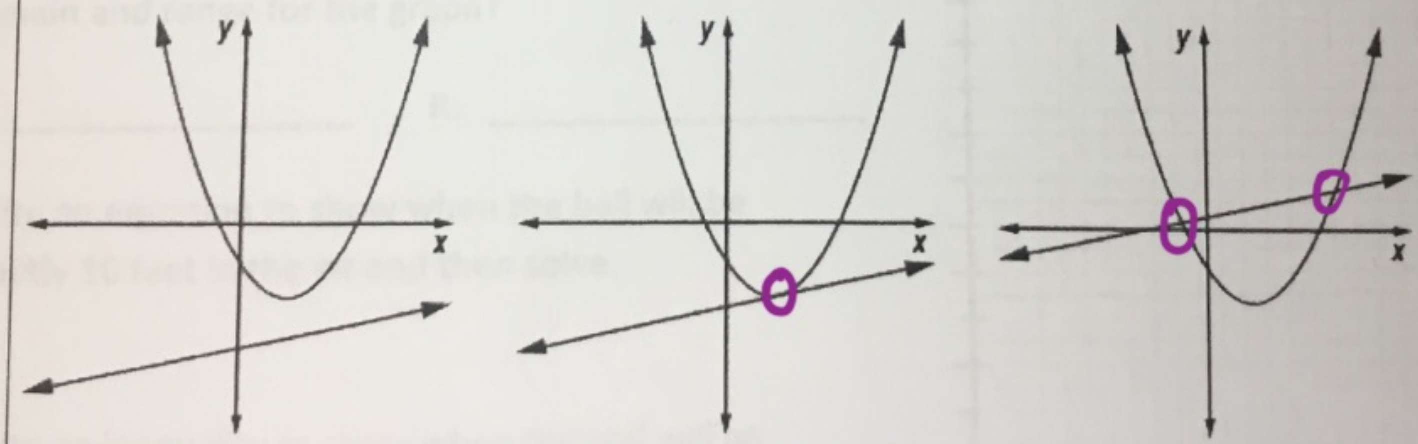
Unit 3
Lesson 5
Linear vs. Quadratic Systems

Lesson 5 → Linear vs. Quadratic Systems

➤ When a linear function and a quadratic function are graphed on the same coordinate plane, the graphs below represent the possible number of solutions for the system of equations.

0, 1, or 2 solutions can be found.



➤ Solve each system of equations **graphically**:

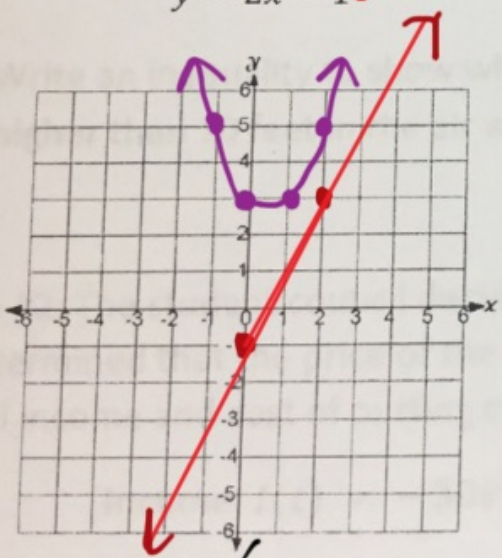
0 Solutions
Doesn't touch

1 solution
touches once

2 Solutions
touches twice

Solve each system of equations **graphically**:

