Subtracting LOGs

Required Materials: LOG 2, 2 x LOG 4, LOG 5, LOG 8, LOG 10, LOG 16, LOG 20, LOG 25, LOG 40, LOG 50, LOG 100

Directions: Using your Ficycle LOGS, explore what happens when you subtract LOGs by comparing the relative heights of two LOGs and finding the LOG that makes up the difference.

Part I: Discovering Log Properties
1. What is the difference between a LOG 20 and a LOG 4?
   Another way of asking this: What do you add to LOG 4 to make it the same height as LOG 20?
   This can be written this using the following notation: LOG 20 – LOG 4 = LOG __
   Check your answer: LOG __ + LOG 4 = LOG 20

2. What is the difference between a LOG 16 and a LOG 4?
   This can be written this using the following notation: LOG 16 – LOG 4 = LOG __

3. What is the difference between a LOG 10 and a LOG 2?
   This can be written this using the following notation: LOG 10 – LOG 2 = LOG __

4. What is the difference between a LOG 100 and a LOG 4?
   This can be written this using the following notation: LOG 100 – LOG 4 = LOG __

5. Someone in class is confused and doesn’t understand how LOG 8 – LOG 2 = LOG 4. Describe how you could show that it is true using LOGS.
   Take LOG 8 and LOG 2 and put them next to each other. In order to make their heights congruent, LOG 4 must be added on top of LOG 2. Therefore, LOG 8 – LOG 2 = LOG 4.
   Before moving on to Part II make sure everyone in your group has the same answers to the above problems.

Part II: Applying knowledge
6. LOG 40 – LOG 10 = LOG __
7. LOG 40 – LOG 5 = LOG __
8. LOG 40 – LOG 4 = LOG __
9. LOG 20 – LOG 5 = LOG __
10. LOG 20 – LOG 2 = LOG __
11. LOG 40 – LOG 20 = LOG __
12. LOG 100 – LOG 50 = LOG __
13. Barney incorrectly thinks that \( \log 25 - \log 5 = \log 20 \). What is his mistake? How could you show him that he has made an error using \( \log \)s?

\( \text{Take } \log 25 \text{ and } \log 5 \text{ and put them next to each other. In order to make their heights congruent, a second } \log 5 \text{ must be added on top of } \log 5. \)

\( \text{Therefore, } \log 25 - \log 5 = \log 5. \)

Part III: Generalizing

14. Look back at your answers to Part I & Part II. What’s the pattern? Is it possible to subtract \( \log \)s even if you don’t have them in front of you? In your own words, what is the rule or pattern for subtracting \( \log \)s?

\( \text{Yes, it is possible. In order to subtract two } \log \text{s, take the argument of the first } \log \text{ and divide it by the argument of the second } \log. \text{ This gives you the argument of your final } \log. \)

15. Use your rule to determine: \( \log 50 - \log 5 = \log \underline{10} \)

16. Describe the pattern using variables: \( \log A - \log B = \log (A/B) \)

17. **Vocabulary**: The number that comes after the word \( \log \) is referred to as the argument.

   a. What’s the argument in “\( \log 50 \)”? \( 50 \)
   
   b. What’s the argument in “\( \log 356 \)”? \( 356 \)

18. **Last time we learned that**: To add \( \log \)s we **multiply** their arguments.

   **Today we learned that**: To subtract \( \log \)s we **divide** their arguments.

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

Part IV: Practice & Application

19. \( \log 50 - \log 10 = \log \underline{5} \) \hspace{1cm} 23. \( \log 35 - \log 7 = \log \underline{5} \)

20. \( \log 100 - \log 2 = \log \underline{50} \) \hspace{1cm} 24. \( \log 56 - \log 8 = \log \underline{7} \)

21. \( \log 200 - \log 50 = \log \underline{4} \) \hspace{1cm} 25. \( \log 33 - \log 3 = \log \underline{11} \)

22. \( \log 144 - \log 12 = \log \underline{12} \) \hspace{1cm} 26. \( \log 45 - \log 9 = \log \underline{5} \)
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 the difference of two other \( \log \)s:

For example: \( \log 5 = \log \frac{20}{4} = \log 20 - \log 4 \)

27. \( \log \frac{20}{10} = \log \_\_\_ - \log \_\_\_ \)

28. \( \log \frac{16}{4} = \log \_\_\_ - \log \_\_\_ \)

31. \( \log \frac{x}{10} = \log \_\_\_ - \log \_\_\_ \)

32. \( \log \frac{x}{4} = \log \_\_\_ - \log \_\_\_ \)

For numbers 29 to 30:

Express \( \log 10 \) in two different ways:

29. \( \log 10 = \log \_\_\_ - \log \_\_\_ \)

30. \( \log 10 = \log \_\_\_ - \log \_\_\_ \)

Multiple Possible Responses

33. \( \log \frac{x}{y} = \log \_\_\_ - \log \_\_\_ \)

34. \( \log \frac{2x}{5} = \log \_\_\_ - \log \_\_\_ \)

35. \( \log \frac{2x}{4y} = \log \_\_\_ - \log \_\_\_ \)

36. Generalize: Describe the pattern using variables: \( \log \frac{A}{B} = \log \_\_\_ - \log \_\_\_ \)

Part VI: More Challenging Questions

37. \( \log 1 - \log 10 = \log \_\_\_ \)

38. \( \log \frac{1}{2} - \log \frac{1}{4} = \log \_\_\_ \)

39. \( \log \frac{1}{4} - \log \frac{1}{2} = \log \_\_\_ \)

40. \( \log 5 - \log 2 = \log \_\_\_ = 2 \frac{1}{2} \)

41. \( \log 3^{12} - \log 3^{7} = \log \_\_\_ = 243 \)

42. \( \log x^{6} - \log x^{4} = \log \_\_\_ \)

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