Section 13.3 (Properties of Logarithms)

Logarithms were very important in our history in order to do technical calculations. We will see their use in this way, later in our study of this topic. Remember right now that a logarithm is an exponent and naturally it will behave that way in that it would follow the laws of exponents.

The objectives for this section are:

- Simplify logarithmic expressions using the properties of logarithms
- Evaluate logarithmic expression using the properties of logarithms

The theorem involving Logarithm of a Product would allow us to write the following problems as follows:

1. $\log_5(25\cdot 125)$

2. $\log_t H + \log_t M$

3. $\log 5 + \log x$

4. $\log(xy)$

The theorem involving Logarithm of a Quotient would allow us to write the following problems as follows:

5. $\log_3 \dfrac{27}{9}$

6. $\log_b 42 - \log_b 7$

7. $\log\left(\dfrac{\sqrt[3]{z}}{8}\right)$

8. $\log 81 - \log 9$

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The theorem involving Logarithm of a Power (plus the previous two theorems, would allow us to write the following problems as follows:

9. $\log_{10} y^7$

10. $\log_d T^{-3}$

11. $\log_a xy^4z^3$

12. $\log_a \dfrac{x^4}{yz^2}$

The following problems add just some complexity to the picture along with further theorems.

13. $\log_a \sqrt[4]{\dfrac{x^8y^{12}}{a^3z^5}}$

14. $2\log_b m + \dfrac{1}{2}\log_b n$

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15. $\log_a 2x + 3(\log_a x - \log_a y)$

16. $\log_a (2x+10) - \log_a (x^2 - 25)$

Write each expression as the sum, difference, or multiple of logarithms and then evaluate.

17. $\log\left(\frac{3}{8}\right)$

18. $\log\left(\frac{1}{100}\right)$

19. $\log\sqrt[3]{6}$

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20. The loudness of sound, measured in decibels is given by the formula

$$10\log\left(\frac{I}{I_0}\right)$$

where I is the intensity of the sound and I_0 is the intensity of the faintest sound that can be hear. A busy street has a noise level with intensity $I = 10^7 I_0$. Determine the decibel level.