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*Graphs of Related Functions - Lesson 6*

# Logarithmic Graphs

LI

- Know the Logarithmic Function and Logarithmic Graphs.
- Know how exponential and logarithmic graphs are connected.
- Sketch related graphs of logarithmic functions.

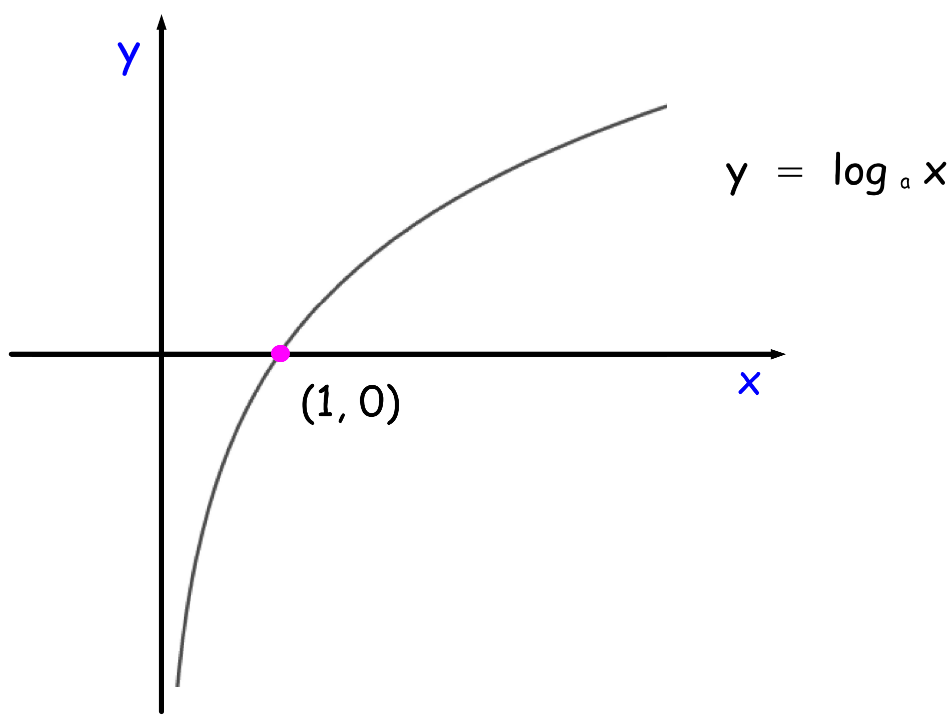
SC

- Graphs of related functions.
- Rules of logarithms.

