How to solve expressions with exponents

Topic TextTopic TermsGlossarySpanish Text In a variable expression with negative exponents and multiple operations, complete the operations step by step. Keep in my order of operations. Start with the exponents. To simplify a negative exponent, take the reciprocal of the term that is being raised by the exponent. Next, start simplifying by writing out all the exponents. For example, write 2x^3 as 2 x x x. Do this to every exponent. Cancel out any variables or constants that are the same in both the numerator and denominator. After canceling, multiply everything together. The result will the the expression in simplest form. exponent quotient product base This intimidating exponent problem can be done if I do it step by step. Not only do I have 2 fractions, but they're being multiplied and I have negative exponents oh my goodness I'm a little scared, but we can do it.First thing I'm going to do is take care of these negative exponents. Negative exponent means whatever was in the top is going to be written in the bottom with the positive exponent. For example 3 to the -1 is going to become 3 to the 1 in the denominator. X that started out in the bottom now has a negative exponent it's going to jump up to the top. That's what happened in the first fraction.The second fraction, all of this stuff is now going to be in the bottom of the fraction squared. It used to be a negative 2, now it's going to be a positive 2. That whole chunk, $(2x)^2$. Now there's y to the third that used to be in the bottom is now going to become y to the third to the positive 2 in top. That was hard because I had to use everything that used to be in the bottom into the top, and I had to apply my new squared.Once I have that set up, I'm going to go through, and take care of these squared. This first fraction will stay the same, this second fraction I'm going to write out as y to the third times y to the third again, that's what y to the third squared is. On the bottom I'll have $2x^2$ times $2x^2$ because it's timed itself.My next step is going to be to write pout all of these Xs and Ys and then cancel out things that were the same on top and bottom. So on top all the way across I have x and then y, y, y, y, y, y again. On the bottom I have 3 times 2 times 2 which is 3 times 2 is 6 times 2 is 12 x, x, x, x again. Great now I have everything all written out, the last thing I'm going to do is cross out anything that shows up on top and bottom like that oops, not both of those Xs, just that first guy is going to get crossed out. There we go. And then I can write my simplified fractional answer.On top I have 1, 2, 3, 4, 5 Ys no 1, 2, 3, 4, 5, 6 y, don't write this. It's not 6×y, it's y times itself 6 times. Y to the 6 on top. On the bottom I have 12, one to those Xs got cancelled out, so then I'm left with x to the third. That's my final answer and I know it's my final answer because I don't have any fractional integers that can be reduced. I also don't have any fractional integers mainly like number on top of number that I can reduce. I also have different letters in the top and bottom so I know those guys can't be simplified any further.When I approach exponents that have negative exponents or problems that have negative exponents, I take care of the negative exponent first, then I write out everything including all the letters and cancel things that are the same on top and bottom. Content of this page: Introduction Properties of exponentials Solved Exercises: Simplifying Expressions with Exponents Introduction Power is an expression of this type ab = a · a · · · a · a that represents the result of multiplying the base, a, by itself as many times as the exponent, b, indicates. We read it as "a to the power of b". For example, 2 3 = 2·2·2 = 8 (the base is 2 and the exponent is 3). Generally, the base as well as the exponent can be any number (real or complex) or they can even be a variable, unknown factor or parameter. The equations with the unknown factor is in the exponent are known as exponential equations. A special case are powers whose exponents are fractions. In this case, the power represents a square root. They appear due to the need to solve an equation of the type x n = a. Another special case are powers with a base of 10, ones with this appearance 10 n. If n is a natural number (0, 1, 2, 3,...) the result is 10...0, being n the number of 0's. If n is a negative number (-1, -2, -3, -4,...), the result is 0.00...1 where the value of n in positive indicates the number of 0's counting the 0 before the comma. These are the type of powers used in scientific notation. Finally, we'll say that the power elevated to 0 is always 1, so, x 0 = 1. In this section, the activities are in order of increasing difficulty: we use the properties of exponentials (power of products, power of quotient, power of a power,..) and, after we'll simplify expressions formed by powers (parenthesis, fractions, negative exponents, parameters..). Product Power Quotient Negative exponent Inverse Inverse of inverse Exercise 1 Show solution We apply the definition of exponentiation, multiplying the base by itself as many