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8-1 Study Guide and Intervention

Multiplying Monomials

Multiply Monomials A **monomial** is a number, a variable, or a product of a number and one or more variables. An expression of the form x^n is called a **power** and represents the product you obtain when x is used as a factor n times. To multiply two powers that have the same base, add the exponents.

Product of Powers	For any number a and all integers m and n, $a^m \cdot a^n = a^{m+n}$.

Example 1 **Simplify $(3x^6)(5x^2)$.**

$(3x^6)(5x^2) = (3)(5)(x^6 \cdot x^2)$ Associative Property

$= (3 \cdot 5)(x^{6+2})$ Product of Powers

$= 15x^8$ Simplify.

The product is $15x^8$.

Example 2 **Simplify $(-4a^3b)(3a^2b^5)$.**

$(-4a^3b)(3a^2b^5) = (-4)(3)(a^3 \cdot a^2)(b \cdot b^5)$

$= -12(a^{3+2})(b^{1+5})$

$= -12a^5b^6$

The product is $-12a^5b^6$.

Lesson 8-1

Exercises

Simplify.

1. $y(y^5)$ — y^6
2. $n^2 \cdot n^7$ — n^9
3. $(-7x^2)(x^4)$ — $-7x^6$
4. $x(x^2)(x^4)$ — x^7
5. $m \cdot m^5$ — m^6
6. $(-x^3)(-x^4)$ — x^7
7. $(2a^2)(8a)$ — $16a^3$
8. $(rs)(rs^3)(s^2)$ — r^2s^6
9. $(x^2y)(4xy^3)$ — $4x^3y^4$
10. $\frac{1}{3}(2a^3b)(6b^3)$ — $4a^3b^4$
11. $(-4x^3)(-5x^7)$ — $20x^{10}$
12. $(-3j^2k^4)(2jk^6)$ — $-6j^3k^{10}$
13. $(5a^2bc^3)\left(\frac{1}{5}abc^4\right)$ — $a^3b^2c^7$
14. $(-5xy)(4x^2)(y^4)$ — $-20x^3y^5$
15. $(10x^3yz^2)(-2xy^5z)$ — $-20x^4y^6z^3$

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8-1 Study Guide and Intervention *(continued)*

Multiplying Monomials

Powers of Monomials An expression of the form $(x^m)^n$ is called a **power of a power** and represents the product you obtain when x^m is used as a factor n times. To find the power of a power, multiply exponents.

Power of a Power	For any number a and all integers m and n, $(a^m)^n = a^{mn}$.
Power of a Product	For any number a and all integers m and n, $(ab)^m = a^mb^m$.

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

$(-2ab^2)^3(a^2)^4 = (-2ab^2)^3(a^8)$ Power of a Power

$= (-2)^3(a^3)(b^2)^3(a^8)$ Power of a Product

$= (-2)^3(a^3)(a^8)(b^2)^3$ Commutative Property

$= (-2)^3(a^{11})(b^2)^3$ Product of Powers

$= -8a^{11}b^6$ Power of a Power

The product is $-8a^{11}b^6$.

Exercises

Simplify.

1. $(y^5)^2$ — y^{10}
2. $(n^7)^4$ — n^{28}
3. $(x^2)^5(x^3)$ — x^{13}
4. $-3(ab^4)^3$ — $-3a^3b^{12}$
5. $(-3ab^4)^3$ — $-27a^3b^{12}$
6. $(4x^2b)^3$ — $64x^6b^3$
7. $(4a^2)^2(b^3)$ — $16a^4b^3$
8. $(4x)^2(b^3)$ — $16x^2b^3$
9. $(x^2y^4)^5$ — $x^{10}y^{20}$
10. $(2a^3b^2)(b^3)^2$ — $2a^3b^8$
11. $(-4xy)^3(-2x^2)^3$ — $512x^9y^3$
12. $(-3j^2k^3)^2(2j^2k)^3$ — $72j^{10}k^9$
13. $(25a^2b)^3\left(\frac{1}{5}abc\right)^2$ — $625a^8b^5c^2$
14. $(2xy)^2(-3x^2)(4y^4)$ — $-48x^4y^6$
15. $(2x^3y^2z^2)^3(x^2z)^4$ — $8x^{17}y^6z^{10}$
16. $(-2n^6y^5)(-6n^3y^2)(ny)^3$ — $12n^{12}y^{10}$
17. $(-3a^3n^4)(-3a^3n)^4$ — $-243a^{15}n^8$
18. $-3(2x)^4(4x^5y)^2$ — $-768x^{14}y^2$

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8-2 Study Guide and Intervention

Dividing Monomials

Quotients of Monomials To divide two powers with the same base, subtract the exponents.

Quotient of Powers	For all integers m and n and any nonzero number a, $\frac{a^m}{a^n} = a^{m-n}$.
Power of a Quotient	For any integer m and any real numbers a and b, $b \neq 0$, $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$.

Example 1 **Simplify $\frac{a^4b^7}{ab^2}$. Assume neither a nor b is equal to zero.**

$\frac{a^4b^7}{ab^2} = \left(\frac{a^4}{a}\right)\left(\frac{b^7}{b^2}\right)$ Group powers with the same base.

