ALGEBRA 1 NOTES

Section 1-1 Variables and Expressions

Lesson Objectives:

- Explain the difference between a constant quantity and a variable quantity
- Recognize the difference between an expression and an equation
- Write an algebraic expression in words and vice versa
- Write an algebraic expression that would describe a given rule or number pattern

Warm-Up:

Consider the population of Florida, the area of Colorado, and the flight time from Philadelphia to S.F. Which of these have a value that varies?

1. Which of the following have values that can vary?_____
   a) the population of Florida
   b) the area of Colorado
   c) the flight time from Philadelphia to San Francisco

2. Which ones have values that don't vary?_____

3. What is a term for values that vary?_____

   What is a term for values that don't vary?_____

Key Concepts:

- What is the difference between a variable quantity and a constant quantity?

  Variable quantity_____

  Constant quantity_____

- What is the difference between an expression and an equation?

  Expression_____

  Equation_____

Rewriting Algebraic Expressions into Words:

List possible words that would describe each of the below operations:

Addition: _____

Subtraction: _____

Multiplication: _____

Division: _____

Example 1 **Write the following algebraic expressions as a word phrase:**

a. $x + 5.2$ _____

b. $12x + 5$ _____

c. $9 - \frac{2}{m}$ _____

d. $4(m + 3)$ _____

Rewriting Words into Algebraic Expressions:

Example 2 **Translate the following phrases into algebraic expressions.**

a. 7 less than h _____

b. The difference of 8 and y _____

c. The quotient of 6 and m less 5 _____

d. The sum of 12 and twice x _____

e. Twice the sum of 12 and x _____

Example 3 Error Analysis:

A student writes "the sum of 8 times a number x plus 3" to describe the expression 8(x + 3).

a. Explain the error.

b. What is a correct way to say the algebraic expression?

Application 1:

Suppose you are analyzing the number of triangles that can be formed by drawing line segments from one vertex of a polygon to the other verticies. Complete the table to discover some number patterns and algebraic rules for this situation.

In the last line of the table, you should have the algebraic rules or expressions for a polygon with n sides. Explain, in words, how one can find the following given a polygon with n sides:

a) The number of line segments that can be drawn from a vextex to the other vertices:

Number of Sides	Number of Segments	Number of Triangles
3	0	1
4	1	
5		
6		
7		
n		

b) The number of triangles that can be drawn inside a polygon with n sides:

Application 2:

While on vacation, you rent a bicycle. You pay $9 for each hour you use it. It costs $5 to rent a helmet while you use the bicycle.
a) Complete the table to find the algebraic rule for the total cost of renting the bicycle for t hours.

b) Write an English word phrase that describes how to find the total cost of renting a bike for t hours:

Number of Hours Rented	Total Rental Cost
1	($9 x 1) + $5 = ____
2	($9 x __) + $5 = ____
3	($9 x __) + $5 = ____
4	($9 x __) + $__ = ____
5	($__ x __) + $__ = ____
t	_____

Application 3:

Susan is paying for her items using gift cards. The clerk tells her that she needs 3 gift cards and an additional $5 to pay for her purchase. Write an algebraic expression to model the total paid using the variable “g” for the value of one gift card.

ALGEBRA 1 NOTES
Section 1-2 Variables and Expressions

Objective:
- To simplify expressions involving exponents
- To use the order of operations to evaluate expressions

Vocabulary: power, exponent, base, simplify evaluate

Warm-Up Write an algebraic expression for each word phrase.

1. The quotient of a number and 7 added to 5.

2. Twice the difference of a number and 2.

3. The cost of a movie ticket is $8.50. Write an expression that gives the total cost of buying n tickets.

ORDER OF OPERATIONS
One easy way to remember the order of operations process is to remember the acronym PEMDAS or the old saying, "**P**lease **E**xcise **M**y **D**ear **A**unt **S**ally."

P – Perform operations in grouping symbols
E – Simplify exponents
$M\ D\}$ - **LEFT to RIGHT** Perform multiplication and division in order from left to right
$A\ \ S\}$ - **LEFT to RIGHT** Perform addition and subtraction in order from left to right

Example 1 Simplify

$2 - 3^2 + 6 + 3 \times 2$

Example 2 Simplify.

