

Lesson 11: The Most Important Property of Logarithms

Classwork

Opening Exercise

Use the logarithm table below to calculate the specified logarithms.

x	$\log(x)$	
1	0	
2	0.3010	
3	0.4771	
4	0.6021	
5	0.6990	
6	0.7782	
7	0.8451	
8	0.9031	
9	0.9542	

a. log(80)

b. log(7000)

- c. log(0.00006)
- d. $\log(3.0 \times 10^{27})$
- e. $\log(9.0 \times 10^k)$ for an integer k



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f. log(3) + log(12)

 $\log(2) + \log(18)$

e.

- d. $\log(6) + \log(6)$
- log(3) + log(4)с.

2.

- log(2) + log(6)b.
- Calculate the following values. Do they appear anywhere else in the table? a. $\log(2) + \log(4)$
- log(x)x 10 12 16 18 20 25 30 36 100

x

1

2

3

4

5

6

7

8

9

NYS COMMON CORE MATHEMATICS CURRICULUM

Exercises 1-5

1. Use your calculator to complete the following table. Round the logarithms to four decimal places.

log(x)

0

0.3010

0.4771

0.6021

0.6990

0.7782

0.8451

0.9031

0.9542



S.69

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What pattern(s) can you see in Exercise 2 and the table from Exercise 1? Write them using logarithmic notation. 3.

4. What pattern would you expect to find for $log(x^2)$? Make a conjecture, and test it to see whether or not it appears to be valid.

5. Make a conjecture for a logarithm of the form log(xyz), where x, y, and z are positive real numbers. Provide evidence that your conjecture is valid.

Example 1

Use the logarithm table from Exercise 1 to approximate the following logarithms.

- a. log(14)
- log(35)b.



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log(72)с.

log(121) d.

Exercises 6-8

6. Use your calculator to complete the following table. Round the logarithms to four decimal places.

x	$\log(x)$]	x	$\log(x)$
2			$\frac{1}{2}$	
4			$\frac{1}{4}$	
5			$\frac{1}{5}$	
8			$\frac{1}{8}$	
10			$\frac{1}{10}$	
16			$\frac{1}{16}$	
20			$\frac{1}{20}$	
50			$\frac{1}{50}$	
100			$\frac{1}{100}$	

7. What pattern(s) can you see in the table from Exercise 6? Write a conjecture using logarithmic notation.

8. Use the definition of logarithm to justify the conjecture you found in Exercise 7.



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Example 2

Use the logarithm tables and the rules we have discovered to estimate the following logarithms to four decimal places.

- a. log(2100)
- b. log(0.00049)
- c. log(4200000)
- d. $\log\left(\frac{1}{640}\right)$



1: The Most Important Property of Logarithms





Lesson Summary

- The notation log(x) is used to represent $log_{10}(x)$.
- The most important property of base 10 logarithms is that for positive real numbers x and y,

 $\log(xy) = \log(x) + \log(y).$

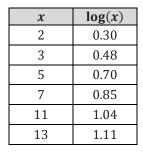
• For positive real numbers *x*,

$$\log\left(\frac{1}{x}\right) = -\log(x).$$

Problem Set

- 1. Use the table of logarithms to the right to estimate the value of the logarithms in parts (a)–(t).
 - a. log(25)
 - b. log(27)
 - c. log(33)
 - d. log(55)
 - e. log(63)
 - f. log(75)
 - g. log(81)
 - h. log(99)
 - i. log(350)
 - j. log(0.0014)
 - k. log(0.077)
 - l. log(49000)
 - m. log(1.69)
 - n. log(6.5)
 - o. $\log\left(\frac{1}{30}\right)$
 - p. $\log\left(\frac{1}{35}\right)$
 - q. $\log\left(\frac{1}{40}\right)$
 - r. $\log\left(\frac{1}{42}\right)$
 - s. $\log\left(\frac{1}{50}\right)$
 - t. $\log\left(\frac{1}{64}\right)$





Lesson 11

M3

ALGEBRA II







- 2. Reduce each expression to a single logarithm of the form log(x).
 - a. $\log(5) + \log(7)$
 - b. $\log(3) + \log(9)$
 - c. $\log(15) \log(5)$
 - d. $\log(8) + \log(\frac{1}{4})$
- 3. Use properties of logarithms to write the following expressions involving logarithms of only prime numbers:
 - a. log(2500)
 - b. log(0.00063)
 - c. log(1250)
 - d. log(2600000)
- 4. Use properties of logarithms to show that $\log(2) \log(\frac{1}{13}) = \log(26)$.
- 5. Use properties of logarithms to show that log(3) + log(4) + log(5) log(6) = 1.
- 6. Use properties of logarithms to show that $\log\left(\frac{1}{2} \frac{1}{3}\right) + \log(2) = -\log(3)$.
- 7. Use properties of logarithms to show that $\log\left(\frac{1}{3} \frac{1}{4}\right) + \left(\log\left(\frac{1}{3}\right) \log\left(\frac{1}{4}\right)\right) = -2\log(3).$





