Math 2 – Honors
Unit 4 – Radical & Rational Functions
Lesson 3 → Square Root & Cube Root Equations

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There are four steps to solving a radical equation:
1) Isolate the radical.
2) Raise both sides to the power of the root.
3) Solve for x.
4) Check for extraneous solution(s).

What is an **EXTRANEOUS** solution? A solution to the final equation but not to the original equation. Extraneous solutions can occur when solving a **square root equation** but not when solving linear or quadratic equations.

➢ Examples:

1. $(\sqrt{x})^2 = (8)^2$

$x = 64$ ✓

2. $(\sqrt{x+7})^2 = (8)^2$

$x + 7 = 64$
$-7 \quad -7$

$x = 57$ ✓

3. $\dfrac{2\sqrt{x+6}}{2} = \dfrac{14}{2}$

$(\sqrt{x+6})^2 = (7)^2$

$x + 6 = 49$

$x = 43$ ✓

4. $-4\sqrt{x} + 11 = 3$

$-4\sqrt{x} + 11 = 3$
$-11 \quad -11$

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

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

$x = 4$ ✓

5. $(x-2)^{1/2} - 2 = 2$
$+2 \quad +2$

$(x-2)^{1/2} = 4$

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

$x - 2 = 16$
$+2 \quad +2$

$x = 18$ ✓

6. $10 - 3\sqrt[3]{2x+5} = -11$
$-10 \quad -10$

$\dfrac{-3\sqrt[3]{2x+5}}{-3} = \dfrac{-21}{-3}$

$(\sqrt[3]{2x+5})^3 = (7)^3$

$2x + 5 = 343$
$-5 \quad -5$

$\dfrac{2x}{2} = \dfrac{338}{2}$ $x = 169$ ✓

7. $(\sqrt{10x^2 - 49})^2 = (3x)^2$ $(3x)(3x)$

$10x^2 - 49 = 9x^2$
$-9x^2 \quad -9x^2$

$x^2 - 49 = 0$ $x^2 = 49$ $x = \pm 7$

$(x-7)(x+7) = 0$

$x = 7$ ✓ $\cancel{x = -7}$

8. $(\sqrt{2x-6})^2 = (\sqrt{5x-15})^2$

$2x - 6 = 5x - 15$
$-2x \quad -2x$

$-6 = 3x - 15$
$+15 \quad +15$

$\dfrac{9}{3} = \dfrac{3x}{3}$

$x = 3$ ✓

9. $((6x-5)^{1/3})^3 = ((3x+2)^{1/3})^3$

$\boxed{6x - 5 = 3x + 2}$
$-3x + 5 \quad -3x + 5$

$3x = 7$ $7/3$

$x = \frac{7}{3}$ ✓

9

$x^2+1x+1x+1$

$(x+1)(x+1)$

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

$3x+7=x^2+2x+1$ $1x+1x+1$

✓

$3x+7=x^2+2x+1$
$-3x-7$ $-3x-7$

$0=x^2-x-6$ $0=(x-3)(x+2)$
$x=3$ $\cancel{x=-2}$

11. $((15-7x)^{1/2})^2=(x-1)^2$

$15-7x=x^2-2x+1$
$-15+7x$ $+7x-15$
$0=x^2+5x-14$
$0=(x+7)(x-2)$
$\cancel{x=-7}$ $x=2$
✓

