Name: __________________________ Date: ___________________

Learning Goal 8.1	Solving exponential and logarithmic equations with same base and with different bases, including base e.

More Questions - Solutions

Power Law	Product Law	Quotient Law	Change of Base
$\log_b x^y = y \log_b x$	$\log_b(xy) = \log_b x + \log_b y$	$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$	$\log_b x = \frac{\log_a x}{\log_a b}$

1. Evaluate.

a. $\log_{36} 2 - \log_{36} 12$

$$= \log_{36}\left(\frac{2}{12}\right)$$
$$= \log_{36}\left(\frac{1}{6}\right)$$
$$= -\frac{1}{2}$$

b. $2\log_3 6 - \frac{1}{2}\log_3 64 + \log_3 2$

$$= \log_3 6^2 - \log_3 \sqrt{64} + \log_3 2$$
$$= \log_3 36 - \log_3 8 + \log_3 2$$
$$= \log_3\left(\frac{36}{8}\right) + \log_3 2$$
$$= \log_3\left(\frac{9}{2}\right) + \log_3 2$$
$$= \log_3\left(\frac{9}{2} \times 2\right)$$
$$= \log_3(9)$$
$$= 2$$

2. Write as a single logarithm.

a. $\frac{n \log_a x}{\log_a y}$

$$= \frac{\log_a x^n}{\log_a y}$$
$$= \log_y x^n$$

b. $\frac{\log_6 64}{\log_6 4}$

$$= \log_4 64$$
$$= 3$$

3. Simplify by changing the base of the logarithm. Check using a calculator.

a. $\log_{125} 625$

$$= \frac{\log_5 625}{\log_5 125}$$
$$= \frac{4}{3}$$

b. $\log_8 32 + \log_{16} 2 - \log_2 4$

$$= \frac{\log_2 32}{\log_2 8} + \frac{\log_2 2}{\log_2 16} - \log_2 4$$
$$= \frac{5}{3} + \frac{1}{4} - 2$$
$$= \frac{20}{12} + \frac{3}{12} - \frac{24}{12}$$
$$= -\frac{1}{12}$$

4. Simplify. State any restrictions on the variable.

$$\log_2(x^2 - 9) - \log_2(x^2 - x - 6)$$
$$= \log_2\left(\frac{x^2 - 9}{x^2 - x - 6}\right)$$
$$= \log_2\left(\frac{(x+3)(x-3)}{(x-3)(x+2)}\right) \quad x \neq -2, 3$$
$$= \log_2\left(\frac{x+3}{x+2}\right)$$

5. Audiologists recommend hearing protection if the sound level in environment exceeds 85 dB. The sound level of a chainsaw is about 85 dB and the maximum level of a AirPods is about 110 dB. How times as intense is the sound of the media player, at the maximum volume, compared to the sound of a chainsaw?

Let $\beta_A =$ the decibel level of the AirPods and $\beta_C =$ the decibel level of the chainsaw.

$$\beta_A - \beta_C = 10\log\left(\frac{I_A}{I_0}\right) - 10\log\left(\frac{I_C}{I_0}\right)$$
$$\beta_A - \beta_C = 10\left(\log\left(\frac{I_A}{I_0}\right) - \log\left(\frac{I_C}{I_0}\right)\right)$$
$$\beta_A - \beta_C = 10\left(\log\left(\frac{I_A}{I_0} \div \frac{I_C}{I_0}\right)\right)$$
$$\beta_A - \beta_C = 10\left(\log\left(\frac{I_A}{I_0} \times \frac{I_0}{I_C}\right)\right)$$
$$\beta_A - \beta_C = 10\left(\log\left(\frac{I_A}{I_C}\right)\right)$$
$$110 - 85 = 10\left(\log\left(\frac{I_A}{I_C}\right)\right)$$
$$25 = 10\left(\log\left(\frac{I_A}{I_C}\right)\right)$$
$$2.5 = \log\left(\frac{I_A}{I_C}\right)$$
$$10^{2.5} = \frac{I_A}{I_C}$$
$$316 \approx \frac{I_A}{I_C}$$

AirPods are over 300 times more intense than a chainsaw when at maximum volume. Turn them down!