Name: key Date: Band:
Algebra 2

Quadratic Applications Study Guide

Solving Nonlinear Systems

1. Solve the system by elimination.

$$2x^2 - 8x + \cancel{y} = -5$$
$$+\ 2x^2 - 16x - \cancel{y} = -31$$

$4x^2 - 24x = -36$

$4x^2 - 24x + 36 = 0$

$x^2 - 6x + 9 = 0$

$(x-3)^2 = 0$

$x - 3 = 0$

$x = 3$

$2(3)^2 - 8(3) + y = -5$

$2(9) - 24 + y = -5$

$18 - 24 + y = -5$

$-6 + y = -5$

$y = 1$

$\boxed{(3,1)}$

Solve the system algebraically using substitution or elimination.

2. $2x^2 - 2 = y$
$-2x + 2 = y$

$2x^2 - 2 = -2x + 2$

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

$x^2 + x - 2 = 0$

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

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

$x = -2$ $x = 1$

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

$y = 4 + 2$ $y = -2 + 2$

$y = 6$ $y = 0$

$\boxed{(-2,6)}$ $\boxed{(1,0)}$

3. $x^2 - 6x + 13 = y$
$-y = -2x + 3$

$x^2 - 6x + 13 = y$

$+\ -2x + 3 = -y$

$x^2 - 8x + 16 = 0$

