

$\sqrt{2} (\sqrt[3]{4})$

Objective: Multiply & divide, rationalize with radicals

Warm Up:

Multiply

1.  $3x(2+4x)$

2.  $(2+3x)(1-4x)$

$$\begin{array}{r} \sqrt{50} \\ \hline \sqrt{25 \cdot 2} \\ 5\sqrt{2} \end{array}$$

Multiply radicals

Main idea: Must have the same index before you can multiply. Take out any negatives first ie. "i's".

Examples:

1.  $\sqrt{5} \cdot \sqrt{10}$   
$$\begin{array}{r} \sqrt{5 \cdot 10} \\ \sqrt{5 \cdot 5 \cdot 2} \\ 5\sqrt{2} \end{array}$$

2.  $\sqrt[3]{5} \cdot -4\sqrt[3]{20}$   
$$\begin{array}{r} 1(-4) \sqrt[3]{5 \cdot 20} \\ -4 \sqrt[3]{100} \end{array}$$

3.  $\sqrt{20x^2} \cdot \sqrt{20x}$   
$$\begin{array}{r} \sqrt{20x^2 \cdot 20x} \\ \sqrt{400x^3} \\ 20x\sqrt{x} \end{array}$$

4.  $\sqrt{18a^2} \cdot 4\sqrt{3a^2}$   
$$\begin{array}{r} 1 \cdot 4 \sqrt{18a^2 \cdot 3a^2} \\ 4 \sqrt{9 \cdot 2a^2 \cdot 3a^2} \\ 3a^2 \cdot 4\sqrt{2 \cdot 3} \\ 12a^2\sqrt{6} \end{array}$$

5.  $2\sqrt{5}(\sqrt{6} + 2)$   
$$\begin{array}{r} 2\sqrt{5}(\sqrt{6}) + 2\sqrt{5}(2) \\ 2\sqrt{30} + 4\sqrt{5} \end{array}$$

$$\begin{array}{r} (\sqrt{5})(\sqrt{5}) \\ (\sqrt{5})^2 \end{array}$$

6.  $(5 - 4\sqrt{5})(-2 + \sqrt{5})$   
$$\begin{array}{r} -10 + 5\sqrt{5} + 8\sqrt{5} - 4\sqrt{25} \\ -10 + 13\sqrt{5} - 4(5) \\ -10 + 13\sqrt{5} - 20 \\ -30 + 13\sqrt{5} \end{array}$$

Divide or rationalize the denominator

You may not keep a radical in the denominator. Simplify denominator first and if necessary, multiply top and bottom by the radical or conjugate.

$$y^3 = \sqrt{y^6} \quad 2\sqrt[3]{6} \quad \sqrt[3]{y^6}$$

### Lesson 2

Divide radicals & rationalize.

$$1. \frac{\sqrt{x^2}}{\sqrt{y^6}} = \frac{x}{y^3}$$

$$2. \frac{\sqrt{\frac{28}{45}}}{\sqrt{\frac{145}{145}}} = \frac{\sqrt{28} \cdot \sqrt{145}}{145}$$

$$= \frac{\sqrt{4 \cdot 7 \cdot 5} \cdot \sqrt{5}}{45}$$

$$= \frac{2 \cdot 3 \sqrt{7 \cdot 5} \cdot \sqrt{5}}{45} = \frac{6\sqrt{35}}{45}$$

$$= \frac{2\sqrt{35}}{15}$$

$$3. \frac{3\sqrt{20}}{2\sqrt{4}}$$

$$= \frac{3 \cdot 2\sqrt{5}}{2 \cdot 2}$$

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

$$= \frac{6\sqrt{5}}{4}$$

$$= \frac{3\sqrt{5}}{2}$$

$$4. \frac{\sqrt{4}\sqrt{3}}{5\sqrt{3}\sqrt{3}} = \frac{2\sqrt{3}}{15}$$

$$5. \frac{\sqrt{12}}{3\sqrt{10n}} = \frac{\sqrt{3} \cdot \sqrt{2}}{3\sqrt{2} \cdot \sqrt{10n}}$$

