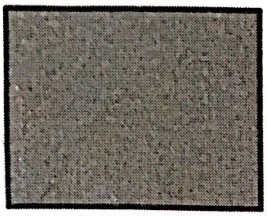
# nit 4, lesson 3 Notes: Factoring $ax^2 + bx + c$ when $a > 1$

## Area of a Rectangle



$Area = 2d^2 + 11d + 12\ units^2$

Given the area, what are the length and width of the figure?

Need to factor!

*What information do you know that could help you determine the dimensions?*

*What do we need to do to answer this question?*

Factor

*How is this different from what we've done before?*

$a \neq 1$

*What would make this easier?*

if a was one!

**Because a ≠ 1, to FACTOR we use a technique called Bottoms Up.**

Go to Factoring Packet, then factor example below.

Ex1: $2d^2 + 11d + 12$ (a, b, c)

multiply

now a=1 → $d^2 + 11d + 24$

24: +8, +3; 11

$(d+8)(d+3)$

÷2 ÷2

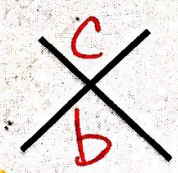
$(d+4)(2d+3)$

| | d | +4 |
|---|---|---|
| 2d | $2d^2$ | 8d |
| +3 | 3d | 12 |

$2d^2 + 11d + 12$ ✓

### *Factoring $ax^2 + bx + c$ when $a > 1$*

1. Can we factor out a GCF?
   - *No*
   - *And a ≠ 1...if it was temporarily moved, we could factor the polynomial: so, move a: multiply it by c.*
2. Factor normally....




3. Wait! You're not done!
   - *Because "a" was multiplied by "c," we now have to divide it out.*
   - *Divide "a" by each constant in the binomial.*
4. Simplify.
5. If a fraction remains, bring "a" from the "bottoms up."

Check! Multiply the binomials to get original polynomial

## Factoring Examples...

1. $2x^2 - 21x - 36$

$x^2 - 21x - 72$

$-72$, $-24$, $+3$, $-21$

$(x-24)(x+3)$

$\frac{}{2}$ $\frac{}{2}$

$(x-12)(2x+3)$

| | $x$ | $-12$ |
|---|---|---|
| $2x$ | $2x^2$ | $-24x$ |
| $+3$ | $+3x$ | $-36$ |

$2x^2 - 24x + 3x - 36$

$-21x$

2. $-2x^2 + 3x + 9$

$x^2 - 3x - 18$

$-18$, $+6$, $-3$, $3$

$(x-3)(x+6)$

$-2$ $-2$

$(-2x-3)(x-3)$

To solve a quadratic equation, it must equal zero.

## Solve the quadratic equation by factoring.

3. $2x^2 - 3x - 7 = 13$

$-13 \quad -13$

$= 0$

$2x^2 - 3x - 20 = 0$

$x^2 - 3x - 40 = 0$

$-40$, $-8$, $+5$, $-3$

$(x-8)(x+5) = 0$

$\frac{}{2}$ $\frac{}{2}$

$x - 4 = 0 \quad 2x + 5 = 0$

$x - 4 = 0 \quad 2x + 5 \neq 0$

$+4 \quad +4 \quad -5 \quad -5$

$x = 4$

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

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

Check!

$2x^2 - 3x - 20 = 0$

$2(4^2) - 3(4) - 20 \stackrel{?}{=} 0$

$2(16) - 12 - 20 \stackrel{?}{=}$

$32 - 32 = 0$ ✓

### How to solve a quadratic equation by factoring

1. Get all terms on one side using addition/subtraction.
   a. *Keep $x^2$ positive.*
2. Use clues in your polynomial to decide on your method:
   a. *GCF?*
   b. *What is the value of a?*
   c. *Bottoms up or no?*
3. Factor.
4. Set each GCF and/or binomial equal to zero. Solve.
5. Solutions make the polynomial equal to zero if it's a solution.