$(x-4)^2 = 0$

$x - 4 = 0$

$x = 4$

$y = (4)^2 - 6(4) + 13$

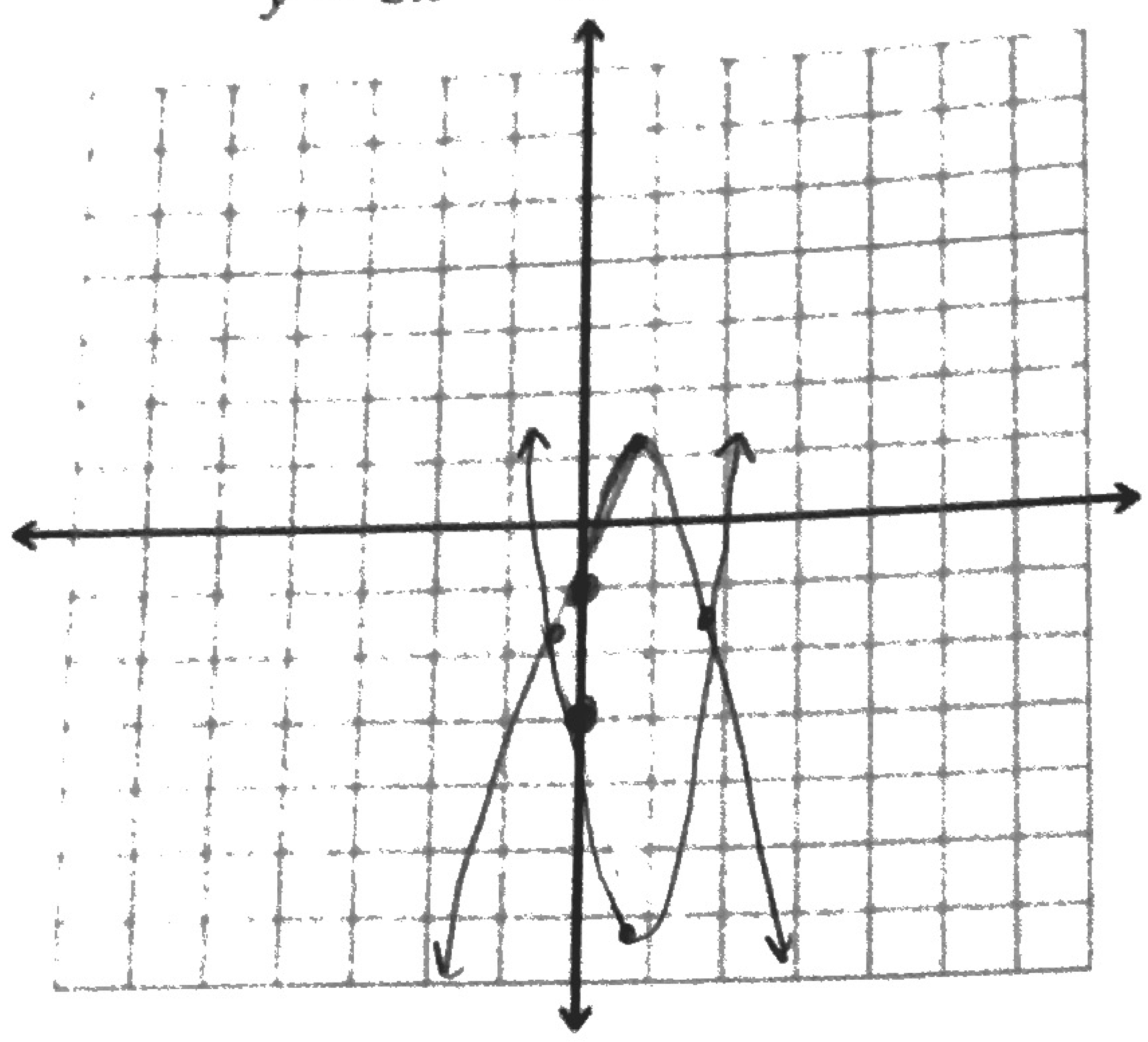
$y = 16 - 24 + 13$

$y = -8 + 13$

$y = 5$

$\boxed{(4,5)}$

4. Solve $\begin{matrix} y = -3x^2 + 5x - 1 \\ y = 5x^2 - 8x - 3 \end{matrix}$ by graphing.



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

$x = \frac{-5}{2(-3)} = \frac{5}{6}$

$y = -3(\frac{5}{6})^2 + 5(\frac{5}{6}) - 1$

$y = 1.08\overline{3}$

$y = 5x^2 - 8x - 3$

$x = \frac{+8}{2(5)} = \frac{8}{10} = \frac{4}{5}$

$y = 5(\frac{8}{10})^2 - 8(\frac{8}{10}) - 3$

$y = -6.2$

$\boxed{(-0.142, -1.768)}$

$\boxed{(1.767, -1.529)}$

Word Problems

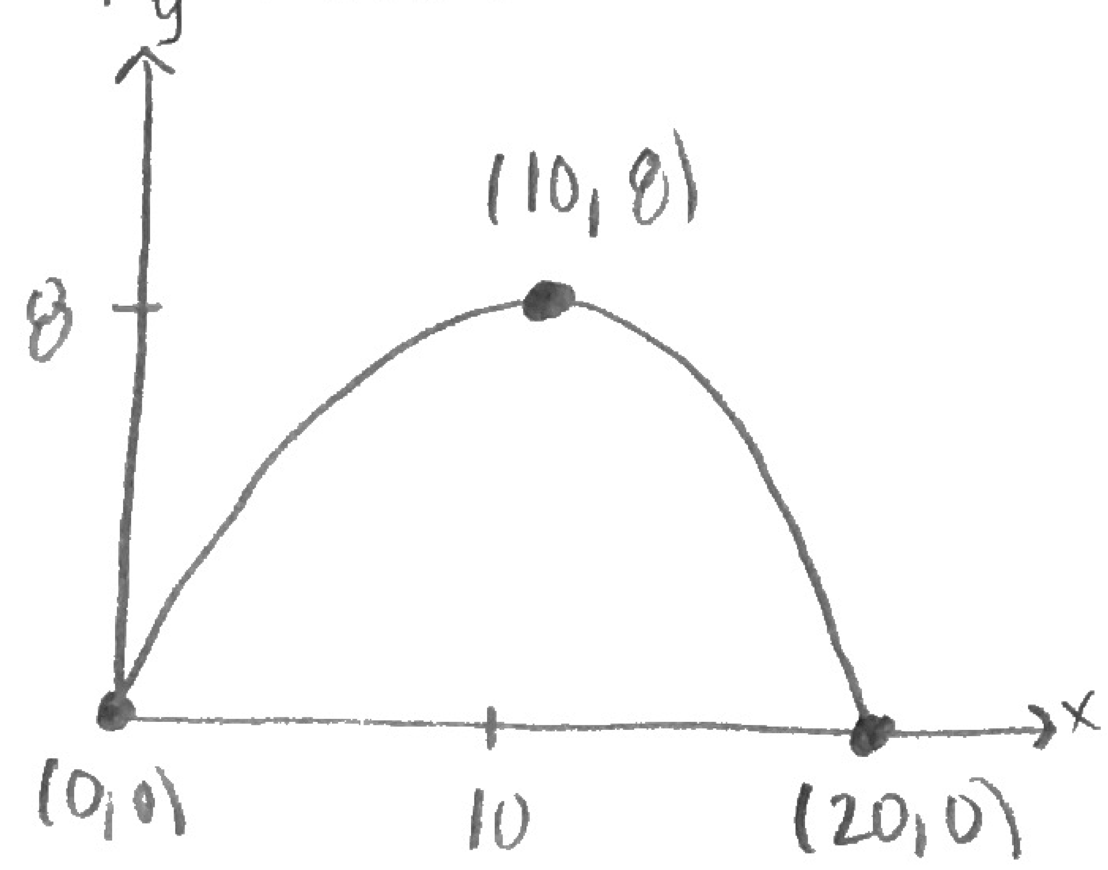
Launched Object

5. A soccer player kicks a ball downfield. The height of the ball increases until it reaches a maximum height of 8 yards, 20 yards away from the player. A second kick is modeled by $y = x(0.4 - 0.008x)$. Which kick travels farther before hitting the ground? Which kick travels higher?

