

Chapter 12

Slope and Writing Equations

The slope of a line on the coordinate plane describes its direction and its steepness.

1. Every straight line has a number that describes its slope.
2. If the top of a line goes to the right, the slope is positive; if the top of the line goes to the left, the slope is negative.

Examples

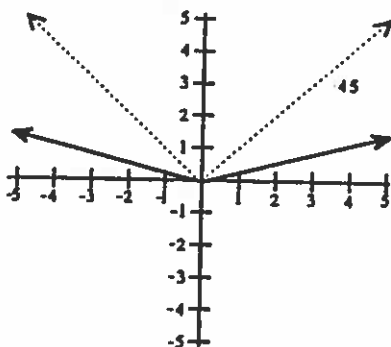


These lines have positive slopes

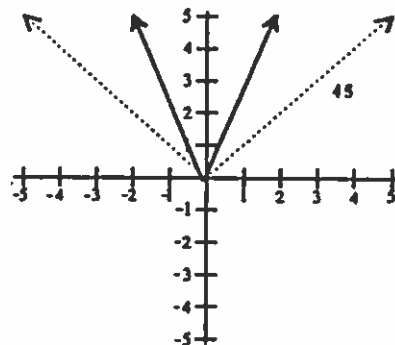


These lines have negative slopes

3. If the angle of the line is steeper than 45 degrees, the slope will be greater than 1.
4. If the line's steepness is less than 45 degrees, the slope will be less than 1. (a fraction)



Examples



These slopes are less than 1

These slopes are greater than 1

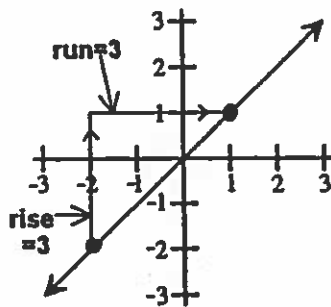
Describe these slopes as positive (+) or negative (-), greater than 1 or less than 1

- | | | | |
|-----|-----|-----|-----|
| 1. | 2. | 3. | 4. |
| 5. | 6. | 7. | 8. |
| 9. | 10. | 11. | 12. |
| 13. | 14. | 15. | 16. |

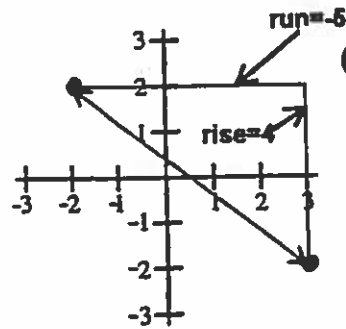
Finding the Slope of a Linear Equation Continued - if the linear equation is on the coordinate plane, the formula $m = \frac{\text{rise}}{\text{run}}$ can be used. Follow these steps: 1) count the number of places from the lowest coordinate up to the level of the highest coordinate. Put that number in the formula across from "rise". 2) From that place "run" sideways to the highest coordinate, counting the places. Put that number across from "run". 3) Simplify the fraction if necessary and that will be the slope.

Examples

Find the slope of the lines on the coordinate planes, using the rise over run formula



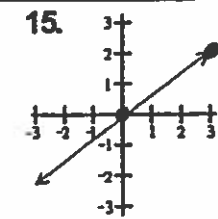
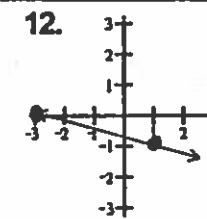
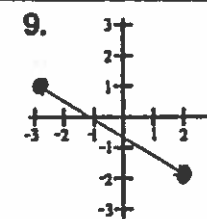
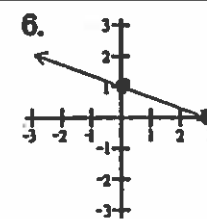
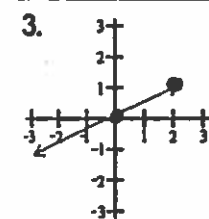
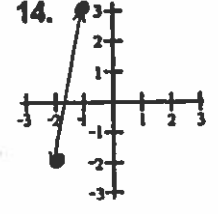
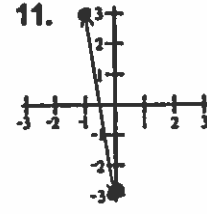
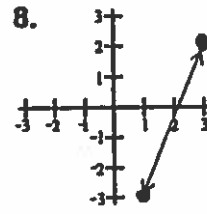
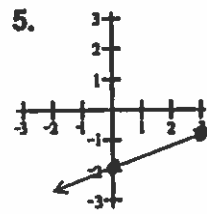
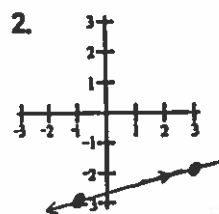
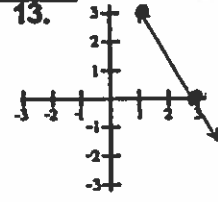
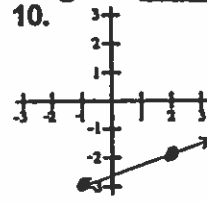
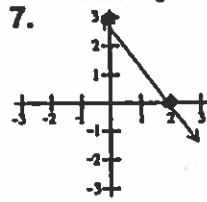
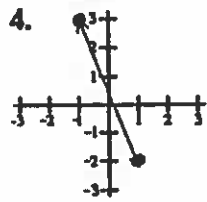
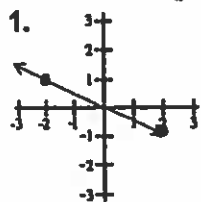
$$m = \frac{\text{rise}}{\text{run}} = \frac{3}{3} = 1$$



