Warm-up

Monday, April 20, 2015

1. Convert $7^3 = x$ to log form.

2. Convert $\log x = 1{,}000{,}000$ to exponential form.

3. What is the inverse of the function $y = (2x - 1)^2 + 3$?

4. What is the inverse of the function $y = \log 3x$?

5. You borrow $5000 Mr. Dixon. He's going to charge you 5% interest and compound it continuously. How much money will you owe him at the end of 3 years?

10
9
8
7
6
5
4
3
2
1

Homework Review…

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49. $2^x = y$
50. $0.7^x = y$
51. $100^x = y$
52. $8^x = y$
53. $2^{x-2} = y$
54. $10^x - 4 = y$

Homework Review…

22. $\log xyz$

$\log x + \log y + \log z$

23. $\log_2 \frac{x}{yz}$

$\log_2 x - \log_2 y - \log_2 z$

24. $\log 6x^3y$

$\log 6 + 3 \log x + \log y$

25. $\log 7(3x - 2)^2$

$\log 7 + 2 \log (3x - 2)$

26. $\log \sqrt{\frac{2rst}{5w}}$

$\frac{1}{2}\log 2 + \frac{1}{2}\log r + \frac{1}{2}\log s + \frac{1}{2}\log t - \frac{1}{2}\log 5 - \frac{1}{2}\log w$

27. $\log \frac{5x}{4y}$

$\log 5 + \log x - \log 4 - \log y$

28. $\log_5 5x^{-5}$

$\log_5 5 - 5 \log_5 x$, or $1 - 5 \log_5 x$

29. $\log \frac{2x^2y}{3k^3}$

$\log 2 + 2 \log x + \log y - \log 3 - 3 \log k$

30. $\log_4 (3xyz)^2$

$2 \log_4 3 + 2 \log_4 x + 2 \log_4 y + 2 \log_4 z$

Use the Change of Base Formula to evaluate each expression. Round your answer to the nearest thousandth.

31. $\log_4 32$ 2.5

32. $\log_3 5$ 1.465

33. $\log_2 15$ 3.907

34. $\log_6 17$ 1.581

35. $\log_6 10$ 1.285

36. $\log_5 6$ 1.113

37. $\log_8 1$ 0

38. $\log_9 11$ 1.091

Objectives

Use properties of logarithms to expand and condense logarithmic expressions.