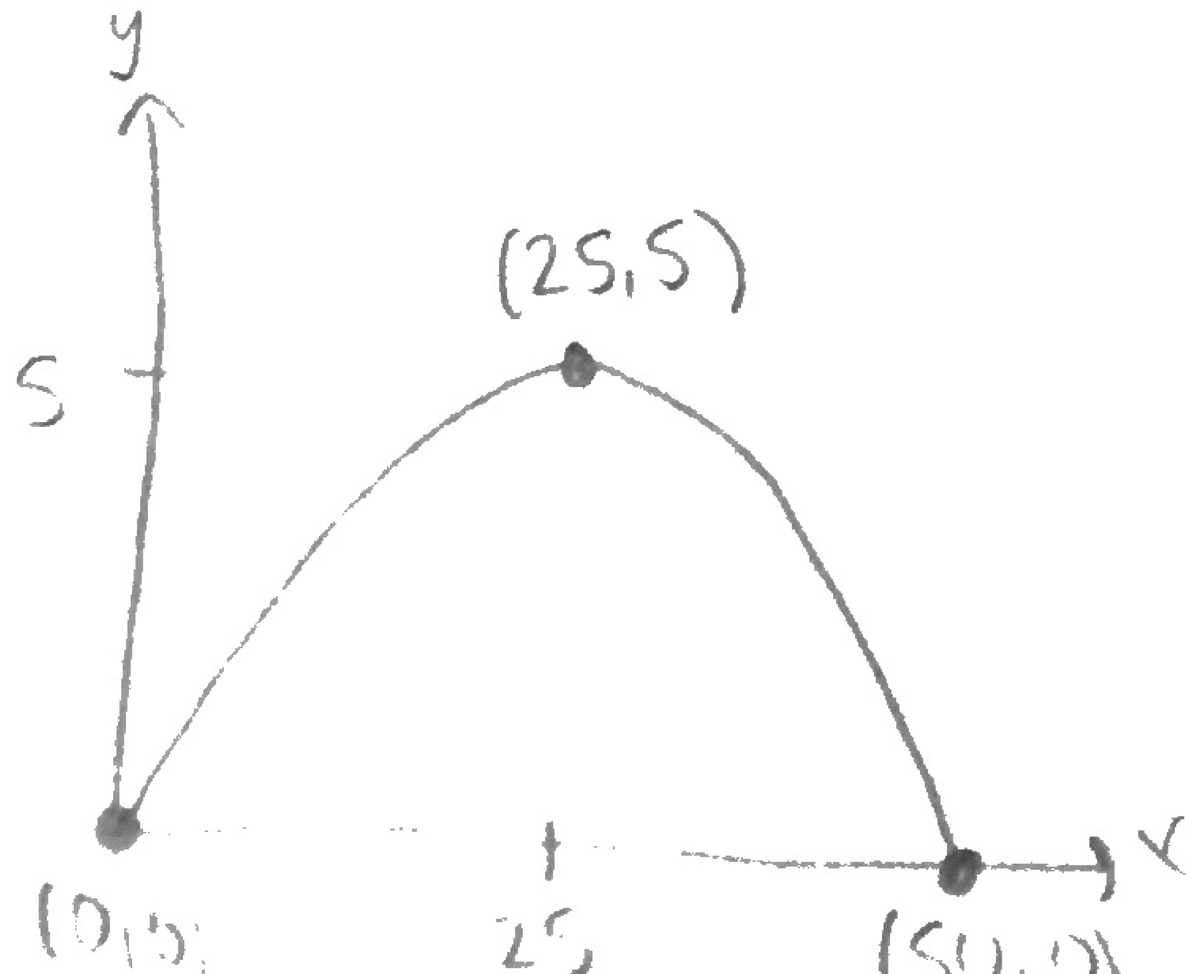
The second kick travels farther.

The first kick travels higher.

