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Integration of e^x

Ex discussion dx = ex + C. 1. Test Since we know the derivative: e.g. ex, we can use the Fundamental Theorem of calculation: ex dx = (ex) dx = ex + Q.E.D. See also the proof that ex = ex. TEST Case 1: Let's say we have an exponential function such as ∫ex(f(x)+f'(x)) dx\displaystyle \int e^x\big(f(x) + f'(x)\big)\, dx∫ex(f(x)+f'(x))dx. In this case, the integral is exf(x)+C.e^xf(x) + C.exf(x)+C. Find the indefinite integral ∫ex(sin(x)+body(x)) dx,\int e^x\big(\sin(x) + \body(x)\big)\, dx,∫ex(sin(x)+body(x))dx, using CCC as an integration constant. We have the integral in the form of ∫ex(f(x)+f'(x)) dx,\displaystyle \int e^x\big(f(x) + f'(x)\big)\, dx,∫ex(f(x)+f'(x))dx, where f(x)=sin(x)f(x) = \sin(x)f(x)=sin(x). So our integral is exsin(x)+C. □e^x\sin(x) + C.\ _\squareexsin(x)+C. □ Case 2: Let's say we have an integration of the form I=∫eaxcos(bx+c).\displaystyle I = \int e^{ax}\cos(bx+c). I=∫eaxcos(bx+c). Its integral is I=eax(acos(bx+c)+bsin(bx+c))a2+b2. I=\dfrac{e^{ax}\big(a\cos(bx+c)+b\sin(bx+c)\big)}{a^2 + b^2}. I=a2+b2eax(acos(bx+c)+bsin(bx+c)) . We will integrate the above using the integration by parts as follows: I=∫eaxcos(bx+c) dx=body(bx+c)eaxa+ba∫eaxsin(bx+c) dx=body (bx+c)eaxa+ba(eaxa+ba (bx+c)−ba∫eaxcos(bx+c)) dx=eax(acos(bx+c)+bs in(bx+c))a2−b2a2I.\begin{aligned} I && = \int e^{ax}\cos(bx+c)\dx\\&&& =body(bx+c)\frac{e^{ax}}{a} + \frac{b}{a} \int e^{ax}\sin(bx+c)\dx\\\\&& =\frac{e^{ax}\big(a\cos(bx+c)+b\sin(bx+c)\right)}\dx\\\\&& =\frac{e^{ax}\big(a\cos(bx+c)+b\sin(bx+c)\big)}{a^2} - \frac{b^2}{a^2}I. \end{aligned}]I =∫eaxcos(bx+c) dx=body(bx+c)eaxa +ab ∫eaxsin(bx+c) dx=body(bx+c)aeax +ab (ab eaxa +ab (aeax sin(bx+c)−ab ∫eaxcos(bx+c)) dx=a2eax(acos(bx+c)+bsin(bx+c)) a −2b2 I. So I(1+b2a2)=eax(acos(bx+c)+bsin(bx+c))a2⇒I=eax(acos(bx+c)+bsin(bx+ c))a2+b2. □\begin{aligned} I\left(1+\frac{b^2}{a^2}\right)&&;; = \frac{e^{ax}\big(a\cos(bx+c)+b\sin(bx+c)\big)}{a^2}\\ \Rightarrow I&;\frac{e^{ax}\big(a\cos(bx+c)+b\sin(bx+c)\big)}{a^2 + b^2}.\ _\square \end{aligned}I(1+a2b2)⇒I =a2eax(acos(bx+c)+bsin(bx+c)) =a2+b2eax(acos(bx+c)+bsin(bx+c)) . □ Note: The example above is also applicable for form I=∫eaxsin(bx+c).\displaystyle I = \int e^{ax}\sin(bx+c). I=∫eax(bx+c). I=∫(bx+c). Find the indefinite integral ∫e2xcos(5x+3) dx,\int e^{2x}\body(5x+3)\, dx,∫e2xcos(5x+3)dx, using CCC as an integration constant. For the above result, we get our answer as e2x(2cos(5x+3)+5sin(5x+3))29+C. \frac{e^{2x}\big(2\cos(5x+3)+5\sin(5x+3)\big)}{29} + C.\ □\frac{e^{2x}\big(2\cos(5x+3)+5\sin(5x+3)\big)}{29} + C.\ Case 3: If the integration is of the form ∫aex+be−xpex+qe−xdx,\displaystyle \int \frac{ae^x + be^{-x}}{pe^x + qe^{-x}} dx,∫pex+qe−xaex+be^{-x}, express (NUM)=α(DEN)+βddx(DEN)+βddx DEN,\text{(NUM)} =\alpha \text{(DEN)} + \beta \frac{d}{dx} \text{(DEN)},(NUM)=α(DEN)+βddx(DEN), where NUM=(the integrand numerator) and DEN=(the integrating denominator), and then integrate as usual. Find the indefinite integral ∫2ex+3e−xex−5e−x dx,\int \frac{2e^x + 3e^{-x}}{e^x - 5e^{-x}}\, dx,∫ex−5e−x2ex+3e−x dx,∫ex−5e−x2ex+3e−xex−5e−x, express \frac{ae^x + be^{-x}}{pe^x + qe^{-x}},∫pex+qe−xaex+be−x dx, using CCC as an integration constant. We can write 2ex+3e−x=α(ex−5e−x)+β(ex+5e−x).2e^x + 3e^{-x} = \alpha(e^x - 2e^x e^{-x}) + \beta(e^x + 5e^{-x}).2ex+3e−x=α(ex−5e−x)+β(ex+5e−x). Comparing ex and e−xe^x coefficients \text{ and } e^{-x}ex and e−x, we get α+β=2\alpha + \beta = 2α+β=2 and α−β=−35,\alpha - \beta = -\frac{3}{5},α−β α=710,β=1310\alpha = \frac{7}{10} \beta=\frac{13}{10}α=107 ,β=1013 . So we have ∫2ex+3e−xex−5e−x dx=α∫dx+β∫ex+5e−xex−5e−x.