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1 Anticipation Guide

The Tools of Algebra

Step 1 *Before you begin Chapter 1*

- Read each statement.
- Decide whether you Agree (A) or Disagree (D) with the statement.
- Write A or D in the first column OR if you are not sure whether you agree or disagree, write NS (Not Sure).

STEP 1 A, D, or NS	Statement	Step 2 A or D
	1. When using the order of operations to simplify an expression, you multiply and divide as you read from left to right.	A
	2. When using the order of operations to simplify an expression, you do all the addition first before doing the subtraction.	D
	3. If $k = 2$ and $m = 7$, the expression $6m - 3k$ has a value of 78.	D
	4. An algebraic expression contains at least one variable.	A
	5. The number 0 is the multiplicative identity.	D
	6. $7 + (6 + 5) = (7 + 6) + 5$ is an example of the Commutative Property of Addition.	D
	7. On a coordinate plane, the x values are found on the vertical axis.	D
	8. In a function, exactly one domain value is assigned to each range value.	A
	9. A negative relationship shown by the points on a scatter plot means that the relationship is not a good one.	D

Step 2 *After you complete Chapter 1*

- Reread each statement and complete the last column by entering an A (Agree) or a D (Disagree).
- Did any of your opinions about the statements change from the first column?
- For those statements that you mark with a D, use a separate sheet of paper to explain why you disagree. Use examples, if possible.

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1-1 Study Guide and Intervention

Words and Expressions

Translate Verbal Phrases into Expressions A **numerical expression** contains a combination of numbers and operations such as addition, subtraction, multiplication, and division. Verbal phrases can be translated into numerical expressions by replacing words with operations and numbers.

+	−	×	÷
plus	minus	times	divide
the sum of	the difference of	the product of	the quotient of
increased by	decreased by	of	divided by
more than	less than		among

Example **Write a numerical expression for each verbal phrase.**

a. the product of seventeen and three

Phrase: the **product** of seventeen and three

Expression: 17×3

b. the total number of pencils given to each student if 18 pencils are shared among 6 students

Phrase: 18 shared **among** 6

Expression: $18 \div 6$

Exercises

Write a numerical expression for each verbal phrase.

1. eleven less than twenty **20 − 11**
2. twenty-five increased by six **25 + 6**
3. sixty-four divided by eight **64 ÷ 8**
4. the product of seven and twelve **7 • 12**
5. the quotient of forty and eight **40 ÷ 8**
6. sixteen more than fifty–four **54 + 16**
7. six groups of twelve **6 • 12**
8. eighty–one decreased by nine **81 − 9**
9. the sum of thirteen and eighteen **13 + 18**
10. three times seventeen **3 • 17**

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1-1 Enrichment

Operations Search

This is a fun activity that you can try on your own as well as with your family or classmates.

In each exercise below, you are given some numbers. Insert operations symbols (+, −, ×, ÷) and parentheses so that a true mathematical sentence is formed. Follow the specific instructions for each problem, remembering to observe the order of operations.

Do not change the order of the numbers. Sample answers given.

1. 5 4 3 2 1 = 3
   $(5 \times 4) \div (3 + 2) - 1 = 3$

2. 5 4 3 2 1 = 0
   $(5 + 4) \div 3 - 2 - 1 = 0$

3. 5 4 3 2 1 = 1
   $(5 + 4) \div 3 - 2 \div 1 = 1$

4. 5 4 3 2 1 = 50
   $5 \times (4 + 3 + 2 + 1) = 50$

Do not change the order of the numbers. You may put two numbers together to form a two-digit number.

5. 1 2 3 4 5 6 7 8 = 90
   $1 + 23 + 45 + 6 + 7 + 8 = 90$

6. 8 7 6 5 4 3 2 1 = 25
   $(8 + 7 + 65) \div 4 + 3 + 2 \times 1 = 25$

Change the order of the numbers and put numbers together to form a two- or three-digit number, as needed. Sample answers are given.

Use these four digits: 4 3 2 1

Make these totals:

7. 1312
   $41 \times 32 = 1312$

8. 2
   $(4 \times 2) \div (3 + 1) = 2$

9. 16
   $4 \times (3 + 2 - 1) = 16$

10. 1
    $(4 + 2) \div 3 - 1 = 1$

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1-2 Study Guide and Intervention

Variables and Expressions

Translate Verbal Phrases An **algebraic expression** is a combination of variables, numbers, and at least one operation. A **variable** is a letter or symbol used to represent an unknown value. To translate verbal phrases with an unknown quantity into algebraic expressions, first define the variable.

Algebraic Expressions

The letter x is most often used as a variable.	$7d$ means $7 \times d$. mn means $m \times n$.	$\frac{b}{5}$ means $b \div 5$.
$x + 3$	$7d - 2$; mn	$\frac{b}{5}$

Example **Translate each phrase into an algebraic expression.**

a. five inches longer than the length of a book

Words	five inches longer than the length of a book
Variable	Let b represent the length of the book.
Expression	$b + 5$

b. two less than the product of a number and eight

Words	two less than the product of a number and eight
Variable	Let n represent the unknown number.
Expression	$8n - 2$

Exercises

Translate each phrase into an algebraic expression.