First kick



Second kick



$y = x(0.4 - 0.008x)$

$0 = x(0.4 - 0.008x)$

$x = 0$ $\quad$ $0.4 - 0.008x = 0$

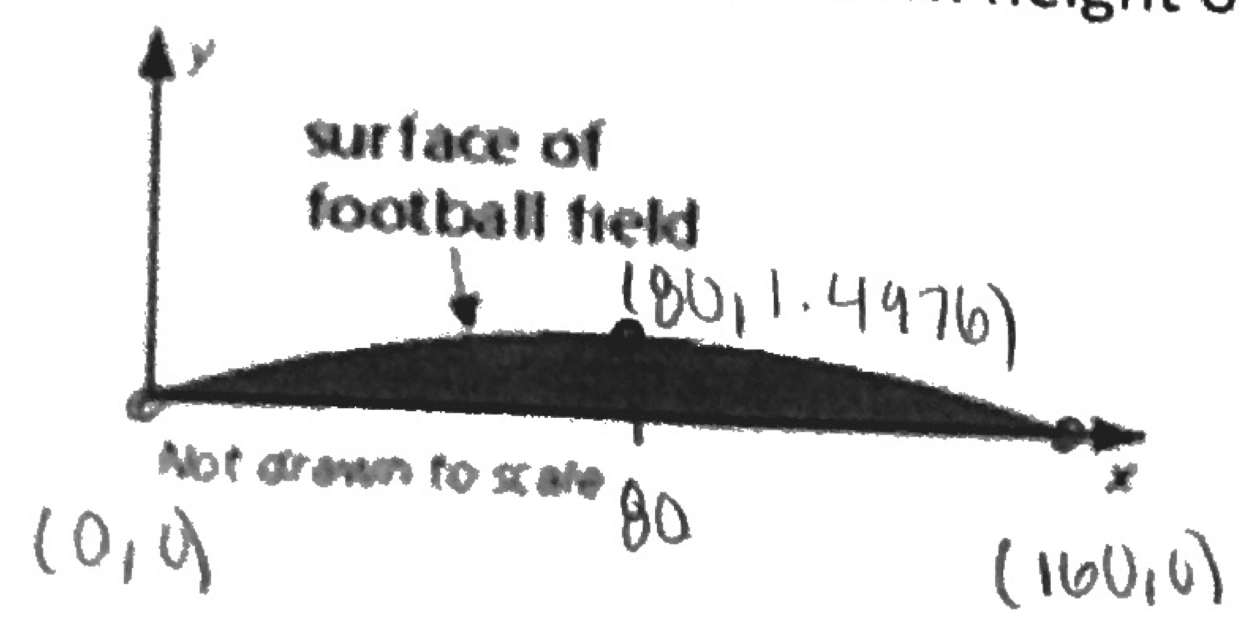
$0.4 = 0.008x$

$50 = x$

$y = 25(0.4 - 0.008 \cdot 25)$

$y = 5$

6. Although a football field appears to be flat, some are actually shaped like a parabola so that rain runs off to both sides. The cross section of a field can be modeled by $y = -0.000234x(x - 160)$, where x and y are measured in feet. What is the width of the field? What is the maximum height of the surface of the field?



