

## What's Going On?

**Checking In**

**Minds on**

Radical Laws

**Action!**

Radical Examples

**Consolidation**

Radical Applications

**Learning Goal - I will be able to simplify radicals.**

## Checking In

# F.F.M.

Please do this before you RAFT

**Determine the equation of the inverse.**

$$f(x) = -2(x-3)^2 + 5$$

$$y = -2(x-3)^2 + 5$$

$$x = -2(y-3)^2 + \cancel{5} + 5$$

$$\frac{x - 5}{-2} = \frac{-2(y-3)^2}{-2}$$

$$\sqrt{-\frac{1}{2}(x-5)} = \sqrt{(y-3)^2}$$

$$\sqrt{-\frac{1}{2}(x-5)} = y - \cancel{3} + 3$$

$$y = \sqrt{-\frac{1}{2}(x-5)} + 3$$

$$f(x) = -2(x-3)^2 + 5$$

a	k	c	d
-2	1	5	3

Inverse!

"1 over"



$$f^{-1}(x) = \sqrt{-\frac{1}{2}(x-5)} + 3$$

a	k	c	d
1	$-\frac{1}{2}$	3	5

**Checking In**

**Weekend Assignment**

Due Thursday

And now, announcing today's topic...

**\*If you are prone to seizures, please look away.**



## Minds on

## Radical Terms

NEW TERM

A radical is a square root, cube root or higher root.

$$\sqrt[n]{x}$$

$$\sqrt[3]{9} = 3$$

$$\sqrt[3]{64} = 4$$

NEW TERM

An entire radical is a radical with a coefficient of 1.

$$\sqrt{8} \quad \sqrt{16} \quad \sqrt{21} \quad \sqrt{37}$$

NEW TERM

A mixed radical is a radical with a coefficient other than 1.

$$2\sqrt{3} \quad 5\sqrt{2} \quad -7\sqrt{1021}$$

NEW TERM

like radicals are radicals that have the same value under the radical symbol.

$$2\sqrt{3} \text{ and } -\sqrt{3} \quad 7\sqrt{2} \text{ and } -8\sqrt{2}$$

**Minds on**

## Radical Laws

$$\sqrt{x} + \sqrt{y}$$

$$\sqrt{9} + \sqrt{16}$$
$$= 7$$

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

$$\sqrt{x} + \sqrt{y} \neq \sqrt{x+y}$$

**Minds on**

## Radical Laws

$$\begin{array}{ccc} & \sqrt{x} - \sqrt{y} & \\ \sqrt{25} - \sqrt{16} & & \sqrt{25-16} \\ = 1 & & = 3 \end{array}$$
$$\sqrt{x} - \sqrt{y} \neq \sqrt{x - y}$$



## Minds on

### Radical Laws

$$\sqrt{x} + \sqrt{x}$$

$\sqrt{36} + \sqrt{36} = 12$  ✓  
 $\sqrt{36+36} \neq \sqrt{72}?$   
 $\sqrt{2(36)} = 2\sqrt{36} = 12$  ✓  
 $\sqrt{x} + \sqrt{x} = 2\sqrt{x}$  **not**  $\sqrt{2x}$

\*These are "like" radicals.

