

# Order of Operations with Radicals

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 24

## Quick Review

When an expression mixes **radicals**, **exponents**, and ordinary arithmetic, follow the usual order of operations — just treat a square root or cube root like a **grouping symbol**. That means you fully simplify *inside* the radical first, then take the root. After that, handle any remaining exponents, then multiplication and division, and finally addition and subtraction. For example, in  $\sqrt{9+16}$  you add first to get  $\sqrt{25} = 5$  — you may *not* split it into  $\sqrt{9} + \sqrt{16}$ . Working left to right within each step keeps you from making sign slips.

◇ **Example:** Evaluate  $\sqrt{36} + 2 \cdot \sqrt[3]{8}$ .

⇒ Treat each radical as its own little package and simplify it first.  $\sqrt{36} = 6$  because  $6^2 = 36$ , and  $\sqrt[3]{8} = 2$  because  $2^3 = 8$ . Now the expression is  $6 + 2 \cdot 2$ . Order of operations says multiply before adding:  $2 \cdot 2 = 4$ . Finally add:  $6 + 4 = 10$ . Notice how taking the roots first turned a scary-looking expression into easy arithmetic.

**Answer:** 10

## PRACTICE

Evaluate each expression using the correct order of operations.

- |                                  |       |   |       |
|----------------------------------|-------|---|-------|
| 1. $\sqrt{25} + 3$               | _____ | 11. $\sqrt{36} \cdot \sqrt{4}$          | _____ |
| 2. $\sqrt{49} - 4$               | _____ | 12. $\sqrt{144} - 2 \cdot 3$            | _____ |
| 3. $2 \cdot \sqrt{16}$           | _____ | 13. $2^2 + \sqrt{49}$                   | _____ |
| 4. $\sqrt{81} \div 3$            | _____ | 14. $\sqrt{16} + 3^2$                   | _____ |
| 5. $\sqrt{9} + \sqrt{16}$        | _____ | 15. $\frac{\sqrt{64}}{2} + 5$           | _____ |
| 6. $\sqrt{9+16}$                 | _____ | 16. $\sqrt{25} \cdot 2 - \sqrt{9}$      | _____ |
| 7. $\sqrt{100 - 36}$             | _____ | 17. $\sqrt{4 \cdot 9}$                  | _____ |
| 8. $\sqrt[3]{27} + \sqrt[3]{64}$ | _____ | 18. $\sqrt[3]{8} + 2^3$                 | _____ |
| 9. $5 + \sqrt[3]{125}$           | _____ | 19. $(\sqrt{16} + \sqrt{9})^2$          | _____ |
| 10. $3 \cdot \sqrt{4} + 1$       | _____ | 20. $\sqrt{121} - \sqrt[3]{27} \cdot 2$ | _____ |

## Word Problems

21. A right triangle has legs of length 6 and 8. The hypotenuse equals  $\sqrt{6^2 + 8^2}$ . Find the length of the hypotenuse. \_\_\_\_\_
22. A square patio has area  $\sqrt{81} + \sqrt{16}$  square yards (after simplifying a builder's expression). What is the area of the patio? \_\_\_\_\_
23. A science score is computed as  $2 \cdot \sqrt{49} + \sqrt[3]{64}$  points. How many points is the score? \_\_\_\_\_
24. A designer needs the value of  $\sqrt{144} - 5 \cdot \sqrt{16}$  centimeters for a measurement. What is that value? \_\_\_\_\_



## Answer Keys

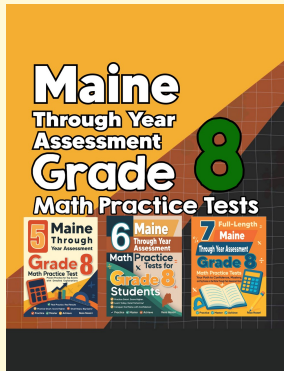
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|-------------------------------------|---|
| 1. <input type="text" value="8"/>   | 13. <input type="text" value="11"/>   |
| 2. <input type="text" value="3"/>   | 14. <input type="text" value="13"/>   |
| 3. <input type="text" value="8"/>   | 15. <input type="text" value="9"/>  |
| 4. <input type="text" value="3"/>   | 16. <input type="text" value="7"/>  |
| 5. <input type="text" value="7"/>   | 17. <input type="text" value="6"/>  |
| 6. <input type="text" value="5"/>   | 18. <input type="text" value="10"/>   |
| 7. <input type="text" value="8"/>   | 19. <input type="text" value="49"/>   |
| 8. <input type="text" value="7"/>   | 20. <input type="text" value="5"/>  |
| 9. <input type="text" value="10"/>  | 21. <input type="text" value="√6&lt;sup&gt;2&lt;/sup&gt; + 8&lt;sup&gt;2&lt;/sup&gt; = √100 = 10"/> |
| 10. <input type="text" value="7"/>  | 22. <input type="text" value="√81 + √16 = 9 + 4 = 13 square yards"/>                                |
| 11. <input type="text" value="12"/> | 23. <input type="text" value="2 · √49 + ∛64 = 14 + 4 = 18 points"/>                                 |
| 12. <input type="text" value="6"/>  | 24. <input type="text" value="√144 - 5 · 16 = √64 = 8 centimeters"/>                                |