4. $3x^2 + x = 14$

$-14 \quad -14$

$3x^2 + x - 14 = 0$

$x^2 + 1x - 42 = 0$

$-42$, $+7$, $-6$, $1$

$(x+7)(x-6) = 0$

$\frac{}{3}$ $\frac{}{3}$

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

$3x + 7 = 0 \quad x - 2 = 0$

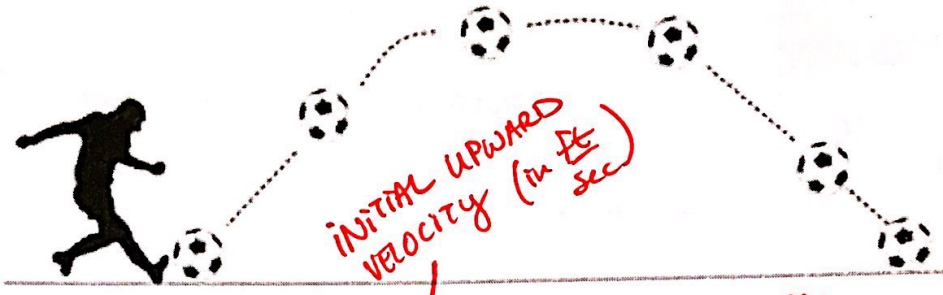
$-7 \quad -7 \quad +2 \quad +2$

$\frac{3x}{3} = \frac{-7}{3}$

$x = -\frac{7}{3}$

$x = 2$

**Vertical Motion:** when an object is projected into the air, the path that it takes as it descends will be called "vertical motion." It can be algebraically represented with



(in ft) ENDING HEIGHT

INITIAL UPWARD VELOCITY (in $\frac{ft}{sec}$)

t = time (in seconds) that the object is in motion

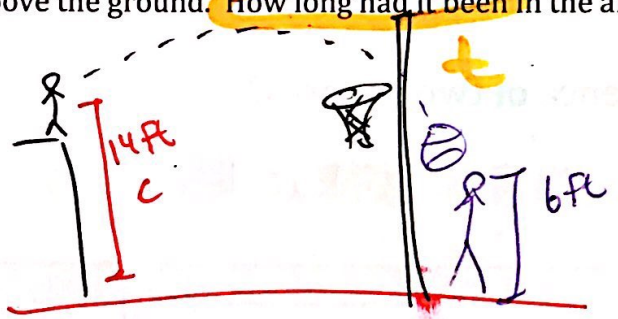
Projectile Motion

...Where...

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

INITIAL HEIGHT (in ft)

Ex 2: From the stands at a basketball court you are shooting a ball towards the basket. From the bleachers, you and the ball are 14 feet above the ground. The ball is shot with an upward velocity of 28 feet/second and is obviously not going to make the basket. So, your friend intercepts the ball 6 feet above the ground. How long had it been in the air by the time your friend catches the ball?




$V = 28 \frac{ft}{sec}$

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

$6 = -16t^2 + 28t + 14$

$-6 \quad\quad -6$

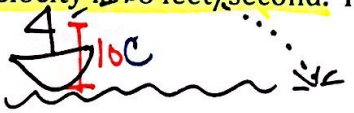
$0 = -16t^2 + 28t + 8$

$\frac{0}{4} = \frac{-16t^2}{4} + \frac{28t}{4} + \frac{8}{4}$

$0 = -4t^2 + 7t + 2$

2 seconds

Ex 3: A flare is launched from the deck of a lifeboat 10 feet above the water surface. The initial upward velocity is 78 feet/second. How long will it take for the flare to return to sea?




c

$h = 0$

$0 = -16t^2 + 78t + 10$

$\frac{0}{2} = \frac{-16t^2}{2} + \frac{78t}{2} + \frac{10}{2}$

GCF?

$= 2(-8t^2 + 39t + 5)$

Bottom's up!

$= 2(t^2 - 39t - 40)$

$(t + 40)(t - 1)$

$t - 5 = 0$

$+5 \quad +5$

$t = 5$

$-8t - 1 = 0$

$+1 \quad +1$

$-8t = 1$

$\frac{-8t}{-8} = \frac{1}{-8}$

Nope $t = -\frac{1}{8}$

$0 = 4(-4t^2 + 7t + 2)$

$t^2 - 7t - 8$

$-8 \quad +8$

$7$

$0 = 4(t - 1)(t + 8)$

$-1$

$0 = 4(-4t - 1)(t - 2)$

$-4t - 1 = 0$

$+1 \quad +1$

$\frac{-4t}{-4} = \frac{1}{-4}$

$t = -\frac{1}{4}$

$t - 2 = 0$

$+2 \quad +2$

$t = 2$

$$12 = -2(5 - x)^2 + 20$$

Exit Ticket: To solve, should we set this equal to zero? Why or why not?