$y = \log_a x$ log base a of x

equivalent to $x = a^y$

The expression $\log_a x$ represents the exponent to which the base "a" must be raised in order to obtain x.

Ex 1

Log Form	Exponential Form
$\log_2 8 = 3$	$2^3 = 8$
$\log_{\frac{1}{2}} 16 = -4$	$\left(\frac{1}{2}\right)^{-4} = 16$
$\log_{10} 100{,}000 = 5$	$10^5 = 100{,}000$
$\log_3 \frac{1}{81} = -4$	$3^{-4} = \frac{1}{81}$
$\log_5 5 = 1$	$5^1 = 5$
$\log_{\frac{3}{4}} 1 = 0$	$\frac{3}{4}^0 = 1$

$\log_2 8 = 3$ $\quad$ $2^3 = 8$

base ↗ $\quad$ ↖ base

Ex 2 Solve each equation.

(a) $\log_x \frac{8}{27} = 3 \Rightarrow \left(x^{\frac{3}{1}}\right)^{\frac{1}{3}} = \left(\frac{8}{27}\right)^{\frac{1}{3}}$

$$x = \frac{8^{\frac{1}{3}}}{27^{\frac{1}{3}}} = \boxed{\frac{2}{3} = x}$$

(b) $\log_4 x = \frac{5}{2} \Rightarrow 4^{\frac{5}{2}} = x$

$$\left(4^{\frac{1}{2}}\right)^5 = 2^5 = \boxed{32 = x}$$

(c) $\log_{49} \sqrt[3]{7} = x \Rightarrow 49^x = \sqrt[3]{7}$

$$49^x = 7^{\frac{1}{3}}$$

$$\left(7^2\right)^x = 7^{\frac{1}{3}}$$

$$\frac{2x}{2} = \frac{1}{3} \cdot \frac{1}{2}$$

$$\boxed{x = \frac{1}{6}}$$