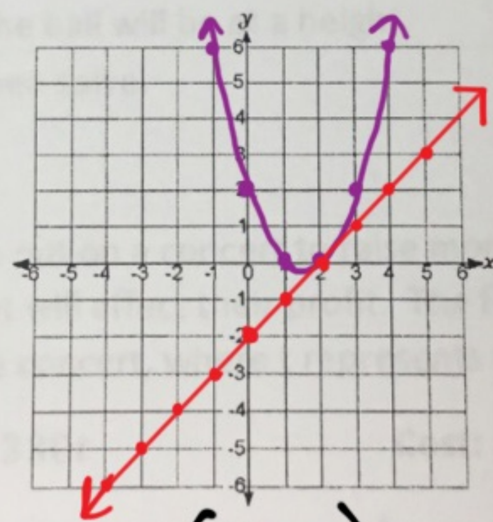
$y = x^2 - x + 3$
$y = 2x - 1$



$(x, y) =$ ∅

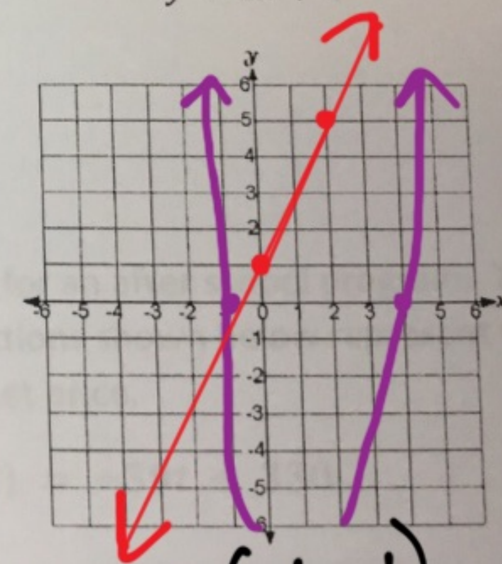
No Solution

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



$(x, y) =$ (2,0)

$y = 10x^2 - 28x - 39$
$y = 2x + 1$



$(x, y) =$ (-1,-1)
(4,9)

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

$2x - 1 = x^2 - x + 3$
$-2x + 1 \quad -2x + 1$
$0 = x^2 - 3x + 4$
$\frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(4)}}{2(1)} = \frac{3 \pm \sqrt{-7}}{2}$

$(x, y) =$ ∅ No Solution

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

$x - 2 = x^2 - 3x + 2$
$-x + 2 \quad -x + 2$
$0 = x^2 - 4x + 4$
$0 = (x-2)(x-2)$
$x - 2 = 0$
$x = 2$
$y = (2) - 2$
$y = 0$

$(x, y) = (2, 0)$

$y = 10x^2 - 28x - 39$
$y = 2x + 1$

$2x + 1 = 10x^2 - 28x - 39$
$-2x - 1 \quad -2x - 1$
$0 = 10x^2 - 30x - 40$
$0 = 10(x^2 - 3x - 4)$
$0 = 10(x-4)(x+1)$
$10 \neq 0$ $\quad x - 4 = 0$, $x = 4$ $\quad x + 1 = 0$, $x = -1$
$y = 2(4) + 1$, $y = 9$
$y = 2(-1) + 1$, $y = -1$

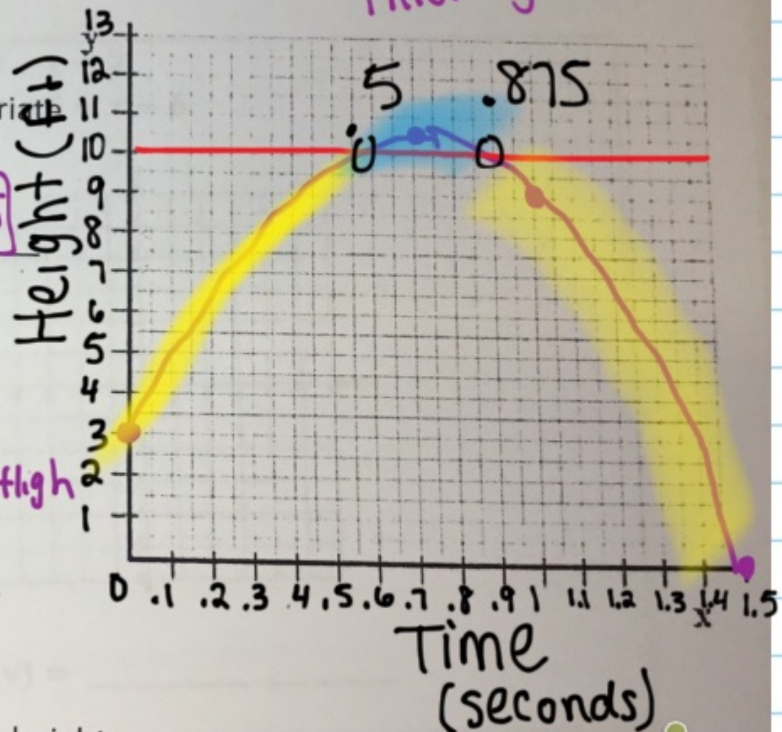
$(x, y) = (4, 9)$, $(-1, -1)$

pg.

