The Quadratic Formula

- Where possible factoring can be used to find the zeros, but unfortunately there are many situations where a quadratic relation has zeros, but we cannot factor.

- In these situations, we must use a more powerful tool, the Quadratic Formula.

- The Quadratic Formula can be used to find the zeros in any situation **(as long as they exist).**

- To use the formula, a quadratic relation must be in standard form and equal to zero.

Quadratic Formula

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

Ex/ Solve.

a) $2x^2 + 5x - 6 = 0$

a b c

opposite sign

$$x = \frac{-5 \pm \sqrt{5^2 - 4(2)(-6)}}{2(2)}$$

$$= \frac{-5 \pm \sqrt{73}}{4}$$ ← positive so has solutions

separate

$$x = \frac{-5 + \sqrt{73}}{4} \qquad x = \frac{-5 - \sqrt{73}}{4}$$

figure out top before dividing

$$= \frac{3.54}{4} \qquad = \frac{-13.54}{4}$$

$x = 0.886$ $\qquad x = -3.39$

b) $x^2 - 4x + 2 = 0$

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

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

$x = 3.41$, $\quad x = 0.586$

c) $x^2 + 20 = 9x$ equal to zero first

$x^2 - 9x + 20 = 0$

$$x = \frac{9 \pm \sqrt{(-9)^2 - 4(1)(20)}}{2(1)}$$

$$= \frac{9 \pm \sqrt{1}}{2}$$

$x = 4$, $\quad x = 5$

★ Could have factored to solve

$x^2 - 9x + 20 = 0$ $\quad M = 20$, $A = -9$

$(x - 4)(x - 5) = 0$ $\quad N = -4, -5$

$x = 4$, $\quad x = 5$

d) $5x^2 + 12x = 0$

$$x = \frac{-12 \pm \sqrt{12^2 - 4(5)(0)}}{2(5)}$$

$$= \frac{-12 \pm \sqrt{144}}{10}$$

$$= \frac{-12 \pm 12}{10}$$

$x = 0$, $\quad x = -2.4$

← also could have factored

$5x^2 + 12x = 0$

$x(5x + 12) = 0$

$x = 0$ $\qquad 5x + 12 = 0$

$5x = -12$

$x = -2.4$

Ex/ Marc has a summer tree-trimming business. Based on experience Marc knows that $P = -2x^2 + 200x - 600$ models his profit, P, in dollars, where x is the amount he charges per hour. How much does he need to charge if he wants to have a profit of \$1000?

make equal zero

$1000 = -2x^2 + 200x - 600$

$0 = -2x^2 + 200x - 600 - 1000$

$0 = -2x^2 + 200x - 1600$

solve with formula

$$x = \frac{-200 \pm \sqrt{200^2 - 4(-2)(-1600)}}{2(-2)}$$

$$= \frac{-200 \pm \sqrt{27200}}{-4}$$

$x = 8.768 \qquad x = 91.23$

∴ If he charges \$8.77 or \$91.23 he will have a profit of \$1000.

Ex/ The sum of the squares of two consecutive integers is 113. Find the integers.

one after the other

x = 1st #

$x + 1$ = 2nd #

squares

$x^2 + (x+1)^2 = 113$

sum

FOIL to standard form and make equal zero

$x^2 + (x+1)(x+1) - 113 = 0$

$x^2 + x^2 + 1x + 1x + 1 - 113 = 0$

$2x^2 + 2x - 112 = 0$

Factor OR formula

$2(x^2 + 1x - 56) = 0$

$2(x+8)(x-7) = 0$

$x = -8 \qquad x = 7$

$x + 1 = -7 \qquad x + 1 = 8$

$m = -56$

$A = 1$

$N = 8, -7$

∴ The numbers are -8 and -7 OR 8 and 7

Homework: Pg. 343 #'s: 3ab,5ac,8abc,14,15