

4.1 Multiplication of Exponents

Need To Know



- Recall exponents
- The idea of exponent properties
- Apply exponent properties

Exponents

Exponents mean repeated multiplication.

$$4^3 \qquad \left(-\frac{2}{3}\right)^2$$

$$-2^4 \qquad (-2)^4$$

Exponent Properties - Multiply

Use the pattern to discover the property.

Simplify:

$$5^2 \cdot 5^6$$

$$x^3 \cdot x^7$$

Exponent Properties

1)

Exponent –Division of Same Base

Use the pattern to discover the property.

Simplify:

$$\frac{3^7}{3^4}$$

$$\frac{x^{11}}{x^5}$$

Exponent Properties

1) $a^r \cdot a^s = a^{r+s}$

2)

Exponent – Zero Power

Look at the pattern and draw a conclusion.

3^4	
3^3	
3^2	
3^1	

Exponent Properties

1) $a^r \cdot a^s = a^{r+s}$

2) $\frac{a^r}{a^s} = a^{r-s}$

3)

Exponent - Power on Power

Use the pattern to discover the property.

Simplify:

$(3^2)^4$

$(x^3)^5$

Exponent Properties

1) $a^r \cdot a^s = a^{r+s}$

2) $\frac{a^r}{a^s} = a^{r-s}$

3) $a^0 = 1$, for all a except 0.

4)

Exponent – Power on Product

Use the pattern to discover the property.

Simplify:

$$(2b)^3$$

$$(xy)^5$$

Exponent Properties

$$1) a^r \cdot a^s = a^{r+s}$$

$$2) \frac{a^r}{a^s} = a^{r-s}$$

$$3) a^0 = 1, \text{ for all } a \text{ except } 0.$$

$$4) (a^m)^n = a^{mn}$$

5)

Exponent – Power on Fractions

Use the pattern to discover the property.

Simplify:

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

$$\left(\frac{a}{z}\right)^2$$

Hand out worksheet

Exponent Properties

$$1) a^m \cdot a^n = a^{m+n}$$

$$2) \frac{a^r}{a^s} = a^{r-s}$$

$$3) a^0 = 1, \text{ for all } a \text{ except } 0.$$

$$4) (a^m)^n = a^{mn}$$

$$5) (ab)^n = a^n b^n$$

$$6) \left(\frac{a}{b}\right)^r = \frac{a^r}{b^r}$$



4.2 Polynomials

Need To Know



- Recall like terms
- Some new vocabulary
- Like Terms and polynomials
- Evaluate polynomials



Like Terms

RECALL:

Definition – a **term** is a part of a mathematical expression made of numbers and variables often combined with parentheses, multiplication or division.

Definition – **Like terms** _____



New Vocabulary

Definition– A **polynomial** is a finite sum of terms.

Examples:

Monomials	Binomials	Trinomials	No Special Name
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New Vocabulary

Definition– The **degree of a** _____ is the number of _____ . (If there is only one variable, then the degree is the exponent.)

Definition– The **degree of a** _____ is the degree _____ , and the leading term is the term with the highest degree.

Definition– The _____ is the numerical factor of the term.



Practice Vocabulary

Answer each for the given polynomial.

The terms

The coefficients

The degree of the terms

The leading term

The degree of the polynomial



Combining Like Terms

Recall

$$3x + 6x$$

Combine like terms:

1. $7x^2 + 3x + 5x^2$
2. $9b^5 + 3b^2 - 2b^5 - 3b^2$
3. $8x^5 - x^4 + 2x^5 + 5x^4 - 4x^4 - x^6$



Evaluating Polynomials

Find the value of $2x^2 - x + 3$ when $x = -3$




Application with Polynomials

Gigabyte Electronics estimates that the total cost of producing x monitors is given by:

$$4000 + 0.6x^2$$

What is the total cost of producing 200 monitors?

end



4.3 Add and Subtract Polynomials

Need To Know



- Adding polynomials
- Opposites of a polynomial
- Subtracting polynomials
- Polynomials problems solving



Adding Polynomials

Add: $(x^2 + 4x - 9) + (7x - 3)$

$$\left(\frac{1}{3}x^9 + 3.4x^5 - 3x^2 + 7\right) + \left(-\frac{3}{4}x^9 - 0.27x^5 + 2x - 5\right)$$