(note: the run is in a negative direction)

$$m = \frac{\text{rise}}{\text{run}} = \frac{4}{-5} = -\frac{4}{5}$$

Find the slope of the lines on the coordinate plane, using the rise over run formula



What Did the Inventor of the 10-Ton Truck So Often Say?



For each exercise, draw a line through the two given points. Find the slope of this line. Write the letter of the exercise in the box containing the slope.

B (4, 4)
(1, 2)

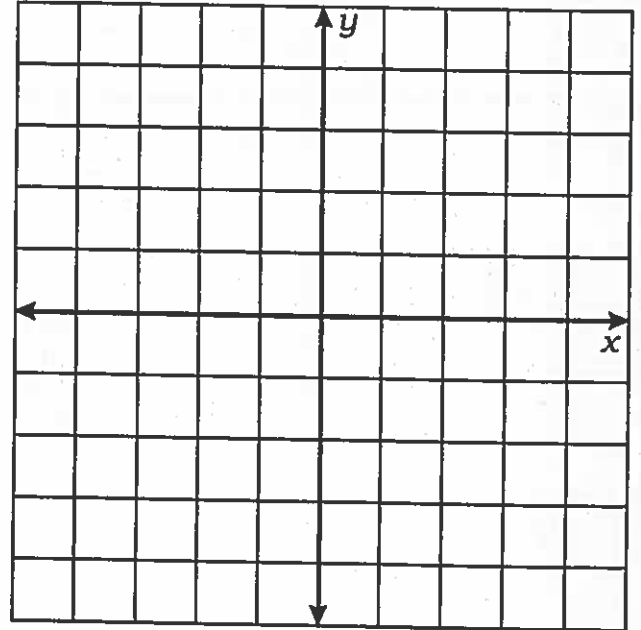
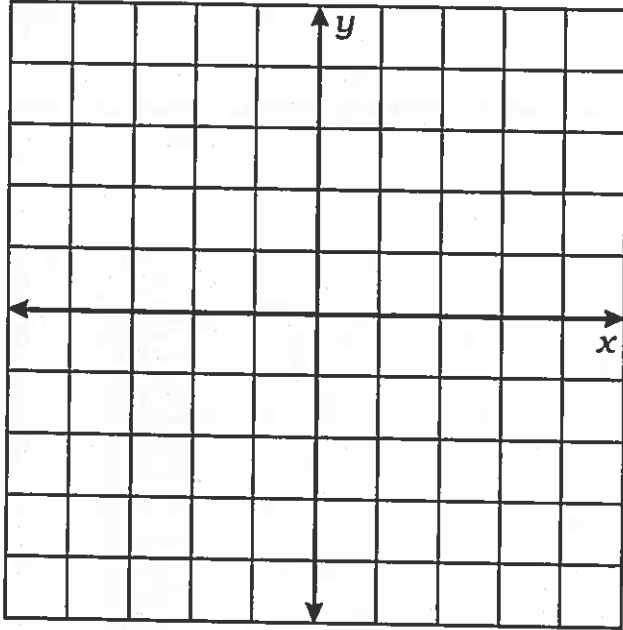
E (2, 0)
(-4, 4)

O (1, -3)
(-3, -4)

I (-1, -3)
(2, 3)

F (-4, 3)
(-2, -1)

O (-3, 0)
(-1, 5)



E (0, 2)
(5, -1)

