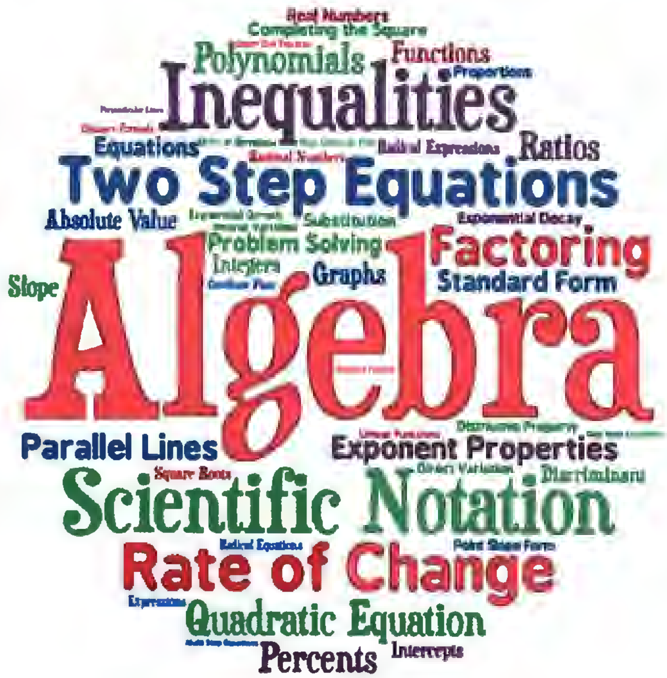
Algebra Summer Math Packet



Summer 2020

Summer Math Packet - PreAlgebra to Algebra Summer 2020

Name ____

This summer math booklet was developed to provide students entering Algebra an opportunity to review necessary math objectives and to improve math performance. We hope this helps to build anticipation for new learning and gives you confidence in your abilities so that you are well prepared for Algebra. This packet will help ease the transition and help you reinforce skills that are needed prior to the start of Algebra to ensure future success.

All students are expected to complete the entire Summer Math packet to the *best of their ability.* Students should show their work so we can see the thought process used to complete the problems. Please circle or box your final answer. Please keep in mind we are looking for *good effort* at completing the problems more than a correct answer. Good effort includes attempting the problems and showing the work/thought process used to achieve an answer.

THIS ASSIGNMENT IS DUE WEDNESDAY, AUGUST 12TH
THE FIRST DAY OF THE NEW SCHOOL YEAR.
THIS PACKET WILL BE WORTH 50 POINTS.
IT WILL COUNT AS THE FIRST GRADE OF THE NINE WEEKS IN MATH CLASS.

Chapters/Lessons and Suggested Completion Dates

Chapter 0 - Lessons 2, 3, 4, 5 . . . . .June 19th
- 0-2 - Real Numbers
- 0-3 - Operations with Integers
- 0-4 - Adding and Subtracting Rational Numbers
- 0-5 - Multiplying and Dividing Rational Numbers

Chapter 1 - Lessons 1, 2, 3 . . . . .July 10th
- 1-1 - Variables and Expressions
- 1-2 - Order of Operations
- 1-3 - Properties of Numbers

Chapter 1 - Lessons 4, 5, 6 . . . . .July 24th
- 1-4 - The Distributive Property
- 1-5 - Descriptive Modeling and Accuracy
- 1-6 - Relations

Chapter 1 - Lessons 7, 8 . . . . August 7th
- 1-7 - Functions
- 1-8 - Interpreting Graphs of Functions

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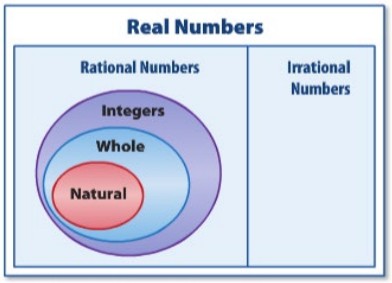
0-2 Algebra 1 Summer Skills
Real Numbers



Classify Real Numbers The set of **real numbers** consists of all whole numbers, integers, rational numbers, and irrational numbers.

- **Natural numbers** are counting numbers (1, 2, 3, …).
- Wh**ole numbers** are counting numbers, including 0 (0, 1, 2, 3, …).
- **Integers** are whole numbers and their negative counterparts (… ,–2, –1, 0, 1, 2, …).
- **Rational numbers** can be written as fractions (–7.5, $\frac{5}{8}$, $\sqrt{16}$, $0.\overline{3}$).
- **Irrational numbers** are decimals that do not repeat or terminate (π, $\sqrt{3}$, $0.121221222\ldots$).

Example 1: Name the set or sets of numbers to which each real number belongs.

a. $\frac{5}{22}$
5 and 22 are integers and 5 ÷ 22 = 0.2272727…, which is a repeating decimal, so this number is a rational number.

b. $\sqrt{56}$
$\sqrt{56}$ = 7.48331477…, which is not a repeating or terminating decimal, so this number is irrational.

c. $\sqrt{81}$
$\sqrt{81}$= 9, this number is a natural number, a whole number, an integer, and a rational number.

Simplify Roots Perfect Squares can be used to simplify square roots of rational numbers. 25 is a perfect square since $\sqrt{25} = 5$. 144 is a perfect square since $\sqrt{144} = 12$.