$$= \frac{\sqrt{3}}{3\sqrt{10n}}$$

$$6. \frac{(3n^2 + \sqrt{2n^2})\sqrt{10n}}{\sqrt{10n}\sqrt{10n}}$$

$$= \frac{3n^2\sqrt{10n} + \sqrt{2n^2} \cdot \sqrt{5} \cdot \sqrt{2n}}{10n}$$

$$= \frac{3n^2\sqrt{10n} + 2n\sqrt{5n}}{10n}$$

$$= \frac{3n\sqrt{10n} + 2\sqrt{5n}}{10}$$

$$7. \frac{4(\sqrt{2+5\sqrt{3}})}{(\sqrt{2-5\sqrt{3}})(\sqrt{2+5\sqrt{3}})} = \frac{4\sqrt{2+5\sqrt{3}}}{\sqrt{4+5\sqrt{6}-5\sqrt{6}-25\sqrt{9}}}$$

$$= \frac{4\sqrt{2+5\sqrt{3}}}{-25(3)}$$

$$= \frac{-4\sqrt{2+5\sqrt{3}}}{75} = \frac{4\sqrt{2+5\sqrt{3}}}{-75}$$

Math

Name \_\_\_\_\_

### Multiplying and Dividing Radicals

Simplify.

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

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

3)  $\sqrt{8} \cdot \sqrt{8}$

4)  $2\sqrt{12} \cdot 4\sqrt{15}$

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

6)  $2\sqrt{5}(5 - 5\sqrt{5})$

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

8)  $5\sqrt{6}(2\sqrt{2} + \sqrt{5})$

9)  $\sqrt{36}(\sqrt{10} + \sqrt{3})$

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

11)  $4\sqrt{5}(\sqrt{3} + 4\sqrt{5})$

12)  $\sqrt{6}(4\sqrt{2} + 5v)$

13)  $\sqrt{5}(-3\sqrt{2n} - 5\sqrt{5})$

14)  $2\sqrt{5a}(3a - 2\sqrt{2})$

15)  $(3 + \sqrt{3})(3 - 4\sqrt{3})$

16)  $(4 + \sqrt{3a})(5 + \sqrt{3})$

17)  $(\sqrt{3x} + 3)(2\sqrt{3} - 4)$

18)  $(-5 + \sqrt{5})(-1 + \sqrt{5})$

19)  $(\sqrt{5} - 3\sqrt{3})(\sqrt{5} + \sqrt{2k})$

20)  $(\sqrt{5} - 2\sqrt{3x})(\sqrt{5x} + \sqrt{4x})$

$$21) \frac{\sqrt{25}}{2\sqrt{4}}$$

$$22) \frac{\sqrt{4}}{3\sqrt{25}}$$

$$31) \frac{2 - 5\sqrt{3}}{2\sqrt{3}}$$

$$41) \frac{5}{4 + 3\sqrt{5}}$$

4

$$23) \frac{\sqrt{3}}{\sqrt{2}}$$

$$24) \frac{\sqrt{4}}{\sqrt{5}}$$

$$33) \frac{\sqrt{3 + 3\sqrt{2}}}{3\sqrt{12}}$$

$$43) \frac{3}{3 - \sqrt{2}}$$

4

$$25) \frac{\sqrt{2}}{5\sqrt{3}}$$

$$26) \frac{\sqrt{4}}{\sqrt{3}}$$

$$35) \frac{\sqrt{3 + 3\sqrt{5}}}{3\sqrt{7}}$$

$$45) \frac{5}{4\sqrt{2} - 4\sqrt{5}}$$

4

$$27) \frac{\sqrt{4}}{5\sqrt{5}}$$

$$28) \frac{\sqrt{2}}{\sqrt{5}}$$

$$37) \frac{\sqrt{2} - \sqrt{3}}{2\sqrt{3}}$$

$$47) \frac{3}{3 - 5\sqrt{2}}$$

4

$$29) \frac{\sqrt{2}}{\sqrt{3}}$$

$$30) \frac{\sqrt{4}}{5\sqrt{3}}$$

$$39) \frac{-5 + \sqrt{2}}{3\sqrt{14}}$$

$$49) \frac{4}{5 + 5\sqrt{2}}$$

5

KEY

