Unit 3 Day 4

Solving Equations with Rational Exponents and Radicals

Day 4 Warm Up

You know a lot about inverses in mathematics – we use them every time we solve equations.

Write down the inverse operation for each of the following (there could be more than one correct answer) and then give a definition for "inverse" in your own words.

If you get stuck, it may be helpful for you to write the expression out and think what you would do to solve an equation that had that expression on one side of the equation.

The phrase…	Is the expression…	And its inverse is…
adding 5 to a number	$x+5$	Subtracting 5 from a number
subtracting 7 from a number		
multiplying a number by $\frac{1}{2}$		
Multiplying a number by $\frac{2}{5}$		
dividing a number by 3		
squaring a number		
Taking the square root of a number		
Raising a number to the 5^{th} power		
Taking the 5^{th} root of a number		
Raising a number to the $\frac{2}{5}$ power		

Use the information from the table above to solve the following equations.

Express your answers in simplified radical form.

a. $\sqrt[3]{x^5} = 64$

b. $(y^{\frac{1}{4}})^3 = 16$

An "inverse" is…

Day 4 Warm Up ANSWERS

Modeling with Exponential Functions: Solving Equations with Rational Exponents and Radicals

The phrase...	Is the expression...	And its inverse is...
adding 5 to a number	$x+5$	Subtracting 5 from a number
subtracting 7 from a number	**x – 7**	**adding 7 to a number**
multiplying a number by $\frac{1}{2}$	**x * 1/2**	**multiply by 2**
Multiplying a number by $\frac{2}{5}$	**x * 2/5**	**multiply by 5/2**
dividing a number by 3	**x/3**	**multiply by 3**
squaring a number	x^2	**take square root**
Taking the square root of a number	$\sqrt{x}$	**squaring a number**
Raising a number to the 5th power	x^5	**raising to the 1/5 power**
Taking the 5th root of a number	$\sqrt[5]{x}^2$	**raising to the 5th power**
Raising a number to the $\frac{2}{5}$ power	$x^{\frac{2}{5}}$	**raising to the 5/2 power**

Day 4 Warm Up ANSWERS

Use the information from the table above to solve the following equations. Express your answers in simplified radical form.

a.

$$\sqrt[3]{x^5} = 64$$

$$\left(\sqrt[3]{x^5}\right)^3 = (64)^3$$

$$x^5 = 64^3$$

$$\sqrt[5]{x^5} = \sqrt[5]{64^3}$$

$$x = \sqrt[5]{64 \bullet 64 \bullet 64}$$

$$x = \sqrt[5]{8 \bullet 8 \bullet 8 \bullet 8 \bullet 8 \bullet 8}$$

$$x = 8\sqrt[5]{8}$$

b.

$$(y^{\frac{1}{4}})^3 = 16$$

$$y^{\frac{3}{4}} = 16$$

$$(y^{\frac{3}{4}})^{\frac{4}{3}} = (16)^{\frac{4}{3}}$$

$$y = \sqrt[3]{16^4} = \sqrt[3]{16 \bullet 16 \bullet 16 \bullet 16}$$

$$y = 16\sqrt[3]{16}$$

$$y = 16\sqrt[3]{2 \bullet 2 \bullet 2 \bullet 2} = 16 \bullet 2\sqrt[3]{2}$$

$$y = 32\sqrt[3]{2}$$

Day 4 Warm Up ANSWERS

An "Inverse" is…???

Inverse Operation Defined

The word inverse means reversed in direction or position. It comes from the Latin word 'inversus,' which means to turn upside down or inside out. In mathematics, an **inverse operation** is an operation that undoes what was done by the previous operation.

Inverse Operation Examples

The four main mathematical operations are

- Addition
- Subtraction
- Multiplication
- Division

The inverse of addition is subtraction, and vice versa. The inverse of multiplication is division, and vice versa. Let's look at some examples to show how inversion works.

