Let's solve some quadratics. As you solve a variety of problems, think about the different strategies as the structure of the problem changes. We will summarize these strategies in notes after we've had some practice.

$(n-10)(n-1)=0$

$n-10=0 \quad n-1=0$

$n=10 \quad n=1$

$n^2-11n+10=0$

$4x^2-9x^2=243$

$2x^2-10=-x^2-1$

Warm Up:
Find the solution

① $f(x)=2x^2-50$

$0=2x^2-50$

$50=2x^2$

$\sqrt{25}=\sqrt{x^2}$

$x=\pm 5$

② $f(x)=4x^2+100$

$0=4x^2+100$

$-100=4x^2$

$x^2=-25$

$x=\pm 5i$

Solving Quadratic Equations by Factoring

Solving Quadratic Equations by Factoring

1. Put the equation in standard form. $ax^2+bx+c=0$
2. FACTOR!
3. Set each factor equal to **zero** and SOLVE.
4. Check your answers!!! (Plug back in.)

Solve each equation.

1. $x^2-x-56=0$

$(x-8)(x+7)=0$

$x-8=0 \rightarrow x=8$

$x+7=0 \rightarrow x=-7$

2. $8x+x^2+7=0$

$x^2+8x+7=0$

$(x+7)(x+1)=0$

$x+7=0 \rightarrow x=-7 \quad x+1=0 \rightarrow x=-1$

① Get the x^2 or quantity squared by itself.

② Square root

③ $\pm$

① $x^2+4=0$

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

$x=\pm 2i$

② $\frac{1}{2}x^2+3=12$

$\frac{1}{2}x^2=9$

$\sqrt{x^2}=\sqrt{18}$

$x=\pm\sqrt{18}$ 3 3 2

$x=\pm 3\sqrt{2}$

Show your work.

$3x^2-51x-180=0$

Finished problems

Ticket out the door. Leave this problem on your board.

Warm up: Multiply the following binomials

A) $(x+4)^2$

B) $(x-12)^2$

C) $(x-7)^2$

D) $\left(x+\frac{2}{3}\right)^2$

Solve by square root method.

Finished problems

Solving Quadratic Equations by Taking the Square Root

Solving Quadratic Equations by Completing the Square

1. Get the _____ or the _____ squared by itself
2. Take the _____ of BOTH sides of the equal sign
3. Don't forget the ____ sign
4. Simplify
5. Check your answers!!!

Solve each equation.

1. $(x+4)^2-3=15$
2. $\frac{1}{2}x^2+3=12$

Solving Quadratic Equations by Completing the Square

$ax^2+bx+c=0$

- "a" needs to be ____
- "b" needs to be _____

Find the value of c that makes the expression a perfect square trinomial.

1. 2. 3.

Write the perfect square trinomial as a binomial squared.

4. 5. 6.

Show your work.

$x^2+6x+4=0$

$x^2+6x+4=0$

$x^2+6x+9=-4+9$

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

$(x+3)^2=5$

$x+3=\pm\sqrt{5}$

$x=-3\pm\sqrt{5}$

Finished problems

$6x^2 - 21x = -15$

Factoring:
$6x^2-21x+15=0$
$2x^2-7x+5=0$
$(2x-5)(x-1)=0$
$2x-5=0$ $x-1=0$
$2x=5$ $x=1$
$x=5/2$