We can only add and subtract like radicals

**Minds on**

$$\sqrt{25} \times \sqrt{16} = 20$$

$$\sqrt{25 \times 16} = 20$$

Radical Laws

$$\sqrt{4} \times \sqrt{9} = 6$$

$$\sqrt{4 \times 9} = 6$$

$$\sqrt{x} \times \sqrt{y}$$

$$\sqrt{x} \times \sqrt{y} = \sqrt{x}\sqrt{y} = \sqrt{x \times y} = \sqrt{xy}$$

**Minds on**

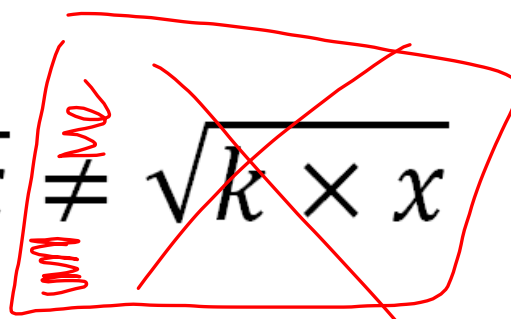
## Radical Laws

$$\sqrt{x} \times k$$

$$\sqrt{25} \times 3$$
$$= 15$$

$$3\sqrt{25}$$
$$= 15$$

$$\sqrt{x} \times k = k\sqrt{x} \neq \sqrt{k \times x}$$



## Minds on

$\sqrt{100} \div \sqrt{25} = 2$

$\sqrt{x} \div \sqrt{y} = 2$

$\frac{\sqrt{36}}{\sqrt{9}} = 2$

$\sqrt{\frac{100}{25}} = 2$

$\sqrt{\frac{36}{9}} = 2$

$\sqrt{x} \div \sqrt{y} = \frac{\sqrt{x}}{\sqrt{y}} = \sqrt{\frac{x}{y}}$

## Minds on

### Radical Laws

$$\sqrt{100} \div 20 = 0.5$$

$$\sqrt{x} \div k$$

$$\sqrt{\frac{100}{20}} = \sqrt{5}$$

$$\sqrt{x} \div k = \frac{\sqrt{x}}{k} \neq \sqrt{\frac{x}{k}}$$

## Minds on

## Radical Laws

$$\sqrt{x} + \sqrt{y} \neq \sqrt{x + y}$$

$$\sqrt{x} - \sqrt{y} \neq \sqrt{x - y}$$

$$\sqrt{x} + \sqrt{x} = 2\sqrt{x} \text{ **not** } \sqrt{2x}$$

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$$\sqrt{x} \times \sqrt{y} = \sqrt{x}\sqrt{y} = \sqrt{x \times y}$$

$$\sqrt{x} \times k = k\sqrt{x} \neq \sqrt{k \times x}$$

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$$\sqrt{x} \div \sqrt{y} = \frac{\sqrt{x}}{\sqrt{y}} = \sqrt{\frac{x}{y}}$$

$$\sqrt{x} \div k = \frac{\sqrt{x}}{k} \neq \sqrt{\frac{x}{k}}$$

**Action!**

## Radical Examples

Expressing as a Mixed Radical

1. Break the value under the radical sign into its ***prime factors***.
2. Remove duplicate factors from the radical sign and place in front.

**Action!**

## Radical Examples

1. Express each of the following as a *mixed radical* in lowest terms.

a.  $\sqrt{27}$

$$\begin{aligned} &= \sqrt{9 \times 3} \\ &= \sqrt{9} \times \sqrt{3} \\ &= 3 \times \sqrt{3} \\ &= 3\sqrt{3} \end{aligned}$$

$$\begin{aligned} &= \sqrt{9 \times 3} \\ &= \sqrt{3 \times 3 \times 3} \\ &= 3\sqrt{3} \end{aligned}$$



$$\text{b. } \sqrt{32}$$

$$\begin{aligned} & \sqrt{8 \times 4} \\ &= \sqrt{4 \times 2 \times 4} \\ &= \sqrt{2 \times 2 \times 2 \times 2 \times 2} \\ &= 4\sqrt{2} \end{aligned}$$
$$\begin{aligned} &= \sqrt{16 \times 2} \\ &= 4\sqrt{2} \end{aligned}$$

$$\text{c. } \sqrt{56}$$

$$= \sqrt{4 \times 14}$$

$$= \sqrt{4} \times \sqrt{14}$$

$$= 2\sqrt{14}$$

$$\begin{array}{r} 1 \\ 4 \\ \cancel{9} \\ \cancel{16} \\ \cancel{25} \\ \cancel{36} \end{array}$$

**Action!**

## Radical Examples

Expressing as an Entire Radical

1. Square the coefficient and put this new value under the radical sign.

\*If the coefficient was negative, leave the negative sign out front.

