Derivatives for logs + exponetials

e^x - most common

$\log_e(x) = \ln(x)$ natural logarithm

$\boxed{\frac{d}{dx}\ln(x) = \frac{1}{x}}$ $\boxed{\frac{d}{dx}e^x = e^x}$

Chain Rule

Let f and g be two functions. Then, $\frac{d}{dx}(f(g(x))) = f'(g(x)) \cdot g'(x)$

Generally the "inside function" g:

- polynomial-eque functions
  - $3x^2 + 2x + \sqrt{x}$

Generally the "outside function" f:

- e^x (or some other exponential)
- $\ln(x)$ (or some other logarithm)
- x^n

$h(x) = (5x^2+4x-3)^{10}$ $h'(x) = 10(5x^2+4x-3)^9 \cdot (10x+4)$

outside:

$f(x) = x^{10}$ $f'(x) = 10x^9$

Inside:

$g(x) = 5x^2+4x-3$ $g'(x) = 10x+4$

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$$\frac{d}{dx}\left(a^{f(x)}\right) = f'(x)\, a^{f(x)} \ln(a)$$

$$\frac{d}{dx}\left(e^x\right) = (1)e^x \ln(e) = e^x$$

$$\frac{d}{dx}\left(\log_a(f(x))\right) = f'(x) \cdot \frac{1}{f(x)\ln(a)}$$

1.) $f(x) = 8^{5x}$

$f'(x) = 5(8^{5x})\ln(8)$

2.) $g(x) = \sqrt{3x^2+4} = (3x^2+4)^{1/2}$

$g'(x) = \frac{1}{2}(3x^2+4)^{-1/2} \cdot 6x$

$= \dfrac{6x}{2\sqrt{3x^2+4}} = \boxed{\dfrac{3x}{\sqrt{3x^2+4}}}$

$h(x) =$

3.) $\ln(15x^5+4x^3-7x+2)$

$$h'(x) = \frac{1}{(15x^5+4x^3-7x+2)\ln(e)} \cdot (75x^4+12x^2-7)$$

$$h'(x) = \frac{75x^4+12x^2-7}{15x^5+4x^3-7x+2}$$

4.) $f(x) = 12xe^{2x} + \ln(2x+1)$

$f'(x) = \frac{d}{dx}\left(12xe^{2x}\right) + \frac{d}{dx}\left(\ln(2x+1)\right)$

$\boxed{= (12)(e^{2x}) + (2e^{2x})(12x) + \frac{2}{2x+1}}$