Warm up

1) What value of x makes the expression true?

a) $5^x = 125$

b) $2^x = 1/32$

c) $(-3)^x = -243$

2) Expand $y = \log (x^2 y^3)$

3) Condense $f(x) = 2 \log_4 (x-1) - 4 \log_4 (x+3)$

4) Change to exponential form: $\log_3 81 = 2x$

7. $\log 10^3$ 3

34. $\log x = 4$ 10,000

20. $5^{\log_5 8}$ 8

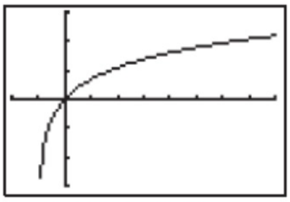
22. $10^{\log 14}$ 14

In Exercises 53–58, graph the function, and analyze it for do range, continuity, increasing or decreasing behavior, bounde extrema, symmetry, asymptotes, and end behavior.

54. $f(x) = \ln(x + 1)$

56. $f(x) = -\log(x + 2)$

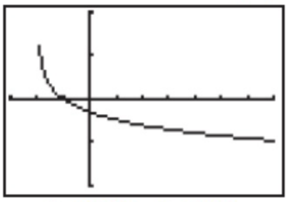
54.



$[-2, 8]$ by $[-3, 3]$

Domain: $(-1, \infty)$; Range: $(-\infty, \infty)$; Continuous; Always decreasing; Not symmetric; Not bounded; No local extrema; Asymptote: $x = -1$; $\lim_{x \to \infty} f(x) = \infty$

56.



$[-3, 7]$ by $[-2, 2]$

Domain: $(-2, \infty)$; Range: $(-\infty, \infty)$; Continuous; Always decreasing; Not symmetric; Not bounded; No local extrema; Asymptote: $x = -2$; $\lim_{x \to \infty} f(x) = -\infty$

8. $\log xy^3 = \log x + \log y^3 = \log x + 3\log y$

14. $\log x + \log 5 = \log 5x$

19. $2\ln x + 3\ln y = \ln x^2 + \ln y^3 = \ln(x^2y^3)$

24. $\log_5 19$ 1.8295

27. $\log_{0.5} 12$ −3.5850

30. $\log_7 x = \dfrac{\ln x}{\ln 7}$

34. $\log_4 x = \dfrac{\log x}{\log 4}$

35. $\log_{1/2}(x + y) = \dfrac{\log(x + y)}{\log(1/2)} = -\dfrac{\log(x + y)}{\log 2}$

Objective:

Solving exponential and Log equations

Solving Exponential Equations with like bases

STEPS
1. Get the same base on each side.
2. If $b^x = b^y$, then x=y.
3. Solve for the variable.
4. Check please!

$$\frac{1}{25} = 125^{2x+3}$$

$5^{-2} = (5^3)^{2x+3}$

$5^{-2} = 5^{6x+9}$

$6x+9=-2$

$6x=-11$

$x=-11/6$

$3^{2x}=81$

$3^{2x}=3^4$

$2x=4$

$x=2$

$$3^{5x} = 9^{2x-1}$$

$3^{5x} = (3^2)^{2x-1}$

$3^{5x} = 3^{4x-2}$

$5x=4x-2$

$x=-2$

$2^2 \to 2^7$

$3^2 \to 3^5$

$4^2 \to 4^4$

$5^2 \to 5^4$

Practice:

1. $2^{x+1} = 4^{-1}$

2. $\left(\frac{1}{3}\right)^3 = 9^x$

How to...

Evaluate Logarithmic Expressions

STEPS

1. set $\log_b a$ equal to x
2. change to exponential form $b^x = a$
3. get the bases the same
4. solve for x

GUIDED PRACTICE:

Evaluate each expression.

7. $\log_3 243 = x$

b a c

$3^x = 243$

$3^x = 3^5$

$x = 5$

3. $\log_2 32 = 3x$

base answer exp.

$2^{3x} = 32$

$2^{3x} = 2^5$

$x = 5/3$

What if you cannot get the same base in an exponential equation $b^x = a$?

$\log_7 x^2$

$2 \log_7 x$

- *Remember...*
  The Power Property of Logarithms says:

  $n \log_b m$ changes to $\log_b m^n$ **(power up)**

- Well, it works the other way, too:

  $\log_b m^n$ changes to $n \log_b m$ **(power down)**

GUIDED PRACTICE

Solve each equation. Round to four decimal places.

2. $3^x = 11$ ← **You cannot get the same base, so take the log of each side!**

$\log 3^x = \log 11$

$x \log 3 = \log 11$

$x = \frac{\log 11}{\log 3} = 2.1827$

● **CALCULATOR TIP** **log(11) ENTER ÷ (log(3) ENTER**

TI: blue keystrokes; CASIO: blue AND red keystrokes

BOTH: ***It is important to close parentheses after the number AND always follow ÷ by the left parentheses (***

3. $5^{2x} = 32$

4. $3^{n+1} = 7$

How to solve a logarithmic equation:

STEPS:

1. Condense the logarithms
2. If $\log_b a = p$ then change to exponential form and solve.
3. If $\log_b x = \log_b y$, then $x = y$.
4. Solve.
5. CHECK! Remember for $\log_b a = p$, both a and b must be positive!!

GUIDED PRACTICE:

Solve.

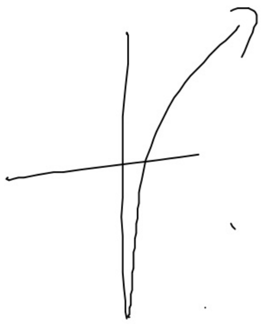
1. $\log_3 5 + \log_3 x = \log_3 10$

$\log_3 5x = \log_3 10$

$5x = 10$

$x = 2$

~~$x = 4$~~



5. $\log_2 x + \log_2 (x + 2) = 3$

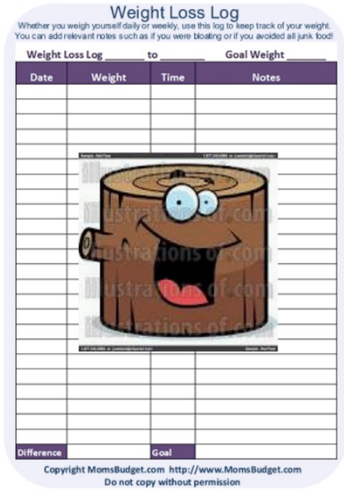
6. $\log_{10} 16 - \log_{10} 2x = \log_{10} 2$

7. $4\log_2 x + \log_2 5 = \log_2 405$

8. $3\log_2 x - 2\log_2 5x = 2$

How to...

Solve Logarithmic Equations using Exponentiation



Raise both sides to the same base.

- This is called __exponentiation__.
- *Remember...*

  A base raised to a log with the same base rule:

  $$b^{\log_b x} = x$$

  - Therefore,
  - simplifies to $x = 10^a$