Algebra 2

Ch2

Mr. VanAlstine

Name:____

Hour____

Name________________________ Class________________ Date __________

Lesson 2-1

Relations and Functions

Lesson Objectives	NAEP 2005 Strand: Algebra
1 Graphing relations	Topic: Algebraic Representations
2 Identifying functions	Local Standards: ______________

Vocabulary

A relation is ______________________________

The domain of a relation is ______________________________

____

The range of a relation is ______________________________

____

A mapping diagram links ______________________________

____

A function is ______________________________

____

Use the vertical-line test to determine whether ______________________________

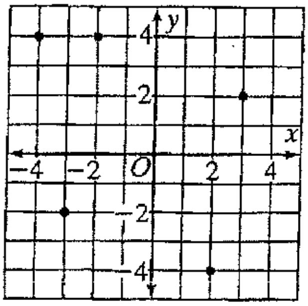
____

Function notation $f(x)$ is read as ______________________________

Note that $f(x)$ does *not* mean "f ☐ x."

Examples

① **Finding Domain and Range** Write the ordered pairs for the relation. Find the domain and range.



The domain is

The range is

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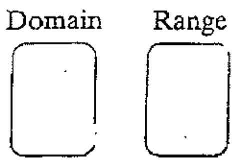
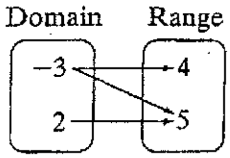
❷ Making a Mapping Diagram Make a mapping diagram for the relation $\{(-1,7),(1,3),(1,7),(-1,3)\}$.



Pair the domain elements with the range elements.

❸ Identifying Functions Determine whether the relation is a function.



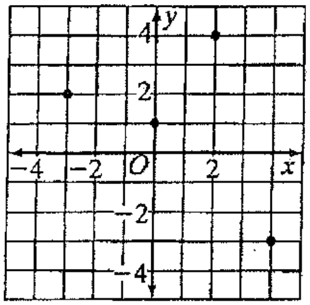
The element −3 of the domain is paired with both ______ and ______ of the range.

The relation ______ a function.

Quick Check

1. Find the domain and range of each relation.

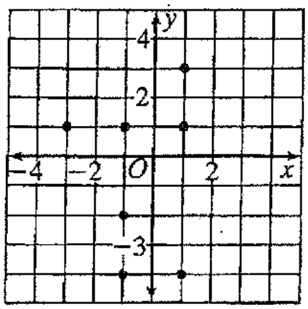
a.



domain:

range:

b.



domain:

range:

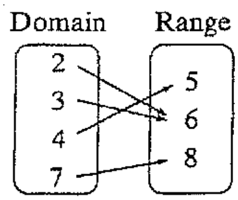
2. Make a mapping diagram for each relation.

a. $\{(0,2),(1,3),(2,4)\}$

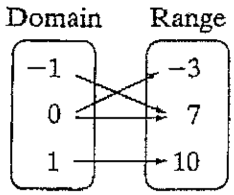
b. $\{(2,8),(-1,5),(0,8),(-1,3),(-2,3)\}$

3. Determine whether each relation is a function.

a.



b.



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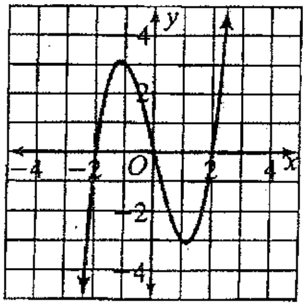
Examples

④ Using the Vertical-Line Test Use the vertical-line test to determine whether the graph represents a function.



If you move an edge of a ruler from left to ☐ across the graph, keeping the edge ☐ as you do so, you see that the edge of the ruler never intersects the graph in more than one point in any position. Therefore, the graph ☐ represent a function.

⑤ Evaluating Functions Find $f(2)$ for each function.

a. $f(x) = -x^2 + 1$

$f(2) =$

b. $f(x) = |3x|$

$f(\square) =$

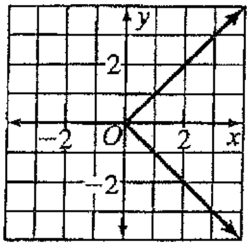
c. $f(x) = \frac{9}{1 - x}$

$f(\square) =$

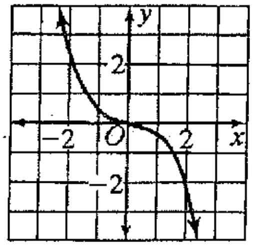
Quick Check

4. Use the vertical-line test to determine whether each graph represents a function.

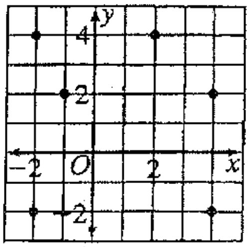
a.



b.



c.



5. Find $f(-3)$, $f(0)$, and $f(5)$ for each function.

a. $f(x) = 3x - 5$

b. $f(a) = \frac{3}{4}a - 1$

c. $f(y) = -\frac{1}{5}y + \frac{3}{5}$

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Practice 2-1 Show graphs + Work on Graph Paper (Next page in packet)

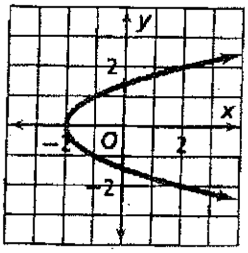
Relations and Functions

For each function, find $f(-2)$, $f\left(-\frac{1}{2}\right)$, $f(3)$, and $f(7)$.

1. $f(x) = 5x + 2$ **2.** $f(x) = -\frac{1}{3}x + 1$ **3.** $f(x) = -3x + 1.8$

Use the vertical line test to determine whether each graph represents a function.

4.



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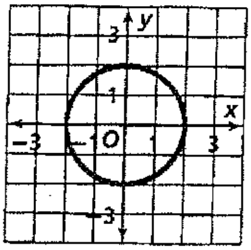

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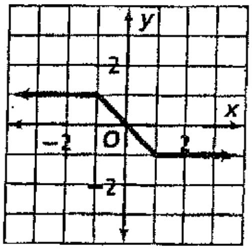


Graph each relation. Find the domain and range.

7. $\left\{(1, -2), \left(2, \frac{3}{4}\right), \left(3, 3\frac{1}{2}\right), (5, 9)\right\}$

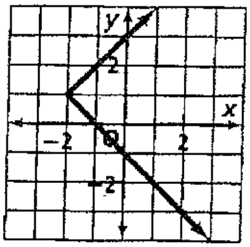
8. $\{(-3, 5), (0, -2), (0, 4), (1, -2)\}$

9. $\{(-1, 2), (2, 2), (3, 2)\}$

10. $\{(0.5, -1), (0.5, 0), (0.5, 1), (0.5, 3)\}$

Determine whether each graph represents y as a function of x.

11.