$-7 + 4 + (2^3 - 8 \div -4)$

ORDER OF OPERATIONS

Evaluate each expression. Remember your Order of Operations process (PEMDAS).
FORMAT PROPERLY!!

1. $15 \div 3(5) - 4$

2. $3 + 8(2)^2 - 4$

3. $32 \div [16 \div (8 \div 2)]$

4. $10(3 - 6^2) + 8 \div 2$

Evaluating Expressions – *Use Order of Operations to evaluate expressions!*

Example 3 Evaluate the following expressions when $x = -5$. Format properly!

a. $3x + 4$

b. $-3x^2$

c. $\frac{4x^2-1}{x+2}$

Evaluating Expressions (con't)

Evaluate each expression given that $x = 5,\ y = -4,\ and\ z = 6$.

1. $3y^2 + x$

2. $2xy - z$

3. $5z + (y - x)^2$

4. $\dfrac{(-2x)^2}{yz-1}$

EXTRA PRACTICE

Simplify each using the Order of Operations and proper formatting.

1. $6 - 4 + 2(3)$

2. $(12 - 4) \div 8$

EXTRA PRACTICE (con't)

3. $16 \div 2(5)(3) \div 6$

4. $\frac{5+[30-(8-1)^2]}{11-2^2}$

Evaluate each expression given that $x = 5$, $y = -4$, and $z = 6$.

5. $2(x + z) - y$

6. $\frac{-xy}{2}$

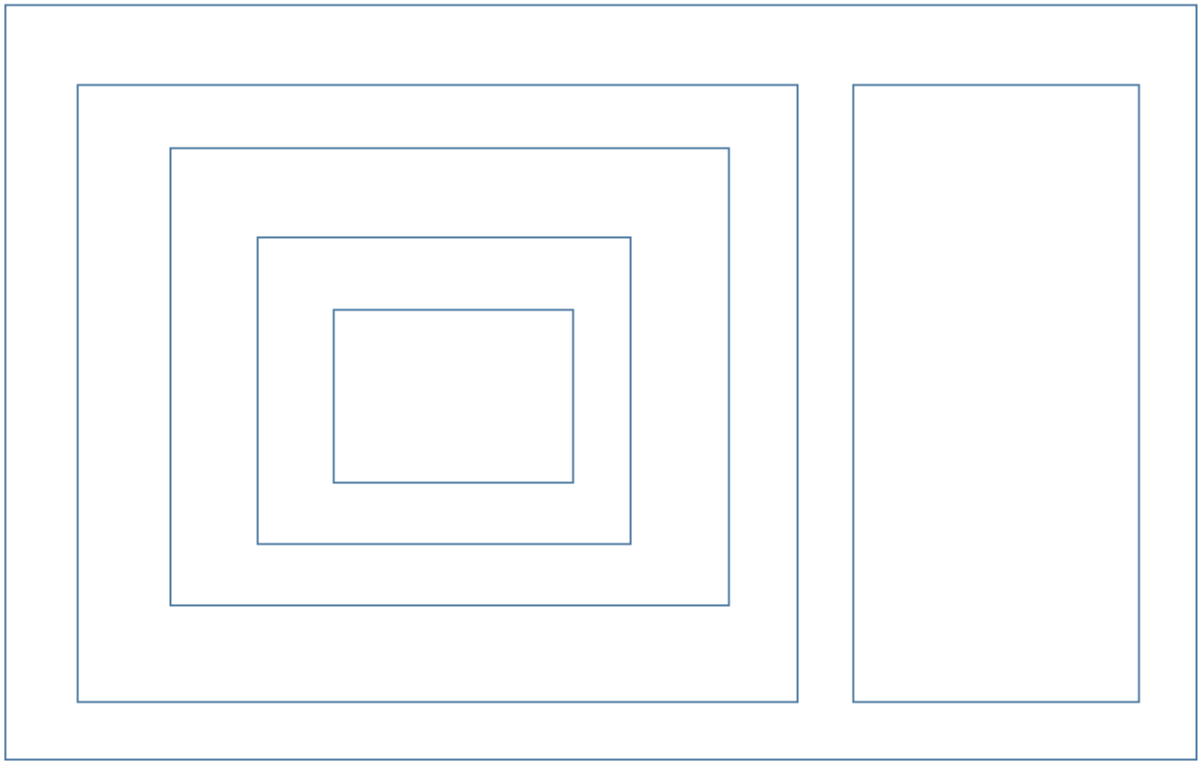
ALGEBRA 1 NOTES

Section 1-3 Real Numbers and the Number Line

Objective:

- To classify, graph, and compare real numbers
- To find and estimate square roots

SETS OF NUMBERS



<u>Example 1</u> Place an "x" in the set(s) to which each number belongs.

	Natural	Whole	Integer	Rational	Irrational	Real
$\sqrt{36}$						
$-4.353535\ldots$						
18π						
$-\frac{17}{5}$						

List the set of perfect squares from 1^2 to 15^2.

<u>Example 2</u> Simplify each expression.

a. $\sqrt{\frac{49}{81}}$ b. $\sqrt{0.25}$ c. $\sqrt{1600}$

<u>Example 3</u> Estimate the square root. Round to the nearest integer.

a. $\sqrt{35}$ b. $\sqrt{61}$ c. $\sqrt{200}$

<u>Example 4</u> Order the numbers from least to greatest.

a. $-3,\ \sqrt{37},\ \sqrt{11},\ 5.5, -\frac{60}{11}$ b. $-\frac{1}{6}, -0.3, \sqrt{1},\ -\frac{2}{13},\ \frac{7}{8}$

ALGEBRA 1 NOTES
Section 1-4 Properties of Real Numbers

Objective:
- To identify and use properties of real numbers

Vocabulary: equivalent expressions, deductive reasoning, counterexample

WARM-UP Evaluate using proper formatting!

1. $p^2 - p \; if \; p = -3$

2. $-2(x-y)^2 \; if \; x = 3 \; and \; y = -4$

PROPERTIES OF REAL NUMBERS

PROPERTY	ADDITION	MULTIPLICATION
COMMUTATIVE		
ASSOCIATIVE		
IDENTITY		
INVERSE		
MULTIPLICATION PROPERTY OF 0	N/A	
MULTIPLICATION PROPERTY OF -1	N/A	
DISTRIBUTIVE PROPERTY		

Match each algebraic statement with the name of the property is shows:

_____Commutative Property of Addition:	A. -1 • a = -a
_____Commutative Property of Multiplication:	B. 3 × 2 = 6
_____Additive Identity:	C. a + b = b + a
_____Multiplicative Identity:	D. a ÷ b = a × (1/b)
_____Associative Property of Addition:	E. a – b = a + (-b)
_____Associative Property of Multiplication:	F. a + (-a) = 0
_____Zero Property of Multiplication:	G. a • 1 = a
_____Multiplicative Property of -1:	H. (a • b) • c = a • (b • c)
_____Inverse Property of Addition	I. a • 0 = 0
_____Inverse Property of Multiplication	J. a • b = b • a
_____Definition of Subtraction	K. (a + b) + c = a + (b + c)
_____Definition of Division	L. a(1/a) = 1
_____Number Fact	M. a + 0 = a

Simplify each expression. Justify each step.

1. 5 + (3*x* + 2) = _____

   = _____

   = _____

2. $\frac{12st}{4t}$

Tell whether the expressions in each pair are equivalent.

3. (12 - 7) + x and 5x

4. 8 + 6 + *b* and 8 + 6*b*

5. p(4 - 4) and 0

6. $\frac{24xy}{2y}$ *and* $12x$

What is a counter example?

Use deductive reasoning to tell whether each statement is *true* or *false*.
If it is false, give a counter-example.

7. For all real numbers a and b, $a - b = b - a$.

8. For all real numbers p, q, and r, $p - q - r = p - r - q$.

9. For all real numbers x, y, and z, $(x + y) + z = z + (x + y)$.

10. For all real numbers n, $n + 1 = n$.

Show how to use mental math to simplify each expression.