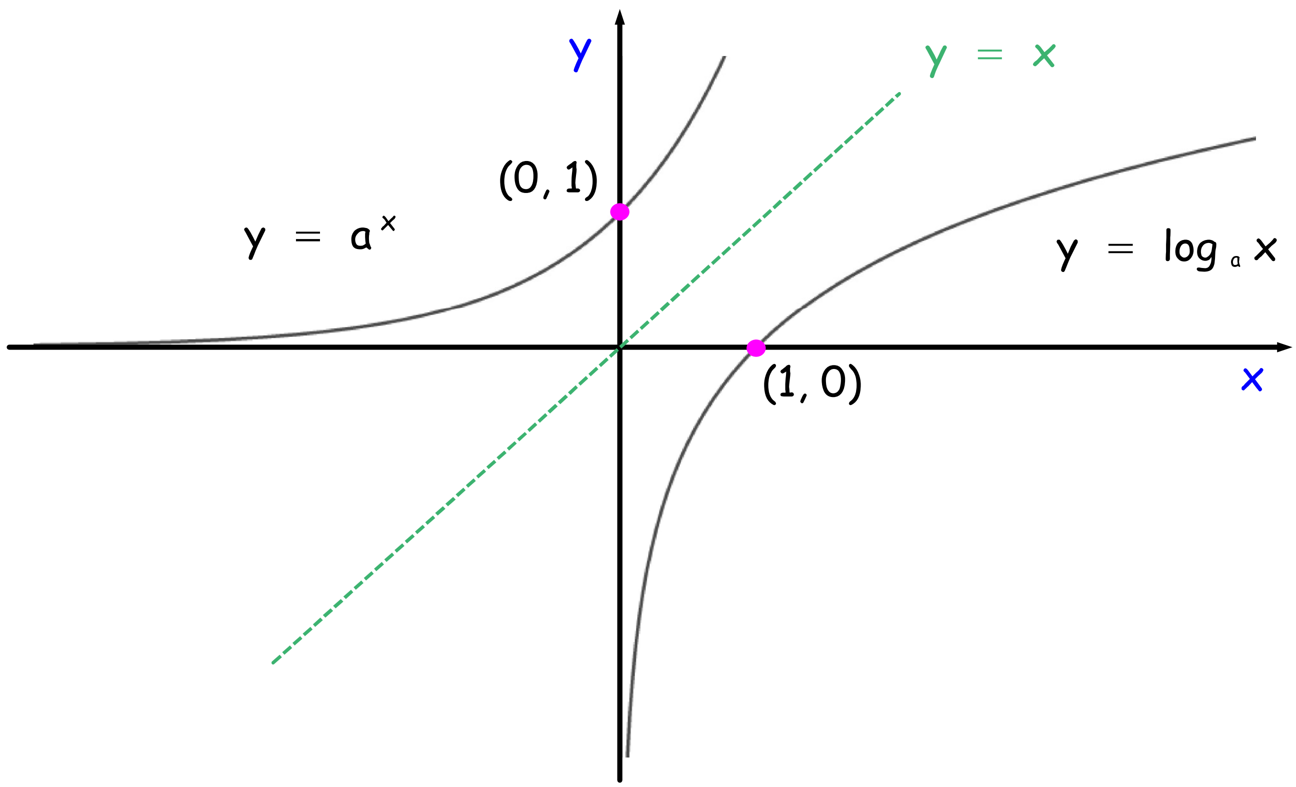
The Logarithmic Graph

For any $a > 0$, the Logarithmic Function to Base a is the function $y = \log_a x$

For any $a > 0$, the Logarithmic Graph to Base a is the graph of the logarithmic function $y = \log_a x$



How the Exponential and Logarithmic Graphs are Related

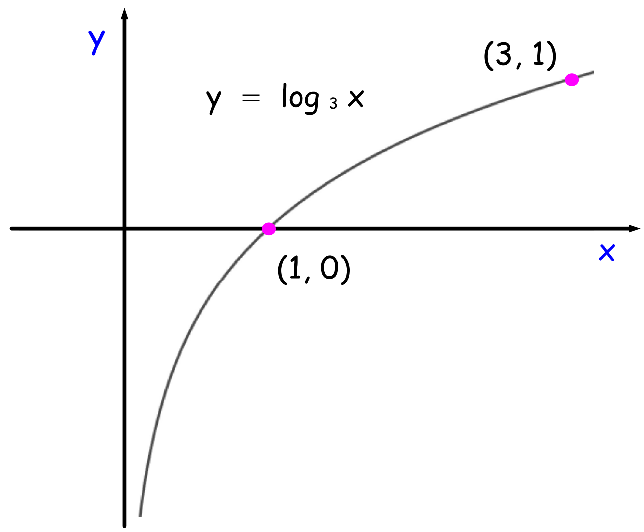



The logarithmic graph is obtained by reflecting the graph of the corresponding (same base) exponential function in the line $y = x$

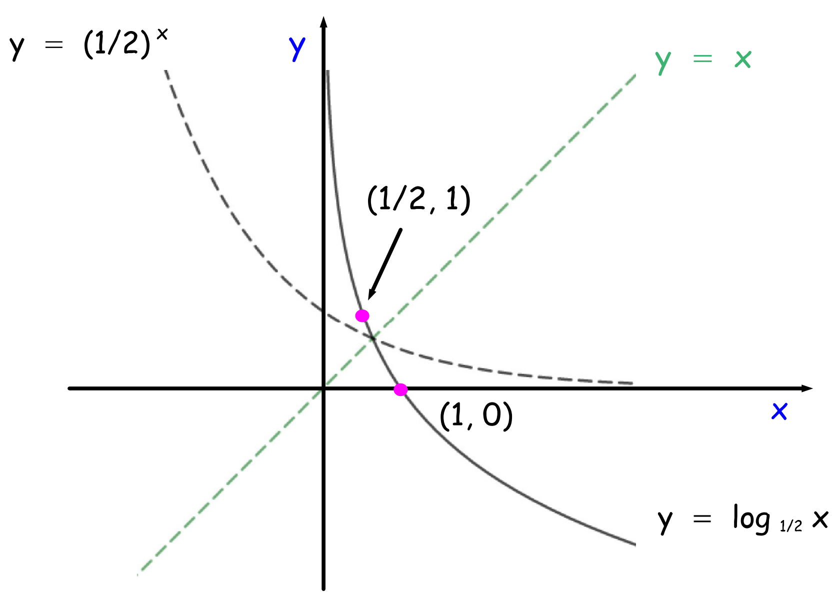
Example 1

Sketch the graphs of $y = \log_3 x$ and $y = \log_{1/2} x$ on separate diagrams, indicating where each graph crosses the y - axis.

Also indicate the coordinates (d, 1) for $y = \log_3 x$ and (e, 1) for $y = \log_{1/2} x$.