$2x^2-7x = -5$

$b=-7 \to -\frac{7}{2} \to \frac{49}{4} \to \frac{49}{8}$

$2x^2-7x+\frac{49}{8} = 9/8$

$2(x^2-\frac{7}{2}x+\frac{49}{16}) = 9/8$

$2(x-\frac{7}{4})^2 = 9/8$

$(x-\frac{7}{4})^2 = 9/16$

$x-\frac{7}{4} = \pm 3/4$

$x = \frac{7}{4} \pm \frac{3}{4}$

$\frac{7}{4}+\frac{3}{4}=\frac{10}{4}=\frac{5}{2}$

$\frac{7}{4}-\frac{3}{4}=\frac{4}{4}=1$

$ax^2+bx+c=0$

$ax^2+bx = -c$

$\left(\frac{b}{2}\right)^2 \div a \to \frac{b^2}{4a}$

$ax^2+bx+\frac{b^2}{4a} = -c+\frac{b^2}{4a}$

$-c+\frac{b^2}{4a} \to \frac{-4ac}{4a}+\frac{b^2}{4a} \to \frac{b^2-4ac}{4a}$

$a(x^2+\frac{b}{a}x+\frac{b^2}{4a^2}) = \frac{b^2-4ac}{4a}$

$(x+\frac{b}{2a})(x+\frac{b}{2a}) = \frac{b^2-4ac}{4a^2}$

$(x+\frac{b}{2a})^2 = \frac{b^2-4ac}{4a^2}$

$x+\frac{b}{2a} = \pm\frac{\sqrt{b^2-4ac}}{2a}$

$x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$

$ax^2+bx+c=0$

CTSquare:

Ex $2x^2+6x+1=0$

$2x^2+6x+\frac{9}{2} = -1+\frac{9}{2}$

$b=6 \to 3 \to 9 \to \frac{9}{2}$

$2(x^2+3x+\frac{9}{4}) = \frac{7}{2}$

$2(x+\frac{3}{2})(x+\frac{3}{2}) = \frac{7}{2}$

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

$(x+\frac{3}{2})^2 = \frac{7}{4}$

$x+\frac{3}{2} = \pm\frac{\sqrt{7}}{2}$

$x = -\frac{3}{2} \pm \frac{\sqrt{7}}{2} = \frac{-3\pm\sqrt{7}}{2}$

$\sqrt{\frac{7}{4}} = \frac{\sqrt{7}}{\sqrt{4}} = \frac{\sqrt{7}}{2}$

Quadratic Formula

$ax^2+bx+c=0$

$ax^2+bx+\frac{b^2}{4a} = -c+\frac{b^2}{4a}$

$b \to \frac{b}{2} \to \frac{b^2}{4} \to \frac{b^2}{4a}$

$ax^2+bx+\frac{b^2}{4a} = \frac{b^2-4ac}{4a}$

$a(x^2+\frac{b}{a}x+\frac{b^2}{4a^2}) = \frac{b^2-4ac}{4a}$

$a(x+\frac{b}{2a})(x+\frac{b}{2a}) = \frac{b^2-4ac}{4a}$

$a(x+\frac{b}{2a})^2 = \frac{b^2-4ac}{4a}$

$(x+\frac{b}{2a})^2 = \frac{b^2-4ac}{4a^2}$

$x+\frac{b}{2a} = \pm\frac{\sqrt{b^2-4ac}}{2a}$

$x = -\frac{b}{2a} \pm \frac{\sqrt{b^2-4ac}}{2a} = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$

Quad.F

Scratch

$\frac{-4ac}{4a}+\frac{b^2}{4a}$

$\frac{b^2-4ac}{4a}$

$6x^2-21x = -15$

$6x^2-21x+15=0$

$3(2x^2-7x+5)=0$

$2x^2-7x+5=0$

$(2x-5)(x-1)=0$

$2x-5=0$ | $x-1=0$

$2x=5$ | $x=1$

$x=5/2$

:)

$4x^2+28x = -49$

$4x^2+28x+49 = -49+49$

$b=28 \to 14 \to 196 \to 49$

$4x^2+28x+49=0$

$4(x^2+7x+\frac{49}{4})=0$

$4(x+\frac{7}{2})^2=0$

$(x+\frac{7}{2})^2=0$

$x+\frac{7}{2}=0$

$x=-\frac{7}{2}$

IF b^2-4ac is a perfect Square, then it's factorable.

