Square Roots and Perfect Squares

Name: ____________________	Date: ____________	Score: _____ / 17

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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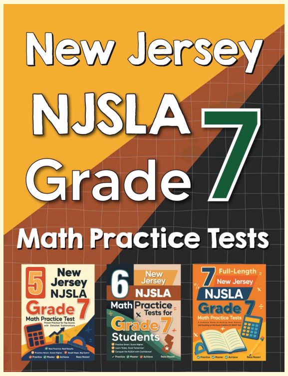

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