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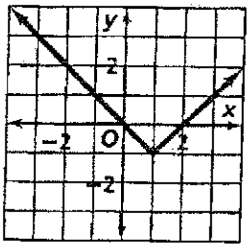

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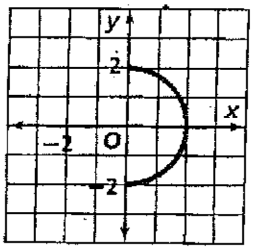

Make a mapping diagram for each relation, and determine whether it is a function.

14. $\{(1, 2), (2, 3), (2, 4), (3, 5)\}$

15. $\{(-1, 1), (0, 0), (1, 1), (2, 4), (3, 9)\}$

Suppose $f(x) = -3x + 2$ and $g(x) = \frac{1}{2}x - 1$. Find each value.

16. $f\left(\frac{1}{3}\right)$ **17.** $3g(4)$ **18.** $\frac{g(-2)}{f(3)}$ **19.** $\frac{f(-1)}{g(5)}$

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Lesson 2-2

Linear Equations

Lesson Objectives
1. Graphing linear equations
2. Writing equations of lines

NAEP 2005 Strand: Algebra
Topics: Patterns, Relations, and Functions; Algebraic Representations

Local Standards: ____________________

Vocabulary and Key Concepts

⤵ Most important stuff to memorize!

Slope Formula

$$\text{slope} = \frac{\boxed{}\ \text{change (rise)}}{\boxed{}\ \text{change (run)}} = \frac{\boxed{} - \boxed{}}{\boxed{} - \boxed{}}, \text{ where } x_2 - x_1 \neq 0$$

Point-Slope Form

The line through point (x_1, y_1) with $\boxed{}$ m has the equation below.

Slope-Intercept Form

$\boxed{}$ $\boxed{}$

$y = mx + b$

Equations of a Line

$\boxed{}$ Form	$\boxed{}$ Form	$\boxed{}$ Form
$y - 2 = -3(x + 4)$	$3x + y = -10$	$y = -3x - 10$

A linear function is ______________________________

A linear equation is ______________________________

The standard form of a linear equation is ______________________________

____

In a linear equation, the dependent variable is ______________________________

____

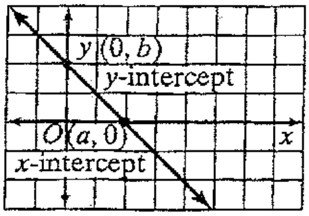
In a linear equation, the independent variable is ____________

The y-intercept of a line is ______________________________

____

The x-intercept of a line is ______________________________

____



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Examples

❶ **Graphing a Linear Equation** The equation $10x + 5y = 40$ models how you can give $.40 change if you have only dimes and nickels. The variable x is the number of dimes, and y is the number of nickels. Graph the equation. Explain what the x- and y-intercepts represent. Describe the domain and the range.

find "x int" $10x + 5y = 40$

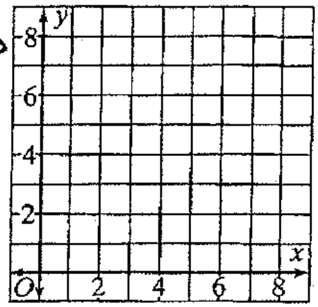
$10x + 5y = 40$ find "y-intercept"

Set x or y equal to zero to find each intercept.

$x =$ ☐

$y =$ ☐

Use the intercepts to graph the equation.



The x-intercept is ☐, which means that the change can be given using ☐ dimes and 0 nickels. The y-intercept is ☐, which means that the change can be given using ☐ dimes and ☐ nickels.

*discuss Graph

❷ **Finding Slope** Find the slope of the line through the points $(-2, 7)$ and $(8, -6)$.

$\boxed{\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}}$ **Use the slope formula.**

The slope of the line is ☐.

Quick Check

1. Find the slope of the line through each pair of points.
   - **a.** $(-2, -2)$ and $(4, 2)$
   - **b.** $(0, -3)$, and $(7, -9)$

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Examples

❸ **Writing an Equation Given the Slope and a Point** Write the point Slope equation of the line with slope 3 through the point (−1, 5).

(x, y)

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

*Now put into Standard form: Ax+BY=C

❹ **Writing an Equation Given Two Points** Write in Slope Intercept form an equation of the line through (4, −3) and (5, −1).

$y = mx + b$

m=

b=

Quick Check

Ax+By=C

2. Write in standard form the equation of each line. by
   a. slope 2, through (4, −2)
   b. slope $\frac{5}{6}$, through (5, 6)

3. Write in Slope Intercept form the equation of the line through each pair of points.
   a. (5, 0) and (−3, 2)
   b. (5, 1) and (−4, −3)

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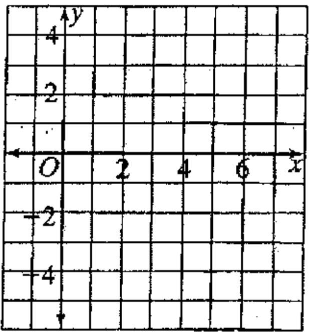
Examples

❺ Finding Slope Using Slope-Intercept Form Find the slope of $-7x + 2y = 8$.

❻ Writing an Equation of a Perpendicular Line Write an equation of the line through $(5, -3)$ and perpendicular to $y = 4x + 1$. Graph both lines.



How to graph $y=mx+b$?

1. plot the b (yintercept)
2. from that point, plot your m (slope = rise↑ then over→run) Plot that point
3. draw Line

Quick Check

4. Find the slope of each line.

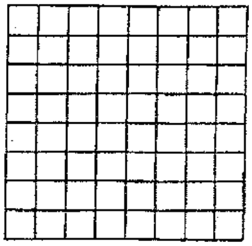
a. $3x + 2y = 1$

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

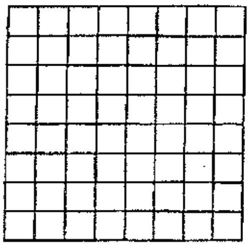
c. $Ax + By = C$

5. Write an equation for each line. Then graph the line.

a. through $(-1, 3)$ and perpendicular to the line $y = 5x - 3$



b. through $(2, 1)$ and parallel to the line $y = \frac{2}{3}x + \frac{5}{8}$



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Reteaching 2-2

Linear Equations

OBJECTIVE: Using the slope-intercept form to write equations of lines

MATERIALS: None

- The slope-intercept formula is $y = mx + b$, where m represents the slope of the line, and b represents its y-intercept. The y-intercept is the point at which the line crosses the y-axis.
- The slope of a horizontal line is always zero, and the slope of a vertical line is always undefined.

Example

Find the equation of the line that contains the point $(3, -1)$ and has a slope of $-\frac{4}{3}$.

$$-1 = \left(-\frac{4}{3}\right)(3) + b$$

← **To find b, substitute the values $-\frac{4}{3}$ for m, 3 for x, and -1 for y into the slope-intercept formula.**

$$-1 = -4 + b$$

$$3 = b$$

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

← **Substitute $-\frac{4}{3}$ for m and 3 for b into the slope-intercept formula.**

Exercises

Write the equation of each line. Show ALL work on Next blank page!