11. $36 + 12 + 4$

12. $19.2 + 0.6 + 12.4 + 0.8$

13. $2 \cdot 16 \cdot 10 \cdot 5$

14. $12 \cdot 18 \cdot 0 \cdot 17$

Order of Operations Practice

1. Explain the difference between $-3^2 and\ (-3)^2$.

Simplify using the Order of Operations and proper formatting!

2. $-6^2 + 15 \div 5(3)$

3. $9 \div 3 + 7(4) \div 2$

4. $5 + \ (-4)^2 \div 8(2)$

5. $-2(4-7)^2 \div 9 - 8 + 3$

6. $\dfrac{2(-8) \div -4}{5-7}$

ALGEBRA 1 NOTES
Section 1.5 Adding and Subtracting Real Numbers

Objective: To find sums and differences of real numbers

Warm-Up Place an "x" in the set(s) to which each number belongs.

	Natural	Whole	Integer	Rational	Irrational	Real
$\frac{2}{3}$						
-2π						
$\sqrt{25}$						

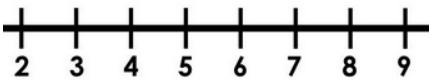
Rules for Adding & Subtracting

SAME SIGNS → ADD

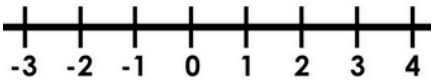
DIFFERENT SIGNS → SUBTRACT (take their difference)

Example 1 Represent each sum using a number line.

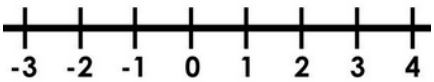
a. 3 + 5



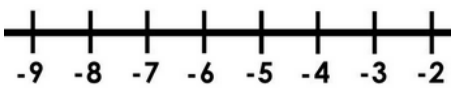
b. 3 + (-5)



c. – 3 + 5



d. – 3 + (- 5)



Example 2 Find each sum.

a. $-12 + 7$

b. $-18 + (-2)$

c. $-4.8 + 9.5$

d. $\frac{3}{4} + \left(-\frac{5}{6}\right)$

Subtracting Numbers:
To subtract a number, add its opposite: $a - b = a + (-b)$

To subtract a negative number, add: $a - (-b) = a + b$
(the opposite of a negative is a positive)

Example 3 Find each difference.

a. $-8 - (-13)$

b. $3.5 - 12.4$

c. $-5.2 - 7.5$

d. $\frac{1}{6} - \frac{3}{4}$

Example 4 The Kelvin temperature scale is related to the degrees Celsius temperature by the formula $x = 273 + y$, where x is the number of Kelvins and y is the temperature in degrees Celsius. What is the temperature in Kelvins given the degrees Celsius?

a. $-22℃$

b. $-32℃$

ALGEBRA 1 NOTES

Section 1.6 Multiplying and Dividing Real Numbers

Objective:

- To find products and quotients of real numbers

Rules of Multiplication and Division

SAME SIGNS → POSITIVE RESULT

DIFFERENT SIGNS → NEGATIVE RESULT

MULTIPLICATION		**DIVISION**	
$(-)(-) = (+)$	$(-)(+) = (-)$	$\frac{(-)}{(-)} = +$	$\frac{(+)}{(-)} = (-)$
$(+)(+) = (+)$	$(+)(-) = (-)$	$\frac{(+)}{(+)} = +$	$\frac{(-)}{(+)} = (-)$

Example 1 **Find each product.**

a. $(-3)(11)$

b. $(-2.1)(-5.2)$

c. $8\left(-\frac{3}{4}\right)$

d. $\left(-\frac{4}{5}\right)^2$

e. $\left(-\frac{1}{5}\right)\left(-\frac{10}{11}\right)$

f. $3(8.1)$

Example 2 **Simplify each expression.**

a. $\sqrt{900}$

b. $-\sqrt{36}$

c. $\pm\sqrt{\frac{25}{144}}$

d. $\sqrt{1.21}$

e. $\pm\sqrt{\frac{64}{81}}$

f. $-\sqrt{0.09}$

Example 3 **Find each quotient.**

a. $\frac{5}{12} \div \frac{10}{3}$

b. $-42 \div -7$

c. $6 \div \frac{2}{3}$

d. $\frac{27}{-9}$

e. $-\frac{7}{9} \div \frac{14}{3}$

f. $\dfrac{-\frac{2}{3}}{-\frac{4}{5}}$

ALGEBRA 1 NOTES
Section 1-7 The Distributive Property

Objective: To use the distributive property to simplify expressions

Warm-Up Consider a rectangle that is 3 inches by (5x + 7) inches.