\int \frac{2e^x + 3e^{-x}}{e^x - 5e^{-x}} dx=\alpha\int dx + \beta \int \frac{e^x + 5e^{-x}}{e^x - 5e^{-x}} dx. \qquad (1)∫ex−5e−x2ex+3e−x=α∫dx+β∫ex−5e−xex+5e−x dx. (1) Leave e−5e −x =t,e^x - 5e^{-x} = t,e^x-5e−x=t, then (ex+5e−x)dx=dt,(e^x + 5e^{-x})dx = dt,(ex+5e^{-x})dx=dt, gives (1)=710∫dx+1310∫dtt=7x10+1310ln|t|+C=7x10+1310ln | ex−5e−x| || <3> <1>+C.\begin{aligned} (1) &=\frac7{10} \int dx +\frac{13}{10}\int \frac{dt}{t}\\ &;=\frac{7x}{10} +\frac{13}{10}\ln |t| + C \\&;\frac{7x}{10} +\frac{13}{10}\ln \big|e^x - 5e^{-x}\big| + C, \end{aligned}(1) =107 ∫dx+1013 ∫tdt =107x +1013 ln|t| +C=107x+1013 ln | ex−5e x−| | +C, where CCC is the integration constant. □ _\square□ \square above, enter the function to integrate. The integration variable, integration limits and more can be changed to Options. Click Go! to initiate the integral/anti-derivative calculation. The result will be shown below. For those with a technical background, the following section explains how the Integral Calculator works. First, one analyses the mathematical function. It transforms it into a shape that is best under way for a computer, i.m. a tree (see figure below). In doing so, the Integral Calculator must respect the order of operations. A specialty in mathematical expressions is that the multiplication sign can be left out sometimes, for example we write 5x instead of 5*x. The Integral Calculator must detect these cases and insert the multiplication sign. The analyzer is implemented in JavaScript, based on the shunting-yard algorithm, and can be run directly in the browser. This allows quick feedback while typing transforming the tree into LaTeX code. MathJax is in charge of in the browser. When you click the Go! button, the Integral Calculator sends the mathematical function and configuration (variable of integration and integration limits) to the server, where it is analyzed again. This time, the function is transformed into a form that can be understood by the Maxima computer algebra system.Maxima is responsible for really calculating the integral of the mathematical function. Maxima's output is transformed into LaTeX again and then presented to the user. Antiderivative is calculated using the Risch algorithm, which is difficult to understand for humans. That is why showing the calculation steps is very difficult for integrals. In order to show the steps, the calculator applies the same integration techniques that a human would apply. The program that does this has been developed over several years and is written in Maxima's own programming language. It consists of more than 17000 lines of code. When the integrand matches a known form, it applies fixed rules to solve the integral decomposition (e.g. partial fraction for rational functions, trigonometric replacement for integrands that involve the square roots of a quadratic polynomial or part integration for products of certain functions). Otherwise, try different substitutions and transformations until the integral is resolved, time runs out or there is nothing left to try. The calculator does not have the mathematical intuition that is very useful to find an antiderivative, but on the other hand can test a large number of possibilities in a short period of time. Step-by-step antiderivatives are usually much shorter and smarter than those found by Maxima.La Function Check response must solve the difficult task of determining whether two mathematical expressions are equivalent. Their