

ARE YOU A RADICAL OR JUST A SQUARE ROOT?

EXAMPLES

1. “**Squaring**” a number means using that number as a **factor** two times.

$$8^2 = 8(8) = 64$$

$$(-8)^2 = (-8)(-8) = 64$$

Make sure students realize that $-x^2$ means $-(x^2)$, not $(-x)^2$. Thus, parentheses are necessary for indicating the square of a negative number.

2. **Warm-up activity:** Have students evaluate each expression:

- a. 4^2
- b. $(-4)^2$
- c. $(0.5)^2$
- d. $(-0.5)^2$

ANSWERS

- a. 16
- b. 16
- c. 0.25
- d. 0.25

3. The “**inverse**” of “**squaring**” is finding a “**square root**.” To find a “**square root**” of 64, you must find “**two equal factors**” whose product is 64.

$$x^2 = x(x) = 64$$

Since **8** times **8** is **64**, one square root of **64** is **8**. Since **(-8)** times **(-8)** is also **64**, another square root of **64** is **(-8)**.

4. **If $x^2 = y$, the “x” is a “square root” of “y.”**

**Definition of
“Square Root”**

0, 1

5. **Thought Provoker:** What numbers equal their own square roots?
6. An expression like $\sqrt{64}$ is called a “**radical expression**.” The symbol $\sqrt{\quad}$ is a “**radical sign**.” It indicates the “**nonnegative**” or “**principal square root**” of the expression under the “**radical sign**” called the “**radicand**.”

Radical sign $\rightarrow \sqrt{64} \leftarrow$ radicand

7. The square root of a “**negative**” number is not defined for this set of numbers (Explain that the “**square root**” of a “**negative**” number is not defined over the set of “**real numbers**” because the “**square**” of a “**real**” number is never “**negative.**”)

Consider the equation $\sqrt{-25} = n$. An “equivalent” equation is $(-25) = n^2$. There is “no” real number value for “n” that satisfies this equation.

8.

Radical sign $\rightarrow \sqrt{64}$ \leftarrow radicand

- a) $\sqrt{64} = 8 \rightarrow \sqrt{64}$ indicates the “**principal**” square root of 64.
 b) $-\sqrt{64} = -8 \rightarrow -\sqrt{64}$ indicates the “**negative**” square root of 64.
 c) $\pm\sqrt{64} = \pm 8 \rightarrow \pm\sqrt{64}$ indicates “**both**” square roots of 64.

\pm means
positive or
negative.

9. **Example:** Find $\sqrt{49} \rightarrow$ Since $7^2 = 49$, we know that $\sqrt{49} = 7$.
10. **Example:** Find $\sqrt{81} \rightarrow$ Since $9^2 = 81$, we know that $\sqrt{81} = 9$.
11. **Example:** Find $\sqrt{121} \rightarrow$ Since $11^2 = 121$, we know that $\sqrt{121} = 11$.
12. **Example:** Find $\sqrt{144} \rightarrow$ Since $12^2 = 144$, we know that $\sqrt{144} = 12$.
13. **Example:** Find $-\sqrt{36} \rightarrow$ Since $(6)^2 = 36$, we know that $-\sqrt{36} = -6$.
14. **Example:** Find $-\sqrt{25} \rightarrow$ Since $(5)^2 = 25$, we know that $-\sqrt{25} = -5$.
15. **Example:** Find $\pm\sqrt{0.09} \rightarrow$ Since $(0.3)^2 = 0.09$, we know that $\pm\sqrt{0.09} = \pm 0.3$.
16. **Example:** Find $\pm\sqrt{1.69} \rightarrow$ Since $(1.3)^2 = 1.69$, we know that $\pm\sqrt{1.69} = \pm 1.3$

17. To simplify a “**radical**” expression, find the “**square root**” of any factors of the “**radicand**” that are “**perfect**” squares. For example, to simplify $\sqrt{196}$, find any “**factors**” of “**196**” that are “**perfect**” squares. You can use the “**prime factorization**” of “**196**” shown:

$$\begin{aligned}\sqrt{196} &= \sqrt{2 \cdot 2 \cdot 7 \cdot 7} \\ &= \sqrt{2^2 \cdot 7^2} \\ &= \sqrt{2^2} \cdot \sqrt{7^2} \\ &= 2 \cdot 7 \\ &= 14\end{aligned}$$

Check: $14^2 = 196$
Encourage students to check square roots by squaring!

18.

For any numbers “a” and “b,” where $a \geq 0$ and $b \geq 0$,
 $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$.

**Product Property
of Square Roots**

19. Before introducing the next example, have students find square roots of numbers when given the prime factorizations. Point out that to find the square root of a power, divide the exponent by 2. For example:

$$\sqrt{2^4 \cdot 3^4 \cdot 5^2} = 2^2(3^2)(5) = 180$$

20. **Example:** Simplify $\sqrt{576}$. →

Find the prime factorization of 576.
Express the radicand using exponents.
Use the Product Property of Square Roots.
Simplify each radical.

$$\begin{aligned}\sqrt{576} &= \sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3} \\ &= \sqrt{2^6 \cdot 3^2} \\ &= \sqrt{2^6} \cdot \sqrt{3^2} \\ &= 2^3 \cdot 3 \\ &= 24\end{aligned}$$