1. eight inches taller than Mycala's height $h + 8$
2. twelve more than four times a number $4n + 12$
3. the difference of sixty and a number $60 - n$
4. three times the number of tickets sold $3t$
5. fifteen dollars more than a saved amount $s + 15$
6. the quotient of the number of chairs and four $\frac{c}{4}$
7. a number of books less than twenty-three $23 - b$
8. five more than six times a number $6n + 5$
9. seven more boys than girls $g + 7$
10. twenty dollars divided among a number of friends minus three $\frac{20}{f} - 3$

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2-2 Enrichment

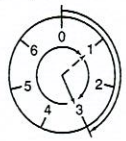
Modular Arithmetic

In modular arithmetic, there is a finite set of numbers. An example of a finite set would be the numbers on the face of a clock. No matter how many numbers are added together, the answer will still be one of the twelve numbers found on the face of the clock.

Example 1 In mod 12, $5 + 8 + 2 = 3$.

To find the sum, start at 0. Count 5 units in a clockwise direction, then 8 units, and then 2 units. You should end at the number 3.

Example 2 In mod 7, $3 + 5 + 2 = 3$.



To find the sum, start at 0. Count 3 units in a clockwise direction, then 5 units, and then 2 units. You should end at the number 3.

Exercises

Find each sum in mod 12.

1. $6 + 8 + 4$ **6**
2. $7 + 9 + 11 + 5$ **8**
3. $6 + 4 + 11 + 12 + 5$ **2**
4. $1 + 4 + 9 + 11 + 6$ **7**
5. $7 + 10 + 9 + 12 + 10$ **0**
6. $6 + 12 + 5 + 12 + 8 + 12$ **7**
7. $12 + 12 + 12 + 12 + 6$ **6**
8. $4 + 9 + 3 + 7 + 8 + 11 + 5$ **11**
9. $6 + 10 + 7 + 8 + 4 + 3 + 9$ **11**
10. $9 + 2 + 4 + 3 + 10 + 12 + 4 + 11$ **7**

Find each sum in mod 7.

11. $2 + 4 + 3$ **2**
12. $5 + 1 + 6 + 3$ **1**
13. $2 + 2 + 4 + 6 + 7$ **0**
14. $5 + 3 + 4 + 6 + 1$ **5**
15. $7 + 7 + 7 + 7 + 5$ **5**
16. $6 + 5 + 1 + 2 + 4$ **4**
17. $4 + 3 + 1 + 5 + 6 + 2$ **0**
18. $4 + 2 + 1 + 6 + 7 + 5 + 4 + 3$ **4**
19. $6 + 5 + 4 + 3 + 2 + 1 + 7 + 6$ **6**
20. $5 + 7 + 4 + 4 + 2 + 6 + 1 + 2$ **3**

21. **Can you find a pattern to these exercises? Explain.** **Yes; the sum in mod *x* is the remainder when the sum is divided by *x*.**

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2-3 Study Guide and Intervention

Subtracting Integers

Subtracting Integers	To subtract an integer, add its additive inverse.

Example 1 **Find each difference.**

a. $9 - 17$

$9 - 17 = 9 + (-17)$ To subtract 17, add −17.
$= -8$ Simplify.

b. $-7 - 3$

$-7 - 3 = -7 + (-3)$ To subtract 3, add −3.
$= -10$ Simplify.

Example 2 **Find each difference.**

a. $4 - (-5)$

$4 - (-5) = 4 + 5$ To subtract −5, add +5.
$= 9$ Simplify.

b. $-6 - (-2)$

$-6 - (-2) = -6 + 2$ To subtract −2, add +2.
$= -4$ Simplify.

Exercises

Find each difference.

1. $9 - 16$ **−7**
2. $7 - 19$ **−12**
3. $12 - 21$ **−9**
4. $-5 - 3$ **−8**
5. $-8 - 9$ **−17**
6. $-13 - 17$ **−30**
7. $7 - (-4)$ **11**
8. $9 - (-9)$ **18**
9. $-11 - (-2)$ **−9**
10. $-6 - (-9)$ **3**
11. $-6 - 4$ **−10**
12. $-16 - (-20)$ **4**
13. $-14 - 4$ **−18**
14. $8 - (-6)$ **14**
15. $-10 - (-6)$ **−4**
16. $13 - (-17)$ **30**
17. $24 - (-16)$ **40**
18. $17 - (-9)$ **26**
19. $-24 - 8$ **−32**
20. $18 - (-9)$ **27**
21. $26 - 49$ **−23**
22. $-45 - (-26)$ **−19**
23. $-15 - (-25)$ **10**
24. $29 - (-6)$ **35**

Answers (Lesson 2-2 and Lesson 2-3)

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1-3 Study Guide and Intervention

Properties

Properties of Addition and Multiplication In algebra, there are certain statements called **properties** that are true for any numbers.

Property	Explanations	Example
Commutative Property of Addition	$a + b = b + a$	$6 + 3 = 3 + 6$ $9 = 9$
Commutative Property of Multiplication	$a \cdot b = b \cdot a$	$4 \cdot 5 = 5 \cdot 4$ $20 = 20$
Associative Property of Addition	$(a + b) + c =$ $a + (b + c)$	$(3 + 4) + 7 = 3 + (4 + 7)$ $14 = 14$
Associative Property of Multiplication	$(a \cdot b) \cdot c =$ $a \cdot (b \cdot c)$	$(2 \cdot 5) \cdot 8 = 2 \cdot (5 \cdot 8)$ $80 = 80$
Additive Identity	$a + 0 = 0 + a = a$	$10 + 0 = 0 + 10 = 10$
Multiplicative Identity	$a \cdot 1 = 1 \cdot a = a$	$5 \cdot 1 = 1 \cdot 5 = 5$
Multiplicative Property of Zero	$a \cdot 0 = 0 \cdot a = 0$	$15 \cdot 0 = 0 \cdot 15 = 0$

Example 1 **Is subtraction of whole numbers associative? If not, give a counterexample.**

$(9 - 4) - 2 \stackrel{?}{=} 9 - (4 - 2)$ State the conjecture.

