

Section 2.3 – Adding and Subtracting Radical Expressions

This booklet belongs to: _____ Block: _____

- Remember that we can **add *like terms together***
 - **Example:** $3x + 4x = 7x$
- Since **the x represents a constant** unknown we can treat it like an object
- We can **do the same for *radicals***
 - **Example:** $5\sqrt{3} + 3\sqrt{3} = (5 + 3)\sqrt{3} = 8\sqrt{3}$

Five root three's plus three root three's is eight root three's

The root three is the object in this case.

- Sometimes it doesn't look possible or easy at first glance, but try **simplifying first!**

Example: Simplify $\sqrt{27} + \sqrt{12} - \sqrt{8}$

Solution:

$$\begin{aligned}\sqrt{27} + \sqrt{12} - \sqrt{8} &= \sqrt{9 \cdot 3} + \sqrt{4 \cdot 3} - \sqrt{4 \cdot 2} \\ &= \sqrt{9} \cdot \sqrt{3} + \sqrt{4} \cdot \sqrt{3} - \sqrt{4} \cdot \sqrt{2} \\ &= 3\sqrt{3} + 2\sqrt{3} - 2\sqrt{2} \\ &= 5\sqrt{3} - 2\sqrt{2}\end{aligned}$$

Can't do anything further!

Example: Simplify $\sqrt{27xy} + \sqrt{8xy}$

Solution:

$$\begin{aligned}\sqrt{27xy} + \sqrt{8xy} &= \sqrt{9 \cdot 3 \cdot xy} + \sqrt{4 \cdot 2 \cdot xy} \\ &= \sqrt{9} \cdot \sqrt{3xy} + \sqrt{4} \cdot \sqrt{2xy} \\ &= 3\sqrt{3xy} + 2\sqrt{2xy}\end{aligned}$$

Can't do anything further, the radicals are different

Example: Simplify $-3\sqrt{12} + 4\sqrt{75}$

Solution:

$$\begin{aligned} -3\sqrt{12} + 4\sqrt{75} &= -3\sqrt{4 \cdot 3} + 4\sqrt{25 \cdot 3} \\ &= -3\sqrt{4} \cdot \sqrt{3} + 4\sqrt{25} \cdot \sqrt{3} = -3(2) \cdot \sqrt{3} + 4(5) \cdot \sqrt{3} \\ &= -6\sqrt{3} + 20\sqrt{3} = \mathbf{14\sqrt{3}} \end{aligned}$$

Can't do anything further!

Example: Simplify $2\sqrt[3]{16} - 3\sqrt[3]{54}$

Solution:

$$\begin{aligned} 2\sqrt[3]{16} - 3\sqrt[3]{54} &= 2\sqrt[3]{8 \cdot 2} - 3\sqrt[3]{27 \cdot 2} \\ &= 2\sqrt[3]{8} \cdot \sqrt[3]{2} - 3\sqrt[3]{27} \cdot \sqrt[3]{2} \rightarrow 2(2)\sqrt[3]{2} - 3(3)\sqrt[3]{2} \\ &= 4\sqrt[3]{2} - 9\sqrt[3]{2} = \mathbf{-5\sqrt[3]{2}} \end{aligned}$$

Example: Simplify $\sqrt{20r^2t} - 2\sqrt{45t^3}$

Solution:

$$\begin{aligned} \sqrt{20r^2t} - 2\sqrt{45t^3} &= \sqrt{4r^2 \cdot 5t} - 2\sqrt{9t^2 \cdot 5t} \\ &= 2r\sqrt{5t} - 6t\sqrt{5t} \\ &= 2\sqrt{5t}(r - 3t) \end{aligned}$$

Can factor out a 2 from each term, and a $\sqrt{5t}$, so $2\sqrt{5t}$

Example: Simplify $\sqrt{32x} + \sqrt{48y} - \sqrt{50x} + \sqrt{27y}$

Solution:

$$\begin{aligned} \sqrt{32x} + \sqrt{48y} - \sqrt{50x} + \sqrt{27y} &= \sqrt{16 \cdot 2 \cdot x} + \sqrt{16 \cdot 3 \cdot y} - \sqrt{25 \cdot 2 \cdot x} + \sqrt{9 \cdot 3 \cdot y} \\ &= \sqrt{16} \cdot \sqrt{2} \cdot \sqrt{x} + \sqrt{16} \cdot \sqrt{3} \cdot \sqrt{y} - \sqrt{25} \cdot \sqrt{2} \cdot \sqrt{x} + \sqrt{9} \cdot \sqrt{3} \cdot \sqrt{y} \\ &= 4\sqrt{2x} + 4\sqrt{3y} - 5\sqrt{2x} + 3\sqrt{3y} \end{aligned}$$

Simplify first

$$\begin{aligned} &= 4\sqrt{2x} - 5\sqrt{2x} + 3\sqrt{3y} + 4\sqrt{3y} \end{aligned}$$

Group like terms together

$$= -\sqrt{2x} + 7\sqrt{3y}$$

All Done!