**Action!**

## Radical Examples

2. Express as an *entire radical*.

a.  $5\sqrt{13}$

$$= \sqrt{5^2 \times 13}$$

$$= \sqrt{325}$$

$$\text{b. } -4\sqrt{7}$$

$$= -\sqrt{(4 \times 4) \times 7}$$

$$= -\sqrt{112}$$

$$c. -4\sqrt{70}$$

$$= -\sqrt{14 \times 14 \times 70}$$

$$= -\sqrt{13,720}$$

**Action!**

## Radical Examples

### Adding and Subtracting Radicals

1. Express each radical as a mixed radical in lowest terms.
2. Add and subtract the coefficients of like radicals

**Action!**

## Radical Examples

3. Simplify. Write as a mixed radical, in lowest terms.

$$\text{a. } \sqrt{12} + \sqrt{48}$$

$$= \sqrt{4 \times 3} + \sqrt{16 \times 3}$$

$$= \sqrt{4} \times \sqrt{3} + \sqrt{16} \times \sqrt{3}$$

$$= 2\sqrt{3} + 4\sqrt{3}$$

$$= 6\sqrt{3}$$



$$\text{b. } \sqrt{8} - \sqrt{18}$$

$$= \sqrt{4 \times 2} - \sqrt{9 \times 2}$$

$$= \sqrt{\underline{2 \times 2} \times 2} - \sqrt{\underline{3 \times 3} \times 2}$$

$$= 2\sqrt{2} - 3\sqrt{2}$$

$$= -1\sqrt{2} \text{ (or) } -\sqrt{2}$$

**Action!**

## Radical Examples

### Multiplying Radicals

1. Multiply the coefficients and the values under the radical signs.
2. Write radicals as mixed radicals in lowest terms.
3. Add and subtract any like radicals.

$$\text{c. } -4\sqrt{3} \times 8\sqrt{13}$$
$$= (-4)(8)(\sqrt{3})(\sqrt{13})$$

$$= -32\sqrt{39}$$

We were trying to see if we could break this thing down any further or differently.

We couldn't!

~~$$= -\sqrt{32 \times 32 \times 39}$$
$$= -\sqrt{39936}$$~~

This is obvious because we already got it into lowest terms here.

$$d. 7\sqrt{24} - 2\sqrt{75} + 3\sqrt{54} - \sqrt{108}$$

$$= 7\sqrt{4 \times 6} - 2\sqrt{25 \times 3} + 3\sqrt{9 \times 6} - \sqrt{36 \times 3}$$

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

$$= 14\sqrt{6} - 10\sqrt{3} + 9\sqrt{6} - 6\sqrt{3}$$

$$= 23\sqrt{6} - 16\sqrt{3}$$

$$e. (2\sqrt{5} - 3\sqrt{2})(7\sqrt{10} + 3\sqrt{6})$$

**FOIL!!!!!!!!!!!!!!**

$$= (2\sqrt{5})(7\sqrt{10}) + (2\sqrt{5})(3\sqrt{6}) + (-3\sqrt{2})(7\sqrt{10}) + (-3\sqrt{2})(3\sqrt{6})$$

$$= 14\sqrt{50} + 6\sqrt{30} - 21\sqrt{20} - 9\sqrt{12}$$

$$= 14\sqrt{25 \times 2} + 6\sqrt{6 \times 5} - 21\sqrt{4 \times 5} - 9\sqrt{4 \times 3}$$

$$= 14(5)\sqrt{2} + 6\sqrt{3 \times 2 \times 5} - 2(21)\sqrt{5} - 9(2)\sqrt{3}$$

$$= 70\sqrt{2} + 6\sqrt{30} - 42\sqrt{5} - 18\sqrt{3}$$

$$= 70\sqrt{2} - 18\sqrt{3} - 42\sqrt{5} + 6\sqrt{30}$$

**Action!**

## Why Radicals?

Why are we learning about radicals in the Quadratic Functions unit?

