Day 5: Characteristics of Quadratic Functions

Warm-Up:

Hint: you must use calculator for 1 of them!

7. Jason and Jim jumped off of a cliff into the ocean in Acapulco while vacationing Jason's height as a function of time could be modeled by the function $h(t) = -16t^2 + 16t + 480$, while Jim's height could be modeled by $h(t) = -16t^2 + 12t + 480$ where t is the time in seconds and h is the height in feet. Whose jump was higher and by how much?

d Fix -16t² Jason

Jason: $-16(t^2 - t - 30) = -16(t-6)(t+5) \rightarrow$ zeros $(6,0)(-5,0)$

Jim: use calc to get zeros $(-5.115, 0)$ $(5.865, 0)$

x of vertex $= \frac{6+5}{2} = \frac{1}{2}$

Jason $(\frac{1}{2}, 48)$

x of vertex $= \frac{-5.115 + 5.865}{2} = .375$

$y = -16(\frac{1}{2})^2 + 16(\frac{1}{2}) + 48$

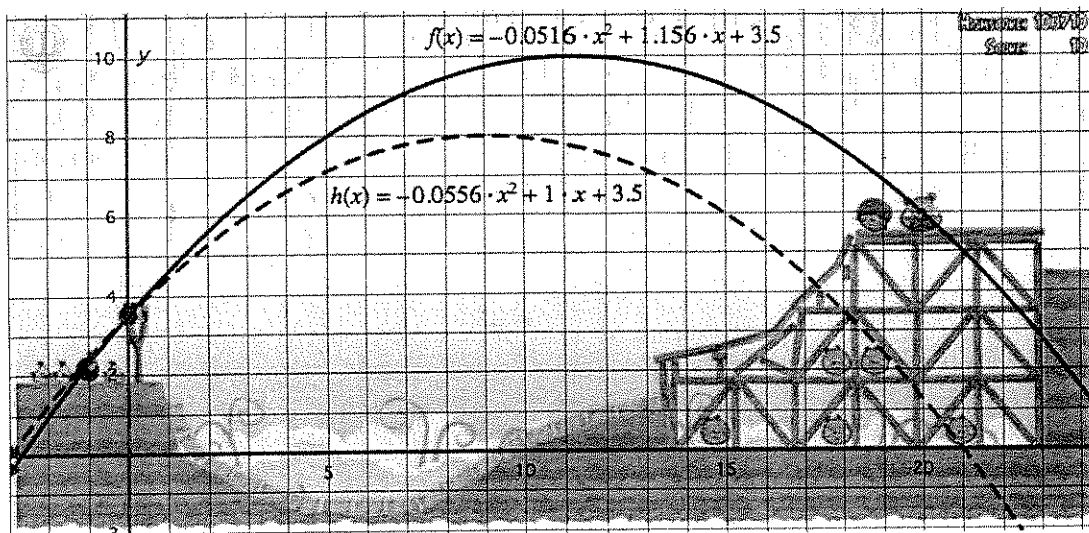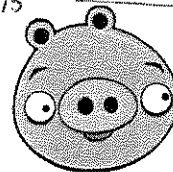$(.375, 482.25)$ Jim

$y = -16(.375)^2 + 12(.375) + 48$
$= 482.25$

Jason   Jim
484   482.25

Jason jumped 1.75 ft higher

$f(x) = -0.0516 \cdot x^2 + 1.156 \cdot x + 3.5$

$h(x) = -0.0556 \cdot x^2 + 1 \cdot x + 3.5$

Round 1: Projectiles and Parabolas

Look at the two trajectories above.

1. What is the same about the two equations?

both are opening down, both have y-int of (0, 3.5)

2. What does the y-intercept represent? What part of the equation gives you the y-intercept?

The launch point was at a height of 3.5.
The c - the constant.

3. What do the x-intercepts represent?

On the right side, the x-intercepts are the landing points — where the birds hit the ground

4. The highest part of the bird's flight is represented by what part of the parabola?

The maximum

5. How far does Angry Bird fly in h(x)? How high does he go? How far away from the catapult is he when he is at his highest? When he is 15 feet away, how high is he flying?