$0 = -0.000234x(x-160)$

$-0.000234x = 0 \qquad x - 160 = 0$

$x = 0 \qquad x = 160$

$\boxed{\text{width of field} = 160 \text{ ft}}$

$x = 80$

$y = -0.000234(80)(80-160)$

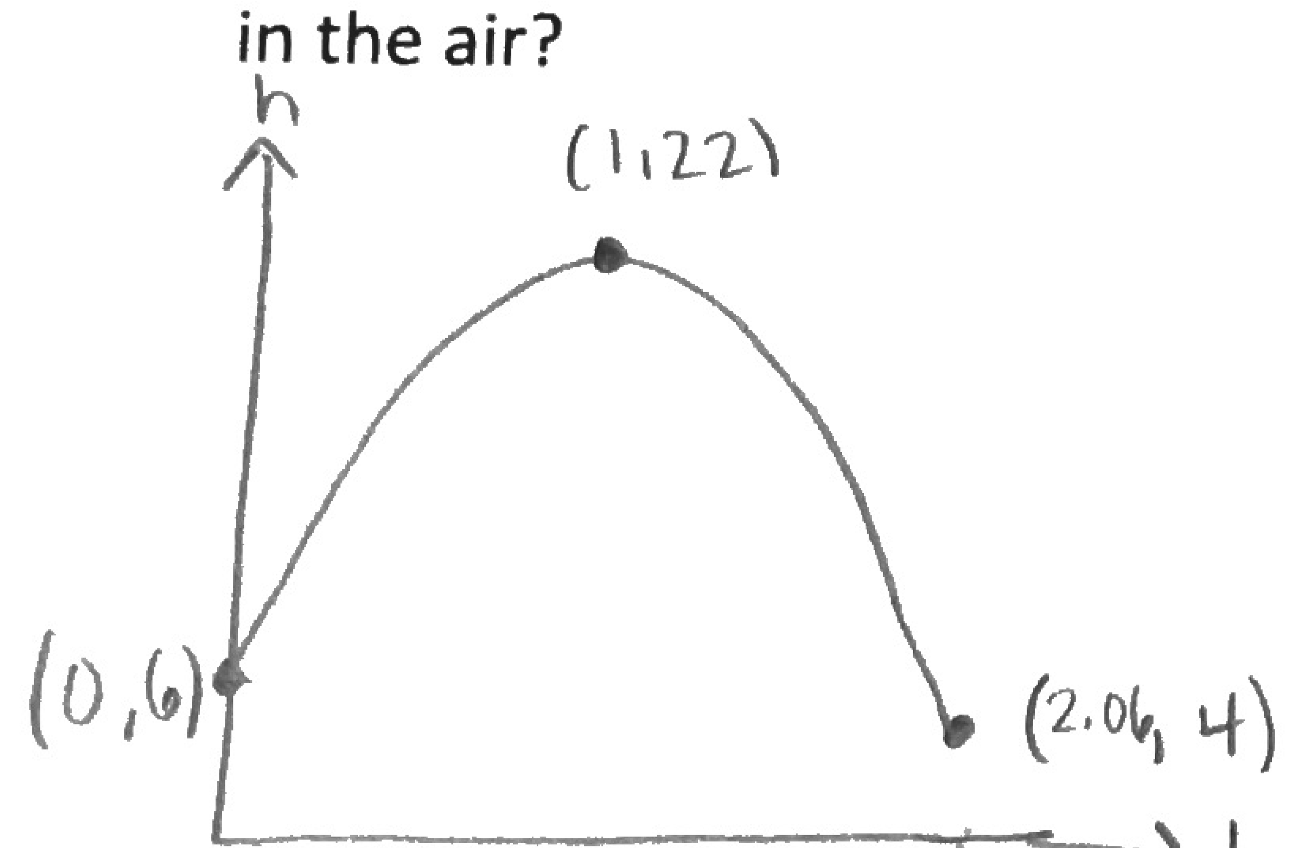
$y = 1.4976$

$\boxed{\text{max height} = 1.4976 \text{ ft}}$

7. While marching, a drum major tosses a baton into the air and catches it. The height h (in feet) of the baton t seconds after it is thrown can be modeled by the function $h = -16t^2 + 32t + 6$.

A. Find the maximum height of the baton.

B. The drum major catches the baton when it is 4 feet above the ground. How long is the baton in the air?



(A) $t = \frac{-32}{2(-16)} = 1$ $\qquad \boxed{\text{max height} = 22 \text{ ft}}$