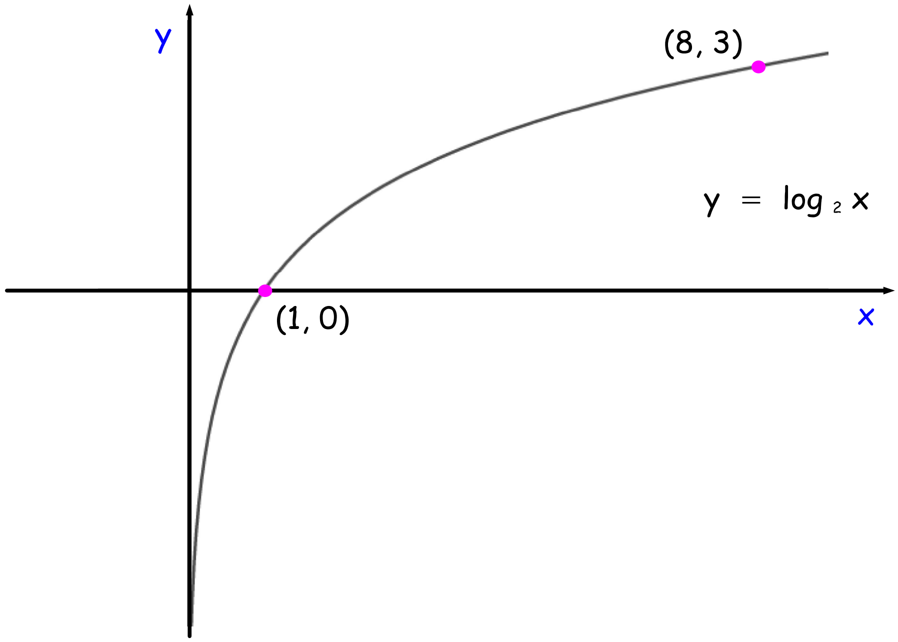



The graph of $y = \log_{1/2} x$ is obtained by reflecting the graph of $y = (1/2)^x$ in the line $y = x$.



Example 2

Shown below is the graph of $y = \log_2 x$.

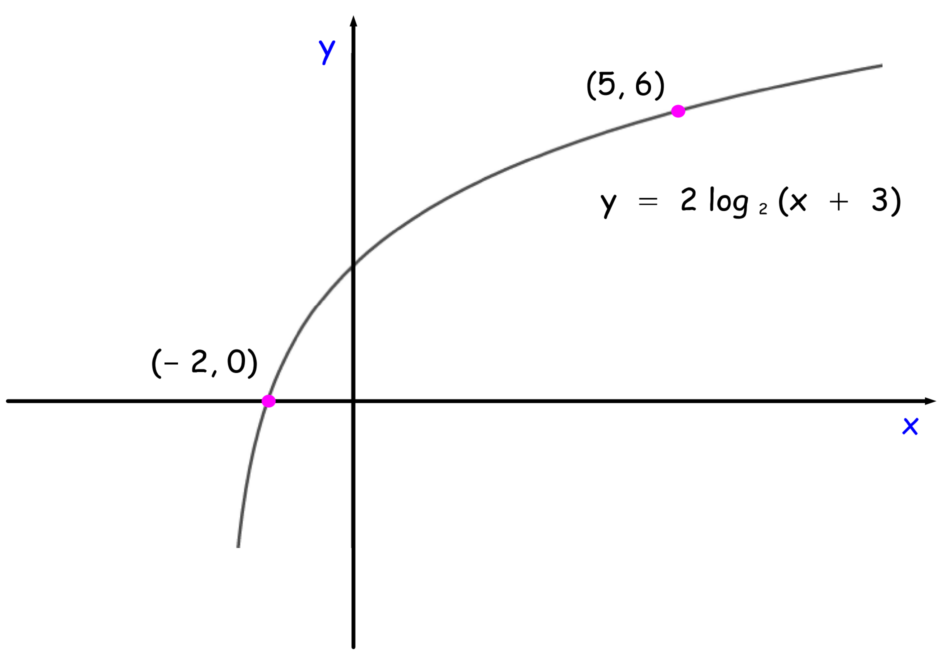



Sketch the graph of $2 \log_2 (x + 3)$.

