Algebra 2 Logarithms Workbook

3 lessons · printable · answer key at the back

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Contents

Logarithms

WORKED EXAMPLE

$\log_2$ <u>64</u> $= 6$

$2^6 = 64$

1. Logarithms

Work out each logarithm, or find the missing number.

1 $\log_4$ ______ $= 3$

2 $\log_7$ ______ $= 3$

3 $\log_4$ ______ $= 4$

4 $\log_2 4 =$ ______

5 $\log_8$ ______ $= 2$

6 $\log_5 15625 =$ ______

7 $\log_3 27 =$ ______

8 $\log_5$ ______ $= 2$

9 $\log_2$ ______ $= 14$

10 $\log_9$ ______ $= 2$

11 $\log_7$ ______ $= 4$

12 $\log_9$ ______ $= 3$

13 $\log_3 \frac{1}{9} =$ ______

14 $\log_4 4096 =$ ______

15 $\log_7$ ______ $= 2$

16 $\log_8$ ______ $= 3$

17 $\log_6$ ______ $= 4$

18 $\log_6$ ______ $= 3$

19 $\log_4 \frac{1}{64} =$ ______

20 $\log_4 \frac{1}{1024} =$ ______

21 $\log_8 \frac{1}{512} =$ ______

22 $\log_2$ ______ $= 10$

23 $\log_2 \frac{1}{8} =$ ______

24 $\log_3 243 =$ ______

25 $\log_5$ ______ $= 3$

26 $\log_5 \frac{1}{25} =$ ______

27 $\log_6 46656 =$ ______

28 $\log_9 \frac{1}{81} =$ ______

2. Simplifying radicals

Simplify each square root.

29 $\sqrt{126}$

30 $\sqrt{240}$

31 $\sqrt{350}$

32 $\sqrt{44}$

33 $\sqrt{18}$

34 $\sqrt{150}$

35 $\sqrt{63}$

36 $\sqrt{99}$

37 $\sqrt{605}$

38 $\sqrt{176}$

1-2

The Laws of Logarithms

WORKED EXAMPLE

$\log_5 2 + \log_5 12 = \log_5$ 24

$\log_5 m + \log_5 n = \log_5 (m \times n)$

$2 \times 12 = 24$

$= \log_5 24$

3. Laws of logarithms

Write each of these as one logarithm.

1 $\log_2 4 + \log_2 6 = \log_2$ ____

2 $\log_5 6 + \log_5 7 = \log_5$ ____

3 $\log_{10} 27 - \log_{10} 9 = \log_{10}$ ____

4 $2 \log_3 11 = \log_3$ ____

5 $\log_{10} 2 + \log_{10} 4 = \log_{10}$ ____

6 $\log_2 6 + \log_2 8 = \log_2$ ____

7 $\log_5 2 + \log_5 5 = \log_5$ ____

8 $2 \log_{10} 9 = \log_{10}$ ____

9 $2 \log_2 6 = \log_2$ ____

10 $\log_{10} 3 + \log_{10} 3 = \log_{10}$ ____

11 $\log_{10} 108 - \log_{10} 9 = \log_{10}$ ____

12 $\log_2 12 - \log_2 2 = \log_2$ ____

13 $\log_2 3 + \log_2 11 = \log_2$ ____

14 $\log_5 132 - \log_5 12 = \log_5$ ____

15 $\log_2 22 - \log_2 2 = \log_2$ ____

16 $\log_2 42 - \log_2 7 = \log_2$ ____

3. Laws of logarithms (continued)

Write each of these as one logarithm.

17 $\log_5 12 - \log_5 3 = \log_5$ ______

18 $\log_2 72 - \log_2 6 = \log_2$ ______

19 $\log_2 44 - \log_2 11 = \log_2$ ______

20 $\log_5 24 - \log_5 12 = \log_5$ ______

21 $\log_{10} 88 - \log_{10} 8 = \log_{10}$ ______

22 $\log_2 30 - \log_2 5 = \log_2$ ______

23 $\log_3 4 + \log_3 4 = \log_3$ ______

24 $\log_5 84 - \log_5 12 = \log_5$ ______

4. Simplifying radicals

Simplify each cube root.

25 $\sqrt[3]{96}$

26 $\sqrt[3]{128}$

27 $\sqrt[3]{162}$

28 $\sqrt[3]{704}$

29 $\sqrt[3]{81}$

30 $\sqrt[3]{192}$

31 $\sqrt[3]{72}$

32 $\sqrt[3]{576}$

33 $\sqrt[3]{270}$

34 $\sqrt[3]{56}$

Exponential Functions

WORKED EXAMPLE

$f(x) = 12 \cdot 3^x$ **$f(2) =$** 108

$f(2) = 12 \cdot 3^2$
$3^2 = 9$
$12 \cdot 9 = 108$

5. Evaluate exponential functions

Evaluate each exponential function at the value given.

