# LOGARITHMS

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# CONCEPT

1. $\log_a (xy) = \log_a x + \log_a y$

2. $\log_a \left(\frac{x}{y}\right) = \log_a x - \log_a y$

3. $\log_x x = 1$

4. $\log_a 1 = 0$

5. $\log_a (x^n) = n(\log_a x)$

6. $\log_a x = \frac{1}{\log_x a}$

7. $\log_a x = \frac{\log_b x}{\log_b a} = \frac{\log x}{\log a}$.

**If $a^x = N$,**

**Then, $\log_a N = x$**

- **Logarithms are defined only for positive numbers.**
- **Logarithms are not defined for zero or negative numbers.**
- **Characteristic:** The internal part of the logarithm.
- **Mantissa:** The decimal part of the logarithm.

12.3456

- **Natural log:** Base "e".
- **Common log:** Base "10".

i. $a^m \times a^n = a^{m+n}$

ii. $\frac{a^m}{a^n} = a^{m-n}$

iii. $(a^m)^n = a^{mn}$

iv. $(ab)^n = a^n b^n$

v. $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

vi. $a^0 = 1$

**1. $\log_x y = 100$ and $\log_x 2 = 10$, then the value of y is**

A. 2^10 B. 2^1000 C. 2^100 D. 2^10000

$$x^{100} = y = (x^{10})^{10}$$

$$x^{10} = 2$$

$$y = (x^{10})^{10} = 2^{10}$$

**2. What is the value of $\log(ab^2) - \log(ac) + \log(abc^4) - 3\log(bc)$?** $= \log(bc)^3$

A. log (ab) B. log c C. log b D. log a ✓

$$\log\left(\frac{ab^2 \times abc^4}{ac \times b^3c^3}\right)$$

$$= \log a$$

$$\log\left(\frac{ab^2 \times abc^4}{ac \times b^3c^3}\right)$$

**3. The value of log 9/8 – log 27/32 + log 3/4 is ?**

A. 0 B. 1 C. 2 D. 3

$\log a - \log b = \log \frac{a}{b}$

$\log a + \log b = \log ab$

$\log \left( \frac{9/8 \times 3/4}{27/32} \right) = \log \left( \frac{9 \times 3 \times 32}{8 \times 4 \times 27} \right)$

$= \log 1 = 0$

**4. The simplified form of log(75/16) - 2 log(5/9) + log(32/243) is?**

A. 2 log 2 ✓B. log 2 C. log 3 D. log 5

$$\log\left(\frac{75/16 \times 32/243}{(5/9)^2}\right)$$

$$= \log\left(\frac{3^2 \times 3 \times 2^5 \times 3^4}{2^4 \times 3^5 \times 5^2}\right)$$

$$= \log 2$$

**5. Find the value of $\log (a^2 / bc) + \log (b^2 / ac) + \log (c^2 / ab)$?**

A. 0 B. 1 C. abc D. $ab^2c^2$

$$\log\left(\frac{a^2 \times b^2 \times c^2}{bc \times ac \times ab}\right)$$

$$\log 1 = 0$$

**6. The equation $\log_a(x) + \log_a(1+x) = 0$ can be written as?**

A. $x^2 + x + 1 = 0$
B. $x^2 + x - 1 = 0$
C. $x^2 - x - 1 = 0$
D. $x^2 - x + 1 = 0$

$\log_a\left(x(1+x)\right) = 0$

$a^0 = x(1+x) = x + x^2 = 1$

$x^2 + x - 1 = 0$

$\log_a 1$

$\log_a x + \log_a(1+x) - \log_a 1$

**7. $\log_{10}(10) + \log_{10}(100) + \log_{10}(1000) + \log_{10}(10000) + \log_{10}(100000)$ is equal to?**

A. 15 B. 12 C. 16 D. 14 $\log_{10}(100)$

$1 + 2 + 3 + 4 + 5$

$= 15$

**8. The value of $\log_2 (1/64)$ is?**

A. 6 B. – 6 C. 7 D. None of these

$$\log_2\left(\frac{1}{64}\right) = \log_2 2^{-6}$$

$$= -6 \times 1$$

$$= -6$$

**9. If log 125 / log 5 = x, then x is equal to?**

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

$\log_5 125 = x$

$x = 3$

**10. If $\log_x (0.1) = -1/3$, then the value of x is -**

A. 10 B. 100 C. 1000 D. 1/1000

$$x^{-1/3} = \frac{1}{10}$$

$$\frac{1}{x^{1/3}} = \frac{1}{10}$$

$$x^{1/3} = 10$$

$$x = 10^3 = 1000$$

**11. If $\log_8 x + \log_8 (1/6) = 1/3$ then, the value of x will be:**

A. 12 B. 16 C. 18 D. 24

$$x^{1/3} = \sqrt[3]{x}$$

$$\log_8\left(x \times \frac{1}{6}\right) = \frac{1}{3}$$

$$8^{1/3} = \frac{x}{6}$$

$$2 = \frac{x}{6} \quad \Rightarrow x = 12$$

**12. If log {(a+b)/3} = 0.5 (log a + log b), then the correct relation between a and b will be:**

A. $a^2+b^2 = 7ab$ ✓

B. $a^2-b^2 = 7ab$

B. C. $(a+b)^2 = 2$

D. $(a+b)/3 = (1/2)(a+b)$

$$\log\left(\frac{a+b}{3}\right) = 0.5(\log ab)$$

$$= \log(ab)^{0.5}$$

$$\frac{a+b}{3} = (ab)^{0.5}$$

(squaring)

$$\frac{(a+b)^2}{3^2} = (ab^{0.5})^2 = ab$$

$$a^2+b^2+2ab = 9ab$$

$$a^2+b^2 = 7ab$$

**13. If log x = log 3 + 2 log 2 - (3/4) log 16. The value of x will be:**

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

$$\log x = \log\left(\frac{3 \times 2^2}{16^{3/4}}\right)$$

$$= \log\left(\frac{3 \times 4}{2^{4 \times 3/4}}\right)$$

$$= \log\left(\frac{3 \times 4}{8_2}\right) = \log \frac{3}{2}$$

$$x = \frac{3}{2}$$

**14. It is given that $\log_{64} x = 2/6$, then, the value of x will be?**

A. 2 ✓B. 4 C. 6 D. 8

$64^{2/6} = x$

$6^{6 \times 2/6} = x$

$2^2 = x = 4$

**15. What will be the value of $\log_3 (1/9) + \log_9 81$?**

A. 2 B. -2 C. 0 D. 4

$3^x = 1/9 = \frac{1}{3^2} = 3^{-2}$

$x = -2$

$-2 + 2 = 0$

# ANSWER KEY - LOGARITHMS

| QUESTION | ANSWER | QUESTION | ANSWER | QUESTION | ANSWER |
|---|---|---|---|---|---|
| 1 | A | 6 | B | 11 | A |
| 2 | D | 7 | A | 12 | A |
| 3 | A | 8 | B | 13 | C |
| 4 | B | 9 | B | 14 | B |
| 5 | A | 10 | C | 15 | C |