difference is calculated and simplified as far as possible using Maxima. For example, this involves writing trigonometric/hyperbolic functions in their exponential forms. If you can prove that the difference is simplified to zero, the task is resolved. Otherwise, a probabilistic algorithm is applied that evaluates and compares both functions in randomly chosen places. In the case of antiderivatives, the whole procedure is repeated with the derivative of each function, since the antiderivatives can differ in a constant. Interactive function charts are calculated in your browser and displayed within a canvas element (HTML5). For each function to be graphed, the calculator creates a JavaScript function, which is then evaluated in small steps in order to draw the chart. While graphics, singularities (e.g. dust) are detected and treated especially. Gesture control is implemented using Hammer.js.If you have any questions or ideas for improvements to the Integral Calculator, feel free to write me an email. If this message, means that problems loading external resources to our website. If you're behind a web filter, make sure the *.kastatic.org and *.kasandbox.org domains are unlocked. Integration can be used to find areas, volumes, central points and many useful things. But it is often used to find the area under the chart of a function like this: The integral of many functions are well known, and there are useful rules to solve the integral of more complicated functions, many of which are shown here. There are examples below to help you. Common functions Constant Integral Function ∫a dx ax + Variable C ∫x dx x2/2 + Square C ∫x2 dx x3/3 + C ∫ reciprocal (1/x) dx ln|x| + C Exponential ∫ex dx ex + C ∫ax dx ax/ln(a) + C ∫ln(x) dx x ln(x) − x + Trigonometry C (x in radians) ∫cos(x) dx sin(x) + C ∫sin(x) dx -body(x) + C ∫sec2(x) dx tan(x) + C Rules Function Integral multiplication by constant ∫cf(x) dx c∫f(x) power rule dx (n≠-1 1) ∫xn dx xn+1n+1 + C Sum Rule ∫(f +g) dx ∫f dx + ∫g dx Difference Rule ∫(f -g) dx ∫f dx - ∫g dx integration by parts View integration by part Replacement rule View integration by replacement examples From the table above is listed as −body(x) + C Is written as: ∫sin(x) dx = −body(x) + C From the table above is listed as ln|x| + C Is written as: ∫(1/x) dx = ln|x| + C Vertical bars || on both sides of x mean absolute value, because we do not want to give negative values to the natural logarithm function. Power rule The question asks what is the integral of x3 ? We can use the power rule, where n = 3:∫xn dx = xn + 1n + 1 + C ∫x3 dx = x44 + C √x is also x0.5 We can use the power rule, where n=1/2: ∫xn dx = xn+1n+1 + C ∫x0.5 dx = x1.51.5 + C Multiplication by constant We can move the 6 out of the integral: ∫6x2 dx = 6∫x2 dx And now use the power rule in x2: = 6 x33 + C = C: Simplify 2x3+ Sum Rule C Use sum rule: ∫cos x + x dx = ∫cos x dx + ∫x dx Work the integral of each one (using the table above): = sin x + x2/2 + C Difference rule Use the rule of difference: ∫als - 3 dw = ∫ew dw − ∫3 dw Next , work the integral of each (using table above) : = ew − 3w + C Sum, Difference, Constant multiplication and power rules Use sum and difference rule: ∫8z + 4z3 − 6z2 dz = ∫8z dz + ∫4z3 dz − ∫6z2 dz Constant multiplication: = 8∫z dz + 4∫z3 dz − 6∫z2 dz power rule: = 8z2/2 + 4z4/4 − 6z3/3 + C Simplify: = 4z2 + z4 − 2z3 + C Part integration See integration by parts Replacement rule Get lots of practice Don't forget the dx (or dz, etc)Don't forget the + C Copyright © <9> 201 MathsIsFun.com MathsIsFun.com 7