



9.3b

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1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169

9.3 Continued : Properties of Radicals

Product Property of Radicals:  $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$

Example:  $\sqrt{4 \cdot 5} = \sqrt{4} \cdot \sqrt{5} = 2\sqrt{5}$

Practice: Simplify with the product property:

1)  $\sqrt{50} = \sqrt{25} \cdot \sqrt{2} = 5\sqrt{2}$       2)  $\sqrt{48} = \sqrt{16} \cdot \sqrt{3} = 4\sqrt{3}$

Quotient Property of Radicals:  $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

Example:  $\sqrt{\frac{9}{25}} = \frac{\sqrt{9}}{\sqrt{25}} = \frac{3}{5}$        $\frac{\sqrt{16} \cdot \sqrt{2}}{\sqrt{25} \cdot \sqrt{2}} = \frac{4}{5}$

Practice: Simplify with the quotient property:

1)  $\sqrt{\frac{16}{81}} = \frac{\sqrt{16}}{\sqrt{81}} = \frac{4}{9}$       2)  $\sqrt{\frac{32}{50}} = \frac{\sqrt{16} \cdot \sqrt{2}}{\sqrt{25} \cdot \sqrt{2}} = \frac{4}{5}$

Remember:  $\sqrt{a} \cdot \sqrt{a} = a$        $\sqrt{5} \cdot \sqrt{5} = 5$        $\sqrt{3} \cdot \sqrt{3} = 3$

★ DO NOT LEAVE A RADICAL IN THE DENOMINATOR. ★

To undo a radical in the denominator we rationalize the denominator.

- Multiply the numerator and denominator by the square root left in the denominator.

Examples: Simplify the following expressions.

1)  $\sqrt{\frac{1}{7}} = \frac{\sqrt{1}}{\sqrt{7}} = \frac{1}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} = \frac{\sqrt{7}}{7}$       2)  $\sqrt{\frac{1}{18}} = \frac{\sqrt{1}}{\sqrt{18}} = \frac{1}{\sqrt{9} \cdot \sqrt{2}} = \frac{1}{3\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{3 \cdot 2} = \frac{\sqrt{2}}{6}$

3)  $\sqrt{\frac{3}{5}} = \frac{\sqrt{3}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{15}}{5}$       4)  $\sqrt{\frac{9}{13}} = \frac{\sqrt{9}}{\sqrt{13}} = \frac{3}{\sqrt{13}} \cdot \frac{\sqrt{13}}{\sqrt{13}} = \frac{3\sqrt{13}}{13}$

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9.3 Continued : Properties of Radicals

Product Property of Radicals:  $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$

Example:  $\sqrt{4 \cdot 5} = \frac{\sqrt{4} \cdot \sqrt{5}}{2\sqrt{5}}$

Practice: Simplify with the product property:

1)  $\sqrt{50} = \frac{\sqrt{25} \cdot \sqrt{2}}{5\sqrt{2}}$       2)  $\sqrt{48} = \frac{\sqrt{16} \cdot \sqrt{3}}{4\sqrt{3}}$

Quotient Property of Radicals:  $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

Example:  $\sqrt{\frac{9}{25}} = \frac{\sqrt{9}}{\sqrt{25}} = \frac{3}{5}$        $\frac{\sqrt{16} \cdot \sqrt{2}}{\sqrt{25} \cdot \sqrt{2}} = \frac{4}{5}$

Practice: Simplify with the quotient property:

1)  $\sqrt{\frac{16}{81}} = \frac{\sqrt{16}}{\sqrt{81}} = \frac{4}{9}$       2)  $\sqrt{\frac{32}{50}} = \frac{\sqrt{16} \cdot \sqrt{2}}{\sqrt{25} \cdot \sqrt{2}} = \frac{4}{5}$

Remember:  $\sqrt{a} \cdot \sqrt{a} = a$        $\sqrt{5} \cdot \sqrt{5} = 5$        $\sqrt{3} \cdot \sqrt{3} = 3$

★ DO NOT LEAVE A RADICAL IN THE DENOMINATOR. ★

To undo a radical in the denominator we rationalize the denominator.

- Multiply the numerator and denominator by the square root left in the denominator.

Examples: Simplify the following expressions.

1)  $\sqrt{\frac{1}{7}} = \frac{\sqrt{1}}{\sqrt{7}} = \frac{1}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} = \frac{\sqrt{7}}{7}$       2)  $\sqrt{\frac{1}{18}} = \frac{\sqrt{1}}{\sqrt{18}} = \frac{1}{\sqrt{9} \cdot \sqrt{2}} = \frac{1}{3\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{3 \cdot 2} = \frac{\sqrt{2}}{6}$

3)  $\sqrt{\frac{3}{5}} = \frac{\sqrt{3}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{15}}{5}$       4)  $\sqrt{\frac{9}{13}} = \frac{\sqrt{9}}{\sqrt{13}} = \frac{3}{\sqrt{13}} \cdot \frac{\sqrt{13}}{\sqrt{13}} = \frac{3\sqrt{13}}{13}$

Page 512 5-8  $\frac{5 \cdot \sqrt{1}}{1 \cdot \sqrt{25}}$

5)  $\frac{\sqrt{4}}{\sqrt{9}} = \frac{2}{3}$       6)  $5\sqrt{\frac{1}{25}} = \frac{5\sqrt{1}}{\sqrt{25}} = \frac{5}{5} = 1$

7)  $\frac{\sqrt{1}}{\sqrt{3}} = \frac{1}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$

8)  $\frac{\sqrt{4}}{\sqrt{25}} = \frac{2}{5}$

$$8) \sqrt{\frac{27 \div 3}{15 \div 3}} = \frac{\sqrt{9}}{\sqrt{5}} = \frac{3}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{3\sqrt{5}}{5}$$

$$\frac{\sqrt{27}}{\sqrt{15}} = \frac{\sqrt{9 \cdot 3}}{\sqrt{5 \cdot 3}}$$

$$33) \frac{\sqrt{4}}{\sqrt{16}} = \frac{2}{4} = \frac{1}{2} \quad 37) \frac{\sqrt{36}}{\sqrt{25}} = \frac{6}{5}$$

$$\frac{4}{16} = \frac{\sqrt{4}}{\sqrt{16}} = \frac{1}{2}$$

$$41) \sqrt{\frac{18 \div 2}{32 \div 2}} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{3}{4}$$

$$45) \sqrt{20} = \sqrt{4 \cdot 5} = 2\sqrt{5}$$

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$$47) \frac{\sqrt{1}}{\sqrt{5}} = \frac{1}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{5}}{5}$$

$$51) \sqrt{\frac{6}{15}} = \frac{\sqrt{6}}{\sqrt{15}} = \frac{1}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$$

$$55) \frac{\sqrt{11}}{\sqrt{11}} = \frac{1}{\sqrt{11}} \cdot \frac{\sqrt{11}}{\sqrt{11}} = \frac{\sqrt{11}}{11}$$

$$59) \frac{4\sqrt{25}}{4 \cdot 5} = \frac{20}{20}$$

$$63) \frac{-6\sqrt{4}}{-6 \cdot 2} = \frac{-12}{-12}$$

$$67) \frac{\frac{3}{2}\sqrt{24}}{\frac{3}{2} \cdot 2 \cdot \sqrt{6}} = \frac{3\sqrt{4} \cdot \sqrt{6}}{3\sqrt{6}}$$

$$71) \sqrt{\frac{21 \div 7}{35 \div 7}}$$

$$\frac{\sqrt{3}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{15}}{5}$$

$$\frac{3\sqrt{2}}{9} = \frac{\sqrt{2}}{3}$$