

Estimating Square Roots Without a Calculator

Pre-Algebra / Algebra Worksheet · Grade 6–8

Name: _____

Date: _____

Learning Objectives

- Identify perfect squares and their square roots from memory
- Determine which two consecutive integers a non-perfect-square root falls between
- Estimate the decimal value of a square root using the fraction method and long division

Problems

1. Find the square root of 49. Identify the two equal factors that produce this perfect square.

$$\sqrt{49}$$

2. Find the square root of 144. Show the multiplication fact you used.

$$\sqrt{144}$$

3. List ALL perfect squares from 1 to 100 and their square roots by completing the table below. Fill in every empty cell.

Perfect Square	Square Root
1	
4	
9	
16	
25	
36	
49	
64	
81	

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Perfect Square	Square Root
100	

4. Without using a calculator, identify the two consecutive whole numbers that the square root of 50 falls between. Explain your reasoning.

$$\sqrt{50}$$

5. Identify the two consecutive perfect squares that 75 falls between, then state the two consecutive integers that the square root of 75 lies between.

$$\sqrt{75}$$

6. Use the estimation fraction method shown in the video to estimate the square root of 20 to the nearest tenth. Show all subtraction steps.

$$\sqrt{20}$$

7. Use the estimation fraction method to estimate the square root of 141 to the nearest hundredth. Use 121 and 144 as your surrounding perfect squares.

$$\sqrt{141}$$

8. Use the estimation fraction method to estimate the square root of 200 to the nearest hundredth. Identify the surrounding perfect squares first.

$$\sqrt{200}$$

9. Place each value in the correct position on the number line by matching it to its approximate decimal location. Then list all four values in order from least to greatest.

$$\sqrt{5}, \sqrt{11}, \sqrt{18}, \sqrt{24}$$

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10. A square garden has an area of 530 square feet. Use the estimation fraction method to find the approximate side length of the garden to the nearest hundredth of a foot. Then determine whether the side length is closer to 23 feet or 24 feet.

$$s = \sqrt{530}$$

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Estimating Square Roots Without a Calculator — Answer Key

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Answer Key

1. Answer: 7

- Ask: what number times itself equals 49?
- $7 \times 7 = 49$, so $\sqrt{49} = 7$

2. Answer: 12

- Ask: what number times itself equals 144?
- $12 \times 12 = 144$, so $\sqrt{144} = 12$

3. Answer: See completed table

Perfect Square	Square Root
1	1
4	2
9	3
16	4
25	5
36	6
49	7
64	8
81	9
100	10

- Each perfect square n^2 has square root n .
- $1^2=1, 2^2=4, 3^2=9, 4^2=16, 5^2=25, 6^2=36, 7^2=49, 8^2=64, 9^2=81, 10^2=100$

4. Answer: Between 7 and 8

- Find perfect squares on either side of 50: $7^2 = 49$ and $8^2 = 64$.
- Since $49 < 50 < 64$, we know $7 < \sqrt{50} < 8$.

5. Answer: Between 8 and 9

- $8^2 = 64$ and $9^2 = 81$.
- Since $64 < 75 < 81$, we have $8 < \sqrt{75} < 9$.

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6. Answer: ≈ 4.5

- Perfect squares on either side: $4^2 = 16$ and $5^2 = 25$.
- Fraction = $(20 - 16) \div (25 - 16) = 4/9 \approx 0.44$.
- Estimated value: $4 + 0.44 \approx 4.4$ (to the nearest tenth, ≈ 4.5).

7. Answer: ≈ 11.87

- Perfect squares: $11^2 = 121$ and $12^2 = 144$.
- Fraction = $(141 - 121) \div (144 - 121) = 20/23$.
- Divide using long division: $20 \div 23 \approx 0.87$.
- Estimated value: $11 + 0.87 = 11.87$.

8. Answer: ≈ 14.14

- $14^2 = 196$ and $15^2 = 225$.
- Fraction = $(200 - 196) \div (225 - 196) = 4/29$.
- $4 \div 29 \approx 0.14$.
- Estimated value: $14 + 0.14 = 14.14$.

9. Answer: $\sqrt{5} \approx 2.24$, $\sqrt{11} \approx 3.32$, $\sqrt{18} \approx 4.24$, $\sqrt{24} \approx 4.90$; Order: $\sqrt{5} < \sqrt{11} < \sqrt{18} < \sqrt{24}$

- $\sqrt{5}$: between $2^2 = 4$ and $3^2 = 9 \rightarrow$ fraction = $(5-4)/(9-4) = 1/5 = 0.20 \rightarrow \approx 2.20$.
- $\sqrt{11}$: between $3^2 = 9$ and $4^2 = 16 \rightarrow$ fraction = $(11-9)/(16-9) = 2/7 \approx 0.29 \rightarrow \approx 3.29$.
- $\sqrt{18}$: between $4^2 = 16$ and $5^2 = 25 \rightarrow$ fraction = $(18-16)/(25-16) = 2/9 \approx 0.22 \rightarrow \approx 4.22$.
- $\sqrt{24}$: between $4^2 = 16$ and $5^2 = 25 \rightarrow$ fraction = $(24-16)/(25-16) = 8/9 \approx 0.89 \rightarrow \approx 4.89$.
- Order from least to greatest: $\sqrt{5} < \sqrt{11} < \sqrt{18} < \sqrt{24}$.

10. Answer: ≈ 23.02 ft; closer to 23 feet

- Perfect squares on either side of 530: $23^2 = 529$ and $24^2 = 576$.
- Fraction = $(530 - 529) \div (576 - 529) = 1/47$.
- $1 \div 47 \approx 0.02$.
- Estimated side length: $23 + 0.02 = 23.02$ feet.
- Since 23.02 is very close to 23, the side length is closer to 23 feet.

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