$= (a^{4-1})(b^{7-2})$ Quotient of Powers

$= a^3b^5$ Simplify.

The quotient is a^3b^5.

Example 2 **Simplify $\left(\frac{2a^3b^5}{3b^2}\right)^3$. Assume that b is not equal to zero.**

$\left(\frac{2a^3b^5}{3b^2}\right)^3 = \frac{(2a^3b^5)^3}{(3b^2)^3}$ Power of a Quotient

$= \frac{2^3(a^3)^3(b^5)^3}{(3)^3(b^2)^3}$ Power of a Product

$= \frac{8a^9b^{15}}{27b^6}$ Power of a Power

$= \frac{8a^9b^9}{27}$ Quotient of Powers

The quotient is $\frac{8a^9b^9}{27}$.

Exercises

Simplify. Assume that no denominator is equal to zero.

1. $\frac{5^5}{5^2}$ 5^3 or 125
2. $\frac{m^6}{m^4}$ m^2
3. $\frac{p^5n^4}{p^2n}$ p^3n^3
4. $\frac{a^2}{a}$ a
5. $\frac{x^5y^3}{x^5y^2}$ y
6. $\frac{-2y^7}{14y^5}$ $-\frac{1}{7}y^2$
7. $\frac{xy^6}{y^4x}$ y^2
8. $\left(\frac{2a^2b}{a}\right)^3$ $8a^3b^3$
9. $\left(\frac{4p^4q^4}{3p^2q^2}\right)^3$ $\frac{64}{27}p^6q^6$
10. $\left(\frac{2v^5w^3}{v^4w^3}\right)^4$ $16v^4$
11. $\left(\frac{3r^6s^3}{2r^5s}\right)^4$ $\frac{81}{16}r^4s^8$
12. $\frac{r^7s^7t^2}{s^3r^3t^2}$ r^4s^4

Lesson 8-2

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8-2 Study Guide and Intervention *(continued)*

Dividing Monomials

Negative Exponents Any nonzero number raised to the zero power is 1; for example, $(-0.5)^0 = 1$. Any nonzero number raised to a negative power is equal to the reciprocal of the number raised to the opposite power; for example, $6^{-3} = \frac{1}{6^3}$. These definitions can be used to simplify expressions that have negative exponents.

Zero Exponent	For any nonzero number a, $a^0 = 1$.
Negative Exponent Property	For any nonzero number a and any integer n, $a^{-n} = \frac{1}{a^n}$ and $\frac{1}{a^{-n}} = a^n$.

The simplified form of an expression containing negative exponents must contain only positive exponents.

Example **Simplify $\frac{4a^{-3}b^6}{16a^2b^6c^{-5}}$. Assume that the denominator is not equal to zero.**

$\frac{4a^{-3}b^6}{16a^2b^6c^{-5}} = \left(\frac{4}{16}\right)\left(\frac{a^{-3}}{a^2}\right)\left(\frac{b^6}{b^6}\right)\left(\frac{1}{c^{-5}}\right)$ Group powers with the same base.

$= \frac{1}{4}(a^{-3-2})(b^{6-6})(c^5)$ Quotient of Powers and Negative Exponent Properties

$= \frac{1}{4}a^{-5}b^0c^5$ Simplify.

$= \frac{1}{4}\left(\frac{1}{a^5}\right)(1)c^5$ Negative Exponent and Zero Exponent Properties

$= \frac{c^5}{4a^5}$ Simplify.

The solution is $\frac{c^5}{4a^5}$.

Exercises

Simplify. Assume that no denominator is equal to zero.

1. $\frac{2^2}{2^{-3}}$ 2^5 or 32
2. $\frac{m}{m^{-4}}$ m^5
3. $\frac{p^{-8}}{p^3}$ $\frac{1}{p^{11}}$
4. $\frac{b^{-4}}{b^{-5}}$ b
5. $\frac{(-x^{-1}y)^0}{4w^{-1}y^2}$ $\frac{w}{4y^2}$
6. $\frac{(a^2b^3)^2}{(ab)^{-2}}$ a^6b^8
7. $\frac{x^4y^0}{x^{-2}}$ x^6
8. $\frac{(6a^{-1}b)^2}{(b^2)^4}$ $\frac{36}{a^2b^6}$
9. $\frac{(3st)^2u^{-4}}{s^{-1}t^2u^7}$ $\frac{9s^3}{u^{11}}$
10. $\frac{s^{-3}t^{-5}}{(s^2t^3)^{-1}}$ $\frac{1}{st^2}$
11. $\left(\frac{4m^2n^2}{8m^{-1}\ell}\right)^0$ 1
12. $\frac{(-2mn^2)^{-3}}{4m^{-6}n^4}$ $-\frac{m^3}{32n^{10}}$

Answers

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8-4 Study Guide and Intervention

Polynomials

Degree of a Polynomial A **polynomial** is a monomial or a sum of monomials. A **binomial** is the sum of two monomials, and a **trinomial** is the sum of three monomials. Polynomials with more than three terms have no special name. The **degree** of a monomial is the sum of the exponents of all its variables. The **degree of the polynomial** is the same as the degree of the monomial term with the highest degree.

