

Types of Functions We Can't Yet Differentiate

▶ $f(x) = (x^6 - 14x^5 + 27x^{-3} - 13)(101x^{-1} + 14x^6 + 13 - 42\sqrt{x})$

▶ $g(x) = \frac{x^7 - \sqrt{x}}{14x^2 + 12}$

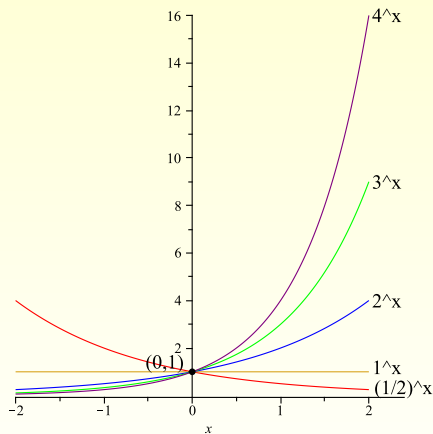
▶ $h(x) = \left(x^2 + 13x - \frac{2}{x}\right)^{1/3}$

▶ $j(x) = \cos(x^2)$

▶ $k(x) = \sin(e^{14x})$

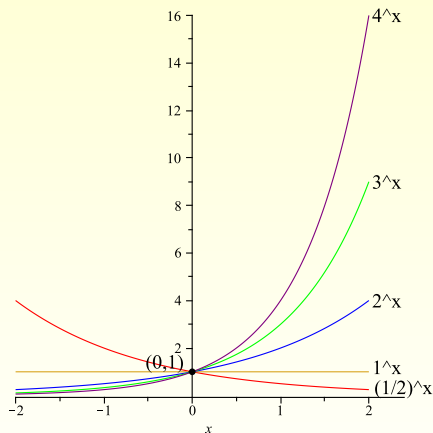
▶ $m(x) = \ln(\sqrt{x} - 14)$

What IS e ?



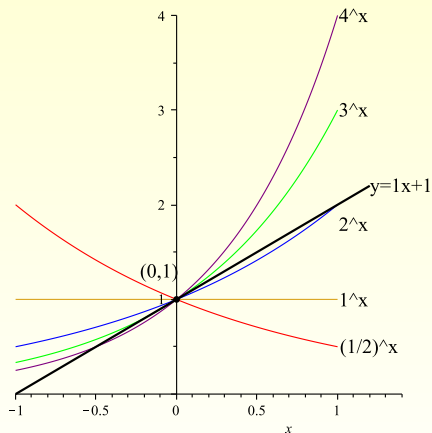
- Recall: The graph of b^x passes through the point $(0, 1)$ for all b , since $b^0 = 1$.

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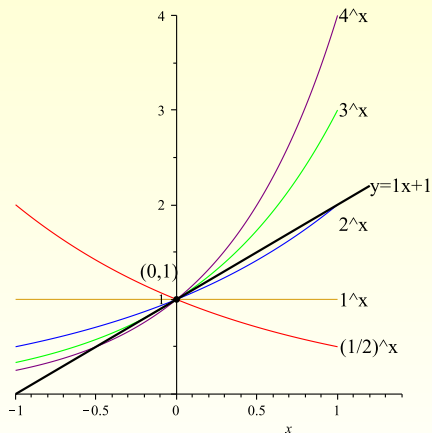
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- ▶ The larger b is, the steeper the slope at $(0, 1)$ is.
- ▶ If $b \geq 3$, the slope of b^x at $(0, 1)$ is larger than 1; if $b \leq 2$, the slope of b^x at $(0, 1)$ is less than 1.

