

Radical Operations

Questions: How do operations on radicals compare with operations on polynomials?

Goals: Simplify Radical expressions

Warm-Up

Simplify

$$1) \frac{x^2 + 5x - 14}{x^2 - 6x + 8} = \frac{(x+7)(x-2)}{(x-4)(x-2)} = \boxed{\frac{x+7}{x-4}}$$

$$2) \frac{x^2 - 3x - 4}{x^2 - 16} = \frac{(x+1)(x-4)}{(x+4)(x-4)} = \boxed{\frac{x+1}{x+4}}$$

Notes 5.5 : Radicals and Roots

$$\sqrt{25} = 5 \quad 5^2 = 25$$

square rooting
and squaring
are opposites

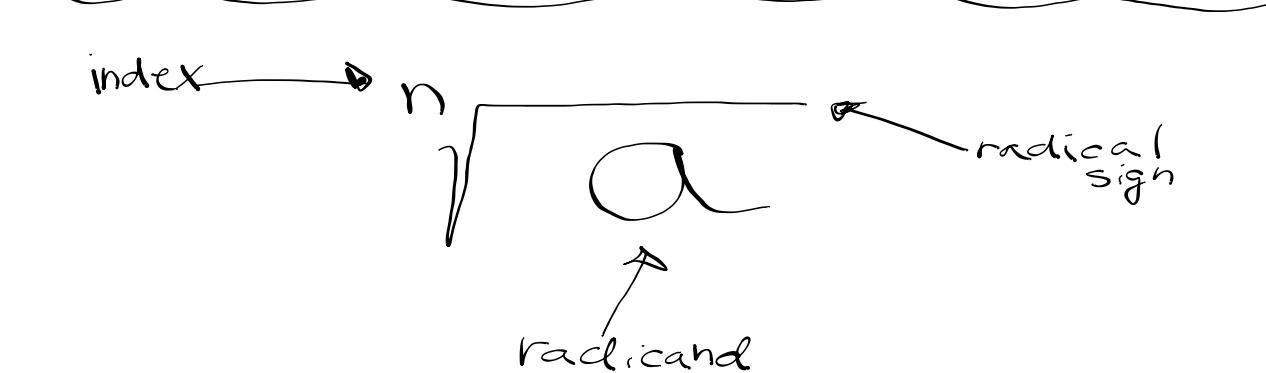
$\sqrt{5 \cdot 5}$

$\sqrt{5^2}$. "5 is a square root of 25"

$$\sqrt[3]{27} = 3 \quad 3^3 = 27$$

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

$\sqrt[3]{3^3}$ "3 is the cube root of 27"



Ex 1) a.) Simplify

$$\sqrt{64}$$

8
 |
 8
 |
 4 2
 |
 2 2

$$\boxed{8}$$



Simplify

1b.) $\sqrt{32x^5y^4}$

$$\sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot x \cdot x \cdot x \cdot x \cdot y \cdot y \cdot y \cdot y}$$

$\sqrt{a^2} = a$

$$\sqrt{2^2 \cdot 2^2 \cdot 2 \cdot x^2 \cdot x^2 \cdot x \cdot y^2 \cdot y^2}$$

$$2 \cdot 2 \cdot x \cdot x \cdot y \cdot y \sqrt{2 \cdot x}$$

$$\boxed{4x^2y^2\sqrt{2x}}$$

1. c.) $\sqrt[5]{32x^{15}y^{20}}$

Example 2.