$3x^2 - 7 = 47$

$3x^2 = 54$

$x^2 = 18$

$x = \pm\sqrt{18}$

$x = \pm 3\sqrt{2}$

$3x^2 - 54 = 0$

$a = 3$

$b = 0$

$c = -54$

$x = \frac{0 \pm \sqrt{0^2 - 4(3)(-54)}}{6}$

$5(x-4)^2 = 125$

$(x-4)^2 = 25$

$x - 4 = \pm 5$

$x = 4 \pm 5$

$4 + 5 = 9$

$4 - 5 = -1$

$\frac{1}{3}(x+4)^2 - 1 = 5$

$\frac{1}{3}(x+4)^2 = 6$

$(x+4)^2 = 18$

$x + 4 = \pm\sqrt{18}$

$x = -4 \pm 3\sqrt{2}$

$-\frac{3}{5}x^2 - 2 = -5$

$-\frac{3}{5}x^2 = -3$

$x^2 = 5$

$x = \pm\sqrt{5}$

$-3 \div -\frac{3}{5}$

$-\frac{3}{1} \cdot \frac{5}{-3}$

5

$2x^2 + 2x + 9 = x^2$

$x^2 + 2x + 9 = 0$

$x^2 + 2x + 1 = -9 + 1$

$(x+1)(x+1) = -8$

$(x+1)^2 = -8$

$x + 1 = \pm 2i\sqrt{2}$

$x = -1 \pm 2i\sqrt{2}$

Complete the square:

$2x^2 + 4x + 13 = 6$

$2x^2 + 4x + 2 = -7 + 2$

$b = 4 \rightarrow 2 \rightarrow 4 \rightarrow (2)$

$2(x^2 + 2x + 1) = -5$

$2(x+1)(x+1) = -5$

$2(x+1)^2 = -5$

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

$x + 1 = \pm\sqrt{-\frac{5}{2}}$

$x = -1 \pm i\sqrt{\frac{5}{2}}$ or $-1 \pm i\sqrt{\frac{5}{2}}$

$ax^2+bx+c=0$

$ax^2+bx+\frac{b^2}{4a}=-c+\frac{b^2}{4a}$

$b \to \frac{b}{2} \to \frac{b^2}{4} \to \frac{b^2}{4a}$

$ax^2+bx+\frac{b^2}{4a}=\frac{b^2-4ac}{4a}$

$a\left(x^2+\frac{b}{a}x+\frac{b^2}{4a^2}\right)=\frac{b^2-4ac}{4a}$

$a\left(x+\frac{b}{2a}\right)\left(x+\frac{b}{2a}\right)=\frac{b^2-4ac}{4a}$

$a\left(x+\frac{b}{2a}\right)^2=\frac{b^2-4ac}{4a}$

$\left(x+\frac{b}{2a}\right)^2=\frac{b^2-4ac}{4a^2}$

$x+\frac{b}{2a}=\pm\frac{\sqrt{b^2-4ac}}{2a}$

$x=-\frac{b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a}$

$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

$6x^2-21x=-15$

$2x^2-7x=-5$

$2x^2-7x+5=0$

$(2x-5)(x-1)=0$

$2x-5=0 \quad x-1=0$

$2x=5 \quad x=1$

$x=5/2$

QF:

$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

$a=2 \quad b=-7 \quad c=5$

$\frac{1}{3}(x+4)^2-1=5$

$\frac{1}{3}(x+4)^2=6$

$(x+4)^2=18$

$x+4=\pm 3\sqrt{2}$

$x=-4\pm 3\sqrt{2}$

$-\frac{3}{5}x^2-2=-5$

$-\frac{3}{5}x^2=-3$

$x^2=-3\cdot\frac{5}{-3}$

$x^2=5$

$x=\pm\sqrt{5}$

$5(x-4)^2=125$

$(x-4)^2=25$

$x-4=\pm 5$

$x=4\pm 5$

$4+5=9$

$4-5=-1$

$4x^2+7x-15=0$

$(x+3)(4x-5)=0$

$x+3=0 \quad 4x+5=0$

$x=-3 \quad 4x=-5$

$x=-5/4$

$4x^2+28x=-49$ QFD

$2x^2+2x+9=x^2$ Complete the square.

$x^2+2x+1=-9+1$

$b=2 \to 1 \to 1$

$(x+1)(x+1)=-8$

$(x+1)^2=-8$

$x+1=\pm 2i\sqrt{2}$

$x=-1\pm 2i\sqrt{2}$

Ticket out the door: Leave this problem on your board.