• 21 units → so x-intercept → is how far h(x) goes
• 8 units is how high he goes in h(x)
• 9 units from catapult when he is at his highest
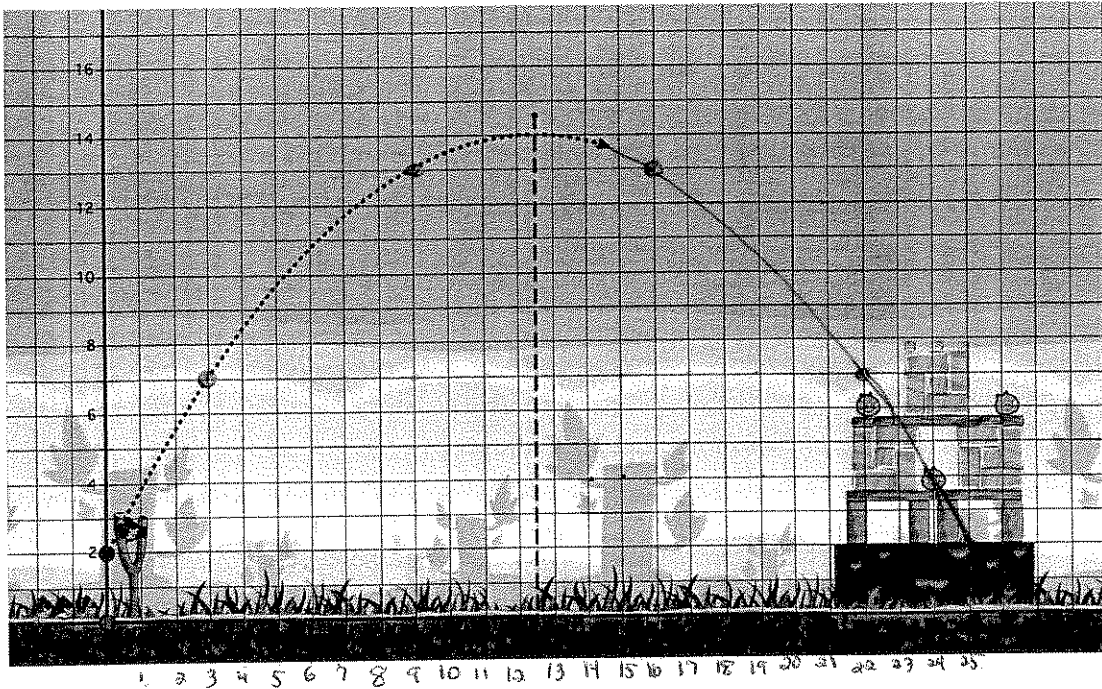
Round 2

1. When Angry Bird is 9 feet away, how high is he flying?

   13 feet

2. The axis of symmetry is provided. What part of the parabola does this pass through? What does this part represent about Angry Bird's flight?

   the vertex

   his highest point

3. How high does the bird fly?

   14 feet

   Axis of Symmetry $x = 12.5$

4. Reflect points over the axis of symmetry to complete the parabola. Do you hit any pigs?
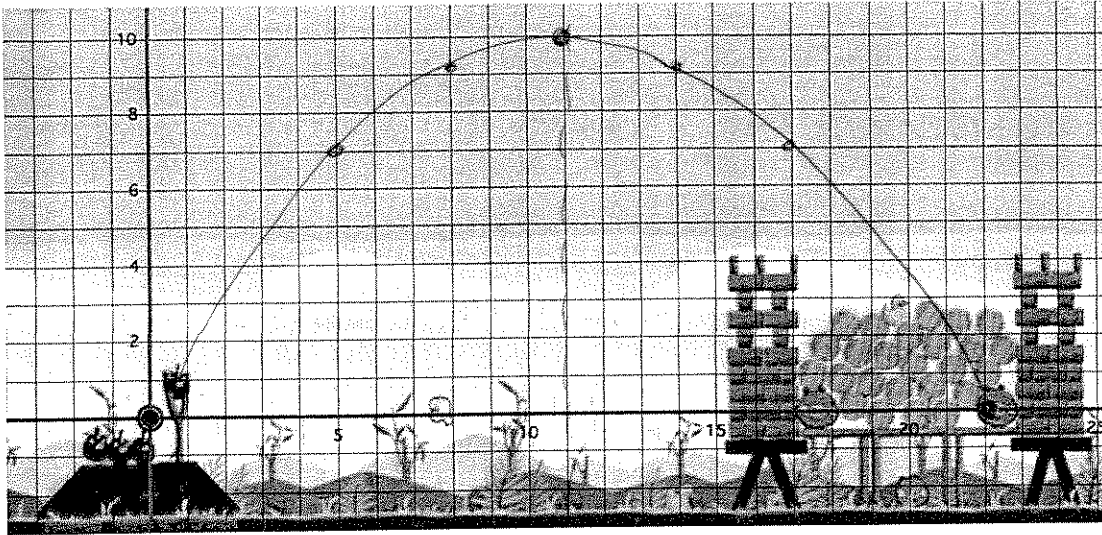
   yes!

