# **CHAPTER 4** – **Exponents**

**Lesson 1 – Review Exponent Laws (Part 1)**

We use exponent laws to simplify expressions and make evaluating powers easier to calculate.



Product of Powers:

Quotient of Powers:

Power of a Power:

Power of a Product:

Power of a Quotient:

Zero exponent:

\*\*\*Negative exponent:

Examples:

* *Multiplying Powers with the* ***Same Base***

Rule: add the exponents

Method 1: Use Repeated Multiplication

23 × 22 =

Method 2: Apply the Exponent Laws

23 × 22 =

Examples:

85 × 84 = a6 × a = 72 × 7□ =76

* *Divide Powers with the* ***Same Base***

Rule: subtract the exponents

Method 1: Use Repeated Multiplication

(-5)9 ÷(-5)4 =

Method 2: Apply the Exponent Laws

(-5)9 ÷(-5)4 =

Examples:

916 ÷97 = a10 ÷a4 = x6 ÷x□ =x3

*Practice of multiplying and dividing exponents: Simplify and evaluate where possible.*

a) y7 × y12 = b) 53 + 52= c) 517 ÷510 = d) a20 ÷a4 =

e) (-6)10 ÷(-6)5 = f) = g) =

* *Raised Powers*

Rule: multiply the powers

Method 1: Use Repeated Multiplication

(23)2 =

Method 2: Apply the Exponent Laws

(23)2 =

Examples:

(a10)4 = (32)2 = ((-1)6)3 =

*Practice*: (42)5 = (x3)3 = (m4)3 = (-23)5 =

* *Exponent of Zero*

Rule: any number or expression raised to the power of zero is 1.

Why?

Let’s look at the descending powers of base 2 starting with 24 = 16, 8, 4, 2, \_\_\_\_

Examples: (a) (b) 2-3 × 23

**Homework:** *“1.5 The Exponent Rules” Worksheet*



Lesson **2** – Rational Exponents (Part 1)

Before beginning to work with rational exponents, you must work well with fractions!

To *add/subtract* *fractions*, you must have common denominators first!

To *multiply fractions*, multiply numerator by numerator and multiply denominator by denominator **or** if possible cross-multiply.

Don’t forget to *reduce* final answers.

A. Add or Subtract and reduce answer. *Show all steps!*

1. 2. 3.

B. Multiply and reduce to lowest terms

1. 2. 3.

Also, it may help to know how to convert decimals to fractions and vice-versa.

Convert the following decimal numbers to fractions and reduce.

(a) 0.6 (b) 1.25

Convert the following fractions to decimals

(a) (b)

Evaluate the following and determine the similarities and differences.

What can you conclude?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Similarly, = \_\_\_\_\_\_\_. In fact any exponent of = = \_\_\_\_\_\_\_.

This may be good to know for questions when evaluating.

***Continuing Exponent Laws from last class – Same laws but with rational exponents***

|  |  |  |  |
| --- | --- | --- | --- |
| x^m.x^n  | x^(m+n)= |  (31/2)×(33/4) =  |  |
| (x^m)/(x^n) | x^(m-n)= |  33/4 ÷ 30.25= |   |
| (x^m)^n | x^(mn)= |   (x5)1/2= |  |

Write each product or quotient as a power with a single exponent.

|  |  |  |
| --- | --- | --- |
| 1. (51/3)(55/3)
 | 1. (*x*7)(*x*1/4)
 | c) [(*t*4/3)(*t*1/3)]0 |
| d) 33/430.25 Homework: Textbook Page 180 #1 (a) to (i) Quiz on: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | e) (27*x*6)2/3 | f) (16*x*4)0.5 |

**Lesson 3 – Review Exponent Laws (Part 2)**

* *Products and Quotients to an Exponent*

Rule: Raise power to each of the numbers

Method 1: Use Repeated Multiplication

1. [2 × (-3)]4 (b) (¾)3

Method 2: Apply the Exponent Laws

1. [2 × (-3)]4 (b) (¾)3

Examples: (32×30)2= (3ab)3= (a2b5)3= (-2mn)(-4m3n2)=

***Note:*** (5 + 4)3 ≠ 53 + 43

*Practice:*

 (a) [7 × (-2)]3 (b) (c) (2xy)3 (d) 2ab(-3ab) (e)

* *Negative Exponent*

Using your calculator determine the power 2-2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Now change your answer to a fraction.

