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## 10.2. Advanced Algebra

### Logarithms and Logarithmic Functions

DATE: 12/5

Target 4C. Understand how to move between exponential and logarithmic forms.



In general, the inverse of  $y = b^x$  is  $x = b^y$ . In  $x = b^y$ ,  $y$  is called the **logarithm**, base  $b$ , of  $x$ . Usually written as  $y = \log_b x$  and is read "y equals log base b of x".

**Logarithm with base  $b$** : Suppose  $b > 0$  and  $b \neq 1$ . For  $x > 0$ , there is a number  $y$  such that  $\log_b x = y$  if and only if  $b^y = x$ .

**Logarithmic to Exponential Form** We use the "loopy loop"  
Write each equation in exponential form.

1.  $\log_8 1 = 0$        $8^0 = 1$

2.  $\log_2 \frac{1}{16} = -4$        $2^{-4} = \frac{1}{16}$

3.  $\log_3 9 = 2$        $3^2 = 9$

4.  $\log_{10} \frac{1}{100} = -2$        $10^{-2} = \frac{1}{100}$

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**Exponential to Logarithmic Form**

We use the "loopy loop" again

Write each equation in logarithmic form.

5.  $10^3 = 1000$   $\log_{10}(1000) = 3$

6.  $9^{\frac{1}{2}} = 3$   $\log_9(3) = \frac{1}{2}$

7.  $5^3 = 125$   $\log_5(125) = 3$

8.  $27^{\frac{1}{3}} = 3$   $\log_{27}(3) = \frac{1}{3}$

**Evaluate Logarithmic Expressions**

9. Evaluate  $\log_2 64 = 6$

Let  $\log_2 64 = y$

$2^y = 64$

$2^y = 2^6$

$\therefore y = 6$

$64 = 2^6$

10. Evaluate  $\log_3 243$

Let  $\log_3 243 = y$

$3^y = 243$

$3^y = 3^5$

$\therefore y = 5$

Recall:

$b^y = b^x \Rightarrow x = y$

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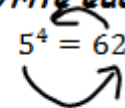
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### Now You Practice!

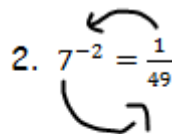
Write each equation in logarithmic form.

1.  $5^4 = 625$



$$\log_5(625) = 4$$

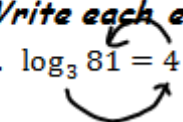
2.  $7^{-2} = \frac{1}{49}$



$$\log_7\left(\frac{1}{49}\right) = -2$$

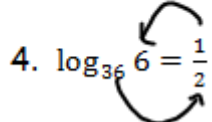
Write each equation in exponential form.

3.  $\log_3 81 = 4$



$$3^4 = 81$$

4.  $\log_{36} 6 = \frac{1}{2}$



$$36^{\frac{1}{2}} = 6$$

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*Evaluate each expression.*

5.  $\log_4 256 = y$



$$4^y = 256$$

$$4^y = 4^4$$

$$\therefore y = 4$$

6.  $\log_2 \frac{1}{8} = y$

$$2^y = \frac{1}{8}$$

$$2^y = \frac{1}{2^3}$$

$$2^y = 2^{-3}$$

$$\therefore y = -3$$