480/81
Day 1
Notes

6.9 NOTES – LOGS WITH OTHER BASES

KEY

OBJECTIVES:

1) Rewrite an exponential equation as a logarithm.
2) Evaluate a log.
3) Solve a logarithmic equation.

LOGARITHM: A logarithm is just an EXPONENT!

$y = \log_b x$ if and only if $b^y = x$, where $x > 0,\ b > 0,\ b \neq 1$

y is the logarithm
b is the base
x is the argument

2^5 the exponent is called a base 2 logarithm.
$5 = \log_2 32$ 5 is "log to the base 2 of 32"

Fill in the table below.

EXPONENTIAL FORM	LOGARITHMIC FORM
$3^4 = 81$	$\log_3 81 = 4$
$6^3 = 216$	$\log_6 216 = 3$
$3^{-4} = \frac{1}{81}$	$\log_3 \frac{1}{81} = -4$
$10^{-5} = 0.0001$	$\log 0.00001 = -5$
$2^{-5} = \frac{1}{32}$	$\log_2 \frac{1}{32} = -5$
$25^{\frac{1}{2}} = 5$	$\log_{25} 5 = \frac{1}{2}$
$32^{\frac{3}{5}} = 8$	$\log_{32} 8 = \frac{3}{5}$
$\left(\frac{1}{4}\right)^3 = \frac{1}{64}$	$\log_{\frac{1}{4}} \frac{1}{64} = 3$

$\log x = \log_{10} x$

EVALUATING LOGS

1) If $3^4 = 81$, then $\log_3 81 = 4$

2) If $9^0 = 1$, then $\log_9 1 = 0$

3) $\log_2 64$

$2^? = 64$

6

4) $\log_4 \frac{1}{16}$

$4^? = \frac{1}{16}$

-2

5) $\log_3 243$

$3^? = 243$

5

6) $\log_{25} 5$

$25^? = 5$

$(5^2)^? = 5$

$\frac{1}{2}$

7) $\log_7 \frac{1}{49}$

$7^? = \frac{1}{49}$ $7^? = 7^{-2}$

-2

8) $\log_8 4$

$8^? = 4$

$(2^3)^? = 2^2$

$\frac{2}{3}$

9) $\log_6 6^8$

$6^? = 6^8$

8

10) $3^{\log_3 11}$

$\log_3 ? = \log_3 11$

11

SOLVING LOGARITHMIC EQUATIONS

A logarithmic equation can ask you one of several things: 1) to find the argument
2) to find the logarithm/exponent
3) to find the base

FINDING THE ARGUMENT:

11) $\log_3 x = -4$

$3^{-4} = x$

$x = \frac{1}{81}$

12) $\log_{\sqrt{2}} x = 6$

$\left(2^{\frac{1}{2}}\right)^6 = x$

$2^3 = x$

$x = 8$

13) $\log_{\frac{1}{2}} x = -4$

$\left(\frac{1}{2}\right)^{-4} = x$

$\left(2^{-1}\right)^{-4} = x$

$2^4 = x$

$x = 16$

14) $\log_8 x = \frac{4}{3}$

$8^{\frac{4}{3}} = x$

$\left(2^3\right)^{\frac{4}{3}} = x$

$2^4 = x$

$x = 16$

FINDING THE LOGARITHM/EXPONENT:

15) $\log_2 8 = x$

$2^x = 8$

$2^x = 2^3$

$x = 3$

16) $\log_{27} 81 = x$

$27^x = 81$

$(3^3)^x = 3^4$

$3x = 4$

$x = \frac{4}{3}$

17) $\log_{\frac{1}{4}} 16 = x$

$\left(\frac{1}{4}\right)^x = 16$

$\left(4^{-1}\right)^x = 4^2$

$-x = 2$

$x = -2$

18) $\log_{-\frac{1}{4}} 64 = x$

NO SOLUTION!

can't have a negative base!

FINDING THE BASE:

19) $\log_x 4 = \frac{2}{3}$

$x^{\frac{3}{3}} = 4$

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

$x = 2^3$

$x = 8$

20) $\log_x \frac{1}{16} = 2$

$x^2 = \frac{1}{16}$

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

$x = \pm\frac{1}{4}$

$x = \frac{1}{4}$ ~~$-\frac{1}{4}$~~

can't have a negative base

21) $\log_x \frac{1}{4} = -2$

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

$\left(x^{-2}\right)^{-\frac{1}{2}} = \left(2^{-2}\right)^{-\frac{1}{2}}$

$x = 2^1$

$x = 2$

22) $\log_x 4 = 0$

$x^0 = 4$

impossible

NO SOLUTION!

ALWAYS CHECK YOUR SOLUTIONS!