Chapter 1

Summary and Vocabulary

- Algebra is a powerful language for describing patterns and real-world situations. Its power comes from the use of **variables.** Variables are letters or other symbols that can be replaced by any number from a set, the **domain** of the variable.
- An **algebraic expression** is a sequence of symbols that contains variables, numbers, and operations. Rules for the **order of operations** ensure that different individuals evaluating the same expressions will get the same values. Scientific and graphing calculators usually follow the same rules of order of operations.
- Algebraic expressions can describe the nth term in a pattern. Two algebraic expressions are **equivalent** if they have the same value. Graphs and tables can be used to explore whether algebraic expressions are equivalent. For example, tables show that $(x - 1) + 3 + (x - 1)$ and $2x + 1$ each have the same value for any particular value of x. This suggests that the expressions are equivalent. The graphs of $y = (x - 1) + 3 + (x - 1)$ and $y = 2x + 1$ also suggest that the expressions are equivalent. On the other hand, the expression $2x + 3$ produces different values from those of the other two expressions, so it is not equivalent to the others.
- The **absolute value** of a number is its distance from 0 on a number line. The distance between two numbers on a number line with coordinates x and y is $|x - y|$. Statistics can be useful in describing data that do not fit an exact algebraic pattern. Two measures of spread are the **range** and the **mean absolute deviation (m.a.d.).** The m.a.d. applies the idea of absolute value.

Theorems and Properties

Algebraic Definition of Subtraction (p. 7)
Algebraic Definition of Division (p. 7)
Associative Property of Multiplication (p. 9)
Associative Property of Addition (p. 10)
Transitive Property of Equality (p. 10)
Commutative Property of Addition (p. 16)
Commutative Property of Multiplication (p. 16)

Vocabulary

1-1
variable
algebraic expression
evaluating the expression

1-2
pattern, instance
define a variable
term, factor

1-3
sequence, term
equivalent expressions
counterexample

1-4
scatterplot
domain of a variable

1-5
window
Xmin, Xmax
Ymin, Ymax
Xscl, Yscl
standard window

1-6
absolute value
origin

1-7
range
mean absolute deviation (m.a.d.)
symmetric
skewed right
skewed left
uniform

Chapter 1 Self-Test

Take this test as you would take a test in class. You will need graph paper. Then use the Selected Answers section in the back of the book to check your work.

1. Consider the following pattern:

$$9 \cdot 4 + 9 \cdot 1 = 9 \cdot 5$$
$$9 \cdot 4 + 9 \cdot 2 = 9 \cdot 6$$
$$9 \cdot 4 + 9 \cdot 3 = 9 \cdot 7$$
$$9 \cdot 4 + 9 \cdot 4 = 9 \cdot 8$$
$$9 \cdot 4 + 9 \cdot 5 = 9 \cdot 9$$

   a. Write the next three instances of the pattern.

   b. Describe the pattern using one variable.

2. Provide an example illustrating the Commutative Property of Multiplication.

3. Rewrite the division problem as a multiplication problem $3x \div 7y$.

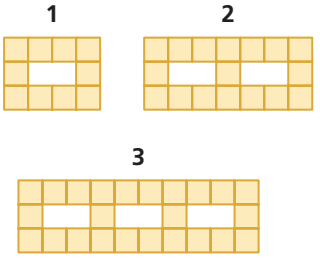
4. At a sports store, authentic jerseys cost \$179 and customized T-shirts cost \$24. Let j = the number of jerseys purchased and let t = the number of T-shirts purchased. Write an expression describing the total cost of all clothing purchased at the sports store.

5. a. Complete the table of values for the provided expressions.

n	$\frac{6n-12}{3}$	$-4+2n$
–5	?	?
–3	?	?
0	?	?
2	?	?

   b. Do $\frac{6n-12}{3}$ and $-4+2n$ seem to be equivalent expressions?

6. Consider the sequence of square tile designs shown here.



   a. Determine how many tiles would be required to make the next term.

   b. Complete the table describing the number of square tiles used for various patterns in the sequence.

n	1	2	3	4	5	6
Number of Tiles	10	17	?	?	?	?

   c. Write an expression for the number of square tiles in the nth term.

   d. Create a scatterplot from the table.

7. Consider the following expressions:

   Expression 1: $\frac{m}{2} + \frac{3}{2}$

   Expression 2: $\frac{3+m}{4}$

   a. Find a value for m that shows that Expressions 1 and 2 are *not* equivalent.

   b. Write an expression that is equivalent to Expression 1.

