Good afternoon: warm ups

$y = \tan(2x^3)$ $\quad \frac{dy}{dx}$

$\frac{dy}{dx} = \sec^2(2x^3) \cdot 6x^2$

$6x^2 \cdot \sec^2(2x^3)$

$y = x$

$f(x) = 5x^2 \csc(3x^2)$ (f, g)

Find $f'(x)$

$\frac{d}{dx} \csc x = -\csc(x)\cot(x) \cdot 1$

Product Rule

$f'g + fg'$

$g' = ?$

$10x \cdot \csc(3x^2) + 5x^2 \cdot -\csc(3x^2)\cot(3x^2) \cdot 6x$

$10x \cdot \csc(3x^2) - 30x^3 \csc(3x^2)\cot(3x^2)$

Your history with functions

Constant $y = 4$ $y' = 0$

Linear $y = 3x$ $y' = 3$

Absolute Value ✓

Quadratic $y = x^2$ $y' = 2x$

Cubic, Quartic, Polynomial $y = 4x^{90} \rightarrow y' = 360x^{89}$

Rational $y = \frac{3x-5}{x+2}$

Exponential

Logarithmic

Trigonometric

Inverse Trigonometric

Can you take its derivative?

The Derivative of Log and Exponentials

Some review:

$x^b\, x^a = x^{b+a}$

$(x^b)^a = x^{ba}$

$\log_b a = x \rightleftharpoons b^x = a$

$\log_e x \rightleftharpoons \ln x$

$\log x + \log y = \log (xy)$

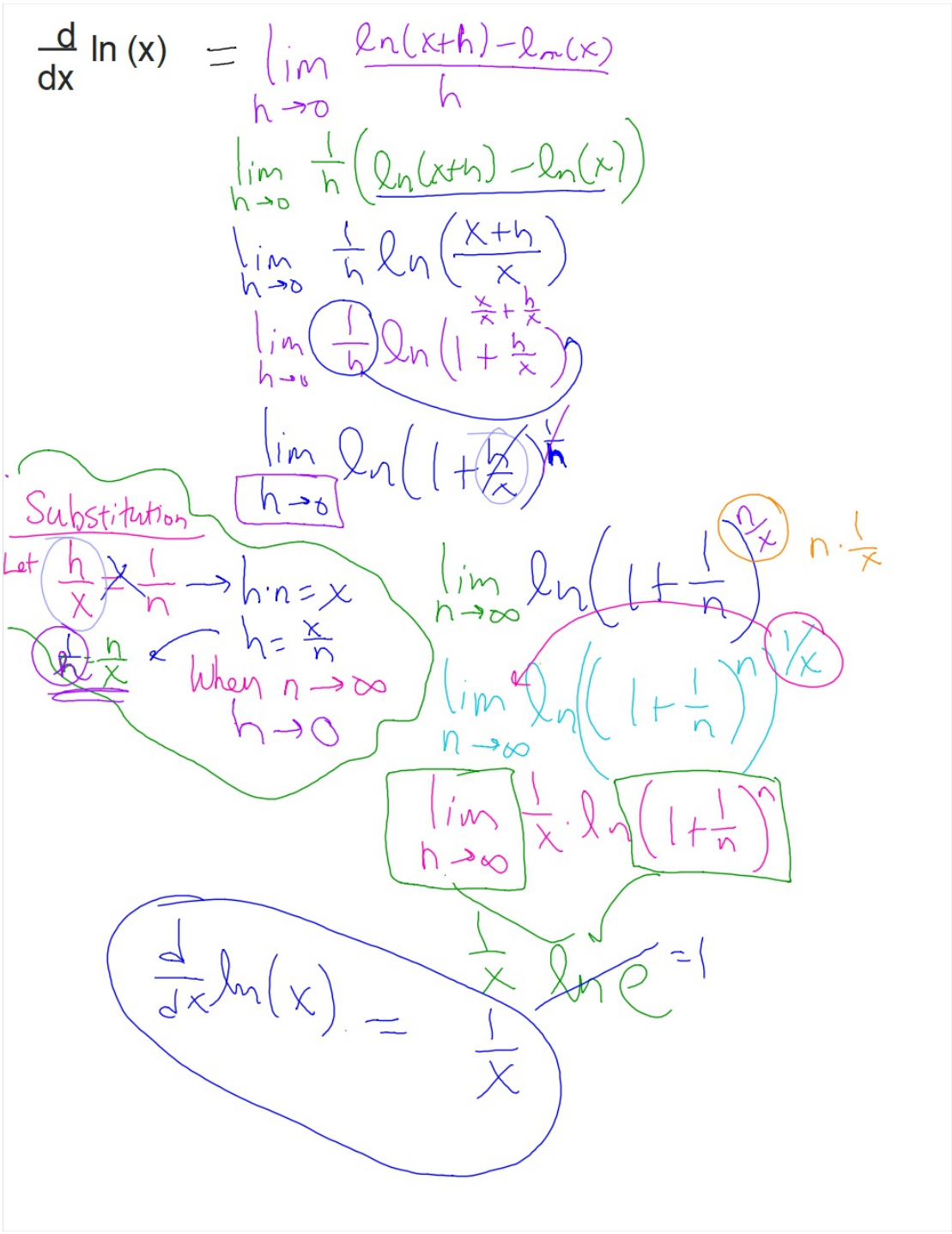
$\log x - \log y = \log \left(\frac{x}{y}\right)$