1 $f(x) = 10 \cdot 4^x$ **$f(3) =$** ____

2 $f(x) = 12 \cdot 2^x$ **$f(0) =$** ____

3 $f(x) = 12 \cdot 8^x$ **$f(2) =$** ____

4 $f(x) = 7 \cdot 3^x$ **$f(3) =$** ____

5 $f(x) = 2 \cdot 2^x$ **$f(5) =$** ____

6 $f(x) = 10 \cdot 7^x$ **$f(2) =$** ____

7 $f(x) = 10 \cdot 9^x$ **$f(2) =$** ____

8 $f(x) = 3 \cdot 8^x$ **$f(1) =$** ____

9 $f(x) = 12 \cdot 2^x$ **$f(4) =$** ____

10 $f(x) = 6 \cdot 3^x$ **$f(3) =$** ____

11 $f(x) = 12 \cdot 6^x$ **$f(3) =$** ____

12 $f(x) = 3 \cdot 2^x$ **$f(6) =$** ____

13 $f(x) = 8 \cdot 5^x$ **$f(2) =$** ____

14 $f(x) = 8 \cdot 2^x$ **$f(6) =$** ____

15 $f(x) = 2 \cdot 7^x$ **$f(1) =$** ____

16 $f(x) = 7 \cdot 5^x$ **$f(3) =$** ____

5. Evaluate exponential functions (continued)

Evaluate each exponential function at the value given.

17 $f(x) = 5 \cdot 6^x$ $f(1) =$ ______

18 $f(x) = 6 \cdot 2^x$ $f(5) =$ ______

19 $f(x) = 10 \cdot 4^x$ $f(2) =$ ______

20 $f(x) = 7 \cdot 2^x$ $f(5) =$ ______

21 $f(x) = 12 \cdot 3^x$ $f(5) =$ ______

22 $f(x) = 4 \cdot 4^x$ $f(4) =$ ______

23 $f(x) = 12 \cdot 2^x$ $f(5) =$ ______

24 $f(x) = 5 \cdot 8^x$ $f(3) =$ ______

6. Rational exponents

Work out each one. Take the root first, then raise it.

25 $81^{1/2} =$ ______

26 $49^{1/2} =$ ______

27 $1000^{4/3} =$ ______

28 $216^{2/3} =$ ______

29 $625^{1/4} =$ ______

30 $16^{1/4} =$ ______

31 $2401^{1/4} =$ ______

32 $25^{5/2} =$ ______

33 $1296^{1/4} =$ ______

34 $81^{5/4} =$ ______

Answer Key (1 of 2)

Logarithms

Logarithms

1. $\log_4 64 = 3$
2. $\log_7 343 = 3$
3. $\log_4 256 = 4$
4. $\log_2 4 = 2$
5. $\log_8 64 = 2$
6. $\log_5 15625 = 6$
7. $\log_3 27 = 3$
8. $\log_5 25 = 2$
9. $\log_2 16384 = 14$
10. $\log_9 81 = 2$
11. $\log_7 2401 = 4$
12. $\log_9 729 = 3$
13. $\log_3 1/9 = -2$
14. $\log_4 4096 = 6$
15. $\log_7 49 = 2$
16. $\log_8 512 = 3$
17. $\log_6 1296 = 4$
18. $\log_6 216 = 3$
19. $\log_4 1/64 = -3$
20. $\log_4 1/1024 = -5$
21. $\log_8 1/512 = -3$
22. $\log_2 1024 = 10$
23. $\log_2 1/8 = -3$
24. $\log_3 243 = 5$
25. $\log_5 125 = 3$
26. $\log_5 1/25 = -2$
27. $\log_6 46656 = 6$
28. $\log_9 1/81 = -2$

Simplifying radicals

29. $\sqrt{126} = 3\sqrt{14}$
30. $\sqrt{240} = 4\sqrt{15}$
31. $\sqrt{350} = 5\sqrt{14}$
32. $\sqrt{44} = 2\sqrt{11}$
33. $\sqrt{18} = 3\sqrt{2}$
34. $\sqrt{150} = 5\sqrt{6}$
35. $\sqrt{63} = 3\sqrt{7}$
36. $\sqrt{99} = 3\sqrt{11}$
37. $\sqrt{605} = 11\sqrt{5}$
38. $\sqrt{176} = 4\sqrt{11}$

The Laws of Logarithms

Laws of logarithms

1. $\log_2 4 + \log_2 6 = \log_2 24$
2. $\log_5 6 + \log_5 7 = \log_5 42$
3. $\log_{10} 27 - \log_{10} 9 = \log_{10} 3$
4. $2 \log_3 11 = \log_3 121$
5. $\log_{10} 2 + \log_{10} 4 = \log_{10} 8$
6. $\log_2 6 + \log_2 8 = \log_2 48$