$h = -16(1)^2 + 32(1) + 6$

$h = 22$

(B) $4 = -16t^2 + 32t + 6$

$0 = -16t^2 + 32t + 2$

$0 = -8t^2 + 16t + 1$

$x = \frac{-16 \pm \sqrt{(16)^2 - 4(-8)(1)}}{2(-8)}$

$x = \frac{-16 \pm 12\sqrt{2}}{-16}$

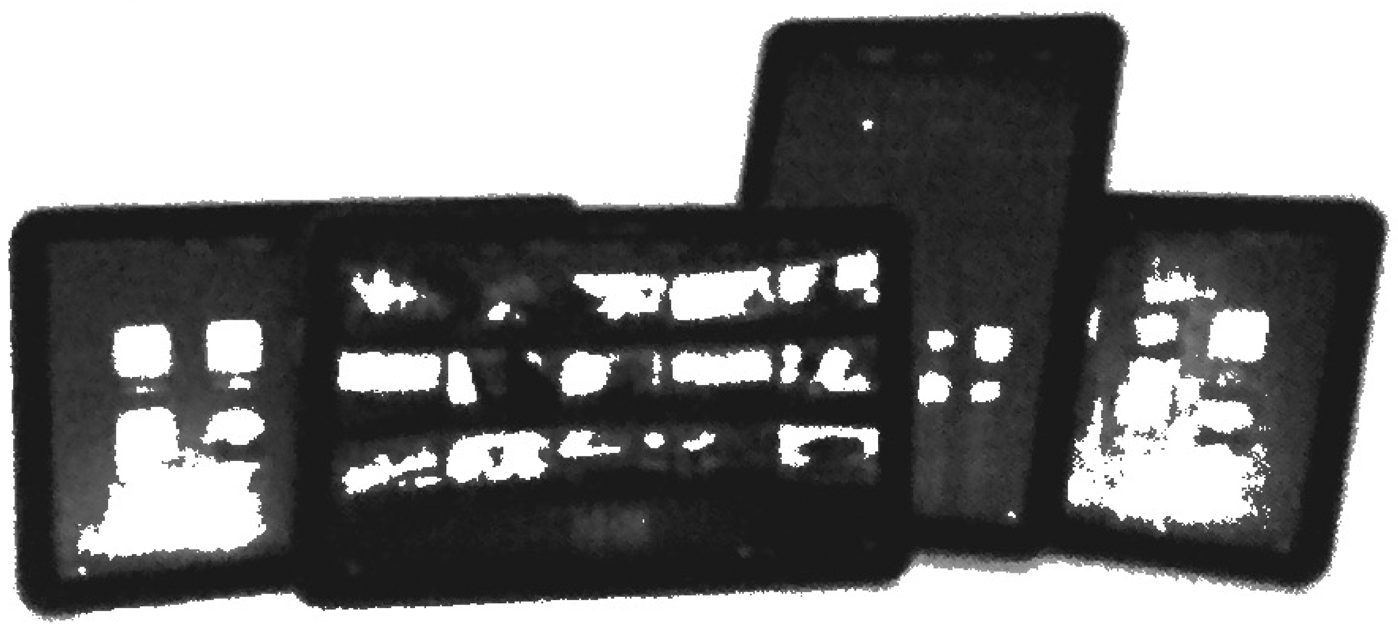
$x = \frac{-4 \pm 3\sqrt{2}}{-4}$

$x = \frac{-4 + 3\sqrt{2}}{-4} \approx -0.01$

$x = \frac{-4 - 3\sqrt{2}}{-4} \approx 2.06$

$\boxed{\text{About } 2.06 \text{ s}}$

8. A number A of tablet computers sold (in millions) can be modeled by the function $A = 4.5t^2 + 43.5t + 17$, where t represents the year after 2010. In what year did the tablet computer sales reach 65 million?



