3 / Practice and Apply

Use Practice Book pp. 223–224

Assignment Guide	
Decelerated	1–6, 11–14, 23
Average	2–22 Even, 23
Accelerated	7–10, 15–23

■ Before assigning the exercises on Practice Book pages 223–224, discuss the examples in the teaching display. Discuss how the individual expressions were simplified before adding and subtracting in the second example.

■ Before students add and subtract the expressions in exercises 1–10, review with them the properties of real numbers that apply. Note that it is not necessary to simplify any of the expressions before adding or subtracting in exercises 1–4.

Errors Commonly Made
Some students may become intimidated by radical expressions. Suggest that they think of identical radicals as the same variable and that they use the same properties they would use to simplify a variable expression. Thus, $3\sqrt{2} - 5\sqrt{2}$ can be thought of as $3x - 5x$, or $-2x$, which is equivalent to $-2\sqrt{2}$.

■ Before completing exercises 11–20, have students explain when it is necessary to use absolute value symbols when simplifying radical expressions that include variables.

Problem Solving
■ Discuss possible strategies for solving problems 21–22. Students may wish to draw a diagram for exercise 21.

TEST PREPARATION
■ Have students explain the errors in the incorrect answer choices.

9-2 Add and Subtract Radical Expressions

Name _____ Date _____

Simplify: $-7\sqrt{2} + 8\sqrt{11} + 16\sqrt{2} - 13\sqrt{11}$

$-7\sqrt{2} + 8\sqrt{11} + 16\sqrt{2} - 13\sqrt{11}$ ◄— Identify like radicands.

$(-7\sqrt{2} + 16\sqrt{2}) + (8\sqrt{11} - 13\sqrt{11})$ ◄— Use the Commutative and Associative Properties of Equality.

$(-7 + 16)\sqrt{2} + (8 - 13)\sqrt{11}$ ◄— Apply the Distributive Property.

$9\sqrt{2} - 5\sqrt{11}$ ◄— These terms have unlike radicands. Do not combine.

Simplify: $11\sqrt{50x^2} + 4x^3\sqrt{8x^4} - 7x\sqrt{28x^8} - 3\sqrt{32x^2}$

$11\sqrt{25x^2 \bullet 2} + 4x^3\sqrt{4x^4 \bullet 2} - 7x\sqrt{4x^8 \bullet 7} - 3\sqrt{16x^2 \bullet 2}$ ◄— Factor out perfect squares in the radicand, wherever possible.

$11\sqrt{25x^2} \bullet \sqrt{2} + 4x^3\sqrt{4x^4} \bullet \sqrt{2} - 7x\sqrt{4x^8} \bullet \sqrt{7} - 3\sqrt{16x^2} \bullet \sqrt{2}$ ◄— Use the Product Property of Square Roots.

$11(5|x|\sqrt{2}) + 4x^3(2x^2\sqrt{2}) - 7x(2x^4\sqrt{7}) - 3(4|x|\sqrt{2})$ ◄— Simplify.

$55|x|\sqrt{2} + 8x^5\sqrt{2} - 14x^5\sqrt{7} - 12|x|\sqrt{2}$ ◄— Identify like radicands and like terms.

$8x^5\sqrt{2} - 14x^5\sqrt{7} + (55|x|\sqrt{2} - 12|x|\sqrt{2})$ ◄— Use the Commutative Property of Equality.

$8x^5\sqrt{2} - 14x^5\sqrt{7} + (55|x| - 12|x|)\sqrt{2}$ ◄— Apply the Distributive Property.

$8x^5\sqrt{2} - 14x^5\sqrt{7} + 43|x|\sqrt{2}$ ◄— Simplify.

Simplify each expression. (*Hint:* $a\sqrt{x} \pm b\sqrt{x} = (a \pm b)\sqrt{x}$, where a and $b \geq 0$.)

1. $6\sqrt{7} - 4\sqrt{13} + 9\sqrt{7} + 11\sqrt{13}$

$(6\sqrt{7} + 9\sqrt{7}) - (4\sqrt{13} - 11\sqrt{13})$
$(6 + 9)\sqrt{7} - (4 - 11)\sqrt{13}$
$15\sqrt{7} + 7\sqrt{13}$

2. $5\sqrt{14} - 2\sqrt{10} + 3\sqrt{14} + 14\sqrt{10}$

$(14\sqrt{10} - 2\sqrt{10}) + (5\sqrt{14} + 3\sqrt{14})$
$(14 - 2)\sqrt{10} + (5 + 3)\sqrt{14}$
$12\sqrt{10} + 8\sqrt{14}$