$$\sqrt[5]{a^5} = a$$

Breaking
Quintuplets
out of jail

$$\begin{aligned}\sqrt[5]{243a^{10}b^{15}} \\ \sqrt[5]{(3)^5(a^2)^5(b^3)^5}\end{aligned}$$

$$3a^2b^3$$

Notes. 5.6 : Radical ExpressionsProduct Property of Radicals

$$\star \quad \sqrt[n]{a \cdot b} = \sqrt[n]{a} \cdot \sqrt[n]{b}$$

$$\text{Example. } \sqrt[3]{30} = \sqrt[3]{15} \cdot \sqrt[3]{2}$$

Quotient Property of Radicals

$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

Example 3. Simplify

$$\sqrt{\frac{x^4}{y^5}}$$

When simplifying radicals,
fraction radicands are not allowed

$$\frac{\sqrt{x^4}}{\sqrt{y^5}}$$

Quotient Property

$$\frac{\sqrt{x^4}}{\sqrt{y^5}} \cdot \frac{\sqrt{y^5}}{\sqrt{y^5}}$$

Rationalize the denominator

$$\frac{\sqrt{x^4 \cdot y^5}}{\sqrt{y^5 \cdot y^5}}$$

Product Property

$$\cancel{y^5} = 1$$

$$\frac{x^2 y^2 \sqrt{y}}{y^5}$$

Simplify

$$\frac{x^2 \sqrt{y}}{y^3}$$

Example 3b Simplify

$$\sqrt[5]{\frac{5}{4a}}$$

$$\frac{\sqrt[5]{5}}{\sqrt[5]{4a}}$$

$$\frac{\sqrt[5]{5}}{\sqrt[5]{4a}} \cdot \frac{\sqrt{8a^4}}{\sqrt{8a^4}}$$

$$\frac{\sqrt[5]{40a^4}}{\sqrt[5]{32a^5}}$$

$$\frac{\sqrt[5]{40a^4}}{2a}$$

Notes Like-terms

$$-2x^3 \quad \frac{1}{2}x^3$$

(brace under both terms)

$$x^5 \quad 2x^5$$

(brace under both terms)

$$2x^2y^3 \quad 3x^2y^3$$

(brace under both terms)

like-terms: same variable
same powers

$$2\sqrt{2} \quad -4\sqrt{2}$$

(brace under both terms)

$$3\sqrt[3]{7} \quad 4\sqrt[3]{7}$$

(brace under both terms)

$$8\sqrt[3]{11} \quad 9\sqrt[4]{11}$$

(brace under both terms, crossed out with a large green X)

radical like-terms: same index
same radicand

Example 4. Simplify $3\sqrt{45} - 5\sqrt{80} + 4\sqrt{20}$

Step 1:
Simplify each term $3\sqrt{3 \cdot 3 \cdot 5} - 5\sqrt{2 \cdot 2 \cdot 2 \cdot 5} + 4\sqrt{2 \cdot 2 \cdot 5}$

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

$$9\sqrt{5} - 20\sqrt{5} + 8\sqrt{5}$$

$$(9 - 20 + 8)\sqrt{5}$$

$$\boxed{-3\sqrt{5}}$$

Example 5. Simplify

$$\frac{1 - \sqrt{3}}{5 + \sqrt{3}}$$

$$(a+b)(a-b)$$

$$a^2 - b^2$$

$$\frac{1 - \sqrt{3}}{5 + \sqrt{3}} \cdot \frac{5 - \sqrt{3}}{5 - \sqrt{3}}$$

Multiply by the conjugate

$$\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$$

Top

	1	- $\sqrt{3}$
5	5	- $5\sqrt{3}$
$\sqrt{3}$	- $\sqrt{3}$	3
	8 - 6 $\sqrt{3}$	

Bottom

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

F $5 \cdot 5 = 25$

O $-5\sqrt{3}$

I $5\sqrt{3}$

L -3

$$= 22$$

$$\frac{8 - 6\sqrt{3}}{22}$$

$$\frac{4 - 3\sqrt{3}}{11}$$

homework : page 254-255
due: Thursday #17 - 47 odd
57, 58

Friday

Exit Ticket: Simplify

① *Example 4* $2\sqrt{12} - 3\sqrt{27} + 2\sqrt{48}$

② *Example 3* $\sqrt[3]{\frac{2}{9x}}$