Section 2.3 – Practice Problems

Simplify each expression

1. $6\sqrt{2} + 3\sqrt{2}$

2. $5\sqrt{3} - 9\sqrt{3}$

3. $7\sqrt{32} + 4\sqrt{2}$

4. $7\sqrt{48} + 4\sqrt{3}$

5. $3\sqrt[3]{54} + 5\sqrt[3]{16}$

6. $5\sqrt[4]{48} - 2\sqrt[4]{243}$

7. $7\sqrt{63} - 2\sqrt{28}$

8. $3\sqrt{40} - 8\sqrt{90}$

9. $4\sqrt{12} + 2\sqrt{27} - 3\sqrt{75}$

10. $5\sqrt{18} - 4\sqrt{50} - 2\sqrt{72}$

Simplify each expression

11. $\sqrt{3x^2} + \sqrt{12x^2}$

12. $3\sqrt{2x^3} + 5x\sqrt{8x}$

13. $\sqrt{4x^7} - 5x^2\sqrt{x^3} + 3x\sqrt{x^5}$

14. $\sqrt{9x^3} - \sqrt{25x^3} + x\sqrt{16x}$

15. $3\sqrt{125x^2y} + 6x\sqrt{80y}$

16. $5\sqrt{12x} - 3\sqrt{27x}$

17. $5x\sqrt{63y} + 3\sqrt{28x^2y}$

18. $3y\sqrt{24x^2y^2} + 6x\sqrt{54y^3}$

19. $5\sqrt{8x^2y^3} - 3x\sqrt{32y^3}$

20. $\sqrt{9x + 27} + \sqrt{x + 3}$

Simplify each expression

21. $\sqrt[3]{27} - 4\sqrt[3]{8}$

22. $3\sqrt[3]{6} + 2\sqrt[3]{48}$

23. $\sqrt[3]{x^4} - \sqrt[3]{x^7}$

24. $x\sqrt[3]{8x^5} + \sqrt[3]{27x^8}$

25. $6\sqrt[3]{8x^2} - 2\sqrt[3]{27x^2}$

26. $4\sqrt[3]{27x^2} + 6\sqrt[3]{8x^2}$

27. $-4\sqrt[3]{256x^4} - 2x\sqrt[3]{32x}$

28. $\frac{5}{2}\sqrt[3]{16x^4y^5} + xy\sqrt[3]{54xy^2}$

Find the perimeter, in centimeters, (as simplified as possible) of a...

29. Rectangle with sides $3\sqrt{12}$ cm and $2\sqrt{8}$ cm

30. Right angle triangle with base $\sqrt{27}$ cm and height $\sqrt{12}$ cm (Hint: use Pythagorean Theorem to find hypotenuse)

31. A rectangle with sides $3\sqrt{20}$ cm and $\sqrt{125}$ cm

32. Explain why $\sqrt{a+b} \neq \sqrt{a} + \sqrt{b}$. Give examples.

Answer Key – Section 2.3

1. $9\sqrt{2}$	17. $21x\sqrt{7y}$
2. $-4\sqrt{3}$	18. $6xy^2\sqrt{6} + 18xy\sqrt{6y}$
3. $32\sqrt{2}$	19. $-2xy\sqrt{2y}$
4. $32\sqrt{3}$	20. $4\sqrt{y+3}$
5. $19\sqrt[3]{2}$	21. -5
6. $4\sqrt[4]{3}$	22. $7\sqrt[3]{6}$
7. $17\sqrt{7}$	23. $x^3\sqrt{x} - x^2\sqrt[3]{x}$
8. $-18\sqrt{10}$	24. $5x^2\sqrt[3]{x^2}$
9. $-\sqrt{3}$	25. $6\sqrt[3]{x^2}$
10. $-17\sqrt{2}$	26. $24\sqrt[3]{x^2}$
11. $3x\sqrt{3}$	27. $-20x^3\sqrt[3]{4x}$
12. $13x\sqrt{2x}$	28. $8xy\sqrt[3]{2xy^2}$
13. 0	29. $(12\sqrt{3} + 8\sqrt{2})\text{cm}$
14. $2x\sqrt{x}$	30. $(5\sqrt{3} + \sqrt{39})\text{cm}$
15. $39x\sqrt{5y}$	31. $22\sqrt{5}\text{cm}$
16. $\sqrt{3}x$	32. <i>See Website</i>

Extra Work Space