Section 6.1

Objectives:

- Multiply, divide and simplify monomials and expressions involving powers.
- Add, subtract, and multiply polynomials.

I. Multiply Monomials

A. Monomials – a ____________, a ______________, or a product of a __________ and one or more _______________.

1. Note: monomials do _____ involve the ______________ of variables. $\left(\text{i.e., } \frac{3x^3}{y}\right)$

2. Example: $3x^4y$

B. Coefficient vs. Exponent

1.

a) The number in front of a variable – $5x$

b) Means to add the unknown number by itself 5 times – $x+x+x+x+x$

2.

a) The power of a variable – x^5

a) Means to multiply the unknown number by itself 5 times – $x \cdot x \cdot x \cdot x \cdot x$

C. Work Together

1. Using a calculator find the value of each expression.

a. $5^3 \cdot 5^5$ b. $5^6 \cdot 5^2$ c. $5^1 \cdot 5^7$ d. $5^4 \cdot 5^4$

2. How else could the each expression above be written? Use your calculator to verify.

a. 5^{15} b. 25^{15} c. 25^8 d. 5^8

3. Using your definition of exponents, why does this work?

4. Rewrite the following expressions using only one exponent. Verify on your calculator.

a. $7^3 \cdot 7^2$ b. $1.2^3 \cdot 1.2^3$ c. $3^2 \cdot 3^5$ d. $4^3 \cdot 6^2$

5. Did they all check out? If not, why not?

6. Using a calculator find the value of each expression.

a. $\frac{5^7}{5^3}$ b. $\frac{5^{12}}{5^8}$ c. $\frac{5^5}{5}$ d. $\frac{5^6}{5^2}$

7. How else could the each expression be written? Use your calculator to verify.

a. $1^{\frac{7}{3}}$ b. $5^{\frac{7}{3}}$ c. 5^4 d. 1^4

8. Using your definition of exponents, why does this work?

9. Rewrite the following expressions using only one positive exponent. Verify on your calculator.

a. $\frac{5^9}{5^2}$ b. $\frac{3^5}{3^2}$ c. $\frac{2^3}{2^7}$ d. $\frac{4^3}{6^2}$

D. Write some rules

1. Multiplying Powers with the SAME Bases: $a^m a^n =$
2. Dividing Powers with the SAME Bases: $\frac{a^m}{a^n} =$

E. Simplify the following expressions using the multiplication rule.

1. $(-2a^3b)(-5ab^4)$
2. $(-3x^2y)(5x^3y^5)$

F. Simplify the following expressions using the division rule.

1. $\frac{36m^3n^2}{2m^2n}$
2. $\frac{12x^5y^3}{6x^2y^2}$

II. Negative Exponents & Exponents of Zero

A. Exponent of Zero.

Work Together

1. Replace each blank with a whole number or a fraction in lowest terms. (No decimals or calculators).
2. We can describe the pattern in the first column of the table as dividing by 2. What happens in the other columns?

$2^3 = 8$	$5^3 = 125$	$10^3 = 1,000$
$2^2 = 4$	$5^2 = 25$	$10^2 = 100$
$2^1 = 2$	$5^1 = 5$	$10^1 = 10$
$2^0 =$ _____	$5^0 =$ _____	$10^0 =$ _____
$2^{-1} =$ _____	$5^{-1} =$ _____	$10^{-1} =$ _____
$2^{-2} =$ _____	$5^{-2} =$ _____	$10^{-2} =$ _____
$2^{-3} =$ _____	$5^{-3} =$ _____	$10^{-3} =$ _____

3. What pattern do you notice in the row containing 0 as an exponent? Is this true for all numbers?

4. Write a rule for an exponent of zero: $a^0 =$

B. Negative Exponents

Work Together

1. Complete each expression:

a) $2^{(-1)} = \frac{1}{\_\_} = \frac{1}{2^{-}}$ b) $2^{(-2)} = \frac{1}{\_\_} = \frac{1}{2^{-}}$ c) $2^{(-3)} = \frac{1}{\_\_} = \frac{1}{2^{-}}$

2. Does this pattern hold true for the other columns?

3. Write a rule for negative exponents: $a^{-n} =$

4. Write each expression as a simple fraction or integer.

a. 3^{-4} b. $(-7)^0$ c. $(-4)^{-3}$ d. 7^{-3} e. -3^{-2}

5. Using your knowledge of negative exponents, what do you think the following equal?

a. $\dfrac{1}{2^{-3}}$ *b.* $\dfrac{1}{3^{-2}}$ *c.* $\dfrac{1}{4^{-2}}$ *d.* $\dfrac{1}{2^{-4}}$ *e.* $\dfrac{1}{5^{-3}}$

