8.1 Solving Systems of Equations Graphically

(2,4)

$y = x^2$

$y = 2 + x$

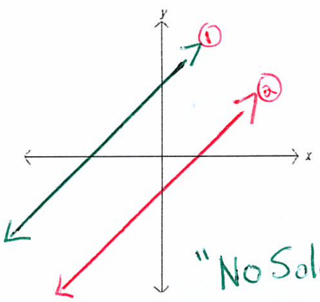
Linear Equations

- have a degree of 1
- graph as a straight line
- examples: $y = 8x - 3$

Quadratic Equations

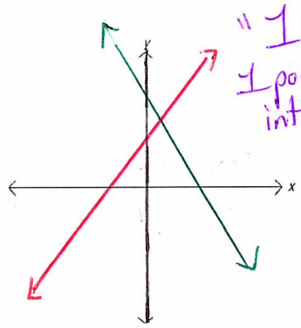
- have a degree of 2
- graph as a parabola
- examples: $y = x^2 + 4x - 3$ or $y = 3(x-2)^2 + 4$

System of Linear Equations



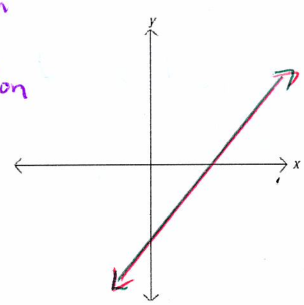
"No Solutions"

No point of intersection



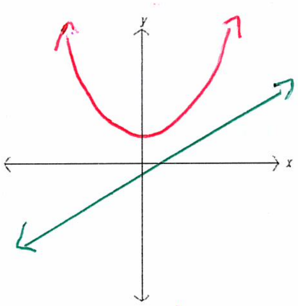
"1 solution"

1 point of intersection

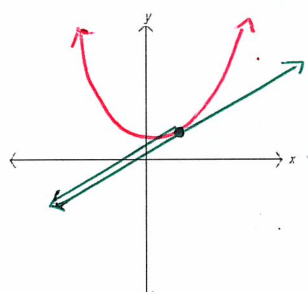


"Infinite Solutions"

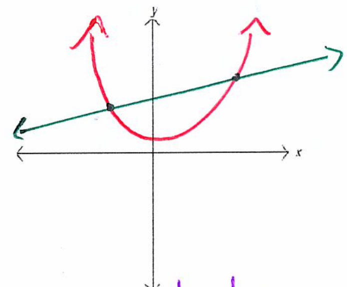
System of Linear-Quadratic Equations



No Solution

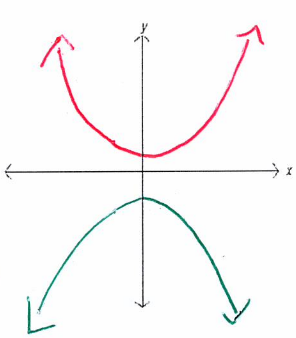


1 Solution

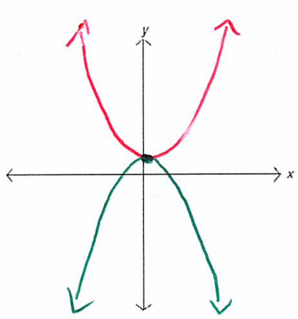


2 Solutions

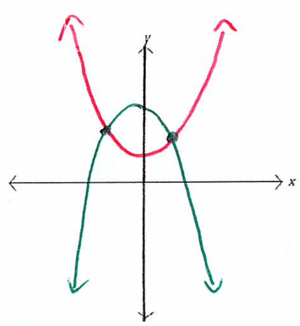
System of Quadratic-Quadratic Equations



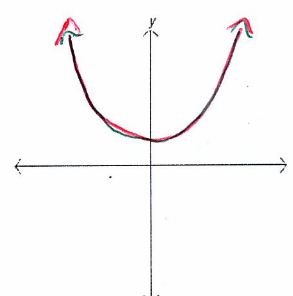
No Solutions



1 Solution



2 Solutions



Infinite Solutions

Examples 2 an pages 428 using the graphing calculator (Desmos)

Example2)a) What type of system of equations is represented? b)Solve the following system of equations graphically. c) verify your solution(s)

① $4x - y + 3 = 0$

② $2x^2 + 8x - y + 3 = 0$

a) System of linear-quadratic equations

b) Use graphing calc (0,3) and (-2,-5)

c) Substitute x=0 y=3 into both equations. Make sure the LHS=RHS. and substitute x=-2 y=-5.