Example **State whether each expression is a polynomial. If the expression is a polynomial, identify it as a *monomial, binomial,* or *trinomial*. Then give the degree of the polynomial.**

Expression	Polynomial?	Monomial, Binomial, or Trinomial?	Degree of the Polynomial
$3x - 7xyz$	Yes. $3x - 7xyz = 3x + (-7xyz)$, which is the sum of two monomials	binomial	3
-25	Yes. -25 is a real number.	monomial	0
$7n^3 + 3n^{-4}$	No. $3n^{-4} = \frac{3}{n^4}$, which is not a monomial	none of these	—
$9x^3 + 4x + x + 4 + 2x$	Yes. The expression simplifies to $9x^3 + 7x + 4$, which is the sum of three monomials	trinomial	3

Exercises

State whether each expression is a polynomial. If the expression is a polynomial, identify it as a *monomial, binomial,* or *trinomial*.

1. 36 yes; monomial
2. $\frac{3}{q^2} + 5$ no
3. $7x - x + 5$ yes; binomial
4. $8g^2h - 7gh + 2$ yes; trinomial
5. $\frac{1}{4y^2} + 5y - 8$ no
6. $6x + x^2$ yes; binomial

Find the degree of each polynomial.

7. $4x^2y^3z$ 6
8. $-2abc$ 3
9. $15m$ 1
10. $s + 5t$ 1
11. 22 0
12. $18x^2 + 4yz - 10y$ 2
13. $x^4 - 6x^2 - 2x^3 - 10$ 4
14. $2x^2y^2 - 4xy^3$ 5
15. $-2r^8s^4 + 7r^2s - 4r^7s^6$ 13
16. $9x^2 + yz^8$ 9
17. $8b + bc^5$ 6
18. $4x^4y - 8zx^2 + 2x^5$ 5
19. $4x^2 - 1$ 2
20. $9abc + bc - d^5$ 5
21. $h^3m + 6h^4m^2 - 7$ 6

Lesson 8-4

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8-4 Study Guide and Intervention *(continued)*

Polynomials

Write Polynomials in Order The terms of a polynomial are usually arranged so that the powers of one variable are in **ascending** (increasing) order or **descending** (decreasing) order.

Example 1 **Arrange the terms of each polynomial so that the powers of x are in ascending order.**

a. $x^4 - x^2 + 5x^3$
$-x^2 + 5x^3 + x^4$

b. $8x^3y - y^2 + 6x^2y + xy^2$
$-y^2 + xy^2 + 6x^2y + 8x^3y$

Example 2 **Arrange the terms of each polynomial so that the powers of x are in descending order.**

a. $x^4 + 4x^5 - x^2$
$4x^5 + x^4 - x^2$

b. $-6xy + y^3 - x^2y^2 + x^4y^2$
$x^4y^2 - x^2y^2 - 6xy + y^3$

Exercises

Arrange the terms of each polynomial so that the powers of x are in ascending order.

1. $5x + x^2 + 6$
$6 + 5x + x^2$
2. $6x + 9 - 4x^2$
$9 + 6x - 4x^2$
3. $4xy + 2y + 6x^2$
$2y + 4xy + 6x^2$
4. $6y^2x - 6x^2y + 2$
$2 + 6y^2x - 6x^2y$
5. $x^4 + x^3 + x^2$
$x^2 + x^3 + x^4$
6. $2x^3 - x + 3x^7$
$-x + 2x^3 + 3x^7$
7. $-5cx + 10c^2x^3 + 15cx^2$
$-5cx + 15cx^2 + 10c^2x^3$
8. $-4nx - 5n^3x^3 + 5$
$5 - 4nx - 5n^3x^3$
9. $4xy + 2y + 5x^2$
$2y + 4xy + 5x^2$

Arrange the terms of each polynomial so that the powers of x are in descending order.

10. $2x + x^2 - 5$
$x^2 + 2x - 5$
11. $20x - 10x^2 + 5x^3$
$5x^3 - 10x^2 + 20x$
12. $x^2 + 4yx - 10x^5$
$-10x^5 + x^2 + 4yx$
13. $9bx + 3bx^2 - 6x^3$
$-6x^3 + 3bx^2 + 9bx$
14. $x^3 + x^5 - x^2$
$x^5 + x^3 - x^2$
15. $ax^2 + 8a^2x^5 - 4$
$8a^2x^5 + ax^2 - 4$
16. $3x^3y - 4xy^2 - x^4y^2 + y^5$
$-x^4y^2 + 3x^3y - 4xy^2 + y^5$
17. $x^4 + 4x^3 - 7x^5 + 1$
$-7x^5 + x^4 + 4x^3 + 1$
18. $-3x^6 - x^5 + 2x^8$
$2x^8 - 3x^6 - x^5$
19. $-15cx^2 + 8c^2x^5 + cx$
$8c^2x^5 - 15cx^2 + cx$
20. $24x^2y - 12x^3y^2 + 6x^4$
$6x^4 - 12x^3y^2 + 24x^2y$
21. $-15x^3 + 10x^4y^2 + 7xy^2$
$10x^4y^2 - 15x^3 + 7xy^2$

Answers

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8-5 Study Guide and Intervention

Adding and Subtracting Polynomials

Add Polynomials To add polynomials, you can group like terms horizontally or write them in column form, aligning like terms vertically. **Like terms** are monomial terms that are either identical or differ only in their coefficients, such as $3p$ and $-5p$ or $2x^2y$ and $8x^2y$.