1. $m = 4$; contains $(3, 2)$

2. $m = -2$; contains $(4, 7)$

3. $m = 0$; contains $(3, 0)$

4. $m = -1$; contains $(-5, -2)$

5. $m = 3$; contains $(-2, -4)$

6. $m = 0$; contains $(0, -7)$

7. $m = 8$; contains $(5, 0)$

8. $m = -1$; contains $(0, 7)$

9. $m = 0$; contains $(3, 8)$

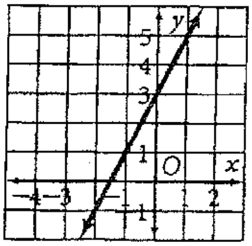
10. $m = 4$; contains $(2, 5)$

11. $m = 7$; contains $(3, 2)$

12. $m = -1$; contains $(2, -6)$

Write the equation of each line.

13.



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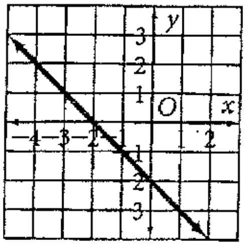

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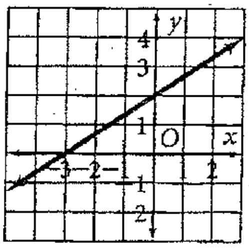

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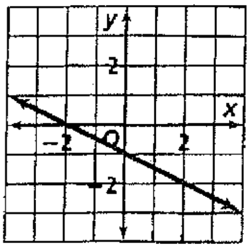
Practice 2-2 Show Work and Staple on sep. paper

Linear Equations

Find the slope of each line.

1. $2x - 5y = 0$
2. $5x - y = -7$
3. $x - \frac{2}{3}y = \frac{1}{4}$

4.



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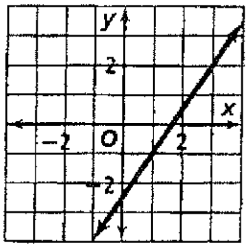

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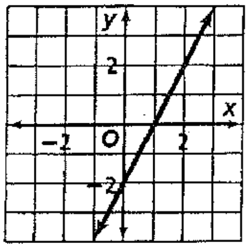

7. through $(4, -1)$ and $(-2, -3)$
8. through $(3, -5)$ and $(1, 2)$

Write in point-slope form the equation of the line through each pair of points.

9. $(0, 1)$ and $(3, 0)$
10. $\left(\frac{1}{2}, \frac{2}{3}\right)$ and $\left(-\frac{3}{2}, \frac{5}{3}\right)$
11. $(-3, -2)$ and $(1, 6)$

Graph each equation.

12. $4x + 3y = 12$
13. $\frac{x}{3} - \frac{y}{6} = 1$
14. $y = -\frac{3}{2}x + \frac{1}{2}$

Write in standard form an equation of the line with the given slope through the given point.

15. slope $= -4$; $(2, 2)$
16. slope $= \frac{2}{5}$; $(-1, 3)$
17. slope $= 0$; $(3, -4)$

Find the slope and the intercepts of each line.

18. $3x - 4y = 12$
19. $y = -2$
20. $f(x) = \frac{4}{5}x + 7$
21. $x = 5$

Write an equation for each line. Then graph the line.

22. through $(-1, 3)$ and parallel to $y = 2x + 1$
23. through $(2, 2)$ and perpendicular to $y = -\frac{3}{5}x + 2$
24. through $(-3, 4)$ and vertical
25. through $(4, 1)$ and horizontal

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Lesson 2-3

Direct Variation

Lesson Objective	**NAEP 2005 Strand:** Algebra
1 Writing and interpreting a direct variation	**Topic:** Algebraic Representations **Local Standards:** ____________________

Vocabulary

Direct variation is ____

____

The constant of variation is ______________________________________

____

Examples

① **Identifying Direct Variation from an Equation** For each function, tell whether y varies directly with x. If so, find the constant of variation.

a. $3y = 7x + 7$

Since you cannot write the equation in the form $y = kx$, y does $\boxed{\quad\quad}$ vary directly with x.

b. $5x = -2y$

$5x = -2y$ is equivalent to $y = \boxed{\quad}$, so y varies directly with x.

The constant of variation is $\boxed{\quad}$.

② **Finding Constant Variation** The perimeter of a square varies directly as the length of a side of the square. The formula $P = 4s$ relates the perimeter to the length of a side.

a. Find the constant of variation.

b. Find how long a side of the square must be for the perimeter to be 64 cm.

$P = 4s$ **Use the direct variation.**

The sides of the square must have length $\boxed{\quad}$ cm.

Quick Check

1. For each function, determine whether y varies directly with x. If so, find the constant of variation.

a. $y = \frac{x}{2}$ **b.** $2y - 1 = x$ **c.** $\frac{5}{6}x = \frac{1}{3}y$

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Example

3 Using a Proportion Suppose y varies directly with x, and $y = 15$ when $x = 27$. Find y when $x = 18$. Let $(x_1, y_1) = (27, 15)$ and let $(x_2, y_2) = (18, y)$.

$y=K_1X_1$ $y_2=K_2 \cdot X_2$

$K=\frac{y_1}{X_1}$ $K=\frac{y_2}{X_2}$

$$\boxed{\frac{y_1}{X_1}=\frac{y_2}{X_2}}$$

Direct Variation Formula

Quick Check

2. The circumference of a circle varies directly with the diameter of the circle. The formula $C = \pi d$ relates the circumference to the diameter.
   a. What is the constant of variation?
   b. Find the diameter of a circle with circumference 105 cm to the nearest tenth.

3. Find the missing value for each direct variation.
   a. If $y = 4$ when $x = 3$, find y when $x = 6$.
   b. If $y = 7$ when $x = 2$, find y when $x = 8$.
   c. If $y = 10$ when $x = -3$, find x when $y = 2$.

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Reteaching 2-3

Direct Variation

Exercises

Find the missing value for each direct variation. Show Work Above

1. If $y = 8$ when $x = 4$, find y when $x = 6$.

2. If $y = 12$ when $x = 3$, find y when $x = 5$.

3. If $y = 9$ when $x = 3$, find x when $y = 7$.

4. If $y = -6$ when $x = 2$, find x when $y = 9$.

5. If $y = \frac{3}{2}$ when $x = \frac{1}{4}$, find y when $x = \frac{2}{3}$.

6. If $y = 7$ when $x = 2$, find x when $y = 3$.

7. The height of an object varies directly with the length of its shadow. A person 6 ft tall casts an $8\frac{1}{2}$ ft shadow, while a tree casts a 38 ft shadow. How tall is the tree?

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Practice 2-3 Show work on this page is OK.

Direct Variation

For each direct variation, find the constant of variation. Then find the value of y when $x = 3$.

1. $y = 3$ when $x = -2$
2. $y = \frac{3}{4}$ when $x = \frac{1}{8}$
3. $y = -\frac{3}{8}$ when $x = -\frac{2}{3}$

Determine whether y varies directly as x. If so, find the constant of variation.

