Logarithmic Function 1

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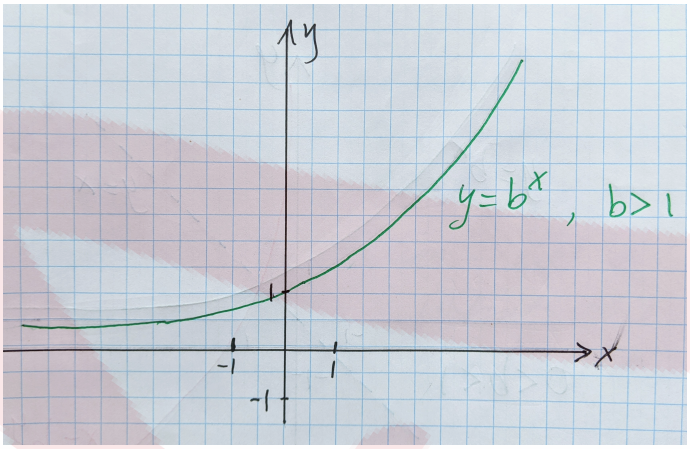
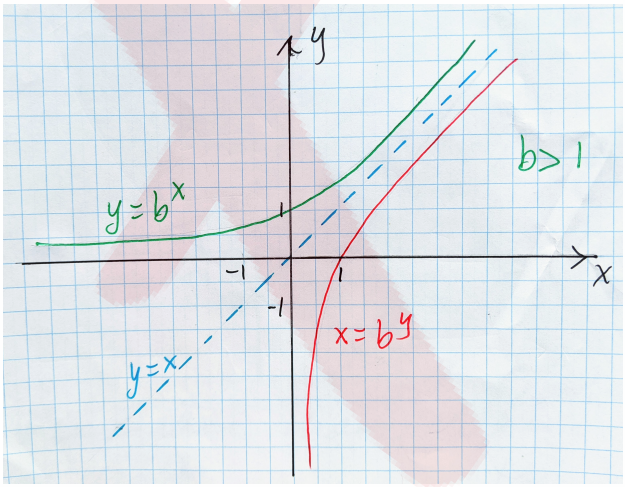
Logarithmic Function

The inverse of the exponential function is called the *logarithm function*. Let's start by seeing what the logarithm function looks like. We know what the exponential function $f(x) = b^x, b > 1$ look like.



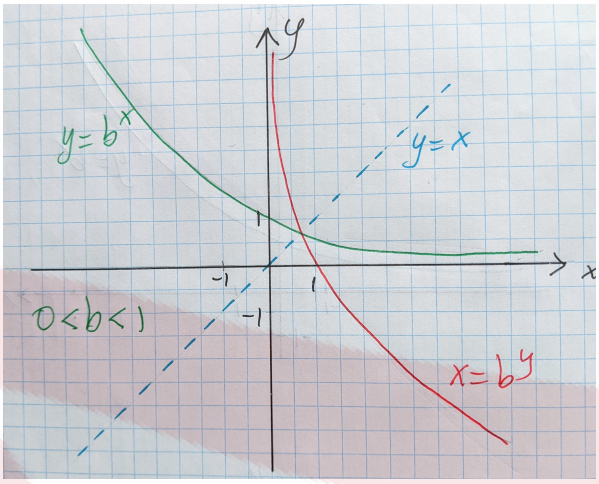
Remmber how the graph of the inverse of a function is obtained? The graph of the inverse of a function is obtained by reflecting the graph of the function $f(x)$ in the line $y = x$. Let's do this now for the exponential function $f(x) = b^x$.



Now, how do we find the algebraic expression for the inverse of a function? We interchange the x and y values in the original function $f(x)$ and then solve for y. Let's do the first part,

$$x = b^y, \quad b > 1$$

We can do the same for when $0 < b < 1$.



The logaithm function is the inverse of the exponential function. How is the inverse function written? $x = b^y$ represents the inverse of $y = b^x$. Solving $x = b^y$ for y gives the following function and notation:

$$x = b^y \iff y = \log_b x$$

where $y = \log_b x$ is read as "y equals log of x, base b", where the function y is defined for $x > 0$. To summarize,

Exponential	Logarithm
$x = b^y$	$y = \log_b x$

for $b > 0$ and $b \neq 1$. What does the logaithm function mean? $y = \log_b x$ means, the base b must be raised to the power y to give the value x.

Exercises

1. Change to exponential or logarithmic form.

   a) $\log_5\left(\frac{1}{25}\right) = -2$

   b) $\log_{1/3} 9 = -2$

   c) $\log_7 1 = 0$

   d) $\log_y\left(\frac{1}{7}\right) = -1$

2. Change to logarithmic form.

   a) $3^2 = 9$

   b) $8^0 = 1$

   c) $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$

   d) $36^{1/2} = 6$

   e) $125 = 5^3$

   f) $49 = 7^2$