Example 1 **Find $(2x^2 + x - 8) + (3x - 4x^2 + 2)$.**

Horizontal Method

Group like terms.

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

$= [(2x^2 + (-4x^2)] + (x + 3x) + [(-8) + 2)]$

$= -2x^2 + 4x - 6.$

The sum is $-2x^2 + 4x - 6$.

Example 2 **Find $(3x^2 + 5xy) + (xy + 2x^2)$.**

Vertical Method

Align like terms in columns and add.

$$\begin{array}{rl} & 3x^2 + 5xy \\ (+) & 2x^2 + xy \\ \hline & 5x^2 + 6xy \end{array}$$

Put the terms in descending order.

The sum is $5x^2 + 6xy$.

Exercises

Find each sum.

1. $(4a - 5) + (3a + 6)$
   $7a + 1$
2. $(6x + 9) + (4x^2 - 7)$
   $4x^2 + 6x + 2$
3. $(6xy + 2y + 6x) + (4xy - x)$
   $10xy + 5x + 2y$
4. $(x^2 + y^2) + (-x^2 + y^2)$
   $2y^2$
5. $(3p^2 - 2p + 3) + (p^2 - 7p + 7)$
   $4p^2 - 9p + 10$
6. $(2x^2 + 5xy + 4y^2) + (-xy - 6x^2 + 2y^2)$
   $-4x^2 + 4xy + 6y^2$
7. $(5p + 2q) + (2p^2 - 8q + 1)$
   $2p^2 + 5p - 6q + 1$
8. $(4x^2 - x + 4) + (5x + 2x^2 + 2)$
   $6x^2 + 4x + 6$
9. $(6x^2 + 3x) + (x^2 - 4x - 3)$
   $7x^2 - x - 3$
10. $(x^2 + 2xy + y^2) + (x^2 - xy - 2y^2)$
    $2x^2 + xy - y^2$
11. $(2a - 4b - c) + (-2a - b - 4c)$
    $-5b - 5c$
12. $(6xy^2 + 4xy) + (2xy - 10xy^2 + y^2)$
    $-4xy^2 + 6xy + y^2$
13. $(2p - 5q) + (3p + 6q) + (p - q)$
    $6p$
14. $(2x^2 - 6) + (5x^2 + 2) + (-x^2 - 7)$
    $6x^2 - 11$
15. $(3z^2 + 5z) + (z^2 + 2z) + (z - 4)$
    $4z^2 + 8z - 4$
16. $(8x^2 + 4x + 3y^2 + y) + (6x^2 - x + 4y)$
    $14x^2 + 3x + 3y^2 + 5y$

Lesson 8-5

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8-5 Study Guide and Intervention *(continued)*

Adding and Subtracting Polynomials

Subtract Polynomials You can subtract a polynomial by adding its additive inverse. To find the additive inverse of a polynomial, replace each term with its additive inverse or opposite.

Example **Find $(3x^2 + 2x - 6) - (2x + x^2 + 3)$.**

Horizontal Method

Use additive inverses to rewrite as addition. Then group like terms.

$(3x^2 + 2x - 6) - (2x + x^2 + 3)$

$= (3x^2 + 2x - 6) + [(-2x) + (-x^2) + (-3)]$

$= [3x^2 + (-x^2)] + [2x + (-2x)] + [-6 + (-3)]$

$= 2x^2 + (-9)$

$= 2x^2 - 9$

The difference is $2x^2 - 9$.

Vertical Method

Align like terms in columns and subtract by adding the additive inverse.

$$\begin{array}{rl} & 3x^2 + 2x - 6 \\ (-) & x^2 + 2x + 3 \\ \hline \end{array}$$

$$\begin{array}{rl} & 3x^2 + 2x - 6 \\ (+) & -x^2 - 2x - 3 \\ \hline & 2x^2 - 9 \end{array}$$

The difference is $2x^2 - 9$.

Exercises

Find each difference.

1. $(3a - 5) - (5a + 1)$
   $-2a - 6$
2. $(9x + 2) - (-3x^2 - 5)$
   $3x^2 + 9x + 7$
3. $(9xy + y - 2x) - (6xy - 2x)$
   $3xy + y$
4. $(x^2 + y^2) - (-x^2 + y^2)$
   $2x^2$
5. $(6p^2 + 4p + 5) - (2p^2 - 5p + 1)$
   $4p^2 + 9p + 4$
6. $(6x^2 + 5xy - 2y^2) - (-xy - 2x^2 - 4y^2)$
   $8x^2 + 6xy + 2y^2$
7. $(8p - 5q) - (-6p^2 + 6q - 3)$
   $6p^2 + 8p - 11q + 3$
8. $(8x^2 - 4x - 3) - (-2x - x^2 + 5)$
   $9x^2 - 2x - 8$
9. $(3x^2 - 2x) - (3x^2 + 5x - 1)$
   $-7x + 1$
10. $(4x^2 + 6xy + 2y^2) - (-x^2 + 2xy - 5y^2)$
    $5x^2 + 4xy + 7y^2$
11. $(2h - 6j - 2k) - (-7h - 5j - 4k)$
    $9h - j + 2k$
12. $(9xy^2 + 5xy) - (-2xy - 8xy^2)$
    $17xy^2 + 7xy$
13. $(2a - 8b) - (-3a + 5b)$
    $5a - 13b$
14. $(2x^2 - 8) - (-2x^2 - 6)$
    $4x^2 - 2$
15. $(6z^2 + 4z + 2) - (4z^2 + z)$
    $2z^2 + 3z + 2$
16. $(6x^2 - 5x + 1) - (-7x^2 - 2x + 4)$
    $13x^2 - 3x - 3$