## Answers to Multiplying and Dividing Radicals

- 1) 3                      2) -30                      3) 8                      4)  $48\sqrt{5}$   
5)  $3\sqrt{3} + \sqrt{15}$                       6)  $10\sqrt{5} - 50$                       7)  $3\sqrt{3} + 3\sqrt{2}$                       8)  $20\sqrt{3} + 5\sqrt{30}$   
9)  $\sqrt{30b} + 3\sqrt{b}$                       10)  $-3\sqrt{15n} - 9n\sqrt{2}$                       11)  $4\sqrt{15} + 80$                       12)  $8\sqrt{3} + 5\sqrt{6}$   
13)  $-3\sqrt{10n} - 25$                       14)  $6a\sqrt{5a} - 4\sqrt{10a}$                       15)  $-3 - 9\sqrt{3}$   
16)  $20 + 4\sqrt{3} + 5\sqrt{3a} + 3\sqrt{a}$                       17)  $6\sqrt{x} - 4\sqrt{3x} + 6\sqrt{3} - 12$                       18)  $10 - 6\sqrt{5}$   
19)  $5 + \sqrt{10k} - 3\sqrt{15} - 3\sqrt{6k}$                       20)  $5\sqrt{x} + 2\sqrt{5x} - 2x\sqrt{15} - 4x\sqrt{3}$   
21)  $\frac{5}{4}$                       22)  $\frac{2}{15}$                       23)  $\frac{\sqrt{6}}{2}$                       24)  $\frac{2\sqrt{5}}{5}$   
25)  $\frac{\sqrt{6}}{15}$                       26)  $\frac{2\sqrt{3}}{3}$                       27)  $\frac{2\sqrt{5}}{25}$                       28)  $\frac{\sqrt{10}}{5}$   
29)  $\frac{\sqrt{6}}{3}$                       30)  $\frac{2\sqrt{3}}{15}$                       31)  $\frac{2\sqrt{3} - 15}{6}$                       32)  $\frac{2\sqrt{3} + 2\sqrt{6}}{15}$   
33)  $\frac{1 + \sqrt{6}}{6}$                       34)  $\frac{5\sqrt{17} - \sqrt{34}}{17}$                       35)  $\frac{\sqrt{21} + 3\sqrt{35}}{21}$                       36)  $\frac{\sqrt{15} + 9}{9}$   
37)  $\frac{\sqrt{6} - 3}{6}$                       38)  $\frac{\sqrt{30} - 2\sqrt{5}}{50}$                       39)  $\frac{-5\sqrt{14} + 2\sqrt{7}}{42}$                       40)  $\frac{5 - \sqrt{15}}{5}$   
41)  $\frac{20 + 15\sqrt{5}}{29}$                       42)  $\frac{20 - 5\sqrt{5}}{11}$                       43)  $\frac{9 + 3\sqrt{2}}{7}$                       44)  $\frac{-3 - 6\sqrt{2}}{14}$   
45)  $\frac{-5\sqrt{2} - 5\sqrt{5}}{12}$                       46)  $\frac{-4\sqrt{5} - 16}{11}$                       47)  $\frac{-9 - 15\sqrt{2}}{41}$                       48)  $\frac{-3\sqrt{3} + 6\sqrt{5}}{17}$   
49)  $\frac{-4 + 4\sqrt{2}}{5}$                       50)  $\frac{5 + \sqrt{5}}{10}$