

TOPIC: SOLVING EXPONENTIAL & LOGARITHMIC EQUATIONS

Solving Exponential Equations Using Like Bases

- ◆ We **evaluated** exp. functions for given x ; we **solve** exp. *equations* for unknown x to make the statement _____.
- To solve exp. equations, rewrite each side to have same _____ & set _____ equal, solving for ____.

Recall	Exponential Function	New	Exponential Equation
	$f(x) = 2^x$ $f(4) = 2^4$ $f(4) = 16$		$16 = 2^x$ $2\text{---} = 2^x$ $\text{---} = \text{---}$

EXAMPLE

Solve each exponential equation by expressing each side as a power of the same base.

(A)

 $64 = 2^x$

(B)

 $5^{x+1} = \sqrt{5}$

(C)

 $27 = 9^x$

COMMON POWERS	
Squares	Cubes
$2^2 = 4$	$2^3 = 8$
$3^2 = 9$	$3^3 = 27$
$4^2 = 16$	$4^3 = 64$
$5^2 = 25$	$5^3 = 125$
$6^2 = 36$	Other
$7^2 = 49$	$2^4 = 16$
$8^2 = 64$	$2^5 = 32$
$9^2 = 81$	$3^4 = 81$
$10^2 = 100$	

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PRACTICE

Solve the exponential equations.

(A)

$$4^{x+7} = 16$$

(B)

$$100^x = 10^{x+17}$$

(C)

$$81^{x+1} = 27^{x+5}$$

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Solving Exponential Equations Using Logs

◆ If you **CANNOT** rewrite sides of exponential equation to have the same base, solve using log or ln.

Like Bases

$$16 = 2^x$$

$$2^4 = 2^x$$

$$4 = x$$

Unlike Bases

$$17 = 2^x$$

$$2^{???} = 2^x$$

Properties of Logarithms

Name	Property
Product Rule	$\log_b(m \times n) = \log_b m + \log_b n$
Quotient Rule	$\log_b\left(\frac{m}{n}\right) = \log_b m - \log_b n$
Power Rule	$\log_b m^n = n \log_b m$

EXAMPLE

Solve each exponential equation by using logs.

(A)

$$10^x + 64 = 100$$

(B)

$$3 = 2^{x+1}$$

HOW TO: SOLVE EXP. EQNS WITH LOGS

- 1) _____ exp. expression(s)
- 2) If base 10: Take _____ of both sides
If NOT base 10: Take _____ of both sides
- 3) Use log rules to get x out of exponent
- 4) _____ for x
- 5) (If asked) Approximate using calculator

◆ Recall: The log or ln of some number is a _____, not a variable! Treat it like any other number.

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PRACTICE

Solve the exponential equations.

(A)

$$2 \cdot 10^{3x} = 5000$$

(B)

$$900 = 10^{x+17}$$

(C)

$$e^{2x+5} = 8$$

(D)

$$7^{2x^2-8} = 1$$

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Solving Logarithmic Equations

- ◆ When solving log equations, you'll encounter two possibilities: $\log_b M = \log_b N$ **OR** $\log_b M = c$
 - If a logarithmic equation can be written as $\log_b M = \log_b N$, set ____ = ____ & solve for x .

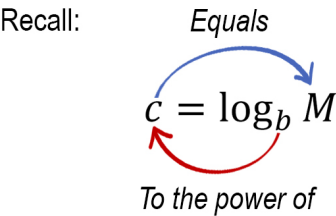
Recall	Exponential Equation	New	Logarithmic Equation
	$16 = 2^x$		$\log_2(x + 1) = \log_2 5$
	$2^4 = 2^x$		_____ = _____
	$4 = x$		_____ = _____

EXAMPLE Solve the log equation.

$\ln(x + 4) - \ln 2 = \ln 8$

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Power Rule	$\log_b m^n = n \log_b m$

- If a log equation **CANNOT** be written as $\log_b M = \log_b N$ put in _____ form, then solve for x .



EXAMPLE Solve the log equation.

$\log_2(4x) = 5$

HOW TO:SOLVE LOG EQNS: EXP FORM
1) _____ log expression
2) Put in exponential form
3) _____ for x .
4) _____ solution by plugging x in M <ul style="list-style-type: none">• If $M > 0$, DONE• If $M < 0$, _____ a solution

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PRACTICE

Solve the logarithmic equations.

(A)

$$\log_3(3x + 9) = \log_3 5 + \log_3 12$$

(B)

$$\log(x + 2) + \log 2 = 3$$

(C)

$$\log_7(6x + 13) = 2$$