25. During one week, an automobile manufacturing plant produced 4,837 luxury cars, 8,952 vans, and 848 station wagons. How many vehicles did the company produce that week? 14,637 vehicles

26. One year, people in the United States bought $46,446,000,000 worth of life insurance. The following year people bought $48,427,000,000 worth of life insurance. How much was the increase in the amount of life insurance purchased? $1,981,000,000

Lesson 50

4.2 Exponents

An **exponent** is a figure, usually a number, written a little to the right and above a number or letter (called the **base**) and indicates the number of times the base is to be used as a factor.

In the expression 3^2, 3 is the base and 2 is the exponent. The exponent indicates the number of times the base should be used as a factor. Therefore, 3^2 means that 3 should be used as a factor two times.

The expression 3^5 is read *three to the fifth power.* Usually when the exponent is 2, the base is said to be **squared.** For instance, 4^2 is read *four squared.* When the exponent is 3, the base is said to be cubed; 3^3 is read *three cubed.*

The base of an expression with an exponent does not have to be a number. It can be a letter. For instance, $x \cdot x \cdot x$ can be written as x^3 and read *x cubed.*

Two exponent rules that should be remembered are given.

1. Any number or letter to the first power is equal to that number or variable.
   $5^1 = 5$ $y^1 = y$
2. Any number (except 0) or letter to the zero power is equal to one.
   $5^0 = 1$ $y^0 = 1$

Example 4.2a

3^{2} ← exponent, ← base = $3 \cdot 3$ $\quad y^{5}$ ← exponent, ← base = $y \cdot y \cdot y \cdot y \cdot y$ $\quad x^{2}$ ← exponent, ← base = $x \cdot x$

Example 4.2b

Write using exponents. Read each answer.

$yyyy = y^4$ $\quad 2xxx = 2x^3$ $\quad xxyyy = x^2y^3$

Example 4.2c

Write using exponents and solve the numerical coefficients. Read each answer.

$2 \cdot 2 \cdot x \cdot x = 2^2x^2 = 4x^2$

$5 \cdot 5 \cdot 5 \cdot yyyy = 5^3y^4 = 125y^4$

Practice Problems 4.2

Identify the base and the exponent in each of these problems.

1. 7^3

base 7

exponent 3

2. y^8

base y

exponent 8

3. x^3

base x

exponent 3

Write each of the following using exponents. Do not solve the numerical coefficient.

4. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ 3^5

5. $yyyyyyyy$ y^8

6. $xxxxyy$ x^4y^2

7. $2 \cdot b \cdot b \cdot b$ $2b^3$

8. $aaabbbb$ a^3b^4

9. $6ccc$ $6c^3$

10. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$ 2^9

11. $aaxyyy$ a^2xy^3

12. $5xyy$ $5xy^2$

Complete the chart.

	Algebra	English
13.	6^3	six cubed
14.	5^2	five squared
15.	x^5	x to the fifth power
16.	y^2	y squared
17.	7^3	seven cubed

Write using exponents and solve the numerical coefficient.

18. $2 \cdot 2 \cdot 2 \cdot 2$ $2^4 = 16$

19. $4 \cdot 4 \cdot x \cdot x$ $4^2x^2 = 16x^2$

20. $yyyyy$ y^5

21. $9 \cdot 9 \cdot r \cdot r \cdot r$ $9^2r^3 = 81r^3$

22. $3 \cdot x \cdot x \cdot y \cdot y$ $3x^2y^2$

23. $4 \cdot 4 \cdot 4 \cdot a \cdot a \cdot b \cdot b \cdot b$
$4^3a^2b^3 = 64a^2b^3$

24. $m \cdot n \cdot n \cdot n$ mn^3

25. $6 \cdot 6 \cdot 6 \cdot 6 \cdot x$ $6^4x = 1{,}296x$

26. $5 \cdot 5 \cdot 5 \cdot 5 \cdot y \cdot y \cdot z$
$5^4y^2z = 625y^2z$

27. $8 \cdot 8 \cdot x \cdot y \cdot y \cdot y$
$8^2xy^3 = 64xy^3$

28. $3 \cdot 3 \cdot 3 \cdot r \cdot r \cdot r$ $3^3r^3 = 27r^3$

29. $7 \cdot 7 \cdot xxx$ $7^2x^3 = 49x^3$

30. $xxxxyyzzz$ $x^4y^2z^3$

31. $10 \cdot 10 \cdot a \cdot b \cdot b$
$10^2ab^2 = 100ab^2$

32. $wwxxxy$ w^2x^3y

Write the following expressions without using exponents. Do not solve the numerical coefficients.