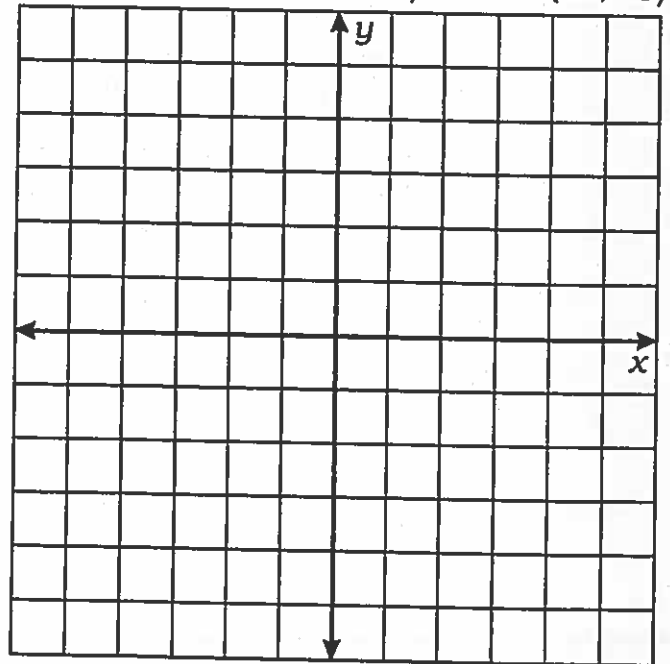
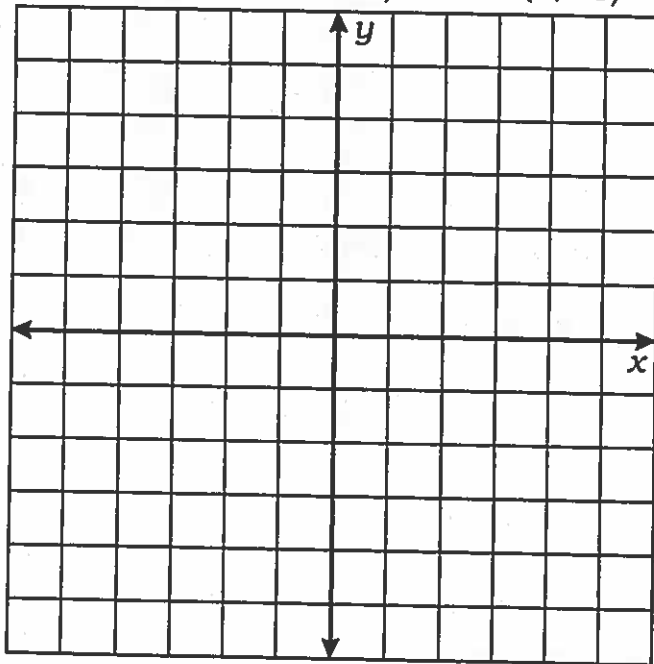
D (5, 6)
(2, -1)

L (-5, 2)
(0, -3)

D (0, 0)
(2, -6)

G (4, 5)
(-2, 4)

S (2, -3)
(-5, -3)



$\frac{1}{3}$	-3	2	$-\frac{2}{3}$	0	-2	-1	$-\frac{7}{2}$	$\frac{2}{3}$	$-\frac{3}{5}$	$-\frac{1}{5}$	$\frac{1}{6}$	$\frac{5}{2}$	$\frac{1}{4}$	$\frac{7}{3}$	3
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Finding the Slope of a Linear Equation Continued

If two coordinates are given, the formula: $m = \frac{y_1 - y_2}{x_1 - x_2}$ is used. When using this formula, y_1 is the value of y in the first coordinate and y_2 is the value of y in the second coordinate. x_1 is the value of x in the first coordinate and x_2 is the value of x in the second coordinate. When these values are put into the formula and the numerators and denominators are simplified, the result will be the slope.

Example

Find the slope given two coordinates

(4,1), (2,-5)

$$m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{1 - (-5)}{4 - 2} = \frac{1 + 5}{2} = \frac{6}{2} = 3$$

Find the slope given the coordinates

1. (3,4), (-2,3)

6. (4,-6), (3,-2)

2. (6,-2), (0,2)

7. (-3,-4), (-1,6)

3. (-2,5), (3,0)

8. (-5,-1), (6,7)

4. (6,-1), (-1,-4)

9. (5,-1), (4,-3)