check x=0 y=3

① $4(0) - (3) + 3 = 0$

$-3 + 3 = 0$

$0 = 0$ ✓

② $2(0)^2 + 8(0) - (3) + 3 = 0$

$-3 + 3 = 0$

$0 = 0$ ✓

Check x=-2 y=-5

① $4(-2) - (-5) + 3 = 0$

$-8 + 5 + 3 = 0$

$-3 + 3 = 0$

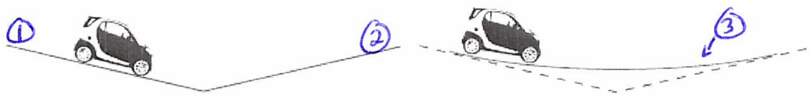
$0 = 0$ ✓

② $2(-2)^2 + 8(-2) - (-5) + 3 = 0$

$8 - 16 + 8 = 0$

$0 = 0$ ✓

Example 3) Engineers use vertical curves to improve the comfort and safety of roadways. Vertical Curves are parabolic in shape and are used for transitions from one straight grade to another. Each grade line is tangent to the curve.



What does it mean for each grade line to be tangent to the curve?

Suppose surveyors model the first grade line for a section of road with the linear equation ① $y = -0.06x + 2.6$ **, the second grade line with the linear equation** ② $y = 0.09x + 2.35$ **, and the parabolic curve with the quadratic equation** ③ $y = 0.0045x^2 + 2.8$ **a) Write the two systems of equations that would be used to determine the coordinates of the points of tangency.**

b) Using graphing technology, show the surveyors layout of the vertical curve and determine the points of tangency to the nearest hundredth

d) Interpret each point of tangency.

a) System 1

② $y = 0.09x + 2.35$

③ $y = 0.0045x^2 + 2.8$

System 2

① $y = -0.06x + 2.6$

③ $y = 0.0045x^2 + 2.8$

The points of tangency are where the lines touch the parabola

b) Graph all 3 functions in your graphing calc. $\boxed{2^{nd}}$ Calc (Trace) #5 intersect.

Find all intersection points between each line and the parabola.

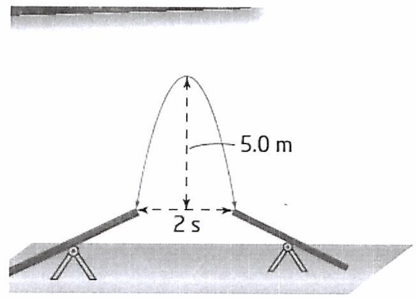
(-6.667, 3) (10, 3.25)

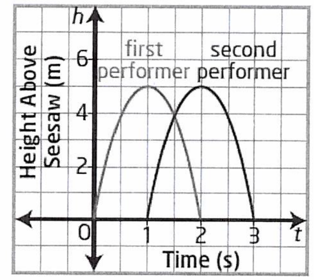
(-6.67, 3.00) (10.00, 3.25) ← rounded to the nearest hundredth.

c) This means that the vertical curve (parabola) starts at the location (-6.67, 3.00) on the surveyors grid system and ends at the location (10.00, 3.25)

Example 4) Suppose that in one stunt, two Cirque du soleil performers are launched toward each other from two slightly offset seesaws. The first performer is launched, and 1s later the second performer is launched in the opposite direction. They both perform a flip and give each other a high five in the air. Each performer is in the air for 2s. The height above the seesaw versus time for each performer during the stunt is approximated by a parabola as shown. Their paths are shown on a coordinate gird.

a) Determine the system of equations That models the performers' height during the stunt.
b) Solve the system graphically
c) Interpret your solution with respect to this situation.





a) First performer

vertex = (1,5)

point = (0,0)

$y = a(x-p)^2 + q$

$0 = a(0-1)^2 + 5$

$0 = a(1) + 5 - 5$

$-5 = a$

$y = -5(x-1)^2 + 5$

second performer

vertex = (2, 5)

point = (1,0)

$y = a(x-p)^2 + q$

$0 = a(1-2)^2 + 5$

$0 = a(1) + 5$

$-5 = a$

$y = -5(x-2)^2 + 5$

b) put into graphing calculator

(1.5, 3.75)

c) At 1.5 secs each performer is 3.75m above the seesaw

Assignment: Page 435 #4ad, 5cd, 10, 15 using the graphing calculator. Sketch graphs and identify the solution(s). Use solution brackets.

Assignment: Page 435 # 2, 3, 6, 7, 8, ~~15~~ (these questions do not need a graphing calculator)