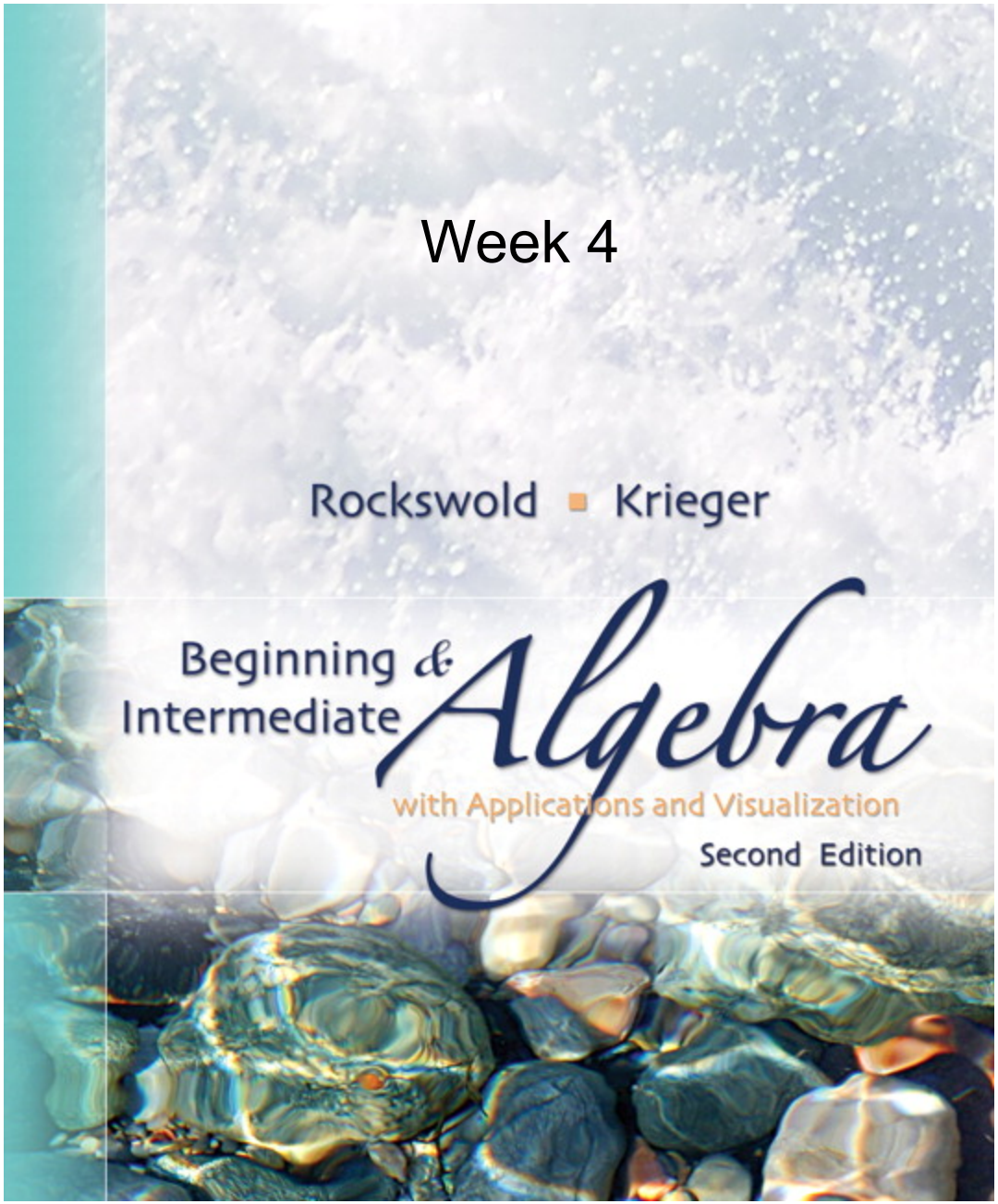
Week 4
Rockswold ▪ Krieger
Beginning & Intermediate Algebra
with Applications and Visualization
Second Edition

Due for this week…

- Homework 4 (on MyMathLab – via the Materials Link) → Monday night at 6pm.
- Prepare for the final (available tonight 10pm to Saturday Aug 20th 11:59pm)
- Do the MyMathLab Self-Check for week 4.
- Learning team presentations week 5.

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Final Exam logistics

- Here is what I've found out about the final exam in MyMathLab (running from the end of class this week (week 4 at 10pm) to Saturday night 8/20/2011 at 11:59pm (the first Saturday after the last day of class).