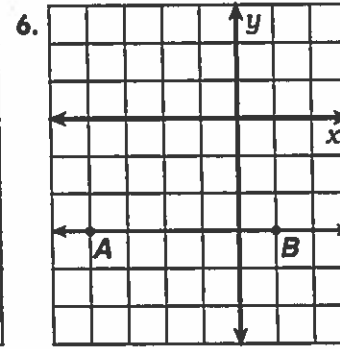
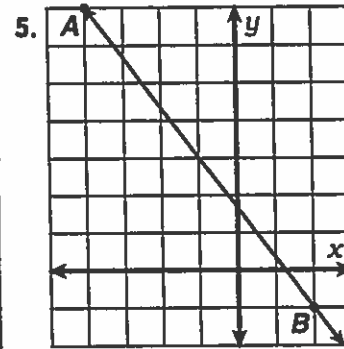
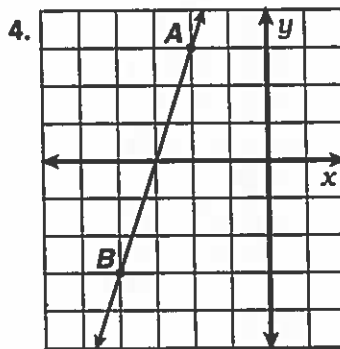
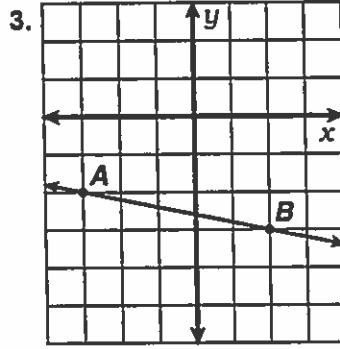
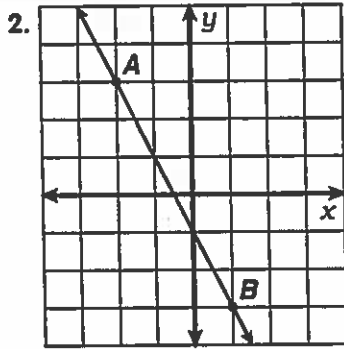
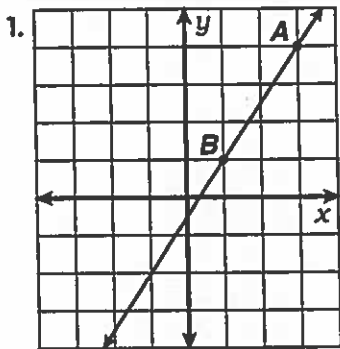
5. (-6,-4), (-1,3)

10. (-5,2), (1,6)

What Is Used To Repair Big, Brass Band Instruments?

Cross out the letter pair next to each correct answer. For each letter pair that you DONT cross out, write the upper case letter in the box containing the lower case letter.

In Exercises 1-6, find the slope of \overleftrightarrow{AB} .



answers 1-6

- i • O** $-\frac{4}{3}$
- e • U** $-\frac{2}{3}$
- g • R** $\frac{3}{2}$
- a • T** 3
- b • A** $-\frac{3}{5}$
- j • V** -2
- d • L** 0
- l • E** $\frac{7}{2}$
- h • N** $-\frac{1}{5}$

In Exercises 7-18, find the slope of the line that passes through the two given points.

7. (5, 1); (8, 3)

8. (6, 3); (1, 4)

f • P 1

k • U $-\frac{7}{4}$

answers 7-12

a • S $-\frac{1}{5}$

9. (2, -2); (5, 7)

10. (1, -6); (9, -8)

c • N 3

d • B $-\frac{8}{3}$

g • A 2

11. (-3, 7); (-10, 0)

12. (-9, 4); (-6, -4)

i • G $\frac{2}{5}$

h • N $\frac{2}{3}$

m • E $-\frac{1}{4}$

answers 13-18

13. (0, -3); (-2, 7)

14. (2, 8); (0, 3)

j • L -3

h • R -5

d • T $\frac{5}{7}$

15. (-6, 4); (6, -5)

16. (-5, -9); (-1, -1)

f • N $\frac{4}{9}$

f • B $-\frac{2}{5}$

c • T $\frac{5}{2}$

17. (-2, 11); (7, 15)

18. (-5, 6); (0, 0)

d • S $-\frac{3}{4}$

m • D $-\frac{6}{5}$

j • O 2

a	b	c	d	e	f	g	h	i	j	k	l	m
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Finding the Slope of a Linear Equation (line) - there are 4 ways to find the slope of a linear equation. Which method to use will depend on what information is given.

Standard Form of a Linear Equation - when the equation is in this form ($3x + 4y = 2$), it is best to use the formula: $m = -\frac{A}{B}$. (The symbol for slope is the letter "m".) In this formula, "A" is the coefficient of "x" and "B" is the coefficient of "y". When these values are substituted into the formula, the slope becomes obvious.

Slope-Intercept Form of a Linear Equation - when the equation is in this form ($y = 2x - 7$), The slope is the rational number in front of the variable, "x".

Examples

Standard Form

- a. Find the slope
 $3x + 4y = 2$
 $A = 3, B = 4$
 $m = -\frac{A}{B} = -\frac{3}{4}$
- b. Find the slope
 $5x - 2y = 6$
 $A = 5, B = -2$
 $m = -\frac{A}{B} = -\frac{5}{-2} = \frac{5}{2}$

Slope - Intercept Form

- c. Find the slope
 $y = -4x + 1$
 The slope is (-4).
- d. Find the slope
 $y = \frac{2}{3}x - 7$
 The slope is $\frac{2}{3}$

Find the slope (the method used should be determined by the form of the equation)