4. $y = \frac{4}{9}x$
5. $y = -1.2x$
6. $y + 4x = 0$
7. $y - 3x = 1$
8. $y = 3x$
9. $y + 2 = x$
10. $y - \frac{3}{5}x = 0$
11. $y = -3.5x + 7$

For each function, determine whether y varies directly as x. If so, find the constant of variation and write the equation.

12.

x	y
1	1
2	4
3	9

13.

x	y
−1	−3
1	3
3	9

14.

x	y
−2	−1
2	1
5	$\frac{5}{2}$

15.

x	y
−2	−3
0	1
1	3

Write an equation for a direct variation with a graph that passes through each point.

16. $(6, 2)$
17. $(-1.5, 9)$
18. $(-5, 90)$
19. $(7, 3)$
20. $\left(-1, -\frac{2}{3}\right)$
21. $\left(\frac{3}{5}, -\frac{7}{2}\right)$
22. $(10, 25)$
23. $(3, 165)$

In Exercises 24–27, y varies directly as x.

24. If $y = 3$ when $x = 2$, find x when $y = 5$.
25. If $y = -4$ when $x = \frac{1}{2}$, find y when $x = \frac{2}{3}$.
26. If $y = -14$ when $x = -7$, find x when $y = 22$.
27. If $y = \frac{5}{17}$ when $x = 10$, find y when $x = 5$.
28. A 15-minute long-distance telephone call costs \$.90. The cost varies directly as the length of the call. Write an equation that relates the cost to the length of the call. How long is a call that costs \$1.32?
29. The distance a spring stretches varies directly as the amount of weight that is hanging on it. A weight of 2.5 pounds stretches a spring 18 inches. Find the stretch of the spring when a weight of 6.4 pounds is hanging on it.

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Lesson 2-4

Using Linear Models

Lesson Objectives

1 Modeling real-world data

2 Predicting with linear models

NAEP 2005 Strand: Algebra

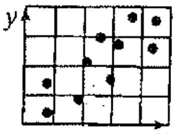
Topics: Algebraic Representations; Variables, Expressions, and Operations; Equations and Inequalities

Local Standards: ____________________

Vocabulary

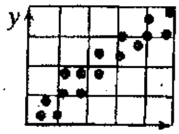
A scatter plot is ____

____



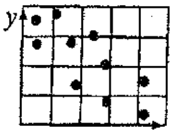
Weak

__________ correlation



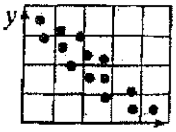
Strong

__________ correlation



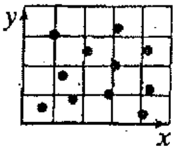
Weak

__________ correlation



Strong

__________ correlation



__________ correlation

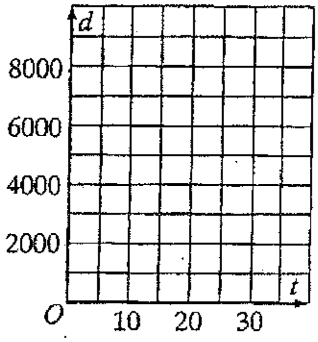
A trend line is ____

____

Examples

① **Transportation** Suppose an airplane descends at a rate of 300 ft/min from an elevation of 8000 ft.

Write and graph an equation to model the plane's elevation as a function of the time it has been descending. Interpret the intercept at which the graph intersects the vertical axis.



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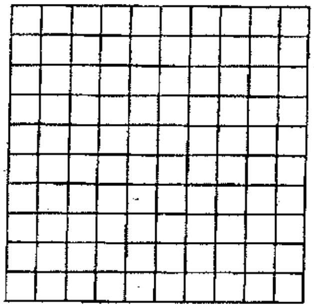
Quick Check

1. Suppose a balloon begins descending at a rate of 20 ft/min from an elevation of 1350 ft.

   a. Write an equation to model the balloon's elevation as a function of time. What is true about the slope of this line?

   b. Graph the equation. Interpret the h-intercept.



$t=0 \quad h=?$

$t=1 \quad h=?$

$m=$

$b=$

2. A candle is 7 in. tall after burning for 1 h, and 5 in. tall after burning for 2 h. Write a linear equation to model the height of the candle.

$t=1\text{ hr} \quad h=7$

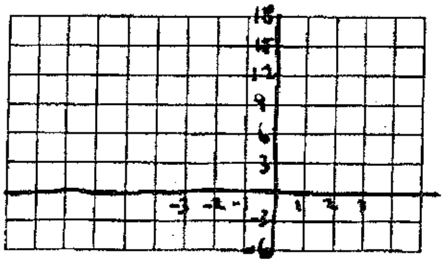
$t=2\text{ hr} \quad h=5$

$m=$

$b=$

3. Graph the data points. Decide whether a linear model is reasonable. If so, draw a trend line and write its equation. * pick 2 "good points" to make the equation!

   $\{(-7.5, 19.75), (-2, 9), (0, 6.5), (1.5, 3), (4, -1.5)\}$



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Activity 35: Making a Scatter Plot

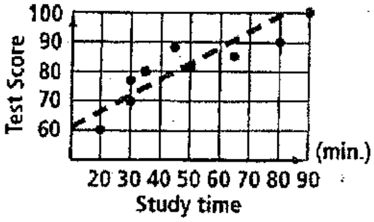
*Graphing Calculator Exploration

MATERIALS: ruler, tape measure

In this activity, you will make a scatter plot to show the relationship between two variable quantities.

To understand the procedure, read the table below, listing the number of minutes several students spent studying for a math test and the scores they achieved on the test. Then look at the *scatter plot* based on this table.

	Students								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Study Time (in min.)	20	65	30	90	45	30	80	50	35
Test Score	60	85	70	100	88	77	90	82	80



The straight dotted line in the scatter plot shows the *line of best fit* of the given data. It is the line that the data points cluster about. Since the slope of this line is positive, there is a *positive* correlation between study times and tests scores. A negative slope indicates a *negative* correlation between the times and scores. If the data does not cluster about any single line, they are *unrelated*.

Split into groups of between 7 and 9 students. Each group will make a scatter plot of foot length and height (in either centimeters or inches) of the students in the group.

1. With a ruler, measure the length of the right foot of each group member, and with a tape measure, determine the height of each student. Fill in the data you find in the following table.

	Students								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Foot Length									
Height									

2. Make a scatter plot of the data: Mark foot lengths on the vertical axis and heights on the horizontal axis. Plot the values you wrote down in the table above.