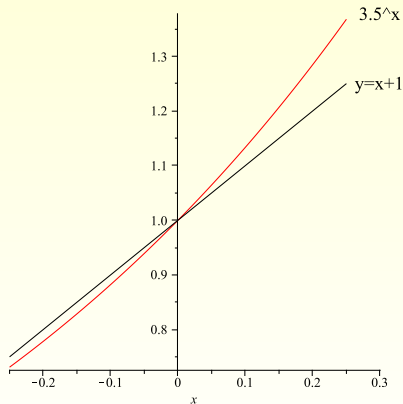
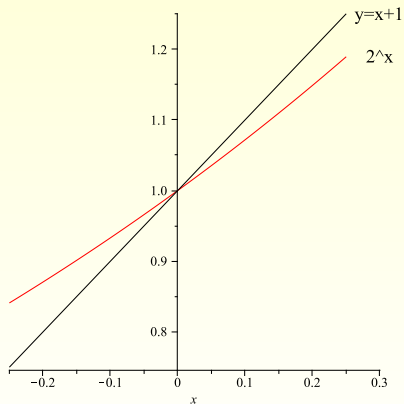
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- ▶ Recall: The graph of b^x passes through the point $(0, 1)$ for all b , since $b^0 = 1$.
- ▶ The larger b is, the steeper the slope at $(0, 1)$ is.
- ▶ If $b \geq 3$, the slope of b^x at $(0, 1)$ is larger than 1; if $b \leq 2$, the slope of b^x at $(0, 1)$ is less than 1.
- ▶ There is some number b between 2 and 3 for which b^x has slope 1 at $(0, 1)$.

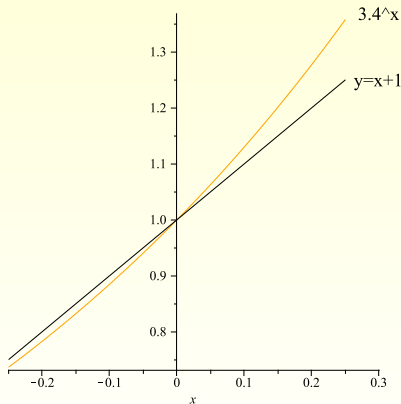
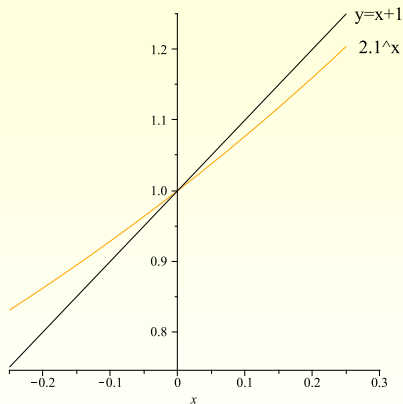
For what b is slope of b^x at $x = 0$ equal to 1?

That is, for what b is $y = x + 1$ the line tangent to b^x at $(0, 1)$?