Example 2: Simplify each square root.

a. $\sqrt{\frac{4}{121}}$

$\sqrt{\frac{4}{121}} = \sqrt{\left(\frac{2}{11}\right)^2} = \frac{2}{11}$

b. $\sqrt{\frac{4}{121}}$

$\sqrt{\frac{4}{121}} = \sqrt{\left(\frac{2}{11}\right)^2} = \frac{2}{11}$

Exercises

Name the set or sets of numbers to which each real number belongs.

1. $-\sqrt{64}$

2. $\frac{56}{7}$

3. $\frac{36}{6}$

4. $\sqrt{28}$

Simplify each square root.

5. $-\sqrt{25}$

6. $\pm\sqrt{36}$

7. $\pm\sqrt{1.44}$

8. $\sqrt{\frac{16}{49}}$

9. $\sqrt{\frac{169}{196}}$

10. $\sqrt{\frac{25}{324}}$

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0-3 Algebra 1 Summer Skills *(continued)*

Operations with Integers

An integer is any number from the set (… ,–2, –1, 0, 1, 2, …). You can follow the **Rules for Intege**rs to add, subtract, multiply, and divide integers.

RULES FOR INTEGERS (SIGNED NUMBERS)

ADDITION

+ and + = +

– and – = –

+ and - = +

+ and – = –

SUBTRACTION

ADD THE OPPOSITE!

(Change the subtraction sign to an addition sign.
Change the sign of the second number.
Now follow the Addition rules!)

MULTIPLICATION AND DIVISION

+ and + = +	+ and – = –
– and – = +	– and + = –

Exercises

Find each sum or difference.

1. –77 + (–46) **2.** 12 – 34 **3.** 41+ **(**–56)

4. 50 – 82 **5.** – 47 – 13 **6.** – 80 + 102

7. A dolphin swimming 24 feet below the ocean's surface dives 18 feet straight down. How many feet below the ocean's surface is the dolphin now?

Find each product or quotient.

8. –64 ÷ (–8) **9.** 8(–22) **10.** 54 ÷ **(**–6)

11. 30(14) **12.** –23(5) **13.** –200 ÷ 2

14. Ed earns $11 per hour. He works 14 hours a week. His employer withholds $32 from each paycheck for taxes. If he is paid weekly, what is the amount of his paycheck?

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0-4 Algebra 1 Summer Skills

Adding and Subtracting Rational Numbers

Add and Subtract Like Fractions To add or subtract fractions with the same denominators, called **like denominators,** add or subtract the numerators and write the sum or difference over the denominator.

Example 1: Find each sum or difference. Write in simplest form.

a. $\frac{3}{5}+\frac{1}{5}$

$\frac{3}{5}+\frac{1}{5}=\frac{3+1}{5}=\frac{4}{5}$

b. $\frac{7}{16}-\frac{1}{16}$

$\frac{7}{16}-\frac{1}{16}=\frac{7-1}{16}=\frac{6}{16}$

c. $\frac{4}{9}-\frac{7}{9}$

$\frac{4}{9}-\frac{7}{9}=\frac{4-7}{9}=-\frac{3}{9}$ or $-\frac{1}{3}$

Add and Subtract Unlike Fractions Fractions with different denominators are called unlike fractions. To add or subtract fractions with unlike denominators, rename the fractions with a common denominator. Then add or subtract. Simplify if possible.

Example 2: Find each sum or difference. Write in simplest form.

a. $\frac{1}{2}+\frac{2}{3}$

$\frac{1}{2}+\frac{2}{3}=\frac{3}{6}+\frac{4}{6}=\frac{3+4}{6}=\frac{7}{6}$ or $1\frac{1}{6}$

b. $\frac{3}{8}-\frac{1}{3}$

$\frac{3}{8}-\frac{1}{3}=\frac{9}{24}-\frac{8}{24}=\frac{9-8}{24}=\frac{1}{24}$

c. $\frac{2}{5}-\frac{3}{4}$

$\frac{2}{5}-\frac{3}{4}=\frac{8}{20}-\frac{15}{20}=\frac{8-15}{20}=-\frac{7}{20}$

Exercises

Find each sum or difference. Write in simplest form.

1. $\frac{2}{3}+\frac{1}{3}$

2. $\frac{6}{7}-\frac{3}{7}$

3. $\frac{5}{8}+\frac{7}{8}$

4. $\frac{4}{3}+\frac{4}{3}$

5. $\frac{7}{15}-\frac{2}{15}$

6. $\frac{3}{7}+\frac{5}{14}$

7. $\frac{3}{8}+\frac{1}{6}$

8. $\frac{13}{20}-\frac{2}{5}$

9. $-\frac{1}{6}-\frac{2}{3}$

10. $\frac{1}{2}-\frac{4}{5}$

11. $-\frac{4}{5}+\left(-\frac{1}{3}\right)$

12. $-\frac{1}{12}-\left(-\frac{3}{4}\right)$

13. About $\frac{7}{10}$ of the surface of the Earth is covered by water. The rest of the surface is covered by land. How much of the Earth's surface is covered by land?

