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. $\sqrt{25}+3$ ________
2. $\sqrt{49}-4$ ________
3. $2\cdot\sqrt{16}$ ________
4. $\sqrt{81}\div 3$ ________
5. $\sqrt{9}+\sqrt{16}$ ________
6. $\sqrt{9+16}$ ________
7. $\sqrt{100-36}$ ________
8. $\sqrt[3]{27}+\sqrt[3]{64}$ ________
9. $5+\sqrt[3]{125}$ ________
10. $3\cdot\sqrt{4}+1$ ________
11. $\sqrt{36}\cdot\sqrt{4}$ ________
12. $\sqrt{144}-2\cdot 3$ ________
13. $2^2+\sqrt{49}$ ________
14. $\sqrt{16}+3^2$ ________
15. $\frac{\sqrt{64}}{2}+5$ ________
16. $\sqrt{25}\cdot 2-\sqrt{9}$ ________
17. $\sqrt{4\cdot 9}$ ________
18. $\sqrt[3]{8}+2^3$ ________
19. $(\sqrt{16}+\sqrt{9})^2$ ________
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 $\sqrt{144-5\cdot 16}$ centimeters for a measurement. What is that value? ________

Answer Keys

1. $\boxed{8}$
2. $\boxed{3}$
3. $\boxed{8}$
4. $\boxed{3}$
5. $\boxed{7}$
6. $\boxed{5}$
7. $\boxed{8}$
8. $\boxed{7}$
9. $\boxed{10}$
10. $\boxed{7}$
11. $\boxed{12}$
12. $\boxed{6}$
13. $\boxed{11}$
14. $\boxed{13}$
15. $\boxed{9}$
16. $\boxed{7}$
17. $\boxed{6}$
18. $\boxed{10}$
19. $\boxed{49}$
20. $\boxed{5}$
21. $\boxed{\sqrt{6^2+8^2}=\sqrt{100}=10}$
22. $\boxed{\sqrt{81}+\sqrt{16}=9+4=13 \text{ square yards}}$
23. $\boxed{2\cdot\sqrt{49}+\sqrt[3]{64}=14+4=18 \text{ points}}$
24. $\boxed{\sqrt{144-5\cdot16}=\sqrt{64}=8 \text{ centimeters}}$

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 $2\cdot4=8$.
4. $\sqrt{81}=9$, then $9\div3=3$.
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 $3\cdot2=6$, then $6+1=7$.
11. $\sqrt{36}=6$ and $\sqrt{4}=2$, then $6\cdot2=12$.
12. $\sqrt{144}=12$; multiply $2\cdot3=6$; 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 $8\div2=4$; then $4+5=9$.
16. $\sqrt{25}=5$, so $5\cdot2=10$; $\sqrt{9}=3$; then $10-3=7$.
17. Multiply inside: $4\cdot9=36$, 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 $3\cdot2=6$; 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: $2\cdot7=14$, then $14+4=18$ points.
24. Inside the radical, multiply first: $5\cdot16=80$. Then subtract: $144-80=64$. Finally $\sqrt{64}=8$ centimeters.

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