CHAPTER 2: INTRODUCTION TO VARIABLES AND PROPERTIES OF ALGEBRA

Chapter Objectives
By the end of this chapter, students should be able to:

By the end of this chapter, students should be able to:
- ✓ Interpret different meanings of variables
- ✓ Evaluate algebraic expressions
- ✓ Writing algebraic expressions
- ✓ Identify properties of algebra
    - Commutative
    - Associative
    - Identity
    - Inverse
    - Distributive

Contents

SECTION 2.1 INTRODUCTION TO VARIABLES

A. WHAT IS A VARIABLE?

When someone is having trouble with algebra, they may say, "I don't speak math!" While this may seem weird to you, it is a true statement. Math, like English, French, Spanish, or Arabic, is a like a language that you must learn in order to be successful. In order to understand math, you must practice the language.

Action words, like run, jump, or drive, are called verbs. In mathematics, *operations* are like *verbs* because they involve doing something. Some operations are familiar, such as addition, multiplication, subtraction, or division.

Operations can also be much more complex like a raising to an exponent or taking a square root.

A **variable** is one of the most important concepts of mathematics, without variables we would not get far in this study. A **variable** is a symbol, usually an English letter, written to replace an unknown or changing quantity.

Definitions
A **variable**, usually represented by a letter or symbol, can be defined as: • A quantity that may *change* within the context of a mathematical problem. • A *placeholder* for a specific value. An **algebraic expression** is a mathematical statement that can contain numbers, variables, and operations (addition, subtraction, multiplication, division, etc…).

	MEDIA LESSON
	Introduction to variables and variable expressions (Duration 7:54)

View the video lesson, take notes and complete the problems below.

Definition:

- A _____ is a _____ that represents an _____.

    a) How many hours will you study tomorrow?

    _____

    _____

    b) How much will you pay to have your car repaired?

    _____

    _____

- A_____ consists of _____, _____, _____ and _____ like _____, _____, _____ and _____.

- Often _____ and _____ are used _____. The difference is a _____ _____ contain a variable while the _____.

Mathematical Expressions	Equations
_____	_____
_____	_____
_____	_____

- Writing variable expressions

    a) It costs $9 per adult and $5 per child to go to the movies.

    Variable expression for the cost of a group go to the movies: _____

    _____

    _____

    b) It costs $30 per day to rent a car plus $0.10 per mile.

    Variable expression for the total rental cost: _____

    _____

    _____

Evaluating variable expressions

c) Evaluate $5x + 7$ when $x = 6$

d) Evaluate $4m - 3n$ when $m = 9$ and $n = 7$

e) Evaluate $p^2 - 3q + 7$ when $p = 11, q = 8$

f) Evaluate $\dfrac{36}{d} + 7e - 9f$ when $d = 9,\ e = 3,$ and $f = 1$

	MEDIA LESSON
[QR code]	Why all the letters in algebra? (Duration 3:03)

View the video lesson, take notes and complete the problems below.

What question do students ask a lot when they start Algebra?

_____

What are other things besides letters that can be used as a variable?

_____

B. MEANING OF A VARIABLE IN MATHEMATICS

	MEDIA LESSON Meaning of a variable (Duration 4:13)

View the video lesson, take notes and complete the problems below.

Definitions of a variable

1) **Define variable as a changing value**
   A variable is a letter that represents _____ or _____ that may _____ within the context of a mathematical problem.
   Example: _____

   _____

2) **Define variable as a placeholder**
   A variable is a letter that represents _____ or _____ that will remain _____ based on the confines of the mathematical problem.
   Example: _____

   _____

Example: Determine if the description describes a changing value (CV) or a placeholder (P) then determine a possible variable.

Scenario	Changing Value (CV) or Placeholder (P)	Variable
The elevation of Mount Humphrey's		
The water level of a pool as it is being filled		
The number of calories consumed throughout the day		
The monthly car payment with a fixed interest loan		
The amount of gas consumed by your car as you drive		
The cost of a new textbook for a specific class from the bookstore at the beginning of the semester		

YOU TRY

Scenario	Changing Value (CV) or Placeholder (P)	Variable
The number of cars in the parking lot at this moment		
The number of cars pass by an intersection throughout the day		
The altitude of an airplane during a trip		
The temperature in the Dead Valley on at midnight on January 1st in 1905		
The balance of your checking account today		

	MEDIA LESSON
	Why aren't we using the multiplication sign? (Duration 3:08)

View the video lesson, take notes and complete the problems below.