a. Find the perimeter using $P = 2l + 2w$.

b. Find the area.

Simplify each expression by combining like terms.

1. $4t + 6t$
2. $8x + 3 - 5x - 9$
3. $7m^2n + 4m^2n^2 - 4m^2n - 5m^2n^2 - 5mn^2$
4. $-2y - 5y$
5. $8xy^4 - 7xy^3 - 11xy^4$
6. $-17mn + 4mn - mn + 10mn$

Simplify each expression.

7. $(6 + 9v)6$
8. $15(3y - 5)$
9. $\frac{1}{3}(3z - 12)$
10. $\frac{81f-63}{9}$
11. $\frac{15x-21}{12}$
12. $\frac{3n+5}{7}$

Simplify by distributing a negative.

13. $-(6 + d)$ 14. $-(-r + 1)$ 15. $-(-x + y - 1)$ 16. $-(f + 3g - 7)$

Simplify each expression.

17. $4(2h + 1) + 3(4h + 7)$ 18. $-2(5 - 4s + 6t) - 5s + t$ 19. $7(3 + x) - 4(x + 1)$

Use mental math with the distributive property to find each product.

20. 3.2×3 21. 149×2 22. 6×397

23. You buy 75 candy bars at a cost of \$0.49 each. What is the total cost of 75 candy bars? Show how to use mental math.

24. The tax a plumber must charge for a service call is given by the expression $0.06(35 + 25h)$ where h is the number of hours the job takes. Rewrite this expression using the Distributive Property. What is the tax for a 5 hour job and a 20 hour job?

ALGEBRA 1 NOTES
Section 1-8 An Introduction to Equations

Objective: To solve equations using tables and mental math

Vocabulary: equation, open sentence, solution of an equation

WARM-UP Simplify each expression.

1. $6(4x-3)+6(4-3x)$

2. $\frac{1}{2}(4p+16)-\frac{2}{3}(6p-9)$

EXAMPLE 1 Tell whether each equation is true, false, or open. Explain.

a. $-42-10=-52$

b. $3(-6)+5=26-3$

c. $45\div x-14=22$

d. (12 + 8) ÷ (-10) = -12 ÷ -6

e. $32\div -4+6=-72\div 8+7$

f. $-14n-7=7$

EXAMPLE 2 Tell whether the given number is a solution of each equation.

a. $3b-8=13;\ -7$

b. $12=14-2f;\ -1$

c. $7c-(-5)=26;\ 3$

EXAMPLE 3 Use mental math to find the solution of each equation.

a. $12b = 60$

b. $t - 7 = 10$

c. $12 = 5 - h$

d. $6 - g = 12$

e. $\frac{x}{4}=3$

f. 4m - 5 = 11

g. $\frac{12}{m}=2$

h. - 3d + 10 = 43

EXAMPLE 4 **Use a table to find the solution of each equation.**

a. $2x - 1 = 11$

b. $-\frac{1}{3}m - 5 = -6$

EXAMPLE 5 **Use a table to find two consecutive integers between which the solution lies.**

a. 7t - 20 = 33

b. 7.5 = 3.2 - 2.1n

EXAMPLE 6 **Write an equation for each sentence.**

a. The difference of a number and 7 is 8.

b. 6 times the sum of a number and 5 is 16.

c. A computer programmer works 40 hours per week. What is an equation that relates the number of weeks w that the programmer works and the number of hours h that the programmer spends working?

d. There are 68 members of the marching band. The vans the band uses to travel to games each carry 15 passengers. How many vans does the band need to reserve for each away game?