- | | | |
|---------------------------|-----------------------------|--------------------------------------|
| 1. $2x + y = 7$ | 7. $5x - 2y = -3$ | 13. $y = 5x + 9$ |
| 2. $6x - 5y = 2$ | 8. $8x - 6y = 4$ | 14. $y = \frac{5}{3}x + \frac{1}{2}$ |
| 3. $4x + 3y = 5$ | 9. $y = 6x + 3$ | 15. $6x + 10y = 0$ |
| 4. $y = 2x + 3$ | 10. $9x - 2y = -4$ | 16. $y = -7x - 3$ |
| 5. $y = -3x - 4$ | 11. $y = -\frac{5}{8}x - 6$ | 17. $5x - y = 2$ |
| 6. $y = \frac{1}{2}x - 6$ | 12. $x + 4y = 8$ | 18. $x + y = 4$ |

Writing Linear Equations - given certain information, a linear equation can be written. The slope-intercept formula is: $y = mx + b$. The 4 letters stand for the following: y is the coordinate "y", m is the slope, x is the coordinate "x", and b is the "y-intercept". To write an equation, you must have the slope and y-intercept (m and b). They are put into the formula and a linear equation in slope-intercept form is written.

Examples

Write the equation in slope-intercept form

a. slope = -5
y-intercept = 7
 $y = mx + b$
 $y = -5x + 7$

b. $m = 8$
 $b = -3$
 $y = mx + b$
 $y = 8x - 3$

Write the equation in slope intercept form, using the formula: $y = mx + b$

1. slope = -5, y-intercept = -2

6. $m = 7$, y-intercept = 2

2. slope = 3, y-intercept = 7

7. slope = $\frac{4}{5}$, $b = 1$

3. $m = -6$, $b = 4$

8. $m = 2$, $b = -\frac{3}{2}$

4. $m = 10$, $b = -6$

9. slope = $-\frac{1}{5}$, y-intercept = $\frac{3}{4}$

5. slope = -1, $b = -6$

10. slope = 9, $b = -9$

Writing an Equation Given the Slope and One Coordinate - even though the "y-intercept" is not given, one can still write a linear equation given the slope and one set of points.

Follow these steps: 1) substitute the values of "x" and "y" (from the coordinate given) into the slope-intercept formula for the "x" and "y", 2) substitute the slope into the formula for "m", 3) solve the formula for "b", the y-intercept, 4) substitute the slope and the y-intercept into the formula and you have written a linear equation.

Example

Write an equation given the slope and one set of points

The problem:	a. slope = 3, (4, -6)	b. (put the slope and the y-intercept
The formula:	$y = mx + b$	into the formula again)
The substitution:	$-6 = 3(4) + b$	
Solve for b:	$-6 = 12 + b$	$y = mx + b$
	$\frac{-12 \quad -12}{-18 = \quad \quad b}$	$y = 3x - 18$

Write the equation given the slope and one set of points

1. slope = 4, (3, -1)

5. slope = 4, (-2,3)

2. slope = -7, (-2, 5)

6. m = -3, (5,0)

3. m = 9, (-5,-3)

7. m = -1, (6, -3)

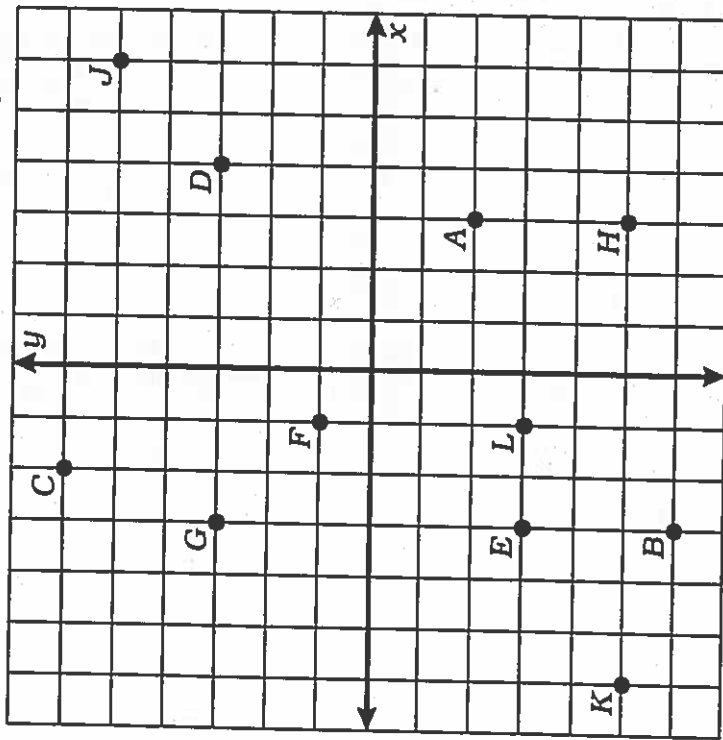
4. m = -1, (4,8)

8. slope = 5, (-7,-2)

