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ABSTRACT

This teacher guide is part of the materials prepared for an individualized program for ninth-grade algebra and basic mathematics students. Materials written for the program are to be used with audiovisual lessons recorded on tape cassettes. For an evaluation of the program see ED 086 545. In this guide, the teacher is provided with objectives for each topic area and guided to materials written for a given topic. Three short criterion tests are included for each topic covered. Work with polynomials is presented in this package. Polynomials are added, subtracted and multiplied togetner. Negative exponents and zero as an exponent are introduced together with rules for operating with exponential notation. This work was prepared under an ESEA Title III contract. (JP)

# ALGEBRA I

## PACKAGE 03-06

## WORKING WITH POLYNOMIALS

Prepared by

Russ Thompson and Albert Fuller

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In order to solve more complex problems you must now learn how to perform the operations of addition, subtraction, multiplication, and division with polynomials. A polynomial is the indicated sum of monomials. A monomial is a term which is either a numeral, a variable or the indicated product of a numeral and one or more variables. Thus $x + 2$, and $3x + 5ab^2$ are polynomials.

PACKAGE GOAL: Given two polynomials, you should be able to perform any of the basic operations with them.

PACKAGE OBJECTIVES:

1. Given two polynomials, write their sum in simplest form, and check the sum by substitution.
2. Given an equation in which symbols of grouping are used to indicate addition or subtraction, solve it.
3. Given two monomials, or a monomial to be used as a factor more than once, write their product.
4. Given a polynomial and a monomial, write their product, and solve related applied problems.
5. Given two polynomials, write their product and solve related applied problems.
6. Given a polynomial, raise it to a given power and solve related applied problems.
7. Given a problem in dividing monomials, write the quotient.
8. Given an expression in which exponents of zero, negative exponents or both occur, write it in simple form.
9. Given a polynomial, divide it by a given monomial.
10. Given a polynomial divide it by a given polynomial.

I. U. #03-06-01

# ADDING POLYNOMIALS

You will need to recall that:

1. Similar terms are terms that are exactly alike or that differ only in their numerical coefficients.

2. To simplify an expression combine its similar terms.

OBJECTIVES:

1. When asked to write the definition of monomial, binomial, trinomial, or polynomial, write it.

2. Given a monomial, write its degree.

3. Given a polynomial, write its degree.

4. Given a polynomial, arrange it in either increasing or decreasing degree in a particular variable.

5. Given a polynomial, write it in simple form.

6. Given two polynomials, write their sum in simplest form.

ACTIVITIES:

1. Study page 205. (Objectives 1, 2)

2. Study page 206. (Objectives 3, 5)

3. Study page 207. (Objective 4)

4. Do the even numbered oral exercises 2 - 20 Page 207. (Answers are in the Teacher's Edition) (Objective 5)

5. Do the even numbered oral exercises 22 - 30 Page 207. (Answers are in the Teacher's Edition) (Objective 4)

6. Write some of the odd numbered part A written exercises page 208. (Answers are in the back of your text book)

7. If you like challenges and puzzles you will want to try some of the part B exercises, pages 208, 209.

Criterion Test 03-06-01-01

1. (a) Write the definition of a monomial.

   (b) Write the definition of a binomial.

   (c) Write the definition of a trinomial.

   (d) Write the definition of a polynomial.

2. Write the degree of the monomial.

   (a) $7a^2b^6c$ (b) $4xyz^2$

3. Write the degree of the polynomial.

   (a) $3x^2 + 5xy + 25y^2$ (b) $x^2 + x^2y^2 + y^2$

4. Arrange in decreasing degree of y.

   (a) $3x^2 + 5xy + 25y^2$ (b) $x^2 - x^2y + y^2$

5. Write in simple form.

   (a) $(5T - 6) + (T + 7)$ (b) $(3r + 2s) + (5r + 2s)$

6. Write the sum in simplest form.

   (a) $17r^2 + 9r + 2$ and $r - 5 + 9r^2$

   (b) $T^3 - T^2 + 3$ and $2T^3 - 3T^2 + 2T$

Criterion Test 03-06-01-02

1. (a) Write the definition of a monomial.

   (b) Write the definition of a binomial.

   (c) Write the definition of a trinomial.

   (d) Write the definition of a polynomial.

2. Write the degree of the monomial.

   (a) $3x^2y^2$ (b) $2xyz^4$

3. Write the degree of the polynomial.

   (a) $5x^4 + 3x^3y^3 + xy$

   (b) $3xy + 2x + 1$

4. Arrange in decreasing degree of x.

   (a) $x^2y^3z^4 - x^3y^2z + xyz$

   (b) $4 + x^2z^2 + 7xyz$

5. Write in simple form.

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

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

6. Write the sum in simplest form.

   (a) $a^2 + ab - b^2$ and $5ab + b^2 - a^2$

   (b) $(25x^2 + 36y^2) + [(10x^2 - (6y)^2)]$

Criterion Test 03-06-01-03

1. (a) Write the definition of a monomial.

