

# Square Roots and Perfect Squares

Name: \_\_\_\_\_

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When you multiply a whole number by itself you get a **perfect square**: 1, 4, 9, 16, 25, 36, ... The **square root** is the reverse question— $\sqrt{n}$  asks “what number times itself gives  $n$ ?” For example,  $\sqrt{25} = 5$  because  $5 \times 5 = 25$ . Here is a tip that will save you loads of time: memorise the first twelve or so perfect squares so you can recognise them instantly. You will also learn how to *estimate* square roots of numbers that are not perfect squares (for instance,  $\sqrt{10}$  is between 3 and 4, closer to 3). These skills pop up everywhere—area problems, the Pythagorean theorem, and simplifying radicals in later courses.

## Key Concepts & Quick Review

**Perfect Square:** A number  $n$  such that  $n = k^2$  for some whole number  $k$ .

**Common perfect squares (memorise these!):**

|       |   |   |   |    |    |    |    |    |    |     |     |     |
|-------|---|---|---|----|----|----|----|----|----|-----|-----|-----|
| $k$   | 1 | 2 | 3 | 4  | 5  | 6  | 7  | 8  | 9  | 10  | 11  | 12  |
| $k^2$ | 1 | 4 | 9 | 16 | 25 | 36 | 49 | 64 | 81 | 100 | 121 | 144 |

**Square Root:**  $\sqrt{k^2} = k$ .  $\sqrt{25} = 5$  because  $5 \times 5 = 25$ .

**Inverse relationship:** Squaring and square-rooting undo each other:  $\sqrt{n^2} = n$  and  $(\sqrt{n})^2 = n$  (for  $n \geq 0$ ).

## Examples

① Find  $\sqrt{144}$ .

**Think It Through:** Ask yourself: what number times itself equals 144? Since  $12 \times 12 = 144$ , the square root of 144 is 12.

**Answer:**  $\sqrt{144} = 12$

② Determine whether 90 is a perfect square. If not, find the two consecutive whole numbers whose squares it falls between.

**Think It Through:**  $9^2 = 81$  and  $10^2 = 100$ . Since  $81 < 90 < 100$ , the number 90 is **not** a perfect square. It falls between  $9^2$  and  $10^2$ , so  $\sqrt{90}$  is between 9 and 10.

**Answer:** *Not a perfect square;  $9 < \sqrt{90} < 10$*




## Practice Problems

Find each square root or perfect square.



- |                   |       |                   |       |
|-------------------|-------|-------------------|-------|
| 1. $\sqrt{49} =$  | _____ | 9. $\sqrt{400} =$ | _____ |
| 2. $\sqrt{64} =$  | _____ | 10. $7^2 =$       | _____ |
| 3. $\sqrt{121} =$ | _____ | 11. $11^2 =$      | _____ |
| 4. $\sqrt{196} =$ | _____ | 12. $15^2 =$      | _____ |
| 5. $\sqrt{225} =$ | _____ | 13. $13^2 =$      | _____ |
| 6. $\sqrt{169} =$ | _____ | 14. $20^2 =$      | _____ |
| 7. $\sqrt{1} =$   | _____ | 15. $14^2 =$      | _____ |
| 8. $\sqrt{256} =$ | _____ |                   |       |

### Study Tips

-  Memorise  $1^2$  through  $15^2$ . That table lets you answer most square-root problems instantly.
-  If a number ends in 2, 3, 7, or 8, it is **never** a perfect square.
-  Squaring and taking a square root are **inverse operations**, just like multiplication and division.

### Word Problems

16. A square garden has an area of 196 square feet. What is the length of each side of the garden? If a fence costs \$4.50 per foot, how much would it cost to fence the entire garden? \_\_\_\_\_

17. Carlos knows that one perfect square is 64 and the next perfect square is 81. He says the square root of 70 must be closer to 8 than to 9. Is Carlos correct? Use the distances between 70 and each perfect square.  
\_\_\_\_\_



## Answer Keys

- |       |   |
|-------|---|
| 1) 7  | 10) 49  |
| 2) 8  | 11) 121   |
| 3) 11 | 12) 225   |
| 4) 14 | 13) 169   |
| 5) 15 | 14) 400   |
| 6) 13 | 15) 196   |
| 7) 1  | 16) Side 14 <i>ft</i> ; perimeter 56 <i>ft</i> ; cost \$252 |
| 8) 16 | 17) Yes; $\sqrt{70}$ is closer to 8                         |
| 9) 20 |   |

### Step-by-Step Explanations

**Strategy:** For Square Roots and Perfect Squares, connect square roots to square numbers; ask which non-negative number squared gives the radicand, and check by squaring back. The reverse check, squaring the answer, keeps the square-root work honest.

**Practice 1:**  $\sqrt{49} =$  **Answer:** 7

At the beginning of the practice, ask which number squared gives the radicand, or square the given base when the exponent is 2.

**Practice 15:**  $14^2 =$  **Answer:** 196

For the second model problem, ask which number squared gives the radicand, or square the given base when the exponent is 2.

**Word-problem notes:**

**16. Answer:** Side = 14 *ft*; Perimeter = 56 *ft*; Cost = \$252.

Since the garden is a square, each side is  $\sqrt{196} = 14$  feet. The perimeter is  $4 \times 14 = 56$  feet. The total fence cost is  $56 \times 4.50 = 252$  dollars.

**17. Answer:** Yes.  $70 - 64 = 6$  while  $81 - 70 = 11$ , so 70 is closer to 64 and  $\sqrt{70}$  is closer to 8.

$70 - 64 = 6$  and  $81 - 70 = 11$ . Because 70 is only 6 away from 64 but 11 away from 81,  $\sqrt{70}$  is closer to  $\sqrt{64} = 8$  than to  $\sqrt{81} = 9$ . Carlos is correct.



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