Simplify: $\frac{2\pm\sqrt{-8}}{4}$

$\frac{2\pm 2i\sqrt{2}}{4}$

$\frac{1\pm i\sqrt{2}}{2}$

$\sqrt{8}$

$\sqrt{2\cdot 2\cdot 2}$

$\frac{5\pm 2\sqrt{-125}}{10}$

125

5 5 5

$\frac{5\pm 2\cdot 5i\sqrt{5}}{10}$

$\frac{5\pm 10i\sqrt{5}}{10} = \frac{1\pm 2i\sqrt{5}}{2}$

$\frac{8\pm\sqrt{-160}}{4}$

$\frac{8\pm 4i\sqrt{10}}{4}$

$2\pm i\sqrt{10}$

$5 \pm 3\sqrt{-50}$

$5 \pm 3 \cdot 5i\sqrt{2}$

$\boxed{5 \pm 15i\sqrt{2}}$

$2 \pm 7\sqrt{96}$

$2 \pm 7(2 \cdot 2\sqrt{6})$

$\boxed{2 \pm 28\sqrt{6}}$

96 = 2 · 48 = 2 · 24 = 2 · 12 = 2 · 6 = 2 · 3

Solve:

$2x^2 + 5x + 10 = 0$

$x = \frac{-5 \pm \sqrt{25 - 4(20)}}{2(2)}$

$= \frac{-5 \pm \sqrt{-55}}{4}$

$= \frac{-5 \pm i\sqrt{55}}{4}$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a = 2$

$b = 5$

$c = 10$

$2x^2 - 3x + 4 = x^2 + 5x - 1$

$x^2 - 8x + 5 = 0$ | $a = 1$, $b = -8$, $c = 5$

$x = \frac{8 \pm \sqrt{64 - 4(5)}}{2}$

$x = \frac{8 \pm \sqrt{44}}{2} = \frac{8 \pm 2\sqrt{11}}{2} = \boxed{4 \pm \sqrt{11}}$

$-3x^2 + 5x - 7 = -9 + 7x$ $\quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$-3x^2 - 2x + 2 = 0$

$x = \frac{2 \pm \sqrt{4 - 4(-6)}}{-6} = \frac{2 \pm \sqrt{28}}{-6}$

$x = \frac{2 \pm 2\sqrt{7}}{-6} = \frac{1 \pm \sqrt{7}}{-3} = \frac{-1 \pm \sqrt{7}}{3}$

QF:

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ → discriminant.

$b^2 - 4ac < 0$	$b^2 - 4ac = 0$	$b^2 - 4ac > 0$
(is neg)	Exactly 1 sol.	2 real sol.
2 complex sol.	$-b/2a$	
(Not real)		

