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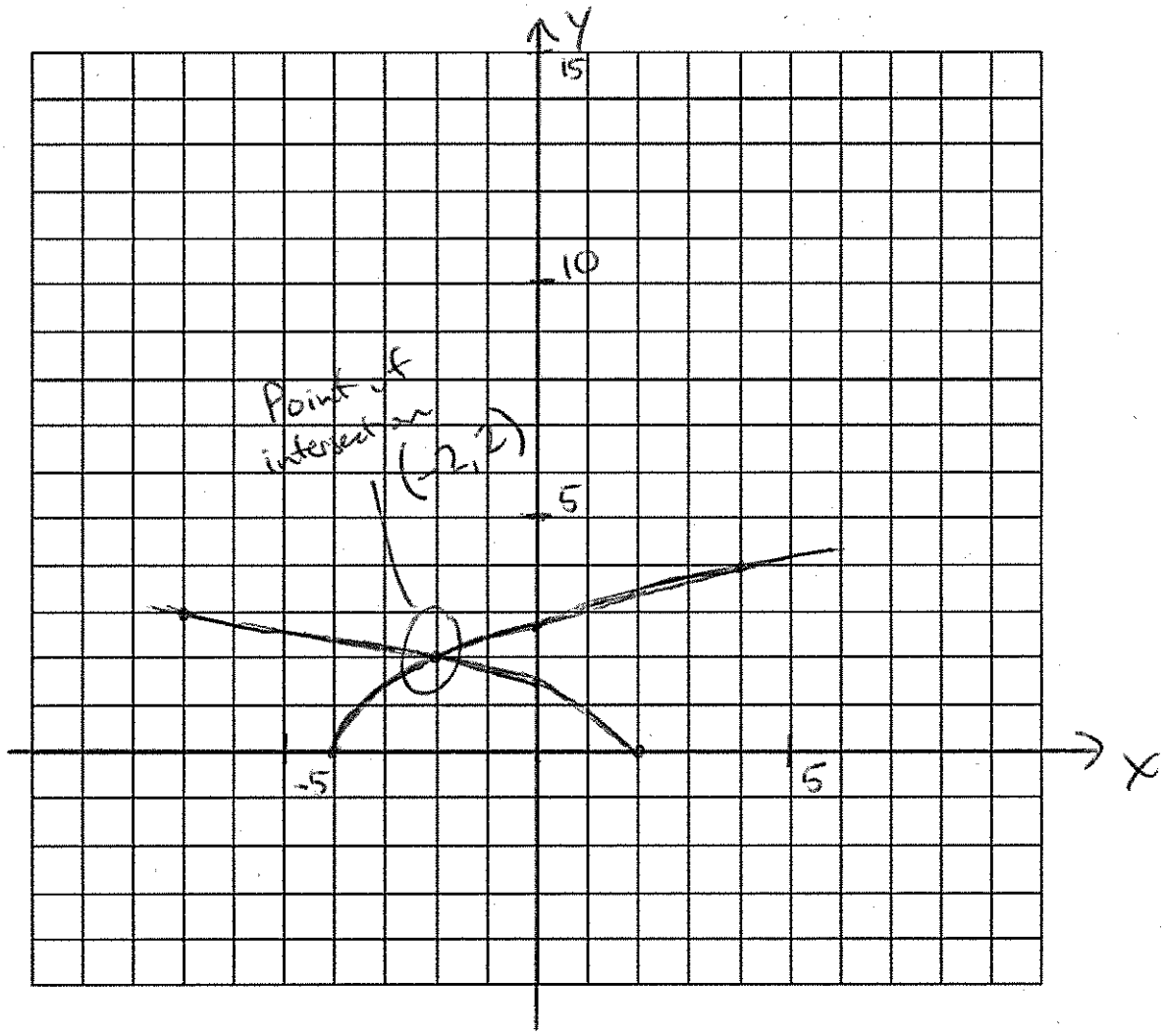
Factoring: Lesson #7