Adding Polynomials - Columns

$$\text{Add: } (2x^4 + 3x^3 + 4x) + (5x^3 - 6x - 3)$$



The Opposite of a Polynomial

Write the opposite of $(2x^2 + 3x - 4)$ in two ways

Simplify:

$$-(5x^2 - 6x + 3)$$

$$-\left(-\frac{3}{4}x^9 - 0.27x^5 + 2x - 5\right)$$



Subtracting Polynomials

Subtract:

$$(2x^2 + 3x + 4) - (5x^2 - 6x + 3)$$

Subtract:

$$x^2 + 5x - 3$$

$$\underline{4x^2 - 4x - 5}$$



Practice – time permitting

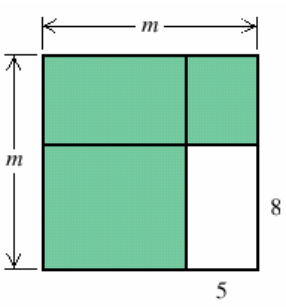
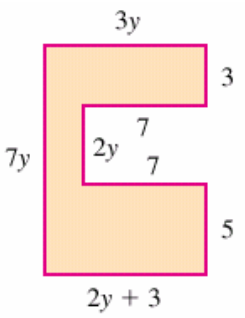
Simplify:

$$(2y^2 - 7y - 8) - (6y^2 + 6y - 8) + (4y^2 - 2y + 3)$$

Polynomial Problem Solving

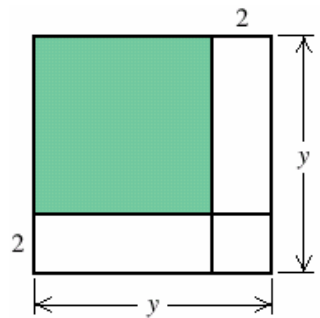
Find the perimeter

Find shaded area



Polynomial Problem Solving

Find $(y-2)^2$, i.e. find the shaded area.



4.4 Multiplication of Polynomials

Need To Know



- Multiply a monomial times a polynomial
- Multiply a polynomial times a polynomial
- Multiply a binomial times a binomial

Monomial times Monomial

Recall Multiplication:

$$(-x^3)(x^4)$$

$$(-4y^4)(6y^2)(-3y^2)$$

Exponent Properties

1) $a^r \cdot a^s = a^{r+s}$

2) $(a^r)^s = a^{rs}$

3) $(ab)^r = a^r b^r$



Monomial times Polynomial

Recall:

$$a(b + c) =$$

Exponent Properties

1) $a^r \cdot a^s = a^{r+s}$

2) $(a^r)^s = a^{rs}$

3) $(ab)^r = a^r b^r$

Multiply:

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



Polynomial times Polynomial

Multiply:

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

Recall Column Multiply

$$324$$

$$\underline{x \ 13}$$



Polynomial times Polynomial

Multiply:

$$(2x^2 + x + 1)(x^2 - 4x + 3)$$



Binomial times Binomial

Multiply:

$$z + 5$$

$$\underline{z - 4}$$

Multiply:

$$(z - 4)(z + 5)$$

Short Cut: **FOIL**

Multiply:

F -

O -

I -

L -

Practice

$$(3x + 5)(x - 4)$$

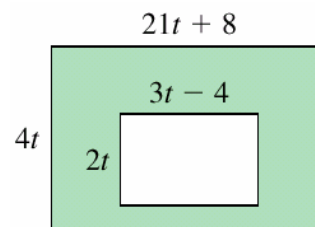
$$(x + 2y)(a + b)$$

$$(4x + 1)(3x - 5)$$

Polynomial Problem Solving

Find a polynomial for the shaded area

Area = Whole - White



4.5 Binomial Squares and Special Products

Need To Know

- More binomials times binomials
- Squares of binomials
- Product of a sum and difference binomial



Binomial times Binomial

Multiply by distributive law:

$$(y + 5)(y - 4)$$

Short Cut: **FOIL**

Multiply:

F – first terms

O – outer terms

I – inner terms

L – last terms



Binomial times Binomial

Multiply

$$(x^2 - 3)(x - 1)$$

$$(1 + 2t^2)(1 + 3t^3)$$

Short Cut: **FOIL**

Multiply:

F – first terms

O – outer terms

I – inner terms

L – last terms



Squares of Binomials

Simplify:

$$(x + 3)^2$$

$$(A + B)^2$$

Short Cut: **FOIL**

F – first terms mult.

O – outer terms mult.

I – inner terms mult.

L – last terms mult.