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



The profit,  $P(a)$ , of a particular company, in thousands of dollars, is modelled by the function

$$P(a) = -5a^2 + 400a - 2550$$

where  $a$  is the amount spent on advertising, in thousands of dollars.

**What is the maximum profit possible?**

Quadratic Formula

$$a = -5$$

$$b = 400$$

$$c = -2550$$

$$a = \frac{-400 \pm \sqrt{400^2 - 4(-5)(-2550)}}{2(-5)}$$

$$= \frac{-400 \pm \sqrt{160,000 - 51,000}}{-10}$$

$$= \frac{-400 \pm \sqrt{109,000}}{-10}$$

Now, we would ordinarily take the square root of 109,000. It would not be a solid number, so we would be approximating. That's bad!

**Let's reduce the value under the radical!**



$$= \frac{-400 \pm \sqrt{109,000}}{-10}$$

Now, we would ordinarily take the square root of 109,000. It would not be a solid number, so we would be approximating. That's bad!

**Let's reduce the value under the radical!**

$$= \frac{-400 \pm \sqrt{100 \times 1090}}{-10}$$

$$= \frac{-400 \pm \sqrt{100 \times 10 \times 109}}{-10}$$

$$= \frac{-400 \pm 10\sqrt{1090}}{-10}$$

factor out 10!!

$$= \frac{-40 \pm \sqrt{1090}}{-1}$$

Factor out -1!

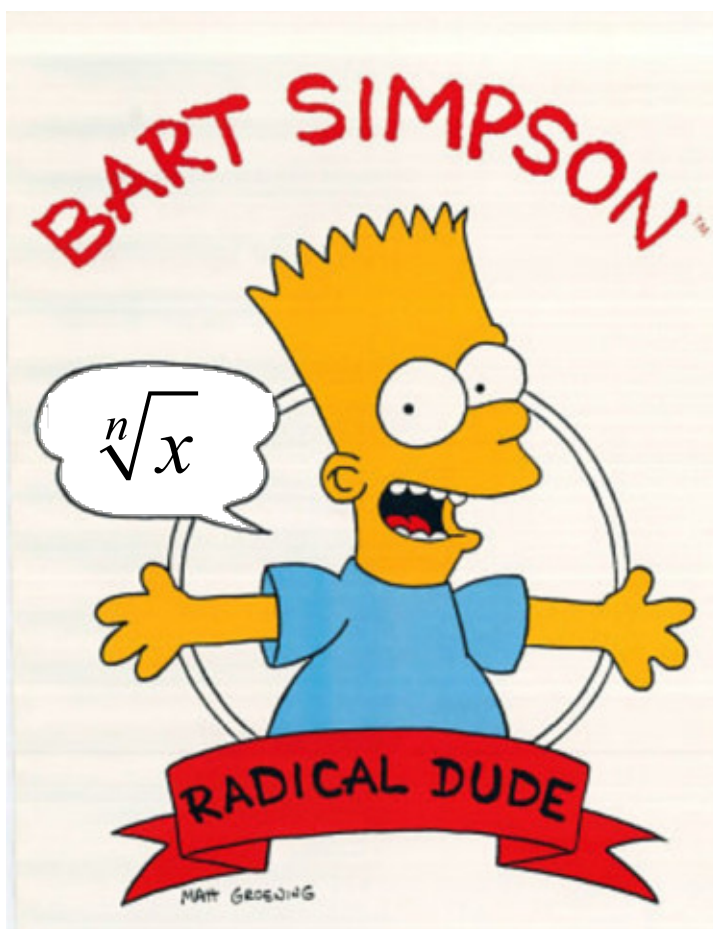
$$= 40 \mp \sqrt{1090}$$

**Consolidation**

# You Try!

Simplify fully.

$$(1 - \sqrt{3})(2 + \sqrt{6})(5 + \sqrt{2})$$



**Consolidation**

# Homework