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	
0.001	
0.0001	0.693

b)

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

2) What is the value to the nearest thousandth of

a) $\ln 2$? 0.693

b) $\ln 3$? 1.099

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

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

16) $y = 17x + 24x^{\frac{1}{2}}$

$y' = 17 + 12x^{-\frac{1}{2}}$

$y' = 17 + \frac{12}{x^{\frac{1}{2}}} = 17 + \frac{12}{\sqrt{x}}$

Section 3.2 The Exponential Function

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

$f(x) = 2^x$

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

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

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

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

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

$$f'(x) = \lim_{h\to 0} \frac{3^{x+h} - 3^x}{h} = 3^x \lim_{h\to 0} \frac{3^h - 1}{h}$$

$$= 3^x \cdot \ln 3$$

So in general $\frac{d}{dx}\left[a^x\right] = a^x \cdot \ln a$

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

ex: $f(x) = \pi^x + x^\pi$

$$\underset{a^x}{\uparrow} \qquad \underset{x^n}{\uparrow}$$

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

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

$$\underset{c}{\uparrow} \qquad \underset{x^n}{\uparrow}$$

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

$$f(x) = c + g(x)$$
$$f'(x) = 0 + g'(x)$$

$$f(x) = c\,g(x)$$
$$f'(x) = c\,g'(x)$$

ex: $z = (\ln 4)\, 4^x$

$$z' = \underline{(\ln 4)} \cdot 4^x \underline{\ln 4}$$

$$z = \ln 4 + 4^x$$

$$z' = 0 + 4^x \ln 4$$

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

$z' = 4^x \ln 4$

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9) $y = \frac{3^x}{3} + \frac{33}{\sqrt{x}}$

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

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

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

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

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