3. From your scatter plot, is there a correlation between foot length and height? ____________ If so, is it positive? ____________________

4. Measure the height and the circumference of the head of each group member and make a scatter plot of the data. Is there a positive correlation between the data? ____________________

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Lesson 2-5

Absolute Value Functions and Graphs

Lesson Objective
1 Graphing absolute value functions

NAEP 2005 Strand: Algebra
Topic: Algebraic Representations
Local Standards: ____________________

Vocabulary

An absolute value function is ____

____

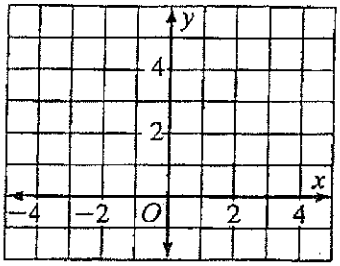
The vertex of a function is ____

____

Examples

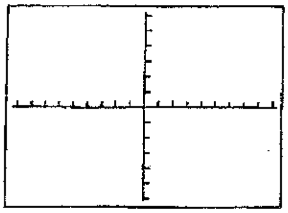
① **Graphing an Absolute Value Function** Graph $y = |2x - 1|$ by using a table of values. Evaluate the equation for several values of x. Make a table of values.

	−1.5	−1	−0.5	0	0.5	1	1.5	2	2.5
	4								



Graph the function.

② **Using a Graphing Calculator** Graph $y = |x - 3| - 1$ on a graphing calculator. Use the absolute value key. Graph the equation $Y_1 = \text{abs}(X - 3) - 1$.



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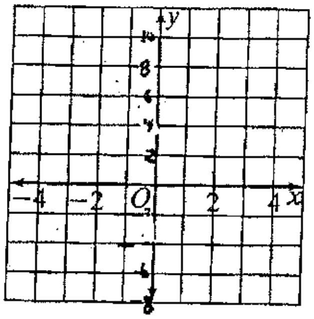
③ **Writing Two Linear Equations** Use the definition of absolute value to graph $y = |3x + 6| - 2$.

step1 find the Vertex. Set Abs value equal to zero. Solve for x. find y.

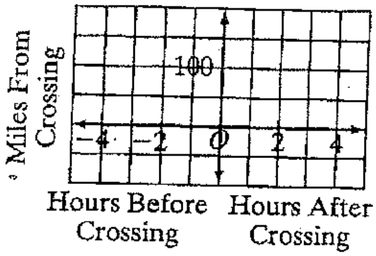
Step 2 find one x point on each side of the vertex

x	y

Step 3 Sketch graph



④ **Travel** A train traveling on a straight track at 50 mi/h passes a certain crossing halfway through its journey each day. Sketch a graph of its trip based on its distance and time from the crossing.

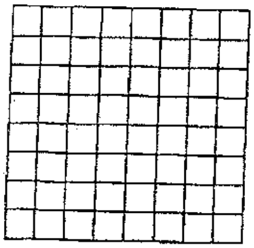


The equation $d = |50t|$ models the train's distance from the crossing.

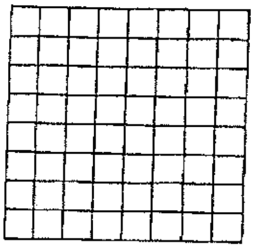
Quick Check

1. Graph each equation.

a. $y = |2x - 5|$



b. $y = -|x + 1| - 2$



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2. Graph each equation on a graphing calculator. Then sketch the graph.

a. $y = -|-x| + 5$

b. $y = 3 - \left|\frac{x}{2}\right|$

3. Graph each equation on calculator. Then sketch the graph.

a. $y = \left|\frac{3}{2}x + 4\right| - 3$

b. $y = 2 - |x + 1|$

4. a. Use the information from Example 4. Suppose the same train travels at a speed of 25 mi/h. How would the graph of the train's journey change?

b. Sketch a new graph.

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Reteaching 2-5

Absolute Value Functions and Graphs

Exercises

Find the vertex of each absolute value function.

1. $f(x) = |5x|$
2. $f(x) = |x + 3|$
3. $f(x) = |x - 4|$
4. $f(x) = |3x + 1|$
5. $f(x) = \left|\frac{1}{2}x - 3\right|$
6. $f(x) = \left|\frac{1}{4}x + 2\right|$

Find the vertex of each absolute value function. Then graph the function by plotting several other points. Show ALL Graphs Above!

7. $f(x) = |2x - 1|$

9. $f(x) = |2x + 4|$

11. $f(x) = |x - 2|$

13. $f(x) = |3x|$

14. $f(x) = \left|\frac{1}{2}x + 1\right|$

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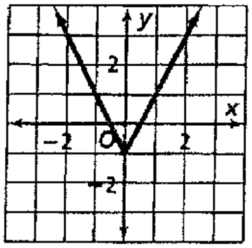
Practice 2-5

Absolute Value Functions and Graphs

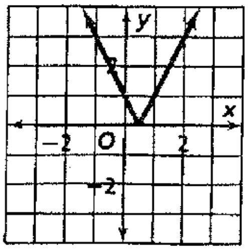
Match each equation with its graph.

1. $y = |x - 1|$
2. $y = 2|x - 1|$
3. $y = |2x| - 1$
4. $y = |x| - 1$
5. $y = |2x - 1|$
6. $y = |2x| - 2$

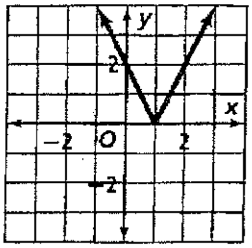
A.



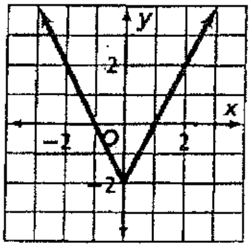
B.



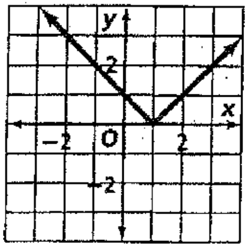
C.



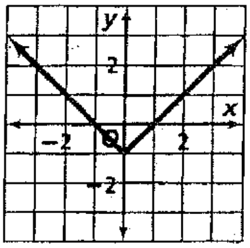
D.



E.



F.



Graph each absolute value equation. graph Below - make several small graphs

13. $y = |3 - x|$
14. $y = -\frac{2}{3}\left|\frac{1}{3}x\right|$
15. $y = 3 - |x + 1|$
16. $y = -|-x - 2|$
18. $y = -|x| + 2$

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Lesson 2-6

Families of Functions

Lesson Objectives	**NAEP 2005 Strand:** Algebra
① Analyzing translations	**Topic:** Algebraic Representations
② Analyzing stretches, shrinks, and reflections	**Local Standards:** ____________________

Vocabulary

A translation is ____

____

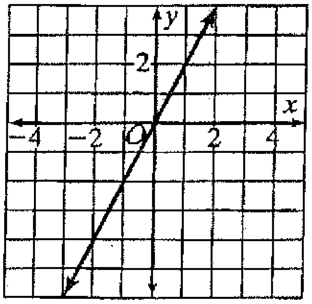
A parent function is ____

____

Examples

① a. **Vertical Translation** Describe the translation $y = 2x - 3$ and draw its graph.

The parent is $y = 2x$, and $k = -$☐. Translate the graph of $y = 2x$ ☐ 3 units.



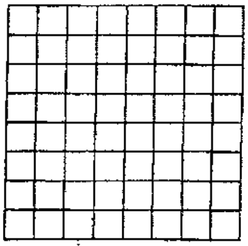
b. Write an equation to translate the graph of $y = |4x|$ down 5 units.

