

# Day 07 Solving Radical Equations

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## A. Solving an Equation with One Radical:

1. Isolate the radical.
2. Raise both sides to the power of the index.
3. Simplify and solve for the variable.
4. Check for extraneous solutions.

Practice problems:

1.  $(\sqrt{x})^2 = (\frac{1}{9})^2$

$x = \frac{1}{81}$

$\checkmark: \sqrt{\frac{1}{81}} = \frac{1}{9}$

2.  $\sqrt[4]{2x-13} = -9$   
 $(\sqrt[4]{2x-13})^4 = (-9)^4$

$2x = 256$   
 $x = 128$

$\checkmark: \sqrt[4]{256-13} = -9$   
 $4-13 = -9$

3.  $\sqrt{x-5} - 7 = 0$   
 $(\sqrt{x-5})^2 = (7)^2$

$x-5 = 49$   
 $x = 54$

$\checkmark: \sqrt{54-5} - 7 = 0$   
 $\sqrt{49} - 7 = 0$   
 $7-7 = 0$

4.  $(\sqrt[3]{x+40})^3 = (-5)^3$

$x+40 = -125$   
 $x = -165$

$\checkmark: \sqrt[3]{-165+40} = -5$   
 $\sqrt[3]{-125} = -5$

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

$x^2 - 8x + 16 = 2x$   
 $x^2 - 10x + 16 = 0$   
 $(x-8)(x-2) = 0$

$x = 8, 2$   
 $\uparrow$   
extr. sol.

$\checkmark: 8-4 = \sqrt{16}$   
 $4 = \sqrt{16}$

FA  
 $x = 8$

6.  $(\sqrt{3x+13})^2 = (x+5)^2$

$3x+13 = x^2+10x+25$   
 $0 = x^2+7x+12$

$0 = (x+4)(x+3)$

$x = -4, -3$

$\checkmark: \sqrt{-4+13} = -4+5$   
 $\sqrt{9} = 1$   
 $\checkmark: \sqrt{-3+13} = -3+5$   
 $\sqrt{10} = 2$

7.  $2\sqrt[3]{1-3x} + 4 = 6$

$2\sqrt[3]{1-3x} = 2$   
 $(\sqrt[3]{1-3x})^3 = (1)^3$

$1-3x = 1$   
 $-3x = 0 \Rightarrow x = 0$

$\checkmark: 2\sqrt[3]{1+4} = 6$   
 $2 \cdot 1 + 4 = 6$   
 $2+4 = 6$

## B. Solving an Equation with Rational Exponents:

1. Isolate the variable or expression that is raised to the power.
2. Raise both sides of the equation to the reciprocal power of the rational exponent.
3. Simplify.
4. Check for extraneous solutions.

8.  $x^{\frac{1}{3}} - \frac{2}{5} = 0$

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

$x = \frac{8}{125}$

$\checkmark: (\frac{8}{125})^{\frac{1}{3}} - \frac{2}{5} = 0$   
 $\frac{2}{5} - \frac{2}{5} = 0$

9.  $3(x+1)^{\frac{4}{3}} = 48$   
 $(x+1)^{\frac{4}{3}} = (16)^{\frac{3}{4}}$

$x+1 = \pm 8$

$x = -1+8 = 7$   
 $-1-8 = -9$

$\checkmark: 3(8)^{\frac{4}{3}} = 48$   
 $3(2^4) = 48$   
 $3(-8)^{\frac{4}{3}} = 48$   
 $3(-2)^4 = 48$

10.  $-(3x+4)^{\frac{1}{2}} + 3 = 0$

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

$3x+4 = 9$   
 $3x = 5$

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

$\checkmark: -(3 \cdot \frac{5}{3} + 4)^{\frac{1}{2}} + 3 = 0$   
 $-(5+4)^{\frac{1}{2}} + 3 = 0$   
 $-\sqrt{9} + 3 = 0$   
 $-3 + 3 = 0$

**C. Solving an Equation with Two Radicals:**

1. Isolate one of radical on each side of the equation.
2. Raise both sides to the power of the index.
3. Simplify and solve for the variable.
4. Check for extraneous solutions.