Solving Radical Equations Using Factoring Part One

1. Complete the following table of values for $y = \sqrt{2-x}$ and $y = \sqrt{2x+8}$ and sketch the radical expressions on the grid below. Circle the point of intersection of the two radical expressions on the graph and label its coordinates.

x	$y = \sqrt{2-x}$
-7	3
-2	2
0	$\sqrt{2} \cong 1.4$
2	0

x	$y = \sqrt{2x+8}$
-4	0
-2	2
0	$2\sqrt{2} \cong 2.8$
4	4



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2. Algebraically, determine any restrictions on values of the variable in these radical equations.

a. $\sqrt{4x-16}=13$

$4x-16\geq 0$

$4x\geq 16$

$x\geq 4, x\in\mathbb{R}$

b. $\sqrt{3x-1}+8=0$

$3x-1\geq 0$

$3x\geq 1$

$x\geq \frac{1}{3}, x\in\mathbb{R}$

c. $\sqrt{4x-2}+\sqrt{2-x}=10$

$4x-2\geq 0$ $\quad 2-x\geq 0$

$4x\geq 2$ $\quad 2\geq x$

$x\geq \frac{1}{2}$ $\quad x\leq 2$

$\frac{1}{2}\leq x\leq 2, x\in\mathbb{R}$

d. $\sqrt{3x-1}-\sqrt{4-2x}=3$

$3x-1\geq 0$ $\quad 4-2x\geq 0$

$3x\geq 1$ $\quad 4\geq 2x$

$x\geq \frac{1}{3}$ $\quad 2\geq x$

$\frac{1}{3}\leq x\leq 2, x\in\mathbb{R}$

e. $\sqrt{8x+6}=\sqrt{2x-3}$

$8x+6\geq 0$ $\quad 2x-3\geq 0$

$8x\geq -6$ $\quad 2x\geq 3$

$x\geq -\frac{3}{4}$ $\quad x\geq \frac{3}{2}$

$x\geq \frac{3}{2}, x\in\mathbb{R}$

f. $\sqrt{x-1}=\sqrt{x-4}$

$x-1\geq 0$ $\quad x-4\geq 0$

$x\geq 1$ $\quad x\geq 4$

$x\geq 4, x\in\mathbb{R}$

3. Solve the following radical equations algebraically. Verify the solution.

a. $\sqrt{x-2}=5$

$x-2=25$

$x=27$

LS $= \sqrt{27-2} = \sqrt{25} = 5$ $\quad$ RS $= 5$ ✓

b. $\sqrt{3x+1}=5$

$3x+1=25$

$3x=24$

$x=8$

LS $= \sqrt{3(8)+1} = \sqrt{25} = 5$ $\quad$ RS $= 5$ ✓

c. $\sqrt{5x-9}-2=7$

$5x-9=81$

$5x=90$

$x=18$

LS $= \sqrt{5(18)-9}-2 = \sqrt{81}-2 = 7$ $\quad$ RS $= 7$ ✓

d. $2\sqrt{1-3x}+1=9$

$1-3x=16$

$-3x=15$

$x=-5$

LS $= 2\sqrt{1-3(-5)}+1 = 2\sqrt{16}+1 = 9$ $\quad$ RS $= 9$ ✓

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4. Solve the following radical equations algebraically. Verify the solution.