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0-5 Algebra 1 Summer Skills *(continued)*

Multiplying and Dividing Rational Numbers

Multiply Fractions To multiply fractions, multiply the numerators and multiply the denominators: $\frac{a}{b} \cdot \frac{c}{d} = \frac{a \cdot c}{b \cdot d}$, where $b, d \neq 0$. Fractions may be simplified either before or after multiplying. When multiplying negative fractions, assign the negative sign to the numerator.

Example 1: Find each product. Write in simplest form.

a. $-\frac{8}{15} \cdot \frac{5}{7} = \frac{-8}{15} \cdot \frac{5}{7}$

$= \frac{-8}{\cancel{15}_{3}} \cdot \frac{\cancel{5}^{1}}{7}$

$= \frac{-8}{21} = -\frac{8}{21}$

b. $7\frac{1}{2} \cdot 2\frac{2}{3} = \frac{15}{2} \cdot \frac{8}{3}$

$= \frac{\cancel{15}^{5}}{\cancel{2}_{1}} \cdot \frac{\cancel{8}^{4}}{\cancel{3}_{1}}$

$= \frac{20}{1}$ or 20

Divide Fractions Two numbers whose product is 1 are called multiplicative inverses or reciprocals. For any fraction $\frac{a}{b}$, where $a, b \neq 0$, $\frac{b}{a}$ is the multiplicative inverse and $\frac{a}{b} \cdot \frac{b}{a} = 1$. This means that $\frac{2}{3}$ and $\frac{3}{2}$ are multiplicative inverses because $\frac{2}{3} \cdot \frac{3}{2} = 1$. To divide by a fraction, multiply by its multiplicative inverse: $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c} = \frac{ad}{bc}$, where $b, c, d \neq 0$.

Example 2: Find each quotient. Write in simplest form.

a. $\frac{3}{4} \div \frac{5}{8} = \frac{3}{4} \cdot \frac{8}{5}$

$= \frac{3}{\cancel{4}_{1}} \cdot \frac{\cancel{8}^{2}}{5}$

$= \frac{6}{5}$ or $1\frac{1}{5}$

b. $-6\frac{2}{5} \div 2\frac{1}{5} = \frac{-32}{5} \div \frac{11}{5}$

$= \frac{-32}{5} \cdot \frac{5}{11}$

$= \frac{-32}{\cancel{5}_{1}} \cdot \frac{\cancel{5}^{1}}{11}$

$= \frac{-32}{11}$ or $-2\frac{10}{11}$

Exercises

Find each product or quotient.

1. $\frac{2}{9} \cdot \frac{1}{2}$

2. $-\frac{9}{4} \cdot \frac{1}{18}$

3. $\left(-\frac{30}{11}\right) \cdot \left(-\frac{1}{3}\right)$

4. $\frac{16}{9} \div \frac{4}{9}$

5. $\frac{3}{7} \div \left(-\frac{1}{5}\right)$

6. $-1\frac{1}{3} \div \frac{2}{3}$

7. A large pizza at Pizza Shack has 12 slices. If Bob ate $\frac{1}{4}$ if the pizza, how many of the slices of pizza did he eat?

8. How many boards, each 2 feet 8 inches long, can be cut from a board 16 feet long if there is no waste?

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1-1 Algebra 1 Summer Skills
Variables and Expressions

Write Verbal Expressions An **algebraic expression** consists of one or more numbers and variables along with one or more arithmetic operations. In algebra, **variables** are symbols used to represent unspecified numbers or values. Any letter may be used as a variable.

Example: Write a verbal expression for each algebraic expression.

+	−	×	÷
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

a. $6n^2$
the product of 6 and *n* squared

b. $n^3 - 12m$
the difference of *n* cubed and twelve times *m*

Exercises
Write a verbal expression for each algebraic expression.

1. $w - 1$

2. $\frac{1}{3}a^3$

3. $81 + 2x$

4. $12d$

5. 8^4

6. 6^2

7. $2n^2 + 4$

8. $a^3 . b^3$

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1-1 Algebra 1 Summer Skills *(continued)*

Variables and Expressions

Write Algrebraic Expressions Translating verbal expressions into algebraic expressions is an important algebraic skill.

Example: Write an algebraic expression for each verbal expression.

a. four more than a number *n*

The words *more than* imply addition.

four more than a number *n*
$4 + n$
The algebraic expression is $4 + n$.

b. the difference of a number squared and 8

The expression *difference of* implies subtraction.

the difference of a number squared and 8
$n^2 - 8$
The algebraic expression is $n^2 - 8$.

Exercises

Write an algebraic expression for each verbal expression.

1. a number decreased by 8

2. a number divided by 8

3. a number squared

4. four times a number

5. a number divided by 6

6. a number multiplied by 37

7. the sum of 9 and a number

8. 3 less than 5 times a number

9. twice the sum of 15 and a number

10. one-half the square of b

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1-2 Algebra 1 Summer Skills

Order of Operations

Evaluate Numerical Expressions Numerical expressions often contain more than one operation. To evaluate them, use the rules for order of operations shown below.

Order of Operations	**Step 1** Evaluate expressions inside grouping symbols. **Step 2** Evaluate all powers. **Step 3** Do all multiplication and/or division from left to right. **Step 4** Do all addition and/or subtraction from left to right.

Example 1: Evaluate each expression.

a. $\mathbf{3^4}$

$3^4 = 3 \bullet 3 \bullet 3 \bullet 3$ Use 3 as a factor 4 times.