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Final Exam logistics

- There will be 50 questions.
- You have only one attempt to complete the exam.
- Once you start the exam, it must be completed in that sitting. (Don't start until you have time to complete it that day or evening.)
- You may skip and get back to a question BUT return to it before you hit submit.
  You must be in the same session to return to a question.
- There is no time limit to the exam (except for 11:59pm Saturday night after the last class).
- You will **not** have the following help that exists in homework:
  - Online sections of the textbook
  - Animated help
  - Step-by-step instructions
  - Video explanations
  - Links to similar exercises
- You will be logged out of the exam automatically after 3 hours of inactivity. Your session will end.
- **IMPORTANT!** You will also be logged out of the exam if you use your back button on your browser. You session will end.

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5.1 Rules for Exponents

- Review of Bases and Exponents
- Zero Exponents
- The Product Rule
- Power Rules

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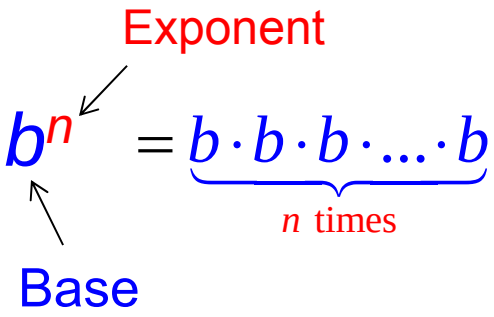
Review of Bases and Exponents

The expression 5^3 is an exponential expression with *base* 5 and *exponent* 3.

Its value is $5 \cdot 5 \cdot 5 = 125$.



EVALUATING EXPRESSIONS

When evaluating expressions, use the following order of operations.

1. Evaluate exponents.
2. Perform negation.
3. Do multiplication and division from left to right.
4. Do addition and subtraction from left to right.

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EXAMPLE Evaluating exponential expressions

Evaluate each expression.

a. $2+\frac{4^2}{8}$ b. -3^4 c. $(-3)^4$

Solution

a. $2+\frac{4^2}{8}$

$$= 2+\frac{\overbrace{4\cdot 4}^{2 \text{ factors}}}{8}$$

$$= 2+\frac{16}{8}$$

$$= 2+2=4$$

b. -3^4

$$= -(\overbrace{3\cdot 3\cdot 3\cdot 3}^{4 \text{ factors}})$$

$$= -81$$

c. $(-3)^4$

$$= \overbrace{(-3)\cdot(-3)\cdot(-3)\cdot(-3)}^{4 \text{ factors}}$$

$$= 81$$

Try some of Q: 11-16, 19-26

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Zero Exponents

ZERO EXPONENT

For any nonzero real number b,

$$b^0 = 1.$$

The expression 0^0 is undefined.

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EXAMPLE Evaluating exponential expressions

Evaluate each expression. Assume that all variables represent nonzero numbers.

a. 8^0

b. $4\left(\frac{2}{3}\right)^0$

c. $\left(\frac{x^3y^7}{2z}\right)^0$

Solution

a. $8^0 = 1$

b. $4\left(\frac{2}{3}\right)^0$

$= 4(1) = 4$

c. $\left(\frac{x^3y^7}{2z}\right)^0 = 1$

Try some of Q: 17-18

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The Product Rule

THE PRODUCT RULE

For any real number a and natural numbers m and n,

$$a^m \cdot a^n = a^{m+n}.$$

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EXAMPLE Using the product rule

Multiply and simplify.

a. $3^2 \cdot 3^4$ b. $3x^2 \cdot 6x^7$ c. $x^2(3x + 4x^2)$

Solution

a. $3^2 \cdot 3^4$

$= 3^2 \cdot 3^4$

$= 3^{2+4}$

$= 3^6$

$= 729$

b. $3x^2 \cdot 6x^7$

$= 3 \cdot 6 \cdot x^2 \cdot x^7$

$= 18x^{2+7}$

$= 18x^9$

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

$= x^2 \cdot 3x + x^2 \cdot 4x^2$

$= 3x^3 + 4x^4$

Try some of Q: 27-42

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Exponent Rules

RAISING A POWER TO A POWER

For any real number a and natural numbers m and n,

$$(a^m)^n = a^{mn}.$$

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EXAMPLE Raising a power to a power

Simplify the expression.

