

## Integrals

100	<b>Answer</b>	The solution to $\int \frac{x}{\sqrt{4-x^2}} dx$ .
	<b>Question</b>	What is $-\sqrt{4-x^2} + C$ ? <span style="float: right;">[[usub with <math>u = 4 - x^2</math>]]</span>
200	<b>Answer</b>	The solution to $\int (\ln x)^2 dx$ .
	<b>Question</b>	What is $x(\ln x)^2 - 2(x \ln x - x) + C$ ? <span style="float: right;">[[parts with <math>u = (\ln x)^2</math>, <math>dv = dx</math>]]</span>
300	<b>Answer</b>	The solution to $\int \tan^3 x \sec^8 x dx$ .
	<b>Question</b> <b>OR</b>	What is $\frac{1}{10} \sec^{10} x - \frac{1}{8} \sec^8 x + C$ ? <span style="float: right;">[[<math>\int (\sec^2 x - 1) \sec^7 x (\sec x \tan x) dx</math>]]</span> What is $\tan x + \tan^3 x + \frac{3}{5} \tan^5 x + \frac{1}{7} \tan^7 x + C$ ? <span style="float: right;">[[<math>\int \tan^3 x (\tan^2 x + 1)^3 \sec^2 x dx</math>]]</span>
400	<b>Answer</b>	The solution to $\int \frac{2x^3 - x^2 + 2}{x^3 + 1} dx$ .
	<b>Question</b>	What is $2x - \frac{1}{3} \ln  x^3 + 1  + C$ ? <span style="float: right;">[[<math>\int (2 - \frac{x^2}{x^3+1}) dx</math>]]</span>
500	<b>Answer</b>	The solution to $\int \frac{3x^3 + 2x + 3}{x^2(x^2 + 1)} dx$ .
	<b>Question</b>	What is $2 \ln  x  - 3x^{-1} + \frac{1}{2} \ln  x^2 + 1  - 3 \tan^{-1} x + C$ ? <span style="float: right;">[[<math>\int (\frac{2}{x} + \frac{3}{x^2} + \frac{x-3}{x^2+1}) dx</math>]]</span>

## Potpourri

100	<b>Answer</b>	An integral that becomes $\int u^2 du$ after a $u$ -substitution.
	<b>Question</b>	What is $\int \sin^2 x \cos x dx$ ? <span style="float: right;">[[many possible questions]]</span>
200	<b>Answer</b>	An integral that becomes $x \tan^{-1} x - \int \frac{x}{1+x^2} dx$ after integration by parts.
	<b>Question</b>	What is $\int \tan^{-1} x dx$ ? <span style="float: right;">[[<math>u = \tan^{-1} x</math>, <math>dv = dx</math>]]</span>
300	<b>Answer</b>	The algebraic function that is equal to $\tan^2(\sin^{-1} \frac{x}{2})$ .
	<b>Question</b>	What is $\frac{x^2}{4-x^2}$ ? <span style="float: right;">[[<math>(\frac{x}{\sqrt{4-x^2}})^2</math>]]</span>
400	<b>Answer</b>	The form of the partial fraction decomposition for $\frac{x^4 + 1}{(x^2 + x + 1)^2(x^2 + x - 2)}$ . (do <u>not</u> solve for $A$ , $B$ , etc.)
	<b>Question</b>	What is $\frac{Ax + B}{x^2 + x + 1} + \frac{Cx + D}{(x^2 + x + 1)^2} + \frac{E}{x - 1} + \frac{F}{x + 2}$ ? <span style="float: right;">[[factor!]]</span>
500	<b>Answer</b>	The sigma notation formula for the Trapezoid Rule for approximating $\int_a^b f(x) dx$ with $n$ trapezoids.
	<b>Question</b>	What is $\sum_{k=1}^n \frac{f(x_{k-1}) + f(x_k)}{2} \Delta x$ ?