$= 81$ Multiply.

b. $\mathbf{6^3}$

$6^3 = 6 \bullet 6 \bullet 6$ Use 6 as a factor 3 times.

$= 216$ Multiply.

Example 2: Evaluate each expression.

a. $\mathbf{3[2 + (12 \div 3)^2]}$

$3[2 + (12 \div 3)^2] = 3(2 + 4^2)$ Divide 12 by 3.

$= 3(2 + 16)$ Find 4 squared.

$= 3(18)$ Add 2 and 16.

$= 54$ Multiply 3 and 18.

b. $\mathbf{\frac{3 + 2^3}{4^2 \cdot 3}}$

$\frac{3 + 2^3}{4^2 \cdot 3} = \frac{3 + 8}{4^2 \cdot 3}$ Evaluate power in numerator.

$= \frac{11}{4^2 \cdot 3}$ Add 3 and 8 in the numerator.

$= \frac{11}{16 \cdot 3}$ Evaluate power in denominator.

$= \frac{11}{48}$ Multiply.

Exercises

Evaluate each expression.

1. 5^2 **2.** 3^3 **3.** 10^4

4. 12^2 **5.** 8^3 **6.** 2^8

7. $(8 - 4) \bullet 2$ **8.** $(12 + 4) \bullet 6$ **9.** $10 + 8 \bullet 1$

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1-2 Study Algebra 1 Summer Skills *(continued)*

Order of Operations

Evaluate Algebraic Expressions Algebraic expressions may contain more than one operation. Algebraic expressions can be evaluated if the values of the variables are known. First, replace the variables with their values. Then use the order of operations to calculate the value of the resulting numerical expression.

Example: Evaluate $x^3 + 5(y - 3)$ if $x = 2$ and $y = 12$.

$x^3 + 5(y - 3) = 2^3 + 5(12 - 3)$	Replace x with 2 and y with 12.
$= 8 + 5(12 - 3)$	Evaluate 2^3.
$= 8 + 5(9)$	Subtract 3 from 12.
$= 8 + 45$	Multiply 5 and 9.
$= 53$	Add 8 and 45.

The solution is 53.

Exercises

Evaluate each expression if $x = 2$, $y = 3$, $z = 4$, $a = \frac{4}{5}$, and $b = \frac{3}{5}$.

1. $x + 7$

2. $3x - 5$

3. $x + y^2$

4. $x^3 + y + z^2$

5. $6a + 8b$

6. $23 - (a + b)$

7. $\frac{y^2}{z^2}$

8. $2xyz + 5$

9. $x(2y + 3z)$

10. $(10x)^2 + 100a$

11. $\frac{3xy - 4}{7x}$

12. $a^2 + 2b$

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1-3 Algebra 1 Summer Skills
Properties of Numbers

Identity and Equality Properties The identity and equality properties in the chart below can help you solve algebraic equations and evaluate mathematical expressions.

Additive Identity	For any number a, $a + 0 = a$.
Additive Inverse	For any number a, $a + (-a) = 0$.
Multiplicative Identity	For any number a, $a \bullet 1 = a$.
Multiplicative Property of 0	For any number a, $a \bullet 0 = 0$.
Multiplicative Inverse Property	For every number $\frac{a}{b}$, where $a, b \neq 0$, there is exactly one number $\frac{b}{a}$ such that $\frac{a}{b} \bullet \frac{b}{a} = 1$.
Reflexive Property	For any number a, $a = a$.
Symmetric Property	For any numbers a and b, if $a = b$, then $b = a$.
Transitive Property	For any numbers a, b, and c, if $a = b$ and $b = c$, then $a = c$.
Substitution Property	If $a = b$, then a may be replaced by b in any expression.

Example: Evaluate 24 • 1 – 8 + 5(9 ÷ 3 – 3). Name the property used in each step.

$24 \bullet 1 - 8 + 5(9 \div 3 - 3) = 24 \bullet 1 - 8 + 5(3 - 3)$	Substitution; 9 ÷ 3 = 3
$= 24 \bullet 1 - 8 + 5(0)$	Substitution; 3 – 3 = 0
$= 24 - 8 + 5(0)$	Multiplicative Identity; 24 • 1 = 24
$= 24 - 8 + 0$	Multiplicative Property of Zero; 5(0) = 0
$= 16 + 0$	Substitution; 24 – 8 = 16
$= 16$	Additive Identity; 16 + 0 = 16

Exercises

Evaluate each expression. Name the property used in each step.

1. $2\left[\frac{1}{4} + \left(\frac{1}{2}\right)^2\right]$

2. $15 \bullet 1 - 9 + 2(15 \div 3 - 5)$

3. $2(3 \bullet 5 \bullet 1 - 14) - 4 \bullet \frac{1}{4}$

4. $18 \bullet 1 - 3 \bullet 2 + 2(6 \div 3 - 2)$

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1-3 Algebra 1 Summer Skills *(continued)*

Properties of Numbers

Commutative and Associative Properties The Commutative and Associative Properties can be used to simplify expressions. The Commutative Properties state that the order in which you add or multiply numbers does not change their sum or product. The Associative Properties state that the way you group three or more numbers when adding or multiplying does not change their sum or product.