$5 - 2 \stackrel{?}{=} 9 - 2$ Simplify.

$3 \stackrel{?}{=} 7$ Simplify.

This is a counterexample. So, subtraction of whole numbers is not associative.

Example 2 **Name the property shown by the statement.**

$15 \times b = b \times 15$ The order of the numbers and variables changed. This is the Commutative Property of Multiplication.

Exercises

1. State whether the following conjecture is true or false: The multiplicative identity applies to division also. If false, give a counterexample. **Sample answer: False; $4 \div 1 = 4$, not 1.**

Name the property shown by each statement.

2. $75 + 25 = 25 + 75$ **Commutative Property of Addition**

3. $2 \cdot (3 \cdot 4) = (2 \cdot 3) \cdot 4$ **Associative Property of Multiplication**

4. $14 \cdot 1 = 14$ **Multiplicative Identity**

5. $p \cdot 0 = 0$ **Multiplicative Property of Zero**

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1-3 Study Guide and Intervention *(continued)*

Properties

Simplify Algebraic Expressions To **simplify** an algebraic expression, perform all possible operations. Properties can be used to help simplify an expression that contains variables.

Example **Simplify each expression.**

a. $(9 + r) + 7$

$(9 + r) + 7 = (r + 9) + 7$ Commutative Property of Addition

$= r + (9 + 7)$ Associative Property of Addition

$= r + 16$ Add 9 and 7.

b. $3 \cdot (x \cdot 5)$

$3 \cdot (x \cdot 5) = 3 \cdot (5 \cdot x)$ Commutative Property of Multiplication

$= (3 \cdot 5) \cdot x$ Associative Property of Multiplication

$= 15x$ Multiply 3 and 5.

Exercises

Simplify each expression.

1. $24 + (x + 6)$ **$30 + x$**
2. $3 \cdot (4a)$ **$12a$**
3. $9 + (12 + c)$ **$21 + c$**
4. $13d \cdot 0$ **0**
5. $(3 + f) + 17$ **$f + 20$**
6. $11 + (m + 5)$ **$m + 16$**
7. $(b + 0) + 7$ **$b + 7$**
8. $15(a \cdot 1)$ **$15a$**
9. $4w(6)$ **$24w$**
10. $(n + 7) + 12$ **$n + 19$**
11. $(7 \cdot x) \cdot 8$ **$56x$**
12. $21 \cdot (s \cdot 0)$ **0**

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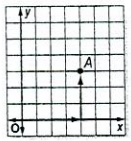
1-4 Study Guide and Intervention

Ordered Pairs and Relations

Ordered Pairs In mathematics, a **coordinate system** is used to locate points. The horizontal number line is called the ***x*-axis** and the vertical number line is called the ***y*-axis**. The point where the two axes intersect is the **origin** (0, 0). An **ordered pair** of numbers is used to locate points in the coordinate plane. The point (4, 3) has an ***x*-coordinate** of 4 and a ***y*-coordinate** of 3.

Example 1 **Graph $A(4, 3)$ on the coordinate plane.**

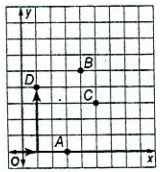


Step 1 Start at the origin.

Step 2 Since the x-coordinate is 4, move 4 units to the right.

Step 3 Since the y-coordinate is 3, move 3 units up. Draw a dot.

Example 2 **Write the ordered pair that names point *D*.**



Step 1 Start at the origin.

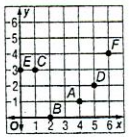
Step 2 Move right on the x-axis to find the x-coordinate of point D, which is 1.

Step 3 Move up the y-axis to find the y-coordinate, which is 4.

The ordered pair for point D is (1, 4).

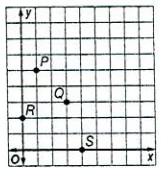
Exercises

Graph each ordered pair on the coordinate plane.



1. $A(4, 1)$
2. $B(2, 0)$
3. $C(1, 3)$
4. $D(5, 2)$
5. $E(0, 3)$
6. $F(6, 4)$

Refer to the coordinate plane shown at the right. Write the ordered pair that names each point.



7. P **(1, 5)**
8. Q **(3, 3)**
9. R **(0, 2)**
10. S **(4, 0)**

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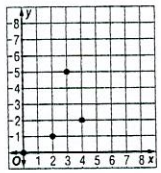
1-4 Study Guide and Intervention *(continued)*

Ordered Pairs and Relations

Relations A **relation** is a set of ordered pairs, such as {(0, 3), (1, 2), (3, 6), (7, 4)}. A relation can also be shown in a table or a graph. The set of x-coordinates is the **domain** of the relation, while the set of y-coordinates is the **range** of the relation.

Example **Express the relation {(0, 0), (2, 1), (4, 2), (3, 5)} as a table and as a graph. Then determine the domain and range.**

x	y
0	0
2	1
4	2
3	5



The domain is {0, 2, 4, 3}, and the range is {0, 1, 2, 5}.

Exercises

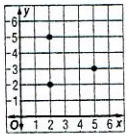
Express each relation as a table and as a graph. Then determine the domain and range.

1. {(4, 6), (0, 3), (1, 4)}

x	y
4	6
0	3
1	4

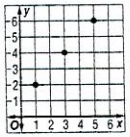
2. {(2, 5), (5, 3), (2, 2)}

x	y
2	5
5	3
2	2



3. {(1, 2), (3, 4), (5, 6)}

x	y
1	2
3	4
5	6



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1-5 Study Guide and Intervention

Words, Equations, Tables, and Graphs

Represent Functions Functions are relations in which each member of the domain is paired with *exactly* one member in the range. The **function rule** describes the operation(s) which must be performed on a domain value to get the corresponding range value. **Function tables** organize and display the input values (the x-coordinates), the function rule, and the output values (the y-coordinates).

