Questions on 1.3? We will take our quiz soon!

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3. $4^{3x} = 2^{2x-8}$

4. $3^{5x-4} = 9^{2x-3}$ 5. $8^{x+1} = 2^{2x+3}$ 6. $5^{x} = \frac{1}{125}$ 7. $3^{x+1} = \frac{1}{81}$

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

$5x-4 = 4x-6$

$x = -2$

Set

Topic: Writing the logarithmic form of an exponential equation.

Definition of Logarithm: *For all positive numbers a, where a ≠ 1, and all positive numbers x*

$y = \log_a x$ *means the same as* $x = a^y$.

*(Note the **base** of the exponent and the **base** of the logarithm are both **a**.)*

8. Why is it important that the definition of logarithms states that the base of the logarithm not equal 1?

9. Why is it important that the definition states that the base of the logarithm is positive?

10. Why is it necessary that the definition states that **x** in the expression $\log_a x$ is positive?

Write the following exponential equations in logarithmic form.

8.50 x 11.00 in

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Write the following exponential equations in logarithmic form.

Exponential form	Logarithmic form
11. $\underset{a}{5}^{\overset{y}{4}} = 625 \leftarrow x$	$\log_5 625 = 4$
12. $3^2 = 9$	
13. $\left(\frac{1}{2}\right)^{-3} = 8$	
14. $10^4 = 1000$	

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Secondary Mathematics III

8.50 x 11.00 in

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The functions $f(x), g(x), and\ h(x)$ are defined below.

$f(x) = -2x$ $g(x) = 2x + 5$ $h(x) = x^2 + 3x - 10$

Calculate the indicated function values. Simplify your answers.

19. $f(a)$
20. $f(b^2)$
21. $f(a+b)$
22. $f(g(x))$
23. $g(a)$
24. $g(b^2)$
25. $g(a+b)$
26. $h(f(x))$
27. $h(a)$
28. $h(b^2)$
29. $h(a+b) =$
30. $h(g(x))$

$(a+b)^2+3(a+b)-10=$

$(a+b)(a+b)+3a+3b-10=$

8.50 x 11.00 in

$a^2+2ab+b^2+3a+3b-10$

30 $h(g(x))=$

$h(2x+5)=$

$(2x+5)^2+3(2x+5)-10=$

$(2x+5)(2x+5)+6x+15-10=$

$4x^2+20x+25+6x+5=$

$\boxed{4x^2+26x+30}$

Sep 6-1:18 PM

QUIZ #3: Exponential Functions & Their Inverses

$f(x) = 4x + 1$ $g(x) = x^2$

Simplify the following:

1) $f(g(x))$

2) $g(f(x))$

1.4 Pulling a Rabbit Out of a Hat

A Solidify Understanding Task

I have a magic trick for you:

- Pick a number, any number. x
- Add 6 $x+6$
- Multiply by the result by 2 $2(x+6)$
- Subtract 12 $2(x+6)-12$
- Divide by 2
- The answer is the number you started with!

$$\frac{2(x+6)-12}{2} = \frac{2x+\cancel{12}-\cancel{12}}{2}$$

$$\frac{2x}{2} = x$$

People are often mystified by such tricks but those of us who have studied inverse operations and inverse functions can easily figure out how they work and even create our own number tricks. Let's get started by figuring out how inverse functions work together.

For each of the following function machines, decide what function can be used to make the output the same as the input number. Describe the operation in words and then write it symbolically.

Here's an example:

Input Output

$x = 7$ → $7 + 8 = 15$ → 7

$f(x) = x + 8$

$f(7)=7+8$

$\boxed{f^{-1}(x) = x - 8}$

$f^{-1}(15)=15-8=7$

In words: Subtract 8 from the result

To find an inverse function algebraically:

1- Switch x & y

2- Solve for y

ex: $f(x)=x+8$

$$\begin{aligned} x &= y+8 \\ -8 &\quad -8 \\ \hline x-8 &= y \\ x-8 &= f^{-1}(x) \end{aligned}$$

1.

Input Output

$x = 7$ → $3 \cdot 7 = \underline{21}$ → 7

$f(x) = 3x$

$\boxed{f^{-1}(x) = \frac{x}{3}}$

$\frac{x}{3} = \frac{3y}{3}$

$y = \frac{x}{3}$

In words: $\div 3$

2.