The graph of $y = |4x|$, shifted 5 units down, means $k =$ ☐.
An equation is $y =$ ☐.

Quick Check

1. a. Describe the translation $y = |x| + 1$. Then draw the graphs of $y = |x|$ and $y = |x| + 1$ in the same coordinate plane.

☐



b. Write an equation for the translation of $y = |x|$

i. down $\frac{1}{2}$ unit.

☐

ii. up 3.5 units.

☐

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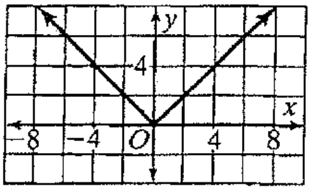
flip if negative   Steepness   horiz. shift   vertical shift

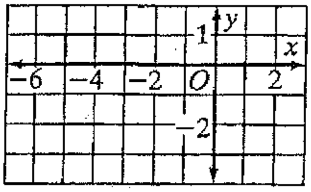
$y = a \cdot |x-h| + K$

Examples

❷ a. **Horizontal Translations** The dashed graph at the right is a translation of $y = |x|$. Write an equation for the graph.
The parent function is $y =$ ☐, and $h =$ ☐. Translate the graph of $y = |x|$ right ☐ units. The equation of the translated graph is $y =$ ☐.



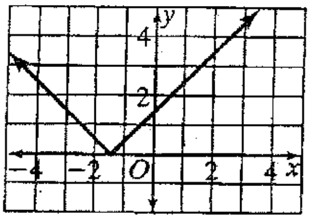
b. Describe the translation $y = -|x + 3|$ and draw its graph.
Translate the graph of $y = -|x|$, 3 units ☐.



Quick Check

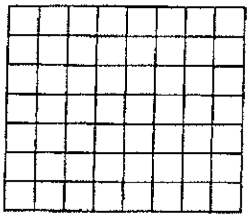
2. a. The graph is a translation of $y = |x|$. Write an equation for the graph.

☐



b. Describe the translation $y = |x - 1|$. Then draw the graphs of $y = |x|$ and $y = |x - 1|$ in the same coordinate plane.

☐



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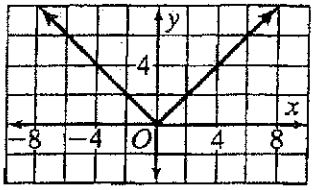
flip if negative   Steepness   horiz. shift   vertical shift

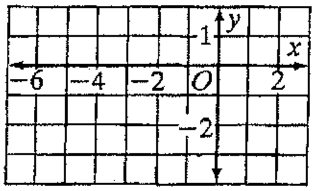
$$y = a \cdot |x - h| + K$$

Examples

② a. **Horizontal Translations** The dashed graph at the right is a translation of $y = |x|$. Write an equation for the graph. The parent function is $y =$ ______, and $h =$ ______. Translate the graph of $y = |x|$ right ______ units. The equation of the translated graph is $y =$ ______.



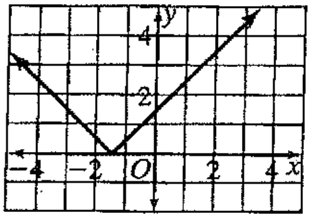
b. Describe the translation $y = -|x + 3|$ and draw its graph. Translate the graph of $y = -|x|$, 3 units ______.



Quick Check

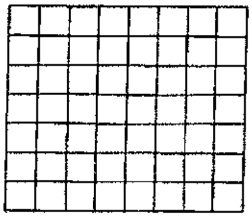
2. a. The graph is a translation of $y = |x|$. Write an equation for the graph.

______



b. Describe the translation $y = |x - 1|$. Then draw the graphs of $y = |x|$ and $y = |x - 1|$ in the same coordinate plane.

______



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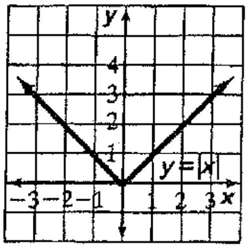
Examples

❸ Graphing $y = a|x|$.

a. Describe and then draw the graph of $y = 3|x|$.

b. Write an equation for a vertical shrink of $y = |x|$ by a factor of $\frac{1}{4}$.



❹ Graphing $y = -a|x|$.

Multiple Choice Which equation describes the graph?

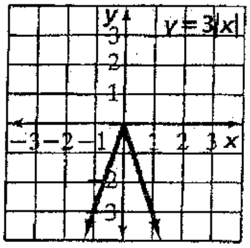
A. $y = 3|x|$

B. $y = -3|x|$

C. $y = \frac{1}{3}|x|$

D. $y = -\frac{1}{3}|x|$

The parent function is $y = |x|$. This is a reflection across the x-axis of $y =$ ☐. The answer is ☐.

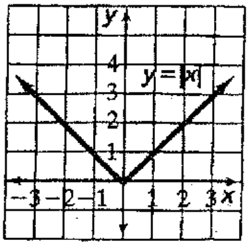


Quick Check

3. **a.** Describe the stretch or shrink $y = \frac{1}{3}|x|$. Then draw the graphs of $y = |x|$ and $y = \frac{1}{3}|x|$ in the same coordinate plane.

   b. Write an equation for the vertical stretch of $y = |x|$ by a factor of 3.

   ☐



4. A function is a vertical stretch of $y = |x|$ by a factor of 5. Write an equation for the reflection of the function across the x axis.

   ☐

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Reteaching 2-6

Families of Functions

OBJECTIVE: Analyzing vertical, horizontal, and combined translations of the absolute value function

MATERIALS: Graph paper

If h and k are positive numbers, then

$g(x) = |x| + k$ shifts the graph of $f(x) = |x|$ up k units;

$g(x) = |x| - k$ shifts the graph of $f(x) = |x|$ down k units;

$g(x) = |x + h|$ shifts the graph of $f(x) = |x|$ left h units;

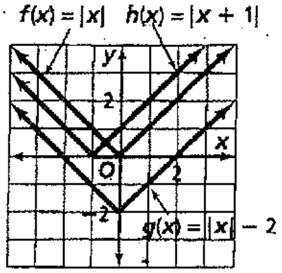
$g(x) = |x - h|$ shifts the graph of $f(x) = |x|$ right h units.

Examples

Graph each translation of $f(x) = |x|$.

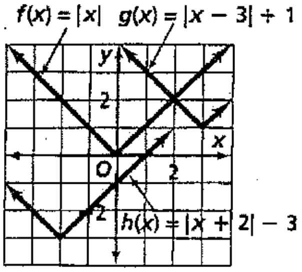
1. a. $g(x) = |x| - 2$ ← **Shift the graph of $f(x) = |x|$ down 2 units.**

   b. $h(x) = |x + 1|$ ← **Shift the graph of $f(x) = |x|$ left 1 unit.**



2. a. $g(x) = |x - 3| + 1$ ← **Shift the graph of $f(x) = |x|$ right 3 units and up 1 unit.**

   b. $h(x) = |x + 2| - 3$ ← **Shift the graph of $f(x) = |x|$ left 2 units and down 3 units.**



Exercises

Complete each sentence. Then graph the translation of $f(x) = |x|$.

