SECTION 3.2

Radical Lesson

$\sqrt{n}$ - Radical $\sqrt{\ }$ - Radical Symbol n - Radicand

Simplifying Radicals (Square Roots):

1) Find the largest perfect square factor of the radicand.
2) Factor the radicand using the perfect square factor.
3) $\sqrt{\text{Perfect Square}}$ comes outside the radical, the other factor (non-perfect square stays inside the radical.

Ex: Simplify. (Exact Roots – no decimal approximations)

1) $\sqrt{18} = 3\sqrt{2}$ 2 9, 3 3

2) $\sqrt{24} = 2\sqrt{6}$ 2 12, 2 6, 2 3

3) $\sqrt{147} = 7\sqrt{3}$ 3 49, 7 7

4) $\sqrt{605} = 11\sqrt{5}$ 5 121, 11 11

5) $\sqrt{72} = 6\sqrt{2}$ 2 36, 6 6

6) $\sqrt{84} = 2\sqrt{21}$ 2 42, 2 21, 3 7

7) $\sqrt{128} = 8\sqrt{2}$ 2 64, 8 8

8) $\sqrt{49x^2} = 7x$ 7 7 x x

9) $\sqrt{64x^2y^3} = 8x\sqrt{y}$ 8 8 x x y y y

10) $\sqrt{125a^2b} = 5a\sqrt{5b}$ 5 25, 5 5

11) $\sqrt{98c^3d^4} = 7cd^2\sqrt{2c}$ 2 49, 7 7

Multiplying Radicals: $a\sqrt{b} \cdot c\sqrt{d} = ac\sqrt{bd}$

Ex: Simplify.

1) $3\sqrt{5} \cdot \sqrt{2}$

$= 3\sqrt{10}$

2) $2\sqrt{14} \cdot \sqrt{21}$

2 7, 3 7

$2\sqrt{2 \cdot 7 \cdot 3 \cdot 7} =$

$2 \cdot 7\sqrt{6} =$

$14\sqrt{6}$

3) $2\sqrt{10} \cdot 5\sqrt{5} =$

$10\sqrt{50} = 10 \cdot 5\sqrt{2} =$

2 25, 5 5

$50\sqrt{2}$

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<u>A Radical Expression is simplified when</u>:

1) The radicand does not contain any perfect square factors.
2) The radicand is not a fraction.
3) No radicals in the denominator. (Rationalize the Denominator)

Dividing Radicals: $\frac{a\sqrt{b}}{c\sqrt{d}} = \frac{a}{c}\sqrt{\frac{b}{d}}$

Ex: Simplify. $\frac{6\sqrt{15}}{2\sqrt{5}} = \frac{6}{2} \cdot \sqrt{\frac{15}{5}} = 3\sqrt{3}$

Rationalize the Denominator: Multiply the numerator and denominator by a quantity so the denominator is an exact root.

$$\frac{\sqrt{a}}{\sqrt{b}} \cdot 1 = \frac{\sqrt{a}}{\sqrt{b}} \cdot \frac{\sqrt{b}}{\sqrt{b}} = \frac{\sqrt{ab}}{\sqrt{b^2}} = \frac{\sqrt{ab}}{b}$$

Ex: Simplify.

1) $\frac{\sqrt{11}}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} = \frac{\sqrt{66}}{6}$

2) $\frac{2\sqrt{7}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{2\sqrt{35}}{5}$

3) $\frac{3\sqrt{5}}{\sqrt{8}} \cdot \frac{\sqrt{8}}{\sqrt{8}} = \frac{3\sqrt{40}}{8} = \frac{3 \cdot 2\sqrt{10}}{8} = \frac{6\sqrt{10}}{8} = \frac{3\sqrt{10}}{4}$

Operations with Radical Expressions: Radical expressions in which the radicands are alike can be added or subtracted in the same way that monomials are added or subtracted.

<u>Monomials</u>

$4x + 5x = 9x$

<u>Radical Expressions</u>

$4\sqrt{5} + 5\sqrt{5} = 9\sqrt{5}$

Ex: Simplify each expression.

1) $6\sqrt{7}+5\sqrt{7}-3\sqrt{7}$

$8\sqrt{7}$

2) $5\sqrt{6}+3\sqrt{7}+4\sqrt{7}-2\sqrt{6}$

$3\sqrt{6}+7\sqrt{7}$

If the radicals in a radical expression are not in simplest form, simplify each radical first. Then look to see if there are like radicals.

3) $4\sqrt{27}+5\sqrt{12}+8\sqrt{75}$

3 9   3 4   3 25

3 3   2 2   5 5

$4\cdot 3\sqrt{3}+2\cdot 5\sqrt{3}+5\sqrt{3}$

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

$27\sqrt{3}$

4) $3\sqrt{45}+4\sqrt{80}-2\sqrt{125}$

3 15   2 40   5 5 5

3 5   2 20

2 10

2 5

$9\sqrt{5}+16\sqrt{5}-10\sqrt{5}=$

$15\sqrt{5}$

Radical Practice

Directions: Simplify. (Exact Roots – no decimal approximations)