8. Consider the following expressions.

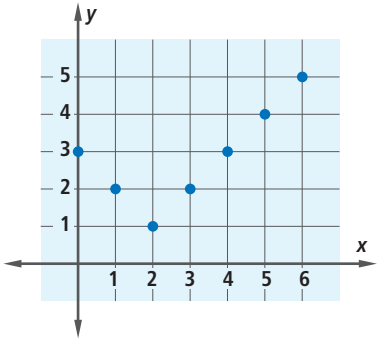
   Expression 1: $\frac{101x+200}{100}$

   Expression 2: $x + 2$

   a. What does a standard window seem to suggest about equivalence of the expressions?

b. Are the expressions equivalent? Why or why not?

9. An expression is graphed below. Use the graph to answer the following questions.



a. What is the value of the expression when $x = 4$?

b. Use the graph to complete the following table of values.

x	0	1	2	3	4	5
y	?	?	?	?	?	?

c. **Multiple Choice** Which of the following expressions best describes the values plotted on the graph?

A $|x + 2|$
B $|x - 2| + 1$
C $|x + 2| - 1$
D $3 - x$

10. Graph $y = x - 15$ using the window $-10 \le x \le 10$ and $-10 \le y \le 10$. The result will be a line. Adjust the window to reveal where the line crosses both the x- and the y-axes. Describe your new viewing window in the space provided.

Xmin: ? Xmax: ?
Ymin: ? Ymax: ?

In 11–13, use the following information. Over the past week, students in Mr. Cy Metric's class reported paying the following amounts for entrance to a movie. The results are graphed in a dot plot.

$6, $7, $9, $8, $10, $2, $7, $10, $10, $9, $8, $8, $9, $9, $10

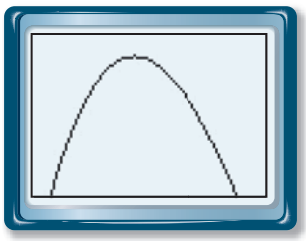
11. Identify the shape of the dot plot as symmetric, skewed right, skewed left, or uniform.

12. Calculate the mean and mean absolute deviation for the data set. Round to the nearest tenth.

13. Do data have more spread or less spread than a set with a mean of 8.8 and a mean absolute deviation of 2.6? Explain your reasoning.

14. a. Graph $y = 0.5x^3 + x^2 - 5.5x - 5$ on a graphing calculator. View the graph with the standard window and sketch the results.

b. Change the values in the window to get the graph to look like the one below. What are the values of your window's Xmin, Xmax, Ymin, and Ymax?



Chapter 1 Chapter Review

SKILLS
PROPERTIES
USES
REPRESENTATIONS

SPUR stands for Skills, Properties, Uses, and Representations. The Chapter Review Questions are grouped according to the SPUR Objectives in this Chapter.

SKILLS Procedures used to get answers

OBJECTIVE A **Evaluate numerical and algebraic expressions. (Lesson 1-1)**

In 1–4, evaluate the numerical expression.

1. $20 \div 5 \div 5$
2. $70 - 4 \cdot (-3) \div 2$
3. $\frac{5 \cdot 0.43^2}{0.43}$
4. $\left(\frac{3}{8} + \frac{5}{6}\right) \cdot 4 + \frac{3}{5}$

In 5–10, evaluate the algebraic expression for the given variable.

5. $4x^2$ for $x = 13$
6. $-6q - q$ when $q = -3.64$
7. $\frac{-5x}{2} + \frac{3}{-x}$ if $x = 7$
8. $\left(\frac{n}{3}\right)^3$ for $n = 24$
9. $4(p - q)$ when $p = 13\frac{1}{2}$ and $q = 2\frac{3}{5}$
10. $y - x \div 4 \cdot (-2)$ when $x = 8$ and $y = -3$

OBJECTIVE B **Use variables to describe patterns in instances or tables. (Lessons 1-2, 1-3)**

11. Three instances of a pattern are given below. Describe the pattern using one variable.

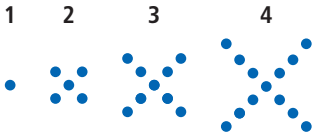
$$4(2) + 3(2) = 7(2)$$
$$4(-3.1) + 3(-3.1) = 7(-3.1)$$
$$4\left(\frac{2}{5}\right) + 3\left(\frac{2}{5}\right) = 7\left(\frac{2}{5}\right)$$

12. The number of zeros in each term is 2 greater than in the previous term in the table below.

Term Number	1	2	3	4
Term	0	000	00000	0000000

   a. How many zeros are in the sixth term?
   b. In words, explain how to use the term number to find the number of zeros in the nth term.
   c. Use n to represent the term number. Write an algebraic expression for the number of zeros in the nth term.