Squares of Binomials

Simplify:

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

$$(A - B)^2$$

Short Cut: **FOIL****F** – first terms mult.**O** – outer terms mult.**I** – inner terms mult.**L** – last terms mult.


Squares of Binomials

Simplify:

$$(x + 6y)^2$$

$$(4n - 6)^2$$

Formulas to Know

$$(A + B)^2 = A^2 + 2AB + B^2$$

$$(A - B)^2 = A^2 - 2AB + B^2$$



Product of a Sum and Difference

Simplify:

$$(a + 3)(a - 3)$$

Short Cut: **FOIL**

F – first terms mult.

O – outer terms mult.

I – inner terms mult.

L – last terms mult.

$$(A + B)(A - B)$$



Product of a Sum and Difference

$$(2x - 5)(2x + 5)$$

Formulas to Know

$$(A + B)^2 = A^2 + 2AB + B^2$$

$$(A - B)^2 = A^2 - 2AB + B^2$$

$$(A + B)(A - B) = A^2 - B^2$$

$$(3n + 6m)(3n - 6m)$$

Practice

$$(4a + 7b)^2$$

$$(a - 1/2)^2$$

$$(6x + 1/4)(6x - 1/4)$$

Formulas to Know

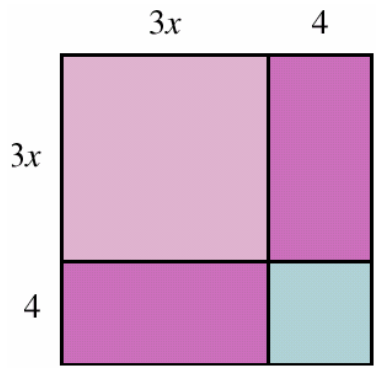
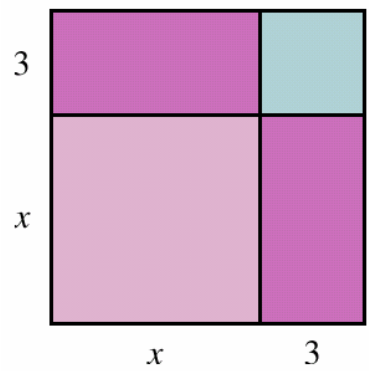
$$(A + B)^2 = A^2 + 2AB + B^2$$

$$(A - B)^2 = A^2 - 2AB + B^2$$

$$(A + B)(A - B) = A^2 - B^2$$

Polynomial Problem Solving

Find the total area of the shaded rectangles



end



4.6 Multivariable Polynomials

Need To Know



- Evaluating a Polynomial
- Like Terms and Degree
- Addition and Subtraction of Polynomials
- Multiplication of Polynomials



Evaluating Polynomials

Find the value of $2x^2 - xy + 3y^2$ for $x = -2$ & $y = 4$

Evaluating Polynomials

An amount of money P invested at a yearly rate r for t years will grow to an amount of A given by $A = P(1 + r)^t$. What will you have from investing \$1000 at 6% for 3 years?

New Vocabulary

Definition- The **degree of a term** is the number of variable factors in the term. The **degree of a polynomial** is the degree of the leading term, and the **leading term** is the term with the highest degree.

$$6 - xy + 3x^2y^2 - 2x^3yz^2 + y^5$$

Term	Coefficient	Degree	Deg of Poly



Add and Subtract Polynomials

Simplify:

$$(2x^2 - 3xy + y^2) + (-4x^2 - 6xy - y^2) + (4x^2 + xy - y^2)$$

$$(A^3 - B^3) - (-2A^3 + A^2B - AB^2 - 3B^3)$$



Multiplying Polynomials

Multiply:

$$(a + b + c)(a + b - c)$$



FOILING Polynomials

Multiply:

$$(5x + 3y)(2x - 3y)$$

$$(4r + 3t)^2$$

$$(p^3 - 5q)(p^3 + 5q)$$

end



4.7.a Dividing a Polynomial

Need To Know

- Recall the distributive property
- Recall dividing fractions
- Divide a polynomial by a monomial





