What we've been doing.

$f(x) = x^3 \xrightarrow{\text{derivative}} f'(x) = 3x^2$

(position) $\longrightarrow$ (velocity)

(velocity) $\longrightarrow$ accelleration

Now, we go backwards

position $\xleftarrow{\text{anti-derivative}}$ velocity

$\frac{1}{3}x^3$ $\qquad$ x^2

d/dx

$3 \cdot \frac{1}{3}x^2 = x^2$

$\left(\frac{1}{3}x^3 + 27\right)' = x^2$

$\left(\frac{1}{3}x^3 + 227\right)' = x^2$

$\frac{1}{5}x^5 \longleftarrow x^4$

d/dx

$5 \cdot \frac{1}{5}x^4 = x^4$

Rule #1:

an anti-derivative of x^n is $\dfrac{x^{n+1}}{n+1}$

☆ kick it up by one and divide by it

Notation!

what the variable is

$$\underbrace{\int x^4\, dx}_{} = \frac{x^5}{5} + C$$

represents an unknown constant

the most general anti-derivative of x^4 with respect to x.

"the integral of x^4 $\underbrace{\text{with respect to } x}_{dx}$

THERE ARE MANY DIFFERENT FUNCTIONS WITH THE SAME DERIVATIVE

Ex. $$\int x^3 + 2x^5 \, dx = \frac{x^4}{4} + \frac{2x^6}{6} + C$$

$$= \boxed{\frac{x^4}{4} + \frac{x^6}{3} + C}$$

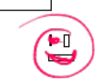
Fraction Exponents

$$x^{1/2} \xrightarrow{d/dx} \frac{1}{2}x^{-1/2} \quad \text{(power rule)}$$

$$x^{1/2} \xrightarrow{\text{anti-deriv.}} \frac{x^{3/2}}{\left(\frac{3}{2}\right)} = \boxed{\frac{2}{3}x^{3/2} + C}$$

check:

$$\left(\frac{2}{3}x^{3/2} + C\right)' = \frac{2}{3}\cdot\frac{3}{2}x^{1/2} = \boxed{x^{1/2}}$$



$$\int \cos x \, dx = \sin x + C$$

$$\int \sec^2 x \, dx = \tan x + C$$

$$\int \underbrace{x(1+x^3)}_{\text{product!}} \, dx \neq \frac{x^2}{2}\left(x + \frac{x^4}{4}\right)$$

b/c

$$\left(\left(\frac{x^2}{2}\right)\left(x + \frac{x^4}{4}\right)\right)'$$

$$\left(\frac{x^3}{2} + \frac{x^6}{8}\right)'$$

$$\frac{3x^2}{2} + \frac{6x^5}{8}$$

|| after distributing

$$\int x + x^4 \, dx = \frac{x^2}{2} + \frac{x^5}{5} + C$$

$$\int 2 \, dx = 2x + C$$

10/12/16
Name

$6 = 6x^0 \xrightarrow{a.d.} \frac{6x^1}{1} = 6x$

Antiderivatives 1

For problems 1 - 7, find the antiderivative. Check your answer.

1. $\int \frac{1}{2}x^2 - 2x + 6\,dx =$ $\frac{\frac{1}{2}x^3}{3} - \frac{2x^2}{2} + 6x + C$

2. $\int \underbrace{x(2-x)^2}\,dx =$

$\int x(4 - 4x + x^2)\,dx = \int 4x - 4x^2 + x^3\,dx = \boxed{2x^2 - \frac{4x^3}{3} + \frac{x^4}{4} + C}$

3. $\int \sqrt[4]{x^3} + \sqrt[3]{x^4}\,dx$

$\sqrt[2]{x^1} = x^{\frac{1}{2}}$

$\int x^{3/4} + x^{4/3}\,dx = \frac{x^{7/4}}{\left(\frac{7}{4}\right)} + \frac{x^{7/3}}{\left(\frac{7}{3}\right)} + C = \boxed{\frac{4}{7}x^{7/4} + \frac{3}{7}x^{7/3} + C}$

4. $\int 3e^x + 7\sec^2 x\,dx$

5. $\int 2\sqrt{x} + 6\cos x\,dx$