Why the multiplication sign "x" is not being used much when we get to algebra?

_____

	MEDIA LESSON
	Why is 'x' the symbol for an unknown? (Duration 3:57)

View the video lesson, take notes and complete the problems below.

Why is it that x is the unknown?

_____

C. VARIABLE EXPRESSIONS

In mathematics, especially in algebra, we look for **patterns** in the numbers that we see. Using mathematical verbs and variables studied in previous lessons, *expressions* can be written to *describe a pattern*.

Definition
An algebraic expression is a mathematical phrase combining numbers and/or variables using mathematical operations.

An algebraic expression consists of coefficients, variables, and terms. Given an algebraic expression, a

- **coefficient** is the number in front of the variable.
- **variable** is a letter representing any number.
- **term** is a product of a coefficient and variable(s).
- **constant:** a number with no variable attached. A term whose value never changes.

For example, t, $2x$, $3st$, $7x^2$, $5ab^3c$ are all examples of terms because each is a product of a coefficient and variable(s).

$$\underbrace{5xy^2}_{term} \underbrace{-2x}_{term} \underbrace{-3}_{\substack{constant \\ term}}$$

$$\underset{coefficient}{5} \overset{variable}{xy^2} \underset{}{-2} x \underset{constant}{-3}$$

	MEDIA LESSON
	Algebraic expression vocabulary (Duration 5:52)

View the video lesson, take notes and complete the problems below.

Terms: _____.

Constant Term: _____.

Example 1: Consider the algebraic expression $4x^5 + 3x^4 - 22x^2 - x + 17$

    a) List the terms:_____

    b) Identify the constant term: _____

Factors: _____.

Coefficient: _____.

Example 2: Complete the table below.

	$-4m$	$-x$	$\frac{1}{2}bh$	$\frac{2r}{5}$
List the Factors				
Identify the Coefficient				

Example 3: Consider the algebraic expression $5y^4 - 8y^3 + y^2 - \frac{y}{4} - 7$.

    a) How many terms are there? _____

    b) Identify the constant term. _____

    c) What is the coefficient of the first term? _____

    d) What is the coefficient of the second term? _____

    e) What is the coefficient of the third term? _____

    f) List the factors of the fourth term._____

YOU TRY

Consider the algebraic expression $2m^3 + m^2 - 2m - 8$.

    a) How many terms are there? _____

    b) Identify the constant term. _____

    c) What is the coefficient of the first term? _____

    d) What is the coefficient of the second term? _____

    e) List the factors of the third term. _____

D. WRITING ALGEBRAIC EXPRESSIONS

MEDIA LESSON
[Write algebraic expressions](#) (Duration 6:18)

View the video lesson, take notes and complete the problems below.

Example 1: Juan is 6 inches taller than Niko. Let N represent Niko's height in inches. Write an algebraic expression to represent Juan's height.

        Niko's height: _____

        Juan's height: _____

Example 2: Juan is 6 inches taller than Niko. Let J represent Juan's height in inches. Write an algebraic expression to represent Niko's height.

        Niko's height: _____

        Juan's height: _____

Example 3: Suppose sales tax in your town is currently 9.8%. Write an algebraic expression representing the sales tax for an item that costs D dollars.

Cost: _____

Sales tax: _____

Example 4: You started this year with $362 saved and you continue to save an additional $30 per month. Write an algebraic expression to represent the total amount saved after m months.

Number of months: _____

Total amount saved: ___ _____

Example 5: Movie tickets cost $8 for adults and $5.50 for children. Write an algebraic expression to represent the total cost for A adults and C children to go to a movie.

Number of adults: _____

Number of children: ___ _____

Total Cost: _____

YOU TRY

Complete the following problems. Show all steps as in the media examples.

a) There are about 80 calories in one chocolate chip cookie. If we let n be the number of chocolate chip cookies eaten, write an algebraic expression for the number of calories consumed.

Number of cookies: _____

Number of calories consumed: _____

b) Brendan recently hired a contractor to do some necessary repair work. The contractor gave a quote of $450 for materials and supplies plus $38 an hour for labor. Write an algebraic expression to represent the total cost for the repairs if the contractor works for h hours.

Number of hours worked: _____

Total cost: _____

c) A concession stand charges $3.50 for a slice of pizza and $1.50 for a soda. Write an algebraic expression to represent the total cost for P slices of pizza and S sodas.