   (b) Write the definition of a binomial.

   (c) Write the definition of a trinomial.

   (d) Write the definition of a polynomial.

2. Write the degree of the monomial.

   (a) $25x^2y^3z^4$ (b) $3xy$

3. Write the degree of the polynomial.

   (a) $5a^2 + 2ab + b^2$ (b) $3a + 2b + c$

4. Arrange in <u>increasing</u> degree of x.

   (a) $x^2 + 3xy + y^2$ (b) $25x^4 + 5 + 20x^3 + x + 2x^2$

5. Write in simple form.

   (a) $(5ab + 3 + 2) + (4ab + 5 - 2ab)$

   (b) $(6x + 4y) + (5x + 2a)$

6. Write the sum in simplest form.

   (a) $6x^2 + 3a + 4$ and $(4 + 3a + 6)$

   (b) $5x + 4 + x^2$ and $5 + 4x + x^2$

Answers to Criterion Tests

Test 03-06-01-01

1. (a) A monomial is a term which is either a numeral (9) or a variable (x) or an indicated product of a numeral and one or more variables (3x or 5x2y).

   (b) A binomial is a polynomial having two terms.

   (c) A trinomial is a polynomial having three terms.

   (d) An indicated sum of monomials is a polynomial.

2. (a) 9 (b) 4

3. (a) 2 (b) 4

4. (a) $25y^2 + 5xy + 3x^2$ (b) $y^2 - x^2y + x^2$

5. (a) $6T + 1$ (b) $8r + 4s$

6. (a) $26r^2 + 10r - 3$ (b) $3T^3 - 4T^2 + 2T + 3$

Test 03-06-01-02

1. (a) A monomial is a term which is either a numeral (9) or a variable (x) or an indicated product of a numeral and one or more variables (3x or $5x^2y$).

   (b) A binomial is a polynomial having two terms.

   (c) A trinomial is a polynomial having three terms.

   (d) An indicated sum of monomials is a polynomial.

2. (a) 4 (b) 6

3. (a) 6 (b) 2

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

5. (a) $9x^2 - 2x$ (b) $8a^2$

6. (a) $6ab$ (b) $35x^2$

Answers to Criterion Tests (Cont.)

Test 03-06-01-03

1. (a) A monomial is a term which is either a numeral (9) or a variable (x) or an indicated product of a numeral and one or more variables ($3x$ or $5x^2y$).

   (b) A binomial is a polynomial having two terms.

   (c) A trinomial is a polynomial having three terms.

   (d) An indicated sum of monomials is a polynomial.

2. (a) 9 (b) 2

3. (a) 2 (b) 1

4. (a) $y^2 + 3xy + x^2$ (b) $5 + x + 2x^2 + 20x^3 + 25x^4$

5. (a) $7ab + 10$ (b) $3x + 4y + 2a$

6. (a) $6x^2 + 6a + 14$ (b) $2x^2 + 9x + 9$

I. U. #03-06-02

# SUBTRACTING POLYNOMIALS

OBJECTIVES:

1. Given an expression in which symbols of grouping are used to indicate an addition or subtraction, rewrite the expression without the symbols of inclusion to grouping.

2. Given an equation in which symbols of grouping are used to indicate an addition or subtraction, rewrite the equation without the symbols of inclusion to grouping.

3. Given an equation in which symbols of grouping are used to indicate an addition or subtraction, solve it.

ACTIVITIES:

1. Study page 209. (Objectives 1, 2, 3)

2. Do enough of the odd numbered exercises in SM, pages 210, 211, to be sure you have achieved objectives 1, 2, 3.

3. If you like challenges and puzzels you will want to try some of the part B exercises on page 211 or even some of the part C exercises on page 212 SM. (Reinforcement of objectives 1, 2, 3).

