CHAPTER 1 STUDY GUIDE

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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

2. twenty-five increased by six

3. sixty-four divided by eight

4. the product of seven and twelve

5. the quotient of forty and eight

6. sixteen more than fifty–four

7. six groups of twelve

8. eighty–one decreased by nine

9. the sum of thirteen and eighteen

10. three times seventeen

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Study Guide and Intervention *(continued)*

Words and Expressions

Order of Operations Evaluate, or find the numerical value of, expressions with more than one operation by following the **order of operations**.

Step 1 Evaluate the expressions inside grouping symbols.

Step 2 Multiply and/or divide from left to right.

Step 3 Add and/or subtract from left to right.

Example **Evaluate each expression.**

a. $\mathbf{6 \cdot 5 - 10 \div 2}$

$6 \cdot 5 - 10 \div 2 = 30 - 10 \div 2$ — Multiply 6 and 5.

$= 30 - 5$ — Divide 10 by 2.

$= 25$ — Subtract 5 from 30.

b. $\mathbf{4(3 + 6) + 2 \cdot 11}$

$4(3 + 6) + 2 \cdot 11 = 4(9) + 2 \cdot 11$ — Evaluate (3 + 6).

$= 36 + 22$ — Multiply 4 and 9, and 2 and 11.

$= 58$ — Add 36 and 22.

c. $\mathbf{3[(7 + 5) \div 4 - 1]}$

$3[(7 + 5) \div 4 - 1] = 3[12 \div 4 - 1]$ — Evaluate (7 + 5) first.

$= 3(3 - 1)$ — Divide 12 by 4.

$= 3(2)$ — Subtract 1 from 3.

$= 6$ — Multiply 3 and 2.

Exercises

Evaluate each expression.

1. $6 + 3 \cdot 9$

2. $7 + 7 \cdot 3$

3. $14 - 6 + 8$

4. $26 - 4 + 9$

5. $10 \div 5 \cdot 3$

6. $22 \div 11 \cdot 6$

7. $2(6 + 2) - 4 \cdot 3$

8. $5(6 + 1) - 3 \cdot 3$

9. $2[(13 - 4) + 2(2)]$

10. $4[(10 - 6) + 6(2)]$

11. $\dfrac{(67 + 13)}{(34 - 29)}$

12. $6(4 - 2) + 8$

13. $3[(2 + 7) \div 9] - 3$

14. $(8 \cdot 7) \div 14 - 1$

15. $\dfrac{4(18)}{2(9)}$

16. $(9 \cdot 8) - (100 \div 5)$

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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 $b \div 5$.
$x + 3$	$7d - 2$ $\quad mn$	$\frac{b}{5}$

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
2. twelve more than four times a number
3. the difference of sixty and a number
4. three times the number of tickets sold
5. fifteen dollars more than a saved amount
6. the quotient of the number of chairs and four
7. a number of books less than twenty-three
8. five more than six times a number
9. seven more boys than girls
10. twenty dollars divided among a number of friends minus three

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Study Guide and Intervention (continued)

Variables and Expressions

Evaluate Expressions To evaluate an algebraic expression, replace the variable(s) with known values and follow the order of operations.

Substitution Property of Equality

Words	If two quantities are equal, then one quantity can be replaced by the other.
Symbols	For all numbers a and b, if $a = b$, then a may be replaced by b.

Example ALGEBRA **Evaluate each expression if $r = 6$ and $s = 2$.**

a. $8s - 2r$

$8s - 2r = 8(2) - 2(6)$ Replace r with 6 and s with 2.

$= 16 - 12$ or 4 Multiply. Then subtract.

b. $3(r + s)$

$3(r + s) = 3(2 + 6)$ Replace r with 6 and s with 2.

$= 3 \cdot 8$ or 24 Evaluate the parentheses. Then multiply.

c. $\frac{5rs}{4}$

$\frac{5rs}{4} = 5rs \div 4$ Rewrite as a division expression.

