Table of Derivatives

In the following table, a and n are constants, e is the base of the natural logarithms, and u and v denote functions of x.

1. $\frac{d}{dx}(a) = 0$

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

3. $\frac{d}{dx}(au) = a\frac{du}{dx}$

4. $\frac{d}{dx}(u + v) = \frac{du}{dx} + \frac{dv}{dx}$

5. $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$

6. $\frac{d}{dx}(u/v) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

7. $\frac{d}{dx}(u^n) = nu^{n-1}\frac{du}{dx}$

8. $\frac{d}{dx}e^u = e^u\frac{du}{dx}$

9. $\frac{d}{dx}a^u = (\log_e a)a^u\frac{du}{dx}$

10. $\frac{d}{dx}\log_e u = (1/u)\frac{du}{dx}$

11. $\frac{d}{dx}\log_a u = (\log_a e)(1/u)\frac{du}{dx}$

12. $\frac{d}{dx}u^v = vu^{v-1}\frac{du}{dx} + u^v(\log_e u)\frac{dv}{dx}$

13. $\frac{d}{dx}\sin u = \cos u\frac{du}{dx}$

14. $\frac{d}{dx}\cos u = -\sin u\frac{du}{dx}$

15. $\frac{d}{dx}\tan u = \sec^2 u\frac{du}{dx}$

16. $\frac{d}{dx}\text{ctn}\, u = -\csc^2 u\frac{du}{dx}$

17. $\frac{d}{dx}\sec u = \sec u \tan u\frac{du}{dx}$

18. $\frac{d}{dx}\csc u = -\text{csu}\,\text{ctn}\, u\frac{du}{dx}$

19. $\frac{d}{dx}\sin^{-1} u = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx}, (-\frac{1}{2}\pi \leq \sin^{-1} u \leq \frac{1}{2}\pi)$

20. $\frac{d}{dx}\cos^{-1} u = \frac{-1}{\sqrt{1-u^2}}\frac{du}{dx}, (0 \leq \cos^{-1} u \leq \pi)$

21. $\frac{d}{dx}\tan^{-1} u = \frac{1}{1+u^2}\frac{du}{dx}$

22. $\dfrac{d}{dx}\operatorname{ctn}^{-1} u = \dfrac{-1}{1+u^2}\dfrac{du}{dx}$

23. $\dfrac{d}{dx}\sec^{-1} u = \dfrac{1}{u\sqrt{u^2-1}}\dfrac{du}{dx}, (-\pi \le \sec^{-1} u < -\tfrac{1}{2}\pi;$

$0 \le \sec^{-1} u < \tfrac{1}{2}\pi)$

24. $\dfrac{d}{dx}\csc^{-1} u = \dfrac{-1}{u\sqrt{u^2-1}}\dfrac{du}{dx}, (-\pi < \csc^{-1} u \le -\tfrac{1}{2}\pi;$

$0 < \csc^{-1} u \le \tfrac{1}{2}\pi)$

25. $\dfrac{d}{dx}\sinh u = \cosh u\dfrac{du}{dx}$

26. $\dfrac{d}{dx}\cosh u = \sinh u\dfrac{du}{dx}$

27. $\dfrac{d}{dx}\tanh u = \operatorname{sech}^2 u\dfrac{du}{dx}$

28. $\dfrac{d}{dx}\operatorname{ctnh} u = -\operatorname{csch}^2 u\dfrac{du}{dx}$

29. $\dfrac{d}{dx}\operatorname{sech} u = -\operatorname{sech} u \tanh u\dfrac{du}{dx}$

30. $\dfrac{d}{dx}\operatorname{csch} u = -\operatorname{csch} u \operatorname{ctnh} u\dfrac{du}{dx}$

31. $\dfrac{d}{dx}\sinh^{-1} u = \dfrac{1}{\sqrt{u^2+1}}\dfrac{du}{dx}$

32. $$\frac{d}{dx}\cosh^{-1} u = \frac{1}{\sqrt{u^2-1}}\frac{du}{dx}$$

33. $$\frac{d}{dx}\tanh^{-1} u = \frac{1}{1-u^2}\frac{du}{dx}$$

34. $$\frac{d}{dx}\text{ctnh}^{-1} u = \frac{-1}{u^2-1}\frac{du}{dx}$$

35. $$\frac{d}{dx}\text{sech}^{-1} u = \frac{-1}{u\sqrt{1-u^2}}\frac{du}{dx}$$

36. $$\frac{d}{dx}\text{csch}^{-1} u = \frac{-1}{u\sqrt{u^2+1}}\frac{du}{dx}$$

Additional Relations with Derivatives

$$\frac{d}{dt}\int_a^t f(x)\,dx = f(t)$$

$$\frac{d}{dt}\int_t^a f(x)\,dx = -f(t)$$

If $x = f(y)$, then

$$\frac{dy}{dx} = \frac{1}{\dfrac{dx}{dy}}$$

If $y = f(u)$ and $u = g(x)$, then

$$\frac{dy}{dx} = \frac{dy}{du}\cdot\frac{du}{dx} \qquad \text{(chain rule)}$$

If $x = f(t)$ and $y = g(t)$, then

$$\frac{dy}{dx} = \frac{g'(t)}{f'(t)},$$

and

$$\frac{d^2y}{dx^2} = \frac{f'(t)g''(t) - g'(t)f''(t)}{[f'(t)]^3}$$

(*Note*: exponent in denominator is 3.)