Criterion Test 03-06-02-01

1. Rewrite without the symbols of grouping.

   (a) $(4a + 3b) + (8a + 5b)$

   (b) $(h^2 + 6h + 9) - (25 - 10h + h^2)$

2. Rewrite without the symbols of grouping.

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

   (b) $(5a + 6) - (4a - 2) = (2a + 8) - (5a + 4)$

3. Solve:

   (a) $(3a + 4) - (5a + 2) = (8a - 2) - (4a + 4)$

   (b) $(5a - 5) - (-3a - 2) = (2a + 8) - (-2a + 5)$

Criterion Test 03-06-02-02

1. Rewrite without the symbols of grouping.

   (a) $(x + 5) + (3x - 8)$

   (b) $(2x - 10) - (5x - 5)$

2. Rewrite without the symbols of grouping.

   (a) $(2s - 5) - (3s - 2) = (5s + 4) - (-2s + 2)$

   (b) $(3x + y) - (2x - y) = (x + y) - (7x - 2y)$

3. Solve.

   (a) $(3x - 3) - (-5x - 4) = (3x + 6) - (-3x - 7)$

   (b) $(5x + 2) - (4x + 2) = (2x + 4) - (2x + 2)$

Criterion Test 03-06-02-03

1. Rewrite without the symbols of grouping.

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

   (b) $(-2x - y) - (-2x - y)$

2. Rewrite without the symbols of grouping.

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

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

3. Solve.

   (a) $(4x + 4) - (2x - 2) = (2x + 6) - (4x - 6)$

   (b) $(x + 4) - (-x + 4) = (-x + 4) - (-x - 4)$

Answers to Criterion Tests.

Test 03-06-02-01

1. (a) $4a + 3b + 8a + 5b$ (b) $h^2 + 6h + 9 - 25 + 10h - h^2$

2. (a) $-2 - 3a - 4 + a = 3 - a - 5 + a$

   (b) $5a + 6 - 4a + 2 = 2a + 8 - 5a - 4$

3. (a) $a = 1\frac{1}{3}$ (b) $a = 1\frac{1}{2}$

Test 03-06-02-02

1. (a) $x + 5 + 3x - 8$ (b) $2x - 10 - 5x + 5$

2. (a) $2s - 5 - 3s + 2 = 5s + 4 + 2s - 2$

   (b) $3x + y - 2x + y = x + y - 7x + 2y$

3. (a) $x = 6$ (b) $x = 2$

Test 03-06-02-03

1. (a) $2x + y + 2x + y$ (b) $-2x - y + 2x + y$

2. (a) $2x - 3y - 4y - 5 = 2y - 8 - 8y + 2$
   (b) $4x - 2 + 4x + 2 = -4x - 2 - 4x - 2$

3. (a) $x = 1\frac{1}{2}$ (b) $x = 4$

I. U. #03-06-03

# PRODUCTS AND POWERS OF MONOMIALS

OBJECTIVES:

1. When asked to write "The Rule of exponents for multiplication", write, "For all positive integers m and n, $b^m \cdot b^n = b^{m+n}$

2. When asked to write "The rule of exponents for a power of a product", write, "For every positive integer m, $(ab)^m = a^m \cdot b^m$."

3. When asked to write "The rule of exponents for a power of a power," write, "For all positive integers m and n, $(b^m)^n = b^{mn}$."

4. Given two monomials, or a monomial to be used as a factor more than once, write their product.

ACTIVITIES:

1. Study page 212, SM and do some of the odd numbered part A exercises on page 213. (Objective 1 and its application) (Parts B and C for fun and reinforcement.)

2. Study page 214, SM, and do some of the odd numbered exercises part A, page 215. (Objectives 2, 3, 4) (Parts B and C for fun and reinforcement)

Criterion Test 03-06-03-01

1. Write the rule of exponents for multiplication.
2. Write the rule of exponents for a power of a product.
3. Write the rule of exponents for a power of a power.
4. Write the product.
   (a) $4b(3b)^3$
   (b) $ab^3(-a^2)$
   (c) $(ab^2)^2(-4a^2)^2$
   (d) $(a^2bc)^2(ab^2c)^2(-abc^3)^4$

Criterion Test 03-06-03-02

1. Write the rule of exponents for multiplication.
2. Write the rule of exponents for a power of a product.
3. Write the rule of exponents for a power of a power.
4. Write the product.
   (a) $(x^2)(2x^3)$
   (b) $(3x^2y^3)^3$
   (c) $(2 \cdot 3 \cdot x)^2$
   (d) $(x^2yz^3)(-5xy^2z)^2(2x^2y^2z)$

Criterion Test 03-06-03-03

1. Write the rule of exponents for multiplication.
2. Write the rule of exponents for a power of a product.
3. Write the rule of exponents for a power of a power.
4. Write the product.
   (a) $(25x^2y^0)(2x^4y^4)$
   (b) $(5x^2y^3z^4)^4$
   (c) $(2x^2y)\ (-2x^2y)^3(x^2y^2)$
   (d) $(2 \cdot 3 \cdot 4 \cdot x)^2$

Answers to Criterion Tests

Test 03-06-03-01

1. For all positive integers m and n, $b^m \cdot b^n = b^{m+n}$
2. For every positive integer m, $(ab)^m = a^m \cdot b^m$
3. For all positive integers m and n, $(b^m)^n = b^{mn}$
4. (a) $108b^4$ (b) $-a^3b^3$ (c) $16a^6b^4$ (d) $a^{10}b^{10}c^{16}$