Commutative Properties	For any numbers a and b, $a + b = b + a$ and $a \cdot b = b \cdot a$.
Associative Properties	For any numbers a, b, and c, $(a + b) + c = a + (b + c)$ and $(ab)c = a(bc)$.

Example 1: Evaluate 6 • 2 • 3 • 5 using properties of numbers. Name the property used in each step.

$6 \cdot 2 \cdot 3 \cdot 5 = 6 \cdot 3 \cdot 2 \cdot 5$	Commutative Property
$= (6 \cdot 3)(2 \cdot 5)$	Associative Property
$= 18 \cdot 10$	Multiply.
$= 180$	Multiply.

The product is 180.

Example 2: Evaluate 8.2 + 2.5 + 2.5 + 1.8 using properties of numbers. Name the property used in each step.

$8.2 + 2.5 + 2.5 + 1.8$

$= 8.2 + 1.8 + 2.5 + 2.5$	Commutative Prop.
$= (8.2 + 1.8) + (2.5 + 2.5)$	Associative Prop.
$= 10 + 5$	Add.
$= 15$	Add.

The sum is 15.

Exercises

Evaluate each expression using properties of numbers. Name the property used in each step.

1. $12 + 10 + 8 + 5$

2. $10 \cdot 7 \cdot 2.5$

3. $4 \cdot 8 \cdot 5 \cdot 3$

4. $12 + 20 + 10 + 5$

5. $3\frac{1}{2} + 4 + 2\frac{1}{2} + 3$

6. $3.5 + 2.4 + 3.6 + 4.2$

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1-4 Algebra 1 Summer Skills
The Distributive Property

Evaluate Expressions The Distributive Property can be used to help evaluate expressions.

Distributive Property	For any numbers a, b, and c, $a(b + c) = ab + ac$ and $(b + c)a = ba + ca$ and $a(b - c) = ab - ac$ and $(b - c)a = ba - ca$.

Example 1: Use the Distributive Property to rewrite 6(8 + 10). Then evaluate.

$6(8 + 10) = 6 \cdot 8 + 6 \cdot 10$ Distributive Property

$= 48 + 60$ Multiply.

$= 108$ Add.

Example 2: Use the Distributive Property to rewrite $-2(3x^2 + 5x + 1)$. Then simplify.

$-2(3x^2 + 5x + 1) = -2(3x^2) + (-2)(5x) + (-2)(1)$ Distributive Property

$= -6x^2 + (-10x) + (-2)$ Multiply.

$= -6x^2 - 10x - 2$ Simplify.

Exercises

Use the Distributive Property to rewrite each expression. Then evaluate.

1. $20(31)$

2. $12 \cdot 4\frac{1}{2}$

3. $5(311)$

4. $5(4x - 9)$

5. $3(8 - 2x)$

6. $12\left(6 - \frac{1}{2}x\right)$

7. $12\left(2 + \frac{1}{2}x\right)$

8. $\frac{1}{4}(12 - 4t)$

9. $3(2x - y)$

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1-4 Algebra 1 Summer Skills *(continued)*

The Distributive Property

Simplify Expressions A **term** is a number, a variable, or a product or quotient of numbers and variables. **Like terms** are terms that contain the same variables, with corresponding variables having the same powers. The Distributive Property and properties of equalities can be used to simplify expressions. An expression is in **simplest form** if it is replaced by an **equivalent** expression with no like terms or parentheses.

Example : Simplify $4(a^2 + 3ab) - ab$.

$4(a^2 + 3ab) - ab = 4(a^2 + 3ab) - 1ab$	Multiplicative Identity
$= 4a^2 + 12ab - 1ab$	Distributive Property
$= 4a^2 + (12 - 1)ab$	Distributive Property
$= 4a^2 + 11ab$	Substitution

Exercises

Simplify each expression. If not possible, write *simplified*.

1. $12a - a$ **2.** $3x + 6x$ **3.** $3x - 1$

4. $20a + 12a - 8$ **5.** $3x^2 + 2x^2$ **6.** $-6x + 3x^2 + 10x^2$

Write an algebraic expression for each verbal expression. Then simplify, indicating the properties used.

7. six times the difference of $2a$ and b, increased by $4b$

8. two times the sum of x squared and y squared, increased by three times the sum of x squared and y squared

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1-5 Algebra 1 Summer Skills

Descriptive Modeling and Accuracy

Descriptive Modeling A **metric** is a rule for assigning a number to some characteristic or attribute. A metric is helpful when using numbers to model real-world situations.

Example: An academic club uses a metric to determine which students can be a member. The total number of points possible is 50, and candidates either pass or fail. A candidate with at least 80% of the points will "pass." The table shows the number of points for each candidate. Tell the number of students that will be a member and not be a member of the academic club.

First find 80% of 50 to determine the minimum score that will allow students to be a member of the academic club.

80% of 50 = 0.8 × 50 = 40

Find the number of scores in the table that are 40 or above. These students will be members of the academic club.

Find the number of scores in the table that are less than 40. These students will not be member of the academic club.