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8-6 Study Guide and Intervention

Multiplying a Polynomial by a Monomial

Product of Monomial and Polynomial The Distributive Property can be used to multiply a polynomial by a monomial. You can multiply horizontally or vertically. Sometimes multiplying results in like terms. The products can be simplified by combining like terms.

Example 1 **Find $-3x^2(4x^2 + 6x - 8)$.**

Horizontal Method

$-3x^2(4x^2 + 6x - 8)$

$= -3x^2(4x^2) + (-3x^2)(6x) - (-3x^2)(8)$

$= -12x^4 + (-18x^3) - (-24x^2)$

$= -12x^4 - 18x^3 + 24x^2$

Vertical Method

$$\begin{array}{r} 4x^2 + 6x - 8 \\ (\times) \qquad -3x^2 \\ \hline -12x^4 - 18x^3 + 24x^2 \end{array}$$

The product is $-12x^4 - 18x^3 + 24x^2$.

Example 2 **Simplify $-2(4x^2 + 5x) - x(x^2 + 6x)$.**

$-2(4x^2 + 5x) - x(x^2 + 6x)$

$= -2(4x^2) + (-2)(5x) + (-x)(x^2) + (-x)(6x)$

$= -8x^2 + (-10x) + (-x^3) + (-6x^2)$

$= (-x^3) + [-8x^2 + (-6x^2)] + (-10x)$

$= -x^3 - 14x^2 - 10x$

Exercises

Find each product.

1. $x(5x + x^2)$ **$5x^2 + x^3$**
2. $x(4x^2 + 3x + 2)$ **$4x^3 + 3x^2 + 2x$**
3. $-2xy(2y + 4x^2)$ **$-4xy^2 - 8x^3y$**
4. $-2g(g^2 - 2g + 2)$ **$-2g^3 + 4g^2 - 4g$**
5. $3x(x^4 + x^3 + x^2)$ **$3x^5 + 3x^4 + 3x^3$**
6. $-4x(2x^3 - 2x + 3)$ **$-8x^4 + 8x^2 - 12x$**
7. $-4cx(10 + 3x)$ **$-40cx - 12cx^2$**
8. $3y(-4x - 6x^3 - 2y)$ **$-12xy - 18x^3y - 6y^2$**
9. $2x^2y^2(3xy + 2y + 5x)$ **$6x^3y^3 + 4x^2y^3 + 10x^3y^2$**

Simplify.

10. $x(3x - 4) - 5x$ **$3x^2 - 9x$**
11. $-x(2x^2 - 4x) - 6x^2$ **$-2x^3 - 2x^2$**
12. $6a(2a - b) + 2a(-4a + 5b)$ **$4a^2 + 4ab$**
13. $4r(2r^2 - 3r + 5) + 6r(4r^2 + 2r + 8)$ **$32r^3 + 68r$**
14. $4n(3n^2 + n - 4) - n(3 - n)$ **$12n^3 + 5n^2 - 19n$**
15. $2b(b^2 + 4b + 8) - 3b(3b^2 + 9b - 18)$ **$-7b^3 - 19b^2 + 70b$**
16. $-2z(4z^2 - 3z + 1) - z(3z^2 + 2z - 1)$ **$-11z^3 + 4z^2 - z$**
17. $2(4x^2 - 2x) - 3(-6x^2 + 4) + 2x(x - 1)$ **$28x^2 - 6x - 12$**

Lesson 8-6

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8-6 Study Guide and Intervention *(continued)*

Multiplying a Polynomial by a Monomial

Solve Equations with Polynomial Expressions Many equations contain polynomials that must be added, subtracted, or multiplied before the equation can be solved.

Example **Solve $4(n - 2) + 5n = 6(3 - n) + 19$.**

$4(n - 2) + 5n = 6(3 - n) + 19$	Original equation
$4n - 8 + 5n = 18 - 6n + 19$	Distributive Property
$9n - 8 = 37 - 6n$	Combine like terms.
$15n - 8 = 37$	Add 6n to both sides.
$15n = 45$	Add 8 to both sides.
$n = 3$	Divide each side by 15.

The solution is 3.

Exercises

Solve each equation.

