Scott

Forward Derivatives

$D[1] = ?$ 0

$D[a] = ?$ 0

$D[x] = ?$ 1

$D[ax] = ?$ a

$D[x^2] = ?$ $2x$

$D[ax^2] = ?$ $2ax$

$D[x^3] = ?$ $3x^2$

$D[ax^3] = ?$ $3ax^2$

.
.
.

$D[x^n] = ?$ $n(x)^{(n-1)}$

$D[ax^n] = ?$ $nax^{(n-1)}$

Reverse Derivatives

1 D[?] = 0	C D[?] = 0
x D[?] = 1	ax D[?] = a
$\frac{x^2}{2}$ D[?] = x	$\frac{ax^2}{2}$ D[?] = ax
$\frac{x^3}{3}$ D[?] = x^2	$\frac{ax^3}{3}$ D[?] = ax^2
$\frac{x^4}{4}$ D[?] = x^3	$\frac{ax^4}{4}$ D[?] = ax^3
.	.
.	.
.	.
$\frac{x^{n+1}}{n+1}$ D[?] = x^n	$\frac{ax^{n+1}}{n+1}$ D[?] = ax^n

Forward Derivatives

$D[e^{x}] = ?e^{x}$

$D[e^{2x}] = ?e^{2x} \cdot D(2x)$

$\hookrightarrow 2e^{2x}$

$D[e^{3x}] = ?e^{3x} \cdot D(3x)$

$\hookrightarrow 3e^{3x}$

$D[e^{ax}] = ?e^{ax} \cdot D(ax)$

$\hookrightarrow ae^{ax}$

Reverse Derivatives

$(e^{x})\ D[\ ?\ ] = e^{x}$

$\left[\frac{e^{2x}}{2}\right]\ D[\ ?\ ] = e^{2x}$

$\left[\frac{e^{3x}}{3}\right]\ D[\ ?\ ] = e^{3x}$

$\left[\frac{e^{ax}}{a}\right]\ D[\ ?\ ] = e^{ax}$

Forward Derivatives

$D[\ln x] = ?$ $\frac{1}{x}$

$D[\ln 2x] = ?$ $\frac{D(2x)}{2x} = \frac{2}{2x} = \frac{1}{x}$

$D[\ln 3x] = ?$ $\frac{1}{x}$

$D[\ln ax] = ?$ $\frac{1}{x}$

Reverse Derivatives

No rule to reverse?

$D[\ ?\ ] = \ln x$

$D[\ ?\ ] = \ln 2x$

$D[\ ?\ ] = \ln 3x$

$D[\ ?\ ] = \ln ax$

Forward Derivatives

$D[\sin x] = ?$

$\cos x$

$D[\sin 2x] = ?$

$2\cos 2x$

$D[\sin 3x] = ?$

$3\cos 3x$

$D[\sin ax] = ?$

$a\cos ax$

Reverse Derivatives

$D[\ ?\ ] = \sin x$

$-\cos x$

$D[\ ?\ ] = \sin 2x$

$\frac{-\cos 2x}{2}$

$D[\ ?\ ] = \sin 3x$

$\frac{-\cos 3x}{3}$

$D[\ ?\ ] = \sin ax$

$\frac{-\cos ax}{a}$

Forward Derivatives

$D[\cos x] = ?$

$-\sin x$

$D[\cos 2x] = ?$

$-2\sin 2x$

$D[\cos 3x] = ?$

$-3\sin 3x$

$D[\cos ax] = ?$

$-a\sin ax$

Reverse Derivatives

$D[\ ?\ ] = \cos x$

$\sin x$

$D[\ ?\ ] = \cos 2x$

$\frac{\sin 2x}{2}$

$D[\ ?\ ] = \cos 3x$

$\frac{\sin 3x}{3}$

$D[\ ?\ ] = \cos ax$

$\frac{\sin ax}{a}$

More Reverse Derivatives

$\ln x$ $D[\ ?\ ] = \frac{1}{x}$

$\left(-x^{-1}\right)$ $D[\ ?\ ] = \frac{1}{x^2}$

$\left(-\frac{x^{-2}}{2}\right)$ $D[\ ?\ ] = \frac{1}{x^3}$

$\left(-\frac{1}{(n-1)x^{n-1}}\right)$ $D[\ ?\ ] = \frac{1}{x^n}$

$\ln x$ $D[\ ?\ ] = \frac{1}{x}$

$2\ln x$ $D[\ ?\ ] = \frac{2}{x}$

$= \ln x^2$

$\ln x^3$ $D[\ ?\ ] = \frac{3}{x}$

$= 3\ln x$

$n\ln x$ $D[\ ?\ ] = \frac{n}{x}$

$= \ln x^n$

Reverse Derivative Rules

$D[\ ?\ ]$

Given a function f(x), we want to solve $D[\ h(x)\ ] = f(x)$ for a reverse derivative function h(x).

$D[\ ?\ ]$

If $D[\ h(x)\ ] = 0$, then $h(x) = C$ (any constant number)

If $D[\ h(x)\ ] = a$, then $h(x) = ax + C$

If $D[\ h(x)\ ] = x$, then $h(x) = \frac{x^2}{2} + C$

If $D[\ h(x)\ ] = x^n$, then $h(x) = \frac{x^{n+1}}{n+1} + C$, $n \neq -1$

If $D[\ h(x)\ ] = \frac{1}{x}$, then $h(x) = \ln x + C$

More Reverse Derivative Rules

Given a function f(x), we want to solve D[h(x)] = f(x) for a reverse derivative function h(x).

If D[h(x)] = e^{ax}, then h(x) = $\frac{e^{ax}}{a}$ + C

If D[h(x)] = sin(ax), then h(x) = $-\frac{\cos(ax)}{a}$ + C

If D[h(x)] = cos(ax), then h(x) = $\frac{\sin(ax)}{a}$ + C