# Review: Derivative and Integration Rules

The left column is for differentiation rules. The right column is for the corresponding integration rule *if such a rule exists.*

| Differentiation Rules | Integration Rules |
|---|---|
| (a) $\frac{d}{dx}(\tan(x)) =$ $\sec^2 x$ | $\int \sec^2 x\, dx = \tan x + C$ |
| (b) $\frac{d}{dx}(k \cdot g(x)) =$ $K \frac{d}{dx}[g(x)]$ <br> $k$ is a constant | $\int K g(x) dx = K \int g(x) dx$ <br> (const. outside $\int$) |
| (c) $\frac{d}{dx}(e^x) =$ $e^x$ | $\int e^x\, dx = e^x + C$ |
| (d) $\frac{d}{dx}\left(x^k\right) =$ $K\, x^{K-1}$ <br> $K \neq -1$ | $\int x^K dx = \frac{x^{K+1}}{K+1} + C$ |
| (e) $\frac{d}{dx}(\ln(x)) =$ $\frac{1}{x}\, dx$ | $\int \frac{1}{x} dx = \ln\|x\| + C$ |
| (f) $\frac{d}{dx}\left(x^k\right) =$ $K\, x^{K-1}$ <br> $k \neq -1$ | $\int x^K dx = \frac{x^{K+1}}{K+1} + C$ |
| (g) $\frac{d}{dx}(\sin(x)) =$ $\cos(x)$ | $\int \cos x\, dx = \sin x + C$ |
| (h) $\frac{d}{dx}(\cos(x)) =$ $-\sin x$ | $\int \sin(x)\, dx = -\cos(x) + C$ |
| (i) $\frac{d}{dx}(\sec(x)) =$ $\sec x \tan x$ | $\int \sec x \tan x\, dx = \sec x + C$ |

| | Differentiation Rules | Integration Rules |
|---|---|---|
| (j) | $\frac{d}{dx}(\arcsin(x)) = \frac{1}{\sqrt{1-x^2}}$ | $\int \frac{1}{\sqrt{1-x^2}}\,dx = \text{arcsen}(x) + c$ |
| (k) | $\frac{d}{dx}(c) = 0$ <br> $c$ is a constant | why there is the "$+c$" |
| (l) | $\frac{d}{dx}(\arctan(x)) = \frac{1}{1+x^2}$ | $\int \frac{1}{1+x^2}\,dx = \arctan(x) + c$ |
| (m) | $\frac{d}{dx}(f(x) \cdot g(x)) = f \cdot g' + f' \cdot g$ <br> prod. rule | No obvious rule (for now!) <br> $\int f \cdot g \neq \int f \cdot \int g$ !! |
| (n) | $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x) \cdot g(x) - f(x) \cdot g'(x)}{(g(x))^2}$ | No obvious rule <br> $\int \frac{f}{g}\,dx \neq \frac{\int f}{\int g}$ !! |
| (o) | $\frac{d}{dx}(f(g(x))) = f'(g(x)) \cdot g'(x)$ | u-substitution. Find u w/ du <br> $\int \underbrace{\sin(x^3)}_{f'(u)} \underbrace{(3x^2\,dx)}_{du} = \underbrace{-\cos(x^3)}_{f(u)}$ |
| (p) | $\frac{d}{dx}(f(x) + g(x)) = f' + g'$ | $\int (f(x) + g(x))\,dx = \int f(x) + \int g(x)$ |
| (q) | $\frac{d}{dx}(\csc(x)) = -\csc(x)\cot(x)$ | $\int \csc x \cot(x)\,dx = -\csc(x) + C$ |
| (r) | $\frac{d}{dx}(\cot(x)) = -\csc^2(x)$ | $\int \csc^2 x\,dx = -\cot(x) + C$ |
| (s) | $\frac{d}{dx}(2^x) = (\ln 2)\, 2^x$ | $\int 2^x\,dx = \frac{2^x}{\ln 2} + C$ |