Input Output

$x = 7$ → $7^2 = 49$ → 7

$f(x) = x^2$

$\boxed{f^{-1}(x) = \pm\sqrt{x}}$

In words: square root

3.

Input Output

$x = 7$ → $2^7 = 128$ → 7

$f(x) = 2^x$

$\boxed{f^{-1}(x) = \log_2 x}$

In words: log base 2

4.

Input				Output
$x = 7$	→	$2 \cdot 7 - 5 = 9$	→	7

$f(x) = 2x - 5$

$\boxed{f^{-1}(x) = \frac{x+5}{2}}$

In words: add 5 & ÷ by 2

$x = 2y - 5$

$\frac{x+5}{2} = \frac{2y}{2}$

$\frac{x+5}{2} = y$

5.

Input				Output
$x = 7$	→	$\frac{7+5}{3} = 4$	→	7

$\cancel{f}x(x) = \frac{\cancel{x}y+5}{3}$

$\boxed{f^{-1}(x) = 3x - 5}$

In words: mult. by 3 & subtract 5

$3x = y + 5$

$3x - 5 = y$

6.

Input				Output
$x = 7$	→	$(7-3)^2 = 16$	→	7

$f(x) = (x-3)^2$

$\boxed{f^{-1}(x) = \pm\sqrt{x}}$ $+3$?

In words:

$\sqrt{x} = \sqrt{(y-3)^{\cancel{2}}}$

$\pm\sqrt{x} = y - 3$

$+3 \qquad +3$

$3 \pm \sqrt{x} = y \longrightarrow 3 \pm \sqrt{16} = 7$?

$3 \pm 4 = 7$

$\pm\sqrt{x+3} = y \longrightarrow \pm\sqrt{16+3} = 7$?

$\pm\sqrt{19} \neq 7$ x no

$x = 16$

$f(x) = (16-3)^2$

$f(x) = (13)^2$

$f(x) = 169$

$\sqrt{3} \pm \sqrt{x}$

$1\sqrt{3} + 2\sqrt{3} = 3\sqrt{3}$

$3\sqrt{x} + 4\sqrt{x} = 7\sqrt{x}$

$\sqrt{2} \cdot \sqrt{3} = \sqrt{2 \cdot 3} = \sqrt{6}$

$\sqrt{2} + \sqrt{3}$ simplified

7.

Input Output

$x = 7$ → $4-\sqrt{7}$ → 7

$f(x) = 4-\sqrt{x}$

$x = 4-\sqrt{y}$

$+\sqrt{y} \quad +\sqrt{y}$

$-x \quad -x$

$\sqrt{y}^2 = (4-x)^2$

$y = (4-x)^2$

$f^{-1}(x) = \boxed{(-x+4)^2}$ or $(4-x)^2$

In words: subtract x, add $\sqrt{y}$, and square

8.

Input Output

$x = 7$ → $2^7 - 10 = 118$ → 7

f(

$f(7) = 2^7 - 10$

$f(x) = 2^x - 10$

$(x+10) = 2^y$

$f^{-1}(118) = \log_2(118+10)$

$f^{-1}(x) = \log_2(x+10) = 7$

x

In words:

9. Each of these problems began with $x = 7$. What is the difference between the x used in $f(x)$ and the x used in $f^{-1}(x)$?

The x used in f(x) becomes the y in $f^{-1}(x)$ and the y in f(x) becomes the x in $f^{-1}(x)$.

10. In #6, could any value of x be used in $f(x)$ and still give the same output from $f^{-1}(x)$? Explain. What about #7?

#6: $x = 9$

$f(9) = (9-3)^2$

$f(9) = 36$

$f^{-1}(36) = 3 \pm \sqrt{36}$

$f^{-1}(36) = 3 \pm 6$

$f^{-1}(36) = 9, -3$

We only get the $+\sqrt{\ }$ not the $-\sqrt{\ }$.

#7: $x = 9$

$f(9) = 4-\sqrt{9}$

$f(9) = 4-3 = 1$

$f^{-1}(1) = (4-1)^2$

$f^{-1}(1) = 3^2$

$f^{-1}(1) = 9$

This one is fine.

11. Based on your work in this task and the other tasks in this module what relationships do you see between functions and their inverses?

Homework/Classwork

Finish 1.4