Homework Answers ~

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2. $\sqrt[3]{4^4} OR \left(\sqrt[3]{4}\right)^4$

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

4. $\sqrt[3]{7^4} OR \left(\sqrt[3]{7}\right)^4$

$= 7\sqrt[3]{7}$

6. $\sqrt[6]{2^1} OR \left(\sqrt[6]{2}\right)^1$

8. $2^{\frac{1}{6}}$

10. $5^{\frac{5}{4}}$

12. $10^{\frac{1}{6}}$

Homework Answers ~

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14. $\dfrac{1}{\sqrt[2]{5x}}$

16. $\sqrt[5]{a^6}\ \_OR\_\ \left(\sqrt[5]{a}\right)^6$

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

20. $(6x)^{\frac{4}{3}}\ \_OR\_\ 6^{\frac{4}{3}}x^{\frac{4}{3}}$

30. $3n^2$

22. $(6p)^{\frac{1}{2}}\ \_OR\_\ 6^{\frac{1}{2}}p^{\frac{1}{2}}$

26. $\dfrac{1}{2401}$

28. 216

You Try! Notes p. 8

2. $\left(\frac{\sqrt[3]{a^2}}{\sqrt{b}}\right)^{-6}$ $\frac{b^3}{a^4}$

3. $(2\sqrt[4]{a})^3 \bullet \sqrt{a^3}$ $8a^2\sqrt[4]{a}$

5. $\frac{\sqrt{64x^3}}{\sqrt[3]{512x^9}}$ $\frac{1}{x\sqrt{x}}$

6. $\sqrt[4]{625x^8}$ $5x^2$

8. $\frac{1}{\sqrt[3]{-27x^9}}$ $\frac{1}{-3x^3}$

9. $(\sqrt{x} \bullet \sqrt[3]{y^2})^{-6}$ $\frac{1}{x^3y^4}$

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Mixed Review: Simplify each expression.

1. $\sqrt{75y} - 2\sqrt{27y} + \sqrt{45y}$

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

2. $\sqrt{108yz^2} + 3\sqrt{98yz^2} + 2\sqrt{55yz^2}$

$6z\sqrt{3y} + 21z\sqrt{2y} + 2z\sqrt{55y}$

3. $2\sqrt{18a^2b} \cdot 6\sqrt{3b^2}$

$36ab\sqrt{6b}$

4. $\dfrac{3x^{-14}y^{11}}{18x^2}$

$\dfrac{y^{11}}{6x^{16}}$

Tonight's Homework:

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Notes p. 10 **Express final answers as radicals!**

★ = leave as a decimal

Before partner work, let's do two together! ☺

HINT: We'll use the Inverses we discussed during today's warm-up!

Skill	Partner A	Partner B
1	☺ **Do 1st Together** $\sqrt[4]{a} = 14$	$\sqrt[5]{b} = 50$
2	★ $\sqrt[5]{a^9} = 26$	$\sqrt[4]{b^3} = 27$
3	$\left(\sqrt[7]{a}\right)^3 = 21$	$\left(\sqrt{b}\right)^5 = 12$
4	$a^{\frac{1}{5}} = 50$	$b^{\frac{1}{4}} = 14$
5	$a^{\frac{3}{4}} = 27$	$b^{\frac{9}{5}} = 26$ ★
6	$\left(a^{\frac{1}{2}}\right)^5 = 12$	☺ **Do 1st Together** $\left(b^{\frac{1}{7}}\right)^3 = 21$

Compare the answers you got when you practiced Skills 1-3 with the answers you got when you practiced Skills 4-6. Work with your partner to explain your findings.

Notes p. 10 **Express final answers as radicals!** ★ = leave as a decimal

Work with a partner –

Decide who will be Partner A and who will be Partner B.

Skill	Partner A	Partner B
1	$\sqrt[4]{a} = 14$ 38416	$\sqrt[5]{b} = 50$ 312,500,000
2	★ $\sqrt[5]{a^9} = 26$ 6.11	$\sqrt[4]{b^3} = 27$ 81
3	$\left(\sqrt[7]{a}\right)^3 = 21$ $441\sqrt[3]{21}$	$\left(\sqrt{b}\right)^5 = 12$ $\sqrt[5]{144}$
4	$a^{\frac{1}{5}} = 50$ 312,500,000	$b^{\frac{1}{4}} = 14$ 38416
5	$a^{\frac{3}{4}} = 27$ 81	★ $b^{\frac{9}{5}} = 26$ 6.11
6	$\left(a^{\frac{1}{2}}\right)^5 = 12$ $\sqrt[5]{144}$	$\left(b^{\frac{1}{7}}\right)^3 = 21$ $441\sqrt[3]{21}$

Compare the answers you got when you practiced Skills 1-3 with the answers you got when you practiced Skills 4-6. Work with your partner to explain your findings.