1. $g(x) = |x - 2|$ ← Shift the graph of $f(x) = |x|$ _____ 2 units.
2. $g(x) = |x| + 1$ ← Shift the graph of $f(x) = |x|$ _____ 1 unit.
3. $g(x) = |x| - 3$ ← Shift the graph of $f(x) = |x|$ _____ 3 units.
4. $g(x) = |x + 3|$ ← Shift the graph of $f(x) = |x|$ _____ 3 units.
5. $g(x) = |x - 1| - 5$ ← Shift the graph of $f(x) = |x|$ _____ 1 unit and _____ 5 units.
6. $g(x) = |x + 4| + 2$ ← Shift the graph of $f(x) = |x|$ _____ 4 units and _____ 2 units.

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Practice 2-6

Families of Functions

Describe each translation of $f(x) = |x|$ as vertical, horizontal, or combined. Then graph each translation.

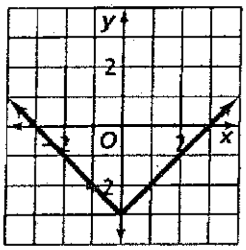
1. $f(x) = |x + 2|$
2. $f(x) = |x + 4|$
3. $f(x) = |x| - 5$
4. $f(x) = |x + 1| - 1$
5. $f(x) = |x - 2| + 1$
6. $f(x) = \left|x - \frac{3}{2}\right|$

Write an equation for each translation.

7. $y = |x|$, 1 unit up, 2 units left
8. $y = |x|$, 4 units right
9. $y = -|x|$, 3 units up, 1 unit right
10. $y = -|x|$, $\frac{3}{2}$ units down, $\frac{1}{2}$ unit right
11. $y = |x|$, 2 units down, 3 units left
12. $y = -|x|$, $\frac{3}{5}$ unit up

Write the equation of each translation of $y = |x|$.

13.



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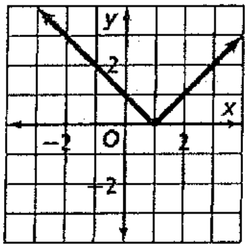

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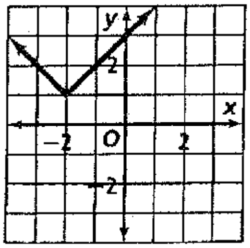
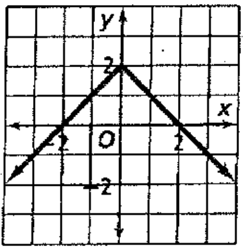


Write the equation of each translation of $y = -|x|$.

16.



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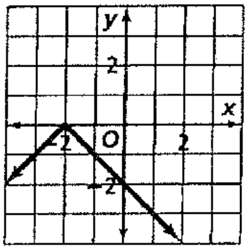

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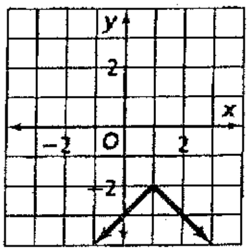
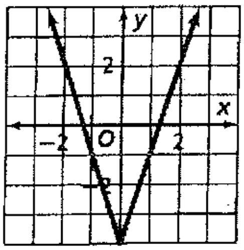


Write the equation for each graph.

19.



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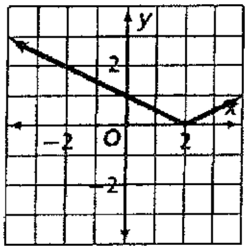

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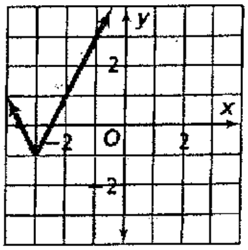

Graph each equation.

22. $y = 3|x|$
23. $y = 2|x| - 3$
24. $y = \frac{1}{2}|x - 1|$

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Lesson 2-7

Two-Variable Inequalities

Lesson Objectives	**NAEP 2005 Strand:** Algebra
① Graphing linear inequalities	**Topic:** Equations and Inequalities
② Graphing absolute value inequalities	**Local Standards:** ____________________

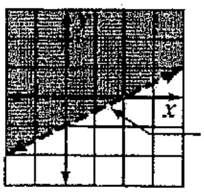
Vocabulary

A linear inequality is ______________________________

____

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

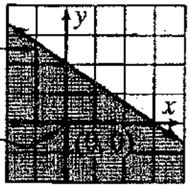
To satisfy the inequality, y-values must be greater than those on the boundary lines.



A ____ boundary line indicates that the line is not part of the solution.

A ____ boundary line indicates that the line is part of the solution.

$2x + 3y \leq 6$



Choose a test point above or below the boundary line.

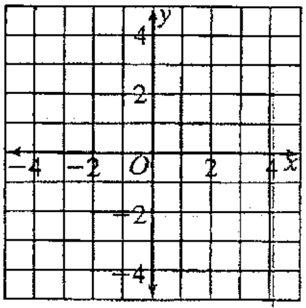
The test point (0, 0) makes the inequality ____.

Shade the region ____ this point.

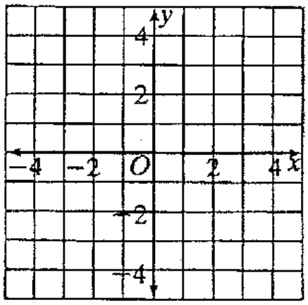
Examples

① **Graphing a Linear Inequality** Graph $y > \frac{3}{2}x + 1$.

Step 1 Graph the boundary line $y=\frac{3}{2}x+1$. Since the inequality is *greater than*, not *greater than or equal to*, use a dotted boundary line.



Step 2 Since the inequality is *greater than*, y-values must be above those on the boundary line. Shade the region Above the boundary line.



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② **Graphing a Linear Inequality** A restaurant has only 15 eggs until more are delivered. An order of scrambled eggs requires 2 eggs. An omelet requires 3 eggs. Write an inequality to model all possible combinations of orders of scrambled eggs and omelets the restaurant can fill until more eggs arrive. Graph the inequality.

Relate number of eggs needed for x orders of scrambled eggs plus number of eggs needed for y orders of omelets is less than or equal to 15

Define Let x = the number of orders for scrambled eggs.

Let y = the number of orders for omelets.

Write 2___ + 3___ ___ ___

Step 1 Find two points on the boundary line.

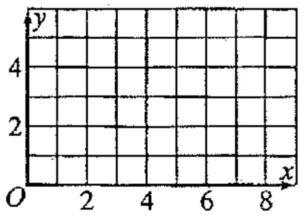
Xint: When $y = 0$, When $x = 0$, y-int:

$x =$ ___ $y =$ ___

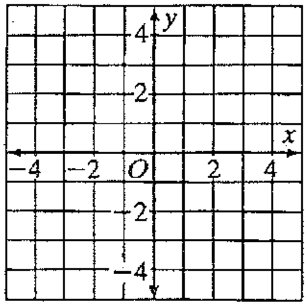
Graph the points (___, ___) and (___, ___). Since the inequality is *less than or equal to*, use a ___ boundary line.

