Good Afternoon!
Please put up your phones, take your seats, and have out your tsunami city homework.

Radical Functions & Equations

A2.AREI.2* **Solve** ~~simple rational and~~ **radical equations** in one variable and understand how extraneous solutions may arise.

What is a radical equation?

Examples of Radical Equations	Non-Examples of Radical Equations
$\sqrt{x}+5=11$	$\sqrt{5}+x^2=11$
$\sqrt[3]{x-4}=7$	$x-4=\sqrt[4]{16}$
$4\sqrt{x-7}+12=28$	$x\sqrt{10}-7+12=28$
$\sqrt[5]{x}=225$	$x^4=\sqrt[3]{27}$

Definitions

Radical Equation: an equation where the variable is found underneath a square root, cube root, or higher root

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

Radicand: the number or expression under a radical symbol

Radicals

$$\left(\sqrt{x}\right)^2 = (6)^2$$

$$x = 36$$

$$\sqrt{36} = 6 \checkmark$$

$$\left(\sqrt{x}\right)^2 = (-6)^2$$

$$x = 36$$

$$\sqrt{36} = 6 \ \times$$

Example 1

$$\sqrt{x} + 5 = 11$$

$$-5 \quad -5$$

$$(\sqrt{x})^2 = (6)^2$$

$$x = 36$$

$$\sqrt{36} + 5 = 11 \checkmark$$

$$6 + 5 = 11$$

$$11 = 11 \checkmark$$

You Try

$$\sqrt{x} - 4 = 7$$

You Try

$$\sqrt{x} - 4 = 7$$
$$\underline{\phantom{(\sqrt{x})} +4 \qquad +4}$$
$$(\sqrt{x})^2 = (11)^2$$
$$x = 121$$

$$\sqrt{121} - 4 = 7 \checkmark$$
$$11 - 4 = 7$$
$$7 = 7 \checkmark$$

Example 2: What's the difference?

$$\left(\sqrt{x-4}\right)^2 = (7)^2$$

$$x - 4 = 49$$
$$\underline{+4 \qquad +4}$$
$$x = 53$$

$$\sqrt{53-4} = 7 \checkmark$$

$$\sqrt{49} = 7$$
$$7 = 7 \checkmark$$

You Try

$$\sqrt{x+6} = 15$$

You Try

$$\left(\sqrt{x+6}\right)^2 = (15)^2$$

$$x + 6 = 225$$
$$\underline{\quad -6 \quad\quad -6 \quad}$$
$$x = 219$$

$$\sqrt{219+6} = 15 \checkmark$$
$$\sqrt{225} = 15$$
$$15 = 15$$

Example 3

$$4\sqrt{x-7} + 12 = 28$$
$$\phantom{4\sqrt{x-7}} \quad -12 \quad -12$$

$$\frac{4\sqrt{x-7}}{4} = \frac{16}{4}$$

$$\left(\sqrt{x-7}\right)^2 = (4)^2$$

$$x - 7 = 16$$
$$+7 \quad +7$$
$$x = 23$$

4) $\sqrt{23-7} + 12 = 28$ ✓

$$4\sqrt{16} + 12 = 28$$
$$4(4) + 12 = 28$$
$$16 + 12 = 28$$
$$28 = 28 \checkmark$$

You Try

$$5\sqrt{x + 3} - 10 = 15$$

You Try

$$5\sqrt{x+3} - 10 = 15$$

$$+10 \qquad +10$$

$$\frac{5\sqrt{x+3}}{5} = \frac{25}{5}$$

$$\left(\sqrt{x+3}\right)^2 = \left(5\right)^2$$

$$x+3 = 25$$
$$-3 \quad -3$$
$$x = 22$$

$$5\sqrt{22+3} - 10 = 15 \checkmark$$
$$5\sqrt{25} - 10 = 15$$
$$5(5) - 10 = 15$$
$$25 - 10 = 15$$
$$15 = 15 \checkmark$$

Proof 1 with Partner

Steps	Reasons
$\sqrt{2x-1}+5=8$	Given Equation

What if our equation was…?

$$\sqrt{x} = -5 \qquad \sqrt{x+5} = -8$$

$$\sqrt{x+7} + 30 = 10$$
$$\underline{\phantom{\sqrt{x+7}} -30 \quad -30}$$
$$\sqrt{x+7} = -20$$

Example 4

$$\left(\sqrt{x-3}\right)^2 = \left(\sqrt{2x+4}\right)^2$$

$$x - 3 = 2x + 4$$
$$\underline{-2x \qquad -2x}$$
$$-x - 3 = 4$$
$$\underline{+3 \quad +3}$$
$$\underline{-x = 7}$$
$$x = -7$$

$$i = \sqrt{-1}$$

$$\sqrt{-7-3} = \sqrt{2(-7)+4}$$
$$\sqrt{-10} = \sqrt{-14+4}$$
$$\sqrt{-10} = \sqrt{-10}$$

Example 5

$$\left(\sqrt{x-12}\right)^2 = \left(2 - \sqrt{x}\right)^2$$

$$x - 12 = 4 \boxed{-2\sqrt{x} - 2\sqrt{x}} + x$$

$$x - 12 = 4 - 4\sqrt{x} + x$$

$$-12 = 4 - 4\sqrt{x}$$
$$\underline{-4 \quad -4}$$
$$-16 = -4\sqrt{x}$$
$$\frac{-16}{-4} = \frac{-4\sqrt{x}}{-4}$$
$$(4)^2 = \left(\sqrt{x}\right)^2$$

$$\left(2 - \sqrt{x}\right)^2 = \left(2 - \sqrt{x}\right)\left(2 - \sqrt{x}\right)$$

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

$$x = 16$$

$$\sqrt{16} - 12 = 2 - \sqrt{16}$$
$$2 = -2 \quad \times$$

You Try

$$\sqrt{x-8} = 4 - \sqrt{x}$$

You Try

$$(\sqrt{x-8})^2 = (4 - \sqrt{x})^2$$

$$(4-\sqrt{x})^2 = (4-\sqrt{x})(4-\sqrt{x})$$

	4	$-\sqrt{x}$
4	16	$-4\sqrt{x}$
$-\sqrt{x}$	$-4\sqrt{x}$	x

$$x - 8 = 16 \;\boxed{-4\sqrt{x} - 4\sqrt{x}} + x$$
$$-x \qquad\qquad\qquad\qquad -x$$

$$-8 = 16 - 8\sqrt{x}$$
$$-16 \quad -16$$

$$-24 = -8\sqrt{x}$$
$$\frac{}{-8} \qquad \frac{}{-8}$$

$$(3)^2 = (\sqrt{x})^2$$

$$9 = x$$

$$\sqrt{9-8} = 4 - \sqrt{9}$$

$$\sqrt{1} = 4 - 3$$

$$1 = 1 \checkmark$$

Cube root!

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

$$x = 27$$