Test 03-06-03-02

1. For all positive integers m and n, $b^m \cdot b^n = b^{m+n}$
2. For every positive integer m, $(ab)^m = a^m \cdot b^m$
3. For all positive integers m and n, $(b^m)^n = b^{mn}$
4. (a) $2x^5$ (b) $27x^{\cdot}y^{\cdot}$ (c) $36x^2$ (d) $50x^6y^7z^6$

Test 03-06-03-03

1. For all positive integers m and n, $b^m \cdot b^n = b^{m+n}$
2. For every positive integer m, $(ab)^m = a^m \cdot b^m$
3. For all positive integers m and n, $(b^m)^n = b^{mn}$
4. (a) $50x^6y^7$ (b) $625x^8y^{12}z^{16}$ (C) $-16x^{10}y^6$
   (d) $576x^2$

I. U. #03-06-04

# MULTIPLYING A POLYNOMIAL BY A MONOMIAL

OBJECTIVES:

1. Given a polynomial and a monomial, write their product and solve related applied problems.

ACTIVITIES:

1. Study page 216, SM.

2. (1) Write enough of the odd numbered part A written exercises to be certain that you can multiply a polynomial by a monomial. You probably will want to try some of the part B and C exercises to be sure you can use your knowledge to solve a related equation. (Objective 1)

   (2) Write the odd numbered part A problems on page 216. (Objective 1)

   (3) If you like challenges and puzzles you will want to try the part B problems on page 219. (Reinforcement of objective 1)

Criterion Test 03-06-04-01

1. (a) Find the product.

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

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

   (b) Solve.

   1. Write an expression for the area of a rectangle whose width is 5 inches shorter than its length.

   2. Write an expression for the area of a triangle whose height is four inches more than the length of its base.

Criterion Test 03-06-04-02

1. (a) Find the product.

   1. $(4y^3 + 3y^2 + 2y)(10ab)$

   2. $(a^2 + b^2 + c^2)(abc)$

   (b) Solve.

   1. Write an expression for the distance traveled by a car which traveled at V miles per hour for 2 hours and then traveled ten miles per hour faster for the next two hours.

   2. Write an expression for the area of a parallelogram whose length is seven inches more than its height.

Criterion Test 03-06-04-03

1. (a) Find the product.

   1. $(3abc + 2ab + a)(abc)$

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

   (b) Solve.

   1. Write an expression for the distance you travel in 2 hours at (200 + V) miles per hour and then four hours at four times that speed.

   2. Write an expression for the area of a trapezoid the sum of whose bases is 12 inches more than its height.

Answers to Criterion Tests

Test 03-06-04-01

1. (a) 1. $12x^3 + 8x^2 + 4x$

   2. $3ax^3 - 9ax^2 + 12ax$

   (b) 1. $x^2 - 5x$

   2. $\frac{x^2 + 4x}{2}$

Test 03-06-04-02

1. (a) 1. $40y^3ab + 30y^2ab + 20yab$

   2. $a^3bc + ab^3c + abc^3$

   (b) 1. $4V + 20$

   2. $H^2 + 7H$

Test 03-06-04-03

1. (a) 1. $3a^2b^2c^2 + 2a^2b^2c + a^2bc$

   2. $9x^8 + 6x^{10} + 3x^{11}$

   (b) 1. $3600 + 18V$

   2. $\frac{H^2 + 12H}{2}$

I. U. #03-06-05

# MULTIPLYING TWO POLYNOMIALS

OBJECTIVES:

Given two polynomials, write their product and solve related applied problems.

ACTIVITIES:

1. Study page 219, SM, and write enough of the odd numbered part A problems, so that you are sure that you can multiply two polynomials together. You will probably want to try some part B and C problems for reinforcement.

2. Study paragraph 6, 7 on pages 220, 221, SM, and do the odd numbered part A problems.

3. If you like challenges and puzzles you will want to try some of the part B and C problems.

Criterion Test 03-06-05-01

1. (A) Write the product.

   1. $(3a + 4b)(2a + 2b)$

   2. $(3a + 4b)(a - b)$

   3. $(2a + 3b)(-a - b)$

   4. $(2a - 3b)(a - b)$

   (B) Solve:

   1. A swimming pool is bordered by a 3 foot sidewalk. If the pool is twice as long as it is wide, and the sidewalk has an area of 396 square feet, what are the dimensions of the pool?

Criterion Test 03-06-05-02

1. (A) Write the product.

