Definition of derivative:

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

$f(x) = x^2 - 2x$ original equation

$f'(x) = \lim_{h \to 0} \frac{(x+h)^2-2(x+h)-[x^2-2x]}{h}$ replace the x's with (x+h) then subtract original equation /h

$f'(x) = \lim_{h \to 0} \frac{x^2+2xh+h^2-2x-2h-x^2+2x}{h}$ multiply the equations out

$f'(x) = \lim_{h \to 0} \frac{2xh+h^2-2h}{h}$ cancel out matching terms

$f'(x) = \lim_{h \to 0} \frac{h(2x+h-2)}{h}$ factor out an h so it can cancel with the denominator

$f'(x) = \lim_{h \to 0} 2x + h - 2$ now apply the limit as h goes to 0 which cancels remaining h's

$f'(x) = 2x - 2$ we now have our derivative

$\frac{d}{dx} x^n = nx^{n-1}$

ex: $\frac{d}{dx}(x^5) = 5x^4$ (multiply exponent with coefficient, then subtract one from exponent)

$\frac{d}{dx} e^{kx} = ke^{kx}$

$\frac{d}{dx}(e^{2x}) = 2e^{2x}$ (rewrite the e term and then multiply by the derivative of the exponent)

$\frac{d}{dx} ln(kx) = \frac{k}{kx}$

$\frac{d}{dx} ln(3x) = \frac{3}{3x} = \frac{1}{x}$ or $\frac{d}{dx} ln(x^2) = \frac{2x}{x^2} = \frac{2}{x}$

Drop the term you are doing the ln of to the denominator, its derivative goes on top.

$\frac{d}{dx} ln(u) = \frac{u'}{u}$

$\frac{d}{dx} 5^x = 5^x ln|x|$ When the exponent is a variable, rewrite the term, times the ln of the base, times the derivative of the exponent.

$\frac{d}{dx} 2^{3x} = 2^{3x} ln|3x| * 3$

(rewrite, ln base, der of exp)