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

$\frac{49}{16}$

13. $\sqrt{x}+3=\sqrt{x+4}$

$\emptyset$

14. $\sqrt{x+8}=\sqrt{x}+\sqrt{3}$

$\frac{25}{12}$

15. $\sqrt{x+3}=\sqrt{x+1}+1$

10

12. $(\sqrt{x+2})^2 = (4-\sqrt{x})^2$ * write twice and foil

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

$x+2 = 16 - 4\sqrt{x} - 4\sqrt{x} + x$

$x+2 = 16 - 8\sqrt{x} + x$

$-x \qquad -x$

$2 = 16 - 8\sqrt{x}$

$-16 \quad -16$

$\frac{-14}{-8} = \frac{-8\sqrt{x}}{-8}$

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

$\frac{49}{16} = x$ ✓

13. $(\sqrt{x}+3)^2 = (\sqrt{x+4})^2$

$(\sqrt{x}+3)(\sqrt{x}+3) = x+4$

$x + 3\sqrt{x} + 3\sqrt{x} + 9$

$x + 6\sqrt{x} + 9 = x + 4$

$-x \qquad -x$

$6\sqrt{x} + 9 = 4$

$-9 \quad -9$

$\frac{6\sqrt{x}}{6} = \frac{-5}{6}$

$(\sqrt{x})^2 = \left(\frac{-5}{6}\right)^2$

$x = \frac{25}{36}$

$\emptyset$

14. $(\sqrt{x+8})^2 = (\sqrt{x}+\sqrt{3})^2$

$x+8 = (\sqrt{x}+\sqrt{3})(\sqrt{x}+\sqrt{3})$

$x+8 = x + \sqrt{3x} + \sqrt{3x} + 3$

$x+8 = x + 2\sqrt{3x} + 3$

$-x \quad -x$

$8 = 2\sqrt{3x} + 3$

$-3 \qquad -3$

$\frac{5}{2} = \frac{2\sqrt{3x}}{2}$

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

$\frac{25}{4} = 3x$

$\frac{25}{12}$ ✓

$3+3+3$

$3 \cdot 3$

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

$x + x + x$

$3x$

15. $\left(\sqrt{x+3}\right)^2 = \left(\sqrt{x+1}+1\right)^2$

$x+3 = (\sqrt{x+1}+1)(\sqrt{x+1}+1)$

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

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

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

$-x \quad -x$

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

$-2 \quad -2$

$\frac{1}{2} = \frac{2\sqrt{x+1}}{2}$

$\left(\frac{1}{2}\right)^2 = \left(\sqrt{x+1}\right)^2$

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

$-1 \quad -1$

$-3/4$ or $-.75 = x$

Direct, joint, inverse, compound

Determine the type of variation and then write an equation for each statement. Then solve.

13. The number (B) of bolts a machine can make *varies directly* as the time (T) it operates. If the machine can make 6578 *bolts* in 2 *hours*, how many bolts can it make in 5 *hours*? Direct

$B = Kh$ $\frac{6578}{2} = \frac{2K}{2}$ $K = 3289$ $b = 5(3289)$ 16,445

14. The number of cooks needed to prepare lunch *varies inversely* with the time. If it takes 9 *cooks four hours* to prepare a school lunch, how long would it take 8 *cooks* to prepare the lunch?

$K = 36$ 4.5

15. The current (I) in an electrical conductor *varies inversely* as the resistance (r) of the conductor. If the current is 2 *amperes* when the resistance in 960 *ohms*, what is the current when the resistance is 480 *ohms*?

$K = 1920$ 4

16. Cheers *varied jointly* as the number of fans and the **square** of the jubilation factor. If there were 100 *cheers* when the number of fans was 100 and the jubilation factor was 4, how many cheers were there when there were only 10 *fans* whose jubilation factor was 20?

$C = Kfj^2$

$C = (.0625)(10)(20)^2$ $K = .0625$

17. The volume of a cone *varied jointly* as the height of the cone and the area of the base. If a cone has a volume of 140 cm^3 when the height is 15 cm and the area of the base is 28 cm^2, find the volume of a cone with a height of 7 cm and a base area of 12 cm^2.

$K = 1/3$ 28

18. The number of girls *varies directly* as the number of boys and *inversely* as the number of teachers. When there were 50 *girls*, there were 10 *boys* and 20 *teachers*. How many boys were there when there were 10 *girls* and 100 *teachers*?

$K = 100$ 10

19. A pitcher's earned run average (ERA) *varies directly* as the number of earned runs allowed and *inversely* as the number of innings pitched. Joe Price had an ERA of 2.55 when he gave up 85 *earned runs in* 300 *innings*. What would be his ERA if he gave up 120 *earned runs in* 600 *innings*?

$K = 9$ 1.8

20. The maximum load that a cylindrical column with a circular cross section can hold *varies directly* as the fourth power of the diameter and *inversely* as the square of the height. A 9 *meter column* with a 2 *meter diameter* will support 64 *metric tons*. How many metric tons can be supported by a column 9 *meters high* and 3 *meters* in *diameter*? $K = 324$

$w = \frac{Kd^4}{h^2}$ $64 = \frac{K(2)^4}{9^2}$ $64 = \frac{16K}{81}$ $\frac{5184}{16} = \frac{16K}{16}$ 324