Mr. Ward Answer Key

Integer Exponents

Before we get into new types of exponents, let's review ***positive*** exponents. Remember that exponents (or powers) are used to express *repeated multiplication*.

If you have the expression 2^3, that's the same as saying 2 * 2 * 2 = 8.

Practice Problems

$4^2 =$ 4·4 = 16 $5^3 =$ 5·5·5 = 125 $2^6 =$ 2·2·2·2·2·2 = 64 (Answers: 16, 125, 64)

Zero Exponent

** Any number to the power of zero is 1. (Yes that easy! Remember this though!) **

Practice Problems

$2^0 =$ 1 $23^0 =$ 1 $(-31.87)^0 =$ 1 (Answers: 1, 1, 1)

Negative Exponents

Negative exponents are like negative people. We don't like being around negative people, we like being around positive people. So we're going to stick with that idea for exponents. We **always** want positive exponents in our problems, not negative ones.

So in order to make a negative person become positive we have to *flip* their emotions. We're going to do the same thing with exponents. We're going to *flip* them. That means if they're negative in the top, they *flip* to the bottom. If they're negative in the bottom, they *flip* to the top.

Example #1

$$4^{-3} = \frac{1}{4^3} = \frac{1}{64}$$

Practice Problems

$$\frac{4a^{-2}}{8ab^{-3}} =$$

Before we tackle this I want to talk about the difference between $2a^{-2}$ and $(2a)^{-2}$. In the first example, only the "a" part has the negative exponent being applied to it, where as in the second example, the negative exponent applies to both the 2 and the "a". Parentheses are very important and make a big difference when going deciding which things have negative exponents and which things don't. Back to our problem!

What has a negative exponent in the top? a (a^{-2})

What has a negative exponent in the bottom? b · (b^{-3})

Now *flip* where these things are. Move the negative exponent part in the top down to the bottom and move the negative exponent part in the bottom up to the top.

$$\frac{4b^3}{8\cdot a\cdot a^2} = \frac{4b^3}{8a^3} = \frac{b^3}{2a^3}$$

Now multiple things together and simplify to get your final answer. If you're not sure what I mean by simplify, look at the numbers 4 and 8. Can't those be reduced?

Assignment: pg 449 #2-23

Multiplication and Division Properties of Exponents

Multiplication:

Example #1 $3^5\cdot 3^2$

Since we know that a power just means *repeated multiplication*, if we wanted to we could write out that problem like this: $(3\cdot 3\cdot 3\cdot 3\cdot 3)\cdot(3\cdot 3)$.

Well when it's all said and done, how many 3's do you have? 7

Therefore our answer would look like this: 3^7

Do you notice how else we could possibly get to the power 7 with the previous powers of 5 and 2?

If you said add them together you are doing great! Below is the general rule.

If *a* is any nonzero real number and *m* and *n* are integers, then $a^m\cdot a^n = a^{m+n}$

** The important thing to remember is that the bases have to be the same in order for us to use this property. For example, $3^2\cdot 5^4$ would not work. **

Example #2 $(4^2)^3$

Just like the first problem, let's write this out the long way to see what's actually going on. Because the 4^2 is raised to the third power, we will have three of them.

$4^2 \cdot 4^2 \cdot 4^2 = (4 \cdot 4) \cdot (4 \cdot 4) \cdot (4 \cdot 4)$

Just like before, how many 4's do we have? 6

Therefore our answer would look like this: 4^6

Do you notice a relationship between the final power of 6 and the two previous powers of 2 and 3?

If you said multiplication, then you're officially awesome! Below is the general rule.

If *a* is any nonzero real number and *m* and *n* are integers, then $(a^m)^n = a^{mn}$

Practice Problem:

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

We can attack this a couple different ways. You can write the whole fraction out 4 times, because of the 4th power, or you can use the rule we just learned.

Remember that 4th power needs to be applied to <u>everything</u> in the parenthesis, even the number 2.

So this is what should be going on in your head and on your paper:

$$\left(\frac{(2)^4(n)^4}{(n^2)^4(m)^4}\right) = \frac{16n^4}{n^8m^4}$$

Now multiply each part out. What do you have? Write it above in the blank space.

You should hopefully get here: $\left(\frac{16n^4}{n^8m^4}\right) = \frac{16}{n^4m^4}$

Now simplify anything that can be simplified. In this case we can simplify the "n" variables. There are 4 of them in the top and 8 of them in the bottom. When we cancel them what's left? Are they in the top or the bottom?

Answer: $\left(\frac{16}{n^4m^4}\right)$

Assignment: pg 464 #1-17 (skip #5)

Division:

Example #1 $\frac{4^6}{4^3}$

Just like we did with the other examples, let's write it out the long way.

$\frac{(4\cdot 4\cdot 4\cdot \cancel{4}\cdot \cancel{4}\cdot \cancel{4})}{(\cancel{4}\cdot \cancel{4}\cdot \cancel{4})} = (4\cdot 4\cdot 4)$ How many 4's are we left with? 3

Therefore our answer would be 4^3 or 64.

Do you notice a relationship between the final power of 3 and the two previous powers of 6 and 3?

Be careful, it's <u>not</u> division it's actually <u>subtraction!</u> Below is the general rule.

If *a* is any nonzero real number and *m* and *n* are integers, then $\frac{a^m}{a^n} = a^{m-n}$

Example #2 $\left(\frac{3x}{y^2}\right)^{-3}$

This is going to take a little bit of remembering from earlier today. Do you remember what we do with a negative power? flip it

That's right! We *flip* it. So after we flip this fraction it will look like this: $\left(\frac{y^2}{3x}\right)^3$

Now we can solve it like the problem you just did. Do this below.

$\frac{(y^2)^3}{(3)^3(x)^3} = \frac{y^6}{27x^3}$ nothing can be simplified so we are done!

Assignment: pg 471 #1-4, 9-16