9.4: Solve Polynomial Equations in Factored Form

Goals: *Understand and find "roots" of polynomial equations
*Factor polynomials by finding the GCF
*Solve polynomial equations by factoring

Roots: The values of x that make the polynomial equation equal 0

Zero-product property: if $ab = 0$, then either a or $b = 0$ (if you multiply two or more things and get zero, one of them must be zero)

Solve using the zero-product property:

Ex: $(x + 2)(x + 4) = 0$ Since you are multiplying the binomials $x + 2$ and $x + 4$ and get zero, then either

$x + 2 = 0$ or $x + 4 = 0$ Solve these as two separate equations

$x = -2$ $x = -4$

Solve:

Ex: $(x - 5)(x - 1) = 0$

$x = 5$ $x = 1$

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

$x = -3$ $x = 5$

Ex: $(2x + 1)(3x - 4) = 0$

$2x + 1 = 0$ $3x - 4 = 0$

-1 -1 $+4$ $+4$

$\frac{2x}{2} = \frac{-1}{2}$ $\frac{3x}{3} = \frac{4}{3}$

$x = -\frac{1}{2}$ $x = 4/3$

Ex: $4x(3x - 2)(5x + 4) = 0$

$\frac{4x}{4} = \frac{0}{4}$ $3x - 2 = 0$ $5x + 4 = 0$

$+2$ $+2$ -4 -4

$\frac{3x}{3} = \frac{2}{3}$ $\frac{5x}{5} = \frac{-4}{5}$

$x = 0$ $x = 2/3$ $x = -4/5$

Factor: Express a polynomial as the product of two factors

Ex: 24 could be expressed as the product of $6 \cdot 4$, or $8 \cdot 3$ or $12 \cdot 2$

Factor by finding the Greatest Common Factor:

Ex: $12x + 42y$

What do both terms have in common that you can divide by? 6
Look for the **greatest** factor they have in common.

$6(2x + 7y)$

When you factor by using the GCF you are essentially: UN-Distributing

Which means you could check your answer by: Distributive Property

Ex: $4x^4 + 24x^3$

$4x^3(x + 6)$

Ex: $14m + 35n$

$7(2m + 5n)$

Ex: $8x + 12y$

$4(2x + 3y)$

Ex: $14y^2 + 21y$

$7y(2y + 3)$

Ex: $6x^2y + 9xy^2$

$3xy(2x + 3y)$

Ex: $4t^2 - 2t$

$2t(2t - 1)$

Solve by factoring first:

Ex: $2x^2 + 8x = 0$

$2x(x + 4) = 0$
$2x = 0$ or $x + 4 = 0$
$x = 0$ or $x = -4$

Ex: $3x^2 + 18x = 0$

$3x(x + 6) = 0$
$3x = 0$ or $x + 6 = 0$
$x = 0$ or $x = -6$

Ex: $a^2 + 5a = 0$

$a(a + 5) = 0$
$a = 0$ or $a + 5 = 0$
$a = 0$ or $a = -5$

Ex: $3s^2 - 9s = 0$

$3s(s - 3) = 0$
$3s = 0$ or $s - 3 = 0$
$s = 0$ or $s = 3$

Solve by factoring:

Ex: $6n^2 = 15n$

$6n^2 - 15n = 0$

Ex: $4x^2 = 2x$

$x = 0$ or $x = ½$

Ex: $4s^2 = 14s$

$s = 0 \text{ or } s = \frac{7}{2}$

$3n(2n - 5) = 0$
$n = 0 \text{ or } n = \frac{5}{2}$

<u>Vertical Motion Model</u>:

h = Height (feet)

t = time (seconds)

v = Initial Velocity (feet/second)

s = initial height (Feet)

$$h = -16t^2 + vt + s$$

Ex: A startled armadillo jumps straight into the air with an initial velocity of 14 ft/s. After how many seconds does it land back on the ground?

$h = -16t^2 + vt + s$

$h = -16t^2 + 14t$ (s = 0 since he starts on the ground)

$h = -2t(8t - 7)$ Factor using GCF

$0 = -2t(8t - 7)$ Replace h with 0 since that would be his height when he reaches the ground again

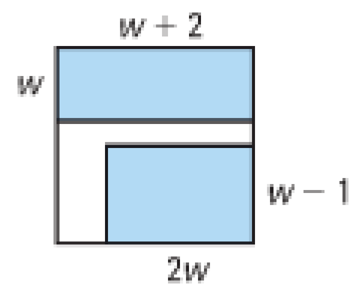
$t = 0$ or $t = \frac{7}{8}$ t = 0 stands for when the armadillo first jumps, so he returns to the ground after seven-eighths of a second.

Ex: A dolphin jumped out of the water with an initial velocity of 32 ft/s. How many seconds does it take for the dolphin to re-enter the water?

$h = -16t^2 + 32t$

$t = 0$ or $t = 2$ 2 seconds to return back to the water.

Ex: Two rectangular rooms in a building's floor plan have different dimensions but the same area. The dimensions (in meters) are shown. What is the value of w?



$w(w + 2) = 2w(w - 1)$

$w^2 + 2w = 2w^2 - 2w$

$-w^2 \qquad -w^2$

$2w = w^2 - 2w$

$-2w \qquad -2w$

$0 = w^2 - 4w$

$0 = w(w - 4)$

$w = 0$ or $w = 4$.

Width can't be zero, so width must be 4 units.