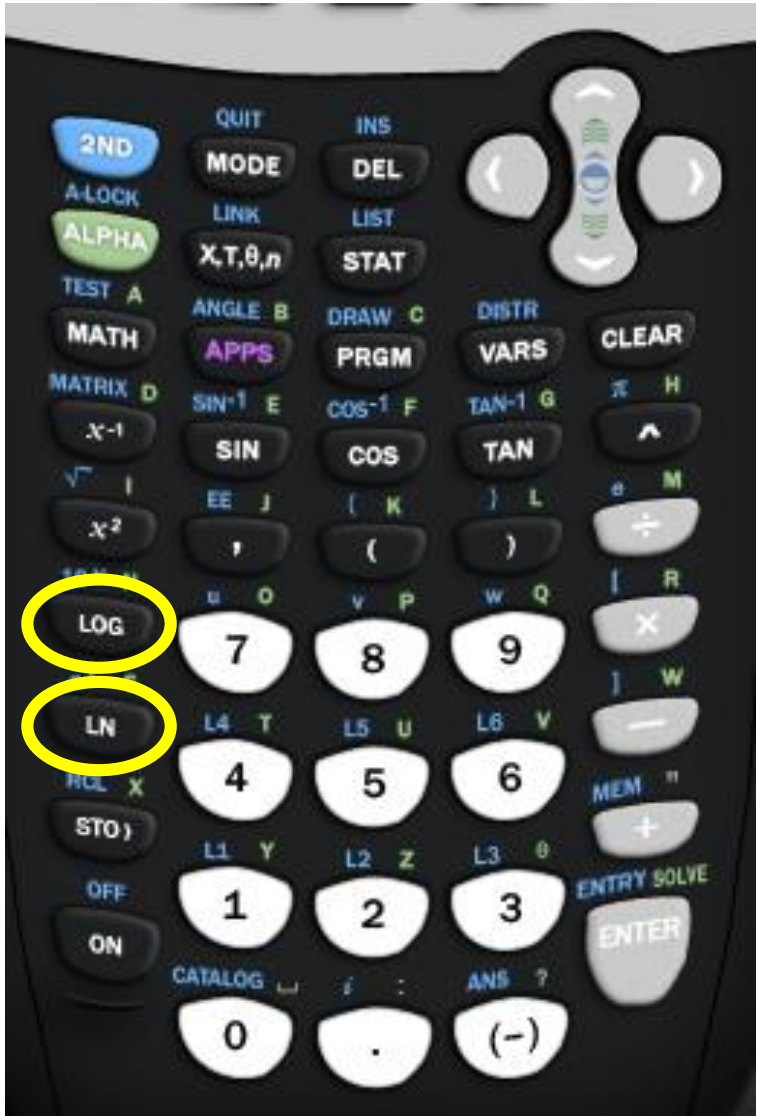
Homework

Packet Page 16-17: 1-21 odd

$$b^x = y \leftrightarrow log_b y = x$$

Is this burned into you brain yet?

$$log_b y = x$$



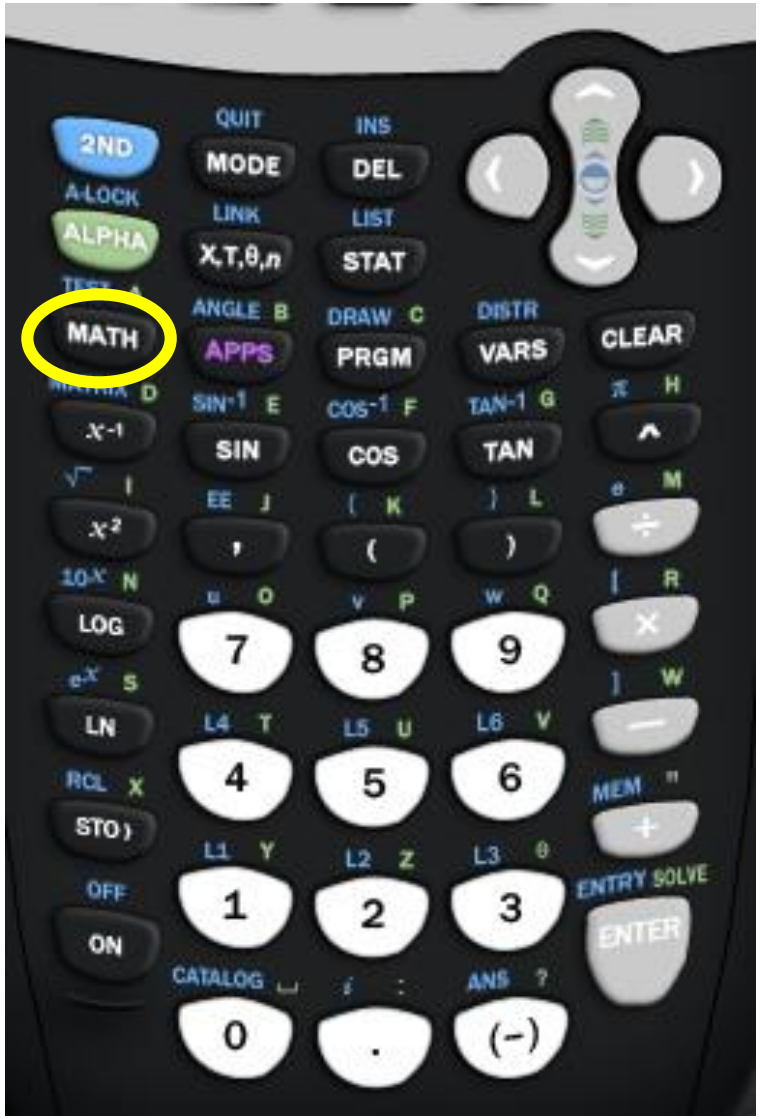
Let's talk about your calculator.

This button is the **common log**. It assumes a base of 10. You can use it to evaluate statements like $\log 13$ or $\log 1000$.