The Laws of Logarithms (continued)

Laws of logarithms (continued)

7. $\log_5 2 + \log_5 5 = \log_5 10$
8. $2 \log_{10} 9 = \log_{10} 81$
9. $2 \log_2 6 = \log_2 36$
10. $\log_{10} 3 + \log_{10} 3 = \log_{10} 9$
11. $\log_{10} 108 - \log_{10} 9 = \log_{10} 12$
12. $\log_2 12 - \log_2 2 = \log_2 6$
13. $\log_2 3 + \log_2 11 = \log_2 33$
14. $\log_5 132 - \log_5 12 = \log_5 11$
15. $\log_2 22 - \log_2 2 = \log_2 11$
16. $\log_2 42 - \log_2 7 = \log_2 6$
17. $\log_5 12 - \log_5 3 = \log_5 4$
18. $\log_2 72 - \log_2 6 = \log_2 12$
19. $\log_2 44 - \log_2 11 = \log_2 4$, and that is 2
20. $\log_5 24 - \log_5 12 = \log_5 2$
21. $\log_{10} 88 - \log_{10} 8 = \log_{10} 11$
22. $\log_2 30 - \log_2 5 = \log_2 6$
23. $\log_3 4 + \log_3 4 = \log_3 16$
24. $\log_5 84 - \log_5 12 = \log_5 7$

Simplifying radicals

25. $\sqrt[3]{96} = 2\sqrt[3]{12}$
26. $\sqrt[3]{128} = 4\sqrt[3]{2}$
27. $\sqrt[3]{162} = 3\sqrt[3]{6}$
28. $\sqrt[3]{704} = 4\sqrt[3]{11}$
29. $\sqrt[3]{81} = 3\sqrt[3]{3}$
30. $\sqrt[3]{192} = 4\sqrt[3]{3}$
31. $\sqrt[3]{72} = 2\sqrt[3]{9}$
32. $\sqrt[3]{576} = 4\sqrt[3]{9}$
33. $\sqrt[3]{270} = 3\sqrt[3]{10}$
34. $\sqrt[3]{56} = 2\sqrt[3]{7}$

Exponential Functions

Evaluate exponential functions

1. $f(x) = 10 \cdot 4^x \rightarrow f(3) = 640$
2. $f(x) = 12 \cdot 2^x \rightarrow f(0) = 12$
3. $f(x) = 12 \cdot 8^x \rightarrow f(2) = 768$
4. $f(x) = 7 \cdot 3^x \rightarrow f(3) = 189$
5. $f(x) = 2 \cdot 2^x \rightarrow f(5) = 64$
6. $f(x) = 10 \cdot 7^x \rightarrow f(2) = 490$
7. $f(x) = 10 \cdot 9^x \rightarrow f(2) = 810$
8. $f(x) = 3 \cdot 8^x \rightarrow f(1) = 24$
9. $f(x) = 12 \cdot 2^x \rightarrow f(4) = 192$
10. $f(x) = 6 \cdot 3^x \rightarrow f(3) = 162$
11. $f(x) = 12 \cdot 6^x \rightarrow f(3) = 2592$
12. $f(x) = 3 \cdot 2^x \rightarrow f(6) = 192$
13. $f(x) = 8 \cdot 5^x \rightarrow f(2) = 200$
14. $f(x) = 8 \cdot 2^x \rightarrow f(6) = 512$
15. $f(x) = 2 \cdot 7^x \rightarrow f(1) = 14$
16. $f(x) = 7 \cdot 5^x \rightarrow f(3) = 875$

Answer Key (2 of 2)

Exponential Functions (continued)

Evaluate exponential functions (continued)

17. $f(x) = 5 \cdot 6^x \rightarrow f(1) = 30$
18. $f(x) = 6 \cdot 2^x \rightarrow f(5) = 192$
19. $f(x) = 10 \cdot 4^x \rightarrow f(2) = 160$
20. $f(x) = 7 \cdot 2^x \rightarrow f(5) = 224$
21. $f(x) = 12 \cdot 3^x \rightarrow f(5) = 2916$
22. $f(x) = 4 \cdot 4^x \rightarrow f(4) = 1024$
23. $f(x) = 12 \cdot 2^x \rightarrow f(5) = 384$
24. $f(x) = 5 \cdot 8^x \rightarrow f(3) = 2560$

Rational exponents

25. 81^(1/2) = 9
26. 49^(1/2) = 7
27. 1000^(4/3) = 10000
28. 216^(2/3) = 36
29. 625^(1/4) = 5
30. 16^(1/4) = 2
31. 2401^(1/4) = 7
32. 25^(5/2) = 3125
33. 1296^(1/4) = 6
34. 81^(5/4) = 243

Solutions (1 of 4)

Logarithms

Logarithms

1. $\log_4$ ________ = 3

$4^3 = 64$

A logarithm names a power. $\log_4$ of a number is 3 when that number IS the 3rd power of 4, so there is nothing to search for — just work the power out.