How would you be able to determine the power of 2-2 without a calculator?

The negative exponent becomes **positive** once the base is reciprocated.

Examples:

a) b) c) d)

This concludes learning all the laws for exponents. There are 7 exponent laws you must become familiar with, please refer to page one at the beginning of this unit.

Next, we will use exponent laws with integers. That means you must know how to add, subtract, multiply and divide integers.

***Quick review:***

1) -3 + 5 2) -12 + 2 3) -7 – 8 4) -5 × -4

5) -6 × -1 × -2 6) -24 ÷ 3 7) 8)

**Lesson 4 – Integral Exponents**

In order to work with integers you have to know how the negative exponent operates.

|  |  |  |  |
| --- | --- | --- | --- |
| x^(-n) | 1/(x^n)= |  (2)-1=  | (1)  |
| x^m.x^n | x^(m+n)= |  32×3-4 =   | (2)  |
| (x^m)/(x^n) | x^(m-n)= |   | (3)  |
| (x^m)^n | x^(mn)= |  (2-2)3= | (4)  |
| x^my^m | (xy)^m= | (5-1×22)2=   | (5)  |
| (x/y)^n | (x^n)/(y^n)= |  = | (6)  |
| (x/y)^(-n) | (y/x)^n,= |  = | (7) |

# Example 1:

1.  B. 

 C.  D. 

 E.  F. 

 G.  H. 

 I.  J. 

# Example 2:

It is estimated that there are 117 billion grasshoppers in an area of 39 000 km2 of Saskatchewan.

a) Approximately how many grasshoppers are there per square kilometer?

Method 1: Arithmetic

Method 2: Use Exponent Rules

b) Approximately how many grasshoppers are there per square meter?

Assignment: Textbook Pg. 169 #2-6

Quiz on: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Lesson 5 – Rational Exponents (Part 2)

|  |  |  |  |
| --- | --- | --- | --- |
| (xy)^m | x^my^m= |  (4*x*3)0.5=  | (4)  |
| (x/y)^n | (x^n)/(y^n)= |   | (5)  |
| x^(-n) | 1/(x^n)= | (2)-0.2= | (6)  |
| (x/y)^(-n) | (y/x)^n,= |  | (7) |

# Example 1:

Write each product or quotient as a power with a single exponent.

(a) = (b)= (c)

(d) (e) (f) (g)

# Example 2:

Evaluate without using a calculator.

(a) (b) (c)

#  (d) (e) (f)

# Example 3:

# Evaluate using a calculator. Express the answer to four decimal places if necessary.

 (a) (b) (c)

# Example 4:

# Food manufactures use a beneficial bacterium called *Lactobacillus bulgaricus* to make yoghurt and cheese. The growth of 10 000 bacteria can be modeled using the formula

# *N*= 10 000(2)*h/42*,where *N* is the number of bacteria after *h* hours.

1. What does the value of 2 in the formula tell you?
2. How many bacteria are present after 42 hours?
3. How many more bacteria are present after 2 h?
4. How many bacteria are present after 105 h?