Number of slices of pizza: _____

Number of sodas: _____

Total cost: _____

	MEDIA LESSON
[QR code]	The story of x (Duration 7:09)

View the video lesson, take notes and complete the problems below.

Example 1: Tell the story of x in each of the following expressions.

a) $x - 5$

b) $5 - x$

c) $2x$

d) x^2

Example 2: Tell the story of x in each of the following expressions.

a) $2x + 4$

b) $2(x + 4)$

c) $5(x - 3)^2 - 2$

Example 3: Write an algebraic expression that summarizes the stories below.

a) Step 1: Add 3 to x
    Step 2: Divide by 2

b) Step 1: Divide x by 2
    Step 2: Add 3

Example 4: Write an algebraic expression that summarizes the stories below.

Step 1: Subtract x from 7
Step 2: Raise to the third power
Step 3: Multiply by 3
Step 4: Add 1

Below is a table of common English words converted into a mathematical expression. You can use this table to assist in translating expressions.

Operation	Words	Example	Translation
Addition	Added to	4 added to n	$n + 4$
	More than	2 more than y	$y + 2$
	The sum of	The sum of r and s	$r + s$
	Increased by	m increased by 6	$m + 6$
	The total of	The total of 8 and x	$8 + x$
	Plus	c plus 2	$c + 2$
Subtraction	Minus	x minus 1	$x - 1$
	Less than	5 less than y	$y - 5$
	Less	4 less r	$4 - r$
	Subtracted from	3 subtracted from t	$t - 3$
	Decreased by	m decreased by 10	$m - 10$
	The difference between	The difference between x and y	$x - y$
Multiplication	Times	12 times x	$12 \cdot x$
	Of	One-third of v	$\dfrac{1}{3}v$
	The product of	The product of n and k	$nk \; or \; n \cdot k$
	Multiplied by	y multiplied by 3	$3y$
	Twice	Twice d	$2d \; or \; 2 \cdot d$
Division	Divided by	n divided by 4	$\dfrac{n}{4}$
	The quotient of	The quotient of t and x	$\dfrac{t}{x}$
Division	The ratio of	The ratio of x to p	$\dfrac{x}{p}$
	Per	2 per b	$\dfrac{2}{b}$
Power	The square of	The square of y	y^2
	The cube of	The cube of k	k^3
Equals	Is	Are	Equal
	Gives	Is equal to	Is equivalent to
	Yields	Results in	was

YOU TRY

Complete the following problems.

a) Tell the story of x in the expression $\dfrac{x-3}{5}$.

b) Write an algebraic expression that summarizes the story below:

> Step 1: Multiply x by 2
> Step 2: Add 5
> Step 3: Raise to the second power.

	MEDIA LESSON
▦	The beauty of algebra (Duration 10:06)

View the video lesson, take notes and complete the problems below.

What algebraic expression did Sal start with when he discussed why the abstraction of mathematics is so fundamental?
_____

E. EVALUATE ALGEBRAIC EXPRESSIONS

	MEDIA LESSON
▦	Evaluate algebraic expressions (Duration 9:33)

View the video lesson, take notes and complete the problems below

To evaluate a algebraic or variable expression:
1. _____
2. _____

PEMDAS
P: _____
E: _____
MD: _____
AS: _____

Example 1: Find the value of each expression when w = 2. Simplify your answers.

a) $w - 6$

b) $6 - w$

c) $5w - 3$

d) w^3

e) $3w^2$

f) $(3w)^2$

g) $\dfrac{4}{5w}$

h) $\dfrac{5w}{4}$

i) 3^w

Example 2: Evaluate $ab + c$ given $a = -5, b = 7$, and $c = -3$.

Example 3: Evaluate $a^2 - b^2$ given $a = -5$ and $b = -3$.

Example 4: A local window washing company charges $11.92 for each window plus a reservation fee of $7.

a) Write an algebraic expression to represent the total cost from the window washing company for washing w windows.

b) Use this expression to determine the total cost for washing 17 windows.

YOU TRY

Given $a = 5, b = -1, c = 2$, evaluate the expressions below. Show all steps.

a) Evaluate $b^2 - 4ac$.

b) Evaluate $2a - 5b + 7c$.