a. $\left(3^2\right)^3$ b. $\left(x^2\right)^5$

Solution

a. $\left(3^2\right)^3$

$= 3^{2 \cdot 3}$

$= 3^6$

b. $\left(x^2\right)^5$

$= x^{2 \cdot 5}$

$= x^{10}$

Try some of Q: 43-48

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Exponent Rules

RAISING A PRODUCT TO A POWER

For any real numbers a and b and natural number n,

$$(ab)^n = a^n b^n.$$

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EXAMPLE Raising a product to a power

Simplify the expression.

a. $(2a)^3$ b. $(-3x^2)^3$ c. $(-2^3h^4)^2$

Solution

a. $(2a)^3$

$= (2a)^3$

$= 2^3a^3$

$= 8a^3$

b. $(-3x^2)^3$

$= (-3x^2)^3$

$= (-3)^3(x^2)^3$

$= -27x^6$

c. $(-2^3h^4)^2$

$= (-8h^4)^2$

$= (-8)^2(h^4)^2$

$= 64h^8$

Try some of Q: 53-62

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Exponent Rules

RAISING A QUOTIENT TO A POWER

For any real numbers a and b and natural number n,

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}. \qquad b \neq 0$$

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EXAMPLE Raising a quotient to a power

Simplify the expression.

a. $\left(\frac{3}{4}\right)^3$ b. $\left(\frac{a}{b}\right)^7$ c. $\left(\frac{x+y}{4}\right)^3$

Solution

a. $\left(\frac{3}{4}\right)^3$

$= \frac{3^3}{4^3} = \frac{27}{64}$

b. $\left(\frac{a}{b}\right)^7$

$= \frac{a^7}{b^7}$

c. $\left(\frac{x+y}{4}\right)^3$

$= \frac{(x+y)^3}{4^3}$

$= \frac{(x+y)^3}{64}$

Try some of Q: 63-74

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EXAMPLE Combining rules for exponents

Simplify the expression.

a. $(3a)^2(4a)^3$ b. $\left(\frac{a^2b^4}{d}\right)^3$ c. $(3a^2b)^2(-5a^3b^4)^3$

Solution

a. $(3a)^2(4a)^3$

$= 3^2a^2 \cdot 4^3a^3$

$= 9a^2 \cdot 64a^3$

$= 576a^5$

b. $\left(\frac{a^2b^4}{d}\right)^3$

$= \frac{(a^2)^3(b^4)^3}{d^3}$

$= \frac{a^6b^{12}}{d^3}$

c. $(3a^2b)^2(-5a^3b^4)^3$

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

$= 9a^4b^2(-125)a^9b^{12}$

$= 9(-125)a^4a^9b^2b^{12}$

$= -1125a^{13}b^{14}$

Try some of Q: 75-86

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5.2 Addition and Subtraction of Polynomials

- Monomials and Polynomials
- Addition of Polynomials
- Subtraction of Polynomials
- Evaluating Polynomial Expressions

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A **monomial** is a number, a variable, or a product of numbers and variables raised to natural number powers.

Examples of monomials: $-8, \quad 7y, \quad x^3, \quad 8x^2y^9, \quad -xy^8$

The **degree of monomial** is the sum of the exponents of the variables. If the monomial has only one variable, its degree is the exponent of that variable.

The number in a monomial is called the **coefficient of the monomial.**

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EXAMPLE Identifying properties of polynomials

Determine whether the expression is a polynomial. If it is, state how many terms and variables the polynomial contains and its degree.

a. $9y^2 + 7y + 4$ b. $7x^4 - 2x^3y^2 + xy - 4y^3$ c. $8x^2 - \frac{3}{x+4}$

Solution

a. The expression is a polynomial with three terms and one variable. The term with the highest degree is $9y^2$, so the polynomial has degree 2.

b. The expression is a polynomial with four terms and two variables. The term with the highest degree is $2x^3y^2$, so the polynomial has degree 5.

c. The expression is not a polynomial because it contains division by the polynomial $x + 4$.

Try some of Q: 19-30

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EXAMPLE Adding like terms

State whether each pair of expressions contains like terms or unlike terms. If they are like terms, then add them.

a. $9x^3, -2x^3$ b. $5mn^2, 8m^2n$

Solution

a. The terms have the same variable raised to the same power, so they are like terms and can be combined.

$$9x^3 + (-2x^3) = (9 + (-2))x^3 = 7x^3$$

b. The terms have the same variables, but these variables are not raised to the same power. They are therefore unlike terms and cannot be added.

