CHAPTER 8

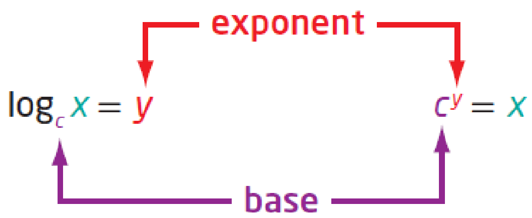
Logarithmic Functions

the <u>inverse</u> of an exponential function

The inverse of $y = c^x$ is ____________

This inverse can be rewritten as ______________

Logarithmic Form **Exponential Form**



where $c > 0, c \neq 1$

Exponential Form and Logarithmic Form

$$\left.\begin{array}{l} 3^2 = 9 \\ \log_3 9 = 2 \end{array}\right\}$$

Example 1:

Evaluate the following logarithms:

a) $\log_7 49$

b) $\log_6 1$

c) $\log_2 \sqrt{8}$

d) $\log_9 \sqrt[5]{81}$

Types of Logarithms

Common Logarithm

└→ base is 10

Example: $\log 100 \longrightarrow$

(not necessary to write the base for common logarithms)

Natural Logarithm

└→ base is e

Example: $\ln 3 \longrightarrow$

Properties:

(i) $\log_c 1 = 0$ Example: $\log_3 1$

(ii) $\log_c c = 1$ Example: $\log_4 4$

(iii) $\log_c c^x = x$ Example: $\log_5 5^2$

(iv) $c^{\log_c x} = x$ Example: $3^{\log_3 9}$

→

Example 2

Determine the unknown value.

i) $\log_5 x = -3$

ii) $\log_x 36 = 2$

iii) $\log_{64} x = \frac{2}{3}$

iv) $\log_x 9 = \frac{2}{3}$

v) If $\log_4 x = 2$, determine $\log_4 8x$

Questions P.380-381

2abcd,3bcd, 4abcd, 12abcd, 13a,14ab 20-21, 24

Graph the inverse of an exponential function

Example 3

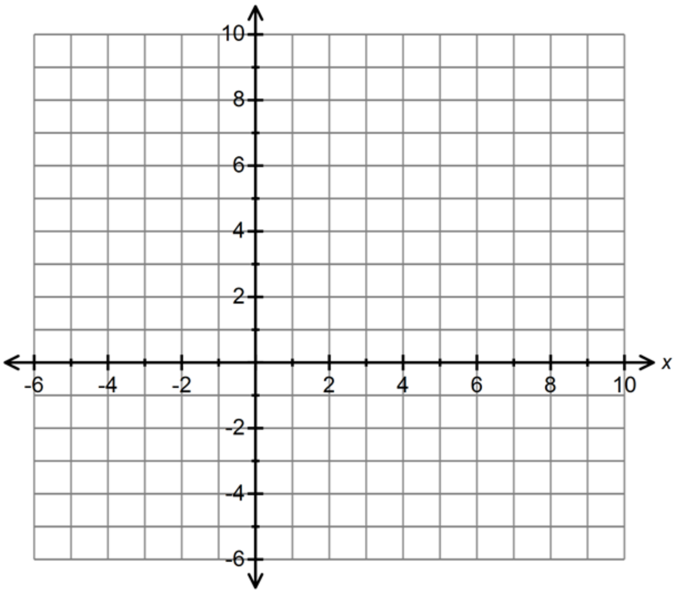
Graph the inverse of $y = 3^x$

$f(x) = 3^x$

X	Y

$f^{-1}(x) =$

X	Y



	$f(x) = 3^x$	$f^{-1}(x)$
Domain		
Range		
x-intercept		
y-intercept		
Asymptotes		

Your Turn

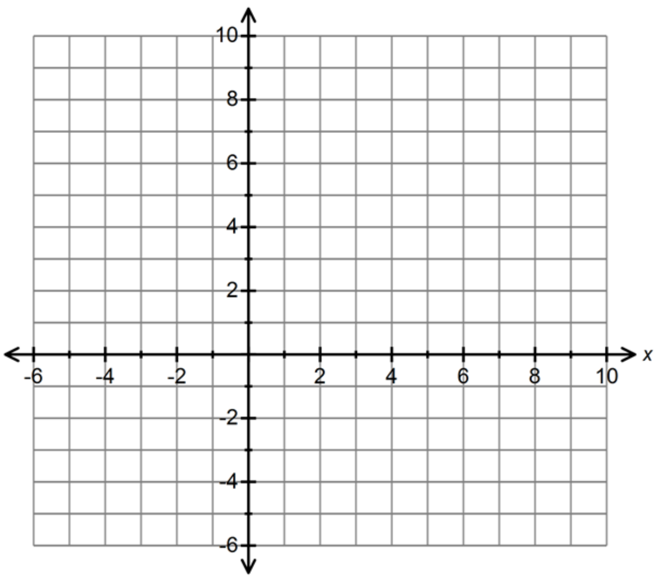
Graph the inverse of $y = \left(\frac{1}{2}\right)^x$

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

X	Y

$f^{-1}(x) =$

X	Y



	$f(x) = \left(\frac{1}{2}\right)^x$	$f^{-1}(x)$
Domain		
Range		
x-intercept		
y-intercept		
Asymptotes		

Example 4

The point $\left(\frac{1}{32}, -5\right)$ is on the graph of the logarithmic function $y = \log_c x$. The point $(k, 256)$ is on the graph of the inverse. Determine the values of c and k.

Questions P.380-381 #1ab, 8ab, 9ab,15, 16

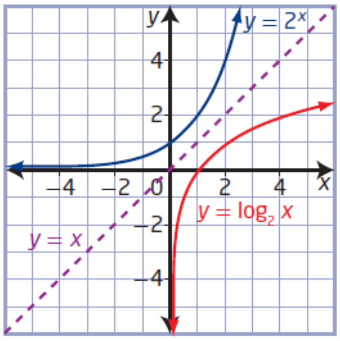
Summary

Key Ideas

- A logarithm is an exponent.
- Equations in exponential form can be written in logarithmic form and vice versa.

Exponential Form	**Logarithmic Form**
$x = c^y$	$y = \log_c x$

- The inverse of the exponential function $y = c^x$, $c > 0$, $c \neq 1$, is $x = c^y$ or, in logarithmic form, $y = \log_c x$. Conversely, the inverse of the logarithmic function $y = \log_c x$, $c > 0$, $c \neq 1$, is $x = \log_c y$ or, in exponential form, $y = c^x$.
- The graphs of an exponential function and its inverse logarithmic function are reflections of each other in the line $y = x$, as shown.



- For the logarithmic function $y = \log_c x$, $c > 0$, $c \neq 1$,
  - the domain is $\{x \mid x > 0, x \in R\}$
  - the range is $\{y \mid y \in R\}$
  - the x-intercept is 1
  - the vertical asymptote is $x = 0$, or the y-axis
- A common logarithm has base 10. It is not necessary to write the base for common logarithms:

$$\log_{10} x = \log x$$

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