13. Refer to the sequence below.



   a. How many dots will be in the seventh term?
   b. In words, describe a method to find the number of dots in the nth term.
   c. Write an algebraic expression for the number of dots in the nth term.

OBJECTIVE C **Determine if two expressions seem equivalent by substituting values or making a table. (Lesson 1-3)**

14. Alyssa and Odell both looked at a pattern. Alyssa thought the nth term could be represented by the expression $3n - 6 + n$, and Odell came up with the expression $-5 + 4n - 1$. Substitute the numbers 3, 5, and 9 in for each expression to determine if they seem to be equivalent.

15. To convert temperatures from Fahrenheit to Celsius, Kimi used the expression $\frac{5}{9}F - 32$ and Edward used the expression $\frac{5}{9}(F - 32)$. Substitute the numbers 9 and 18 for F in each expression to determine if they seem to be equivalent.

16. Fill in each table to determine if $5 + |3n|$ is equivalent to $5 + |-3n|$.

n	$\|5 + 3n\|$
–3	?
–2	?
0	?
4	?
5	?

n	$5 + \|-3n\|$
–3	?
–2	?
0	?
4	?
5	?

OBJECTIVE D Evaluate expressions involving absolute value. (Lesson 1-6)

In 17 and 18, evaluate the numerical expressions.

17. $|(-3)| + |5 - 3|$

18. $|9 \cdot (-2)| + |(-9) \cdot 2|$

In 19–21, evaluate the algebraic expression for the given value of the variable.

19. $|x - 3| \cdot x$ for $x = -2$.

20. $|x - |x||$ for $x = -1$

21. $||x| - |2x + 1||$ for $x = -3$

OBJECTIVE E Calculate the range and mean absolute deviation. (Lesson 1-7)

In 22–25, calculate the range and mean absolute deviation of each data set.

22. 12.6, 10.4, 3.8, 7.2, 5.9, 4.1, 1.5, 2.5

23. $\frac{3}{8}, \frac{3}{4}, \frac{5}{2}, \frac{1}{4}, 2\frac{1}{8}$

24. A student's test scores: 87, 94, 90, 73, 84, 83, 97, 72

25. The Miami Heat's total points in games played in January 2006: 97, 92, 93, 118, 110, 117, 100, 92, 94, 119, 94, 98, 91, 101, and 118

PROPERTIES Principles behind the mathematics

OBJECTIVE F Apply the Algebraic Definitions of Subtraction and Division. (Lesson 1-1)

In 26 and 27, rewrite each subtraction as an addition.

26. $x - y - z$

27. $-8 - y - 32$

28. **Multiple Choice** Which expression is not equivalent to the others?

A $a - b$ B $a + -b$ C $-b + a$ D $b + -a$

29. **True or False** $\frac{x}{7} = \frac{1}{7}x$

In 30 and 31, rewrite the division problem as a multiplication problem.

30. $\frac{7d + 2}{4st}$

31. $6.21 \div 3.14$

OBJECTIVE G Identify and apply the associative, commutative, and transitive properties. (Lessons 1-1, 1-2)

32. $(45 + 23) + 77 = 45 + (23 + 77)$ is an example of what property?

33. What property is described by $x \cdot y = y \cdot x$?

34. Wesley was evaluating the expression $(2 - x) + 3$ and used the Associative Property to rewrite it as $2 - (x + 3)$ to make it easier to compute.

a. Is this correct?

b. If so, evaluate the expressions for values of x to show they are equal. If not, find and correct the mistake Wesley made.

35. Erin had the expression $x + 2 + 2x + 7$. Jamal had the expression $3x + 9$. Kelly's expression was $x + 9 + 2x$. Erin and Jamal discovered their expressions are equivalent. Erin and Kelly's expressions are also equivalent. What property makes Jamal and Kelly's expressions equivalent?

