WARMUP

1) Fill in the chart to the nearest thousandth.

a)

h	$\frac{(2^h-1)}{h}$
1	1
0.1	0.718
0.01	0.696
0.001	0.693
0.0001	0.693

$$\lim_{h\to 0}\frac{2^h-1}{h}=\ln 2$$

b)

h	$\frac{(3^h-1)}{h}$
1	2
0.1	
0.01	
0.001	
0.0001	1.099

$$\lim_{h\to 0}\frac{3^h-1}{h}=\ln 3$$

2) What is the value to the nearest thousandth of:

a) $\ln 2 = \underline{0.693}$

b) $\ln 3 = \underline{1.099}$

Section 3.2 The Exponential Function

$$f(x) = 2^x$$

$$f'(x) = \lim_{h\to 0}\frac{2^{x+h}-2^x}{h} = \lim_{h\to 0}\frac{2^x\cdot 2^h - 2^x}{h}$$

$$= \lim_{h\to 0}\frac{2^x(2^h-1)}{h}$$

$$\lim_{x\to a} c f(x) = c\lim_{x\to a} f(x)$$

$$= 2^x \boxed{\lim_{h\to 0}\frac{2^h-1}{h}}$$

$$f'(x) = 2^x\cdot\ln 2$$

$$f(x) = 3^x$$

$$f'(x) = 3^x\cdot\ln 3$$

In general $\frac{d}{dx}\left[a^x\right] = a^x \cdot \ln a$ $\qquad$ $\ln e^N = N$

$$\frac{d}{dx}\left[e^x\right] = e^x \cdot \ln e = e^x \cdot 1 = e^x$$

$\frac{d}{dx}\left[x^n\right] = nx^{n-1}$

ex: $f(x) = \underset{a^x}{\pi^x} + \underset{x^n}{x^\pi}$

$f'(x) = \pi^x \cdot \ln \pi + \pi x^{\pi - 1}$

ex: $f(x) = e^2 + x^e$

e^2 ← constant

$f'(x) = 0 + ex^{e-1}$

$f'(x) = ex^{e-1}$

ex: $f(x) = (\ln 4) \cdot 4^x$ $\quad$ vs. $\quad$ $f(x) = \underbrace{\ln 4} + \underbrace{4^x}$

$\frac{d}{dx}\left[cf(x)\right] = cf'(x)$ $\quad$ $\frac{d}{dx}\left[c + f(x)\right] = f'(x)$

$f'(x) = (\ln 4) \cdot 4^x \cdot \ln 4$ $\quad$ $f'(x) = 0 + 4^x \cdot \ln 4$

$f'(x) = (\ln 4)^2 \cdot 4^x$ $\quad$ $f'(x) = 4^x \cdot \ln 4$

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9) $y = \dfrac{3^x}{3} + \dfrac{33}{\sqrt{x}} = \dfrac{1}{3} \cdot 3^x + 33x^{-\frac{1}{2}}$

$$y' = \frac{1}{3} \cdot 3^x \ln 3 - \frac{33}{2} x^{-3/2}$$

$$y' = \frac{3^x \ln 3}{3} - \frac{33}{2\sqrt{x^3}}$$

17) $f(x) = x^3 + 3^x$

$$f'(x) = 3x^2 + 3^x \ln 3$$

11) $f(x) = e^{1+x} = e^1 e^x = e \cdot e^x$

$$f'(x) = e^{1+x}$$

$$f'(x) = e^1 \cdot e^x = e^{1+x}$$

25) $f(z) = \overbrace{(\ln 3) z^2} + \overbrace{(\ln 4) e^x}$

$$f'(z) = (\ln 3) \cdot 2z + (\ln 4) \cdot e^x$$

$$= 2(\ln 3) z + (\ln 4) e^x$$