Sec 6-6: Exponential and Logarithmic Equations

# Solve Exponential Equations Using a Common Base

Symbols	Suppose $b > 0$ and $b \ne 1$ , then $b^x = b^y$ if and only if $x = y$ .
Words	If two powers of the same base are equal, then their exponents
	are equal; if two exponents are equal, then the powers with
	the same base are equal.

## Example 1

What is the solution to  $\left(\frac{1}{2}\right)^{x+7} = 4^{3x}$ ?  $\left(3^{-1}\right)^{x+7} = \left(3^{2}\right)^{3x}$ Turn each power into the same base  $2^{-1(x+7)} = 2.3x$ Now set the exponents equal to each other

## Example 1

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### Try It!

**a.** 
$$25^{3x} = 125^{x+2}$$

**b.** 
$$0.001 = 10^{6x}$$

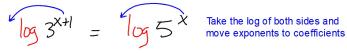
a. 
$$25^{3x} = 125^{x+2}$$
 $(5^{-2})^{3x} = (5^{-3})^{x+2}$ 
 $5^{6x} = 5^{3(x+2)}$ 
 $6x = 3(x+2)$ 
 $6x = 3x + 6$ 
 $-3x - 3x$ 
 $3x = 6$ 
 $3x = 6$ 

**b.** 
$$0.001 = 10^{6x}$$
 $10^{-3} = 10^{6x}$ 
 $10^{-3} = 6x$ 
 $10^{-3} = 6x$ 

# **Property of Equality for Logarithmic Equations**

Symbols	If $x > 0$ , then $\log_b x = \log_b y$ if and only if $x = y$ .
Words	If two logarithms (exponents) of the same base are equal, then
	the quantities are equal; if two quantities are equal, and the
	bases are the same, then the logarithms (exponents) are equal.

# Example 3 What is the solution to $3^{x+1} = 5^x$ ?



distribute log3

$$x \log 3 + \log 3 = x \log 5$$
 move all x terms to one side  $-x \log 3$ 

$$\log 3 = \chi \log 5 - \chi \log 3$$
factor out the x from the two terms on the right side then divide to get x by itself
$$\log 3 = \chi \left(\log 5 - \log 3\right)$$

$$X = \frac{\log 3}{\log 5 - \log 3}$$
  $X = 2.15$