

# Summary of Important Formulas for Differentiation

- 1. Power Rule.** For any real number  $k$ ,  $\frac{d}{dx} x^k = kx^{k-1}$ .
- 2. Derivative of a Constant Function.** If  $F(x) = c$ , then  $F'(x) = 0$ .
- 3. Derivative of a Constant Times a Function.** If  $F(x) = cf(x)$ ,  
then  $F'(x) = cf'(x)$ .
- 4. Derivative of a Sum.** If  $F(x) = f(x) + g(x)$ , then  
 $F'(x) = f'(x) + g'(x)$ .
- 5. Derivative of a Difference.** If  $F(x) = f(x) - g(x)$ , then  
 $F'(x) = f'(x) - g'(x)$ .
- 6. Derivative of a Product.** If  $F(x) = f(x)g(x)$ , then  
 $F'(x) = f(x)g'(x) + g(x)f'(x)$ .
- 7. Derivative of a Quotient.** If  $F(x) = \frac{f(x)}{g(x)}$ , then  
 $F'(x) = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$ .
- 8. Extended Power Rule.** If  $F(x) = [g(x)]^k$ , then  
 $F'(x) = k[g(x)]^{k-1}g'(x)$ .
- 9. Chain Rule.** If  $F(x) = f[g(x)]$ , then  $F'(x) = f'[g(x)]g'(x)$ .  
Or, if  $y = f(u)$  and  $u = g(x)$ , then

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

# Summary of Important Formulas for Differentiation

*(continued)*

$$10. \frac{d}{dx} e^x = e^x$$

$$11. \frac{d}{dx} e^{f(x)} = e^{f(x)} \cdot f'(x)$$

$$12. \frac{d}{dx} \ln x = \frac{1}{x}, \quad x > 0$$

$$13. \frac{d}{dx} \ln f(x) = \frac{f'(x)}{f(x)}, \quad f(x) > 0$$

$$14. \frac{d}{dx} \ln |x| = \frac{1}{x}, \quad x \neq 0$$

$$15. \frac{d}{dx} \ln |f(x)| = \frac{f'(x)}{f(x)}, \quad f(x) \neq 0$$

$$16. \frac{d}{dx} a^x = (\ln a)a^x$$

$$17. \frac{d}{dx} \log_a x = \frac{1}{\ln a} \cdot \frac{1}{x}, \quad x > 0$$

$$18. \frac{d}{dx} \log_a |x| = \frac{1}{\ln a} \cdot \frac{1}{x}, \quad x \neq 0$$

# Table of Integrals

- Antiderivative of a constant:  $\int k dx = kx + C$
- Antiderivative of a constant times a function:  $\int k \cdot f(x) dx = k \int f(x) dx$
- Sum/difference property of antidifferentiation:  
 $\int [f(x) \pm g(x)] dx = \int f(x) dx \pm \int g(x) dx$

1.  $\int x^n dx = \frac{x^{n+1}}{n+1} + C, n \neq -1$
2.  $\int \frac{dx}{x} = \ln x + C, x > 0$
3.  $\int u dv = uv - \int v du$
4.  $\int e^x dx = e^x + C$
5.  $\int e^{ax} dx = \frac{1}{a} \cdot e^{ax} + C$

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6.  $\int xe^{ax} dx = \frac{1}{a^2} \cdot e^{ax}(ax - 1) + C$
7.  $\int x^n e^{ax} dx = \frac{x^n e^{ax}}{a} - \frac{n}{a} \int x^{n-1} e^{ax} dx + C$
8.  $\int \ln x dx = x \ln x - x + C$
9.  $\int (\ln x)^n dx = x(\ln x)^n - n \int (\ln x)^{n-1} dx + C, n \neq -1$
10.  $\int x^n \ln x dx = x^{n+1} \left[ \frac{\ln x}{n+1} - \frac{1}{(n+1)^2} \right] + C, n \neq -1$
11.  $\int a^x dx = \frac{a^x}{\ln a} + C, a > 0, a \neq 1$
12.  $\int \frac{1}{\sqrt{x^2 + a^2}} dx = \ln |x + \sqrt{x^2 + a^2}| + C$
13.  $\int \frac{1}{\sqrt{x^2 - a^2}} dx = \ln |x + \sqrt{x^2 - a^2}| + C$
14.  $\int \frac{1}{x^2 - a^2} dx = \frac{1}{2a} \ln \left| \frac{x-a}{x+a} \right| + C$
15.  $\int \frac{1}{a^2 - x^2} dx = \frac{1}{2a} \ln \left| \frac{a+x}{a-x} \right| + C$
16.  $\int \frac{1}{x\sqrt{a^2 + x^2}} dx = -\frac{1}{a} \ln \left| \frac{a + \sqrt{a^2 + x^2}}{x} \right| + C$
17.  $\int \frac{1}{x\sqrt{a^2 - x^2}} dx = -\frac{1}{a} \ln \left| \frac{a + \sqrt{a^2 - x^2}}{x} \right| + C$
18.  $\int \frac{x}{a + bx} dx = \frac{a}{b^2} + \frac{x}{b} - \frac{a}{b^2} \ln |a + bx| + C$
19.  $\int \frac{x}{(a + bx)^2} dx = \frac{a}{b^2(a + bx)} + \frac{1}{b^2} \ln |a + bx| + C$
20.  $\int \frac{1}{x(a + bx)} dx = \frac{1}{a} \ln \left| \frac{x}{a + bx} \right| + C$
21.  $\int \frac{1}{x(a + bx)^2} dx = \frac{1}{a(a + bx)} + \frac{1}{a^2} \ln \left| \frac{x}{a + bx} \right| + C$
22.  $\int \sqrt{x^2 \pm a^2} dx$   
 $= \frac{1}{2} [x\sqrt{x^2 \pm a^2} \pm a^2 \ln |x + \sqrt{x^2 \pm a^2}|] + C$
23.  $\int x\sqrt{a + bx} dx = \frac{2}{15b^2} (3bx - 2a)(a + bx)^{3/2} + C$
24.  $\int x^2\sqrt{a + bx} dx$   
 $= \frac{2}{105b^3} (15b^2x^2 - 12abx + 8a^2)(a + bx)^{3/2} + C$
25.  $\int \frac{xdx}{\sqrt{a + bx}} = \frac{2}{3b^2} (bx - 2a)\sqrt{a + bx} + C$
26.  $\int \frac{x^2 dx}{\sqrt{a + bx}}$   
 $= \frac{2}{15b^3} (3b^2x^2 - 4abx + 8a^2)\sqrt{a + bx} + C$