USES Applications of mathematics in real-world situations

OBJECTIVE H **Create expressions to model real-world situations. (Lesson 1-2)**

36. In a football board game, a person earns 6 points per receiving touchdown and 3 points per passing touchdown. The person will lose a point for interceptions thrown. Let r = the number of receiving touchdowns, let p = the number of passing touchdowns, and let i = the number of interceptions thrown. Write an expression to represent the total points a person playing the football board game has.

37. Juan is a wedding photographer. He offers two package deals to his clients. Package A costs \$1,225 and Package B costs \$1,405. Let a = the number of Package A deals he sells, and let b = the number of Package B deals he sells. Write an expression to represent the total amount Juan makes selling his wedding package deals.

OBJECTIVE I **Calculate and interpret the spread of a distribution using mean absolute deviation. (Lesson 1-7)**

38. The costs of four video games at two stores are shown in the table below.

Game	Store 1	Store 2
Play Soccer	\$35	\$40
Adventure Trip	\$45	\$40
Be a Robot!	\$48	\$50
Catch the Dragon	\$50	\$60

a. Calculate the mean and the mean absolute deviation for the four videogames at each store.

b. What is the meaning of the mean absolute deviations calculated in Part a?

c. If you could go to only one store for your video game purchases, which would it be? Explain your reasoning.

d. Which store has less variation in the price of video games? Explain your reasoning.

REPRESENTATIONS Pictures, graphs, or objects that illustrate concepts

OBJECTIVE J **Create a scatterplot from a table or expression. (Lesson 1-4)**

39. Suppose Ben Inriver begins with \$50 in a savings account and adds \$20 per week. The table shows the number of weeks that he has saved and the total amount saved.

Week (w)	Total (t)
0	50
1	?
2	?
3	?
4	?

a. Complete the table.

b. Plot the five pairs (w, t).

40. The table below shows the wind chill index for various temperatures when there is a 10 mile per hour wind. Plot the data with temperature on the horizontal axis and wind chill on the vertical axis.

Actual Temperature (°F)	Wind Chill Index (°F)
30°	21
20°	9
10°	–4
0°	–16
–10°	–28
–20°	–41
–30°	–53

Source: NOAA's National Weather Service

OBJECTIVE K Graph ordered pairs from expressions. (Lessons 1-4, 1-5)

41. Use the table below.

n	$2n + (n + 2)$
1	5
2	?
3	?
4	?
5	?

a. Complete the table of values.

b. Graph the ordered pairs with n on the x-axis and $2n + (n + 2)$ on the y-axis.

c. From the graph, predict the value of the expression when n is 11.

42. Suppose the number of seats in the nth row of an auditorium is $32 + 2n$.

a. Evaluate the expression for the rows numbered 2, 3, 4, 5, 6, 7, and 8.

b. Graph the ordered pairs (row number, number of seats) for these values.

OBJECTIVE L Use graphs to determine whether expressions seem to be equivalent. (Lessons 1-4, 1-5, 1-6)

43. Determine if the expressions $x + 2$ and $|x + 2|$ are equivalent by using a graph.

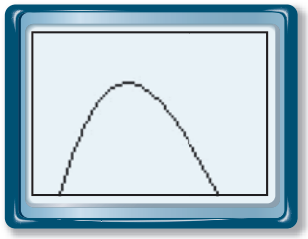
44. James and Luanda both looked at a pattern. James thought the nth term could be represented by the expression $n - 6 + n$, and Luanda came up with the expression $-6 + 2n$. Graph the data and determine if the expressions seem to be equivalent.

45. Use a graph to determine whether the expressions $(y - 1)^2$ and $y^2 + 1$ seem to be equivalent.

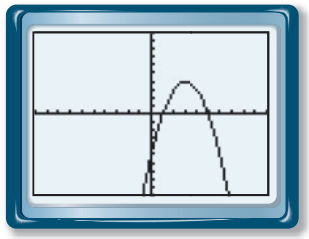
OBJECTIVE M Use graphs to find values, create tables, and select appropriate windows. (Lesson 1-5)

46. a. Graph $y = x^3 - 3x^2$ on your graphing calculator in the standard window and sketch your result.

b. Change your window to match the calculator screen below. Record Xmin, Xmax, Ymin, and Ymax.



In 47 and 48, use the calculator screen below. Each tick mark represents one unit.



47. Make a table of values for x and y when $x = 0$, 2, 3, and 6.

48. Multiple Choice Which of the following expressions best represents that of the values on the graph?

A $|x - 3| + 4$

B $4(x - 3)$

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

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