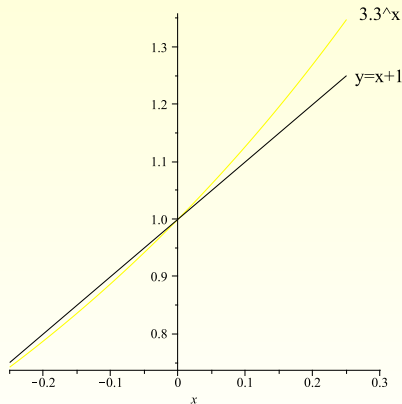
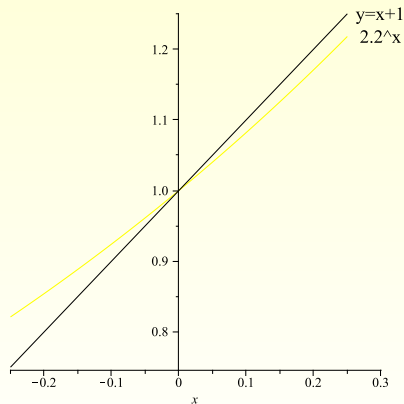
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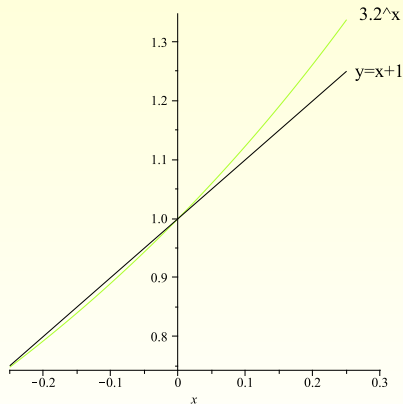
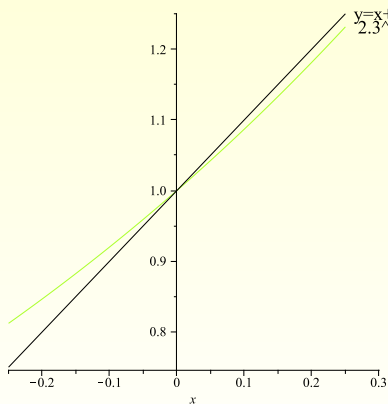
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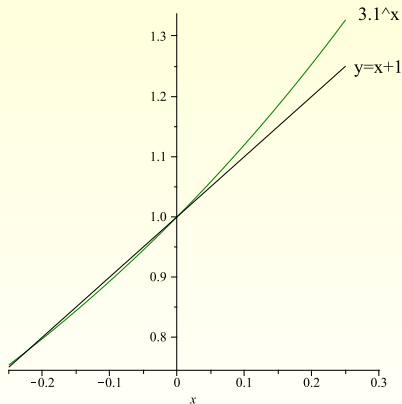
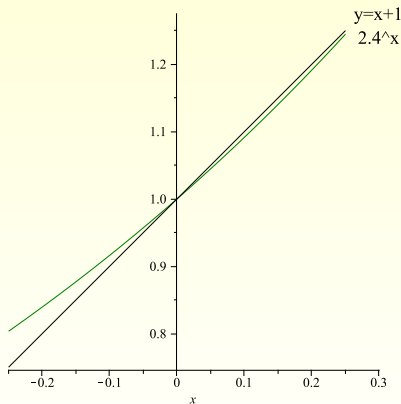
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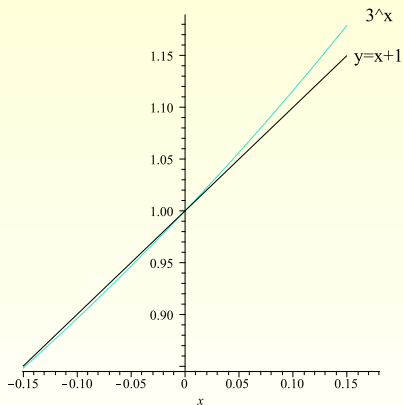
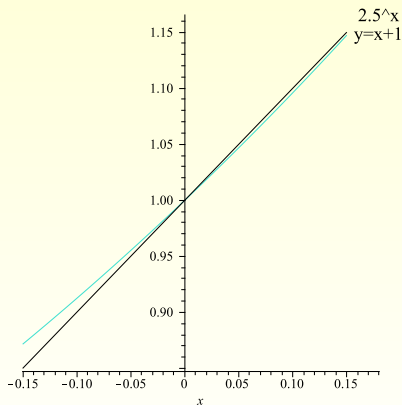
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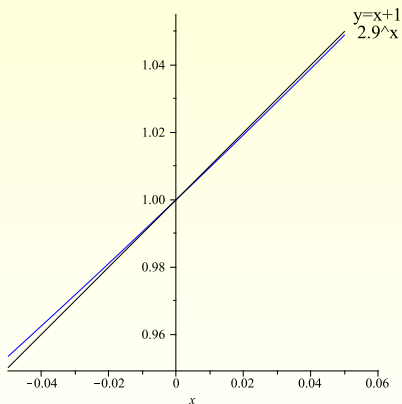
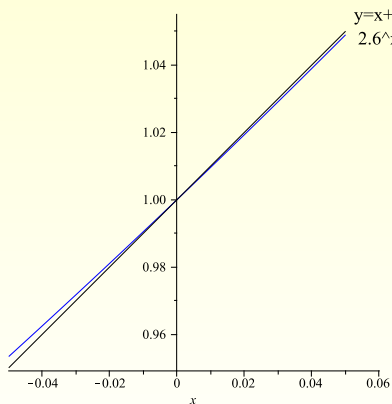
Zoom in!