a. $\sqrt{x+2}=\sqrt{3-x}$ square both sides

$x+2=3-x$

$2x=1$

$x=1/2$

LS $=\sqrt{1/2+2}$ $=\sqrt{5/2}$

RS $=\sqrt{3-1/2}$ $=\sqrt{5/2}$ ✓

b. $\sqrt{2x-1}-\sqrt{3x-8}=0$

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

$2x-1=3x-8$

$7=x$

LS $=\sqrt{2(7)-1}-\sqrt{3(7)-8}$ $=\sqrt{13}-\sqrt{13}$ $=0$

RS $=0$ ✓

c. $\sqrt{4-x}-\sqrt{-4-2x}=0$

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

$4-x=-4-2x$

$x=-8$

LS $=\sqrt{4-(-8)}-\sqrt{-4-2(-8)}$ $=\sqrt{12}-\sqrt{12}$ $=0$

RS $=0$ ✓

d. $\sqrt{2+x}=\sqrt{4-\frac{x}{4}}$ square both sides

$2+x=4-\frac{x}{4}$

$\frac{5}{4}x=2$

$x=8/5$

LS $=\sqrt{2+8/5}$ $=3\sqrt{2/5}$

RS $=\sqrt{4-(8/5)/4}$ $=3\sqrt{2/5}$ ✓

5. Solve the following radical equations algebraically. Verify the solution.

a. $\sqrt{x-2}+x=8$

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

$x-2=x^2-16x+64$

$x^2-17x+66=0$

$(x-11)(x-6)=0$

$\boxed{x=6}$, ~~11~~

LS $x=6$: $=\sqrt{6-2}+6$ $=2+6$ $=8$ ✓

LS $x=11$: $=\sqrt{11-2}+11$ $=3+11$ $=14$ ✗

RS $=8$

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

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

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

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

$16=64x$

$\boxed{x=1/4}$

LS $=\sqrt{4(1/4)+8}-2\sqrt{1/4}$ $=3-1$ $=2$

RS $=2$ ✓

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c. $\sqrt{6x+19} - x = 2$

$(\sqrt{6x+19})^2 = (x+2)^2$

$6x + 19 = x^2 + 4x + 4$

$x^2 - 2x - 15 = 0$

$(x-5)(x+3) = 0$

$\boxed{x = 5}$, ~~-3~~

LS $x = 5$
$= \sqrt{6(5)+19} - 5$
$= 7 - 5$
$= 2$ ✓

LS $x = -3$
$= \sqrt{6(-3)+19} - (-3)$
$= 1 + 3$
$= 4$ ✗

RS $= 2$

d. $\sqrt{7x-54} + 6 = x$

$(\sqrt{7x-54})^2 = (x-6)^2$

$7x - 54 = x^2 - 12x + 36$

$x^2 - 19x + 90 = 0$

$(x-10)(x-9) = 0$

$\boxed{x = 10, 9}$

LS $x = 10$
$= \sqrt{7(10)-54} + 6$
$= 4 + 6$
$= 10$
RS $= 10$ ✓

LS $x = 9$
$= \sqrt{7(9)-54} + 6$
$= 3 + 6$
$= 9$
RS $= 9$ ✓

e. $\sqrt{2x-7} = \sqrt{x} - 1$ Square both sides

$2x - 7 = x - 2\sqrt{x} + 1$

$2\sqrt{x} = -x + 8$ Square again

$4x = x^2 - 16x + 64$

$x^2 - 20x + 64 = 0$

$(x-16)(x-4) = 0$

$\boxed{x = 4}$, 16

LS $x = 4$
$= \sqrt{2(4)-7}$
$= \sqrt{1}$
$= 1$
RS $x = 4$
$= \sqrt{4} - 1 = 1$ ✓

LS $x = 16$
$= \sqrt{2(16)-7}$
$= \sqrt{25}$
$= 5$
RS $x = 16$
$= \sqrt{16} - 1 = 3$ ✗

f. $\sqrt{2-x} = x$

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

$2 - x = x^2$

$x^2 + x - 2 = 0$

$(x+2)(x-1) = 0$

$\boxed{x = 1}$, -2

LS $x = 1$
$= \sqrt{2-1}$
$= \sqrt{1}$
$= 1$
RS $x = 1$
$= 1$ ✓

LS $x = -2$
$= \sqrt{2-(-2)}$
$= \sqrt{4}$
$= 2$
RS
$= -2$ ✗