   1. $(2a + 3b)(3a + 2b)$

   2. $(-2a + 3b)(3a + 2b)$

   3. $(2a - 3b)(3a + 2b)$

   4. $(2a - 3b)(3a - 2b)$

   (B) Solve:

   1. The area occupied by a two inch frame around a picture that is four inches longer than it is wide, is 64 square inches. What are the dimensions of the picture?

Criterion Test 03-06-05-03

1. (A) Write the product.

    1. $(4x - 2y)(2x - 2y)$

    2. $(-3x - y)(2x - 2y)$

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

    4. $(x + y)(x + y)$

(B) Solve:

1. A rectangular patio has a 4 foot strip of grass along both sides and its length, and is beside the house along its length. If the patio is twice as long as it is wide and the grass has an area of 352 square feet, what are the dimensions of the patio.

Answers to Criterion Tests

Test 03-06-05-01

1. (A) 1. $6a^2 + 14ab + 8b^2$

2. $3a^2 + ab - 4b^2$

3. $-2a^2 - 5ab - 3b^2$

4. $2a^2 - 5ab + 3b^2$

(B) 1. 40 ft by 20 ft.

Test 03-06-05-01

1. (A) 1. $6a^2 + 13ab + 6b^2$

2. $-6a^2 + 5ab + 6b^2$

3. $6a^2 - 5ab - 6b^2$

4. $6a^2 - 13ab + 6b^2$

(B) 1. 4 inches by 8 inches

Test 03-06-05-01

1. (A) 1. $8x^2 - 12xy + 4y^2$

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

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

4. $x^2 + 2xy + y^2$

(B) 1. 20 feet by 40 feet

I. U. #03-06-06

# POWERS OF POLYNOMIALS

OBJECTIVES:

1. Given a polynomial, raise it to a given power and solve related applied problems.

ACTIVITIES:

1. Study page 223 "Powers of Polynomials," in SM and write enough of the odd numbered part A exercises so that you are certain that you can raise a polynomial to a given power. You will probably want to try a few of the part B and C exercises to be sure you can do more complicated ones.

2. Write the odd numbered part A problems on page 224 and 225 of SM. If you like challenges and puzzles you will want to try some of the part B problems.

Criterion Test 03-06-06-01

1. (A) Raise to the given power.

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

   (B) Solve:

   1. After a square picture is framed with a three inch frame the picture and frame together occupy 180 square inches more than the picture alone. What are the dimensions of the picture?

Criterion Test 03-06-06-02

1. (A) Raise to the given power.

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

   (B) Solve:

   1. The difference of the squares of two consecutive even integers is 92. Find the integers.

Criterion Test 03-06-06-03

1. (A) Raise to the given power.

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

   (B) Solve:

   1. The difference between the squares of two consecutive odd integers is 48. Find the integers.

Answers to Criterion Tests

Test 03-06-06-01

1. (A) 1. $x^2 + 2x + 1$ 2. $4x^2 - 4xy - y^2$

3. $x^3 - 3x^2y + 3xy^2 - y^3$

4. $27a^3 - 54a^2b + 36ab^2 - 8b^2$

(B) 1. 12 inches on each side.

Test 03-06-06-02

1. (A) 1. $a^2 + 2ab + b^2$ 2. $e^2 - 2ab + b^2$

3. $8a^3 - 36a^2b + 54ab^2 - 27b^3$ 4. $x^3 + 3x^2 + 3x + 1$

(B) 1. ~~11 and 13 or -11 and -13~~

Test 03-06-06-03

1. (A) 1. $x^2 - 2xy + y^2$ 2. $9x^2 + 12xy + 4y^2$

3. ~~$x^3 - 3x^2y + 3xy^2 - y^3$~~

4. $27x^3 - 54x^2y + 36xy^2 - 8y^3$

(B) 1. 11 and 13

I. U. #03-06-07

# THE QUOTIENT OF POWERS

OBJECTIVES:

1. When asked to write a statement of the property of quotients, write, "For all real numbers $x$ and $y$ and all non zero real numbers $c$ and $d$ $\frac{xy}{cd} = \frac{x}{c} \cdot \frac{y}{d}$

2. When asked to write the rules of exponents for division, write, "For all positive integers $m$ and $n$ and non zero real numbers $b$:

   If $m > n$, then $\frac{b^m}{b^n} = b^{m-n}$

   If $m < n$, then $\frac{b^m}{b^n} = \frac{1}{b^{n-m}}$

3. Given a problem in dividing monomials, use the rules of exponents for division together with the property of quotients to write the quotient.

ACTIVITIES:

1. Study pages 225, 226, and 227. (Objectives 1, 2, 3)

2. Write enough of the odd numbered part A exercises on page 228 to be sure that you have achieved objective 3. You will also want to do a few of the part B exercises to be sure you can do more complicated types of exercises.