6. Rewrite each expression so that all exponents are positive.

a. $\dfrac{1}{x^{-2}}$ *b.* w^{-3} *c.* $2w^{-3}$ *d.* $\dfrac{w^{-3}}{x^{-2}}$ *e.* $\dfrac{2w^{-3}}{x^{-2}}$

7. Summary – Fill in the blanks

a) Negative exponents have nothing to do ________________ changes (e.g., making a number ________________ or __________________.)

b) Negative exponent __________________ a number (e.g., causes a number on the bottom to be moved to the _______________ and a number on top to move to the _________________.)

8. Example: $\dfrac{4xy^{-3}}{z^{-2}} = \dfrac{4xz^2}{y^3}$

B. Examples:

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

2. $\dfrac{n^2}{n^{10}}$

III. Power of a Power

Work Together

A. Using a calculator find the value of each expression.

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

B. How else could each individual expression be written using one exponent? Use your calculator to verify.

C. Using your definition of exponents, why does this work?

D. Rewrite the following expressions with one exponent.

a. $\left(3^3\right)^5$ b. $\left(2^5\right)^2$ c. $\left(7^2\right)^6$ d. $2^3 \cdot 2^5$

E. Write a rule: $\left(a^m\right)^n =$

F. Example:

Simplify

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

IV. Definitions

A. Polynomial –

B. Terms –

C. Degree of the Polynomial –

Examples – Find the terms and the degree for each polynomial

1. $x^2 - 3x^3 + 2x$
2. $7xy^2 - 7x^2y + 8x^3y - 16xy^4$

D. Polynomial or Not?

Determine whether the following are polynomials or not and if they are find the degree of the polynomial.

1. $c^4 - 4\sqrt{c} + 18$
2. $-15p^5 + \frac{3}{4}p^2t^7$
3. $x^2 - 3x^{-1} + 7$

V. Operations with Polynomials

A. Adding and Subtracting

1. $\left(2a^3 + 5a - 7\right) - \left(a^3 - 3a + 2\right)$
2. $\left(4x^2 - 9x + 3\right) + \left(-2x^2 - 5x - 6\right)$

B. Multiplying

1. $-y\left(4y^2 + 2y - 3\right)$
2. $\left(a^2 + 3a - 4\right)\left(a + 2\right)$
3. Olivia has a total of $1300 to invest between a government bond and a savings account. The bond has an annual interest rate of 2.2% and the savings account has an annual interest rate of 1.9% per year. Write a polynomial for the total interest she will earn in one year, if she invests x dollars in the government bond.

Homework:

Day 1: p. 958 – 1-19 all; p. 337 – 1-4 all, 41, 43

Day 2: p. 337 – 9-19 all, 24-27 all, 29, 33, 34, 74, 78, 80

Chapter 6.3
Polynomial Functions

Goals:
1. To evaluate polynomial functions.
2. To identify general shapes of the graphs of polynomial functions.

I. Terminology

A. Polynomials in one variable – $a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \dots + a_{n-2}x^2 + a_{n-1}x + a_n$

B. Yes or No to a polynomial of one variable
1.
2.
3.
4.

C. Degree –

D. Leading Coefficient –

E. Examples: If it is a polynomial of one variable, state the degree and leading coefficient. If it is not a polynomial in one variable, explain why.
1. $7z^3 - 4z^2 + z$
2. $6a^3 - 4a^2 + ab^2$
3. $3c^2 + 4c - 2c^{-1}$
4. $9y - 3y^2 + y^4$

II. Polynomial Functions

A. Examples
1. The volume of air in the lungs during a 5-second respiratory cycle can be modeled by $V(t) = -0.037t^3 + 0.125t^2 + 0.173t$, where V is the volume in liters and t is the time in seconds. This model is an example of a polynomial function. Find the volume of air in the lungs 1.5 seconds into the respiratory cycle.