Try some of Q: 31-40

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EXAMPLE Adding polynomials

Add each pair of polynomials by combining like terms.

$$\left(3x^2-4x+8\right)+\left(4x^2+5x-3\right)$$

Solution

$$\left(3x^2-4x+8\right)+\left(4x^2+5x-3\right)=\left(3x^2-4x+8\right)+\left(4x^2+5x-3\right)$$

$$=3x^2+4x^2-4x+5x+8-3$$

$$=(3+4)x^2+(-4+5)x+(8-3)$$

$$=7x^2+x+5$$

Try some of Q: 41-52

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EXAMPLE Adding polynomials vertically

Simplify $\left(7x^2 - 3xy - 7y^2\right) + \left(-2x^2 + xy + 2y^2\right)$.

Solution

Write the polynomial in a vertical format and then add each column of like terms.

$$\begin{array}{r} 7x^2 - 3xy - 7y^2 \\ \underline{-2x^2 + xy + 2y^2} \\ 5x^2 - 2xy - 5y^2 \end{array}$$

Try some of Q: 59-56

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To subtract two polynomials, we add the first polynomial to the *opposite* of the second polynomial. To find the **opposite of a polynomial,** we negate each term.

Polynomial	Opposite
$9 - x$	$-9 + x$
$5x^2 + 4x - 1$	$-5x^2 - 4x + 1$
$-x^4 + 5x^3 - x^2 + 5x - 1$	$x^4 - 5x^3 + x^2 - 5x + 1$

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EXAMPLE Subtracting polynomials

Simplify $\left(5w^3+3w^2-6\right)-\left(5w^3-4w^2-8\right)$.

Solution

The opposite of $\left(5w^3-4w^2-8\right)$ is $\left(-5w^3+4w^2+8\right)$

$$=\left(5w^3+3w^2-6\right)+\left(-5w^3+4w^2+8\right)$$

$$=(5-5)w^3+(3+4)w^2+(-6+8)$$

$$=0w^3+7w^2+2$$

$$=7w^2+2$$

Try some of Q: 63-74

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EXAMPLE Subtracting polynomials vertically

Simplify $\left(10x^2 - 4x + 5\right) - \left(4x^2 + 2x - 1\right)$.

Solution

Write the polynomial in a vertical format and then add the first polynomial and the opposite of the second polynomial.

$$\begin{array}{r} 10x^2 - 4x + 5 \\ \underline{-4x^2 - 2x + 1} \\ 6x^2 - 6x + 6 \end{array}$$

Try some of Q: 75-78

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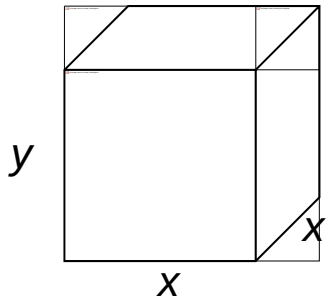
EXAMPLE Writing and evaluating a monomial

Write the monomial that represents the volume of the box having a square bottom as shown. Find the volume of the box if $x = 5$ inches and $y = 3$ inches.



Solution

The volume is found by multiplying the length, width, and height together. This can be written as x^2y. To calculate the volume let $x = 5$ and $y = 3$.

$$x^2y = 5^2 \cdot 3 = 25 \cdot 3 = 75 \text{ cubic inches}$$

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5.3 Multiplication of Polynomials

- Multiplying Monomials
- Review of the Distributive Properties
- Multiplying Monomials and Polynomials
- Multiplying Polynomials

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Multiplying Monomials

A monomial is a number, a variable, or a product of numbers and variables raised to natural number powers. To multiply monomials, we often use the product rule for exponents.

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EXAMPLE Multiplying monomials

Multiply.

a. $-6x^4 \cdot 3x^3$

b. $(6xy^3)(x^4y^2)$

Solution

a. $-6x^4 \cdot 3x^3$

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

$= -18x^7$

b. $(6xy^3)(x^4y^2)$

$= 6xx^4y^3y^2$

$= 6x^{1+4}y^{3+2}$

$= 6x^5y^5$

Try some of Q: 7-16

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EXAMPLE Using distributive properties

Multiply.

a. $3(6+x)$ b. $-4(x-2y)$ c. $(3x-5)(7)$

Solution

a. $3(6+x) = 3\cdot 6 + 3\cdot x$

$= 18 + 3x$

b. $-4(x-2y) = -4(x) + (-4)(-2y)$

$= -4x + 8y$

c. $(3x-5)(7) = 3x(7) - 5(7)$

$= 21x - 35$

Try some of Q: 17-24

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EXAMPLE Multiplying monomials and polynomials

