Precalculus

Topic: Laws of Logarithms

Instructions

Solve the following problems related to the laws of logarithms. Show all work clearly and check your solutions.

Practice Problems

1. **Apply the laws of logarithms to simplify the following expressions:**

   (i) $\log_3 27 + \log_3 9$

   (ii) $\log_5 125 - \log_5 5$

   (iii) $\log_2 32 + \log_2 4$

   (iv) $3\log_2 8 - \log_2 16$

   (v) $\log_7 49 + \log_7 7$

   (vi) $\log_2 \sqrt{32} + \log_2 \sqrt{2}$

   (vii) $\frac{1}{2}\log_3 81 + \log_3 3$

   (viii) $\log_2 \left(\frac{8}{4}\right) + \log_2 16$

2. **Use the laws of logarithms to solve the following real-world problems:**

   (i) The population of a bacteria culture grows according to the formula $P(t) = 5000e^{0.3t}$. Find the time required for the population to reach 15000.

   (ii) A car's value depreciates according to the formula $V(t) = 20000e^{-0.1t}$, where t is the time in years. How much is the car worth after 5 years?

3. **Express the following logarithms as single logarithms using the laws of logarithms:**

(i) $\log_2 8 + \log_2 16$
(ii) $\log_5 25 - \log_5 5$
(iii) $2\log_3 3 - \log_3 9$
(iv) $4\log_4 x - \log_4 x$
(v) $3\log_2 2 + \log_2 4$
(vi) $\log_3 3 + \frac{1}{2}\log_3 81$
(vii) $\log_2 16 - \log_2 8 + \log_2 2$

4. **Using the change of base formula, convert the following logarithms to base 10 (common logarithms):**

(i) $\log_2 16$
(ii) $\log_3 81$
(iii) $\log_5 25$
(iv) $\log_7 49$
(v) $\log_4 64$

Multiple-Choice Questions

1. Which of the following is the correct application of the product rule for logarithms?

A. $\log_b(x+y) = \log_b x + \log_b y$
B. $\log_b(xy) = \log_b x + \log_b y$
C. $\log_b(x^y) = y\log_b x$
D. $\log_b x = \log_x b$

2. Which of the following is the correct application of the quotient rule for logarithms?

A. $\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$
B. $\log_b\left(\frac{x}{y}\right) = \log_b x + \log_b y$
C. $\log_b x = \frac{1}{\log_x b}$
D. $\log_b\left(\frac{x}{y}\right) = \frac{1}{\log_b x} + \log_b y$

3. Which of the following is the correct application of the power rule for logarithms?

A. $\log_b(x^y) = y\log_b x$
B. $\log_b(x^y) = \log_b x + y$
C. $\log_b(x^y) = \frac{1}{y}\log_b x$
D. $\log_b x = y\log_b x$

4. What is the value of $\log_3 27$?

A. 2
B. 3
C. 1
D. 4