## How-To

100	<b>Answer</b>	The $u$ -substitution for integrating $\int \frac{x}{1+x^4} dx$ .
	<b>Question</b>	What is $u = x^2$ ? <span style="float: right;">[[<math>\int \frac{1}{1+u^2} du</math>]]</span>
200	<b>Answer</b>	The parts $u$ and $dv$ for integrating $\int \frac{\ln x}{x^2} dx$ .
	<b>Question</b>	What are $u = \ln x$ and $dv = \frac{1}{x^2} dx$ ?
300	<b>Answer</b>	The $u$ -substitution (after rewriting) for integrating $\int \cos^3 x \sqrt{\sin x} dx$ .
	<b>Question</b>	What is $u = \sin x$ ? <span style="float: right;">[[<math>\int (1 - \sin^2 x) \sqrt{\sin x} \cos x dx</math>]]</span>
400	<b>Answer</b>	The parts $u$ and $dv$ for integrating $\int x^3 \sec^2 x^2 dx$ .
	<b>Question</b>	What are $u = x^2$ and $dv = x \sec^2 x^2 dx$ ?
500	<b>Answer</b>	The trigonometric substitution you would use for $\int \frac{1}{\sqrt{1+4x-x^2}} dx$ .
	<b>Question</b>	What is $x - 2 = \sqrt{5} \sin u$ ? <span style="float: right;">[[<math>\int \frac{1}{\sqrt{5-(x-2)^2}}</math>]]</span>

## Diffy Q

100	<b>Answer</b>	The solution to the initial value problem $\frac{dy}{dx} = 4y, y(0) = 2$ .
	<b>Question</b>	What is $y = 2e^{4x}$ ?
200	<b>Answer</b>	The integrating factor for the differential equation $\frac{xy + 3y'}{x^2 + 1} = x$ .
	<b>Question</b>	What is $e^{\frac{1}{3}x^2}$ ? <span style="float: right;">[[<math>y' + \frac{x}{3}y = \frac{1}{3}x(x^2 + 1)</math>]]</span>
300	<b>Answer</b>	The separated form of the differential equation $\frac{dy}{dx} + x = 2xy$ .
	<b>Question</b>	What is $\frac{1}{2y-1} dy = x dx$ ? <span style="float: right;">[[<math>\frac{dy}{dx} = x(2y - 1)</math>]]</span>
400	<b>Answer</b>	The family of solutions to the differential equation $y' + 2xy = x$ .
	<b>Question</b> <b>OR</b>	What is $y = \frac{1}{2} + Ce^{-x^2}$ ? What is $y = e^{-x^2}(\frac{1}{2}e^{x^2} + C)$ ? <span style="float: right;">[[<math>y'e^{x^2} + 2xe^{x^2}y = xe^{x^2}</math>]]</span>
500	<b>Answer</b>	The solution to the initial value problem $\frac{dy}{dx} = \frac{y^2}{x}, y(1) = 2$ .
	<b>Question</b>	What is $y = \frac{-1}{\ln x  - \frac{1}{2}}$ ? <span style="float: right;">[[<math>\frac{1}{y^2} dy = \frac{1}{x} dx</math>]]</span>

## Numbers

100	<b>Answer</b>	The decimal number that is equal to the Right Hand Sum approximation of $\int_1^3 x^2 dx$ with $n = 4$ (calculator permitted).
	<b>Question</b>	What is 10.75? <span style="float: right;">[[((1.5)<sup>2</sup> + 2<sup>2</sup> + (2.5)<sup>2</sup> + 3<sup>2</sup>)(<math>\frac{1}{2}</math>)]]</span>
200	<b>Answer</b>	The (most simplified) number that is equal to $\int_0^1 x^2 e^x dx$ .
	<b>Question</b>	What is $e - 2$ ? <span style="float: right;">[[parts twice]]</span>
300	<b>Answer</b>	The decimal number that is equal to the Midpoint Sum approximation of $\int_0^6 \sqrt{x} dx$ with $n = 3$ (calculator permitted).
	<b>Question</b>	What is 9.79796? <span style="float: right;">[[<math>(\sqrt{1} + \sqrt{3} + \sqrt{5})(2)</math>]]</span>
400	<b>Answer</b>	The (most simplified) number that is equal to $\int_{\sqrt{2}}^2 \frac{\sqrt{4-x^2}}{x^2} dx$ .
	<b>Question</b>	What is $1 - \frac{\pi}{4}$ ? <span style="float: right;">[[trig sub <math>x = 2 \sin u</math>]]</span>
500	<b>Answer</b>	The smallest integer $n$ so that an approximation of $\int_2^5 x^3 dx$ with $n$ trapezoids will be guaranteed accurate to within 0.01 (calculator permitted).
	<b>Question</b>	What is $n = 83$ ? <span style="float: right;">[[<math>(\frac{(5-2)^3}{12n^2})(30) &lt; 0.01</math>]]</span>

## Final Jeopardy: Integration

???	<b>Answer</b>	The solution to $\int \cos^4 x dx$ .
	<b>Question</b>	What is $\frac{3}{8}x + \frac{1}{4} \sin(2x) + \frac{1}{32} \sin(4x) + C$ ? <span style="float: right;">[[<math>\int (\frac{1+\cos(2x)}{2})^2 dx</math>]]</span>