This button is the **natural log**. It assumes a base of e. You can use it to evaluate statements like $\ln 12$ or $log_e 72$.

But what about $log_7 2401$?

$$log_b y = x$$



But what about $log_7 2401$?

Depending on your calculator, you may be able to evaluate this stament using the MATH button. If you press this key and see option A: logBASE.

If you see option A: logBASE just fill in the base and the argument and press enter.

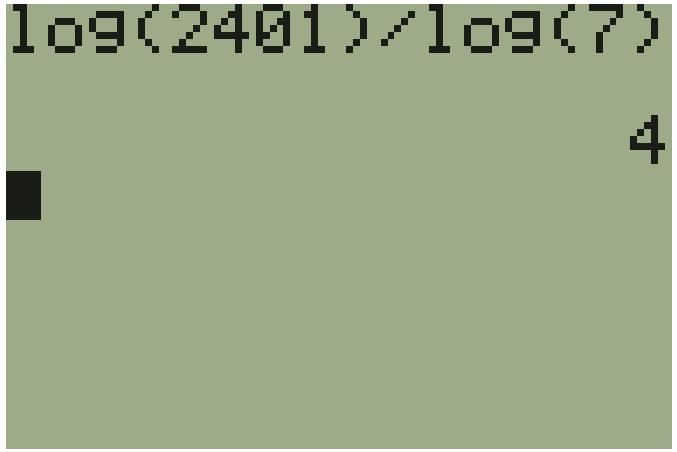
But what about $log_7 2401$?

The rest of you will have to use the **change of base formula**. You will all need to be able to use this formula.

$$log_b a = \frac{\log a}{\log b}$$

So now we can evaluate this log.

$$log_7 2401 = \frac{\log 2401}{\log 7}$$



Properties of Exponents	For all nonzero real numbers x and y and integers m and n.	Algebra	Numbers
Product of Powers Property	To multiply powers with the same base, add the exponents.	$x^m \cdot x^n = x^{m+n}$	$4^3 \cdot 4^2 = 4^{3+2} = 4^5$
Quotient of Powers Property	To divide powers with the same base, subtract the exponents.	$\frac{x^m}{x^n} = x^{m-n}$	$\frac{3^7}{3^2} = 3^{7-2} = 3^5$
Power of a Power Property	To raise one power to another, multiply the exponents.	$(x^m)^n = x^{m \cdot n}$	$(4^3)^2 = 4^{3 \cdot 2} = 4^6$
Power of a Product Property	To find the power of a product, apply the exponent to each factor.	$(xy)^m = x^m y^m$	$(3 \cdot 4)^2 = 3^2 \cdot 4^2$
Power of a Quotient Propterty	To find the power of a quotient, apply the exponent to the numerator and denominator.	$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$	$\left(\frac{3}{5}\right)^2 = \frac{3^2}{5^2}$
Negative Exponent Property	A nonzero base raised to the negative exponent is equal to the reciprocal of the base raised to the positive exponent.	$x^{-n} = \left(\frac{1}{x}\right)^n$ $\left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$	$7^{-2} = \left(\frac{1}{7}\right)^2$ $\left(\frac{3}{2}\right)^{-4} = \left(\frac{2}{3}\right)^4$
Identity Exponent Property	A nonzero quantity raised to the first power is equal to itself.	$x^1 = x$	$8^1 = 8$
Zero Exponent Property	A nonzero quantity raised to the zero power is equal to 1.	$x^0 = 1$	$125^0 = 1$

Let's review some properties of exponents

Remember that logs are exponents so they have similar properties…

Exponent Property	Log Property	Example
$x^0 = 1$	$log_x 1 = 0$	$log_4 1 = 0$
$x^1 = x$	$log_x x = 1$	$log_7 7 = 1$
$x^n = x^n$	$log_x x^n = n$	$log_2 2^9 = 9$

Algebraic Properties of Logarithms

Expand Log Expressions

$$\log_b(xy) = \log_b x + \log_b y$$

$$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$$

$$\log_b x^n = n \log_b x$$

Compress Log Expressions

How are these properties similar to the rules for exponents?