Example **TICKETS** **June is ordering tickets for a show. Tickets cost $22 each and there is a $6 surcharge per order. Make a function table for 4 different input values and write an algebraic expression for the rule. Then state the domain and range of the function.**

Step 1 Create a function table showing the input, rule, and output. Enter 4 different input values.

Step 2 The phrase "Tickets cost $22 each and there is a $6 surcharge per order" translates to $22x + 6$. Use the rule to complete the table.

Input (x)	Rule: $22x + 6$	Output (y)
1	22(1) + 6	28
2	22(2) + 6	50
3	22(3) + 6	72
4	22(4) + 6	94

Step 3 The domain is {1, 2, 3, 4}. The range is {28, 50, 72, 94}.

Exercises

For each ticket cost and surcharge given below, make a function table for 4 different input values and write an algebraic expression for the rule. Then state the domain and range of the function.

1. Ticket cost: $8; surcharge: $1.50

Input (x)	Rule: $8x + 1.50$	Output (y)
1	8(1) + 1.50	9.50
2	8(2) + 1.50	17.50
3	8(3) + 1.50	25.50
4	8(4) + 1.50	33.50

domain {1, 2, 3, 4}; range {9.50, 17.50; 25.50; 33.50}

2. Ticket cost: $12; surcharge: $3

Input (x)	Rule: $12x + 3$	Output (y)
1	12(1) + 3	15
2	12(2) + 3	27
3	12(3) + 3	39
4	12(4) + 3	51

domain {1, 2, 3, 4}; range {15, 27, 39, 51}

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1-5 Study Guide and Intervention *(continued)*

Words, Equations, Tables, and Graphs

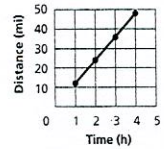
Multiple Representations Functions can be described as words, equations, tables and graphs.

Words The distance biked is equal to 12 miles per hour times the number of hours.
Equation $d = 12t$

Table

Time (h)	Distance (mi)
1	12
2	24
3	36
4	48

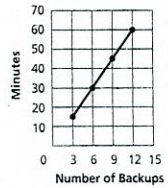
Graph



Example **FILE PROTECTION** **Tori's computer backs up the file she is working on every 5 minutes. Make a function table to find the time for 3, 6, 9, and 12 backups. Then graph the ordered pairs.**

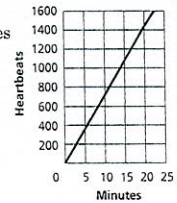
Let m represent the number of minutes and b represent the number of backups. So, the rule is $m = 5b$.

Input (x)	$5b$	Output (y)
3	5(3)	15
6	5(6)	30
9	5(9)	45
12	5(12)	60



Exercise

1. Viktor's heart beats 72 times a minute.
   a. **ALGEBRAIC** Write an equation to find the number of times Viktor's heart beats for any number of minutes. $b = 72m$
   b. **TABULAR** Make a function table to find the number of times Viktor's heart beats in 5, 10, 15, and 20 minutes.
   c. **GRAPHICAL** Graph the ordered pairs for the function.



Input (x)	$72m$	Output (y)
5	72(5)	360
10	72(10)	720
15	72(15)	1,080
20	72(20)	1,440

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1-5 Skills Practice

Words, Equations, Tables, and Graphs

Copy and complete each function table. Then state the domain and range of the function.

1. A phone call costs \$3 a minute.

Input (x)	Rule: $3m$	Output (y)
1	3(1)	3
5	3(5)	15
10	3(10)	30
20	3(20)	60

domain = {1, 5, 10, 20}
range = {3, 15, 30, 60}

2. Jared has 4 less than 3 times the number of trophies that Zach has.

Input (x)	Rule: $3z - 4$	Output (y)
2	3(2) − 4	2
4	3(4) − 4	8
6	3(6) − 4	14
8	3(8) − 4	20

domain = {2, 4, 6, 8}
range = {2, 8, 14, 20}

3. The cost for a class trip is \$5 per student plus \$100 for the bus.

Input (x)	Rule: $5s + 100$	Output (y)
18	5(18) + 100	190
22	5(22) + 100	210
24	5(24) + 100	220
30	5(30) + 100	250

domain = {18, 22, 24, 30}
range = {190, 210, 220, 250}

4. A child's admission is \$4 more than half an adult's admission.

Input (x)	Rule: $\frac{a}{2} + 4$	Output (y)
20	$\frac{20}{2} + 4$	14
26	$\frac{26}{2} + 4$	17
30	$\frac{30}{2} + 4$	19
42	$\frac{42}{2} + 4$	25

domain = {20, 26, 30, 42}
range = {14, 17, 19, 25}

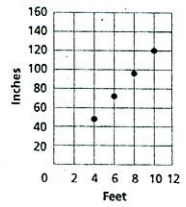
5. **MULTIPLE REPRESENTATIONS** There are 12 inches in 1 foot.

a. **ALGEBRAIC** Write an equation to find the number of inches in any number of feet.

b. **TABULAR** Make a function table to find the number of inches in 4, 6, 8, and 10 feet.

Input (x)	Rule: $i = 12f$	Output (y)
4	$i = 12(4)$	48
6	$i = 12(6)$	72
8	$i = 12(8)$	96
10	$i = 12(10)$	120

c. **GRAPHICAL** Graph the ordered pairs for the function.



