Addition and Subtraction of Radicals

Radicals can be added or subtracted if their indexes are the same and their radicands are exactly alike.

Thus, $2\sqrt{3}+5\sqrt{3}=7\sqrt{3}$. The process is like adding $2x$ and $5x$, where x is replaced by $\sqrt{3}$. The numbers $2\sqrt{3}$ and $5\sqrt{3}$ may be referred to as like terms just as $2x$ and $5x$ are like terms.

▶ To add or subtract radicals, we then proceed as follows:

1. Simplify, if possible, each separate radical.
2. Combine the like terms.

Example 1. $\sqrt{5}+3\sqrt{5}=4\sqrt{5}$

Example 2.
$$\begin{aligned}&\sqrt{50}-3\sqrt{2}\\&=\sqrt{25\cdot 2}-3\sqrt{2}\\&=\sqrt{25}\cdot\sqrt{2}-3\sqrt{2}\\&=5\sqrt{2}-3\sqrt{2}\\&=2\sqrt{2}\end{aligned}$$

In an example of this kind you should, after some practice, be able to leave out the steps printed in color.

Example 3.
$$\begin{aligned}&4\sqrt{27}+6\sqrt{24}-5\sqrt{3}\\&=4\sqrt{9}\cdot\sqrt{3}+6\sqrt{4}\cdot\sqrt{6}-5\sqrt{3}\\&=12\sqrt{3}+12\sqrt{6}-5\sqrt{3}\\&=7\sqrt{3}+12\sqrt{6}\end{aligned}$$

Exercises [A]

Add or subtract as indicated, and simplify results if possible.

1. $\sqrt{2}+3\sqrt{2}$
2. $\sqrt{5}-2\sqrt{5}-3\sqrt{5}$
3. $2\sqrt{6}+4\sqrt{6}$
4. $\sqrt{\frac{3}{2}}+3\sqrt{\frac{3}{2}}$
5. $\sqrt{6}+3\sqrt{6}-5\sqrt{6}$
6. $\sqrt{8}+\frac{1}{2}\sqrt{2}$
7. $\sqrt{3}+2\sqrt{2}$
8. $\sqrt{12}+\sqrt{18}$
9. $\sqrt{20}-\sqrt{45}$
10. $2\sqrt{6}-\sqrt{24}$
11. $\sqrt{18}+\sqrt{32}$
12. $\sqrt{28}+2\sqrt{7}$
13. $2\sqrt{50}+\sqrt{98}$
14. $\frac{1}{2}\sqrt{5}+\frac{1}{4}\sqrt{20}$
15. $\sqrt{40}-\sqrt{90}$
16. $\sqrt{75}+3\sqrt{27}$
17. $\sqrt{\frac{54}{2}}-\sqrt{\frac{600}{5}}$
18. $\sqrt{2a^2}+\sqrt{8a^2}$
19. $\sqrt{x^2}+\sqrt{9x^2}$
20. $\sqrt{b}+\sqrt{4b}$
21. $\sqrt{c}+\sqrt{2c}$
22. $y\sqrt{3}+y\sqrt{3}$
23. $x\sqrt{2}-x$
24. $\sqrt{6}+2\sqrt{24}-\sqrt{54}$
25. $\sqrt{32}+3\sqrt{8}-2\sqrt{18}$
26. $\sqrt{\frac{40}{2}}+\sqrt{\frac{250}{3}}$
27. $\frac{3}{4}\sqrt{45}-\frac{1}{3}\sqrt{20}$
28. $6\frac{1}{3}\sqrt{27}+\frac{5}{6}\sqrt{12}$
29. $\sqrt{\frac{700}{2}}-2\sqrt{28}$
30. $\dfrac{\sqrt{4}}{2}+\dfrac{\sqrt{12}}{3}-\dfrac{2\sqrt{3}}{3}$

1. $4\sqrt{2}$
2. $-4\sqrt{5}$
3. $6\sqrt{6}$
4. $4\sqrt{\frac{3}{2}}$
5. $-\sqrt{6}$
6. $\frac{5}{2}\sqrt{2}$
7. $\sqrt{3} + 2\sqrt{2}$
8. $2\sqrt{3} + 3\sqrt{2}$
9. $-\sqrt{5}$
10. 0
11. $7\sqrt{2}$
12. $4\sqrt{7}$
13. $17\sqrt{2}$
14. $\sqrt{5}$
15. $-\sqrt{10}$
16. $14\sqrt{3}$
17. $3\sqrt{3} - 2\sqrt{30}$
18. $3a\sqrt{2}$
19. $4x$
20. $3\sqrt{b}$
21. $\sqrt{c} + \sqrt{2c}$
22. $2y\sqrt{3}$
23. $x\sqrt{2} - x$
24. $2\sqrt{6}$
25. $4\sqrt{2}$
26. $2\sqrt{5} + 5\sqrt{\frac{10}{3}}$
27. $\frac{19}{12}\sqrt{5}$
28. $\frac{62}{3}\sqrt{3}$
29. $5\sqrt{14} - 4\sqrt{7}$
30. 1