$A = 65$

$65 = 4.5t^2 + 43.5t + 17$

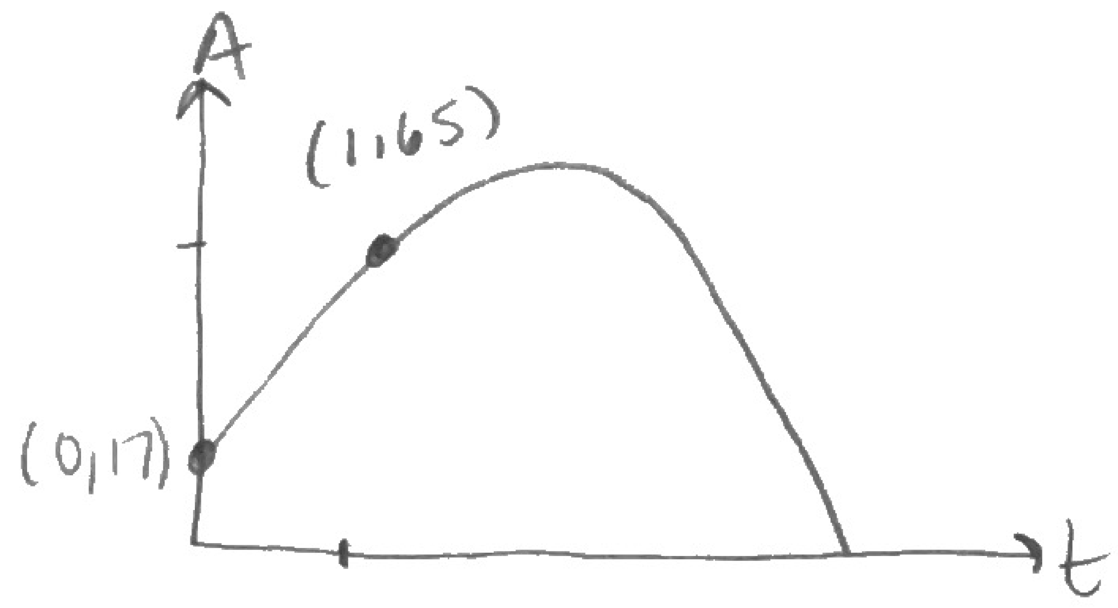
$0 = 4.5t^2 + 43.5t - 48$

$t = \dfrac{-43.5 \pm \sqrt{(43.5)^2 - 4(4.5)(-48)}}{2(4.5)}$

$t = \dfrac{-43.5 \pm 52.5}{9}$

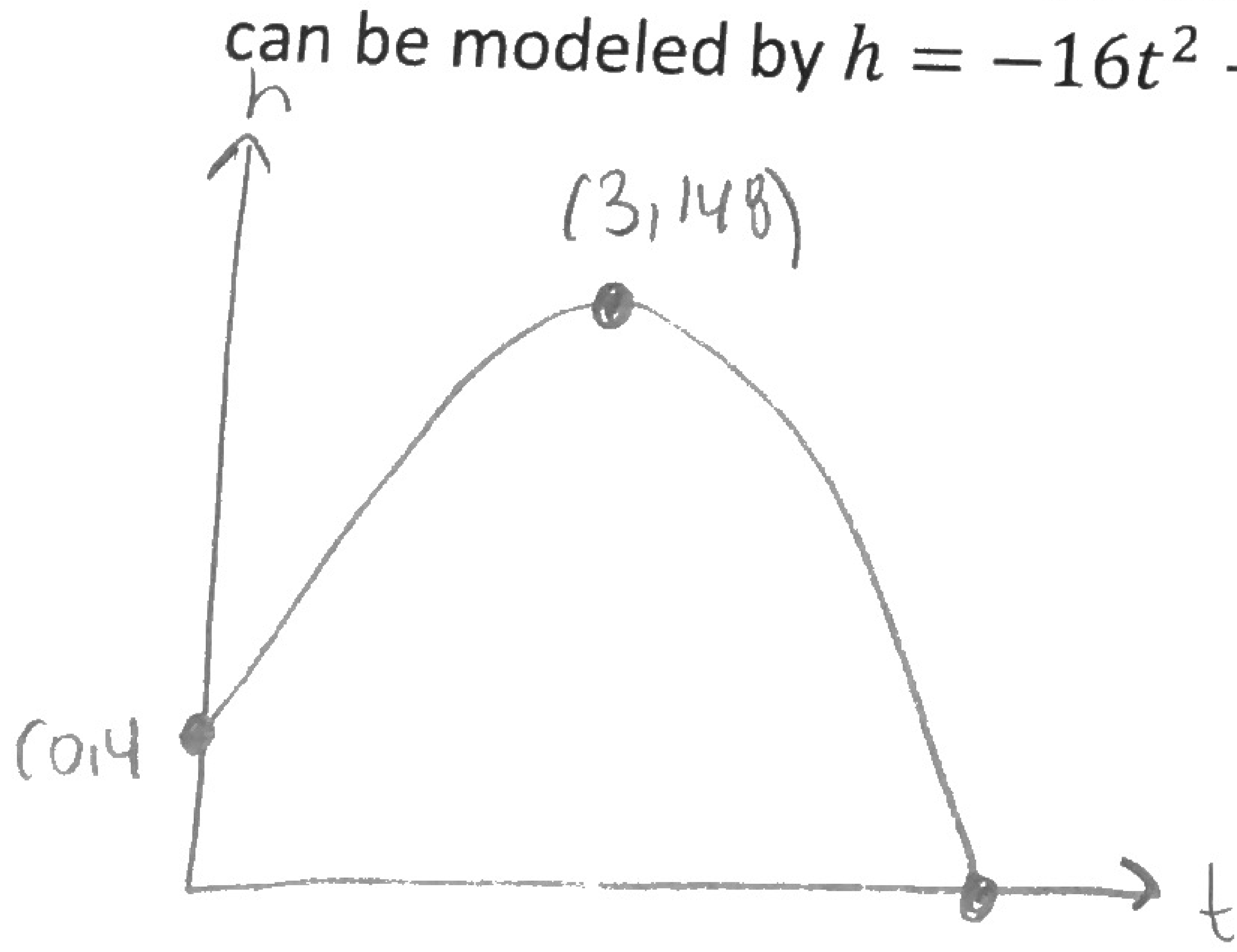
$x = \dfrac{-43.5 + 52.5}{9} = 1$

$x = \dfrac{-43.5 - 52.5}{9} = -10\frac{2}{3}$



$\boxed{2011}$

9. An employee at a local stadium is launching T-shirts from a T-shirt cannon into the crowd during an intermission of a football game. The height h (in feet) of the T-shirt after t seconds can be modeled by $h = -16t^2 + 96t + 4$. Find the maximum height of the T-shirt.



$t = \dfrac{-96}{2(-16)} = 3$

$h = -16(3)^2 + 96(3) + 4$

$h = 148$

$\boxed{\text{max height} = 148\text{ft}}$

Maximizing Revenue

9. A skateboard shop sells 50 skateboards per week when the advertised price is charged. For each \$1 decrease in price, one additional skateboard per week is sold. The shop's revenue can be modeled by $y = (70 - x)(50 + x)$. Find the maximum weekly revenue.

