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9-4 Study Guide and Intervention

Common Logarithms

Common Logarithms Base 10 logarithms are called **common logarithms**. The expression $\log_{10} x$ is usually written without the subscript as $\log x$. Use the LOG key on your calculator to evaluate common logarithms.

The relation between exponents and logarithms gives the following identity.

Inverse Property of Logarithms and Exponents	$10^{\log x} = x$

Example 1 **Evaluate log 50 to four decimal places.**

Example 2 **Solve $3^{2x+1} = 12$.**

Exercises

Use a calculator to evaluate each expression to four decimal places.

1. log 18
2. log 39
3. log 120
4. log 5.8
5. log 42.3
6. log 0.003

Solve each equation or inequality. Round to four decimal places.

7. $4^{3x} = 12$
8. $6^{x+2} = 18$
9. $5^{4x-2} = 120$
10. $7^{3x-1} \geq 21$
11. $2.4^{x+4} = 30$
12. $6.5^{2x} \geq 200$
13. $3.6^{4x-1} = 85.4$
14. $2^{x+5} = 3^{x-2}$
15. $9^{3x} = 4^{5x+2}$
16. $6^{x-5} = 2^{7x+3}$

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9-4 Study Guide and Intervention *(continued)*

Common Logarithms

Change of Base Formula The following formula is used to change expressions with different logarithmic bases to common logarithm expressions.

Change of Base Formula	For all positive numbers a, b, and n, where $a \neq 1$ and $b \neq 1$, $\log_a n = \frac{\log_b n}{\log_b a}$.

Example **Express $\log_8 15$ in terms of common logarithms. Then approximate its value to four decimal places.**

Exercises

Express each logarithm in terms of common logarithms. Then approximate its value to four decimal places.

1. $\log_3 16$

2. $\log_2 40$

3. $\log_5 35$

4. $\log_4 22$

5. $\log_{12} 200$

6. $\log_2 50$

7. $\log_5 0.4$

8. $\log_3 2$

9. $\log_4 28.5$

10. $\log_3 (20)^2$

11. $\log_6 (5)^4$

12. $\log_8 (4)^5$

13. $\log_5 (8)^3$

14. $\log_2 (3.6)^6$

15. $\log_{12} (10.5)^4$

16. $\log_3 \sqrt{150}$

17. $\log_4 \sqrt[3]{39}$

18. $\log_5 \sqrt[4]{1600}$

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9-4 Study Guide and Intervention

Common Logarithms

Common Logarithms Base 10 logarithms are called **common logarithms**. The expression $\log_{10} x$ is usually written without the subscript as $\log x$. Use the LOG key on your calculator to evaluate common logarithms.

The relation between exponents and logarithms gives the following identity.

Inverse Property of Logarithms and Exponents	$10^{\log x} = x$

Example 1 **Evaluate $\log 50$ to four decimal places.**

Use the LOG key on your calculator. To four decimal places, $\log 50 = 1.6990$.

Example 2 **Solve $3^{2x+1} = 12$.**

$3^{2x+1} = 12$	Original equation
$\log 3^{2x+1} = \log 12$	Property of Equality for Logarithms
$(2x + 1) \log 3 = \log 12$	Power Property of Logarithms
$2x + 1 = \frac{\log 12}{\log 3}$	Divide each side by log 3.
$2x = \frac{\log 12}{\log 3} - 1$	Subtract 1 from each side.
$x = \left(\frac{1}{2} \frac{\log 12}{\log 3} 1\right)$	Multiply each side by $\frac{1}{2}$.
$x \approx 0.6309$	

Exercises

Use a calculator to evaluate each expression to four decimal places.

1. $\log 18$ 1.2553
2. $\log 39$ 1.5911
3. $\log 120$ 2.0792
4. $\log 5.8$ 0.7634
5. $\log 42.3$ 1.6263
6. $\log 0.003$ −2.5229

Solve each equation or inequality. Round to four decimal places.

7. $4^{3x} = 12$ 0.5975
8. $6^{x+2} = 18$ −0.3869
9. $5^{4x-2} = 120$ 1.2437
10. $7^{3x-1} \geq 21$ $\{x \mid x \geq 0.8549\}$
11. $2.4^{x+4} = 30$ −0.1150
12. $6.5^{2x} \geq 200$ $\{x \mid x \geq 1.4153\}$
13. $3.6^{4x-1} = 85.4$ 1.1180
14. $2^{x+5} = 3^{x-2}$ 13.9666
15. $9^{3x} = 4^{5x+2}$ −8.1595
16. $6^{x-5} = 2^{7x+3}$ −3.6069

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9-4 Study Guide and Intervention *(continued)*

Common Logarithms

Change of Base Formula The following formula is used to change expressions with different logarithmic bases to common logarithm expressions.

Change of Base Formula	For all positive numbers a, b, and n, where $a \neq 1$ and $b \neq 1$, $\log_a n = \frac{\log_b n}{\log_b a}$

Example **Express $\log_8 15$ in terms of common logarithms. Then approximate its value to four decimal places.**

$\log_8 15 = \frac{\log_{10} 15}{\log_{10} 8}$ Change of Base Formula

≈ 1.3023 Simplify.

The value of $\log_8 15$ is approximately 1.3023.

Exercises

Express each logarithm in terms of common logarithms. Then approximate its value to four decimal places.

1. $\log_3 16$ $\frac{\log 16}{\log 3}$, 2.5237
2. $\log_2 40$ $\frac{\log 40}{\log 2}$, 5.3219
3. $\log_5 35$ $\frac{\log 35}{\log 5}$, 2.2091
4. $\log_4 22$ $\frac{\log 22}{\log 4}$, 2.2297
5. $\log_{12} 200$ $\frac{\log 200}{\log 12}$, 2.1322
6. $\log_2 50$ $\frac{\log 50}{\log 2}$, 5.6439
7. $\log_5 0.4$ $\frac{\log 0.4}{\log 5}$, −0.5693
8. $\log_3 2$ $\frac{\log 2}{\log 3}$, 0.6309
9. $\log_4 28.5$ $\frac{\log 28.5}{\log 4}$, 2.4164
10. $\log_3 (20)^2$ $\frac{2 \log 20}{\log 3}$, 5.4537
11. $\log_6 (5)^4$ $\frac{4 \log 5}{\log 6}$, 3.5930
12. $\log_8 (4)^5$ $\frac{5 \log 4}{\log 8}$, 3.3333
13. $\log_5 (8)^3$ $\frac{3 \log 8}{\log 5}$, 3.8761
14. $\log_2 (3.6)^6$ $\frac{6 \log 3.6}{\log 2}$, 11.0880
15. $\log_{12} (10.5)^4$ $\frac{4 \log 10.5}{\log 12}$, 3.7851
16. $\log_3 \sqrt{150}$ $\frac{\log 150}{2 \log 3}$, 2.2804
17. $\log_4 \sqrt[3]{39}$ $\frac{\log 39}{3 \log 4}$, 0.8809
18. $\log_5 \sqrt[4]{1600}$ $\frac{\log 1600}{4 \log 5}$, 1.1460

Answers