Derivative of the Natural Exponential Function

Introduction

Try to compute the derivative of $f(x) = a^x$ using the definition of derivative.

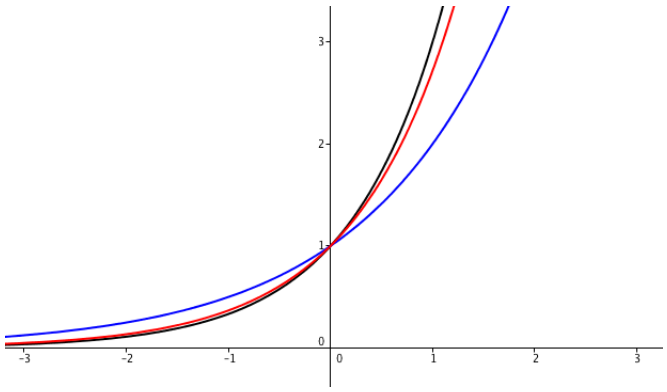
Lets investigate $\lim_{h \to 0} \frac{a^h - 1}{h}$ for different a values.

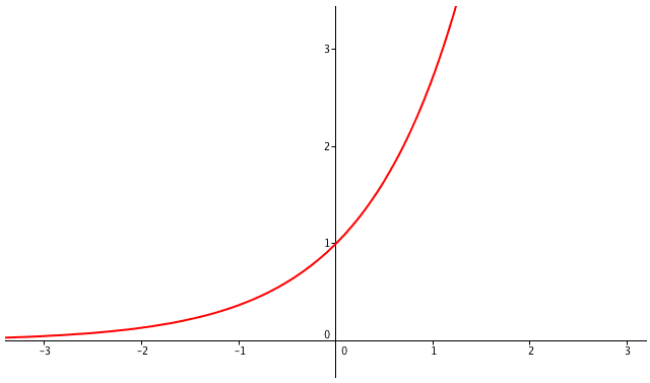
h	$\frac{2^h - 1}{h}$	$\frac{3^h - 1}{h}$
0.1	0.7177	1.1612
0.01	0.6956	1.1047
0.001	0.6934	1.0992
0.0001	0.6932	1.0987

Definition of the Number e

e is the number such that

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





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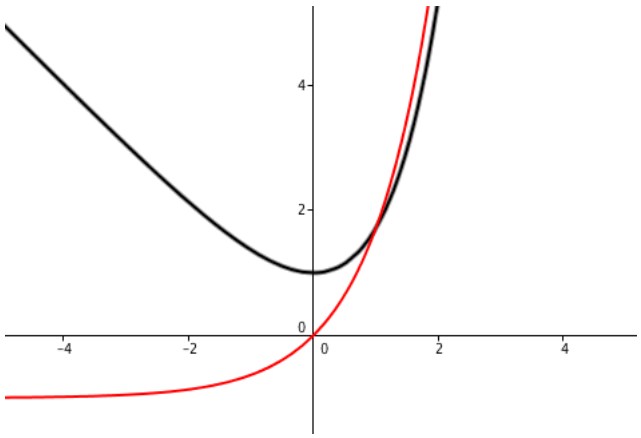
$$\frac{d}{dx}(e^x) = e^x$$

Example 1.

If $f(x) = e^x - x$, find f' and f''. Compare the graphs of f and f'.



Example 2.

At what point on the curve $y = e^x$ is the tangent line parallel to the line $y = 2x$?