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1-5 Practice

Words, Equations, Tables, and Graphs

Copy and complete each function table. Then state the domain and range of the function.

1. Each copy of a book costs \$18 and shipping is \$9 per order.

Input (x)	Rule: $18b + 9$	Output (y)
2	18(2) + 9	45
3	18(3) + 9	63
4	18(4) + 9	81
5	18(5) + 9	99

domain {2, 3, 4, 5}; range {45, 63, 81, 99}

2. The number of girls at a camp is 17 less than twice the number of boys.

Input (x)	Rule: $2b - 17$	Output (y)
40	2(40) − 17	63
58	2(58) − 17	99
82	2(82) − 17	147
100	2(100) − 17	183

domain {40, 58, 82, 100}; range {63, 99, 147, 183}

3. Tom's height is 10 inches more than a third of his older sister's height.

Input (x)	Rule: $\frac{s}{3} + 10$	Output (y)
66	$\frac{66}{3} + 10$	32
57	$\frac{57}{3} + 10$	29
51	$\frac{51}{3} + 10$	27
42	$\frac{42}{3} + 10$	24

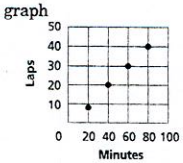
domain {66, 57, 51, 42}; range {32, 29, 27, 24}

4. The charge for a hotel room is \$75 per night plus a \$15 booking fee.

Input (x)	Rule: $75n + 15$	Output (y)
2	75(2) + 15	165
4	75(4) + 15	315
8	75(8) + 15	615
14	75(14) + 15	1,065

domain {2, 4, 8, 14}; range {165, 315, 615, 1,065}

5. **WALKING** Carly walked laps in a charity walk-a-thon. The graph shows the number of laps walked over 80 minutes.



a. **TABULAR** Make a function table showing the input, minutes, and the output, laps walked.

Input (x)	Output (y)
20	8
40	20
60	30
80	40

b. **ALGEBRAIC** Can you write one equation that can be used to find the laps, l, based on the minutes, m? Explain. **No. The change in the laps is not constant, so one equation cannot be used to find any number of laps.**

c. Is the relation a function? Explain.
Yes. Sample answer: Each time is paired with only one set of laps.

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1-6 Study Guide and Intervention

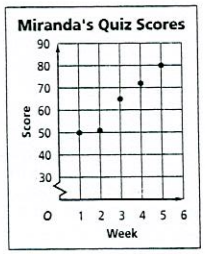
Scatter Plots

Construct Scatter Plots A **scatter plot** is a graph that shows the relationship between two sets of data. In a scatter plot, two sets of data are graphed as ordered pairs on a coordinate system.

Example **SCHOOL** **The table shows Miranda's math quiz scores for the last five weeks. Make a scatter plot of the data.**

Since the points are showing an upward trend from left to right, the data suggest a positive relationship.

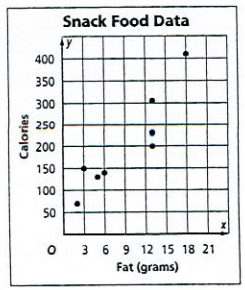
Week	Score
1	50
2	51
3	65
4	72
5	80



Exercise

FOOD **The table below shows the fat grams and calories for several snack foods.**

Food	Fat grams per serving	Calories per serving
doughnut	13	306
corn chips	13	200
pudding	3	150
cake	13	230
snack crackers	6	140
ice cream (light)	5	130
yogurt	2	70
cheese pizza	18	410



1. Make a scatter plot of the data in the table.

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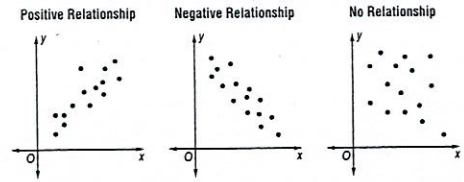
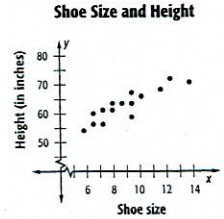
1-6 Study Guide and Intervention *(continued)*

Scatter Plots

Analyze Scatter Plots A scatter plot may show a pattern or relationship of the data.



Example **SHOE SIZE AND HEIGHT** **Determine whether a scatter plot of shoe size and height of people at a gym might show a *positive, negative,* or *no* relationship. Explain your answer.**



Height affects shoe size. A person's shoe size increases as their height increases. Therefore, a scatter plot of the data would show a positive relationship.

Exercises

Determine whether a scatter plot of the data for the following might show a *positive, negative,* or *no* relationship. Explain your answer.

1. fat grams and the amount of calories in food
   Positive; Fat grams affect the number of calories in food.
2. time spent relaxing and blood pressure levels
   Negative; relaxing lowers blood pressure levels.
3. age of a child and number of siblings
   No relationship; number of siblings is not affected by a child's age.
4. age of a tree and its height
   Positive; the age of a tree affects its height.

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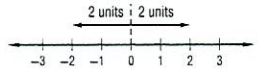
2-1 Study Guide and Intervention *(continued)*

Integers and Absolute Value

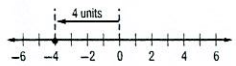
Absolute Value Numbers on opposite sides of zero and the same distance from zero have the same **absolute value**.



The symbol for absolute value is two vertical bars on either side of the number. $|2| = 2$ and $|-2| = 2$

Example 1 **Evaluate each expression.**

a. $|-4|$



$|-4| = 4$ On the number line, −4 is 4 units from 0.

b. $|-3| + |6|$

$|-3| + |6| = 3 + 6$ $|-3| = 3, |6| = 6$

$= 9$ Simplify.

