CCSS • 8.EE.2

# Square Roots and Perfect Squares

| Name: _____ | Date: _____ | Score: _____ / 17 |
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When you multiply a whole number by itself you get a **perfect square**: $1, 4, 9, 16, 25, 36, \ldots$ 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 $\left(\sqrt{n}\right)^2 = n$ (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. $\sqrt{49} =$ _____
2. $\sqrt{64} =$ _____
3. $\sqrt{121} =$ _____
4. $\sqrt{196} =$ _____
5. $\sqrt{225} =$ _____
6. $\sqrt{169} =$ _____
7. $\sqrt{1} =$ _____
8. $\sqrt{256} =$ _____
9. $\sqrt{400} =$ _____
10. $7^2 =$ _____
11. $11^2 =$ _____
12. $15^2 =$ _____
13. $13^2 =$ _____
14. $20^2 =$ _____
15. $14^2 =$ _____

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

## 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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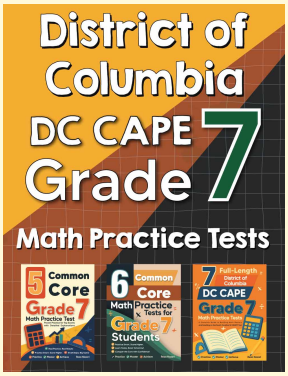


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