1) $\sqrt{45}$

$3\sqrt{5}$

2) $\sqrt{48}$

$4\sqrt{3}$

3) $\sqrt{216}$

$6\sqrt{6}$

4) $\sqrt{12}$

$2\sqrt{3}$

5) $8\sqrt{27}$

$24\sqrt{3}$

6) $10\sqrt{96}$

$40\sqrt{6}$

7) $2\sqrt{200}$

$20\sqrt{2}$

8) $\sqrt{50x^2}$

$5x\sqrt{2}$

9) $\sqrt{144x^3y}$

$12x\sqrt{xy}$

10) $3\sqrt{12}\cdot\sqrt{6}$

$18\sqrt{2}$

11) $2\sqrt{5}\cdot 3\sqrt{15}$

$30\sqrt{3}$

12) $\frac{\sqrt{4}}{5\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{12}}{15} = \frac{2\sqrt{3}}{15}$

13) $\frac{\sqrt{8}}{\sqrt{100}}$

$\frac{2\sqrt{2}}{10} = \frac{\sqrt{2}}{5}$

14) $\frac{\sqrt{15}}{2\sqrt{20}} \cdot \frac{\sqrt{20}}{\sqrt{20}}$

$\frac{\sqrt{300}}{40} = \frac{10\sqrt{3}}{40} = \frac{\sqrt{3}}{4}$

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

$\frac{\sqrt{15}}{3}$

16) $\frac{2\sqrt{2}}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} = \frac{2\sqrt{14}}{7}$

17) $-2\sqrt{3} + 3\sqrt{27}$

$-2\sqrt{3} + 9\sqrt{3}$

$7\sqrt{3}$

18) $-\sqrt{27} - 3\sqrt{45} - \sqrt{20} + 2\sqrt{75}$

$-3\sqrt{3} - 9\sqrt{5} - 2\sqrt{5} + 10\sqrt{3}$

$7\sqrt{3} - 11\sqrt{5}$

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Simplifying Radical Expressions

Date________________ Period____

Simplify.

1) $\sqrt{125n}$ $5\sqrt{5n}$

2) $\sqrt{216v}$ $6\sqrt{6v}$

3) $\sqrt{512k^2}$ $16k\sqrt{2}$

4) $\sqrt{512m^3}$ $16m\sqrt{2m}$

5) $\sqrt{216k^4}$ $6k^2\sqrt{6}$

6) $\sqrt{100v^3}$ $10v\sqrt{v}$

7) $\sqrt{80p^3}$ $4p\sqrt{5p}$

8) $\sqrt{45p^2}$ $3p\sqrt{5}$

9) $\sqrt{147m^3n^3}$

$7mn\sqrt{3mn}$

10) $\sqrt{200m^4n}$ $10m^2\sqrt{2n}$

11) $\sqrt{75x^2y}$

$5x\sqrt{3y}$

12) $\sqrt{64m^3n^3}$ $8mn\sqrt{mn}$

13) $\sqrt{16u^4v^3}$

$4u^2v\sqrt{v}$

14) $\sqrt{28x^3y^3}$ $2xy\sqrt{7xy}$

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Name______________________________________

Adding and Subtracting Radical Expressions

Date__________________ Period____

Simplify.

1) $3\sqrt{6} - 4\sqrt{6}$

$-\sqrt{6}$

2) $-3\sqrt{7} + 4\sqrt{7}$

$\sqrt{7}$

3) $-11\sqrt{21} - 11\sqrt{21}$

$-22\sqrt{21}$

4) $-9\sqrt{15} + 10\sqrt{15}$

$\sqrt{15}$

5) $-10\sqrt{7} + 12\sqrt{7}$

$2\sqrt{7}$

6) $-3\sqrt{17} - 4\sqrt{17}$

$-7\sqrt{17}$

7) $-10\sqrt{11} - 11\sqrt{11}$

$-21\sqrt{11}$

8) $-2\sqrt{3} + 3\sqrt{27}$

$7\sqrt{3}$

9) $2\sqrt{6} - 2\sqrt{24}$

$-2\sqrt{6}$

10) $2\sqrt{6} + 3\sqrt{54}$

$11\sqrt{6}$

11) $-\sqrt{12} + 3\sqrt{3}$

$\sqrt{3}$

12) $3\sqrt{3} - \sqrt{27}$

0

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Name______________________________

Multiplying Radical Expressions

Date________________ Period____

Simplify.

1) $3\sqrt{12} \cdot \sqrt{6}$

$18\sqrt{2}$

2) $\sqrt{5} \cdot \sqrt{10}$

$5\sqrt{2}$

3) $\sqrt{6} \cdot \sqrt{6}$

6

4) $\sqrt{5} \cdot -4\sqrt{20}$

-40

5) $-4\sqrt{15} \cdot -\sqrt{3}$

$12\sqrt{5}$

6) $\sqrt{20x^2} \cdot \sqrt{20x}$

$20x\sqrt{x}$

7) $\sqrt{15n^2} \cdot \sqrt{10n^3}$

$5n^2\sqrt{6n}$

8) $\sqrt{18a^2} \cdot 4\sqrt{3a^2}$

$12a^2\sqrt{6}$

9) $-3\sqrt{7r^3} \cdot 6\sqrt{7r^2}$

$-126r^2\sqrt{r}$

10) $-4\sqrt{28x} \cdot \sqrt{7x^3}$

$-56x^2$

11) $\sqrt{3}(5 + \sqrt{3})$

$5\sqrt{3} + 3$

12) $2\sqrt{5}(\sqrt{6} + 2)$

$2\sqrt{30} + 4\sqrt{5}$

13) $-3\sqrt{3}(2 + \sqrt{6})$

$-6\sqrt{3} - 9\sqrt{2}$

14) $\sqrt{3}(-5\sqrt{10} + \sqrt{6})$

$-5\sqrt{30} + 3\sqrt{2}$

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