1. $2(a - 3) = 3(-2a + 6)$ **3**
2. $3(x + 5) - 6 = 18$ **3**
3. $3x(x - 5) - 3x^2 = -30$ **2**
4. $6(x^2 + 2x) = 2(3x^2 + 12)$ **2**
5. $4(2p + 1) - 12p = 2(8p + 12)$ **-1**
6. $2(6x + 4) + 2 = 4(x - 4)$ **$-3\frac{1}{}$**
7. $-2(4y - 3) - 8y + 6 = 4(y - 2)$ **1**
8. $c(c + 2) - c(c - 6) = 10c - 12$ **6**
9. $3(x^2 - 2x) = 3x^2 + 5x - 11$ **1**
10. $2(4x + 3) + 2 = -4(x + 1)$ **-1**
11. $3(2h - 6) - (2h + 1) = 9$ **7**
12. $3(y + 5) - (4y - 8) = -2y + 10$ **-13**
13. $3(2a - 6) - (-3a - 1) = 4a - 2$ **$2\frac{3}{5}$**
14. $5(2x^2 - 1) - (10x^2 - 6) = -(x + 2)$ **-3**
15. $3(x + 2) + 2(x + 1) = -5(x - 3)$ **$\frac{7}{10}$**
16. $4(3p^2 + 2p) - 12p^2 = 2(8p + 6)$ **$-\frac{3}{2}$**

Answers

NAME ______________________ DATE ________ PERIOD ____

8-7 Skills Practice

Multiplying Polynomials

Find each product.

1. $(m + 4)(m + 1)$
   $m^2 + 5m + 4$

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

3. $(b + 3)(b + 4)$
   $b^2 + 7b + 12$

4. $(t + 4)(t - 3)$
   $t^2 + t - 12$

5. $(r + 1)(r - 2)$
   $r^2 - r - 2$

6. $(z - 5)(z + 1)$
   $z^2 - 4z - 5$

7. $(3c + 1)(c - 2)$
   $3c^2 - 5c - 2$

8. $(2x - 6)(x + 3)$
   $2x^2 - 18$

9. $(d - 1)(5d - 4)$
   $5d^2 - 9d + 4$

10. $(2\ell + 5)(\ell - 4)$
    $2\ell^2 - 3\ell - 20$

11. $(3n - 7)(n + 3)$
    $3n^2 + 2n - 21$

12. $(q + 5)(5q - 1)$
    $5q^2 + 24q - 5$

13. $(3b + 3)(3b - 2)$
    $9b^2 + 3b - 6$

14. $(2m + 2)(3m - 3)$
    $6m^2 - 6$

15. $(4c + 1)(2c + 1)$
    $8c^2 + 6c + 1$

16. $(5a - 2)(2a - 3)$
    $10a^2 - 19a + 6$

17. $(4h - 2)(4h - 1)$
    $16h^2 - 12h + 2$

18. $(x - y)(2x - y)$
    $2x^2 - 3xy + y^2$

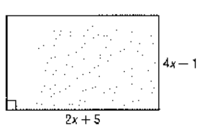
19. $(e + 4)(e^2 + 3e - 6)$
    $e^3 + 7e^2 + 6e - 24$

20. $(t + 1)(t^2 + 2t + 4)$
    $t^3 + 3t^2 + 6t + 4$

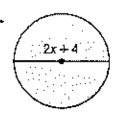
21. $(k + 4)(k^2 + 3k - 6)$
    $k^3 + 7k^2 + 6k - 24$

22. $(m + 3)(m^2 + 3m + 5)$
    $m^3 + 6m^2 + 14m + 15$

GEOMETRY Write an expression to represent the area of each figure.

23. 

$8x^2 + 18x - 5$ units^2

24. 

$(x^2 + 4x + 4)\pi$ units^2

Lesson 8-7

NAME ______________________ DATE ________ PERIOD ____

8-7 Practice (Average)

Multiplying Polynomials

Find each product.