$\log b^a = a \log b$

What IS e?

$$e \approx 2.718$$

$$e = \lim_{n \to \infty} \left(1 + \frac{1}{n}\right)^n$$


$\frac{d}{dx}\ln(x) = \lim_{h\to 0}\frac{\ln(x+h)-\ln(x)}{h}$
$\lim_{h\to 0}\frac{1}{h}\left(\ln(x+h)-\ln(x)\right)$
$\lim_{h\to 0}\frac{1}{h}\ln\left(\frac{x+h}{x}\right)$
$\lim_{h\to 0}\frac{1}{h}\ln\left(1+\frac{h}{x}\right)$
$\lim_{h\to 0}\ln\left(1+\frac{h}{x}\right)^{\frac{1}{h}}$
Substitution
Let $\frac{h}{x}=\frac{1}{n}$
$h\cdot n = x$
$h=\frac{x}{n}$
When $n\to\infty$ $h\to 0$
$\frac{1}{h}=\frac{n}{x}$
$\lim_{n\to\infty}\ln\left(1+\frac{1}{n}\right)^{n/x}$
$n\cdot\frac{1}{x}$
$\lim_{n\to\infty}\ln\left(\left(1+\frac{1}{n}\right)^{n}\right)^{1/x}$
$\lim_{n\to\infty}\frac{1}{x}\cdot\ln\left(1+\frac{1}{n}\right)^{n}$
$\frac{1}{x}\ln e = 1$
$\frac{d}{dx}\ln(x) = \frac{1}{x}$

$$\frac{d}{dx}\ln(e^x) = \frac{1}{e^x}\cdot\frac{d}{dx}e^x \quad ??$$

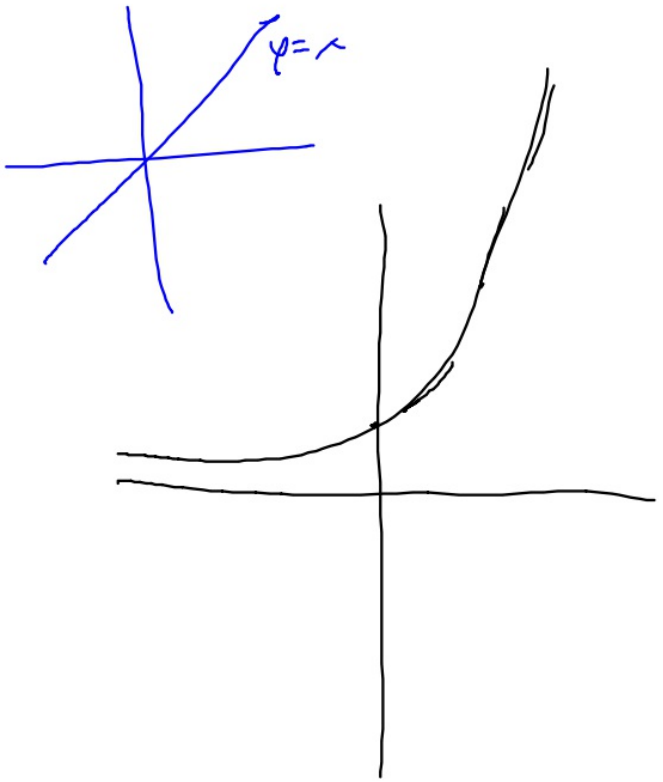
$$\frac{d}{dx}\ln x = \frac{1}{x}$$

$$\frac{d}{dx}\log_e e^x$$

$$\frac{d}{dx}x = \frac{1}{e^x}\cdot\frac{d}{dx}e^x$$

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

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



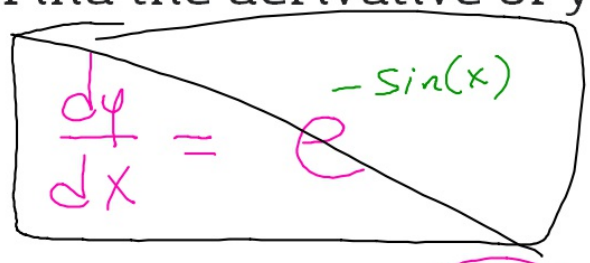
(booklets)

Exponential/Logarithmic Derivatives

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

$$\frac{d}{dx}a^x = a^x \ln\, a \qquad \frac{d}{dx}\log_a x = \frac{1}{x \ln a}$$

Find the derivative of $y = e^{\cos(x)}$



$$\frac{dy}{dx} = e^{\cos(x)} \cdot -\sin(x)$$

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

$f(x) = 3e^{\sin(6x)}$

$f'(x) = ?$

$\cos((6x)6 \neq \cos(36x)$

$$3e^{\sin(6x)} \cdot \cos(6x) \cdot 6$$

$$18 \cdot \cos(6x) \cdot e^{\sin(6x)}$$

Find the derivative of $y = \ln(5x^2-3)$

$$\frac{dy}{dx} = \frac{1}{5x^2-3} \cdot 10x$$

$$\frac{10x}{5x^2-3}$$