SKATEBOARDS
Quality Skateboards for \$70

x = # price decrease   y = weekly revenue

$y = (70-x)(50+x)$

$0 = (70-x)(50+x)$

$70 - x = 0$ $50 + x = 0$

$x = 70$ $x = -50$

$x = \frac{70 + -50}{2} = 10$

$y = (70-10)(50+10)$

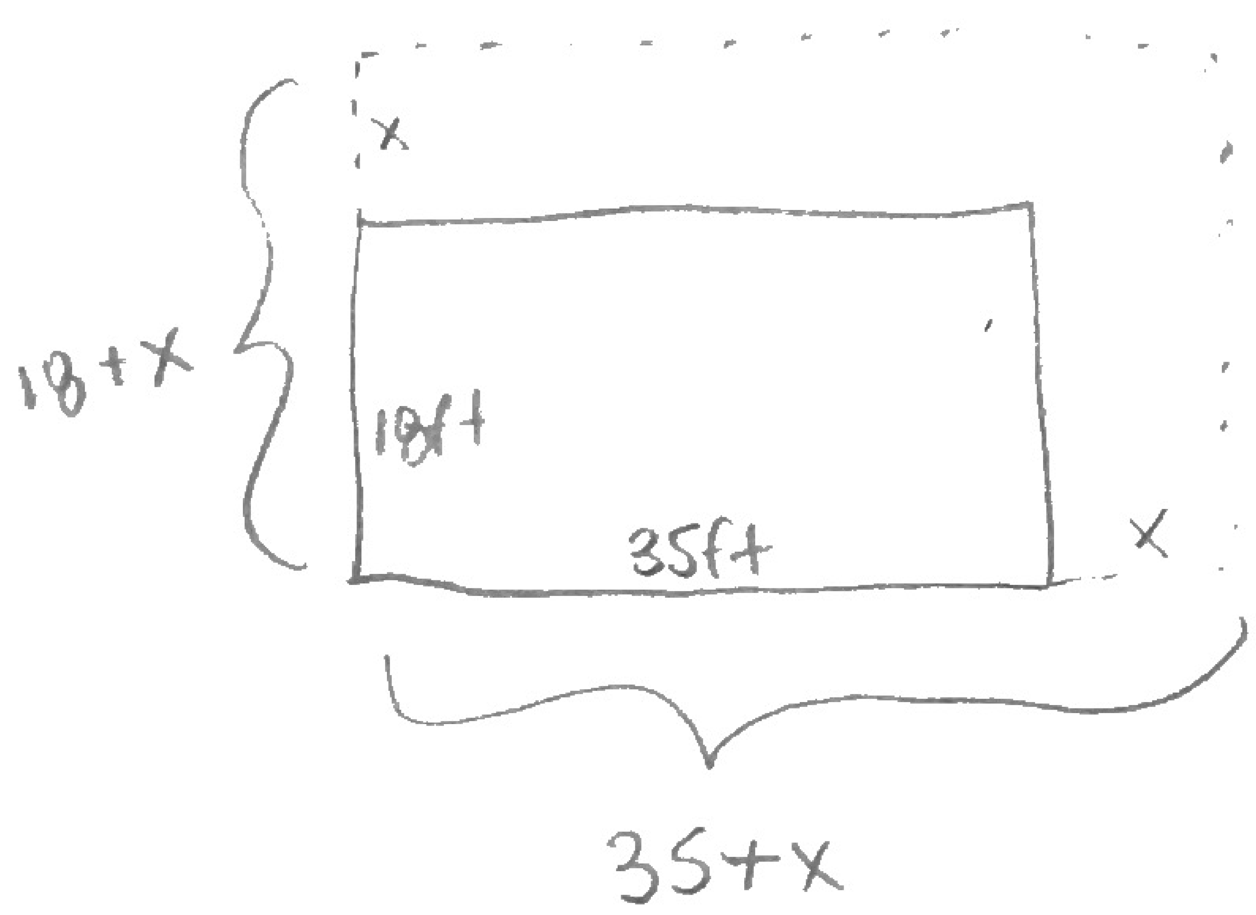
$y = 3600$

$\boxed{\text{charge} = 70 - 10 = \$60}$

$\boxed{\text{max revenue} = \$3600}$

Border/Area Problems

10. A rectangular enclosure at the zoo is 35 feet long by 18 feet wide. The zoo wants to double the area of the enclosure by adding the same distance x to the length and width. Write and solve an equation to find the value of x. What are the dimensions of the enclosure?



new area = new length · new width

$2(35)(18) = (18+x)(35+x)$

$1260 = 630 + 53x + x^2$

$0 = x^2 + 53x - 630$

$0 = (x + 63)(x - 10)$

$x + 63 = 0$ $x - 10 = 0$

$x = -63$ $x = 10$

$\boxed{\begin{array}{l}\text{new length} = 35 + 10 = 45\text{ft} \\ \text{new width} = 18 + 10 = 28\text{ft}\end{array}}$