2. $\log_7$ ________ = 3

$7^3 = 343$

A logarithm names a power. $\log_7$ of a number is 3 when that number IS the 3rd power of 7, so there is nothing to search for — just work the power out.

Simplifying radicals

29. $\sqrt{126}$

$\sqrt{126} = 3\sqrt{14}$

Split 126 into a perfect square times whatever is left: $126 = 9 \times 14$. 9 is 3 squared, and 14 has no square factor of its own — that last part is what makes this the LARGEST perfect square inside, and it is where the answer stops.

A root splits across a product, so the one root becomes two.

$\sqrt{9}$ is 3, so it comes out in front. $\sqrt{14}$ stays under the sign, because 14 has nothing more to give.

30. $\sqrt{240}$

$\sqrt{240} = 4\sqrt{15}$

Split 240 into a perfect square times whatever is left: $240 = 16 \times 15$. 16 is 4 squared, and 15 has no square factor of its own — that last part is what makes this the LARGEST perfect square inside, and it is where the answer stops.

A root splits across a product, so the one root becomes two.

$\sqrt{16}$ is 4, so it comes out in front. $\sqrt{15}$ stays under the sign, because 15 has nothing more to give.

The Laws of Logarithms

Laws of logarithms

1. $\log_2 4 + \log_2 6 = \log_2$ ____

$$\log_2 4 + \log_2 6$$

$$\log_2 m + \log_2 n = \log_2 (m \times n)$$

$$4 \times 6 = 24$$

$$\log_2 4 + \log_2 6 \quad = \quad \log_2 24$$

Both logarithms are to the same base, 2. That is what makes a law available at all — two logarithms to different bases cannot be combined, and checking the bases match is the first thing to do rather than the last.

A SUM of two logarithms with the same base is the logarithm of the two arguments MULTIPLIED. Adding the logs multiplies the numbers — that is the law, and it is the one worth saying out loud, because the operation changes.

So the two arguments become one: $4 \times 6 = 24$. The answer is $\log_2 24$.

2. $\log_5 6 + \log_5 7 = \log_5$ ____

$$\log_5 6 + \log_5 7$$

$$\log_5 m + \log_5 n = \log_5 (m \times n)$$

$$6 \times 7 = 42$$

$$\log_5 6 + \log_5 7 \quad = \quad \log_5 42$$

Both logarithms are to the same base, 5. That is what makes a law available at all — two logarithms to different bases cannot be combined, and checking the bases match is the first thing to do rather than the last.

A SUM of two logarithms with the same base is the logarithm of the two arguments MULTIPLIED. Adding the logs multiplies the numbers — that is the law, and it is the one worth saying out loud, because the operation changes.

So the two arguments become one: $6 \times 7 = 42$. The answer is $\log_5 42$.

Solutions (3 of 4)

Exponential Functions

Evaluate exponential functions

1. $f(x) = 10 \cdot 4^x$ **$f(3)$ =** ____

$$f(3) = 10 \cdot 4^3$$
$$4^3 = 64$$
$$10 \cdot 64 = 640$$

Substitute x = 3: $f(3) = 10 \cdot 4^3$.

Do the power first: $4^3 = 64$.

Then multiply by the coefficient: $10 \cdot 64 = 640$.

2. $f(x) = 12 \cdot 2^x$ **$f(0)$ =** ___

$$f(0) = 12 \cdot 2^0$$
$$12 \cdot 1 = 12$$

Substitute x = 0: $f(0) = 12 \cdot 2^0$.

Anything to the power 0 is 1, so $2^0 = 1$ and $f(0) = 12 \cdot 1 = 12$.

Rational exponents

25. $81^{1/2}$ = ________

$$81^\wedge(1/2) = 9$$

The BOTTOM of the exponent says which root to take, so the square root of 81 comes first. Root before power, always — the other order works and makes the numbers enormous.

The top is 1, so there is nothing left to raise — a exponent of 1/2 IS the square root, written the other way.

So 81^(1/2) is 9.

Solutions (4 of 4)

Exponential Functions (continued)

Rational exponents (continued)

26. $49^{1/2}$ = ________

$49^{(1/2)} = 7$

The BOTTOM of the exponent says which root to take, so the square root of 49 comes first. Root before power, always — the other order works and makes the numbers enormous.

The top is 1, so there is nothing left to raise — a exponent of 1/2 IS the square root, written the other way.

So $49^{(1/2)}$ is 7.