

6.1 Evaluate n^{th} roots Use Rational Exponents

If $b^n = a$, then b is an **nth root of a**.

An n^{th} root is written

$$\sqrt[n]{a}$$

Examples:

1. $\sqrt[3]{8}$

2. $\sqrt[4]{81}$

KEY CONCEPT*For Your Notebook***Real n th Roots of a**

Let n be an integer ($n > 1$) and let a be a real number.

n is an even integer.

$a < 0$ No real n th roots.

$a = 0$ One real n th root: $\sqrt[n]{0} = 0$

$a > 0$ Two real n th roots: $\pm\sqrt[n]{a} = \pm a^{1/n}$

n is an odd integer.

$a < 0$ One real n th root: $\sqrt[n]{a} = a^{1/n}$

$a = 0$ One real n th root: $\sqrt[n]{0} = 0$

$a > 0$ One real n th root: $\sqrt[n]{a} = a^{1/n}$

Examples:

3. $\sqrt[3]{-8}$

4. $\sqrt[4]{-81}$

5. Find the real n th roots of a

a. $n = 4$, $a = 625$

b. $n = 3$, $a = -64$

Notice:

$$\left(a^{\frac{1}{2}}\right)^2 =$$

$$\left(\sqrt{a}\right)^2 =$$

So...

KEY CONCEPT*For Your Notebook***Rational Exponents**

Let $a^{1/n}$ be an n th root of a , and let m be a positive integer.

$$a^{m/n} = (a^{1/n})^m = (\sqrt[n]{a})^m$$

$$a^{-m/n} = \frac{1}{a^{m/n}} = \frac{1}{(a^{1/n})^m} = \frac{1}{(\sqrt[n]{a})^m}, a \neq 0$$

Examples:

6. Rewrite in exponent form: $\sqrt{(72)^3}$

7. Rewrite in radical form: $7^{2/3}$

Examples:

Evaluate without a calculator:

9. $9^{3/2}$

10. $81^{-3/4}$

11. $8^{4/3}$

12. $8^{-4/3}$

Using a calculator:

13. $4^{2/5}$

How did we solve:

$$2x^2 + 6 = 8$$

We are going to do exactly the same for higher degree equations.

Solving equations:

1. get exponential by itself
2. take appropriate root of both sides
(remember \pm if taking even root)
3. solve for x
4. use calculator if rounded answer is needed

Examples:

$$14. x^3 = 64$$

$$15. \frac{1}{2}x^5 = -512$$

$$16. (x + 5)^4 - 7 = 9$$

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USING RATIONAL EXPONENT NOTATION Rewrite the expression using rational exponent notation.

7. $\sqrt[3]{12}$

8. $\sqrt[5]{8}$

9. $(\sqrt[3]{10})^7$

10. $(\sqrt[8]{15})$

USING RADICAL NOTATION Rewrite the expression using radical notation.

11. $5^{1/4}$

12. $7^{1/3}$

13. $14^{2/5}$

14. $21^{9/4}$

FINDING NTH ROOTS Find the indicated real n th root(s) of a .

15. $n = 2, a = 64$

16. $n = 3, a = -27$

17. $n = 4, a = 0$

EVALUATING EXPRESSIONS Evaluate the expression without using a calculator.

21. $\sqrt[6]{64}$

22. $8^{1/3}$

23. $16^{3/2}$

24. $\sqrt[3]{-125}$

25. $27^{2/3}$

26. $(-243)^{1/5}$

27. $(\sqrt[3]{8})^{-2}$

28. $(\sqrt[3]{-64})^4$

29. $(\sqrt[4]{16})^{-7}$

30. $25^{3/2}$

31. $64^{-2/3}$

32. $\frac{1}{81^{-3/4}}$

APPROXIMATING ROOTS Evaluate the expression using a calculator. Round the result to two decimal places when appropriate.

34. $\sqrt[5]{32,768}$

35. $\sqrt[7]{1695}$

36. $\sqrt[9]{-230}$

37. $85^{1/6}$

SOLVING EQUATIONS Solve the equation. Round the result to two decimal places when appropriate.

50. $x^3 = 125$

51. $5x^3 = 1080$

52. $x^6 + 36 = 100$

53. $(x - 5)^4 = 256$

54. $x^5 = -48$

55. $7x^4 = 56$

56. $x^3 + 40 = 25$

57. $(x + 10)^5 = 70$

58. $x^5 - 34 = 181$