Multiply.

a. $4xy(3x^2y-2)$

b. $-ab(a^3-b^3)$

Solution

a. $4xy(3x^2y-2)$

$= 4xy \cdot 3x^2y - 4xy \cdot 2$

$= 12xx^2yy - 8xy$

$= 12x^3y^2 - 8xy$

b. $-ab(a^3-b^3)$

$= -ab \cdot a^3 + ab \cdot b^3$

$= -a^4b + ab^4$

Try some of Q: 25-32

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Multiplying Polynomials

Monomials, binomials, and trinomials are examples of polynomials.

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EXAMPLE Multiplying binomials

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

Solution

$$(x+2)(x+4) = (x+2)(x) + (x+2)(4)$$

$$= x \cdot x + 2 \cdot x + x \cdot 4 + 2 \cdot 4$$

$$= x^2 + 2x + 4x + 8$$

$$= x^2 + 6x + 8$$

Try some of Q: 39-44

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NOTE: This process of multiplying binomials is called *FOIL*. You may use it to remind yourself to multiply the first terms (F), outside terms (O), inside terms (I), and last terms (L).

Multiply the *First terms* to obtain x^2. $(x + 1)(x + 3)$

Multiply the *Outside terms* to obtain $3x$. $(x + 1)(x + 3)$

Multiply the *Inside terms* to obtain x. $(x + 1)(x + 3)$

Multiply the *Last terms* to obtain 3. $(x + 1)(x + 3)$

The following method summarizes how to multiply two polynomials in general.

MULTIPLICATION OF POLYNOMIALS

The product of two polynomials may be found by multiplying every term in the first polynomial by every term in the second polynomial.

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EXAMPLE Multiplying binomials

Multiply each binomial.

a. $(3x-1)(x+4)$ b. $(x^2+2)(3x-1)$

Solution

a. $(3x-1)(x+4) = 3x\cdot x + 3x\cdot 4 - 1\cdot x - 1\cdot 4$

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

$= 3x^2 + 11x - 4$

b. $(x^2+2)(3x-1) = x^2\cdot 3x + x^2\cdot(-1) + 2\cdot 3x + 2\cdot -1$

$= 3x^3 - x^2 + 6x - 2$

Try some of Q: 45-64

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EXAMPLE Multiplying polynomials

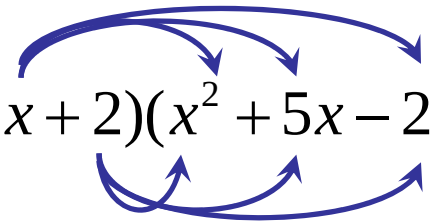
Multiply each expression.

a. $4x(x^2+6x-1)$ b. $(x+2)(x^2+5x-2)$

Solution

a. $4x(x^2+6x-1) = 4x\cdot x^2+4x\cdot 6x+4x\cdot -1$

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



b. $(x+2)(x^2+5x-2) = x\cdot x^2+x\cdot 5x+x\cdot(-2)+2\cdot x^2+2\cdot 5x+2\cdot -2$

$$= x^3+5x^2-2x+2x^2+10x-4$$

$$= x^3+7x^2+8x-4$$

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EXAMPLE Multiplying polynomials

Multiply $3ab(a^2 - 3ab + 4b^2)$.

Solution

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

$$= 3a^3b - 9a^2b^2 + 12ab^3$$

Try some of Q: 65-72

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EXAMPLE Multiplying polynomials vertically

Multiply $(x-1)(2x^2+x-3)$.

Solution

$$
\begin{array}{r}
2x^2+x-3 \\
\underline{\qquad\quad x-1} \\
-2x^2-x+3 \\
2x^3+x^2-3x \\
\hline
2x^3-x^2-4x+3
\end{array}
$$

Try some of Q: 73-78

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5.4 Special Products

- Product of a Sum and Difference
- Squaring Binomials
- Cubing Binomials

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PRODUCT OF A SUM AND DIFFERENCE

For any real numbers a and b,

$$(a + b)(a - b) = a^2 - b^2.$$

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EXAMPLE Finding products of sums and differences

Multiply.

a. $(x + 4)(x - 4)$ b. $(3t + 4s)(3t - 4s)$

Solution

a. We can apply the formula for the product of a sum and difference.

$$(x + 4)(x - 4) = (x)^2 - (4)^2$$
$$= x^2 - 16$$

b. $(3t + 4s)(3t - 4s) = (3t)^2 - (4s)^2$

$$= 9t^2 - 16s^2$$

Try some of Q: 9-24

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EXAMPLE Finding a product

Use the product of a sum and difference to find $31 \cdot 29$.