48	50	43	38
40	42	36	35
49	50	32	26
41	45	32	47
48	32	25	50

	Number of Students
Member	12
Not a Member	8

Exercises

1. **ACADEMICS** A certain nursing school uses a metric to determine which students can enter the nursing program. The total number of points possible is 300, and students either pass or fail. A student with at least 85% of the points will "pass." The last testing cycle had the following number of points: 245, 285, 263, 248, 198, 250, 247, 268, 280, 246, 218, 195, 208, 287, 290, 240, 285, 274, 230, and 255. Tell the number of students that will enter the nursing program.

2. **FINANCIAL LITERACY** Suppose a mortgage company compares the ratio of liabilities to assets as their metric. For example, 0.28 may be its ideal metric for the debt-to-income ratio. Samar has $250,000 in assets. Using this metric, what amount of liabilities could Samar have and be able to take out a loan?

$$\text{Debt-to-income ratio} = \frac{\text{liabilities}}{\text{assets}}$$

$$\boxed{} = \frac{x}{\$250{,}000}$$

$$\$\boxed{} = x$$

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1-5 Algebra 1 Summer Skills *(continued)*

Descriptive Modeling and Accuracy

Appropriate Levels of Accuracy **Accuracy** refers to how close a measured value comes to the actual or desired value.

Example: Elizabeth is buying pain reliever medicine for a child. The amount of medicine depends on the child's weight. The medicine is available in packages that vary by 15 pounds. How accurate does Elizabeth need to be to buy the correct medicine?

Step 1 Make a list of weights of the medicine.

15, 30, 45, 60, 75, 90, 105

Step 2 Determine the accuracy.

Elizabeth needs to be accurate within 15 pounds.

Example: Tom wants to measure the length of a piece of wood. He measured the length of the piece of wood in inches, feet, and centimeters. Which measure is more accurate?

Step 1 List the units of measure in order from largest unit to smallest unit.

foot, inch, centimeter

Step 2 Usually, the smaller the unit of measure, the more accurate the measure.

The measurement in centimeters is the most accurate.

Exercises

1. A coffee table has dimensions given in inches and meters. Which unit of measure is more accurate? Explain.

2. Vadim is purchasing tick medicine for a dog. The amount of medicine depends on the dog's weight. The medicine is available in packages that vary by 12 dog pounds. How accurate does Vadim need to be to buy the correct package of medicine? Explain.

3. A designer is purchasing carpet for a show room that is 13.25 feet by 15.5 feet. The dimensions of the carpet are available in 5-feet increments. What size dimensions should the designer order for the carpet? Explain.

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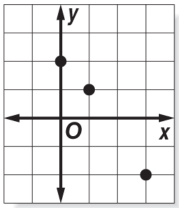
1-6 Algebra 1 Summer Skills
Relations

Represent a Relation A **relation** is a set of ordered pairs. A relation can be represented by a set of ordered pairs, a table, a graph, or a **mapping**. A mapping illustrates how each element of the domain is paired with an element in the range. The set of first numbers of the ordered pairs is the **domain** (*x* values). The set of second numbers of the ordered pairs is the **range** (*y* values) of the relation.

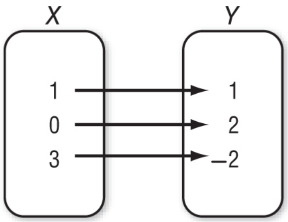
Example: a. Express the relation {(1, 1), (0, 2), (3, –2)} as a table, a graph, and a mapping.

x	*y*
1	1
0	2
3	–2

table



graph



mapping

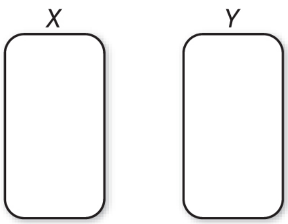
b. Determine the domain and the range of the relation.

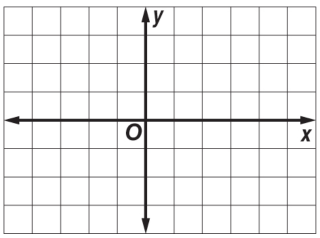
The domain for this relation is {0, 1, 3}. The range for this relation is {–2, 1, 2}.

Exercises

1A. Express the relation {(–2, –1), (3, 3), (4, 3)} as a table, a graph, and a mapping.

x	y





1B. Determine the domain and the range of the relation.

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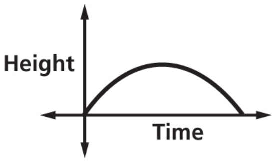
1–6 Algebra 1 Summer Skills *(continued)*

Relations

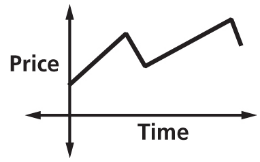
Graphs of a Relation The value of the variable in a relation that is subject to choice is called the **independent variable**. The variable with a value that is dependent on the value of the independent variable is called the **dependent variable**. These relations can be graphed without a scale on either axis, and interpreted by analyzing the shape.
The **domain** (x values) = independent and the **range** (y values) = dependent.

Example 1: The graph below represents the height of a football after it is kicked downfield. Identify the independent and the dependent variable for the relation. Then describe what happens in the graph.



The independent variable is time, and the dependent variable is height. The football starts on the ground when it is kicked. It gains altitude until it reaches a maximum height, then it loses altitude until it falls to the ground.

Example 2: The graph below represents the price of stock over time. Identify the independent and dependent variable for the relation. Then describe what happens in the graph.

