Logarithmic Functions

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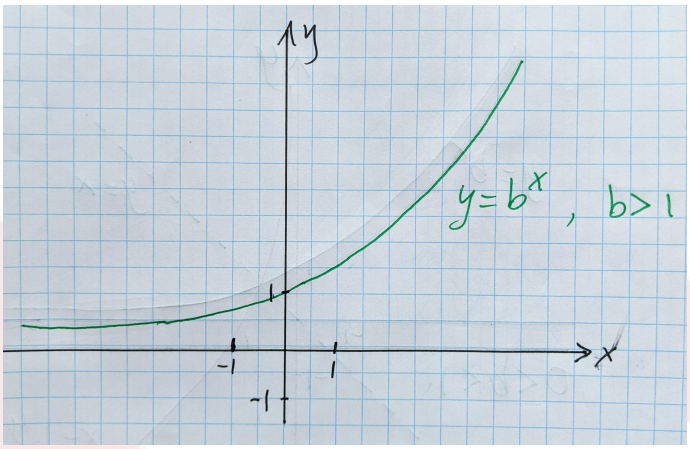
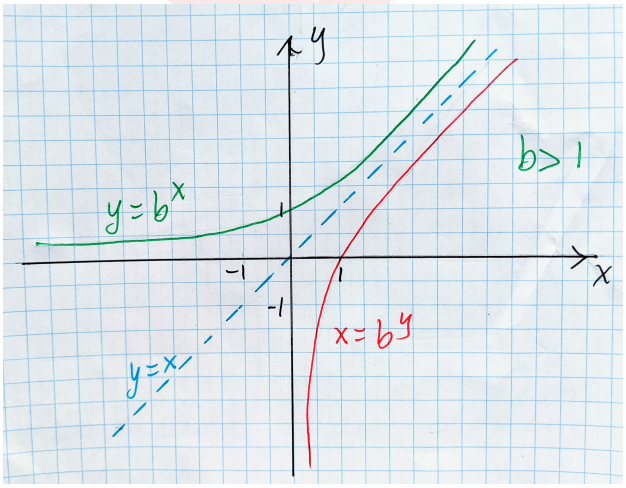
Logarithmic Function

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.



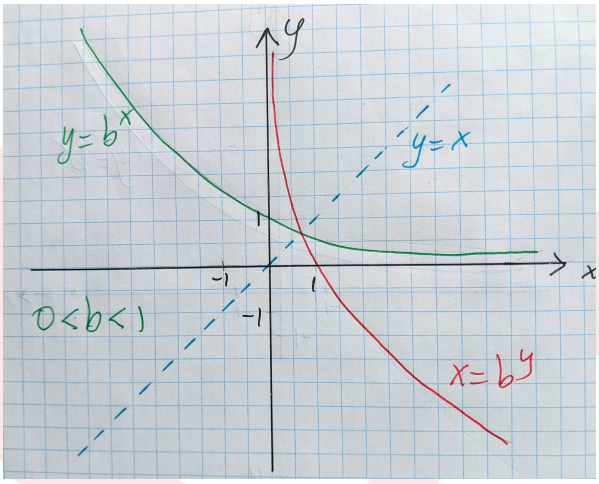
Remmber how the graph of the inverse of a function is obtained? The graph of the inverse of a function is obtained by reflecting the graph of the function $f(x)$ in the line $y = x$. Let's do this now for the exponential function $f(x) = b^x$.



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

Change to exponential or logarithmic form.

(a) $\log_3 81 = 4$

(b) $\log_{25} 5 = \frac{1}{2}$

(c) $5^3 = 125$

(d) $\left(\frac{1}{2}\right)^{-3} = 8$

(e) $3^2 = 9$

(f) $9^0 = 1$

(g) $2^{-3} = \frac{1}{8}$

(h) $27^{2/3} = 9$

(i) $\log_5 125 = 3$

(j) $\log_7 1 = 0$