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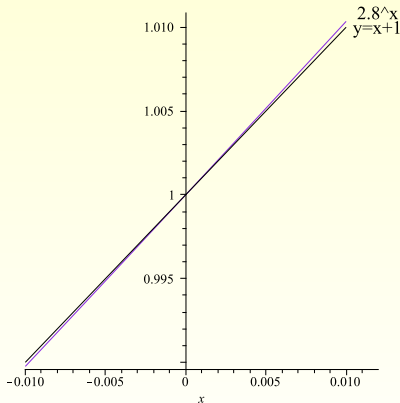
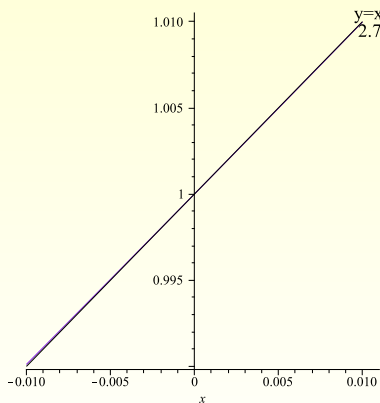
Zoom in again!



For what b is slope of b^x at $x = 0$ equal to 1?

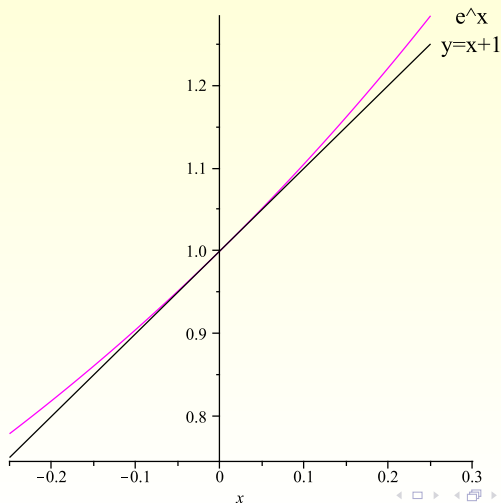
That is, for what b is $y = x + 1$ the line tangent to b^x at $(0, 1)$?

And zoom in one more time!



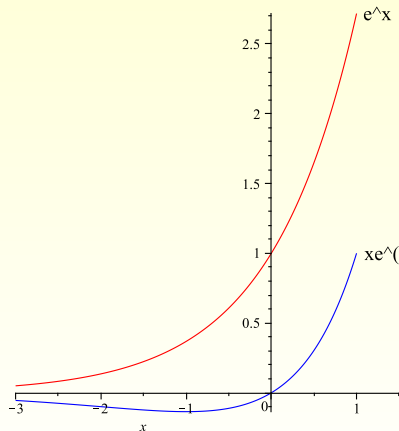
Just the right value of b :

2.71828182845904523536028747135266249775724709369995957496697....



Is $\frac{d}{dx}(e^x) = xe^{x-1}$?

Compare the graphs of e^x and xe^{x-1} :



e^x is always increasing, so $\frac{d}{dx}(e^x)$ should be always positive, but xe^{x-1} is negative for all $x < 0$.

xe^{x-1} is **not** the derivative of e^x .

In Class Work

For each function, find its derivative:

1. $f(x) = 5e^x - 7x^e - 6\ln(x) + \ln(2)$

2. $f(x) = (3^x)(\log_5(x))$

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

4. $f(x) = \ln(5x)$

5. $f(x) = \ln(\tan(x)) + \cos(x^2)$

6. $f(x) = \frac{7 + e^{3+4x}}{8 - \ln(3x)}$