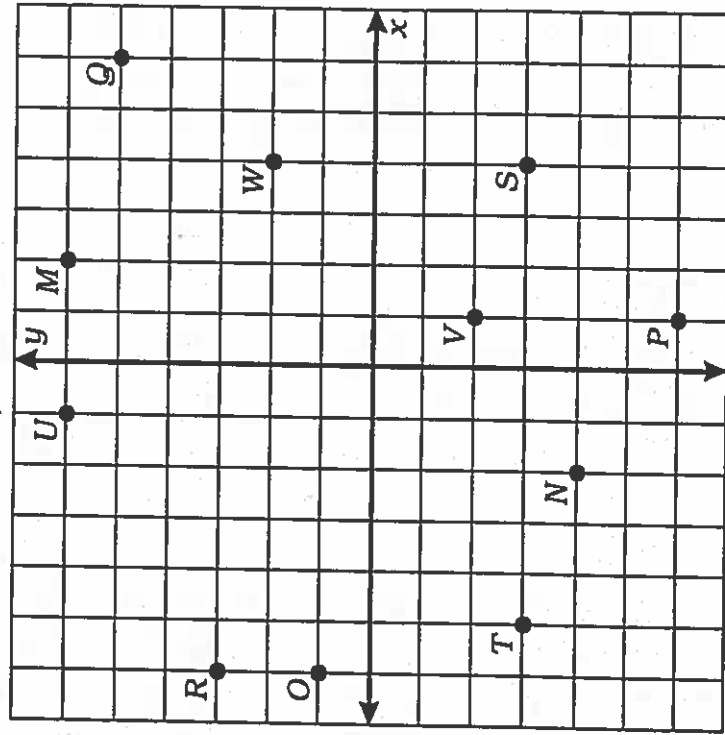
How Did the Light Dress Up For the Costume Party?

For each exercise, draw the line indicated and write its equation. Find your answer in the answer column and cross out the letter next to it. When you finish, the answer to the title question will remain.

Answers 1-6
A $y = 2x - 6$
N $y = \frac{2}{3}x - 4$
M $y = -\frac{4}{3}x - 4$
P $y = \frac{5}{6}x$
O $y = 2x + 3$
H $y = -\frac{1}{2}x + 3$
T $y = -3x + 5$
N $y = -\frac{4}{3}x - 1$
A $y = \frac{2}{3}x - 1$
F $y = -3x - 6$
B $y = -\frac{1}{2}x + 5$



- Equation of \overleftrightarrow{AB} _____
- Equation of \overleftrightarrow{CD} _____
- Equation of \overleftrightarrow{EF} _____
- Equation of \overleftrightarrow{GH} _____
- Equation of \overleftrightarrow{JK} _____
- Equation of \overleftrightarrow{KL} _____



- Equation of \overleftrightarrow{MN} _____
- Equation of \overleftrightarrow{OP} _____
- Equation of \overleftrightarrow{QR} _____
- Equation of \overleftrightarrow{ST} _____
- Equation of \overleftrightarrow{UV} _____
- Equation of \overleftrightarrow{SW} _____

Answers 7-12
G $y = -x - 5$
M $y = -4$
F $y = \frac{5}{2}x + 1$
O $y = -4x + 2$
F $x = 3$
A $y = -4x - 5$
T $y = -3$
S $y = \frac{5}{2}x + 4$
N $x = 4$
A $y = -x + 2$
M $y = \frac{1}{6}x + 4$

Writing an Equation Given Two Sets of Points - using the two sets of points, the slope and the y-intercept can be found.

Follow these steps: 1) use the points to find the slope using $m = \frac{y_1 - y_2}{x_1 - x_2}$ 2) put the slope and one set of points (it doesn't matter which one) into the slope-intercept formula to find the y-intercept 3) put the slope and the y-intercept into the formula to write the equation

Example

Write the equation given two sets of points
(6,-7), (3,-1)

Find the slope	Find the y-intercept	Write the equation
$m = \frac{y_1 - y_2}{x_1 - x_2}$	$y = mx + b$	$y = mx + b$
$m = \frac{-7 - (-1)}{6 - 3} = \frac{-7 + 1}{3} = \frac{-6}{3} = -2$	$-7 = -2(6) + b$	$y = -2x + 5$
	$-7 = -12 + b$	
	$\begin{array}{r} +12 \quad +12 \\ \hline 5 = \quad b \end{array}$	

Write the equation given two sets of points

1. (4,5), (2,1)

2. (3, -2), (-3,-8)

3. (-1,7), (1,5)

Writing An Equation Given Two Sets of Points Continued

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

5. $(3,4), (5,-4)$

6. $(-3,6), (-5,2)$

7. $(6,10), (3,-5)$

8. $(3,-3), (7,5)$

What Happened to the Guy Who Fell Into an Upholstery Machine?