Example 2 **Evaluate $|x| - 7$ if $x = -8$.**

$|x| - 7 = |-8| - 7$ Replace x with −8.

$= 8 - 7$ The absolute value of −8 is 8.

$= 1$ Simplify.

Exercises

Evaluate each expression.

1. $|-6|$ **6**
2. $|15|$ **15**
3. $|-12|$ **12**
4. $|21|$ **21**
5. $|4| - |2|$ **2**
6. $|-8| + |-3|$ **11**
7. $|-10| - |-6|$ **4**
8. $|12| + |-4|$ **16**

ALGEBRA Evaluate each expression if $x = 8$ and $y = -3$.

9. $12 + |y|$ **15**
10. $x - |y|$ **5**
11. $2|x| + 3|y|$ **25**
12. $x + |y|$ **11**
13. $6|y|$ **18**
14. $3x - 4|y|$ **12**

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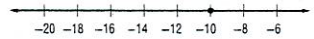
2-1 Skills Practice

Integers and Absolute Value

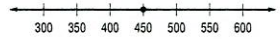
Write an integer for each situation. Then graph on a number line.

1. a bank deposit of $200 **+200 or 200**

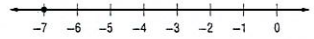
2. a loss of 10 yards **−10**



3. 450 feet above sea level **+450 or 450**



4. 7° below normal **−7**



Replace each ○ with <, >, or = to make a true sentence.

5. $1 \bigcirc 0$ >
6. $-3 \bigcirc 0$ <
7. $0 \bigcirc -1$ >
8. $0 \bigcirc 9$ <
9. $-7 \bigcirc -7$ =
10. $2 \bigcirc -2$ >
11. $-2 \bigcirc 8$ <
12. $-4 \bigcirc 4$ <
13. $5 \bigcirc 5$ =
14. $0 \bigcirc -6$ >
15. $4 \bigcirc 10$ <
16. $6 \bigcirc -6$ >
17. $3 \bigcirc 7$ <
18. $-1 \bigcirc -2$ >
19. $3 \bigcirc 4$ <
20. $-3 \bigcirc -4$ >

Evaluate each expression.

21. $|1|$ **1**
22. $|-10|$ **10**
23. $|-8|$ **8**
24. $|10|$ **10**
25. $|4| + |-4|$ **8**
26. $|9| - |-5|$ **4**
27. $0 + |-1|$ **1**
28. $|-6| + |-5|$ **11**
29. $|-8| - |-8|$ **0**
30. $|12| + |-3|$ **15**
31. $|-15| - |6|$ **9**
32. $|-13| + |-7|$ **20**

ALGEBRA Evaluate each expression if $a = -3$, $b = 0$, and $c = 1$.

33. $|a| - b$ **3**
34. $|c| + 2$ **3**
35. $9 - |a|$ **6**
36. $25 - |b|$ **25**
37. $10 - |b|$ **10**
38. $|-8| + |a|$ **11**

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2-1 Enrichment

Football Statistics

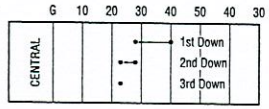
In football, one of the key offensive positions is running back. The job of the running back is to gain as many yards as possible with the ball. The line where the play begins is called the line of scrimmage. If the running back gets beyond the line of scrimmage when he is given the ball, he gains yards on the carry. However, if he is tackled behind the line of scrimmage, he loses yards. When he gains yards, the integer describing the carry is positive. However, when yards are lost, the integer describing the carry is negative.

Example 1 Sam is a running back for Central High School. He gains 3 yards on his first carry. The integer describing the carry is 3.

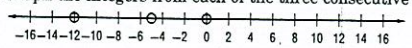
Example 2 Then Sam is tackled 7 yards behind the line of scrimmage on his second carry. The integer describing the carry is −7.

Exercises

Sam carried the ball from the quarterback 15 times in their game against Southwest High School, and three consecutive times in one series of plays. Sam's three consecutive carries are illustrated at the right.



1. On 1st down, Sam was tackled 12 yards behind the line of scrimmage. What integer describes the carry? **−12**
2. On 2nd down, he was tackled 5 yards behind the line of scrimmage. What integer describes the number of yards lost on the play? **−5**
3. On 3rd down, Sam was tackled on the line of scrimmage. What integer represents the yardage gained on the play? **0**
4. Graph the integers from each of the three consecutive carries on the number line below.



5. If you were the coach, would you play Sam in next week's game against North High School based on the five carries shown in the Examples and Exercises 1–3? Why or why not? **No, because he lost yardage on as many plays as he gained yardage.**
6. The table to the right shows the yards gained or lost each of the first five times that the Southwest High School running back carried the ball. Using this information, write the relationship between the yardage gained or lost on each carry by the Southwest High School running back compared to the Central High School's running back, Sam.

Carry	Yards Gained
1	2
2	5
3	−6
4	−2
5	26

Carry 1: 2 < 3; Carry 2: 5 > −7; Carry 3: −6 > −12; Carry 4: −2 > −5; Carry 5: 26 > 0

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2-2 Study Guide and Intervention

Adding Integers

Adding Integers with the Same Sign	Add their absolute values. The sum is: • positive if both integers are positive. • negative if both integers are negative.

Example 1 **Find the sum −3 + (−4).**

−3 + (−4) = −7 Add |−3| and |−4|. The sum is negative.

Adding Integers with Different Signs	Subtract their absolute values. The sum is: • positive if the positive integer's absolute value is greater. • negative if the negative integer's absolute value is greater.

