

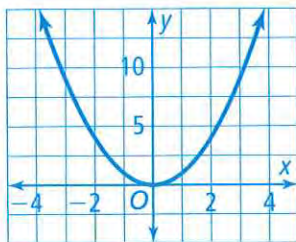
5-1

n th Roots,
Radicals,
and Rational
Exponents

 PearsonRealize.com

EXPLORE & REASON

The graph shows $y = x^2$.



A. Find *all* possible values of x or y so that the point is on the graph.

(a) $(2, \quad)$ (b) $(3, \quad)$ (c) $(-3, \quad)$ (d) $(5, \quad)$

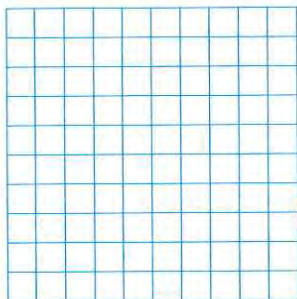
(e) $(\quad, 4)$ (f) $(\quad, -16)$ (g) $(\quad, 7)$ (h) $(\quad, 5)$

B. **Communicate Precisely** Write a precise set of instructions that show how to find an approximate value of $\sqrt{13}$ using the graph. © MP.6

C. Draw a graph of $y = x^3$. Use the graph to approximate each value.

(a) $\sqrt[3]{5}$ (b) $\sqrt[3]{-5}$ (c) $\sqrt[3]{8}$

(d) A solution to $x^3 = 5$ (e) A solution to $x^3 = -5$ (f) A solution to $x^3 = 8$



HABITS OF MIND

Look for Relationships How is $\sqrt[6]{5}$ related to $\sqrt[3]{5}$? © MP.7

**EXAMPLE 1** **Try It! Find All Real n th Roots**

1. Find the specified roots of each number.
 - a. real fourth roots of 81
 - b. real cube roots of 64

EXAMPLE 2 **Try It! Understand Rational Exponents**

2. Explain what each fractional exponent means, then evaluate.
 - a. $25^{\frac{1}{2}}$
 - b. $32^{\frac{2}{3}}$

HABITS OF MIND

Generalize What is true about the denominators of fractional exponents in which absolute value must be considered? **MP8**

EXAMPLE 3 **Try It! Evaluate Expressions With Rational Exponents**

3. What is the value of each expression? Round to the nearest hundredth if necessary.
 - a. $-(16^{\frac{3}{4}})$
 - b. $\sqrt[5]{3.5^4}$

**EXAMPLE 4** **Try It! Simplify n th Roots**

4. Simplify each expression.

a. $\sqrt[3]{-8a^3b^9}$

b. $\sqrt[4]{256x^{12}y^{24}}$

HABITS OF MIND

Make Sense and Persevere What is an example of a variable expression that has both a cube root and a fourth root which can be simplified to an expression without a radical? © MP.1

EXAMPLE 5 **Try It! Use n th Roots to Solve Equations**5. a. Solve the equation $5x^3 = 320$. b. Solve the equation $2p^4 = 162$.**EXAMPLE 6** **Try It! Use n th Roots to Solve Problems**6. One cube has an edge length 3 cm shorter than the edge length of a second cube. The volume of the smaller cube is 200 cm^3 . What is the volume of the larger cube?**HABITS OF MIND**

Communicate Precisely What are the steps necessary to solve the equation $ax^n = b$? © MP.6

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How are exponents and radicals used to represent roots of real numbers?

2. **Error Analysis** Kaitlyn said $\sqrt[3]{10} = 10^3$. Explain Kaitlyn's error. © MP.3

3. **Vocabulary** In the radical expression $\sqrt[5]{125}$, what is the index? What is the radicand?

4. **Reason** Why is $75^{\frac{3}{5}}$ equal to $(75^{\frac{1}{5}})^3$? © MP.2

5. **Critique Arguments** Anastasia said that $(x^8)^{\frac{1}{4}} = \frac{x^8}{x^4} = x^4$. Is Anastasia correct? Explain. © MP.3

6. **Make Sense and Persevere** Is it possible for a rational exponent to be an improper fraction? Explain how $27^{\frac{4}{3}}$ is evaluated or why it cannot be evaluated. © MP.1

Do You KNOW HOW?

Write each expression in radical form.

7. $a^{\frac{1}{5}}$

8. $7^{\frac{2}{3}}$

Write each expression in exponential form.

9. $\sqrt[3]{b}$

10. $\sqrt[4]{p^7}$

11. How many real third roots does 1,728 have?

12. How many real sixth roots does 15,625 have?

13. Solve the equation $4x^3 = 324$.

14. Solve the equation $2x^4 = 2,500$.

Simplify each expression.

15. $\sqrt[3]{27x^{12}y^6}$

16. $\sqrt[5]{-32x^5y^{30}}$

17. A snow globe is packaged in a cubic container that has volume 64 in.^3 . A large shipping container is also a cube, and its edge length is 8 inches longer than the edge length of the snow globe container. How many snow globes can fit into the larger shipping container?