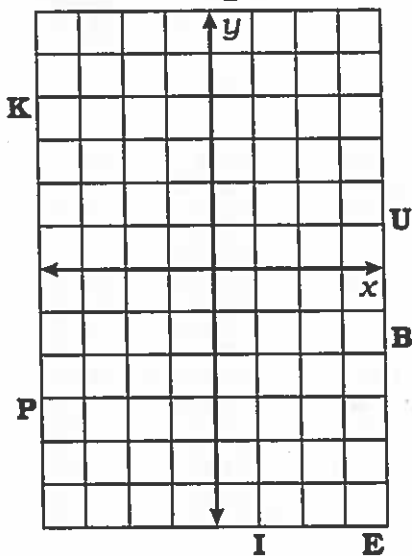


Use the slope and y-intercept to graph each equation. The graph, if extended, will cross a letter. Write this letter in the box containing the exercise number.

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

2 $y = -2x + 1$

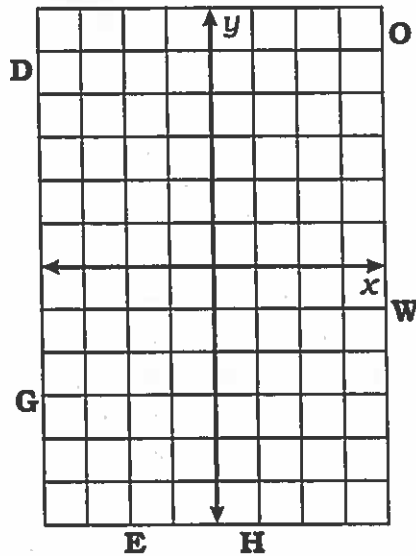
3 $y = -\frac{5}{2}x - 4$



4 $y = \frac{1}{3}x + 4$

5 $y = 3x - 1$

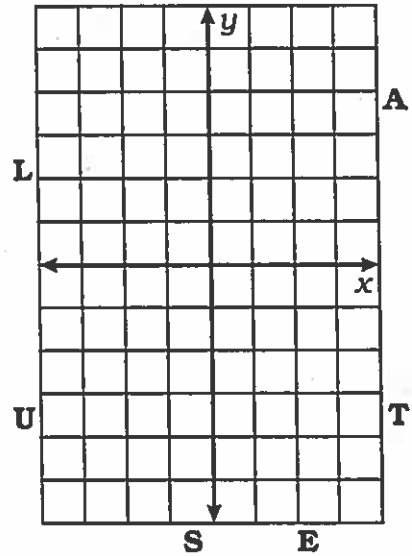
6 $y = -\frac{7}{4}x - 5$



7 $y = -\frac{1}{2}x$

8 $y = -4x + 3$

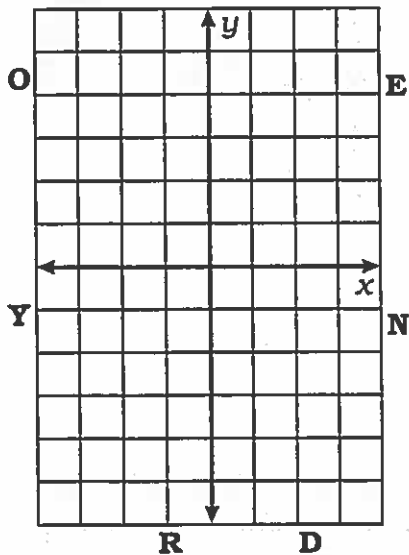
9 $y = \frac{8}{3}x - 5$



10 $y = x + 3$

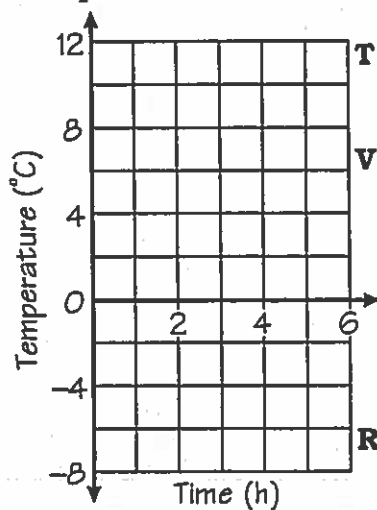
11 $y = -x - 4$

12 $y = x$



13 The temperature is -6°C and rising at a rate of 2° per hour.

14 The temperature is 12°C and dropping at a rate of 3° per hour.

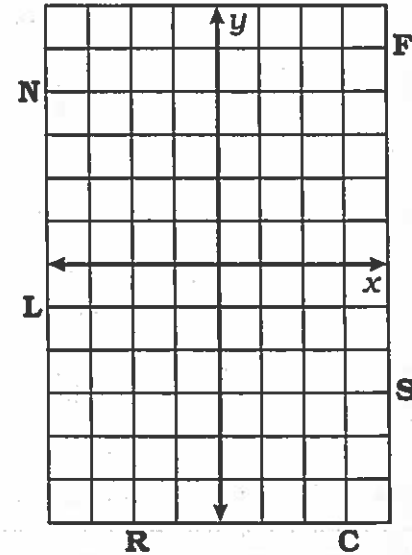


15 $y = 5$

17 $y = -1$

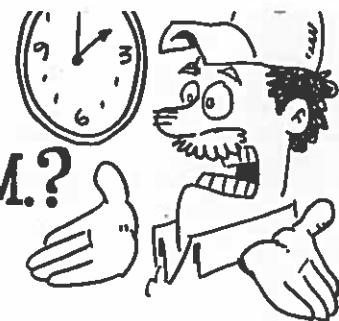
16 $x = -2$

18 $x = 3$



6	12	3	9	15	1	17	7	10	14	8	18	4	13	2	16	5	11
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What Did the Electrician Say To His Daughter When She Came Home at 2 A.M.?