Example 2 **Find each sum.**

a. −5 + 4

−5 + 4 = |−5| − |4| Subtract |4| from |−5|.
= 5 − 4 or 1 Simplify.
= −1 The sum is negative because |−5| > |4|.

b. 6 + (−2)

6 + (−2) = |6| − |−2| Subtract |−2| from |6|.
= 6 − 2 or 4 Simplify.
= 4 The sum is positive because |6| > |−2|.

Exercises

Find each sum.

1. 6 + (−3) **3**
2. −3 + (−5) **−8**
3. 7 + (−3) **4**
4. −4 + (−4) **−8**
5. −8 + 5 **−3**
6. −12 + (−10) **−22**
7. 6 + (−13) **−7**
8. −14 + 4 **−10**
9. 6 + (−6) **0**
10. −15 + (−5) **−20**
11. −9 + 8 **−1**
12. 20 + (−8) **12**
13. −19 + (−11) **−30**
14. 17 + (−9) **8**
15. −16 + (−5) **−21**
16. −12 + 14 **2**
17. 9 + (−25) **−16**
18. −36 + 19 **−17**
19. 7 + (−18) **−11**
20. −12 + (−15) **−27**
21. 10 + (−14) **−4**
22. −33 + 19 **−14**
23. −20 + (−5) **−25**
24. −12 + (−10) **−22**
25. −15 + 4 **−11**
26. −34 + 29 **−5**
27. 46 + (−32) **14**

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2-3 Enrichment

Mental Math: Compensation

To add or subtract in your head, work with multiples of 10 (20, 30, 40, . . .) or 100 (200, 300, 400, . . .) and then adjust your answer.

To add 52, first add 50, then add 2 more.

To subtract 74, first subtract 70, then subtract 4 more.

To subtract 38, first subtract 40, then add 2.

To add 296, first add 300, then subtract 4.

Write the second step you would use to do each of the following.

1. Add 83.
   1) Add 80.
   2) **Add 3 more.**
2. Add 304.
   1) Add 300.
   2) **Add 4 more.**
3. Subtract 62.
   1) Subtract 60.
   2) **Subtract 2 more.**
4. Add 27.
   1) Add 30.
   2) **Subtract 3.**
5. Subtract 79.
   1) Subtract 80.
   2) **Add 1.**
6. Subtract 103.
   1) Subtract 100.
   2) **Subtract 3 more.**
7. Add 499.
   1) Add 500.
   2) **Subtract 1.**
8. Add 294.
   1) Add 300.
   2) **Subtract 6.**
9. Subtract 590.
   1) Subtract 600.
   2) **Add 10.**

Use the method above to add 59 to each of the following.

10. 40
    40 + 60 − 1 = 99
11. 72
    72 + 60 − 1 = 131
12. 53
    53 + 60 − 1 = 112
13. 15
    15 + 60 − 1 = 74

Use the method above to subtract 18 from each of the following.

14. 96
    96 − 20 + 2 = 78
15. 45
    45 − 20 + 2 = 27
16. 71
    71 − 20 + 2 = 53
17. 67
    67 − 20 + 2 = 49

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2-4 Study Guide and Intervention

Multiplying Integers

Multiplying Integers with Different Signs	The product of two integers with different signs is negative.

Example 1 **Find each product.**

a. **4(−3)**
4(−3) = −12

b. **−8(5)**
−8(5) = −40

Multiplying Integers with the Same Sign	The product of two integers with the same sign is positive.

Example 2 **Find each product.**

a. **6(6)**
6(6) = 36

b. **−7(−4)**
−7(−4) = 28

Example 3 **Find 6(−3)(−2).**

6(−3)(−2) = [6(−3)](−2) Use the Associative Property.
= −18(−2) 6(−3) = −18
= 36 −18(−2) = 36

Exercises

Find each product.

1. −5(7)
   −35
2. 6(−9)
   −54
3. −10 · 4
   −40
4. −12 · −2
   24
5. 5(−11)
   −55
6. −15(−4)
   60
7. −14(2)
   −28
8. 6(14)
   84
9. −18 · 2
   −36
10. −9(10)
    −90
11. 12(−6)
    −72
12. −11(−11)
    121
13. −4(−4)(5)
    80
14. 6(−7)(2)
    −84
15. −10(−4)(−6)
    −240
16. −7(−3)(2)
    42
17. −9(4)(2)
    −72
18. 6(−4)(−12)
    288
19. 11(3)(−2)
    −66
20. −5(−6)(7)
    210
21. −3(−4)(−8)
    −96
22. 22(3)(−3)
    −198
23. −8(10)(−2)
    160
24. −6(5)(−9)
    270

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2-4 Enrichment

Cyclic Numbers

Look closely at the products below. Do you see a pattern?

$1 \times 142{,}857 =$ 142,857
$2 \times 142{,}857 =$ 285,714
$3 \times 142{,}857 =$ 428,571
$4 \times 142{,}857 =$ 571,428
$5 \times 142{,}857 =$ 714,285
$6 \times 142{,}857 =$ 857,142

The same six digits repeat in all of the products. Numbers like 142,857 are called *cyclic numbers*.

1. Cyclic numbers are related to prime numbers. A prime number is a number that has exactly two factors, 1 and itself. You can use a calculator and the decimal equivalents of fractions of the form $\frac{1}{p}$, where p is a prime number, to find cyclic numbers. Use a calculator to find the decimal equivalent of each fraction below.

a. $\frac{1}{2}$ 0.5 b. $\frac{1}{3}$ 0.3333 c. $\frac{1}{5}$ 0.2 d. $\frac{1}{7}$ 0.142857

2. Study the decimal equivalents you found. Do you observe a pattern in any of the digits?
The equivalent of $\frac{1}{7}$ contains the same digits as the cyclic number.