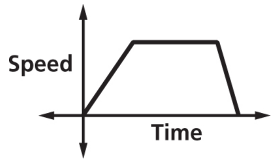


The independent variable is time and the dependent variable is price. The price increases steadily, then it falls, then increases, then falls again.

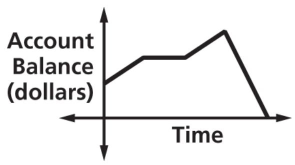
Exercises

Identify the independent and dependent variables for each relation. Then describe what is happening in each graph.

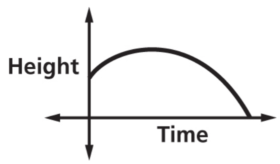
1. The graph represents the speed of a car as it travels to the grocery store.



2. The graph represents the balance of a savings account over time.



3. The graph represents the height of a baseball after it is hit.



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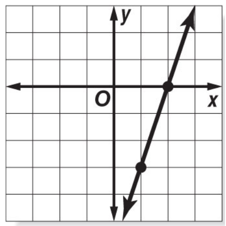
1-7 Algebra 1 Summer Skills
Functions

Identify Functions Relations in which each element of the domain is paired with exactly one element of the range are called **functions**. A function is a relationship between the input (domain/x values) and the output (range/y values). Each input has exactly one output.

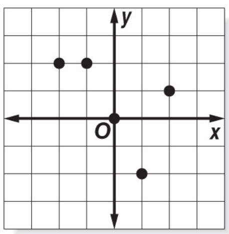
Example 1
Determine whether the relation {(6, –3), (4, 1), (7, –2), (–3, 1)} is a function. Explain.
Since each element of the domain is paired with exactly one element of the range, this relation is a function.

Example 2
Determine whether $3x - y = 6$ is a function.
Since the equation is in the form $Ax + By = C$, the graph of the equation will be a line, as shown at the right.

If you draw a vertical line through each value of x, the vertical line passes through just one point of the graph. Thus, the line represents a function.



Exercises
Determine whether each relation is a function. Answer “yes” or “no”.

1.


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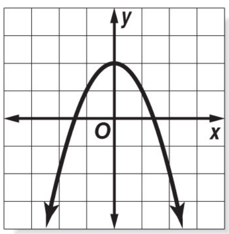

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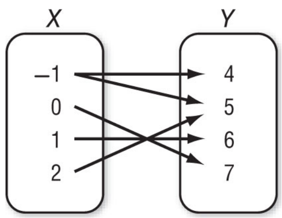

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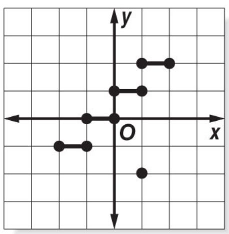

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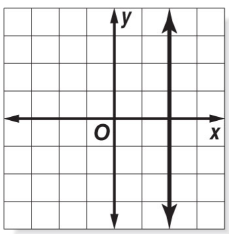

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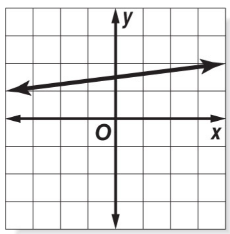

7. {(4, 2), (2, 3), (6, 1)}

8. {(–3, –3), (–3, 4), (–2, 4)}

9. {(–1, 0), (1, 0)}

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1-7 Algebra 1 Summer Skills *(continued)*

Functions

Find Function Values Equations that are functions can be written in a form called **function notation**. For example, $y = 2x - 1$ can be written as $f(x) = 2x - 1$. In the function, x represents the elements of the domain, and $f(x)$ represents the elements of the range. Suppose you want to find the value in the range that corresponds to the element 2 in the domain. This is written $f(2)$ and is read "f of 2." The value of $f(2)$ is found by substituting 2 for x in the equation.

Example: If $f(x) = 3x - 4$, find each value.

a. $f(3)$

$f(3) = 3(3) - 4$ Replace x with 3.
$= 9 - 4$ Multiply.
$= 5$ Simplify.

b. $f(-2)$

$f(-2) = 3(-2) - 4$ Replace x with –2.
$= -6 - 4$ Multiply.
$= -10$ Simplify.

Exercises

If $f(x) = 2x - 4$ and $g(x) = x^2 - 4x$, find each value.

1. $f(4)$

2. $g(2)$

3. $f(-5)$

4. $g(-3)$

5. $f(0)$

6. $g(0)$

7. $f(3) - 1$

8. $f\left(\frac{1}{4}\right)$

9. $g\left(\frac{1}{4}\right)$

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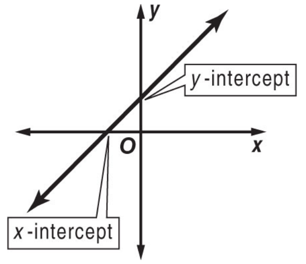
1-8 Algebra 1 Summer Skills