Criterion Test 03-06-07-01

1. Write a statement of the property of quotients.

2. Write the rules of exponents for division.

3. Write the quotient:

(A) $\frac{x^{10}}{x^3}$

(B) $\frac{y^3}{y^{10}}$

(C) $\frac{-10a^2b^{10}}{5a^{10}b^2}$

(D) $\frac{-10x^2yz}{-(2xy^2z)^2}$

Criterion Test 03-06-07-02

1. Write a statement of the property of quotients.

2. Write the rules of exponents for division.

3. Write the quotient:

(A) $\frac{a^5}{a^2}$

(B) $\frac{a^5}{a^{10}}$

(C) $\frac{-12ab^2c^3}{6abc^5}$

(D) $\frac{-18x^2yz^{10}}{-(3xyz)^2}$

Criterion Test 03-06-07-03

1. Write a statement of the property of quotients.

2. Write the rules of exponents for division.

3. Write the quotient:

   (A) $\frac{a^2b^3c^4}{abc^2}$

   (B) $\frac{a^5b^4c^3}{a^{10}b^2c^3}$

   (C) $\frac{(-10ab)^2}{10ab}$

   (D) $\frac{(-4)^2(x^3)^2}{(2)^2(3xyz)^3}$

## Answers to Criterion Tests

Test 03-06-07-01

1. For all real numbers $x$ and $y$ and all nonzero real numbers $c$ and $d$, $\frac{xy}{cd} = \frac{x}{c} \cdot \frac{y}{d}$

2. For all positive integers $m$ and $n$ and nonzero real numbers $b$: If $m > n$, then $\frac{b^m}{b^n} = b^{m-n}$

   If $m < n$, then $\frac{b^m}{b^n} = \frac{1}{b^{n-m}}$

3. (A) $x^7$ (B) $\frac{1}{y^7}$

   (C) $\frac{-2b^8}{a^8}$ (D) $\frac{5}{2y^3z}$

Answers to Criterion Tests (Cont.)

Test 03-06-07-02

1. For all real numbers $x$ and $y$ and all nonzero real numbers $c$ and $d$, $\frac{xy}{cd} = \frac{x}{c} \cdot \frac{y}{d}$

2. For all positive integers $m$ and $n$ and nonzero real numbers $b$: If $m > n$, then $\frac{b^m}{b^n} = b^{m-n}$

   If $m < n$, then $\frac{b^m}{b^n} = \frac{1}{b^{n-m}}$

3. (A) $a^3$

   (B) $\frac{1}{a^5}$

   (C) $\frac{-2b}{c^2}$

   (D) $\frac{2z^8}{y}$

Answers to Criterion Tests (Cont.)

Criterion Test 03-06-07-03

1. For all real numbers $x$ and $y$ and all nonzero real numbers $c$ and $d$, $\frac{xy}{cd} = \frac{x}{c} \cdot \frac{y}{d}$

2. For all positive integers $m$ and $n$ and nonzero real numbers $b$:

   If $m > n$, then $\frac{b^m}{b^n} \quad b^{m-n}$

   If $m < n$, then $\frac{b^m}{b^n} = \frac{1}{b^{n-m}}$

3. (A) $ab^2c^2$

   (B) $\frac{b^2}{a^5}$

   (C) $10ab$

   (D) $\frac{4x^3}{27y^3z^3}$

I. U. #03-06-08

# ZERO AND NEGATIVE EXPONENTS

OBJECTIVES:

1. When asked to define $b^0$ write, "$b^0 = 1$ for every nonzero real number $b$."

2. When asked to define powers with negative exponents write, "$b^n = \frac{1}{b^{-n}}$ and $b^{-n} = \frac{1}{b^n}$"

3. Given an expression in which exponents of zero or a negative exponent or both are used, write an equivalent expression using only positive exponents.

4. Given a fraction, express it as a product of powers.

5. Given an expression in which exponents of zero or negative exponents or both occur, write an equivalent polynomial in simple form.

ACTIVITIES:

1. Study pages 229, 230 "Zero and Negative Exponents", SM. (Objectives 1, 2, 3, 4, 5)

2. Write the odd numbered part A exercises on page 231. (Objectives 3, 4, 5)

   You will probably want to try some of the part B exercises also.

