


**How to get rid of an e in an equation**

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# How to get rid of an e in an equation

How to get e out of an equation. How to get rid of e in a math equation. How to cancel out e in an equation. How do you get rid of e in an equation.

For the West, the world is becoming more and more compelling in its most abstract form. As a theoretical physicist in search of fundamental laws, he loves to compare his work Read More Solving Exponential and Logarithmic Equations Learning Objectives

Solve logarithmic equations. As you know, algebra often requires solving equations to find unknown values. This also applies to exponential and logarithmic equations. There are some strategies you can use, along with some properties you've learned, that you can use to solve these equations. Solving Exponential Equations You might be able to look at an equation like  $4x = 16$  and solve it by asking yourself, "4 to what power is 16?" 4<sup>2</sup> is 16, so x is equal to 2. "Equations like  $4x = 17$  are a bit more difficult. You know x has to be a little bit more than 2, because 17 is just a little bit more than 16. One way to find x more accurately, though, is to use logarithms. When you solved other algebraic equations, you often relied on the idea that you could change both sides of the equation in the same way and still get a real equation. This also applies to logarithms: if  $x = y$ , then  $\log_b x = \log_b y$ , regardless of what b is. Let's look at it with an equation whose solution you already know:  $4x = 16$ . You can use the common log or the natural log. In the following example, you will use the common register. Sample problem Solve  $4x = 16$ .  $4x = 16 \log 4x = \log 16$  Take the common log of both sides. (Remember, when no base is written, it means the base is 10.) What can you do with this new equation?  $\log 4x = \log 16 \log 4x = \log 16$  Use the power property of logarithms to simplify the logarithm on the left side of the equation.  $x \log 4 = \log 16$  Remember that log 4 is a number. You can divide both sides of the equation by log 4 to get x alone. Answer Use a calculator to estimate logarithms and quotient. Just like you knew, x is equal to 2. Now let's try our hardest example,  $4x = 17$ . The procedure is exactly the same. Example Problem Solve  $4x = 17$ .  $4x = 17 \log 4x = \log 17$  Take the common log of both sides.  $\log 4x = \log 17 \log 4x = \log 17$  Use the power property of logarithms to simplify the logarithm on the left.  $x \log 4 = \log 17$  Divide both sides by log 4 to get x alone. Answer Use a calculator to estimate logarithms and quotient. With the example above, you could use the common log or the natural log. You use one of these two bases, as you can then use the calculator to find the values. Sample problem Solve  $e^{2x} = 54$ .  $e^{2x} = 54 \ln e^{2x} = \ln 54$  Since the base is e, use the natural logarithm. (If the base was 10, it would be better to use common logarithms.)  $\ln e^{2x} = \ln 54$   $2x = \ln 54$  Remember that logarithms and exponential functions are inverse. When you have  $\log_b m$ , the logarithm undoes the exponent, and the result is m. So  $\ln e^{2x}$  is equal to  $2x$ .  $x$  is equal to divide both sides by 2 to get x alone. Answer  $x = \frac{\ln 54}{2}$  Use a calculator to evaluate the logarithm and the quotient on the right and you're done! Another type of exponential equation has exponential expressions on both sides. When the bases are the same, or the exponents are the same, you can only compare the parts that are different. Look at these examples. Example Problem Solve  $32x + 5 = 33x + 2$ .  $32x + 5 = 33x + 2$  Here are two exponential expressions with the same base. If the two expressions are equal, then their exponents must be equal. (Think about that a if you have 3a and 3b, and a  $\neq$  b, then 3a cannot have the same value as 3b.)  $2x + 5 = 3x + 2$  Then write a new equation that sets the exponents equal to each other.  $5 = x + 2$   $7 = x$  Solve the linear equation as you would normally do. Check  $32(7) + 5 = 33(7) + 2$   $2319 = 2319$  Prove the solution in the original equation. You don't have to find 319. When both sides say the same thing, you know it's correct! Answer  $x = 7$  Example Problem Solve  $(x + 4)^8 = 78$ .  $(x + 4)^8 = 78$  Again, you have two equal exponential expressions. In this case, both sides have the same exponent, which means that the bases must be equal.  $x + 4 = \sqrt[8]{78}$  Write a new equation that sets the bases equal to each other.  $x = \sqrt[8]{78} - 4$  Solve the linear equation as you would normally do. Control  $(3 + 4)^8 = 78$   $78 = 78$  Test the solution in the original equation. You don't need to find 78. When both sides say the same thing, you know it's correct! Answer  $x = 3$  Solve  $103x + 2 = 13$ . A)  $x = 5$  B)  $x = 1.03$  798... C)  $x = 1.52$  164... D)  $x = 3.11$  394... Show/Answer A)  $x = 5$  Incorrect. You probably forgot to take the logarithm of 13 as well as  $103x + 2$ . The correct answer is  $x = 1.03$  798... B)  $x = 1.03$  798... Correct.  $103x + 2 = 13$  can be rewritten as  $\log 103x + 2 = \log 13$ , and  $\log 103x + 2 = \log 13$ , so  $3x + 2 = \log 13$ . This produces  $x = \frac{\log 13 - 2}{\log 103}$ . C)  $x = 1.52$  164... Incorrect. You probably used a natural logarithm on the right side ( $\ln 13$ ), but common logarithm on the left side ( $\log 103x + 2 = 3x + 2$ ). The correct answer is  $x = 1.03$  798... D)  $x = 3.11$  394... Incorrect. You probably took the logarithms correctly and added 2 to both sides, but you forgot to divide by 3. The correct answer is  $x = 1.03$  798... Solving Logarithmic Equations There are several strategies you can use to solve logarithmic equations. The first is the one you used before: Rewrite the logarithmic equation as an exponential equation! Problem example Solve  $\ln x = 4.657$ . Give x to the place thousandths.  $\ln x = 4.657$   $e^{\ln x} = e^{4.657}$   $x = e^{4.657}$  Remember that natural logarithms have a base of e. Rewrite this logarithm as an exponential equation. Answer  $x = e^{4.657} \approx 105.320$  Use a calculator to evaluate  $e^{4.657}$ , and round to the nearest thousandth. This works regardless of the base. Example Problem Solve  $\log_7 x = 3.843$ . x to thousandths place.  $\log_7 x = 3.843$   $7^{\log_7 x} = 7^{3.843}$   $x = 7^{3.843}$  Rewrite this logarithm as exponential equation. Answer  $x = 7^{3.843} \approx 1768.935$  Use a calculator to evaluate  $7^{3.843}$  and round for thousandth. Logarithmic equations can also include input when the variable has a coefficient different from 1, or when the variable itself is square. In these cases, you must complete some steps in the resolution of the variable. Example problem  $\log_5 3x + 2 = 1.96$ . Give x instead of cents.  $5.196 = 3x + 2$  Rewrite this logarithmic equation as exponential equation.  $23.44 = 127a$ ;  $3x + 2 = 5.196$ .  $7.81 = 375a$ ;  $x + 2 = 5.196$  Solve as you would normally do. In this case, divide both sides by 3, then use the square root property to find possible x values. Do not forget that when using the square root property, both positive and negative roots must be considered. Round the nearest cent. Check  $\log_5 3x + 2 = 1.96$   $\log_5 3(-2.80) + 2 = 1.96$   $\log_5 3(7.84) = 1.96$   $\log_5 23.52 = 1.96$  Check your answer by replacing the x value in the original equation. As  $(-2.80)$  and  $(+2.80)$  are both positive, there is no need to check  $+2.80$  separately. Apply the basic formula change to switch from base 5 to base 10. The control shows that with rounding you get a true statement, so you know the answer is correct. Response  $x = \sqrt[3]{1.96 - 2}$  Equations can also include more than one logarithm. You can use logarithm properties to combine these logarithms into one logarithm. Note: You will find it useful to record which properties you use at each step, whether to be sure to use them correctly, or to help you find errors. Example of problem Solve . First you notice that all logarithms have the same base. (These are common logarithms, so the bases are all 10.) When using the properties, it is absolutely necessary that the bases are the same. Use the power property to rewrite  $\log 3$  as  $\log 3^2$  and rewrite A as .  $\log 9 + \log 4 = \log 36$  Evaluate exponents.  $\log(9 \cdot 4) = \log 36$   $\log 3 = \log 3$  Use product property, to combine  $\log 9 + \log 4$ .  $\log A = \log x \log x$  quotient property. , to combine the  $\log 36 = \log 3$ . Answer  $x = 12$  For the logarithm of 12 and the logarithm of x are equal, x must be equal to 12. Fix  $\log x + \log 3 = \log 24$ . A) 0.460... C) 8 D) 21 Show/hide reply A) 0.460... Errato. Use the product property to combine  $\log x + \log 3$  in a logarithm. The correct answer is 8. B)  $2.892$  incorrect. Use the product property to combine  $\log x + \log 3$  in a logarithm. The correct answer is 8. C) 8 Corretto  $\log x \log 3 = \log 3x$ . Then  $\log 3x = \log 24$ ,  $3x = 24$  and  $x = 8$ . D) 21 Errato. Use the product property to combine  $\log x + \log 3$  in a logarithm. The correct answer is 8. There are several strategies that can be used to solve equations involving exponents and logarithms. Taking the logarithms on both sides is usefulexponential equations. Rewriting a logarithmic equation as an exponential equation is a useful strategy. Using logarithm properties, it's helpful to combine many logarithms into one. Rasmus ehf and Jóhann Ísak Pétursson Exponentials and logarithms print Lesson 3 Natural Logarithms Since calculators and computers have become instruments for most numerical operations, logarithms with base 10 have become less useful. On the other hand a logarithm with another base of 10 has become increasingly useful in many of the sciences. This function is called the natural Logarithm function and has the symbol  $\ln$ .  $f(x)=\ln x$  The base for natural logarithms is a number and you can see on the calculator. and is an irrational number  $e \approx 2.718$  Example 1 Here's how you find the natural logarithm of 2 on a CASIO-calculator: The answer is about 0,693 which is the power we need to raise and to get 2.  $e^{0.693} = 2$  Check this on your computer: Date response is  $1.9997 \approx 2$ . The  $f(x) = \ln x$  and  $g(x) = e^x$  functions are canceled when one function is used on the result of the other. This is the same as it happens with  $f(x) = \log x$  and  $g(x) = 10^x$  or squat a number then taking the square root of the result. In other words, the  $f(x) = \ln x$  is the reverse of the  $g(x) = e^x$  function. Below is true:  $\ln e^x = x$  og  $e^{\ln x} = x$  The number is irrational and therefore we cannot find an exact value for it. We can calculate its value to any number of decimal points by choosing larger and larger values than x and putting them in the following formula. Example 2 Calculate and putting  $x = 1000$  in the formula and using a calculator. Using EXCEL we get the value 2.7182818284591 per e. Then choose  $x = 1000$  gives us only two correct digits. Now try to calculate and using  $x = 1000000$ . Now we have five correct figures. The higher the value of x the more precision in our calculation of e. Example 3 Draw graphs of  $f(x) = \ln x$  and  $g(x) = e^x$ . The first draws a table of values:  $x$   $f(x) = \ln x$   $g(x) = e^x$   $x$  -3 0.05 -1.39 -2 0.14 -0.69 -1 0.37 1 2 0.69 1 2 72 1.39 2 7.39 8 2.08 Note there are no negative values in the column for  $g(x) = e^x$  and there are no negative values in the column x for the reverse function  $g(x) = \ln x$  This is true of the graphs of any two functions that are the opposite of each other. The same rules keep for the natural logarithmic function The following examples show how these rules are used. Example 4 Solve the following equations: a) Move the 2 and write as a power. Put the basic number and on both sides of the equation. And then they cancel each other, leaving us with a square equation. Move the x over the equal sign. Factorise and fix for  $x = 0$  is impossible as there is no way to write 0 as power. b) Write the left side as aput the basic number and. and cancel each otherc) is is Simplify the left by writing as a logarithm. Insert the base and on both sides. Example 5A Solve the following equations: a) Take the logarithm of both sides. b) A Use the rules:  $x^a y = a x + y$  ,  $A^a x/a y = a x \ln A + y$  and  $(a n) m = a n m A$  è to write each side as a power of e. c) Use write the rules: to  $x a y = to x + y$ , and A to  $x/a y = to x \ln A + y$  to write each side as a power of e. Example 6 Solving the equations: a) Take the log of both sides of the equation and use the rule of a  $x = x \ln a^x$  to move the unknown value down in front of the ln. b) Bring the x terms to one side of the equation and the other terms to the other side. Simplify using the rules for indexes. Finally take the log of both sides to move the x down and solve x. c) Separate the powers of 5. divide both sides by 25 then solve x as before. Test quiz 3 on exponentials and logarithms. Remember to use the checklist to keep track of your work.

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