33. 6^3 $6 \cdot 6 \cdot 6$

34. 5^4 $5 \cdot 5 \cdot 5 \cdot 5$

35. x^3 xxx

36. x^2y^3 $xxyyy$

37. $7x^3y$ $7xxxy$

38. x^2y^2z $xxyyz$

39. $9a^3b^2cd^2$ $9aaabbcdd$

40. $5x^5$ $5xxxxx$

41. 2^8 $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

Sharpening Skills *Work problems on notebook paper.*

Write the following as algebraic expressions.

1. x divided by 2 $\frac{x}{2}$

2. 4 less than 3 times x $3x - 4$

3. the sum of 3 and x $3 + x$ or $x + 3$

4. 2 times y divided by 3 $\frac{2y}{3}$ or $\frac{2}{3}y$

5. y increased by x $y + x$ or $x + y$

6. x to the fifth power x^5

7. 5 times y squared $5y^2$

8. x cubed times y squared x^3y^2

9. 3 less than r to the fourth power
$r^4 - 3$

Write using exponents and solve the numerical coefficients.

10. $3 \cdot 3 \cdot 3$ $3^3 = 27$

11. $2 \cdot 2 \cdot xx$ $2^2x^2 = 4x^2$

12. $5 \cdot 5 \cdot 5 \cdot a \cdot a \cdot b \cdot b \cdot b$ $5^3a^2b^3 = 125a^2b^3$

13. $4bbbccd$ $4b^3c^2d$

14. $7 \cdot 7 \cdot x \cdot x \cdot x \cdot y \cdot y$ $7^2x^3y^2 = 49x^3y^2$

15. $9 \cdot 9 \cdot 9 \cdot y \cdot y$ $9^3y^2 = 729y^2$

Solve the word problems.

16. One week, Isaiah Turner memorized 5 Bible verses. The next week he memorized 8 verses. What was his percent of increase? 60%

17. Mr. Carter traveled 424 miles in 8 hours. If he continued to travel at the same average rate of speed, how far could he travel in 13 hours? 689 mi.

18. Ella Allen entered the hospital at 4:00 P.M. on July 7 and left at 11:00 A.M. on July 11. How many hours was Ella in the hospital? 91 hr.

19. In Egypt, $\frac{14}{15}$ of the land is dry and barren desert. To the nearest whole percent, what percent of Egypt is desert? 93%

Lesson 51

4.3 Adding Like Terms

Like terms are terms that have the same literal coefficient represented to the same power but do not necessarily have the same numerical coefficient. The numerical coefficients can be the same number, but it is not necessary. The terms $6xy$ and $4xy$ are like terms because the literal coefficients xy are the same. It is not necessary for the numerical coefficients of 6 and 4 to be the same. The terms $2xy$ and $2az$ are **unlike terms** because the literal coefficients xy and az are different even though the numerical coefficients are the same.

To better organize the work when performing arithmetic operations on polynomials, terms should be arranged in descending or ascending powers of the literal coefficient. Usually descending power is chosen. For example, $4 + 6x^2 + 3x^3 - 2x$ should be rewritten as either $3x^3 + 6x^2 - 2x + 4$ (descending) or $4 - 2x + 6x^2 + 3x^3$ (ascending). This is called simple form.

When two literal coefficients exist in the same polynomial, choose one or the other and arrange in simple form with respect to the literal coefficient chosen. The polynomial $5xy - 2x^2y^2 + 4x^3 + 3y^5$ could be written as $4x^3 - 2x^2y^2 + 5xy + 3y^5$ (descending powers of x) or $3y^5 - 2x^2y^2 + 5xy + 4x^3$ (descending powers of y).

Polynomials can be simplified by adding like terms. It is impossible to combine un-

Example 4.3a

Circle the terms that are like terms to $4ab$.

$2a$ (3ab) $4ac$ $4ab^2$ (2ab) (ab) a^2b^2 (6ab)

Only the terms that have the same literal coefficients ab are like terms to $4ab$.

Example 4.3b

Simplify the polynomial. $3x + 5x + 2x + 3x = 13x$

$3x+$	$5x+$	$2x+$	$3x$
$x+x+x$	$x+x+x+x+x$	$x+x$	$x+x+x$

The four terms in the polynomial are like terms since they have the same literal coefficient x. **Simplify the polynomial by adding the numerical coefficients and keeping the same literal coefficient.**