3. The cyclic number 142,857 has six digits. The next largest cyclic number has sixteen digits. What fraction do you think might help you find the next cyclic number? Explain.
$\frac{1}{17}$; The digits of the equivalent of $\frac{1}{7}$ were related to a cyclic number with 6 digits, so it follows that a cyclic number with 16 digits is related to $\frac{1}{17}$.

4. Explain why the next largest cyclic number cannot be determined using a scientific calculator. **Calculator does not display 16 digits; would need to use a computer.**

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2-5 Study Guide and Intervention

Dividing Integers

Dividing Integers with the Same Sign	The quotient of two integers with the same sign is positive.

Example 1 **Find each quotient.**

a. $14 \div 2$
$14 \div 2 = 7$ The dividend and the divisor have the same sign. The quotient is positive.

b. $\frac{-25}{-5}$
$\frac{-25}{-5} = -25 \div (-5)$ The dividend and divisor have the same sign.
$= 5$ The quotient is positive.

Dividing Integers with Different Signs	The quotient of two integers with different signs is negative.

Example 2 **Find each quotient.**

a. $36 \div (-4)$
$36 \div (-4) = -9$ The signs are different. The quotient is negative.

b. $-\frac{42}{6}$
$-\frac{42}{6} = -7$ The signs are different. The quotient is negative.

Exercises

Find each quotient.

1. $32 \div (-4)$ **−8**
2. $-18 \div (-2)$ **9**
3. $-24 \div 6$ **−4**
4. $-36 \div (-2)$ **18**
5. $50 \div (-5)$ **−10**
6. $-81 \div (-9)$ **9**
7. $-72 \div (-2)$ **36**
8. $-45 \div 3$ **−15**
9. $-60 \div (-12)$ **5**
10. $99 \div (-11)$ **−9**
11. $-200 \div (-4)$ **50**
12. $38 \div (-2)$ **−19**
13. $-144 \div 12$ **−12**
14. $100 \div (-5)$ **−20**
15. $-200 \div (-20)$ **10**
16. $\frac{-28}{2}$ **−14**
17. $\frac{36}{-4}$ **−9**
18. $\frac{-150}{-25}$ **6**

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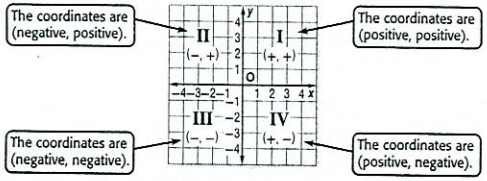
2-6 Study Guide and Intervention

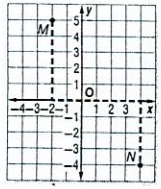
Graphing in Four Quadrants



Example **Graph and label each point on a coordinate plane. Name the quadrant in which each point lies.**

a. $M(-2, 5)$

Start at the origin. Move 2 units left.
Then move 5 units up and draw a dot.
Point $M(-2, 5)$ is in Quadrant II.



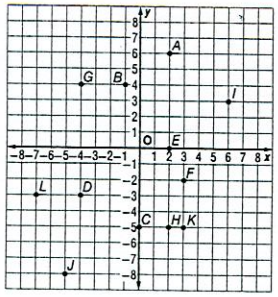
b. $N(4, -4)$

Start at the origin. Move 4 units right.
Then move 4 units down and draw a dot.
Point $N(4, -4)$ is in Quadrant IV.

Exercises

Graph and label each point on the coordinate plane. Name the quadrant in which each point is located.

1. $A(2, 6)$ I
2. $B(-1, 4)$ II
3. $C(0, -5)$ none
4. $D(-4, -3)$ III
5. $E(2, 0)$ none
6. $F(3, -2)$ IV
7. $G(-4, 4)$ II
8. $H(2, -5)$ IV
9. $I(6, 3)$ I
10. $J(-5, -8)$ III
11. $K(3, -5)$ IV
12. $L(-7, -3)$ III



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2-6 Study Guide and Intervention *(continued)*

Graphing in Four Quadrants

Graph Algebraic Relationships A coordinate graph can be used to show relationships between two numbers.

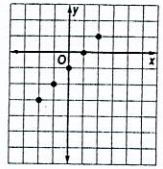
Example **MONEY The difference between Zora's and Charlie's bank accounts is \$1. If x represents Zora's bank account and y represents Charlie's bank account, make a function table of possible values for x and y. Graph the ordered pairs and describe the graph.**

Step 1 Make a table. Choose values for x and y that have a difference of 1.

Step 2 Graph the ordered pairs.

The points are along a diagonal line that crosses the x-axis at $x = 1$.

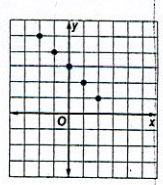
$x - y = 1$		
x	y	(x, y)
2	1	(2, 1)
1	0	(1, 0)
0	−1	(0, −1)
−1	−2	(−1, −2)
−2	−3	(−2, −3)



Exercises

1. **TEMPERATURE** The sum of two temperatures is 3°F. If x represents the first temperature and y represents the second temperature, make a function table of possible values for x and y. Graph the ordered pairs and describe the graph.

$x + y = 3$		
x	y	(x, y)
2	1	(2, 1)
1	2	(1, 2)
0	3	(0, 3)
−1	4	(−1, 4)
−2	5	(−2, 5)



The points are along a line slanting down to the right that crosses the y-axis at 3 and the x-axis at 3