2. Find $f(4)$ if $f(r) = 3r^2 - 3r + 1$

3. Find $p(y^3)$ if $p(x) = 2x^4 - x^3 + 3x$

4. Find $b(2x-1) - 3b(x)$ if $b(m) = 2m^2 + m - 1$

5. Find $f\left(x^3\right)$ if $f(a)=a^3+2a^2+2a$

6. Find $g(2x+1)-2g(x)$ if $g(b)=b^2+3$

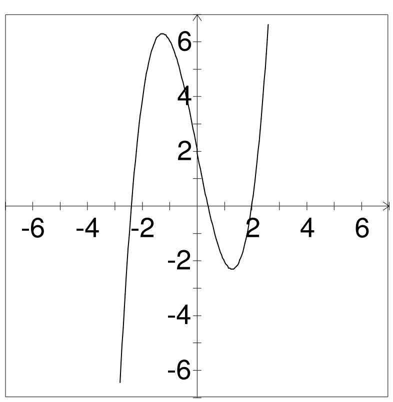
III. Polynomials and Graphs

A. Notes:

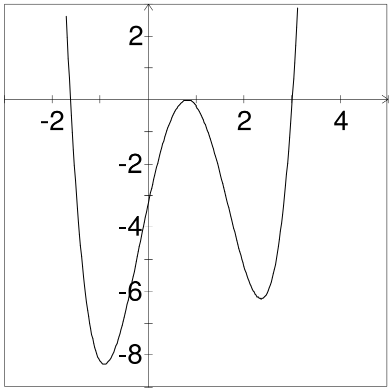
1. ________ degree polynomials – left most and right most points will be either _________ positive or negative (Superman Look)
2. ________ degree polynomials
   a) Left most points will be __________ of right most points (Swimmers Look)
   b) Will always cross the ___________ at least once.
3. Roots (zeros)
   a) Real roots occur where a graph crosses the ___________.
   b) Number of real and non-real roots is _______ to the ________ of the polynomial.
4. End Behavior –

B. Examples: Determine if each graph is an even or odd degree polynomial, state the number of real roots, and describe the end behavior

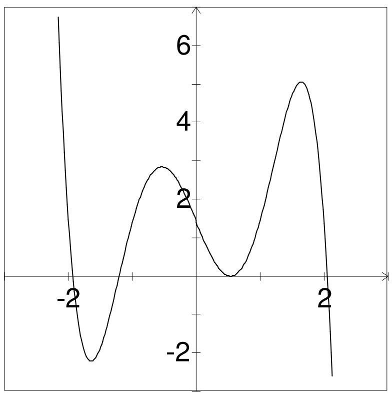
1.



2.



3.



Homework: p. 352 – 1-12 all, 29-39 odds, 51, 63

Section 6.4 – Analyzing Graphs of Polynomial Functions

Goals:
1. To approximate the real zeros of polynomial functions.
2. To find relative maxima and minima of polynomial functions.
3. To graph complete graphs of polynomial functions.

I. Graphing Complete Graphs

A. Def – A complete graph is a graph where all _________________ are seen.

B. Characteristics

1.

2.

C. Examples

1. Graph: $f(x) = -2x^3 - 5x^2 + 3x + 2$
   Give appropriate view window

2. Graph: $f(x) = x^4 - 9x^3 + 25x^2 - 24x + 6$
   Give appropriate view window

II. Finding Characteristics

Examples: Find the relative extrema, *y*-intercept, and roots

1. $f(x) = -2x^3 - 5x^2 + 3x + 2$

2. $f(x) = x^4 - 9x^3 + 25x^2 - 24x + 6$

Homework: p. 361 – 14-21 all (state the viewing window, find the roots, find the *y*-intercepts, and find the relative extrema), 27-29 all, 34-36 all

Section 6.4B – Modeling Real World Data with Polynomials

Goals:
1. To model data whose curve of best fit is a polynomial function.

Year	US Peanut Consumption (millions of pounds)
1970	1118
1980	1087
1985	1499
1990	1492
1991	1639
1992	1581
1993	1547

Example:
The table at the right gives the consumption of peanuts.

- Use a graphing calculator to draw a scatter plot for the data. State the viewing windows and scale factors that you used. Let 1970 = 0
- Calculate and graph curves of best fit that show how the year is related to peanut consumption. Give the equations for:
  - Linear Reg – ____
  - Quadratic Reg – ____
  - Cubic Reg – ____
  - Quartic Reg – ____
- Write the equation for the curve you think best fits the data. Explain why you think it fits the best.
  - Equation ____
  - Explain:
- Based on the cubic regression, what was the consumption in 1994? _____________________.
  Can I use this equation to predict consumption in 2010? Explain.

  Can I use this equation to estimate consumption in 1960? Explain.

  When can I use this equation? Explain.
- Based on the cubic regression, when will consumption be 1500 million pounds? _________

Homework:
Day 1: p. 366 – 1-10 all
Day 2: p. 367 – 1-21 all (15 – just state the viewing window used; 16 and 18 use your calculators and estimate your answers to two decimal places)