The Distributive Property

Recall:

$$a(b + c) = ab + ac$$

Also:

$$(b + c)a = ba + ca$$



The Distributive Property

With a new twist:

$$(b + c) \div a = b \div a + c \div a$$

$$\frac{b + c}{a} =$$



Divide a Polynomial by a Mono

$$(5x^2 - 10) \div 5.$$

$$\frac{8x^3 - 12x^2}{4x}$$



Divide a Polynomial by a Mono

$$(9x^3y^2 - 12x^2y^3) \div (-9xy)$$

$$\frac{21x^3y^2 - 14x^2y^2 + 7x^2y^3}{7x^2y}$$



4.7.b Dividing Polynomials

Need To Know



- Recall long division
- Divide a polynomial by a polynomial



Recall Long Division

$$24 \overline{)8580}$$

Steps for Division

Guess
Multiply
Subtract
Bring Down
Repeat



Polynomial Division

$$x - 2 \overline{)x^2 - 5x + 6}$$

Steps for Division

Guess

Multiply

Subtract

Bring Down

Repeat



Polynomial Division

$$\begin{array}{r} 8x^2 - 6x - 5 \\ \hline 2x - 3 \end{array}$$

Steps for Division

Guess

Multiply

Subtract

Bring Down

Repeat



Polynomial Division

$$\frac{2x^3 - 2x + 1}{2x + 4}$$

Steps for Division

Guess
 Multiply
 Subtract
 Bring Down
 Repeat



Polynomial Division

$$\frac{t^4 - 2t^2 + 4t - 5}{t^2 - 3}$$

Steps for Division

Guess
 Multiply
 Subtract
 Bring Down
 Repeat

4.8.a Negative Exponents

Need To Know



- Review Exponents Properties
- Idea of Negative Exponents
- Negative Exponent Properties and Calculation

Review Exponent Properties

Recall:

The Product Rule	$a^m \cdot a^n = a^{m+n}$
The Quotient Rule	$\frac{a^m}{a^n} = a^{m-n}$
The Power Rule	$(a^m)^n = a^{mn}$
Raising a Product to a power	$(ab)^n = a^n b^n$
Raising a quotient to a power	$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Idea of Negative Exponents

Look at the pattern and draw a conclusion.

3^4	
3^3	
3^2	
3^1	

Definitions:

for all real numbers ($a \neq 0$),

$$a^0 = 1 \text{ and } a^1 = a$$

Definition:

for $a \neq 0$ and n is a positive,

Practice – Simplify Each

$$5^{-3} \qquad \left(\frac{2}{5}\right)^{-1}$$

$$(-2)^{-2} \qquad \frac{y^{-3}}{y^{-5}}$$

$$5x^{-4} \qquad \frac{2^{-3}}{A^{-5}}$$

Generalize

Exponent Properties

Exponent of 1	$a^1 = a$	The Product Rule	$a^m \cdot a^n = a^{m+n}$
Exponent of 0	$a^0 = 1$	The Quotient Rule	$\frac{a^m}{a^n} = a^{m-n}$
Negative Exponents	$a^{-n} = \frac{1}{a^n}$	The Power Rule	$(a^m)^n = a^{mn}$
Think – RECIPROCAL	$\frac{a^{-n}}{b^{-m}} = \frac{b^m}{a^n}$	Raising a Product to a power	$(ab)^n = a^n b^n$
	$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$	Raising a quotient to a power	$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Practice - Simplify

1. $\frac{11^7}{11^9}$

3. $x^{-6} \cdot x^2$

2. $\frac{3^{-4}}{3^{-6}}$

4. $(2x^4)^{-2}$



Practice Exponents Properties

Simplify:

5. $\frac{(2x^3)^2}{x^4}$

6. $\frac{x^{-6}}{(x^3)^4}$

Simplify:

7. $\left(\frac{y^{-8}}{y^{-3}}\right)^2$

8. $\frac{a^5(a^{-2})^4}{(a^{-3})^2}$

end



4.8.B Scientific Notation

Need To Know

- What is Scientific Notation?
- How to write numbers in Scientific Notation
- How to do calculations in Scientific Notation





Scientific Notation

Recall - Powers of Ten

$$3.8497 \times 100$$

$$3.8497 \times 100,000$$

$$3.8497 \div 100$$

$$3.8497 \div 100,000$$



Scientific Notation

Converting: Scientific notation into expanded form.

$$9.2 \times 10^{-5}$$

$$7.083 \times 10^7$$

Converting: Expanded form into scientific notation.

$$35,900,000$$

$$0.000029$$



Scientific Notation–Computation

We use the exponent properties to multiply and divide number in scientific notation.

Examples:

$$(2.3 \times 10^5)(1.5 \times 10^{-8})$$

$$\frac{8 \times 10^{12}}{4 \times 10^{-3}}$$

end