7.1-7.4 Understanding Terms

Define “exponent” and give an example:

Define “base” and give an example:

Define “power” and give an example:

Define “monomial” and given an example:

How do you know when a term has been simplified?

7.2 Multiplying Powers Rule

Discovering the rules of exponents

Here we will work through the exponent rules intuitively so they will stick better in our heads. The one thing you must remember is what an exponent means.

You can think of exponents as repeated multiplication. For instance, 2^5 can be thought of as repeatedly multiplying 2 by itself, 5 times, or $2*2*2*2*2$. We will use this notion to rewrite various expressions involving exponents.

It is important to keep in mind that there are other ways to simplify these expressions (not the least of which is to use our calculator). But we are doing this to help us develop rules that would apply to expressions in general. The first row of each table shows a completed example. Try to leave your expressions in the same form that I have.

1. Complete the table using the idea of repeated multiplication. Then in the final row, use the pattern to write the exponent rule in general. The first one is done for you.

Expression to be simplified	**Work it out!**	**End result**
$2^3 * 2^4$	$(2*2*2)*(2*2*2*2)$ Notice this is seven 2's.	2^7
$3^4 * 3^1$		
$5^4 * 5^5$		
$7^2 * 7^6$		
$x^m * x^n$ where x, m, and n are just numbers like above		Rule:

Does this rule work for $4^3 * 5^2$? Explain. If so, what do you get as the end result?

7.3 Power to a Power Rule

2. Complete the table using the idea of repeated multiplication. Then in the final row, use the pattern to write the exponent rule in general. The first one is done for you.

You'll need to rewrite the part inside the parentheses, and then use the outer exponent to rewrite it again.

Expression to be simplified	Work it out!	End result
$(3^2)^3 \longrightarrow$	$(3*3)^3$ which is $(3*3)*(3*3)*(3*3)$ This is six 3's. $\longrightarrow$	3^6
$(4^3)^4$		
$(2^3)^3$		
$(2^4)^2$		
$(8^3)^1$		
$(x^m)^n$ where x, m, and n are just numbers like above		Rule:

Does this rule work for $(3^2)^5$? Explain. If so, what do you get as the end result?

7.3 Power of a Product

3. Complete the table using the idea of repeated multiplication. Then in the final row, use the pattern to write the exponent rule in general. The first one is done for you.

These problems also use the commutative property of multiplication (repeatedly) that says the order in which I multiply two numbers does not matter. For instance, $3*4=4*3$.

Expression to be simplified	**Work it out!**	**End result**
$(3*4)^2$	$(3*4)*(3*4)$ which is $(3*3)*(4*4)$ This is two 3's and two 4's.	3^2*4^2
$(2*5)^3$		
$(6*3)^4$		
$(4*5)^2$		
$(x*y)^n$ where *x*, *y*, and *n* are just numbers like above		Rule:

Does this rule work for $(1*13)^3$? Explain. If so, what do you get as the end result?

*Does this rule work for fractions?

$\left(\frac{3}{5}\right)^2 = \left(\frac{3}{5}\cdot\frac{3}{5}\right) = \left(\frac{9}{25}\right)$

Yes, it is called "Powers of a Quotient" (7.4)

Describe that rule:

7.4 Dividing Powers

4. Complete the table using the idea of repeated multiplication. Then in the final row, use the pattern to write the exponent rule in general. The first one is done for you.

These problems also use the fact that common factors on top and bottom of a fraction can be cancelled. For instance, $\frac{3*4}{4}=3$ **since the 4's on top and bottom can be thought of as** $\frac{4}{4}$ **which is just 1.**

Expression to be simplified	Work it out!	End result
$\frac{3^5}{3^3}$	$\frac{3*3*3*3*3}{3*3*3}$ If we cancel the three 3's on bottom with three 3's on top (circled), we're left with two 3's on top.	3^2
$\frac{6^6}{6^3}$		
$\frac{5^2}{5^1}$		
$\frac{8^{10}}{8^5}$		
$\frac{x^m}{x^n}$ where x, m, and n are just numbers like above		Rule:

Does this rule work for $\frac{4^2}{4^2}$? Explain. If so, what do you get as the end result?

Does this rule work for $\frac{0^4}{0^2}$? Explain. If so, what do you get as the end result?

7.1-7.4 Summary of all Exponent Rules

Explanation of Rule	Algebraic Example
7.1 Zero Power Rules	
7.1 Negative Exponents Rule	
7.2 Multiplying Powers Rule	
7.3 Power of a Power Rule	
7.3 Power of a Product Rule	
7.4 Dividing Powers	
7.4 Powers of a Quotient Rule	

7.1-7.4 Understanding Terms

Key

Define "exponent" and give an example:

The exponent of a number says how many times to use that number (base) multiplied by itself.

5^3 ← exponent

Define "base" and give an example: Base → 5

The number that is "holding down" the exponent. EVERY base has an exponent. Do not forget the invisible 1 exponent.

Define "exponential notation": Writing a term with an exponent $x^4, 2^4$

Define "monomial" and given an example:
An expression that is a number, a variable or a product of a number and 1 or more variables with whole number exponents. Another name for monomial is term.

$4, 10x, y, 8xy^3$

How do you know when a term has been simplified?

1) Each base only appears once
2) There are no powers of a powers
3) All fractions are simplified (look at both fractional exponents and fractional coefficients)
4) There are no negative exponents
5) There are no zero exponents
6) There are no radicals
7) Variables within a term are in alphabetical order.

7.1-7.4 Summary of all Exponent Rules Key

Explanation of Rule	Algebraic Example
7.1 Zero Power Rules Any non-zero number raised to the zero power is one. Zero raised to the zero power is undefined.	$0^0 =$ undefined $4^0 = 1$ $1{,}000^0 = 1$ $(\frac{1}{2})^0 = 1$
7.1 Negative Exponents Rule To find the positive exponent, take the reciprocal of the base (factor) of the negative exponent.	$2^{-2} = \frac{2^{-2}}{1} = \frac{1}{2^2} = \frac{1}{4}$ $x^{-3} = \frac{x^{-3}}{1} = \frac{1}{x^3}$
7.2 Multiplying Powers Rule To multiply powers that have the same base, ADD the exponents.	$x^4(x^2) = x^6$
7.3 Power of a Power Rule To powers of a power, multiply the exponents.	$(x^4)^2 = x^8$
7.3 Power of a Product Rule To find the power of a product, find the power of each base (factor) by distributing the power (power of a power).	$(a^2b^3c)^2$ $a^{2\cdot2}b^{3\cdot2}c^{1\cdot2}$ $a^4b^6c^2$
7.4 Dividing Powers To divide powers that have the same base, SUBTRACT the exponents.	$\frac{x^4}{x^2} = x^2$
7.4 Powers of a Quotient Rule To find the power of a quotient, find the power of each base (factor) both in the NUMERATOR & DENOMINATOR by distributing the power (power of a power).	$\left(\frac{a^2b}{c^3d}\right)^2 = \left(\frac{a^2b}{c^3d}\right)^2$ $\frac{a^4b^2}{c^6d^2}$