### Step-by-Step Explanations

- |  |  |
|--|--|
| <p>1. Root first: <math>\sqrt{25} = 5</math>, then <math>5 + 3 = 8</math>.</p> <p>2. <math>\sqrt{49} = 7</math>, then <math>7 - 4 = 3</math>.</p> <p>3. <math>\sqrt{16} = 4</math>, then <math>2 \cdot 4 = 8</math>.</p> <p>4. <math>\sqrt{81} = 9</math>, then <math>9 \div 3 = 3</math>.</p> <p>5. Take each root separately: <math>3 + 4 = 7</math>.</p> <p>6. Add inside first: <math>9 + 16 = 25</math>, then <math>\sqrt{25} = 5</math>.</p> <p>7. Subtract inside: <math>100 - 36 = 64</math>, then <math>\sqrt{64} = 8</math>.</p> <p>8. Each cube root separately: <math>3 + 4 = 7</math>.</p> <p>9. <math>\sqrt[3]{125} = 5</math>, then <math>5 + 5 = 10</math>.</p> <p>10. <math>\sqrt{4} = 2</math>, then <math>3 \cdot 2 = 6</math>, then <math>6 + 1 = 7</math>.</p> <p>11. <math>\sqrt{36} = 6</math> and <math>\sqrt{4} = 2</math>, then <math>6 \cdot 2 = 12</math>.</p> <p>12. <math>\sqrt{144} = 12</math>; multiply <math>2 \cdot 3 = 6</math>; then <math>12 - 6 = 6</math>.</p> <p>13. <math>2^2 = 4</math> and <math>\sqrt{49} = 7</math>, then <math>4 + 7 = 11</math>.</p> <p>14. <math>\sqrt{16} = 4</math> and <math>3^2 = 9</math>, then <math>4 + 9 = 13</math>.</p> | <p>15. <math>\sqrt{64} = 8</math>; divide <math>8 \div 2 = 4</math>; then <math>4 + 5 = 9</math>.</p> <p>16. <math>\sqrt{25} = 5</math>, so <math>5 \cdot 2 = 10</math>; <math>\sqrt{9} = 3</math>; then <math>10 - 3 = 7</math>.</p> <p>17. Multiply inside: <math>4 \cdot 9 = 36</math>, then <math>\sqrt{36} = 6</math>.</p> <p>18. <math>\sqrt[3]{8} = 2</math> and <math>2^3 = 8</math>, then <math>2 + 8 = 10</math>.</p> <p>19. Inside first: <math>4 + 3 = 7</math>, then <math>7^2 = 49</math>.</p> <p>20. <math>\sqrt{121} = 11</math>; <math>\sqrt[3]{27} = 3</math>, so <math>3 \cdot 2 = 6</math>; then <math>11 - 6 = 5</math>.</p> <p>21. Work inside the radical first: <math>6^2 = 36</math> and <math>8^2 = 64</math>, so <math>36 + 64 = 100</math>. Then <math>\sqrt{100} = 10</math>.</p> <p>22. Simplify each root on its own: <math>\sqrt{81} = 9</math> and <math>\sqrt{16} = 4</math>. Then add: <math>9 + 4 = 13</math> square yards.</p> <p>23. Roots first: <math>\sqrt{49} = 7</math> and <math>\sqrt[3]{64} = 4</math>. Multiply before adding: <math>2 \cdot 7 = 14</math>, then <math>14 + 4 = 18</math> points.</p> <p>24. Inside the radical, multiply first: <math>5 \cdot 16 = 80</math>. Then subtract: <math>144 - 80 = 64</math>. Finally <math>\sqrt{64} = 8</math> centimeters.</p> |
|--|--|



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