Simplify

$\frac{-4 \pm \sqrt{-16}}{2} = \frac{-4 \pm 4i}{2}$

$= \frac{-2 \pm 2i}{1} = \boxed{-2 \pm 2i}$

$\frac{5 \pm 3\sqrt{12}}{4}$

$\frac{5 \pm 3(2\sqrt{3})}{4}$

$\boxed{\frac{5 \pm 6\sqrt{3}}{4}}$

12 = 4 · 3 = 2 · 2 · 3

$2\sqrt{3}$

$\frac{2 \pm \sqrt{-100}}{14}$

$\frac{2 \pm 10i}{14} = \frac{1 \pm 5i}{7}$

$x^2+12x-5=2x^2+4x$

$0=x^2-8x+5$

$x^2-8x+5=0$

$a=1 \quad b=-8 \quad c=5$

$x=\frac{8\pm\sqrt{64-4(5)}}{2}$

$x=\frac{8\pm\sqrt{44}}{2}$

$x=\frac{8\pm2\sqrt{11}}{2}=4\pm\sqrt{11}$

$2x^2+5x+7=-10$

QF $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

$2x^2+5x+17=0$

$a=2 \quad b=5 \quad c=17$

$x=\frac{-5\pm\sqrt{25-4(34)}}{4}$

$x=\frac{-5\pm\sqrt{-111}}{4}$

$x=\frac{-5\pm i\sqrt{111}}{4}$

$2(x^2-3x+1)=4x^2-6x+1$

$2x^2-6x+2=4x^2-6x+1$

$0=2x^2-1$

$a=2 \quad b=0 \quad c=-1$

$x=\frac{0\pm\sqrt{0-4(-2)}}{4}$

$x=\frac{\pm\sqrt{8}}{4}=\frac{\pm2\sqrt{2}}{4}=\frac{\pm\sqrt{2}}{2}$

$0=2x^2-1$

$1=2x^2$

$\frac{1}{2}=x^2$

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

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

$-3x^2+x+1=0$

$3x^2-x-1=0$

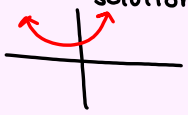
$a=3 \quad b=-1 \quad c=-1$

$x=\frac{1\pm\sqrt{1-4(-3)}}{6}$

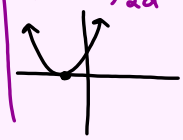
$x=\frac{1\pm\sqrt{13}}{6}$

QF $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ ← Discriminant

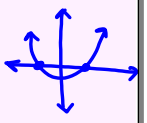
$b^2-4ac<0$ Is negative Then 2 complex solutions



$b^2-4ac=0$ 1 Real solution (which is rational) $x=-b/2a$



$b^2-4ac>0$ 2 real sol. (rational or irrational)



$\frac{2\pm\sqrt{50}}{4}=$

$\frac{2\pm5\sqrt{2}}{4}$

50

25 2

5 5

$\frac{-4\pm2\sqrt{-32}}{6}$

$\frac{-4\pm2\cdot(4i\sqrt{2})}{6}$

$\frac{-4\pm8i\sqrt{2}}{6}$

$\frac{-2\pm4i\sqrt{2}}{3}$

$\sqrt{32}$

$4\sqrt{2}$

/ 1

$\frac{2 \pm \sqrt{-100}}{5} = \frac{2 \pm 10i}{5}$

$\frac{13 \pm \sqrt{-96}}{12} = \frac{13 \pm 4i\sqrt{6}}{12}$

QF $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$2x^2 - 5x + 7 = 2$

$2x^2 - 5x + 5 = 0$

$a=2$, $b=-5$, $c=5$

$x = \frac{5 \pm \sqrt{25-4(10)}}{4}$

$x = \frac{5 \pm \sqrt{-15}}{4}$

$x = \frac{5 \pm i\sqrt{15}}{4}$

$3x^2 - 7x - 10 = 2x^2 + 5x$

$x^2 - 12x - 10 = 0$

$x = \frac{12 \pm \sqrt{144-4(-10)}}{2}$

$x = \frac{12 \pm \sqrt{184}}{2} = \frac{12 \pm 2\sqrt{46}}{2}$

$= 6 \pm \sqrt{46}$

QF: $3(x^2+2x+1) = 5x^2+6x-10$

$3x^2+6x+3 = 5x^2+6x-10$

$-3x^2 \quad -3 \quad -3x^2 \quad -3$

$0 = 2x^2 - 13$

$a=2$, $b=0$, $c=-13$

$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$x = \frac{0 \pm \sqrt{0-4(-26)}}{4}$

$x = \frac{\pm\sqrt{104}}{4} = \frac{\pm 2\sqrt{26}}{4} = \frac{\pm\sqrt{26}}{2}$

$4x^2 - 7x + 5 = 2x^2 + 7 - 3x$

$2x^2 - 4x - 2 = 0$

$x^2 - 2x - 1 = 0$

$a=1$, $b=-2$, $c=-1$

$x = \frac{2 \pm \sqrt{4-4(-1)}}{2} = \frac{2 \pm \sqrt{8}}{2}$

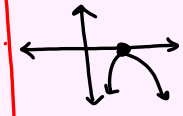
$= \frac{2 \pm 2\sqrt{2}}{2}$

$= 1 \pm \sqrt{2}$

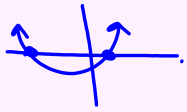
QF $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ ← Discriminant

$b^2-4ac < 0$ is negative. Solutions are complex. * No real sol.

$b^2-4ac = 0$ 1 real sol. of $-b/2a$



$b^2-4ac > 0$ is positive. 2 real solutions



Ex Find the discrimant + determine the number of real solutions.

1) $4x^2 + 6 = 7$

2) $3x^2 + 2x - 1 = 0$

3) $x^2 + 4x + 4 = 0$