Criterion Test 01-06-08-01

1. Define $b^0$.

2. Define "powers with negative exponents".

3. Write an equivalent expression using only positive exponents.

   (A) $ab^{-4}$ (B) $\frac{a}{b^{-4}}$ (C) $(ab^{-2})^0$

4. Express as a product of powers.

   (A) $\frac{x^3}{y^3}$ (B) $\frac{x^{-2}}{y^{-3}}$ (C) $\frac{x^2}{y^{-3}}$

5. Write an equivalent polynomial in simple form.

   (A) $4x^4 + \frac{2x^2}{x^{-2}}$ (B) $\frac{a^{-3}}{a^{-7}} + \frac{4a^2}{a^{-2}}$

   (C) $\frac{-2}{(xy^2)^{-1}} - \frac{5xy}{y^{-1}}$

Criterion Test 03-06-08-02

1. Define $b^0$.

2. Define "powers with negative exponents".

3. Write an equivalent expression using only positive exponents.

   (A) $a^{-3}b$ (B) $\frac{a}{b^{-3}}$ (C) $(a^0b^{-2})^{-1}$

4. Express as a product of powers.

   (A) $\frac{m^3}{n^2}$ (B) $\frac{x^{-4}}{y^{-4}}$ (C) $\frac{xy^{-4}}{m^2n}$

5. Write an equivalent polynomial in simple form.

   (A) $n^0m^3 + \frac{m^6}{m^3}$ (B) $\frac{1}{(xy)^{-1}} + \frac{4x^2}{xy^{-1}}$

   (C) $\frac{4x^3}{-2x^{-2}y^{-3}} - \frac{7xy}{x^{-4}y^{-2}}$

Criterion Test 03-06-06-03

1. Define $b^0$.

2. Define powers with negative exponents.

3. Write an equivalent expression using only positive exponents.

   (A) $\frac{x^0y^{-2}}{z^{-2}}$ (B) $(x^2y^{-2}z^{10})^0$

   (C) $\frac{x^{-4}}{y^{-3}}$

4. Express as a product of powers.

   (A) $\frac{a^3}{b^2}$ (B) $\frac{a^{-3}}{b^2}$ (C) $\frac{x^{-4}}{y^{-3}}$

5. Write an equivalent polynomial in simple form.

   (A) $\frac{(abc^2)^0}{(xyz^2)^{-1}} + \frac{xyz^2}{(abc^2)^0}$

   (B) $\frac{-2}{(rs^2)^{-1}} + \frac{5rs}{s^{-1}}$

   (C) $\frac{xy}{(ab)^{-1}} + \frac{2(ab)}{xy^{-1}}$

Answers to Criterion Tests

Test 03-06-08-01

1. $b^0 = 1$ for every nonzero real number $b$.

2. $b^n = \frac{1}{b^{-n}}$ and $b^{-n} = \frac{1}{b^n}$ for every nonzero real number $b$.

3. (A) $\frac{a}{b^4}$ (B) $ab^4$ (C) 1

4. (A) $x^3y^{-3}$ (B) $x^{-2}y^3$ (C) $x^2y^3$

5. (A) $6x^4$ (B) $5a^4$ $-7xy^2$

Test 03-06-08-02

1. $b^0 = 1$ for every nonzero real number $b$.

2. $b^n = \frac{1}{b^{-n}}$ and $b^{-n} = \frac{1}{b^n}$ for every nonzero real number $b$.

3. (A) $\frac{b}{a^3}$ (B) $ab^3$ (C) $b^2$

4. (A) $m^3n^{-2}$ (B) $x^{-4}y^4$ (C) $xy^{-4}m^{-2}n^{-1}$

5. (A) $2m^3$ (B) $5xy$ (C) $-9x^5y^3$

Answers to Criterion Test (Cont.)

Test 03-06-08-03

1. $b^0 = 1$ for every nonzero real number $b$.

2. $b^n = \frac{1}{b^{-n}}$ and $b^{-n} = \frac{1}{b^n}$ for every nonzero real number $b$.

3. (A) $\frac{a^2}{y^2}$ (B) 1 (C) $\frac{y^3}{x^4}$

4. (A) $a^3b^{-8}$ (B) $a^{-3}b^{-2}$ (C) $x^{-4}y^3$

5. (A) $2xyz^2$ (B) $3rs^2$ (C) $3abxy$

I. U. #03-06-09

# DIVIDING A POLYNOMIAL BY A MONOMIAL

You will need to recall:

The distributive axiom and how to divide one monomial into another monomial.

OBJECTIVES:

1. Given a polynomial, divide it by a given monomial.

ACTIVITIES:

1. Study page 232, SM, and do enough of the odd numbered part A exercises to be sure you have met the objective. You will probably want to try a few of the part B exercises to reinforce your new skill. If you like challenges and puzzles you may want to try some of the more difficult part C exercises on page 234.