times as the exponent indicates: Exercise 2 Show solution If the exponent is negative, first we express the power as a fraction. The exponent will be the denominator, so we apply the Negative Exponent Rule, making positive exponents. Exercise 3 Show solution When we have a power of a power. We apply the rule that consists in multiplying both exponents and we obtain a power with a negative exponent. We continue in the same way as the point before. Exercise 4 Show solution We have the quotient of two powers. Because the base is the same, the rule says that we subtract the exponents (the numerator's minus the denominator's). We obtain a negative exponent. Exercise 5 Show solution We have the multiplication of powers in the numerator, but we can't resolve it because there are different bases (2 and 3). In the denominator we have a power with a base of 6 (3·2). By writing the power in the denominator as the multiplication of powers of bases 3 and 2, we then have the same bases in the numerator and denominator and can now apply the rules. Exercise 6 Show solution First we can eliminate the negative sign on the exponent of the first power writing the inverse fraction. That way, we will have a division of powers with the same base. Exercise 7 Show solution We apply the rules of exponentiation to each of them to simplify the expression. We transform the bases into others (using powers) to obtain bases in common. Exercise 8 Show solution The biggest problem in this expression is the amount of different bases that the powers have. What we will do is break down the bases to prime factors. Notice that 10 = 2·5 and 60 = 6·10 = 2·3·2·5. After this, we only have to multiply or divide powers. Exercise 9 Show solution We apply the properties of exponentiation, but first in the parenthesis to begin eliminating them. Exercise 10 Show solution We have a high exponent, but we don't need to worry about it. The important bit of this exercise is that the base of the power, which is the whole parenthesis, is a subtracting and we don't have rules to resolve it. Due to this, we have to do the work inside the parenthesis until we can apply the rules we have. Exercise 11 Show solution We write the base 18 as a product of prime factors and regroup in powers: 18 = 3·6 = 3·2·3. Exercise 12 Show solution We have a lot of exponents. We apply the rule to the first, which is the power of a multiplication. We have to clearly identify the factors of the multiplication to apply the rules without making mistakes. After, we'll continue with the other exponents. Exercise 13 Show solution We eliminate the first exponent, -1, which means writing the inverse of the base. We also have different bases, but we already know how to solve this problem: writing the bases as products of prime factors and regrouping in powers. We remember that the symbol ":" is a division, the same way as "/" is. Exercise 14 Show solution The difficulty in this problem is the parameters, or what is the same, the letters. We work with them the same way as we do with numbers (the parameters represent numbers after all). Exercise 15 Show solution Although it's simply a issue about writing, we'll represent divisions ":" in the form of fractions "/". We know how to calculate the expression 5 x 5. This expression can be written in a shorter way using something called exponents. $$5\cdot 5=5^{2}$$ An expression that represents repeated multiplication of the same factor is called a power. The number 5 is called the base, and the number 2 is called the exponent. The exponent corresponds to the number of times the base is used as a factor. Example Write these multiplications like exponents $$5\cdot 5\cdot 5=5^{3}$$ $$4\cdot 4\cdot 4\cdot 4\cdot 4=4^{5}$$ $$3\cdot 3\cdot 3\cdot 3=3^{4}$$ Multiplication If two powers have the same base then we can multiply the powers. When we multiply two powers we add their exponents. The rule: $$x^{a}\cdot x^{b}=x^{a+b}$$ Example $$4^{2}\cdot 4^{5}=\left (4\cdot 4 \right)\cdot \left (4\cdot 4\cdot 4\cdot 4\cdot 4 \right)=4^{7}=4^{2+5}$$ Division If two powers have the same base then we can divide the powers. When we divide powers we subtract their exponents. The rule: $$\frac{x^{a}}{ x^{b}}=x^{a-b}$$ Example $$\frac{4^{2}}{ 4^{5}}=\frac{{\color{red} {ot}{4}}\cdot {\color{red} {ot}{4}}}{{\color{red} {ot}{4}}\cdot {\color{red} {ot}{4}}\cdot 4\cdot 4\cdot 4}=\frac{1}{4^{3}}=4^{-3}=4^{2-5}$$ A negative exponent is the same as the reciprocal of the positive exponent. $$x^{-a}=\frac{1}{x^{a}}$$ Example $$2^{-3}=\frac{1}{2^{3}}$$ When you raise a product to a power you raise each factor with a power $$(x\cdot y)^{a}=x^{a}\cdot y^{a}$$ Example $$(2x)^{4}=2^{4}\cdot x^{4}=16x^{4}$$ The rule for the power of a power and the power of a product can be combined into the following rule: $$(x^{a}\cdot y^{b})^{z}=x^{a\cdot z}\cdot y^{b\cdot z}$$ Example $$(x^{3}\cdot y^{4})^{2}=x^{3\cdot 2}\cdot y^{4\cdot 2}=x^{6}\cdot y^{8}$$ Video lessons Rewrite the expressions $$2\cdot 2\cdot 2$$ $$x\cdot x\cdot x\cdot x\cdot x$$ $$3^{4}$$ $$x^{3}$$ Simplify the expression $$\left (x^{2}\cdot y^{3}\cdot z^{5} \right)^{3}$$

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