1. $(q + 6)(q + 5)$
   $q^2 + 11q + 30$

2. $(x + 7)(x + 4)$
   $x^2 + 11x + 28$

3. $(s + 5)(s - 6)$
   $s^2 - s - 30$

4. $(n - 4)(n - 6)$
   $n^2 - 10n + 24$

5. $(a - 5)(a - 8)$
   $a^2 - 13a + 40$

6. $(w - 6)(w - 9)$
   $w^2 - 15w + 54$

7. $(4c + 6)(c - 4)$
   $4c^2 - 10c - 24$

8. $(2x - 9)(2x + 4)$
   $4x^2 - 10x - 36$

9. $(4d - 5)(2d - 3)$
   $8d^2 - 22d + 15$

10. $(4b + 3)(3b - 4)$
    $12b^2 - 7b - 12$

11. $(4m + 2)(4m - 3)$
    $16m^2 - 4m - 6$

12. $(5c - 5)(7c + 9)$
    $35c^2 + 10c - 45$

13. $(6a - 3)(7a - 4)$
    $42a^2 - 45a + 12$

14. $(6h - 3)(4h - 2)$
    $24h^2 - 24h + 6$

15. $(2x - 2)(5x - 4)$
    $10x^2 - 18x + 8$

16. $(3a - b)(2a - b)$
    $6a^2 - 5ab + b^2$

17. $(4g + 3h)(2g + 3h)$
    $8g^2 + 18gh + 9h^2$

18. $(4x + y)(4x + y)$
    $16x^2 + 8xy + y^2$

19. $(m + 5)(m^2 + 4m - 8)$
    $m^3 + 9m^2 + 12m - 40$

20. $(t + 3)(t^2 + 4t + 7)$
    $t^3 + 7t^2 + 19t + 21$

21. $(2h + 3)(2h^2 + 3h + 4)$
    $4h^3 + 12h^2 + 17h + 12$

22. $(3d + 3)(2d^2 + 5d - 2)$
    $6d^3 + 21d^2 + 9d - 6$

23. $(3q + 2)(9q^2 - 12q + 4)$
    $27q^3 - 18q^2 - 12q + 8$

24. $(3r + 2)(9r^2 + 6r + 4)$
    $27r^3 + 36r^2 + 24r + 8$

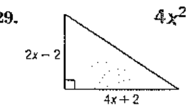
25. $(3c^2 + 2c - 1)(2c^2 + c + 9)$
    $6c^4 + 7c^3 + 27c^2 + 17c - 9$

26. $(2\ell^2 + \ell + 3)(4\ell^2 + 2\ell - 2)$
    $8\ell^4 + 8\ell^3 + 10\ell^2 + 4\ell - 6$

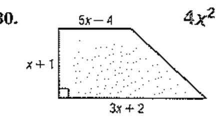
27. $(2x^2 - 2x - 3)(2x^2 - 4x + 3)$
    $4x^4 - 12x^3 + 8x^2 + 6x - 9$

28. $(3y^2 + 2y + 2)(3y^2 - 4y - 5)$
    $9y^4 - 6y^3 - 17y^2 - 18y - 10$

GEOMETRY Write an expression to represent the area of each figure.

29. 

$4x^2 - 2x - 2$ units^2

30. 

$4x^2 + 3x - 1$ units^2

31. **NUMBER THEORY** Let x be an even integer. What is the product of the next two consecutive even integers? $x^2 + 6x + 8$

32. **GEOMETRY** The volume of a rectangular pyramid is one third the product of the area of its base and its height. Find an expression for the volume of a rectangular pyramid whose base has an area of $3x^2 + 12x + 9$ square feet and whose height is $x + 3$ feet.
$x^3 + 7x^2 + 15x + 9$ feet^3

Answers

NAME ______________________ DATE __________ PERIOD ____

8-8 Study Guide and Intervention

Special Products

Squares of Sums and Differences Some pairs of binomials have products that follow specific patterns. One such pattern is called the *square of a sum*. Another is called the *square of a difference*.

Square of a sum	$(a + b)^2 = (a + b)(a + b) = a^2 + 2ab + b^2$
Square of a difference	$(a - b)^2 = (a - b)(a - b) = a^2 - 2ab + b^2$

Example 1 **Find $(3a + 4)(3a + 4)$.**

Use the square of a sum pattern, with $a = 3a$ and $b = 4$.

$(3a + 4)(3a + 4) = (3a)^2 + 2(3a)(4) + (4)^2$
$= 9a^2 + 24a + 16$

The product is $9a^2 + 24a + 16$.

Example 2 **Find $(2z - 9)(2z - 9)$.**

Use the square of a difference pattern with $a = 2z$ and $b = 9$.

$(2z - 9)(2z - 9) = (2z)^2 - 2(2z)(9) + (9)(9)$
$= 4z^2 - 36z + 81$

The product is $4z^2 - 36z + 81$.

Exercises

Find each product.

1. $(x - 6)^2$
   $x^2 - 12x + 36$
2. $(3p + 4)^2$
   $9p^2 + 24p + 16$
3. $(4x - 5)^2$
   $16x^2 - 40x + 25$
4. $(2x - 1)^2$
   $4x^2 - 4x + 1$
5. $(2h + 3)^2$
   $4h^2 + 12h + 9$
6. $(m + 5)^2$
   $m^2 + 10m + 25$
7. $(c + 3)^2$
   $c^2 + 6c + 9$
8. $(3 - p)^2$
   $9 - 6p + p^2$
9. $(x - 5y)^2$
   $x^2 - 10xy + 25y^2$
10. $(8y + 4)^2$
    $64y^2 + 64y + 16$
11. $(8 + x)^2$
    $64 + 16x + x^2$
12. $(3a - 2b)^2$
    $9a^2 - 12ab + 4b^2$
13. $(2x - 8)^2$
    $4x^2 - 32x + 64$
14. $(x^2 + 1)^2$
    $x^4 + 2x^2 + 1$
15. $(m^2 - 2)^2$
    $m^4 - 4m^2 + 4$
16. $(x^3 - 1)^2$
    $x^6 - 2x^3 + 1$
17. $(2h^2 - k^2)^2$
    $4h^4 - 4h^2k^2 + k^4$
18. $\left(\frac{1}{4}x + 3\right)^2$
    $\frac{1}{16}x^2 + \frac{3}{2}x + 9$
19. $(x - 4y^2)^2$
    $x^2 - 8xy^2 + 16y^4$
20. $(2p + 4q)^2$
    $4p^2 + 16pq + 16q^2$
21. $\left(\frac{2}{3}x - 2\right)^2$
    $\frac{4}{9}x^2 - \frac{8}{3}x + 4$

Lesson 8-8

NAME ______________________ DATE __________ PERIOD ____

8-8 Study Guide and Intervention *(continued)*

Special Products

Product of a Sum and a Difference There is also a pattern for the product of a sum and a difference of the same two terms, $(a + b)(a - b)$. The product is called the **difference of squares.**

Product of a Sum and a Difference	$(a + b)(a - b) = a^2 - b^2$

Example **Find $(5x + 3y)(5x - 3y)$.**

$(a + b)(a - b) = a^2 - b^2$ Product of a Sum and a Difference
$(5x + 3y)(5x - 3y) = (5x)^2 - (3y)^2$ a 5x and b 3y
$= 25x^2 - 9y^2$ Simplify.

