mileage Fee	\$0.35/mi	\$0.50

Both plans cost \$135 for 100 miles.

Also available on transparency



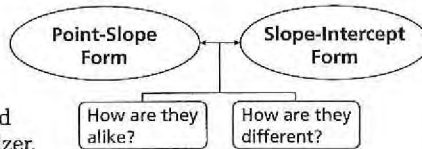
**INTERVENTION**  $\longleftrightarrow$   
**Questioning Strategies**

**EXAMPLE 4**

- Which fee in each plan is related to the slope of the line? Which fee in each plan is related to the y-intercept of the line?

**THINK AND DISCUSS**

1. Explain how to use the slopes and y-intercepts to determine if two lines are parallel.
2. Describe the relationship between the slopes of perpendicular lines.
3. **GET ORGANIZED** Copy and complete the graphic organizer.



**Know it!**  
*Note*

**Use**

**size**

point-slope and slope-intercept equations of a line and how to graph a line. Graph a line and have students write both equations in point-slope and slope-intercept forms. Compare and contrast lines that are parallel, perpendicular, or coinciding.

**ONGOING ASSESSMENT**

**and INTERVENTION**  $\longleftrightarrow$

**Diagnose Before the Lesson**  
3-6 Warm Up, TE p. 190

**Monitor During the Lesson**  
Check It Out! Exercises, SE pp. 191–193  
Questioning Strategies, TE pp. 191–193

**Assess After the Lesson**  
3-6 Lesson Quiz, TE p. 197  
Alternative Assessment, TE p. 197

**Answers to Think and Discuss**

1. If the slopes are the same and the y-intercepts are different, then the lines are  $\parallel$ .
2. If the slopes of  $2 \perp$  lines are multiplied, the product is  $-1$ . Each slope is the opp. reciprocal of the other slope.
3. See p. A3.



Assignment Guide

Assign *Guided Practice* exercises as necessary.

If you finished Examples 1-2

Basic 13-18, 24-30

Average 13-18, 24-31

Advanced 13-18, 24-31, 46

If you finished Examples 1-4

Basic 12-23, 24-44 even,

45-46, 53, 57-61, 67-73

Average 14-22 even, 23-31,

32-52 even, 53, 54, 56-64, 67-73

Advanced 12-23, 24-44 even,

47-52 even, 53-73

Homework Quick Check

Quickly check key concepts.

Exercises: 14, 16, 22, 23, 28, 36

**Teaching Tip** **Kinesthetic** Let students use straws or uncooked spaghetti and graph paper to model a line that passes through the points in **Exercise 2**. Have them use the models to find the slope of the line and then write the equation of the line in slope-intercept form.

Answers

1, 5-7, 12, 16-18. See p. A14.

24-31. For graphs, see p. A14.

State Resources

GUIDED PRACTICE

1. **Vocabulary** How can you recognize the *slope-intercept form* of an equation?

SEE EXAMPLE 1  
p. 191

Write the equation of each line in the given form.

2. the line through (4, 7) and (-2, 1) in slope-intercept form  $y = x + 3$

3. the line through (-4, 2) with slope  $\frac{3}{4}$  in point-slope form.  $y - 2 = \frac{3}{4}(x + 4)$

4. the line with  $x$ -intercept 4 and  $y$ -intercept -2 in slope-intercept form  $y = \frac{1}{2}x - 2$

SEE EXAMPLE 2  
p. 191

Graph each line.

5.  $y = -3x + 4$     6.  $y + 4 = \frac{2}{3}(x - 6)$     7.  $x = 5$

SEE EXAMPLE 3  
p. 192

Determine whether the lines are parallel, intersect, or coincide.

8.  $y = -3x + 4$ ,  $y = -3x + 1$  ||

9.  $6x - 12y = -24$ ,  $3y = 2x + 18$  intersect

10.  $y = \frac{1}{3}x + \frac{2}{3}$ ,  $3y = x + 2$  coincide

11.  $4x + 2y = 10$ ,  $y = -2x + 15$  ||

SEE EXAMPLE 4  
p. 193

12. **Transportation** A speeding ticket in Conroe costs \$115 for the first 10 mi/h over the speed limit and \$1 for each additional mi/h. In Lakeville, a ticket costs \$50 for the first 10 mi/h over the speed limit and \$10 for each additional mi/h. If the speed limit is 55 mi/h, at what speed will the tickets cost approximately the same?