F. LIKE TERMS AND COMBINE LIKE TERMS

Definition
Two terms are **like terms** if the base variable(s) and exponent on each variable are identical. For example, $3x^2y$ and $-7x^2y$ are like terms because they both contain the same base variables, x and y, and the exponents on x (the x is squared on both terms) and y are the same.
Combining like terms: If two terms are like terms, we add (or subtract) the **coefficients**, then keep the variables (and exponents on the corresponding variable) **the same**.

	MEDIA LESSON Like terms and combine like terms (Duration 6:30)

View the video lesson, take notes and complete the problems below.

Example 1: Identify the like terms in each of the following expressions.

$3a - 6a + 10a - a$ | $5x - 10y + 6z - 3x$ | $7n + 3n^2 - 2n^3 + 8n^2 + n - n^3$

Example 2: Combine the like terms.

$3a - 6a + 10a - a$ | $5x - 10y + 6z - 3x$ | $7n + 3n^2 - 2n^3 + 8n^2 + n - n^3$

YOU TRY

Combine the like terms.

a) $3x - 4x + x - 8x$

b) $-5 + 2a^2 - 4a + a^2 + 7$

EXERCISES

Tell the story of x in each of the following expressions.

1) $x - 11$

2) $x + 5$

3) $5x$

4) x^5

5) x^3

6) $2 - x$

7) $2x - 3$

8) $8x^2$

9) $(2x)^2$

10) $7 - 2x$

11) $5(7 - x)^3$

12) $\left(\dfrac{3x-3}{5}\right)^3$

Write an algebraic expression that summarizes the stories below.

13) Step 1: Add 8 to x
Step 2: Raise to the third power

14) Step 1: Divide x by 8
Step 2: Subtract 5

15) Step 1: Subtract 3 from x
Step 2: Multiply by 7

16) Step 1: Multiply x by 10
Step 2: Raise to the 3rd power
Step 3: Multiply by 2

17) Step 1: Add 5 to x
Step 2: Divide by 2
Step 3: Raise to the second power
Step 4: Add 8

18) Step 1: Raise x to the second power
Step 2: Multiply by 5
Step 3: Subtract from 9

19) Step 1: Subtract x from 2
Step 2: Multiply by -8
Step 3: Raise to the third power
Step 4: Add 1
Step 5: Divide by 3

20) Step 1: Multiply x by -4
Step 2: Add 9
Step 3: Divide by 2
Step 4: Raise to the fifth power

Find the value of each expression when $b = -8$. Simplify your answers.

21) $b - 11$

22) $b + 5$

23) $5b$

24) b^2

25) b^3

26) $2 - b$

Evaluate each of the following given $q = 10$.

27) $2q - 3$

28) $8q^2$

29) $(2q)^2$

30) $\dfrac{4}{7q}$

31) $7 - 2q$

32) 2^q

Evaluate the following expressions for the given values. Simplify your answers.

33) $\dfrac{-b}{2a}$ for $a = 6, b = 4$

34) $\dfrac{4x-8}{5+x}$ for $x = 3$

35) $\dfrac{3}{5}ab$ for $a = 8, b = 1\dfrac{2}{3}$

36) $3x^2 + 2x - 1$ for $x = -1$

37) $x^2 - y^2$ for $x = -3, y = -2$

38) $2x - 7y$ for $x = 5, y = 3$

39) Shea bought c candy bars for $1.50 each. Write an algebraic expression for the total amount Shea spent.

40) Suppose sales tax in your town is currently 9%. Write an algebraic expression representing the sales tax for an item that costs d dollars.

41) Ben bought m movie tickets for $8.50 each and p bags of popcorn for $3.50 each.
   a) Write an algebraic expression for the total amount Ben spent.
   b) Use this expression to determine the amount Ben will spend if he buys 6 movie tickets and 4 bags of popcorn.

42) Noelle is 5 inches shorter than Amy. Amy is A inches tall. Write an algebraic expression for Noelle's height.

43) Jamaal studied h hours for a big test. Karla studied one fourth as long. Write an algebraic expression for the length of time that Karla studied.

44) A caterer charges a delivery fee of $45 plus $6.50 per guest.
   a) Write an algebraic expression to represent the total catering cost if g guests attend the reception.
   b) Use the expression to determine the amount of a company luncheon of 50 guests.

45) Tickets to the museum cost $18 for adults and $12.50 for children.
   a) Write an algebraic expression to represent the cost for a adults and c children to visit the museum.
   b) Use this expression to determine the cost for 4 adults and 6 children to attend the museum.

