3-3: Properties of Logarithms

Precalculus
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Properties of Logarithms

- Allows expressions and equations to be simplified

For any positive numbers m, n and b where $\boldsymbol{b \neq 1}$, the following properties apply:

Product Property $\log_b mn = \log_b m + \log_b n$

Quotient Property $\log_b \frac{m}{n} = \log_b m - \log_b n$

Power Property $\log_b m^n = n \log_b m$

What is each expression written as a single logarithm?
If possible, simplify the single logarithm.

$\log_3 x - 2\log_3 7 = \log_3 x - \log_3 7^2$ ← Power Property

$= \log_3 \frac{x}{49}$ ← Quotient Property

$\log_8 48 + \log_8 \frac{4}{3} = \log_8 \left(48 \bullet \frac{4}{3}\right)$ ← Product Property

$= \log_8 64$

$8^x = 64$ ← Change to Exponential Form

$x = 2$

What is each expression written as a single logarithm?
If possible, simplify the single logarithm.

$\log_5 \frac{125}{xy} = \log_5 125 - \log_5 xy$ ← Quotient Property

$= 3 - \log_5 x - \log_5 y$ ← Product Property

$\log x^2 y^2 z^{-1} = \log x^2 + \log y^2 + \log z^{-1}$ ← Product Property

$= 2\log x + 2\log y - \log z$ ← Power Property

Change of Base Formula

- Used to change the base
- Will allow to change to base 10 so the calculator can be used

For any positive numbers m. b and c, with $b \neq 1$ and $c \neq 1$.

$$\log_b m = \frac{\log_c m}{\log_c b}$$

c is the base you want to change to.

What is the value of each expression?

$$\log_9 111 = \frac{\log_c m}{\log_c b} = \frac{\log 111}{\log 9} \approx 2.14$$

$$\log_{216} 36 = \frac{\log_c m}{\log_c b} = \frac{\log 36}{\log 216} \approx .667$$

Homework: p.185 #1-7 odd, 39-49 odd, 53, 57