Homework Help

For Exercises	See Example
13-15	1
16-18	2
19-22	3
23	4

Extra Practice

Skills Practice p. 59  
Application Practice p. 530

PRACTICE AND PROBLEM SOLVING

Write the equation of each line in the given form.

13. the line through (0, -2) and (4, 6) in point-slope form  $y + 2 = 2x$

14. the line through (5, 2) and (-2, 2) in slope-intercept form  $y = 2$

15. the line through (6, -4) with slope  $\frac{2}{3}$  in point-slope form  $y + 4 = \frac{2}{3}(x - 6)$

Graph each line.

16.  $y - 7 = x + 4$     17.  $y = \frac{1}{2}x - 2$     18.  $y = 2$

Determine whether the lines are parallel, intersect, or coincide.

19.  $y = x - 7$ ,  $y = -x + 3$  intersect

20.  $y = \frac{5}{2}x + 4$ ,  $2y = 5x - 4$  ||

21.  $x + 2y = 6$ ,  $y = -\frac{1}{2}x + 3$  coincide

22.  $7x + 2y = 10$ ,  $3y = 4x - 5$  intersect

23. **Business** Chris is comparing two sales positions that he has been offered.

The first pays a weekly salary of \$375 plus a 20% commission. The second pays a weekly salary of \$325 plus a 25% commission. How much must he make in sales per week for the two jobs to pay the same? **\$1000 per week**

Write the equation of each line in slope-intercept form. Then graph the line.

24. through (-6, 2) and (3, 6)  $y = \frac{4}{9}x + \frac{14}{3}$     25. horizontal line through (2, 3)  $y = 3$

$y = \frac{2}{3}x - \frac{16}{3}$     26. through (5, -2) with slope  $\frac{2}{3}$

27.  $x$ -intercept 4,  $y$ -intercept -3  $y = \frac{3}{4}x - 3$

Write the equation of each line in point-slope form. Then graph the line.

28. slope  $-\frac{1}{2}$ ,  $y$ -intercept 2  $y - 2 = -\frac{1}{2}x$     29. slope  $\frac{3}{4}$ ,  $x$ -intercept -2  $y = \frac{3}{4}(x + 2)$

$y + 1 = -(x - 5)$     30. through (5, -1) with slope -1

31. through (4, 6) and (-2, -5)

31.  $y - 6 = \frac{11}{6}(x - 4)$

3-6 PRACTICE A

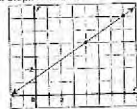
Match the letter of each example to the correct form of a line.

- |                         |   |                                 |
|-------------------------|---|---------------------------------|
| 1. point-slope form     | D | A. $x = 3$                      |
| 2. slope-intercept form | B | B. $y = -x + 1$                 |
| 3. horizontal line      | C | C. $y = -7$                     |
| 4. vertical line        | A | D. $y - 2 = \frac{1}{2}(x - 5)$ |

Write the equation of each line in the given form. Graph each line.



5. the line with slope -2 and  $y$ -intercept 1 in slope-intercept form  
 $y = -2x + 1$



6. the line with slope  $\frac{2}{3}$  through (4, 4) in point-slope form  
 $y - 4 = \frac{2}{3}(x - 4)$



7. the line through (0, 0) and (2, 2) in point-slope form  
 $y = x$



8. the line through (-1, -1) and (2, 2) in slope-intercept form  
 $y = 3x + 2$

9. Bobbie typically grows about 24 centimeters per year, or 2 centimeters per month, during her first year. The average length of a newborn baby is 50 centimeters. Baby A is born 50 centimeters long and grows at 2 centimeters per month. Baby B is born 52 centimeters



3-6 PRACTICE B

Write the equation of each line in the given form.