46) Consider the algebraic expression $5n^8 - n^5 + n^2 + \dfrac{n}{8} - 2$
   a) How many terms are there?_____
   b) Identify the constant term. _____
   c) What is the coefficient of the first term? _____
   d) What is the coefficient of the second term? _____
   e) What is the coefficient of the third term? _____
   f) What is the coefficient of the fourth term? _____

Combine the like terms.

47) $3d - 5d + d - 7d$

48) $3x^2 + 3x^3 - 9x^2 + x - x^3$

49) $a - 2b + 4a + b - (-2b)$

50) $3x - 7y + 9x - 5y - 7$

⊿⟡ Online Quiz | Log on to Canvas to take the section quiz

SECTION 2.2 PROPERTIES OF ALGEBRA

Properties of real numbers are the basic rules when we work with expressions in Algebra.

	Addition	Multiplication
Identity Hint: the number stays true to its "identity".	$a + 0 = a$ *Any number plus zero is the same number.* $7 + 0 = 7$ $x + 0 = x$ ☆ $+ 0 =$ ☆	$a \cdot 1 = a$ *Any number multiplies by one is the same number.* $7 \cdot 1 = 7$ $x \cdot 1 = x$ ☆ $\cdot 1 =$ ☆
Inverse Hint: "Inverse" → reverse → undo	**Additive Inverse** $a + (-a) = 0$ *Any number plus its opposite equals zero.* $2 + (-2) = 0$ $x + (-x) = 0$	**Multiplicative inverse** $a \cdot \dfrac{1}{a} = 1$ if a is not zero *Any number multiplied by its reciprocal is one.* $3 \cdot \dfrac{1}{3} = 1$ $x \cdot \dfrac{1}{x} = 1$
Commutative Hint: "Commute" → move → switch places	$a + b = b + a$ *You can add in any order.* $2 + 3 = 3 + 2$ $x + 5 = 5 + x$ ☺ $+$ ☆ $=$ ☆ $+$ ☺	$a \cdot b = b \cdot a$ *You can multiply in any order.* $2 \cdot 3 = 3 \cdot 2$ $x \cdot 2 = 2 \cdot x$ ☺ $\cdot$ ☆ $=$ ☆ $\cdot$ ☺
Associative Hint: "associate" → different groups → parenthesis	$(a + b) + c = a + (b + c)$ *When you add, you can group in any combination.* $(3 + 5) + 2 = 3 + (5 + 2)$ $(x + y) + z = x + (y + z)$	$(a \cdot b) \cdot c = a \cdot (b \cdot c)$ *When you multiply, you can group in any combination.* $(6 \cdot 2) \cdot 7 = 6 \cdot (2 \cdot 7)$ $(x \cdot y) \cdot z = x \cdot (y \cdot z)$
Distributive Hint: "Distribute" → give out to	$a(b + c) = ab + ac$	$a(b - c) = ab - ac$
	Multiplying a number by a group of numbers added together or subtracted each other is the same as doing each multiplication separately. $5(100 + 20) = 5 \cdot 100 + 5 \cdot 20$ $2(x + y) = 2x + 2y$	

	MEDIA LESSON
[QR code]	Properties of Real Numbers (Duration 9:59)

View the video lesson, take notes and complete the problems below.

The commutative properties _____ _____		
The associative properties _____ _____		
Identity properties _____ _____		
Inverse properties _____ _____ _____ _____		

Distributive property _____ _____			

❖ NOTE: Subtraction and division do not have the associative and communicative properties.

EXERCISES

Identify the property that justifies each problem below.

1) $w + 0 = w$ Name: _____

2) $-x + x = 0$ Name: _____

3) $3(u + v) = 3u + 3v$ Name: _____

4) $5w(6z) = (6z)5w$ Name: _____

5) $(5)\frac{1}{5}x = 1x$ Name: _____

6) $2 \cdot (4a)b = (2 \cdot 4)ab$ Name: _____

7) $(5x + 5) + 4 = 5x + (5 + 4)$ Name: _____

8) $2x(3y + 7z) = 2x(7z + 3y)$ Name: _____

Find the additive inverse and the multiplicative inverse for each problem below.

	Additive inverse	Multiplicative inverse
9) 6		
10) $\dfrac{1}{2}$		
11) -2.5		
12) m (given $m \neq 0$)		

Complete the following table by performing the indicated operations by computing the result in the parentheses first as the order of operations requires.

