

## Notes for 4.4 Evaluating Logs and the Change-of-Base Theorem (pp. 432 – 438)

Name:
Date:
Instructor:

Topics: Common Logs and Applications, Natural Logs and Applications, Change-of-Base Theorem

### I. Common Logarithms

The **common logarithms** have a base of \_\_\_\_\_ and are written as \_\_\_\_\_.

$$y = \log x \text{ if and only if } x = 10^y \text{ (inverses of each other)}$$

These occur in many business and scientific formulas.

\*It has its own key on the calculator that is **LOG**. This key opens a parentheses, so don't forget to close it after you've entered the value or expression.

\*Keep all decimal places in the calculator and round to get the final answer.

Ex.  $\log 317 =$

Check:

Ex.  $\log .65 =$

Check:

Applications of Common Logs:

1. pH of a Solution: The general formula is  $pH = -\log[H_3O^+]$

a. Find the pH of a solution with  $[H_3O^+] = 3.2 \times 10^{-3}$

b. Find the hydronium ion concentration of a solution with  $pH = 5.3$ .

2. Omit Loudness of Sounds (Omit video 5:24 – 6:40)

### II. Natural Logarithms (pp.434 – 436)

The **natural logarithms** have a base of \_\_\_\_\_ and are written as \_\_\_\_\_.

\*The reversal of the initials *ln* is because it comes from the Latin, *logarithmus naturalis*.

$$y = \ln x \text{ if and only if } x = e^y \text{ (inverses of each other)}$$

These are also used in many applications.

Ex.  $\ln 29 =$   
Check:

Omit application about the age of a rock (stop video 8:45 – 9:42)

### III. Change of Base Theorem (pp. 436 – 437)

\*To find the log of a base other than 10 or  $e$ , we transform the log so that it has a common footing of 10 or  $e$ , using this formula:  $\log_a x = \frac{\log_b x}{\log_b a}$ . The values for  $b$  that we use are 10 or  $e$ .

So, for  $x$ ,  $a$ , and  $b$ , where  $a \neq 1$  and  $b \neq 1$ , then  $\log_a x = \frac{\log x}{\log a}$  (using 10 as the base) OR

$$\log_a x = \frac{\ln x}{\ln a} \text{ (using } e \text{ as the base)}$$

Either one is easily entered into the calculator and both give the same result.

Ex. Find  $\log_{5.8} 12.7$  to the nearest hundredth.

\*Calculator notes:

- Remember to close the parentheses that the calculator will automatically open.
- You can put the entire fraction into the calculator to get the answer, instead of finding the logs/lns individually as shown in the video:  $\boxed{\text{LOG}}\boxed{1}\boxed{2}\boxed{\cdot}\boxed{7}\boxed{)}\boxed{\div}\boxed{\text{LOG}}\boxed{5}\boxed{\cdot}\boxed{8}\boxed{)}\boxed{\text{ENTER}}$

Ex. Find  $\log_{\frac{1}{3}} 4$  to the nearest thousandth.

Assignment:

Text: pp. 438 – 439 #5, 6, 11 – 29 odd, 35 – 41 odd