

Math Applications
Section 5.4 Notes
The Real Number System

Name: Key

Key Definitions:

Multiplying and Dividing Radicals: $\sqrt{ab} = \sqrt{a}\sqrt{b}$

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}} \quad (\text{if } b \neq 0)$$

****Use properties of multiplying and dividing radicals when simplifying radicals.**

Ex. Simplify $\sqrt{18} = \sqrt{9}\sqrt{2} = 3\sqrt{2}$

Simplify $\sqrt{54} = \sqrt{9}\sqrt{6} = 3\sqrt{6}$

Rationalizing Denominators: (We can't have a radical in the denominator of a fraction)

Ex. Rationalize the denominator in the following expression $\frac{2}{\sqrt{3}}$.

$$\frac{2}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{2\sqrt{3}}{3}$$

Adding and Subtracting Radicals: $a\sqrt{b} \pm c\sqrt{b} = a \pm c\sqrt{b}$
(You can only add/subtract expressions that have common radicands)

Ex. $3\sqrt{5} + 7\sqrt{5} = 10\sqrt{5}$

$5\sqrt{3} + 8\sqrt{12} = 5\sqrt{3} + 2\sqrt{3} = 7\sqrt{3}$

$5\sqrt{3} + 2\sqrt{3} = 7\sqrt{3}$

Practice Problems
Simplify each radical.

1. $\sqrt{18} = \sqrt{9}\sqrt{2} = 3\sqrt{2}$

2. $\sqrt{27} = \sqrt{9}\sqrt{3} = 3\sqrt{3}$

3. $\sqrt{12} = \sqrt{4}\sqrt{3} = 2\sqrt{3}$

4. $\sqrt{20} = \sqrt{4}\sqrt{5} = 2\sqrt{5}$

5. $\sqrt{75} = \sqrt{25}\sqrt{3} = 5\sqrt{3}$

6. $\sqrt{50} = \sqrt{25}\sqrt{2} = 5\sqrt{2}$

Combine the radicals into a single radical.

7. $3\sqrt{5} + 8\sqrt{5}$

$11\sqrt{5}$

8. $3\sqrt{7} + 2\sqrt{7}$

$5\sqrt{7}$

9. $2\sqrt{20} - 3\sqrt{5}$

$\sqrt{4} \sqrt{5}$
 $2 \cdot 2\sqrt{5} - 3\sqrt{5}$
 $4\sqrt{5} - 3\sqrt{5} = 1\sqrt{5}$

10. $5\sqrt{12} + 4\sqrt{3}$

$\sqrt{4} \sqrt{3}$
 $5 \cdot 2\sqrt{3} + 4\sqrt{3}$
 $10\sqrt{3} + 4\sqrt{3} = 14\sqrt{3}$

11. $5\sqrt{12} - 13\sqrt{18}$

$\sqrt{4} \sqrt{3}$ $\sqrt{9} \sqrt{2}$
 $5 \cdot 2\sqrt{3} - 13 \cdot 3\sqrt{2}$
 $10\sqrt{3} - 39\sqrt{2}$ (not possible)

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

$\sqrt{9} \sqrt{3}$
 $4 \cdot 3\sqrt{3} - 2\sqrt{3}$
 $12\sqrt{3} - 2\sqrt{3} = 10\sqrt{3}$

13. $\sqrt{50} + 2\sqrt{75}$

$\sqrt{25} \sqrt{2}$ $\sqrt{25} \sqrt{3}$
 $5\sqrt{2} + 2 \cdot 5\sqrt{3}$
 $5\sqrt{2} + 10\sqrt{3}$ (not possible)

14. $5\sqrt{28} - 2\sqrt{63}$

$\sqrt{4} \sqrt{7}$ $\sqrt{9} \sqrt{7}$
 $5 \cdot 2\sqrt{7} - 2 \cdot 3\sqrt{7}$
 $10\sqrt{7} - 6\sqrt{7} = 4\sqrt{7}$

15. $7\sqrt{72} + 2\sqrt{18}$

$\sqrt{8} \sqrt{9}$ $\sqrt{9} \sqrt{2}$
 $\sqrt{4} \sqrt{2}$
 $7 \cdot 2 \cdot 3\sqrt{2} + 2 \cdot 3\sqrt{2}$
 $42\sqrt{2} + 6\sqrt{2} = 48\sqrt{2}$

Perform the indicated operations, and simplify if possible.

16. $\sqrt{18}\sqrt{2}$

$\sqrt{36}$ $\sqrt{9} \sqrt{2} \sqrt{2}$
 $= 6$ $= 3 \cdot 2 = 6$

17. $\sqrt{15}\sqrt{5}$

$\sqrt{75}$ $\sqrt{5} \sqrt{3} \sqrt{5}$
 $\sqrt{25} \sqrt{3}$ $= 5\sqrt{3}$
 $= 5\sqrt{3}$

18. $\sqrt{12}\sqrt{15}$

$\sqrt{180}$ $\sqrt{3} \sqrt{4} \sqrt{5} \sqrt{3}$
 $\sqrt{9} \sqrt{20}$ $3 \cdot 2\sqrt{5} = 6\sqrt{5}$
 $\sqrt{4} \sqrt{5}$ $= 3 \cdot 2\sqrt{5}$
 $= 6\sqrt{5}$

19. $\frac{\sqrt{24}}{\sqrt{6}}$

$\sqrt{4}$ $\frac{\sqrt{4} \sqrt{6}}{\sqrt{6}}$ $\sqrt{4}$
 $= 2$ $= 2$

20. $\frac{\sqrt{54}}{\sqrt{6}}$

$\sqrt{9}$ $\frac{\sqrt{6} \sqrt{9}}{\sqrt{6}}$ $\sqrt{9}$
 $= 3$ $= 3$

21. $\frac{\sqrt{32}}{\sqrt{18}}$

$\sqrt{8} \sqrt{4}$ $\sqrt{9} \sqrt{2}$
 $\sqrt{4} \sqrt{2}$
 $\frac{2 \cdot 2\sqrt{2}}{3\sqrt{2}} = \frac{4\sqrt{2}}{3\sqrt{2}} = \frac{4}{3}$

Rationalize the denominator and simplify.

22. $\frac{3}{\sqrt{5}}$

$\frac{3}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{3\sqrt{5}}{5}$

23. $\frac{12}{\sqrt{6}}$

$\frac{12}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} = \frac{12\sqrt{6}}{6}$
 $= 2\sqrt{6}$

24. $\frac{10}{\sqrt{22}}$

$\frac{10}{\sqrt{22}} \cdot \frac{\sqrt{22}}{\sqrt{22}} = \frac{10\sqrt{22}}{22}$
 $= \frac{5\sqrt{22}}{11}$