Derivative Rules and Formulas

Rules:

(1) $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

(2) $\frac{d}{dx}(c) = 0,\ c$ any constant

(3) $\frac{d}{dx}(x) = 1$

(4) $\frac{d}{dx}\left(x^p\right) = p\,x^{p-1},\ p \neq -1$

(5) $\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$

(6) $\frac{d}{dx}(c \cdot f(x)) = c \cdot f'(x)$

(7) $\frac{d}{dx}[f(x) \cdot g(x)] = f'(x) \cdot g(x) + f(x) \cdot g'(x)$

(8) $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x) \cdot g(x) - f(x) \cdot g'(x)}{(g(x))^2}$

(9) $\frac{d}{dx}\left(\frac{1}{g(x)}\right) = \frac{-g'(x)}{(g(x))^2}$

(10) $\frac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$

(11) $\frac{d}{dx}\left(f^{-1}(x)\right) = \left(f^{-1}\right)'(x) = \frac{1}{f'\left(f^{-1}(x)\right)}$

Formulas: (note: u is a function of x)

(1) $\frac{d}{dx}(\sin(x)) = \cos(x)$

(2) $\frac{d}{dx}(\cos(x)) = -\sin(x)$

(3) $\frac{d}{dx}(\tan(x)) = \sec^2(x)$

(4) $\frac{d}{dx}(\sec(x)) = \sec(x)\ \tan(x)$

(5) $\frac{d}{dx}(\cot(x)) = -\csc^2(x)$

(6) $\frac{d}{dx}(\csc(x)) = -\csc(x)\ \cot(x)$

(7) $\frac{d}{dx}(\sinh(x)) = \cosh(x)$

(8) $\frac{d}{dx}(\cosh(x)) = \sinh(x)$

(9) $\frac{d}{dx}(e^x) = e^x$

(10a) $\frac{d}{dx}(a^x) = a^x\ \ln(a)$

(10b) $\frac{d}{dx}(a^u) = a^u\ \ln(a)\,u'$

(11a) $\frac{d}{dx}(\ln(x)) = \frac{1}{x}$

(11b) $\frac{d}{dx}(\ln(u)) = \frac{u'}{u}$

(12) $\frac{d}{dx}(\log_a(x)) = \frac{1}{x\ \ln(a)}$

(13a) $\frac{d}{dx}(\arctan(x)) = \frac{1}{1+x^2}$

(13b) $\frac{d}{dx}(\arctan(u)) = \frac{u'}{1+u^2}$

(14a) $\frac{d}{dx}(\arcsin(x)) = \frac{1}{\sqrt{1-x^2}}$

(14b) $\frac{d}{dx}(\arcsin(u)) = \frac{u'}{\sqrt{1-u^2}}$