Yesterday's problems only had one step. However, today there are multiple steps, meaning that one cannot just simplify the radical or rational exponent until it is ***isolated*** on one side of the equation.

- You can isolate the radical using **Inverse**.

- There are also some problems below in which the rational exponent or radical is applied to the entire side of the equation. Only in these situations will you undo the rational exponents or radicals first. Before solving the entire problem, make sure you know what the first step will be

Steps To Solving Equations With Rational Exponents AND Radicals

"Radical" …. We'll do one of these in a minute!

"Rational Exponent"

①Isolate the Term with the Rational Exponent (Get that term Alone)
②Do the Inverse Operation (Raise both sides to the reciprocal power)
③Solve for the variable
④Check the solution
-Extraneous solution? Or Actual Solution? Or No Solution?

Solving with Rational Exponents and Radicals Lesson

① Isolate the Term with the Rational Exponent (Get that term Alone)
② Do the Inverse Operation (Raise both sides to the reciprocal power)
③ Solve for the variable
④ Check the solution
-Extraneous solution? Or Actual Solution? Or No Solution?

We'll try a couple together!

1. $x^{\frac{1}{4}} - 2 = 3$

2. $4x^{7} - 6 = -2$

x = 625

x = 1

You Try! Finish these on Notes pg. 11

★ = leave as a decimal

5. $3\left(x^{\frac{2}{3}}+5\right)=207$

x = 512

★ 6. $1450=800\left(1+\frac{x}{12}\right)^{7.8}$

x = .95

★ 7. $14.2=222.1\bullet x^{3.5}$

x = .46

8. $3x^{\frac{3}{4}}+5=53$

$32\sqrt[3]{2}$

9. $x^{\frac{1}{2}}-5=0$

x = 25

10. $(2x+7)^{\frac{1}{2}}=3$

x = 1

Steps To Solving Equations With Rational Exponents AND Radicals

"Radical"

①Isolate the Term with the Radical (Get that term Alone)
②Do the Inverse Operation (Raise both sides to the Index)
③Solve for the variable
④Check the solution
-Extraneous solution? Or Actual Solution? Or No Solution?

Solving with Rational Exponents and Radicals Lesson

① Isolate the Term with the Radical (Get that term Alone)
② Do the Inverse Operation (Raise both sides to the Index)
③ Solve for the variable
④ Check the solution
-Extraneous solution? Or Actual Solution? Or No Solution?

We'll try a couple together! **We'll do the bottom two!**

3. $\sqrt{2x-5}=9$

4. $\sqrt[4]{3x+1}-5=0$

x = 43

x = 208

One more example…A tougher one!

Solve

$$x = \sqrt{110 - x}$$

x = 10

You Try! Finish Notes pg. 11

★ = leave as a decimal

★ 11. $\sqrt[3]{x-2} = 4$

x = 66

12. $\sqrt{x+2} - 2 = 12$

x = 194

Whiteboard Practice! ☺

Send a partner to pick up the following
– each person needs 1 of these:
whiteboard
marker
eraser

1. Solve for x.

$$\sqrt[3]{x-2} = 4$$

$$x = 66$$

2. Solve for a.

$$\sqrt{a+2}-2=12$$

$$x=194$$

3. Solve for x.

$$\sqrt{x+1}-3=2$$

$$x=24$$

4. Solve for x.

$$(x-5)^{1/3} = 5$$

$$x = 130$$

5. Solve for x.

$$\sqrt{x-7} = -9$$

No solution! Always check your answers!

6. Solve for x.

$$\sqrt[3]{6-3x}=2$$

$$x=\frac{-2}{3}$$

7. Solve for x.

$$\sqrt{10-3x}=\sqrt{x+2}$$

$$x=2$$

8. Solve for y.

$$\sqrt[3]{12+y} = -3$$

$$x = -39$$

9. Solve for b.

$$\sqrt{5-4b}-2=0$$

$$x=\frac{1}{4}$$

Homework:

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