5. How far would Angry Bird fly if he did not hit any obstacles?

   26 feet

6. Without solving for the whole equation, what is "c" value in standard form? Is "a" positive or negative?

   $c = 2$

   (from y-value of y-intercept)

   a is negative

   (parabola is down like a frown)

Round 3

1. Angry bird and hungry pig are 18 feet away from each other. If angry bird and hungry pig are at the same height (y-value) when angry bird is catapulted, at what distance away is Angry Bird the highest? Think about symmetry.

↳ x-value of vertex   9 feet

$$\frac{0+18}{2} = 9$$

2. Angry Bird wants to hit the pig on the right. The equation representing his flight is: $y = -.083x^2 + 1.82x + 0$

a
Fx
+
equation
missing

Using the picture, what is the y-intercept? $(0,0)$ origin

Using the picture, what are the x-intercepts? $(0,0)(22,0)$

Where is the axis of symmetry? You may use the picture to visualize, but show your algebraic work

using: $\frac{0+22}{2} = 11$ Round to the nearest integer. $11 = x$ Axis of Symmetry   Vertex

average x's of x-intercepts $y = -.083(11)^2 + 1.82(11) + 0$ $(11,10)$

How high does Angry Bird fly (rounded to the nearest integer)? $y = 9.977 \approx 10\,ft$

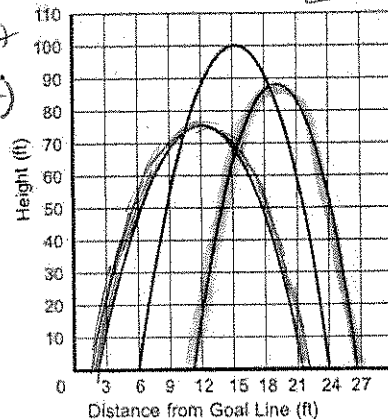Sketch the graph of Angry Bird's flight. $-.083(8)^2 + 1.82(8) + 0$ 110

Practice

$(8, 9.248)$ + 2 mirror pt

$-.083(5)^2 + 1.82(5) + 0 \rightarrow (5, 7.025)$

For each graph, write an equation based on the + do mirror pt

characteristics you're given. Then, explain using

algebraic reasoning which graph has the greatest

maximum and which egg travels the farthest.

seen in exon

= purple $(2,0)(22,0)$ $y = a(x-2)(x-22)$ will see back

Black $(6,0)(24,0)$ $y = a(x-6)(x-24)$

Red $(11,0)(26,0)$ $y = a(x-11)(x-26)$

Distance from Goal Line (ft)

Green Line

Green Line

what do we know?

- zeros
  (2,0) (22,0)
- vertex (12,75)
  - $a < 0$ (a is negative) because frown graph
- axis of symmetry
  $x = 12$

To create line equation

① Use zeros to write factored form equation
$$y = a(x-2)(x-22)$$

② Substitute vertex into factored form equation to solve for a
$$y = a(x-2)(x-22)$$
$$75 = a(12-2)(12-22)$$
$$75 = a(10)(-10)$$
$$75 = a(-100)$$
$$\frac{75}{-100} = a = \frac{-3}{4}$$

③ Write complete factored form
$$y = \frac{-3}{4}(x-2)(x-22)$$

④ Get standard form if requested
$$y = \frac{-3}{4}(x-2)(x-22)$$
$$y = \frac{-3}{4}(x^2 - 22x - 2x + 44)$$
$$y = \frac{-3}{4}(x^2 - 24x + 44)$$
$$y = \frac{-3}{4}x^2 + 18x - 33$$