	Problem 1	Problem 2	Are the Results the Same?
13) Addition	$(5 + 7) + 3$ _____	$5 + (7 + 3)$ _____	_____
14) Subtraction	$(10 - 5) - 4$ _____	$10 - (5 - 4)$ _____	_____
15) Multiplication	$(2 \cdot 3) \cdot 4$ _____	$2 \cdot (3 \cdot 4)$ _____	_____
16) Division	$(600 \div 30) \div 5$ _____	$600 \div (30 \div 5)$ _____	_____

Use the commutative or associative properties to perform the operations in the order you find most simple. Show all your work.

17) $(13 + 29) + 7$

18) $5 \cdot (6 \cdot 8)$

19) $(15 + 4) + 6$

20) $4 \cdot 13 \cdot 5$

Apply distributive property and combine like terms if possible.

21) $8n(5 - m)$

22) $7k(-6x + 6)$

23) $-6(1 + 6x)$

24) $-8x(5 + 10n)$

25) $-(-5 + 9a)$

26) $(n + 1)2$

27) $4(x + 7) + 8(x + 4)$

28) $-8(n + 6) - 8(n + 8)$

29) $-8x + 9(-9x + 9)$

30) $4v - 7(1 - 8v)$

31) $-10(x - 2) - 3$

32) $7(7 + 3v) + 10(3 - 10v)$

33) $(x^2 - 8) - (2x^2 - 7)$

34) $9(b + 10) + 5b$

35) $2n(-10n + 5) - 7(6 - 10n - 3m)$

⚡ **Online Quiz** | Log on to Canvas to take the section quiz

CHAPTER REVIEW

KEY TERMS AND CONCEPTS	
Look for the following terms and concepts as you work through the workbook. In the space below, explain the meaning of each of these concepts and terms in your own words. Provide examples that are not identical to those in the text or in the media lesson.	
Variable	
Algebraic expression	
Coefficient	
Term	
Constant	
Like terms	
Identity property of addition	
Identity property of multiplication	
Additive Inverse property	
Multiplicative Inverse property	
Associative property of addition	
Associative property of multiplication	
Commutative property of addition	
Commutative property of multiplication	
Distributive property	

Tell the story of x in each of the following expressions.

1) $x + 2 - 2^1$

2) $4(x^2 + 3)$

3) $\dfrac{x+3}{5}$

Write an algebraic expression that summarizes the stories below.

4) Step 1: Add 2 to x

   Step 2: Raise to the second power

   Step 3: Divide by 3

5) Step 1: Subtract 2 from x

   Step 2: Divide by 2

   Step 3: Add 1

   Step 4: Divide by 3

Evaluate the following expressions when $a = -4, b = 2, and\ c = -1$. Simplify your answers.

6) $-c^3$

7) $\dfrac{6}{b} + c$

8) $-a - b - c$

9) $\dfrac{b}{2}c - 3$

10) $a^2 + 2a - ac$

11) $\dfrac{c}{2} + \dfrac{1}{2}b$

12) Suppose sales tax in your city is 8.25%. Write an algebraic expression representing the sales tax for an item that cost x dollars.

13) Will bought c candy bars for $1.25 each. Write an algebraic expression for the total amount Will spent.

14) Consider the algebraic expression $2x + 3x^2 - \dfrac{x}{2} - x^{13}$

   a) How many terms are there?_____

   b) Identify the constant terms._____

   c) What is the coefficient of the first term?_____

   d) What is the coefficient of the second term?_____

   e) What is the coefficient of the third term?_____

Combine the like terms of the following expressions.

15) $2x - 3x + -4y$

16) $2x + y - 1 - y - 5x$

17) $1x + 2x - x^2 + 3x - 2x^2$

18) $4x - 2y + 3x + 4y + 2xy$

Simplify. Combine like terms when possible.

19) $(13 + 29) + 1$

20) $4 \cdot (12 \cdot 2)$

21) $n(5 - 2)$

22) $(n + 1)2 + n + 1$

23) $9n - (n + 1) + 7n$

24) $2y + y(y + y)$

25) $z(z + 1) - z + 1$

26) $\dfrac{1}{2}(2x - 4) + 6$

27) $\dfrac{2x+4}{2} + 10(2x - \dfrac{1}{2})$

Find the additive and multiplicative inverse of the following problems.

28) 10

29) $-\dfrac{3}{4}$

30) $\dfrac{-x}{1}$