4.3 Mixed and Entire Radicals

Lesson 2

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Connect — Radicals

Multiplication Property of Radicals

$\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$,
where n is a natural number, and a and b are real numbers

$\sqrt[3]{40} = \sqrt[3]{8} \cdot \sqrt[3]{5}$ or $\sqrt[3]{4} \cdot \sqrt[3]{10}$ or $\sqrt[3]{2} \cdot \sqrt[3]{20}$

We can use this property to simplify square roots and cube roots that are not perfect squares or perfect cubes, but have factors that are perfect squares or perfect cubes.

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Example 1:

$\sqrt{16 \times 9} = \sqrt{16} \times \sqrt{9}$

$\sqrt{144} = 4 \cdot 3$

$12 = 12$ ✓

Example 2:

$\sqrt[3]{8 \times 27} = \sqrt[3]{8} \times \sqrt[3]{27}$

$\sqrt[3]{216} = 2 \cdot 3$

$6 = 6$ ✓

Calculator

3 2nd shift $\sqrt[x]{y}$ 216

216 2nd shift $\sqrt[x]{y}$ 3

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Write Radical in Simplest form

Example 3:

$\sqrt{24} =$

$\sqrt{4} \cdot \sqrt{6}$

$2\sqrt{6}$ simplified

mixed Radical.

Any perfect Squares

Factors
1 · 24
2 · 12
3 · 8
4 · 6

STEPS:

Find the factors of 24. If one is a perfect square use it.

Rewrite 24 as a product of two factors, one which is the perfect square

Solve

* Look for perfect nth factors, where "n" is the index of the radical

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Example 4:

$\sqrt[3]{24} =$

$\sqrt[3]{8} \cdot \sqrt[3]{3}$

$2\sqrt[3]{3}$

mixed Radical

Looking for perfect cube

Factors
1 · 24
2 · 12
3 · 8
4 · 6

STEPS:

Find the factors of 24. If one is a perfect cube use it.

Rewrite 24 as a product of two factors, one which is the perfect cube

Solve

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Example 5:

$\sqrt{80} =$

$\sqrt{16} \cdot \sqrt{5}$

$4\sqrt{5}$

$\sqrt{80} : \sqrt{8 \cdot 10}$

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

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

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

$2 \cdot 2 \cdot \sqrt{5}$ → $4\sqrt{5}$

STEPS:

Find the factors of 80. If one is a perfect square use it.

Continue to break the factors down using prime factorization.

Group the prime factors that are the same

Solve

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Example 6:

$\sqrt[3]{144} =$

$\sqrt[3]{12 \cdot 12}$

$\sqrt[3]{4 \cdot 3 \cdot 4 \cdot 3}$

$\sqrt[3]{2 \cdot 2 \cdot 3 \cdot 2 \cdot 2 \cdot 3}$

$\sqrt[3]{2 \cdot 2 \cdot 2} \cdot \sqrt[3]{2 \cdot 3 \cdot 3}$

$2\sqrt[3]{18}$

STEPS:

Find the factors of 144. If one is a perfect cube use it.

Continue to break the factors down using prime factorization.

Group the prime factors that are the same

Solve

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Example 7:

$\sqrt[4]{162} =$

$\sqrt[4]{81 \cdot 2}$

$\sqrt[4]{9 \cdot 9 \cdot 2}$

$\sqrt[4]{3 \cdot 3 \cdot 3 \cdot 2}$

$\sqrt[4]{3 \cdot 3 \cdot 3} \cdot \sqrt[4]{2}$

$3\sqrt[4]{2}$

STEPS:

Find the factors of 162. Look for factors that appear 4 times.

Continue to break the factors down using prime factorization.

Group the prime factors that are the same

Solve

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Example 8:

To write a radical of index "n" in simplest form, we write the radicand as a product of 2 factors, one of which is the greatest perfect "nth" power.

$\sqrt{200}$ =	$\sqrt{200}$ =	$\sqrt{200}$ =
$\sqrt{4 \cdot 50}$	$\sqrt{25 \cdot 8}$	$\sqrt{100 \cdot 2}$
$\sqrt{4} \cdot \sqrt{50}$	$\sqrt{25} \cdot \sqrt{8}$	$\sqrt{100} \cdot \sqrt{2}$
$2\sqrt{50}$	$5\sqrt{8}$	$10\sqrt{2}$

$10\sqrt{2}$ is in simplest form because of radical contains no perfect square factors other than 1.

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Connect — YOU TRY!

$\sqrt{63}$	$\sqrt[3]{108}$	$\sqrt[4]{128}$
$\sqrt{9 \cdot 7}$	$\sqrt[3]{2 \cdot 54}$	$\sqrt[4]{2 \cdot 64}$
$\sqrt{9} \cdot \sqrt{7}$	$\sqrt[3]{2 \cdot 2 \cdot 27}$	$\sqrt[4]{2 \cdot 8 \cdot 8}$
$3\sqrt{7}$	$\sqrt[3]{2 \cdot 2 \cdot 3 \cdot 9}$	$\sqrt[4]{2 \cdot 2 \cdot 4 \cdot 2 \cdot 4}$
	$\sqrt[3]{2 \cdot 2 \cdot 3 \cdot 3 \cdot 3}$	$\sqrt[4]{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}$
	$\sqrt[3]{3 \cdot 3 \cdot 3} \cdot \sqrt[3]{2 \cdot 2}$	$\sqrt[4]{2 \cdot 2 \cdot 2 \cdot 2} \cdot \sqrt[4]{2 \cdot 2 \cdot 2}$
	$3\sqrt[3]{4}$	$2\sqrt[4]{8}$

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Practice — HOMEWORK!

Textbook Questions:

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