11.  $(\sqrt{x-4})^2 = (\sqrt{2x-3})^2$

$x-4 = 2x-3$

$-4 = x-3$

$-1 = x$

$\checkmark: \sqrt{-5} = \sqrt{-5}$

$\emptyset$ :  
extr. sol.  
b/c it's not real

12.  $(\sqrt[4]{6x-5})^4 = (\sqrt[4]{x+10})^4$

$6x-5 = x+10$

$5x-5 = 10$

$5x = 15$

$x = 3$

$\checkmark: \sqrt[4]{10-5} = \sqrt[4]{13}$   
 $\sqrt[4]{13} = \sqrt[4]{13}$

13.  $(\sqrt[3]{10-3x})^3 = (\sqrt[3]{2-x})^3$

$8(10-3x) = 2-x$

$80-24x = 2-x$

$80 = 2 + 23x$

$78 = 23x \Rightarrow x = \frac{78}{23} \approx 3.39$

$\checkmark$ : Used the STO button to  $\checkmark$

\*14.  $\sqrt{x+9} - \sqrt{x} = \sqrt{3}$

$(\sqrt{x+9})^2 = (\sqrt{x} + \sqrt{3})^2$

$\checkmark: \sqrt{12} - \sqrt{3} = \sqrt{3}$   
 $2\sqrt{3} - \sqrt{3} = \sqrt{3}$

$x+9 = x + 2\sqrt{3x} + 3$

$9 = 2\sqrt{3x} + 3 \Rightarrow 9 = 3x$

$6 = 2\sqrt{3x}$   
 $(3)^2 = (\sqrt{3x})^2$

$3 = x$

\*15.  $(\sqrt{x+2}-7)^2 = (\sqrt{x+9})^2$

$x+2 - 14\sqrt{x+2} + 49 = x+9$

$-14\sqrt{x+2} + 51 = 9$

$-14\sqrt{x+2} = -42$

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

$x+2 = 9$

$x = 7$  (extr. sol.)

FA:  $\emptyset$

$\checkmark: \sqrt{9} - 7 = \sqrt{16}$   
 $3 - 7 = 4$   
 $-4 \neq 4$

$\checkmark: \sqrt{6-5} + \sqrt{9} = 4$   
 $\sqrt{1} + \sqrt{9} = 4$   
 $1 + 3 = 4$

16.  $\sqrt{2x-5} + \sqrt{2x+3} = 4$

$(\sqrt{2x-5})^2 = (-\sqrt{2x+3} + 4)^2$

$2x-5 = 2x+3 - 8\sqrt{2x+3} + 16$

$-5 = -8\sqrt{2x+3} + 19$

$-24 = -8\sqrt{2x+3}$

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

$9 = 2x+3$   
 $6 = 2x$   
 $3 = x$

17.  $\sqrt{x-8} + \sqrt{x+3} = 1$

$(\sqrt{x-8})^2 = (1 - \sqrt{x+3})^2$

$\checkmark: \sqrt{33-8} + \sqrt{33+3} = 1$   
 $\sqrt{25} + \sqrt{36} = 1$   
 $5 + 6 \neq 1$

$x-8 = 1 - 2\sqrt{x+3} + x+3$

$-8 = -2\sqrt{x+3} + 4$

$-12 = -2\sqrt{x+3}$

$(6)^2 = (\sqrt{x+3})^2$

$36 = x+3$   
 $33 = x$  extr

FA:  $\emptyset$

**D. Solving an Equation with a Variable Exponent:**

1. Get like bases (use your power card)
2. Simplify one side of the equation.
3. Raise both sides to the inverse power.
4. Solve and check for extraneous solutions.

18.  $2^{3x} \left(\frac{1}{4}\right)^{2x} = 8$

$2^{3x} \cdot (2^{-2})^{2x} = 8$

$2^{3x} \cdot 2^{-4x} = 8$

$2^{3x-4x} = 8$

$2^{-x} = 8$   
 $\frac{1}{2^x} = 8$   
 $x = -3$

19.  $\frac{64^{-x}}{16^{2x}} = 32^{x-1}$

$2^{-6x} / 2^{8x} = 2^{5(x-1)}$

$2^{-14x} = 2^{5(x-1)}$

$-14x = 5(x-1)$   
 $-14x = 5x - 5$   
 $-19x = -5$   
 $x = \frac{5}{19}$

20.  $9^{2x} \left(\frac{1}{27}\right)^{-3x} = 81^{x+2}$

$3^{2(2x)} (3^{-3})^{-3x} = 3^{4(x+2)}$

$3^{4x} \cdot 3^{9x} = 3^{4x+8}$

$3^{13x} = 3^{4x+8}$

$13x = 4x+8$

$9x = 8$   
 $x = \frac{8}{9}$

Used the STO button to  $\checkmark$  these