Name:
Date:
Revisiting Prerequisite Knowledge for Multiple LOGS

1. Re-write 2 + 2 + 2 + 2 + 2 using multiplication:

   $2 \cdot 5$

2. Re-write 2 + 2 + 2 + 2 using multiplication:

   $2 \cdot 4$

3. Re-write 5 • 4 using addition:

   $5 + 5 + 5 + 5$

4. What is multiplication?

   Multiplication is repeated addition

5. Re-write 2^6 using multiplication:

   $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

6. Re-write 5^2 using multiplication:

   $5 \cdot 5$

7. Re-write 7 • 7 • 7 • 7 • 7 using exponents:

   7^5

8. What is exponentiation?

   Exponentiation is repeated multiplication

Name:
Date:

Multiple LOGs

Required Materials: 6 x LOG 2, 2 × LOG 5, 3 x log 4, LOG 8, LOG 16, LOG 25, LOG 32, and LOG 64

<u>Part I</u>: Discovering Log Properties

1. When linking LOGS together, what is the **product** of having a LOG 5 two times?
   This can be written this using the following notation: LOG 5 + LOG 5 = 2 • LOG 5

   Another way of asking this: *What is the height of a stack of two LOG 5's?*
   Re-writing LOG 5 + LOG 5 as a multiplication problem: LOG 5 + LOG 5 = 2 • LOG 5 = LOG <u>25</u>

   Re-writing 2 • LOG 5 using exponents: *LOG 5^2* LOG 5 + LOG 5 = 2 • LOG 5 = LOG <u>25</u> = LOG $5^{?\,2}$

2. Using your LOGS 4s explore the following problems and determine the correct exponent.
   a. When linking LOGS together, what is the **product** of having a LOG 4 two times?
      This can be written: LOG 4 + LOG 4 = 2 • LOG 4 = LOG <u>16</u> = LOG $4^{?\,2}$

   b. When linking LOGS together, what is the **product** of having a LOG 4 three times?
      This can be written: LOG 4 + LOG 4 + LOG 4 = 3 • LOG 4 = LOG <u>64</u> = LOG $4^{?\,3}$

   c. In a & b above you started with one LOG 4, and added an additional LOG 4 each time. What pattern did you notice?

      Each additional LOG 4 represents another power of 4 in the final argument.

3. Using your LOG 2s explore the following problems and determine the correct exponent.

   a. When linking LOGS together, what is the **product** of having a LOG 2 two times?
      This can be written: LOG 2 + LOG 2 = 2 • LOG 2 = LOG <u>4</u> = LOG $2^{?\,2}$

   b. When linking LOGS together, what is the **product** of having a LOG 2 three times?
      This can be written: LOG 2 + LOG 2 + LOG 2 = 3 • LOG 2 = LOG <u>8</u> = LOG $2^{?\,3}$

   c. When linking LOGS together, what is the **product** of having a LOG 2 four times?
      This can be written: LOG 2 + LOG 2 + LOG 2 + LOG 2 = 4 • LOG 2 = LOG <u>16</u> = LOG $2^{?\,4}$

   d. When linking LOGS together, what is the **product** of having a LOG 2 five times?
      This can be written: LOG 2 + LOG 2 + LOG 2 + LOG 2 + LOG 2 = 5 • LOG 2 = LOG <u>32</u> = LOG $2^{?\,5}$

e. When linking LOGS together, what is the **product** of having a LOG 2 six times?
This can be written: LOG 2 + LOG 2 + LOG 2 + LOG 2 + LOG 2 + LOG 2 = 6 • LOG 2 = LOG _*64*_ = LOG $2^{?6}$

f. In a-e above you started with LOG 2 + LOG 2 = 2 • LOG 2, linking two LOG 2's together and continued to link an additional LOG 2 each time. What pattern did you notice?

Each additional LOG 2 represents another power of 2 in the final argument.

Before moving on to Part II make sure everyone in your group has the same answers to the above problems.

Part II: Applying knowledge. Express your final answer with LOGS using exponents.

4. 2 • LOG 4 = *LOG 4^2*

5. 6 • LOG 2 = *LOG 2^6*

6. 100 • LOG 2 = *LOG 2^{100}*

7. 4 • LOG 3 = *LOG 3^4*

Please Note: You have to write the LOG part yourself here.

8. Bart incorrectly thinks that 2 • LOG 5 = LOG 10. What is his mistake? How could you show him that he has made an error using LOGS?

$2 \cdot LOG\ 5 = LOG\ 5^2$. Stack two LOG 5s on top of each other. The height of this is congruent to LOG 25. So, $2 \cdot LOG\ 5 = LOG\ 25$.

Part III: Generalizing

9. What's the pattern? Is it possible to find the product of multiple LOGS even if you don't have them in front of you? In your own words, what is the rule or pattern for calculating multiple LOGS?

Yes, it is possible to find the product of multiple LOGs, even if you don't have them in front of you. The number that the LOG is being multiplied by turns into the power of the LOG's argument.

10. Use your rule to determine: 5 • LOG 2 = LOG $2^?$
(Check your answer with your response to #3d or using your LOGS)

$5 \cdot LOG\ 2 = LOG\ 2^5 = LOG\ 32$

11. Describe the pattern using variables: **B • LOG A = LOG** _A^B_

Before moving on to Part IV make sure everyone in your group understands Part III.

Part IV: Practice & Application. Express each statement as a single LOG using exponents.

12. 2 • LOG 10 = LOG 10^{2}

13. 4 • LOG 3 = LOG 3^{4}

14. 3 • LOG 7 = LOG 7^{3}

15. 2 • LOG 11 = LOG 11^{2}

16. 3 • LOG 3 = LOG 3^{3}

17. 10 • LOG 3 = LOG 3^{10}

Part V: Working Backwards. You can use the same pattern you discovered to work backwards!
Use the pattern you discovered to work backwards and express each LOG as product:
For example: LOG x^2 = 2 • LOG x

18. LOG 5^2 = 2 LOG 5

19. LOG 4^6 = 6 LOG 4

20. LOG 10^6 = 6 LOG 10

21. LOG 200^7 = 7 LOG 200

22. LOG x^2 = 2 LOG x

23. LOG x^6 = 6 LOG x

24. LOG 2^x = x LOG 2

25. LOG x^z = z LOG x

26. *Generalize*: Express the LOG as a product: **LOG $\mathbf{A^B}$ =** B LOG A

Part VI: More Challenging Question

27. 100 • LOG 1 = LOG 1^{100}

28. 0.25 • LOG 625 = LOG $625^{.25}$

29. $\frac{1}{2}$ • LOG 25 = LOG $25^{1/2}$