# Assignment: Pg. 180-183 #2 – 3, 4(b, d, f), 5 – 7, 10, 14;

# Assignment due: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; Practice Test on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Test on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**CHAPTER 5** – **Polynomials**

# Lesson 1

## Multiplying Polynomials

# Define:

# *monomial*

# \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

For Example:

*binomial:*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

For Example:

*trinomial:*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

For Example:

*polynomial:*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

For Example:

*distributive property:*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

For Example:

Example 1: Expand and Simplify

1. 3(-7a+2)
2. 2x(3x2-5xy)-5y(x2-2y2) + 3(x3-y3)

Example 2: Multiply Binomials

1. (2a-4)(a+2)
2. (2b+7)2
3. (x+1)2+(x-3)2
4. ( 3w-2)(4w+5)-4(w-7)(2w+3)

Example 3: Multiply a Binomial and a Trinomial

a) (2x-1)(3x2+7x-5)

1. (r-4)(3r2+8r-6)
2. (5-x)3

Example 4:

The painting shown is *Deep Magenta Square* by Richard Anuszkiewicz. It can be used to represent binomial multiplication. The length of the border in the painting is 30cm.

1. What polynomial expression represents the total area of the painting?
2. What is the total area of the painting if the red square has an area of 3600 cm2.

 30

 30 cm

 30 cm 30 cm

 x

 30 cm 30

 30 x 30

Assignment: Pg. 209 #4f, 5f, 6all + Worksheet “Why is a Stick of Gum like a Sneeze”

Quiz on 4.1 on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Lesson 2

# **Common Factors**

Example 1: Determine the Greatest Common Factor (GCF) of 16x2y+24x2y3

Method 1: Use Prime Factorization.

Method 2: List the factors

 Method 3: GCF of coefficient and lowest common degree of variables.

# Example 2: Factor the following

a) 9x2-12x+18

b) 28ab2-16a2b

c) 3xy+5y

Example 3: Write each in factored form

a) 6x2(2x-3) + x(2x-3)-7(2x-3)

b) y2 + 8xy + 2y + 16x

#

Example 4:

The students in Mr. Noyle’s Construction class have decided they want to build dog houses for their class project. The class will be split into groups. Each group will construct their dog house with the same type and amount of lumber, Mr. Noyle has 24 ten foot 1 by 4s, 32 eight foot 2 by 4s, and 8 sheets of plywood (4’by 8’) available to use for this project.

1. What is the maximum number of groups of students that can build dog houses?
2. How much of each lumber type will each group have to work with?
3. What is the total length of 2 by 4s and 1 by 4s that each group will have to work with?

Assignment: 3.6 Reviewing Common Factors Worksheet

Lesson 3

### Factoring Trinomials ax2+bc+c

Example 1: Factor the following, if possible:

1. x2+x-12
2. 5x2-35x+60

c) x2+ 4x+6

1. x4+11x2+24
2. (x+b)2+6(x+b)+8

Example 2: Factor the following, if possible:

1. 3x2-10x+8
2. 10x2-22x+4
3. 3y2-11y +6
4. 3x2+ 2x +4
5. 2x2+5xy+2y2
6. 8a2+18a-5

Example 3:

A rescue worker launches a signal flare into the air from the side of a mountain. The height of the flare can be represented by the formula h=-16t2+144t+160. In the formula, h is the height, in feet, above the ground, and t is the time, in seconds.

a) What is the factored from of the formula?

b) What is the height of the flare after 5.6s?

Assignment: 3.8, 3.9 Worksheet. Quiz on Lessons 1-4 on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Warm-up

# Factor Completely:

1. 2

# Lesson 4

### Factoring Special Trinomials.

*Difference of Squares*: an expression of the form a2-b2 that involves the subtraction of two squares. For example: x2-4, y2-25

Example 1: Factor a Difference of Squares

Factor if possible.

1. 36x2-49
2. 16m2 + 121n2
3. 8m2-2n2
4. 3a3-12ab2
5. 81a4-16
6. (x+3)2-y2
7. x4-(2x-1)2

# *Perfect Square Trinomial*: The result of squaring a binomial. For example, (x+5)2=x2+10x+25 is a perfect square trinomial.

# Example 2: Factor Perfect Square Trinomials

Factor each trinomial if possible.

1. x2+6x+9
2. 2x2-44x+242
3. c2-12x-36
4. 3b2+24b+48

Assignment: Worksheet 3.10 Practice Test on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Test on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_