Interpreting Graphs of Functions

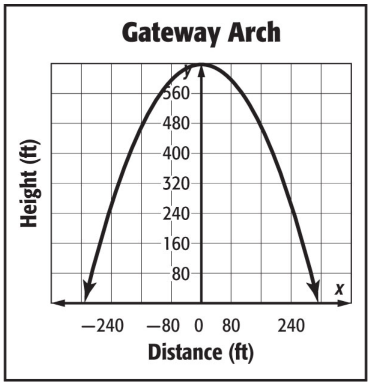
Interpret Intercepts and Symmetry The **intercepts** of a graph are points where the graph intersects an axis. The y-coordinate of the point at which the graph intersects the y-axis is called a ***y*-intercept.** Similarly, the x-coordinate of the point at which a graph intersects the x-axis is called an ***x*-intercept.**



A graph possesses **line symmetry** in a line if each half of the graph on either side of the line matches exactly

Example

ARCHITECTURE The graph shows a function that approximates the shape of the Gateway Arch, where x is the distance from the center point in feet and y is the height in feet. Identify the function as *linear* or *nonlinear*. Then estimate and interpret the intercepts, and describe and interpret any symmetry.



Linear or Nonlinear: Since the graph is a curve and not a line, the graph is nonlinear.

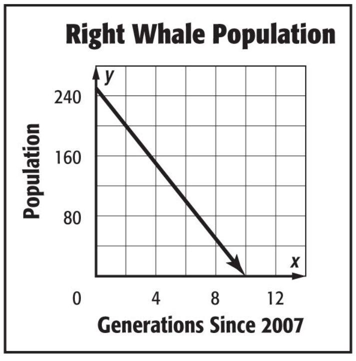
***y*-Intercept:** The graph intersects the y-axis at about (0, 630), so the y-intercept of the graph is about 630. This means that the height of the arch is 630 feet at the center point.

***x*-Intercept(s):** The graph intersects the x-axis at about (–320, 0) and (320, 0). So the x-intercepts are about –320 and 320. This means that the object touches the ground to the left and right of the center point.

Symmetry: The right half of the graph is the mirror image of the left half in the y–axis. In the context of the situation, the symmetry of the graph tells you that the arch is symmetric. The height of the arch at any distance to the right of the center is the same as its height that same distance to the left.

Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph and any symmetry.

1.



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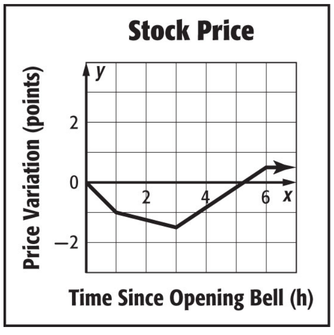

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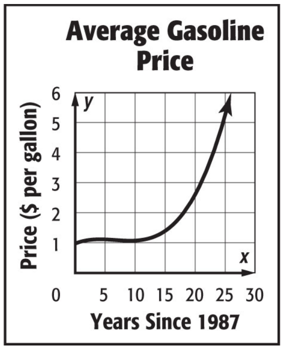

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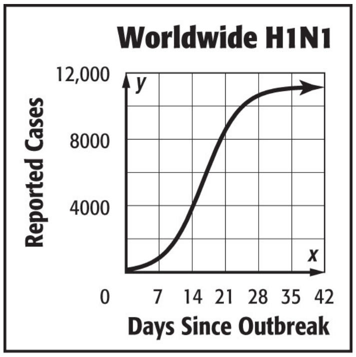
1-8 Algebra 1 Summer Skills *(continued)*

Interpreting Graphs of Functions

Interpret Extrema and End Behavior Interpreting a graph also involves estimating and interpreting where the function is increasing, decreasing, positive, or negative, and where the function has any extreme values, either high or low.

Example

HEALTH The outbreak of the H1N1 virus can be modeled by the function graphed at the right. Estimate and interpret where the function is positive, negative, increasing, and decreasing, the *x*-coordinates of any relative extrema, and the end behavior of the graph.



Positive: for x between 0 and 42

Negative: no parts of domain

This means that the number of reported cases was always positive. This is reasonable because a negative number of cases cannot exist in the context of the situation.

Increasing: for x between 0 and 42 **Decreasing:** no parts of domain

The number of reported cases increased each day from the first day of the outbreak.

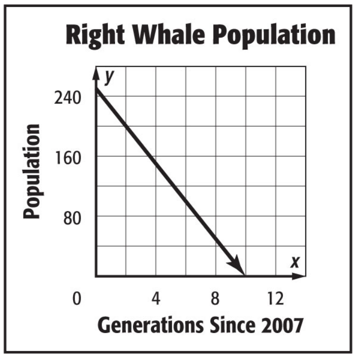
Relative Maximum: at about $x = 42$ **Relative Minimum:** at $x = 0$

The extrema of the graph indicate that the number of reported cases peaked at about day 42.

End Behavior: As x increases, y appears to approach 11,000. As x decreases, y decreases. The end behavior of the graph indicates a maximum number of reported cases of 11,000.

Estimate and interpret where the function is positive, negative, increasing, and decreasing, the *x*–coordinate of any relative extrema, and the end behavior of the graph.

1.



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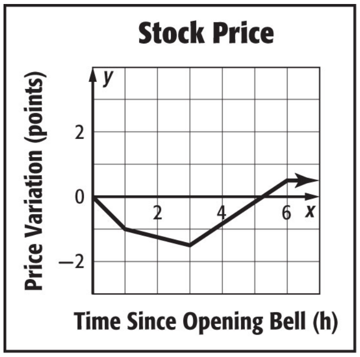

3.