Step 2 Since the inequality is *less than*, y-values must be less than than those on the boundary line. Shade the region ___ the boundary line.

All ordered pairs with whole-number coordinates in the shaded area and on the boundary line represent a combination of x orders of scrambled eggs and y orders of omelets that the restaurant could fill.



③ **Graphing Absolute Value Inequalities** Graph $y \ge |2x| - 3$.



Since the inequality is *greater than* or *equal to*, the boundary is ___ and the shaded region is ___ the boundary.

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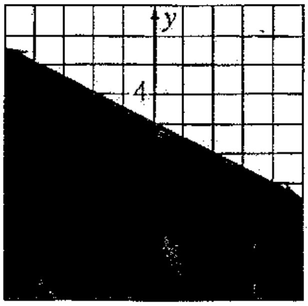
④ **Writing Inequalities** Write an inequality for the graph. The boundary line is given.

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

The boundary line is Solid. The shaded region is below the boundary. This is the graph of

y ☐ $-\frac{1}{2}x + 3$.



Quick Check

1. Graph each inequality.

a. $4x + 2y \le 4$

b. $y \ge 3x$

c. $\frac{x}{3} < -y + 2$

2. Graph each absolute value inequality.

a. $y > -|x + 2| - 3$

X	y
-2	

X+2=0
x=-2

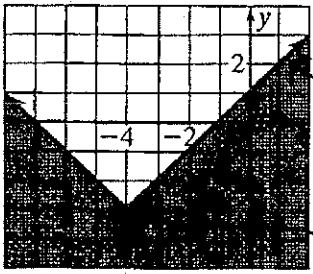
b. $2y + 3 \le -|x - 5|$

X	y
5	

X-5=0
X=5

3. Write an inequality for each graph.

a.



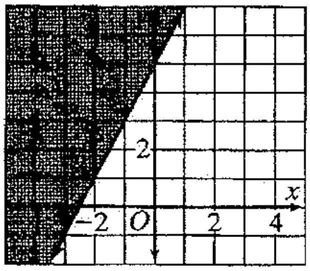
equation of this Line ?

Center ? (vertex)

y

≥ or ≤

b.



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Reteaching 2-7

Two-Variable Inequalities

OBJECTIVE: Graphing inequalities with two variables

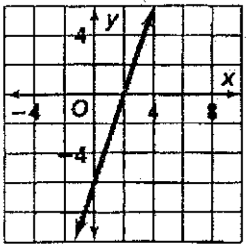
MATERIALS: Highlighting marker

Example

Graph the inequality $6x - 2y \le 12$.

$6x - 2y \le 12$

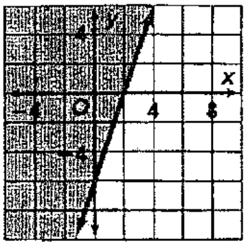
$y \ge 3x - 6$ ← **To graph the boundary line, write the inequality in slope-intercept form as if it were an equation.**



← **The boundary line is solid if the inequality contains ≤ or ≥. The boundary line is dashed if the inequality contains < or >. Graph the boundary line $y = 3x - 6$ as a solid line.**

$0 \ge 3(0) - 6$ ← **Since the boundary line does not contain the origin, substitute the point (0, 0) into the inequality.**

$0 \ge -6$ ← **Simplify. The resulting inequality is true.**



← **Use your highlighting marker to shade the region that contains the origin. If the resulting inequality were false, then you would shade the region that does not contain the origin.**

Exercises

Graph each inequality.

1. $y > 2x$

2. $x + y < 4$

3. $y < x + 1$

4. $y > x - 2$

5. $3x + 4y \le 12$

6. $2y - 3x > 6$

7. $3x - 2 \le 5x + y$

8. $x < -4$

9. $y \ge 5$

10. $x + 2y \ge 4$

11. $x + y < x + 2$

12. $3x - 3y < 3$

13. $x - 1 \ge 0$

14. $2y \le 3$

15. $3x > 2 + y$

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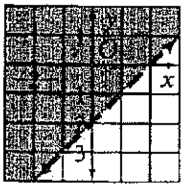
Practice 2-7

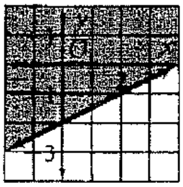
Two-Variable Inequalities

Write an inequality for each graph. In each case, the equation for the boundary line is given.

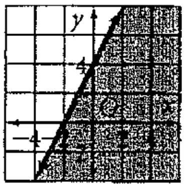
1. $y = x - 2$



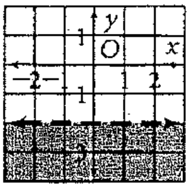
2. $x - 2y = 4$



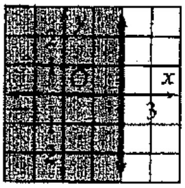
3. $y - 2x = 4$



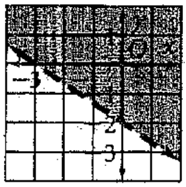
4. $y = -2$



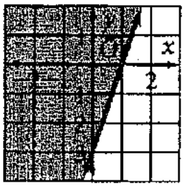
5. $x = 2$



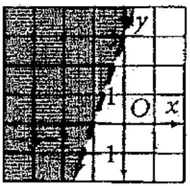
6. $-2x - 3y = 6$



7. $3x - y = 3$



8. $y - 3x = 3$



Graph each inequality on a coordinate plane.

9. $y < x$
10. $y \ge x$
11. $y > 2$
12. $y < 2$
13. $x \le 2$
14. $x > 2$
15. $y \ge |x|$
16. $y > -2x + 1$
17. $y \ge 3x - 4$
18. $4x + 2y \le 8$
19. $4x - 2y \le 4$
20. $4y - 2x \ge 4$
21. $y > |x + 2|$
22. $y \le |x - 2|$
23. $y > |x| + 2$
24. $y < |x| - 2$
25. $y \le |4x| + 1$
26. $y \ge \left|\frac{1}{6}x\right| - 3$
27. $y > -\frac{1}{6}x - 1$
28. $3x \le 5y$

29. You need to make at least 150 sandwiches for a picnic. You are making tuna sandwiches and ham sandwiches.
    a. Write an inequality for the number of sandwiches you can make.
    b. Graph the inequality.
    c. Does the point (90, 80) satisfy the inequality? Explain.

30. A salesperson sells two models of vacuum cleaners. One brand sells for \$150 each, and the other sells for \$200 each. The salesperson has a weekly sales goal of at least \$1800.
    a. Write an inequality relating the revenue from the vacuum cleaners to the sales goal.
    b. Graph the inequality.
    c. If the salesperson sold exactly six \$200 models last week, how many \$150 models did she have to sell to make her sales goal?

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