1. the horizontal line through (5, 7) in point-slope form

$y - 7 = 0$

2. the line with slope  $-\frac{8}{5}$  through (1, -5) in point-slope form

$y + 5 = -\frac{8}{5}(x - 1)$

3. the line through  $(-\frac{1}{2}, -\frac{3}{2})$  and (2, 14) in slope-intercept form

$y = 7x$

4. the line with  $x$ -intercept -2 and  $y$ -intercept -1 in slope-intercept form

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

Graph each line.



5.  $y = \frac{2}{3}(x + 1)$



6.  $y = -\frac{4}{3}(x + 2)$

Determine whether the lines are parallel, intersect, or coincide.

7.  $x - 5y = 0$ ,  $y + 1 = \frac{1}{5}(x + 5)$

coincide

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

parallel

9.  $y - 4(x - 3) = \frac{3}{2} + 4y = -\frac{3}{2}x$

intersect

10. Two relatively small aquifers are the Fresh Springs (FS) aquifer and the Abbeville (AB) aquifer, both in Oklahoma. Suppose that starting on a certain day in 1985, 85 million gallons of water per day were taken from the FS aquifer, and 9 million gallons of water per day were taken from the AB aquifer. If the FS aquifer began with 4500 million gallons of water and the AB aquifer began with 2000 million gallons of water and no rain fell, write a slope-intercept equation for each aquifer and find how many days passed until both aquifers held the same amount of water. (Round to the nearest day)



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

$$y = -2x - 5$$

$$y + 4 = -2x + 6$$

$$y = -2x + 2$$

of the pt. used to find the pt.-slope form are interchanged.

Determine whether the lines are perpendicular.

33.  $y = 3x - 5, y = -3x + 1$  no

34.  $y = -x + 1, y = x + 2$  yes

35.  $y = \frac{2}{3}x + 5, y = \frac{3}{2}x - 8$ , yes

36.  $y = -2x + 4, y = -\frac{1}{2}x - 2$  no

**Multi-Step** Given the equation of the line and point  $P$  not on the line, find the equation of a line parallel to the given line and a line perpendicular to the given line through the given point.

37.  $y = 3x + 7, P(2, 3)$

38.  $y = -2x - 5, P(-1, 4)$

39.  $4x + 3y = 8, P(4, -2)$

40.  $2x - 5y = 7, P(-2, 4)$

**Multi-Step** Use slope to determine if each triangle is a right triangle.

If so, which angle is the right angle?

41.  $A(-5, 3), B(0, -2), C(5, 3)$  yes;  $\angle B$

42.  $D(1, 0), E(2, 7), F(5, 1)$  no

43.  $G(3, 4), H(-3, 4), J(1, -2)$  no

44.  $K(-2, 4), L(2, 1), M(1, 8)$  yes;  $\angle K$

45. **Food** A restaurant charges \$8 for a large cheese pizza plus \$1.50 per topping. Another restaurant charges \$11 for a large cheese pizza plus \$0.75 per topping. How many toppings does a pizza have that costs the same at both restaurants? For 4 toppings, both pizzas will cost \$14.

46. **Estimation** Estimate the solution of the system of equations represented by the lines in the graph. Possible answer:

$$x = 1.2, \text{ and } y = 3.7$$

Write the equation of the perpendicular bisector of the segment with the given endpoints.

47.  $(2, 5)$  and  $(4, 9)$   $y = -\frac{1}{2}x + \frac{17}{2}$

48.  $(1, 1)$  and  $(3, 1)$   $x = 2$

49.  $(1, 3)$  and  $(-1, 4)$   $y = 2x + \frac{7}{2}$

50.  $(-3, 2)$  and  $(-3, -10)$   $y = -4$

51. Line  $\ell$  has equation  $y = -\frac{1}{2}x + 4$ , and point  $P$  has coordinates  $(3, 5)$ .  $y = 2x - 1$

a. Find the equation of line  $m$  that passes through  $P$  and is perpendicular to  $\ell$ .

b. Find the coordinates of the intersection of  $\ell$  and  $m$ .  $(2, 3)$

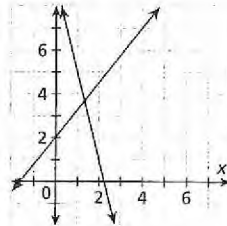
c. What is the distance from  $P$  to  $\ell$ ?  $\sqrt{5}$  units

