

# 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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### Step-by-Step Explanations

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

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