

## 7-4: Properties of Logarithms

Algebra 2  
Mr. Gallo

### Properties of Logarithms

- Allows expressions and equations to be simplified

For any positive numbers  $m$ ,  $n$  and  $b$  where  $b \neq 1$ , 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.

$$\log_3 x - 2 \log_3 7 = \log_3 x - \log_3 7^2 \quad \leftarrow \text{Power Property}$$

$$= \log_3 \frac{x}{49} \quad \leftarrow \text{Quotient Property}$$

$$\log_8 48 + \log_8 \frac{4}{3} = \log_8 \left( 48 \cdot \frac{4}{3} \right) \quad \leftarrow \text{Product Property}$$

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$$= \log_8 64$$

$$8^x = 64 \quad \leftarrow \text{Change to Exponential Form}$$

a.  $\log_4 15x^2$

b. 1

$x = 2$

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

$$\log_5 \frac{125}{xy} = \log_5 125 - \log_5 xy \quad \leftarrow \text{Quotient Property}$$

$$= 3 - \log_5 x - \log_5 y \quad \leftarrow \text{Product Property}$$

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

$$= 2 \log x + 2 \log y - \log z \quad \leftarrow \text{Power Property}$$

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a.  $\log_3 2 + 3 \log_3 5 - \log_3 37$

b.  $2 + 5 \log_3 x$

## 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?

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

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

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$$a. \frac{5}{3} \approx 1.67 \quad b. \approx 2.085$$

**Homework: p.466 #9-43 odd, 73**