Solution

Because $31 = 30 + 1$ and $29 = 30 - 1$, rewrite and evaluate $31 \cdot 29$ as follows.

$$\begin{aligned} 31 \cdot 29 &= (30 + 1)(30 - 1) \\ &= 30^2 - 1^2 \\ &= 900 - 1 \\ &= 899 \end{aligned}$$

Try some of Q: 27-32

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SQUARING A BINOMIAL

For any real numbers a and b,

$$(a + b)^2 = a^2 + 2ab + b^2 \quad \text{and}$$
$$(a - b)^2 = a^2 - 2ab + b^2.$$

That is, the square of a binomial equals the square of the first term, plus (or minus) twice the product of the two terms, plus the square of the last term.

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EXAMPLE Squaring a binomial

Multiply.

a. $(x + 7)^2$ b. $(4 - 3x)^2$

Solution

a. We can apply the formula for squaring a binomial.

$$(x + 7)^2 = (x)^2 + 2(x)(7) + (7)^2$$
$$= x^2 + 14x + 49$$

b. $(4 - 3x)^2 = (4)^2 - 2(4)(3x) + (3x)^2$
$$= 16 - 24x + 9x^2$$

Try some of Q: 33-48

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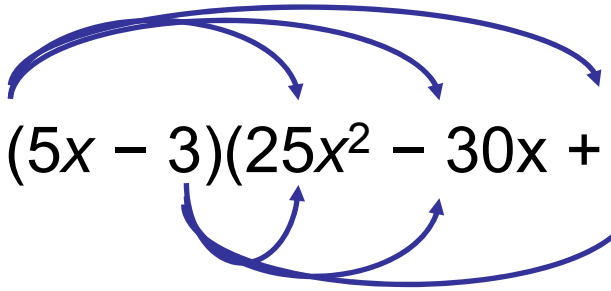
EXAMPLE Cubing a binomial

Multiply $(5x - 3)^3$.

Solution

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



$$= (5x - 3)(25x^2 - 30x + 9)$$

$$= 125x^3 - 150x^2 + 45x - 75x^2 + 90x - 27$$

$$= 125x^3 - 225x^2 + 135x - 27$$

Try some of Q: 49-58

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EXAMPLE Calculating interest

If a savings account pays x percent annual interest, where x is expressed as a decimal, then after 2 years a sum of money will grow by a factor of $(x + 1)^2$.

a. Multiply the expression.
b. Evaluate the expression for $x = 0.12$ (or 12%), and interpret the result.

Solution

a. $(1 + x)^2 = 1 + 2x + x^2$

b. Let $x = 0.12$ $\quad 1 + 2(0.12) + (0.12)^2 = 1.2544$

The sum of money will increase by a factor of 1.2544. For example if \$5000 was deposited in the account, the investment would grow to \$6272 after 2 years.

Try Q: 85

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5.5 Integer Exponents and the Quotient Rule

- Negative Integers as Exponents
- The Quotient Rule
- Other Rules for Exponents
- Scientific Notation

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Negative Integers as Exponents

NEGATIVE INTEGER EXPONENTS

Let a be a nonzero real number and n be a positive integer. Then

$$a^{-n} = \frac{1}{a^n}.$$

That is, a^{-n} is the reciprocal of a^n.

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EXAMPLE Evaluating negative exponents

Simplify each expression.

a. 2^{-5} b. $\dfrac{1}{8^{-1}}$ c. $(a+b)^{-4}$

Solution

a. $2^{-5} = \dfrac{1}{2^5} = \dfrac{1}{2\cdot 2\cdot 2\cdot 2\cdot 2} = \dfrac{1}{32}$

b. $\dfrac{1}{8^{-1}} = 8^1 = 8$

c. $(a+b)^{-4} = \dfrac{1}{(a+b)^4}$

Try some of Q: 13-14

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EXAMPLE Using the product rule with negative exponents

Evaluate the expression. $8^4 \cdot 8^{-2}$

Solution

$$8^4 \cdot 8^{-2} = 8^{4+(-2)} = 8^2 = 64$$

Try some of Q: 15-18

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EXAMPLE Using the rules of exponents

Simplify the expression. Write the answer using positive exponents.

