

Math 115 Formulas

Derivatives:

1. Formal Definition:

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

$$2. \frac{d}{dx}[k] = 0$$

$$3. \frac{d}{dx}[k \cdot f(x)] = k \cdot \frac{d}{dx}[f(x)] = k \cdot f'(x)$$

$$4. \frac{d}{dx}[x] = 1$$

$$5. \text{Power Rule: } \frac{d}{dx}[x^n] = nx^{n-1}$$

6. Sum or Difference Rule:

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

7. Product Rule:

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

8. Quotient Rule:

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

9. Chain Rule:

$$\frac{d}{dx}[f(x)^n] = nf(x)^{n-1}f'(x)$$

Exponential Rules:

$$9. \frac{d}{dx}[e^x] = e^x$$

$$10. \frac{d}{dx}[e^{f(x)}] = e^{f(x)} \cdot \frac{d}{dx}[f(x)]$$

$$11. \frac{d}{dx}[a^x] = (\ln a) \cdot a^x$$

$$12. \frac{d}{dx}[a^{f(x)}] = (\ln a) \cdot a^{f(x)} \cdot \frac{d}{dx}[f(x)]$$

Log Rules:

$$13. \frac{d}{dx}[\ln|x|] = \frac{1}{x}$$

$$14. \frac{d}{dx}[\ln|f(x)|] = \frac{\frac{d}{dx}[f(x)]}{f(x)}$$

$$15. \frac{d}{dx}[\log_a|x|] = \frac{1}{\ln a} \cdot \frac{1}{x}$$

$$16. \frac{d}{dx}[\log_a|f(x)|] = \frac{1}{\ln a} \cdot \frac{\frac{d}{dx}[f(x)]}{f(x)}$$

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Integrals:

$$1. \int k dx = kx + C$$

$$2. \int k \cdot f(x) dx = k \cdot \int f(x) dx$$

$$3. \int x dx = \frac{1}{2} x^2 + C$$

4. Sum or Difference Rule:

$$\int [f(x) \pm g(x)] dx = \int f(x) dx \pm \int g(x) dx$$

5. Power Rule:

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C = \frac{1}{n+1} \cdot x^{n+1}, \text{ when } n \neq -1$$

$$6. \int x^{-1} dx = \int \frac{dx}{x} = \ln |x| + C$$

Exponent Rules:

$$7. \int e^x dx = e^x + C$$

$$8. \int e^{kx} dx = \frac{1}{k} \cdot e^{kx} + C$$

$$9. \int a^x dx = \frac{1}{\ln a} \cdot a^x + C$$

$$10. \int a^{kx} dx = \frac{1}{k(\ln a)} \cdot a^{kx} + C$$