5.3 Converting from Exponential to Logarithmic Forms

Exponential Equation $y = b^x$

Logarithmic Equation $\log_b y = x$

1. Convert each exponential equation to logarithmic form and each logarithmic equation to exponential form.

Exponential Equation	Logarithmic Form
$3^4 = 81$	$\log_3 81 = 4$
$6^1 = 6$	$\log_6 6 = 1$
$x^0 = 1$	$\log_x 1 = 0$
$5^{-2} = \frac{1}{25}$	$\log_5 \frac{1}{25} = -2$
$3^x = 5$	$\log_3 5 = x$
$8^{\frac{2}{3}} = 4$	$\log_8 4 = \frac{2}{3}$

Logarithmic Equation	Exponential Form
$\log_3 9 = 2$	$3^2 = 9$
$\log_x 8 = 3$	$x^3 = 8$
$\log_6 \frac{1}{6} = -1$	$6^{-1} = \frac{1}{6}$
$\log_3 3 = 1$	$3^1 = 3$
$\log_{15} 1 = 0$	$15^0 = 1$
$\log_{81} 9 = \frac{1}{2}$	$81^{\frac{1}{2}} = 9$

2. Simplify the following using the special properties of logarithms.

a. $\log_{10} 10 = x$ $\quad 10^x = 10$ $\quad x = 1$

b. $\log_2 2 = 1$

c. $\log_{16} 1 = x$ $\quad 16^x = 1$ $\quad x = 0$

d. $\log_{16} 16 = 1$ $\quad \log_b b = 1$

e. $\log_b 1 = 0$ $\quad \log_b 1 = 0$

3. Evaluate the following logarithms.

a. $\log 1000 = x$
$10^x = 1000$ $\quad x = 3$

b. $\log 0.00001$
$10^x = .00001$ $\quad -5$

c. $\log_4 16$
$4^x = 16$ $\quad 2$

d. $\log_4 \frac{1}{16}$
$4^x = \frac{1}{16}$ $\quad -2$

e. $\log_{\frac{1}{2}} 4$
$\frac{1}{2}^x = 4$ $\quad -2$

f. $\log_5 25\sqrt{5}$

g. $\log_7 \sqrt[3]{49}$

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4. Solve for x.

a. $\log_4 16 = x$

b. $\log_x 4 = 1$

c. $\log_3(x-5) = 2$

$3^2 = x - 5$

$9 = x - 5$

$+5 \quad +5$

$x = 14$

d. $\log_x 6 = \frac{1}{2}$

e. $\log_2 32 = 3x$

f. $\log_b 64 = 3$

$b^3 = 64$

$b^3 = 4^3$

$b = 4$

Solve:

5. $5^{\log_5 25} = x$

$\log_5 x = \log_5 25$

$x = 25$

6. $7^{\log_7(4x+3)}$

$4x+3$

7. $3^{\log_3 15}$

15

8. $9^{\log_9(x-2)}$

$x-2$