a. $x^4x^{-5}x^6$ b. $4y^3 \cdot 3y^{-5}$

Solution

a. $x^4x^{-5}x^6 = x^{4+(-5)+6} = x^5$

b. $4y^3 \cdot 3y^{-5} = 4 \cdot 3 \cdot y^3 \cdot y^{-5} = 12y^{3+(-5)} = 12y^{-2} = \frac{12}{y^2}$

Try some of Q: 25-36

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THE QUOTIENT RULE

For any nonzero number a and integers m and n,

$$\frac{a^m}{a^n} = a^{m-n}.$$

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EXAMPLE Using the quotient rule

Simplify each expression. Write the answer using positive exponents.

a. $\dfrac{10^3}{10^6}$ b. $\dfrac{x^7}{x^3}$ c. $\dfrac{24x^2y^4}{6x^6y}$

Solution

a. $\dfrac{10^3}{10^6} = 10^{3-6} = 10^{-3} = \dfrac{1}{10^3} = \dfrac{1}{1000}$

b. $\dfrac{x^7}{x^3} = x^{7-3} = x^4$

c. $\dfrac{24x^2y^4}{6x^6y} = \dfrac{24}{6}\cdot\dfrac{x^2}{x^6}\cdot\dfrac{y^4}{y} = 4x^{2-6}y^{4-1} = 4x^{-4}y^3 = \dfrac{4y^3}{x^4}$

Try some of Q: 36-40

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QUOTIENTS AND NEGATIVE EXPONENTS

The following three rules hold for any nonzero real numbers a and b and positive integers m and n.

1. $\dfrac{1}{a^{-n}} = a^n$ **2.** $\dfrac{a^{-n}}{b^{-m}} = \dfrac{b^m}{a^n}$ **3.** $\left(\dfrac{a}{b}\right)^{-n} = \left(\dfrac{b}{a}\right)^n$

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EXAMPLE Working with quotients and negative exponents

Simplify each expression. Write the answer using positive exponents.

a. $\dfrac{1}{3^{-3}}$ b. $\dfrac{2a^{-3}b^{6}}{6a^{5}b^{-4}}$ c. $\left(\dfrac{3}{a^{3}}\right)^{-2}$

Solution

a. $\dfrac{1}{3^{-3}} = 3^{3} = 27$

b. $\dfrac{2a^{-3}b^{6}}{6a^{5}b^{-4}} = \dfrac{2b^{4}b^{6}}{6a^{5}a^{3}} = \dfrac{b^{10}}{3a^{8}}$

c. $\left(\dfrac{3}{a^{3}}\right)^{-2} = \left(\dfrac{a^{3}}{3}\right)^{2} = \dfrac{a^{6}}{3^{2}} = \dfrac{a^{6}}{9}$

Try some of Q: 41-48

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SCIENTIFIC NOTATION

A real number a is in **scientific notation** when a is written in the form $b \times 10^n$, where $1 \leq |b| < 10$ and n is an integer.

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Important Powers of 10

Number	**10^{-3}**	**10^{-2}**	**10^{-1}**	**10^{3}**	**10^{6}**	**10^{9}**	**10^{12}**
Value	Thousandth	Hundredth	Tenth	Thousand	Million	Billion	Trillion

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EXAMPLE Converting scientific notation to standard form

Write each number in standard form.

a. 3×10^{6}

Move the decimal point 6 places to the *right* since the exponent is positive.

$3,000,000$

b. 6.4×10^{-3}

Move the decimal point 3 places to the *left* since the exponent is negative.

0.0064

Try some of Q: 57-68

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WRITING A POSITIVE NUMBER IN SCIENTIFIC NOTATION

For a positive, rational number a expressed as a decimal, if $1 \leq a < 10$, then $a = a \times 10^0$. Otherwise, use the following process to write a in scientific notation.

1. Move the decimal point in a until it becomes a number b such that $1 \leq b < 10$.
2. Count the number of places that the decimal point was moved. Let this positive integer be n.
3. If the decimal point was moved to the *left*, then $a = b \times 10^n$. If the decimal point was moved to the *right*, then $a = b \times 10^{-n}$.

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EXAMPLE Writing a number in scientific notation

Write each number in scientific notation.