Expand the following

$$log_3(9xy^2) = log_3 9 + log_3 x + log_3 y^2$$

$$= log_3 9 + log_3 x + 2log_3 y$$

$$= 2 + log_3 x + 2log_3 y$$

Expand the following

$$log_4\left(\frac{x}{16y}\right) = log_4 x - log_4 16y$$
$$= log_4 x - (log_4 16 + log_4 y)$$
$$= log_4 x - (2 + log_4 y)$$
$$= log_4 x - 2 - log_4 y$$

Expand the following

$$log\left(\frac{100x^2}{y^3}\right) = \log 100x^2 - \log y^3$$

$$= \log 100 + \log x^2 - \log y^3$$

$$= 2 + 2\log x - 3\log y$$

Now let's go the other way. Write the following expression as a single logarithm.

$$2log_3 x + 3log_3 y - log_3 z$$

$$= log_3\, x^2 + log_3 y^3 - log_3 z$$

$$= log_3\, x^2 y^3 - log_3 z$$

$$= log_3 \left(\frac{x^2 y^3}{z}\right)$$

Write following expression as one log statement

$$1 + log_4 x - \frac{1}{2} log_4 y = log_4 4 + log_4 x - log_4 y^{\frac{1}{2}}$$

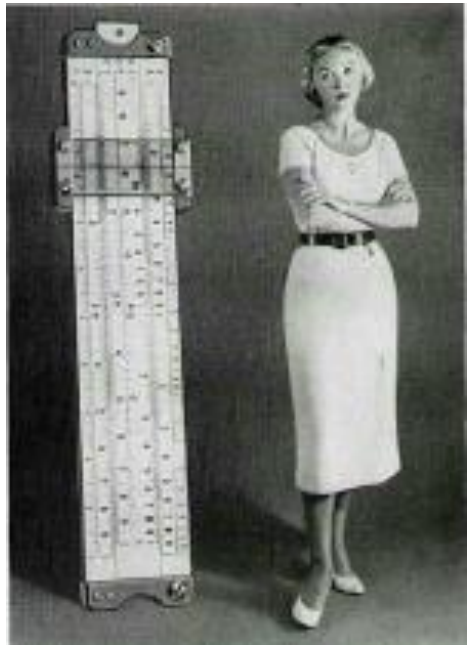
$$= log_4 4x - log_4 y^{\frac{1}{2}}$$

$$= log_4 \frac{4x}{y^{\frac{1}{2}}}$$

$$= log_4 \frac{4x}{\sqrt{y}}$$

Work on your homework problems.
Turn in WBP 201, Do questions 1-4.

Enrichment



We're going to make a slide rule. Get out two sheets of notebook paper.

Fold each sheet in half then half again lengthwise.

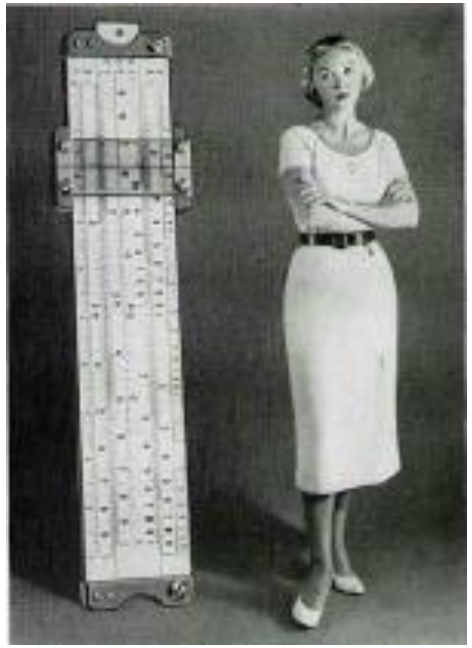
Fold one side in half one more time. Nest the two sheets inside each other.

Starting at the bottom, write the number 1 on the first line. Then double that number and write it on the next line above. Repeat until you get to 41,934,304.

Put the same numbers on the other side of the fold. See sample.

Circle the 1 at the bottom of the left side and write index next to it.

Enrichment



Now let's use the slide rule.

What is 64 times 8,192?

Move the left side of you slide rule so that the 1 is next to the 64.

Now find the number 8192 on the left side of your slide rule.

What number is next to 8192 on the right side of your slide rule?

524288?

Why does this work?