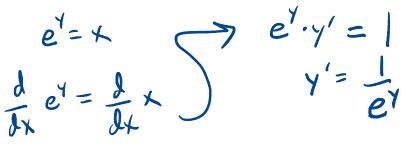
1. I'm tired of doing all the work around here. It's your turn. You're going to show that

$$\frac{d}{dx}\ln(x)=\frac{1}{x}.$$

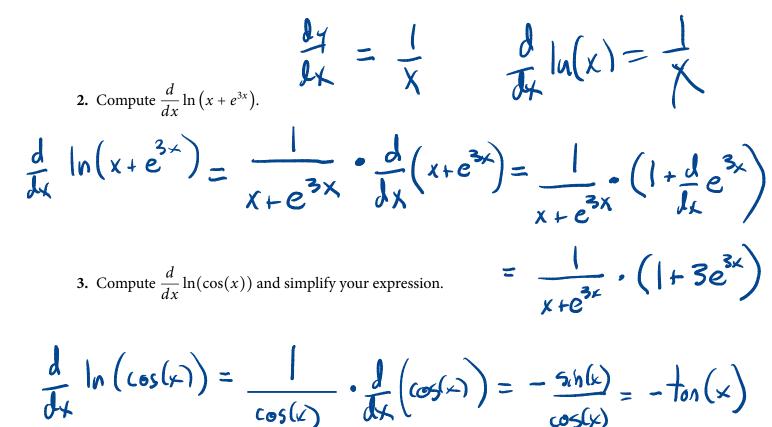
Start with the equation  $y = \ln(x)$ .

1. Solve this equation for *x*.

2. Take an implicit derivative with respect to *x*, and solve for dy/dx.



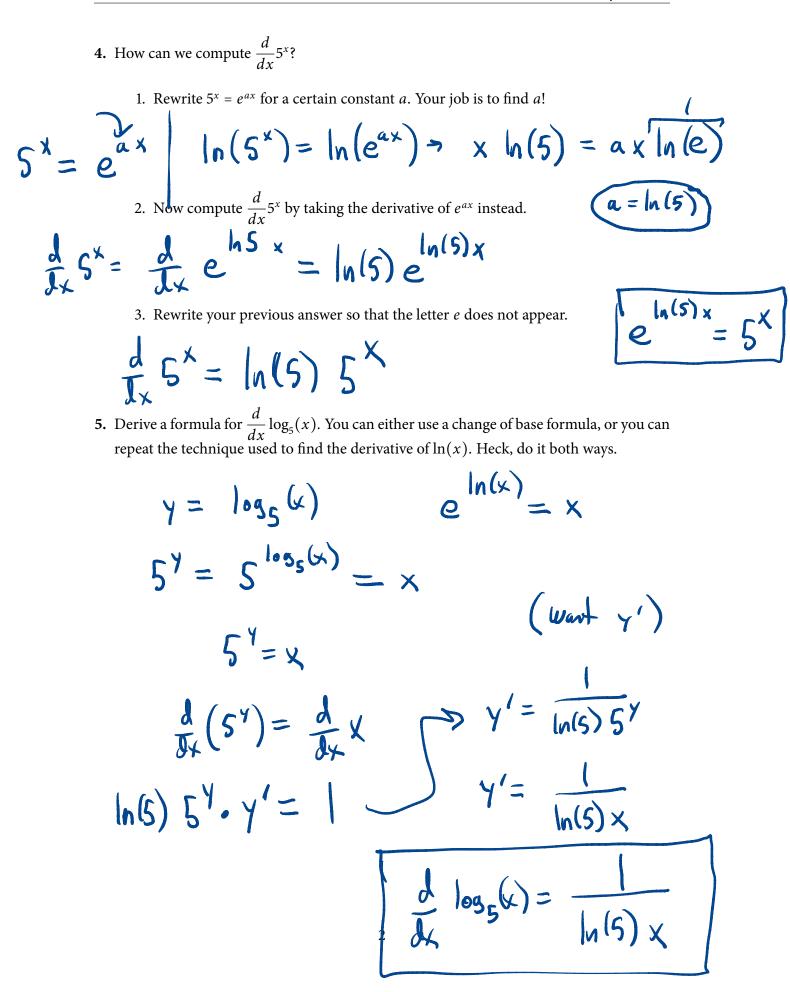
3. Now convert dy/dx into an expression that only involves x. (Tah dah!)



 $\frac{d}{dx} e^{3x} = e^{3x} \cdot d(3x)$ 

inside: 3x outside: ex outside: e

 $= 3e^{3\kappa}$ 



6. Suppose you wish to differentiate

$$f(x)=x^x.$$

The tool to use is called logarithmic differentiation.

- Start with the equation  $y = x^x$ .  $\longrightarrow$  warf  $\frac{dy}{dy}$ , y'
  - 1. Apply the natural logarithm to both sides of the equation and simplify.

$$\ln(y) = \ln(x^{\times}) = \times \ln(x)$$

2. Take an implicit derivative with respect to *x*, and solve for dy/dx.

3. Now convert dy/dx into an expression that only involves *x*. (Tah dah!)

 $\gamma' = \chi^{\times} \left( \ln(x) + 1 \right)$ 

7. Differentiate  $f(x) = x^{\sin(x)}$ .

 $y = x^{\sin(k)} \quad \text{want } y'$   $\ln(y) = \ln(x^{\sin(k)}) = \sinh(x) \ln(x)$   $\frac{1}{y}y' = \cos(x)\ln(x) + \frac{\sinh(x)}{3x} = y' = x^{\sin(k)} \left[\cos(x)\ln(x) + \frac{\sinh(x)}{x}\right]$ 

8. We wish, for whatever bizarre reason, to compute dy/dx if

$$y = \frac{(x^2+1)(x+3)^{1/2}}{x-1}.$$

One can use the product and quotient rules. But logarithmic differentiation can be a useful tool instead. known as logarithmic differentiation.

1. Take the natural logarithm of both sides of the equation.

$$ln(y) = ln(x^{2}+1) + ln((x+3)^{l/2}) - ln(x-1)$$
  
= ln(x^{2}+1) +  $\frac{1}{2}ln(x+3) - ln(x-1)$ 

3. Compute (implicitly) dy/dx and solve for dy/dx.

X-

$$\frac{1}{2} \frac{1}{x^{2}+1} = \frac{1}{2} \frac{1}{x+3} = \frac{1}{x+3} = \frac{1}{x-1}$$
4. Convert the expression for  $\frac{dy}{dx}$  so that it only involves  $x$ , and there are no appearances of  $y$ .  

$$y' = Y \cdot \left[ \frac{2x}{x^{2}+1} + \frac{1}{2} \frac{1}{x+3} - \frac{1}{x-1} \right]$$

$$= \frac{\left(x^{2}+1\right)\left(x+3\right)^{1/2}}{\left(x+3\right)^{1/2}} \cdot \left[ \frac{2x}{x+3} + \frac{1}{2} \frac{1}{x+3} - \frac{1}{x-1} \right]$$