The product is $25x^2 - 9y^2$.

Exercises

Find each product.

1. $(x - 4)(x + 4)$
   $x^2 - 16$
2. $(p + 2)(p - 2)$
   $p^2 - 4$
3. $(4x - 5)(4x + 5)$
   $16x^2 - 25$
4. $(2x - 1)(2x + 1)$
   $4x^2 - 1$
5. $(h + 7)(h - 7)$
   $h^2 - 49$
6. $(m - 5)(m + 5)$
   $m^2 - 25$
7. $(2c - 3)(2c + 3)$
   $4c^2 - 9$
8. $(3 - 5q)(3 + 5q)$
   $9 - 25q^2$
9. $(x - y)(x + y)$
   $x^2 - y^2$
10. $(y - 4x)(y + 4x)$
    $y^2 - 16x^2$
11. $(8 + 4x)(8 - 4x)$
    $64 - 16x^2$
12. $(3a - 2b)(3a + 2b)$
    $9a^2 - 4b^2$
13. $(3y - 8)(3y + 8)$
    $9y^2 - 64$
14. $(x^2 - 1)(x^2 + 1)$
    $x^4 - 1$
15. $(m^2 - 5)(m^2 + 5)$
    $m^4 - 25$
16. $(x^3 - 2)(x^3 + 2)$
    $x^6 - 4$
17. $(h^2 - k^2)(h^2 + k^2)$
    $h^4 - k^4$
18. $\left(\frac{1}{4}x + 2\right)\left(\frac{1}{4}x - 2\right)$
    $\frac{1}{16}x^2 - 4$
19. $(3x - 2y^2)(3x + 2y^2)$
    $9x^2 - 4y^4$
20. $(2p - 5s)(2p + 5s)$
    $4p^2 - 25s^2$
21. $\left(\frac{4}{3}x - 2y\right)\left(\frac{4}{3}x + 2y\right)$
    $\frac{16}{9}x^2 - 4y^2$

Answers

Name: Key Date: ___________

Solving Exponential Equations with Different Bases.

Solve each equation for the variable.

1. $9^{2x-1} \cdot 9^{x+2} = 9^8$

$9^{3x+1} = 9^8$

$3x+1 = 8$

$3x = 7$

$x = \frac{7}{3}$

2. $3^{3x} \cdot 3^{2x-1} = \frac{3^{4x+7}}{3^{2x-1}}$

$3^{5x-1} = 3^{2x+8}$

$5x-1 = 2x+8$

$3x = 9$

$x = 3$

3. $\frac{7^{3x+4}}{7^{x-3}} = 1$

$7^{2x+7} = 7^0$

$2x+7 = 0$

$2x = -7$

$x = \frac{-7}{2}$

4. $\left(\frac{5^{7x+4}}{25^{3x-3}}\right)^2 = 125^{x+2}$

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

$\left(\frac{5^{7x+4}}{5^{6x-6}}\right)^2 = 5^{3x+6}$

$(5^{x+10})^2 = 5^{3x+6}$

$5^{2x+20} = 5^{3x+6}$

$2x+20 = 3x+6$

$14 = x$

5. $(6^x \cdot 36^{2x-2})^3 = 6$

$(6^x \cdot (6^2)^{2x-2})^3 = 6^1$

$(6^x \cdot 6^{4x-4})^3 = 6^1$

$(6^{5x-4})^3 = 6^1$

$6^{15x-12} = 6^1$

$15x - 12 = 1$

$15x = 13$

$x = \frac{13}{15}$

6. $\left(\frac{9^{2x-1}}{9^{x+4}}\right)^2 = 9^{3x-1}$

$(9^{x-5})^2 = 9^{3x-1}$

$9^{2x-10} = 9^{3x-1}$

$2x-10 = 3x-1$

$-9 = x$

7. $8^{3x+4} \cdot 2^{6-x} = \frac{4^{3x}}{16^{x+1}}$

$(2^3)^{3x+4} \cdot 2^{6-x} = \frac{(2^2)^{3x}}{(2^4)^{x+1}}$

$2^{9x+12} \cdot 2^{6-x} = \frac{2^{6x}}{2^{4x+4}}$

$2^{8x+18} = 2^{2x-4}$

$8x+18 = 2x-4$

$6x = -22$

$x = \frac{-11}{3}$

8. $5 \cdot 5^{3x} = 5^{5x-7}$

$5^{3x+1} = 5^{5x-7}$

$3x+1 = 5x-7$

$8 = 2x$

$x = 4$