Check: $24^2 = 576$

21. A similar property for “**quotients**” can also be used to simplify square roots.

For any numbers “a” and “b”, where $a \geq 0$ and $b > 0$,

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

**Quotient Property of
Square Roots**

22. **Example:** Simplify $\sqrt{\frac{9}{16}}$ →

$$\sqrt{\frac{9}{16}} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{3}{4}$$

Check: $(\frac{3}{4})^2 = \frac{9}{16}$

23. **Example:** Simplify $-\sqrt{\frac{81}{121}}$ →

$$-\sqrt{\frac{81}{121}} = -\frac{\sqrt{81}}{\sqrt{121}} = -\frac{9}{11}$$

Check: $(-\frac{9}{11})^2 = \frac{81}{121}$

Name: _____

Date: _____

Class: _____

ARE YOU A RADICAL OR JUST A SQUARE ROOT? WORKSHEET

State the “**square**” of each number:

1. 10

2. 12

3. -7

4. -20

5. 0.3

6. 0.04

7. $\frac{1}{2}$

8. $\frac{4}{7}$

9. $-\frac{7}{8}$

10. $-\frac{11}{4}$

Find the “**principal square root**” of each number:

11. 49

12. 64

13. 16

14. 169

15. $\frac{25}{36}$

16. $\frac{81}{121}$

17. 0.0009

18. 0.0025

19. 0.0036

20. 0.16

Simplify:

21. $\sqrt{36}$

22. $-\sqrt{100}$

23. $\pm\sqrt{144}$

24. $\sqrt{0.36}$

25. $-\sqrt{\frac{289}{100}}$

26. $\pm\sqrt{\frac{961}{729}}$

ARE YOU A RADICAL OR JUST A SQUARE ROOT? WORKSHEET KEY

State the “square” of each number:

1. $10 \rightarrow 100$

2. $12 \rightarrow 144$

3. $-7 \rightarrow 49$

4. $-20 \rightarrow 400$

5. $0.3 \rightarrow 0.09$

6. $0.04 \rightarrow .0016$

7. $\frac{1}{2} \rightarrow \frac{1}{4}$

8. $\frac{4}{7} \rightarrow \frac{16}{49}$

9. $-\frac{7}{8} \rightarrow \frac{49}{64}$

10. $-\frac{11}{4} \rightarrow \frac{121}{16}$

Find the “principal square root” of each number:

11. $49 \rightarrow 7$

12. $64 \rightarrow 8$

13. $16 \rightarrow 4$

14. $169 \rightarrow 13$

15. $\frac{25}{36} \rightarrow \frac{5}{6}$

16. $\frac{81}{121} \rightarrow \frac{9}{11}$

17. $0.0009 \rightarrow 0.03$

18. $0.0025 \rightarrow 0.05$

19. $0.0036 \rightarrow 0.06$

20. $0.16 \rightarrow 0.4$

Simplify:

21. $\sqrt{36} \rightarrow 6$

22. $-\sqrt{100} \rightarrow -10$

23. $\pm\sqrt{144} \rightarrow \pm 12$

24. $\sqrt{0.36} \rightarrow 0.6$

25. $-\sqrt{\frac{289}{100}} \rightarrow -\frac{17}{10}$

26. $\pm\sqrt{\frac{961}{729}} \rightarrow \pm\frac{31}{27}$

Student Name: _____

Date: _____

ARE YOU A RADICAL OR JUST A SQUARE ROOT? CHECKLIST

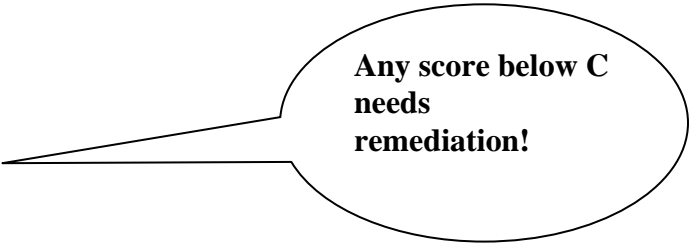
1. On questions 1 thru 10, did the student state the “**square**” of each number correctly?
 - a. All ten (50 points)
 - b. Nine of the ten (45 points)
 - c. Eight of the ten (40 points)
 - d. Seven of the ten (35 points)
 - e. Six of the ten (30 points)
 - f. Five of the ten (25 points)
 - g. Four of the ten (20 points)
 - h. Three of the ten (15 points)
 - i. Two of the ten (10 points)
 - j. One of the ten (5 points)

2. On questions 11 thru 20, did the student find the “**principal square root**” of each number correctly?
 - a. All ten (50 points)
 - b. Nine of the ten (45 points)
 - c. Eight of the ten (40 points)
 - d. Seven of the ten (35 points)
 - e. Six of the ten (30 points)
 - f. Five of the ten (25 points)
 - g. Four of the ten (20 points)
 - h. Three of the ten (15 points)
 - i. Two of the ten (10 points)
 - j. One of the ten (5 points)

3. On questions 21 thru 26, did the student simplify the radical correctly?
 - a. All six (30 points)
 - b. Five of the six (25 points)
 - c. Four of the six (20 points)
 - d. Three of the six (15 points)
 - e. Two of the six (10 points)
 - f. One of the six (5 points)

Total Number of Points _____

- A 117 points and above
- B 104 points and above
- C 91 points and above
- D 78 points and above
- F 77 points and below



**Any score below C
needs
remediation!**