52. Line  $p$  has equation  $y = x + 3$ , and line  $q$  has equation  $y = x - 1$ . Possible answers:

a. Find the equation of a line  $r$  that is perpendicular to  $p$  and  $q$ .  $y = -x + 1$

b. Find the coordinates of the intersection of  $p$  and  $r$  and the coordinates of the intersection of  $q$  and  $r$ .  $(-1, 2)$ ;  $(1, 0)$

c. Find the distance between lines  $p$  and  $q$ .  $2\sqrt{2}$  units



like a right angle. Then have them verify their answer by finding the rise and run of the segments that form the angle.

### Answers

37.  $\parallel$  line:  $y = 3x - 3$ ;

$\perp$  line:  $y = -\frac{1}{3}x + \frac{11}{3}$

38.  $\parallel$  line:  $y = -2x + 2$ ;

$\perp$  line:  $y = \frac{1}{2}x + \frac{9}{2}$

39.  $\parallel$  line:  $y = -\frac{4}{3}x + \frac{10}{3}$ ;

$\perp$  line:  $y = \frac{3}{4}x - 5$

40.  $\parallel$  line:  $y = \frac{2}{5}x + \frac{24}{5}$ ;

$\perp$  line:  $y = -\frac{5}{2}x - 1$



104, the world's largest pizza was baked in Italy. The diameter of the pizza was 5.19 m (17 ft) and it weighed 124 kg (273 lb).

### 3-6 PRACTICE C

1. Lines  $p$  and  $q$  are parallel to line  $r$ .  $AB$ ,  $CD$ , and  $EF$  each have endpoints on  $p$  and  $q$ , one endpoint on each line.  $AB$  is the graph of  $y = -\frac{2}{3}x + \frac{5}{3}$ ,  $CD$  is the graph of  $y = \frac{1}{3}x - \frac{1}{3}$ ,  $EF$  is the graph of  $y = -0.7x + 1.1$ . Name the shortest segment. Explain your answer.

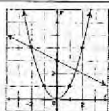
$AB$  is the shortest segment because the shortest distance between parallel

lines is a segment perpendicular to both lines. Lines  $p$  and  $q$  both have a slope of  $2.6 = \frac{13}{5}$ . A segment perpendicular to these lines must have a slope of  $-\frac{5}{13}$ .  $AB$  is the only segment listed that has this slope.

2. A graphic designer draws line  $m$  determined by the equation  $y = -2x + 4$ . She needs to create parallel lines on either side of line  $m$  that are exactly 5 units away. Use the slope formula, the distance formula, and your knowledge of parallel and perpendicular lines to find equations for the parallel lines. (Hint: Although you can get the correct equations by starting from any point on  $m$ , using the  $y$ -intercept is easiest. Begin by using the slope formula to relate  $r$  and  $m$  on the line perpendicular to line  $m$  through the  $y$ -intercept. Then substitute into the distance formula.)

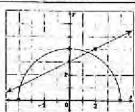
$$y = -2x + 4 + 5\sqrt{5}; y = -2x + 4 - 5\sqrt{5}$$

3. The equations dealt with in Chapter 3 are called *linear* equations. That is because the equations determine lines, not curves. Plot a few points of the equation  $y = x^2$  on the graph and then sketch the equation. Graph the line  $y = \frac{1}{2}x + 3$ . Estimate the intersection points of the line and the parabola from the graph. Then calculate the intersection points. You will have to use the quadratic formula.



Possible answers:  $(-2, 4)$ ,  $(1.5, 2.25)$ ;  $(-2, 4)$ . Actual  $(1.5, 2.25)$

4. Plot a few points of the equation  $y = \sqrt{16 - x^2}$  on the graph and then sketch the equation. Graph the line  $y = \frac{1}{2}x + 3$ . Estimate the intersection points of the line and the curve from the graph. Then calculate the intersection points.



Possible answers:  $(-3.9, 1.1)$ ,  $(1.5, 3.75)$ ;

Actual:  $(-\frac{9}{5}, \frac{4}{5})$ ,  $(\frac{11}{5}, \frac{12}{5})$