Write each equation in slope-intercept form, then find your answer in the rectangle below. Write the letter of the answer in the box containing the exercise number.

1. $-6x + 3y = -9$

2. $5x - y = 1$

3. $2y - 3x = 10$

4. $2y + x = 14$

5. $x - 4y - 8 = 0$

6. $3y + 18 = -8x + 3$

7. $9x - 2y = 7$

8. $x + 5y = 8x - 20$

9. $-2(3y - 1) - x = 0$

Answers 1-9

ⓕ $y = \frac{3}{2}x - 4$

Ⓨ $y = -\frac{1}{2}x + 7$

Ⓢ $y = \frac{9}{2}x - \frac{7}{2}$

Ⓤ $y = 2x - 3$

Ⓤ $y = -\frac{8}{3}x - 5$

Ⓢ $y = 5x - 1$

ⓑ $y = -\frac{8}{3}x + 7$

Ⓝ $y = -\frac{1}{6}x + \frac{1}{3}$

ⓔ $y = \frac{7}{5}x - 4$

Ⓚ $y = \frac{1}{4}x + 5$

ⓐ $y = \frac{3}{2}x + 5$

ⓔ $y = \frac{1}{4}x - 2$

Write each equation in slope-intercept form, then use the slope and y-intercept to graph it. The graph will cross a letter outside the grid. Write this letter in the box containing the exercise number.

10. $2x - y = -1$

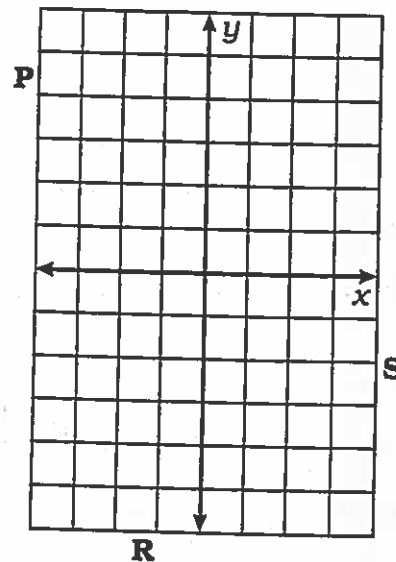
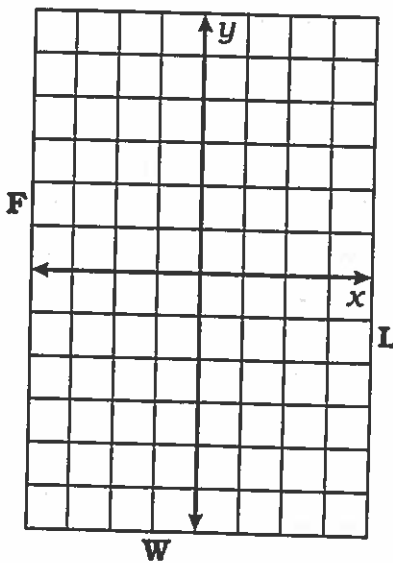
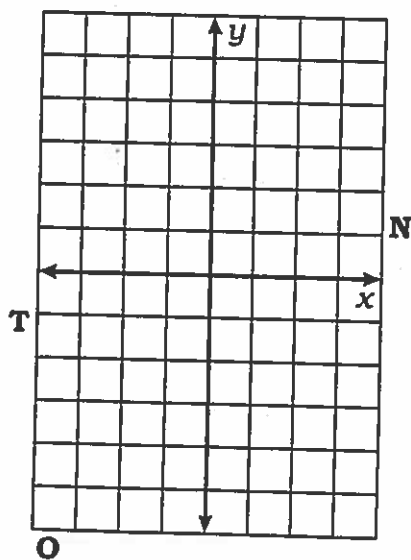
12. $4y + 20 = 5x$

14. $7x - 1 = 3y + 8$

11. $3y + 2x + 12 = 0$

13. $3(x - 1) = 2x - y$

15. $9x + 18y = 0$



	12	2	14	5	4	10	1	7	9	15	6	13	3	11	8
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