The coordinates transform thus :

$(1, 0) \longrightarrow (1 - 3, 0 \times 2) = \underline{(-2, 0)}$

$(8, 3) \longrightarrow (8 - 3, 3 \times 2) = \underline{(5, 6)}$

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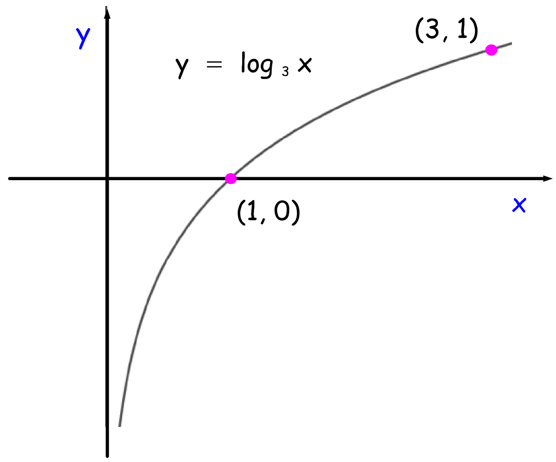
Example 3

The diagram shows the graph of $y = \log_3 x$.




Use this to sketch the graphs of :

(a) $y = \log_3 x^2$.
(b) $y = \log_3 (1/x)$.
(c) $y = \log_3 (9x)$.

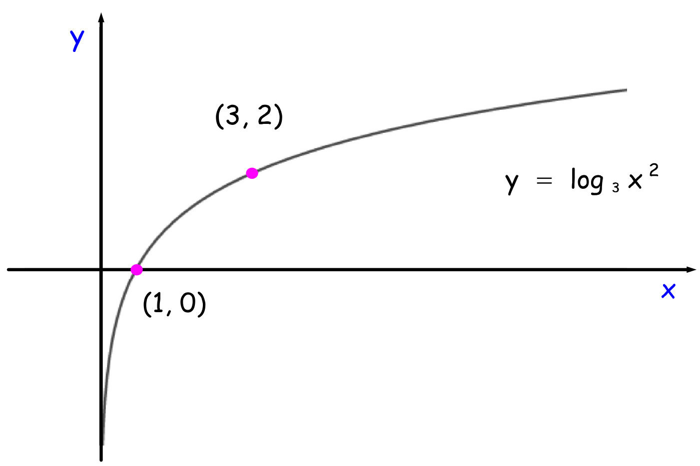
(a) Using the rules of logarithms,

$$y = \log_3 x^2 = 2 \log_3 x$$

The coordinates transform thus :

$(1, 0) \longrightarrow (1, 0 \times 2) = \underline{(1, 0)}$

$(3, 1) \longrightarrow (3, 1 \times 2) = \underline{(3, 2)}$



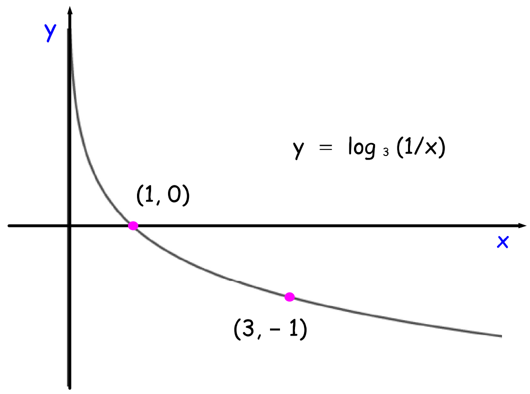
(b) Using the rules of logarithms,

$$y = \log_3 (1/x) = \log_3 x^{-1} = -\log_3 x$$

The coordinates transform thus :

$(1, 0) \longrightarrow (1, 0 \times -1) = \underline{(1, 0)}$

$(3, 1) \longrightarrow (3, 1 \times -1) = \underline{(3, -1)}$



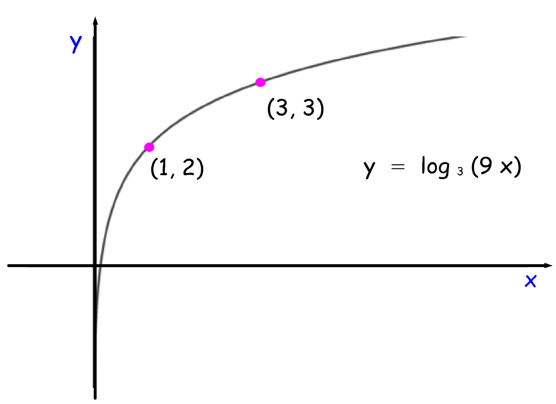

(c) Using the rules of logarithms,

$$\begin{aligned} y = \log_3 (9x) &= \log_3 9 + \log_3 x \\ &= \log_3 3^2 + \log_3 x \\ &= 2 \log_3 3 + \log_3 x \\ &= 2 + \log_3 x \end{aligned}$$

The coordinates transform thus :

$(1, 0) \longrightarrow (1, 0 + 2) = \underline{(1, 2)}$

$(3, 1) \longrightarrow (3, 1 + 2) = \underline{(3, 3)}$



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