Criterion Test 03-06-09-01

1. Divide:

(A) $\frac{14x^2 - 12x}{-2}$

(B) $\frac{25y^3 - 15y^2 + 30y}{-5y}$

(C) $\frac{35KT^2 - 28KT + 7KT^2}{7KT}$

(D) $\frac{x^4y^4 - x^5y^4}{-x^3y^3}$

Criterion Test 03-06-09-02

1. Divide:

(A) $\frac{25a^3b^3 + 15a^2b^3 + 5ab}{5ab}$

(B) $\frac{ax^2 + bx - c}{abc}$

(C) $\frac{16x^5y^3 + 8x^4y^2}{-4x^3y^2}$

(D) $\frac{28x^5 - 16x^3 - 20x}{-4x^2}$

Criterion Test 03-06-09-03

1. (A) $\frac{5x^3 + 10x^2 + 15x}{5}$

(B) $\frac{15m + 5m^2 + 10m^3}{m}$

(C) $\frac{25x^2y^2 + 10xy + 5}{-5xy}$

(D) $\frac{8y^5 - 3y^3}{-y^2}$

Answers to Criterion Tests

Test 03-06-09-01

1. (A) $-7x^2 + 6x$ (B) $-5y^2 + 3y - 6$

   (C) $6T - 4$ (D) $-xy + x^2y$

Test 03-06-09-02

1. (A) $5a^2b^2 + 3ab^2 + 1$ (B) $\frac{x^2}{bc} + \frac{x}{ac} - \frac{1}{ab}$

   (C) $-4x^2y - 2x$ (D) $-7x^3 + 4x + \frac{5}{x}$

Test 03-06-09-03

1. (A) $x^3 + 2x^2 + 3x$ (B) $15 + 5m + 10m^2$

   (C) $-5xy - 2 - \frac{1}{xy}$ (D) $-8y^3 + 3y$

I. U. #03-06-10

# DIVIDING A POLYNOMIAL BY A POLYNOMIAL

You will need to recall:

What is meant by the degree of a variable.

OBJECTIVES:

1. Given a polynomial, arrange it in order of decreasing degree of one variable.
2. Given a polynomial, divide it by a given polynomial.

ACTIVITIES:

1. Study the top of page 207, SM. (Objective 1)
2. Study pages 234 and 235, SM. (Objective 2)
3. Do enough of the odd numbered part A exercises on page 235, SM, to be sure that you have achieved objective 2. You may wish to try some part B or C exercises for the fun of it or for reinforcement of objective 2.

Criterion Test 03-06-10-01

1. Arrange in order of decreasing degree of x.

   (A) $ax + bx^2 + c$ (B) $25x + 13 + 45x^2 + x^3$

2. Divide:

   (A) $6x^2 - 28x + 30 \div 2x - 6$

   (B) $\dfrac{x^2 - 12x + 40}{x - 6}$

   (C) $7 - 13a + 6a^2 \div 2a - 3$

Criterion Test 03-06-10-02

1. Arrange in order of decreasing degree of y.

   (A) $ax^2 + ayx + a^2y^2 + a$

   (B) $5 + 3y + 4x^3y^3$

2. Divide:

   (A) $P^2 - P - 32 \div P + 5$

   (B) $\dfrac{2a + 8 + a^3 - 5a^2}{a - 2}$

   (C) $\dfrac{x^2 + xy - 3y^2}{x - y}$

Criterion Test 03-06-10-03

1. Arrange in order of decreasing degree of a.

   (A) $x^2 + ax + a^2$

   (B) $14 + 3a^2 + 3a$

2. Divide:

   (A) $c^2 - 3c + 28 + c - 7$

   (B) $x^2 - 19x + 6 + 6x^3 + 2x - 3$

   (C) $\dfrac{6a^3 + 6a^2 - 2a - 12}{a^2 - 2}$

Answers to Criterion Tests

Test 03-06-10-01

1. (A) $bx^2 + ax + c$ (B) $x^3 + 45x^2 + 25x + 13$

2. (A) $3x - 5$ (B) $x - 6 + \frac{4}{x - 6}$

(C) $3a - 2 + \frac{1}{2a - 3}$

Test 03-06-10-02

1. (A) $a^2y^2 + ayx + ax^2 + a$ or $a^2y^2 + ayx + a + ax^2$

(B) $4x^3y^3 + 0y^2 + 3y + 5$ or $4x^3y^3 + 3y + 5$

2. (A) $P - 6 - \frac{2}{P + 5}$

(B) $a^2 - 3a - 4$

(C) $x + 2y - \frac{y^2}{x - y}$

Test 03-06-10-03

1. (A) $a^2 + ax + x^2$

(B) $3a^2 + 3a + 14$

2. (A) $c + 4 + \frac{56}{c - 7}$

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

(C) $6a + 6 + \frac{10a}{a^2 - 2}$

THE END
OF
PACKAGE

03-06