Example #1: A ball thrown is modeled by the function: $y = -16x^2 + 22x + 3$. Midget Persons Throwing Shades

Using what you know about quadratic functions, answer the following questions.

1) Sketch the graph :



2) Given the context of the problem, what is an appropriate domain and range for the graph?

D: [0, 1.5] R: [0, 10.5625]

3) Write an equation to show when the ball will be **exactly** 10 feet in the air and then solve.

$y = 10$ $10 = -16x^2 + 22x + 3$

$x = 1/2$, ball is 10 ft high $x = 7/8$ ball is 10 ft high

4) Write an inequality to show when the ball will be at a height **less than** 10 feet in the air and then solve.

[0, .5) ∪ (.875, 1.5]

5) Write an inequality to show when the ball will be at a height **higher than** 10 feet in the air and then solve.

(.5, .875)

$$10 = -16x^2 + 22x + 3$$

$$-10 \qquad\qquad -10$$

$$0 = -16x^2 + 22x - 7$$

$$\frac{-(+22) \pm \sqrt{(-22)^2 - 4(-16)(-7)}}{2(-16)}$$

$$\frac{22 \pm \sqrt{36}}{-32}$$

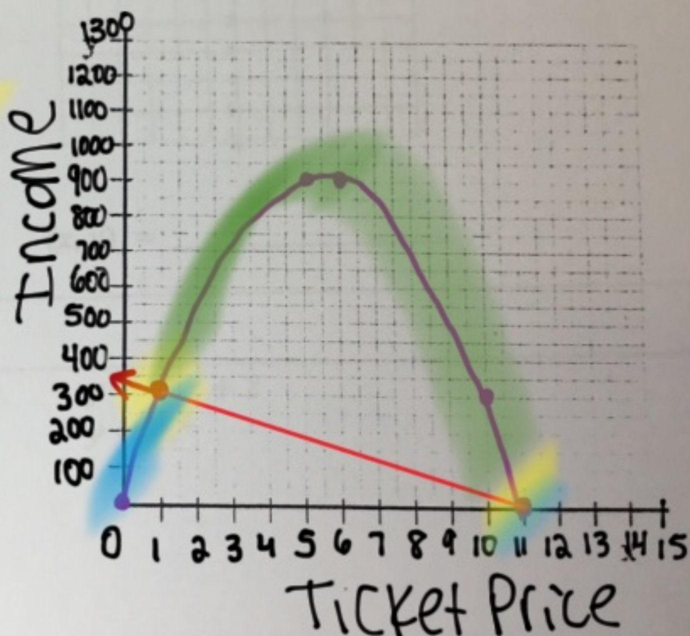
$$\frac{-22+6}{-32} = \frac{-16}{-32} = \frac{1}{2}$$

$$\frac{-22-6}{-32} = \frac{-28}{-32} = \frac{7}{8}$$

Example #2: The student council decides to put on a concert to raise money for an after school program. They have determined that the price of the ticket will affect their profit. The functions shown below represent their potential income and cost of putting on the concert, where t represents ticket price.

Income: $I(t) = -30t^2 + 330t$ **Cost:** $C(t) = -30t + 330$

1) Sketch the graph of each function:



2) Find algebraically and graphically the break-even point. (Hint: $Income = Cost$)

At ticket price 1$, break even
At " of 11$, break even

3) Write an inequality to show where the cost is greater than the income and then solve.

[0,1)∪[11]

4) Write an inequality to show where the income is greater than the cost and then solve.

$-30t+330 = -30t^2+330t$ (1, 11)

5) Which ticket price would you use in order to maximize your profit? Where is this shown on the graph?

Calc max x=5.50 per tix

$$-30t + 330 = -30t^2 + 330t$$

$$+30t - 330 \qquad\qquad +30t - 330$$

$$0 = -30t^2 + 360t - 330$$

$$\frac{-(360) \pm \sqrt{(360)^2 - 4(-30)(-330)}}{2(-30)}$$

$$\frac{-360 \pm \sqrt{90000}}{-60} = \frac{-360 \pm 300}{-60}$$

$$\frac{-360 + 300}{-60} = \frac{-60}{-60} = 1$$

$$\frac{-360 - 300}{-60} = \frac{-660}{-60} = 11$$