

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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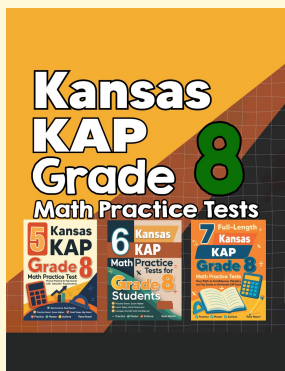
23.

24.

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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