3. $26 - 3\sqrt{21} + 7\sqrt{2} + 18$

$(26 + 18) - 3\sqrt{21} + 7\sqrt{2}$
$44 - 3\sqrt{21} + 7\sqrt{2}$

4. $15 - 4\sqrt{30} + 22 + 8\sqrt{3}$

$(15 + 22) - 3\sqrt{30} + 7\sqrt{3}$
$37 - 4\sqrt{30} + 8\sqrt{3}$

5. $9\sqrt{12} - 7\sqrt{63} + 8\sqrt{75} + 3\sqrt{28}$

$9\sqrt{4 \bullet 3} - 7\sqrt{9 \bullet 7} + 8\sqrt{25 \bullet 3} + 3\sqrt{4 \bullet 7}$
$18\sqrt{3} + 40\sqrt{3} - 21\sqrt{7} + 6\sqrt{7}$
$58\sqrt{3} - 15\sqrt{7}$

6. $5\sqrt{18} - 11\sqrt{125} + 4\sqrt{98} + 2\sqrt{180}$

$5\sqrt{9 \bullet 2} - 11\sqrt{25 \bullet 5} + 4\sqrt{49 \bullet 2} + 2\sqrt{36 \bullet 5}$
$15\sqrt{2} + 28\sqrt{2} - 55\sqrt{5} + 12\sqrt{5}$
$43\sqrt{2} - 43\sqrt{5}$

7. $-9\sqrt{448} - 5\sqrt{1300} + 8\sqrt{325} + 6\sqrt{700}$

$-9(8)\sqrt{7} - 5(10)\sqrt{13} + 8(5)\sqrt{13} + 6(10)\sqrt{7}$
$-72\sqrt{7} + 60\sqrt{7} - 50\sqrt{13} + 40\sqrt{13}$
$-12\sqrt{7} - 10\sqrt{13}$

8. $-6\sqrt{405} - 7\sqrt{1500} + 4\sqrt{735} + 2\sqrt{500}$

$-6(9)\sqrt{5} - 7(10)\sqrt{15} + 4(7)\sqrt{15} + 2(10)\sqrt{5}$
$-54\sqrt{5} + 20\sqrt{5} - 70\sqrt{15} + 28\sqrt{15}$
$-34\sqrt{5} - 42\sqrt{15}$

9. $\sqrt{2366} + \sqrt{1183} - \sqrt{847} - \sqrt{686}$

$13\sqrt{14} - 7\sqrt{14} + 13\sqrt{7} - 11\sqrt{7}$
$6\sqrt{14} + 2\sqrt{7}$

10. $\sqrt{6615} - \sqrt{6250} + \sqrt{3840} - \sqrt{2890}$

$21\sqrt{15} + 16\sqrt{15} - 25\sqrt{10} - 17\sqrt{10}$
$37\sqrt{15} - 42\sqrt{10}$

Use with SOURCEBOOK Lesson 9-2, pages 228–229.

Chapter 9 **223**

Simplify each expression.

11. $3\sqrt{a} - 2\sqrt{5} + \sqrt{a} - 7\sqrt{5}$

$3\sqrt{a} + \sqrt{a} - 2\sqrt{5} - 7\sqrt{5}$
$(3 + 1)\sqrt{a} + (-2 - 7)\sqrt{5}$
$4\sqrt{a} - 9\sqrt{5}$

12. $6\sqrt{b} - 8\sqrt{3} + \sqrt{b} - 11\sqrt{3}$

$6\sqrt{b} + \sqrt{b} - 8\sqrt{3} - 11\sqrt{3}$
$(6 + 1)\sqrt{b} + (-8 - 11)\sqrt{3}$
$7\sqrt{b} - 19\sqrt{3}$

13. $2d - 11\sqrt{99} - 5d + 4\sqrt{704}$

$2d - 5d - 11\sqrt{9 \cdot 11} + 4\sqrt{64 \cdot 11}$
$-3d - 33\sqrt{11} + 32\sqrt{11}$
$-3d - \sqrt{11}$

14. $8f - 6\sqrt{288} - 17f + 3\sqrt{800}$

$8f - 17f - 6\sqrt{144 \cdot 2} + 3\sqrt{400 \cdot 2}$
$-9f - 72\sqrt{2} + 60\sqrt{2}$
$-9f - 12\sqrt{2}$

15. $9|n|\sqrt{17} - 5\sqrt{17n^2} + 11|n|\sqrt{272}$

$9|n|\sqrt{17} - 5|n|\sqrt{17} + 11|n|\sqrt{16 \cdot 17}$
$4|n|\sqrt{17} + 44|n|\sqrt{17}$
$48n\sqrt{17}$

16. $12|m|\sqrt{19} - 6\sqrt{19m^2} + 8|m|\sqrt{1216}$

$12|m|\sqrt{19} - 6|m|\sqrt{19} + 8|m|\sqrt{64 \cdot 19}$
$6|m|\sqrt{19} + 64|m|\sqrt{19}$
$70m\sqrt{19}$

17. $3y^2\sqrt{25} - 12|y|\sqrt{24y} + 9|y|\sqrt{54}$

$15y^2 - 12|y|\sqrt{4 \cdot 6y} + 9|y|\sqrt{9 \cdot 6}$
$15y^2 - 24|y|\sqrt{6y} + 27|y|\sqrt{6}$

