Section 4.3:Multiplying and Dividing Radicals

Note: You can only multiply or divide radicals if they have the same index.

Property #1:
The product of two square roots is equal to the square root of the product.

$$\sqrt{a} \cdot \sqrt{b} = \sqrt{a \cdot b}$$

Example 1: $\sqrt{5} \cdot \sqrt{2}$

NOTE: Be careful!

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

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

Your Turn:

a). $\sqrt{7} \cdot \sqrt{3}$

b). $\sqrt{12} \cdot \sqrt{18}$

NOTE: Always write radicals in simplest form!

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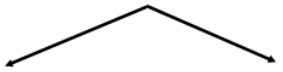
c). $\sqrt{32} \cdot \sqrt{20}$

↳ this question can be done in two ways



Method 1
Multiply first
then simplify

$\sqrt{32} \cdot \sqrt{20}$

Method 2
Simplify first
then multiply

$\sqrt{32} \cdot \sqrt{20}$

Property #2:
The product of two mixed radicals is equal to the product of the rational numbers times the product of the radicals

$$c\sqrt{a} \cdot d\sqrt{b} = c \cdot d\sqrt{a \cdot b}$$

Example 2: $7\sqrt{6} \cdot 2\sqrt{3}$

Your Turn:

a). $3\sqrt{2} \cdot 4\sqrt{5}$

b). $\sqrt[3]{4} - 2\sqrt[3]{16}$

c). $7\sqrt{2} \cdot 3\sqrt{2}$

NOTE: $\sqrt{2 \cdot 2} = \sqrt{4} = 2$
When the radicand is the same number, the radical becomes a rational number!

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Property #3:
You can use the same properties you use with rational numbers to multiply and divide radical numbers. Like distributive property and FOIL.

Recall: Distributive Property

$4x(7x+3)$

This same idea can be applied to radicals.

Example 3: $4\sqrt{2}\left(7\sqrt{5}+\sqrt{3}\right)$

Your Turn:

a). $4\sqrt{10}\left(3\sqrt{7}-6\right)$

b). $2\sqrt[3]{5}\left(\sqrt[3]{3}+2\sqrt[3]{25}\right)$

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Recall: FOIL (Distributive Property Twice)

$(2x-1)(3x+5)$

This same idea can be applied to radicals.

Example: $\left(3+\sqrt{14}\right)\left(4\sqrt{7}-5\sqrt{2}\right)$

Your Turn:

a). $\left(2\sqrt{2}-1\right)\left(9\sqrt{3}-\sqrt{12}\right)$

b). $\left(\sqrt{2}-10\sqrt{3}\right)^2$

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Property #4:
The quotient of two square roots is equal to the square root of the quotient.

$$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$$

Example 4:

a). $\sqrt{\frac{25}{4}}$

b). $\frac{\sqrt{56}}{\sqrt{7}}$

Your Turn:

c). $\sqrt{\frac{16}{121}}$

d) $\frac{\sqrt[3]{625}}{\sqrt[3]{5}}$

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Property #5:
When two radicals are divided and the numbers under the radical signs cannot be divided evenly, we must use a process called ...

Rationalizing the Denominator

... which converts the denominator to a rational number.

Example 5:

a). $\frac{\sqrt{2}}{\sqrt{5}}$

NOTE: To rationalize the denominator we multiply the numerator and denominator by the radical in the denominator.

b). $\frac{\sqrt{8}}{\sqrt{5}}$

Your Turn:

c). $\frac{\sqrt{7}}{\sqrt{3}}$

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Property #6:

When two mixed radicals are divided, we can divide the outsides and divide the radicals.

$$\frac{c\sqrt{a}}{d\sqrt{b}} = \frac{c}{d}\sqrt{\frac{a}{b}}$$

Example 6:

a). $\frac{24\sqrt{14}}{3\sqrt{2}}$

b). $\frac{6\sqrt{30}}{-12\sqrt{3}}$

NOTE: Mixed radicals may also require Rationalizing of the Denominator if the radicals do not divide evenly.

c). $\frac{7\sqrt{10}}{5\sqrt{3}}$

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d). $\frac{14\sqrt{8}}{10\sqrt{3}}$

You can simplify radicals first before rationalizing

Your Turn:

e). $\frac{3\sqrt{7}}{4\sqrt{5}}$

How would you do this one?

f). $\frac{2\sqrt{3}+4\sqrt{5}}{\sqrt{6}}$

We still rationalize the denominator by placing the numerator in brackets and using distributive property.

Your Turn:

g). $\frac{-5\sqrt{8}+\sqrt{11}}{7\sqrt{3}}$

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