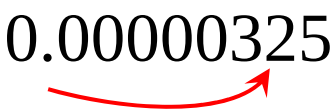
a. 475,000

Move the decimal point 5 places to the *left.*

4.75×10^{5}

b. 0.00000325

Move the decimal point 6 places to the *right.*



3.25×10^{-6}

Try some of Q: 69-80

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5.6 Division of Polynomials

- Division by a Monomial
- Division by a Polynomial

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EXAMPLE Dividing a polynomial by a monomial

Divide.

$$\frac{6x^5 + 18x^3}{6x^2}$$

Solution

$$\frac{6x^5 + 18x^3}{6x^2} = \frac{6x^5}{6x^2} + \frac{18x^3}{6x^2} = x^3 + 3x$$

Try some of Q: 15-22

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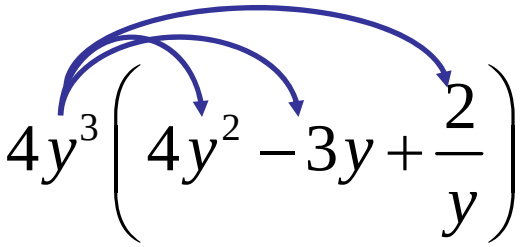
EXAMPLE Dividing and checking

Divide the expression $\dfrac{16y^5 - 12y^4 + 8y^2}{4y^3}$ and check the result.

$$\frac{16y^5 - 12y^4 + 8y^2}{4y^3} = \frac{16y^5}{4y^3} - \frac{12y^4}{4y^3} + \frac{8y^2}{4y^3}$$

$$= 4y^2 - 3y + \frac{2}{y}$$

Check:



$$4y^3\left(4y^2 - 3y + \frac{2}{y}\right) = 4y^3 \cdot 4y^2 - 4y^3 \cdot 3y + 4y^3 \cdot \frac{2}{y}$$

$$= 16y^5 - 12y^4 + 8y^2$$

Try some of Q: 9-14

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EXAMPLE Dividing polynomials

Divide $\dfrac{4x^2+6x-8}{2x-1}$ and check.

Solution

$$
\begin{array}{r}
2x+4 \\
2x-1\overline{)\,4x^2+6x-8} \\
\underline{4x^2-2x} \\
8x-8 \\
\underline{8x-4} \\
-4
\end{array}
$$

The quotient is $2x + 4$ with remainder -4, which also can be written as $2x+4-\dfrac{4}{2x-1}$.

$$\text{Quotient} + \frac{\text{Remainder}}{\text{Divisor}}$$

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EXAMPLE continued

Check:

(Divisor)(Quotient) + Remainder = Dividend

$$(2x - 1)(2x + 4) + (-4) = 2x \cdot 2x + 2x \cdot 4 - 1 \cdot 2x - 1 \cdot 4 - 4$$

$$= 4x^2 + 8x - 2x - 4 - 4$$

$$= 4x^2 + 6x - 8$$

It checks.

Try some of Q: 23-28

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EXAMPLE Dividing polynomials having a missing term

Simplify $(x^3 - 8) \div (x - 2)$.

Solution

$$
\begin{array}{r}
x^2 + 2x + 4 \\
x - 2 \overline{)\, x^3 + 0x^2 + 0x - 8} \\
\underline{x^3 - 2x^2} \\
2x^2 + 0x \\
\underline{2x^2 - 4x} \\
4x - 8 \\
\underline{4x - 8} \\
0
\end{array}
$$

The quotient is $x^2 + 2x + 4$.

Try some of Q: 31-34

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EXAMPLE Dividing with a quadratic divisor

Divide $3x^4 + 2x^3 - 11x^2 - 2x + 5$ by $x^2 - 2$.

Solution

$$
\begin{array}{r}
3x^2 + 2x - 5 \\
x^2 + 0x - 2 \overline{)\,3x^4 + 2x^3 - 11x^2 - 2x + 5} \\
\underline{3x^4 + 0 - 6x^2} \\
2x^3 - 5x^2 - 2x \\
\underline{2x^3 + 0 - 4x} \\
-5x^2 + 2x + 5 \\
\underline{-5x^2 + 0 + 10} \\
2x - 5
\end{array}
$$

The quotient is $3x^2 + 2x - 5 + \dfrac{2x - 5}{x^2 - 2}$.

Try some of Q: 35-38

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End of week 4

- You again have the answers to those problems not assigned
- Practice is SOOO important in this course.
- Work as much as you can with MyMathLab, the materials in the text, and on my Webpage.
- Do everything you can scrape time up for, first the hardest topics then the easiest.
- You are building a skill like typing, skiing, playing a game, solving puzzles.
- NEXT TIME: Team Presentations then MTH 209 for some the week beyond that.