18. $11|x|\sqrt{36} - 4x^2\sqrt{63x} + 10|x|\sqrt{72x}$

$66|x| - 4x^2\sqrt{9 \cdot 7x} + 10|x|\sqrt{36 \cdot 2x}$
$66|x| - 12x^2\sqrt{7x} + 60|x|\sqrt{2x}$

19. $\frac{2}{3}\sqrt{189} + 0.2\sqrt{450x^2} + 8|x|\sqrt{128}$

$2\sqrt{21} + 0.2(3 \cdot 5)|x|\sqrt{2} + 8|x|\sqrt{64 \cdot 2}$
$2\sqrt{21} + 3|x|\sqrt{2} + 64|x|\sqrt{2}$
$2\sqrt{21} + 67|x|\sqrt{2}$

20. $\frac{4}{5}\sqrt{1250} + 0.4\sqrt{300a^2} + 7|a|\sqrt{147}$

$\frac{4}{5}\sqrt{625 \cdot 2} + 4|a|\sqrt{3} + 49|a|\sqrt{3}$
$20\sqrt{2} + 53a\sqrt{3}$

Problem Solving

21. Geometry The perimeter of a rectangle is $42\sqrt{2} + 18\sqrt{5}$. If the width of the rectangle is $7\sqrt{2} + 3\sqrt{5}$, what is the length?

Reason logically; Let p = perimeter, ℓ = length, w = width; $p = 2\ell + 2w$; Substitute:
$42\sqrt{2} + 18\sqrt{5} = 2\ell + 2(7\sqrt{2} + 3\sqrt{5})$
$2w$ is $(7\sqrt{2} + 3\sqrt{5}) + (7\sqrt{2} + 3\sqrt{5}) = 14\sqrt{2} + 6\sqrt{5}$
Solve for 2ℓ: $2\ell = 42\sqrt{2} + 18\sqrt{5} - (14\sqrt{2} + 6\sqrt{5}) =$
$28\sqrt{2} + 12\sqrt{5}$; Note: Because $(14\sqrt{2} + 6\sqrt{5}) +$
$(14\sqrt{2} + 6\sqrt{5}) = 28\sqrt{2} + 12\sqrt{5}$, $\ell = 14\sqrt{2} + 6\sqrt{5}$
So the length of the rectangle is $14\sqrt{2} + 6\sqrt{5}$.

22. Two numbers have a sum of $17\sqrt{11}$ and a difference of $\sqrt{11}$. What are the numbers?

Guess and Test:
$9\sqrt{11} + 8\sqrt{11} = 17\sqrt{11}$ and
$9\sqrt{11} - 8\sqrt{11} = \sqrt{11}$
The numbers are $9\sqrt{11}$ and $8\sqrt{11}$.

TEST PREPARATION

23. Which radical expression is equivalent to $4\sqrt{3x} + 8$?

A. $2\sqrt{12x} + \sqrt{16}$ **B.** $\sqrt{36x} + \sqrt{16}$

C. $\sqrt{36x} + \sqrt{64}$ **D.** $2\sqrt{12x} + \sqrt{64}$

Meeting Individual Needs
See page 225F.

4 / Summarize/Assess

Conceptual Thinking

■ To assess whether students have conceptualized the lesson concepts, lead a discussion in which students explain how to add and subtract radical expressions. Provide examples for students to simplify, such as $3\sqrt{12} + 4\sqrt{27}$ and $\sqrt{720} - \sqrt{500}$. **$18\sqrt{3}$; $2\sqrt{5}$**

In their *Math Journals*, have students determine if the following statements are true or false. If false, have them find the correct sum or difference. $\sqrt{2} + \sqrt{4} = \sqrt{6}$ **false;** $\sqrt{2} + 2\sqrt{3} + \sqrt{27} = 4\sqrt{3}$ **true** $6\sqrt{14} - \sqrt{7} = 12\sqrt{7}$ **false; cannot be simplified further** $4\sqrt{8} - 2\sqrt{8} = 8\sqrt{2}$ **false; $4\sqrt{2}$**

ONLINE Check Your Progress I

Administer Check Your Progress I to assess understanding of Lessons 1–2. For additional practice, assign the online Practice Activities.

5 / Follow-Up

Reteaching

■ Create sets of cards with various radical expressions on them. Most of the expressions on each set should simplify to have like radicands.

Have students work with partners. Provide each pair with a set of cards. Have them choose two cards at random, then have them find the sum and difference of the expressions.

ONLINE See Chapter 9 Alternative Teaching Models.

Additional Resources

ONLINE www.progressinmathematics.com

■ Meeting Individual Needs Activities
■ Alternative Teaching Models
■ Vocabulary Activities
■ Audio Glossary
■ Virtual Manipulatives
■ Check Your Progress I
■ Practice Activities (Lessons 1–2)

End of Lesson ⬡