$= 5(6)(2) \div 4$ Replace r with 6 and s with 2.

$= 60 \div 4$ or 15 Multiply. Then divide.

Exercises

ALGEBRA **Evaluate each expression if $x = 10$, $y = 5$, and $z = 1$.**

1. $x + y - z$
2. $\frac{x}{y}$
3. $2x + 4z$
4. $xy + z$
5. $\frac{6y}{10z}$
6. $x(2 + z)$
7. $x - 2y$
8. $\frac{(x + y)}{z}$

ALGEBRA **Evaluate each expression if $r = 2$, $s = 3$, and $t = 12$.**

9. $2t - rs$
10. $\frac{t}{rs}$
11. $t(4 + r)$
12. $4s + 5r$
13. $\frac{5t}{(r + 3)}$
14. $(t - 2s)7$
15. $\frac{10t}{4s}$
16. $(t + r) - (r + s)$

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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.

Name the property shown by each statement.

2. $75 + 25 = 25 + 75$

3. $2 \cdot (3 \cdot 4) = (2 \cdot 3) \cdot 4$

4. $14 \cdot 1 = 14$

5. $p \cdot 0 = 0$

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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. $24 + (x + 6)$

2. $3 \cdot (4a)$

3. $9 + (12 + c)$

4. $13d \cdot 0$

5. $(3 + f) + 17$

6. $11 + (m + 5)$

7. $(b + 0) + 7$

8. $15(a \cdot 1)$

9. $4w(6)$

10. $(n + 7) + 12$

11. $(7 \cdot x) \cdot 8$

12. $21 \cdot (s \cdot 0)$

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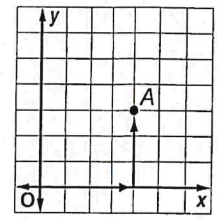
Study Guide and Intervention

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.**

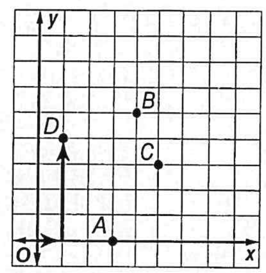


Step 1 Start at the origin.

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.

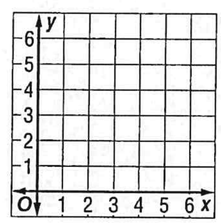
Step 2 Move right on the x-axis to find the x-coordinate of point D, which is 1.

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

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

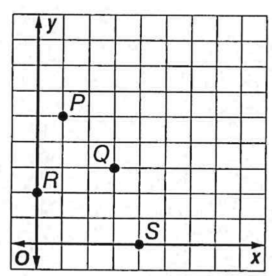
Exercises

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
8. Q
9. R
10. S

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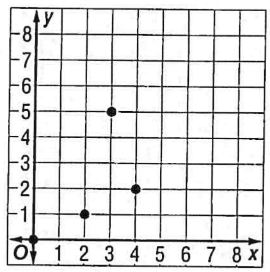
Study Guide and Intervention *(continued)*

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



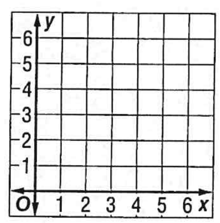
The domain is {0, 2, 4, 3}, and the range is {0, 1, 2, 5}.

Exercises

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

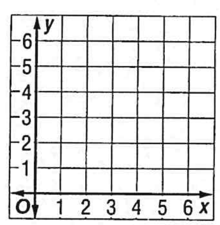
1. {(4, 6), (0, 3), (1, 4)}

x	y



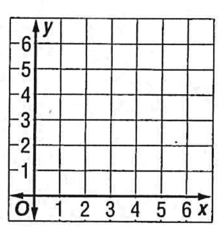
2. {(2, 5), (5, 3), (2, 2)}

x	y



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

x	y



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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:	Output (y)

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

Input (x)	Rule:	Output (y)