

Unit 13: Comparative Analysis of Functional Situations

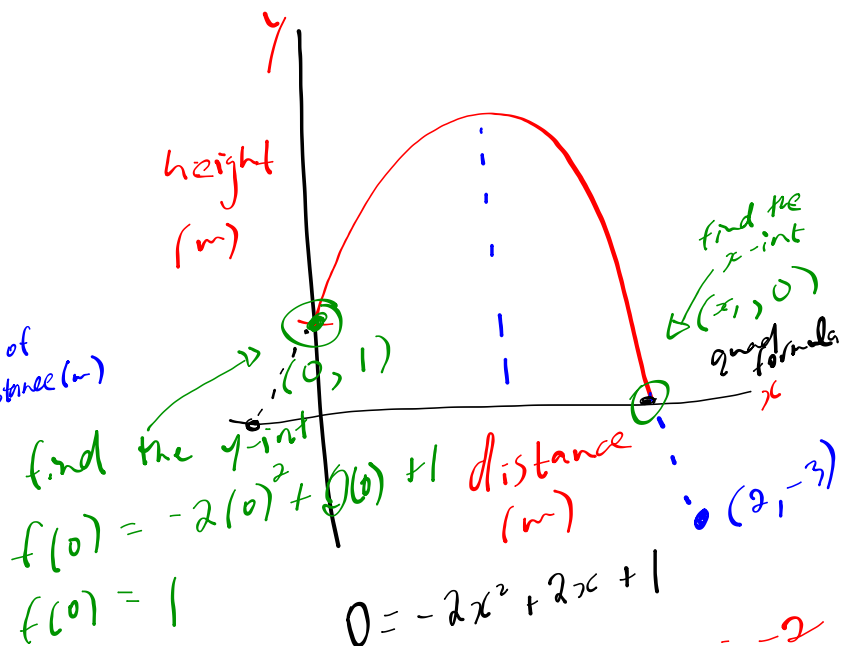
- graph / label axis y
for example: height is a function of distance x
distance is a function of speed x :
 - translate sentences into points
 - translate sentences into equation
 - create equation based on context/diagram
 - be strategic in where you place the x/y axis!
- 2 unknowns → 2 equations
→ 3 unknowns → 3 equations
- make it into one equation one unknown
- substitution
 - comparison
 - elimination

Ammar throws a ball into the air while standing on a ledge. If the trajectory of the ball is described by

$f(x) = -2x^2 + 2x + 1$
 where height (m) is a function of distance (m)
 how high was the ball when it was first thrown?

How far does the ball travel?

1 #



$$x = \frac{-b \pm \sqrt{\Delta}}{2a}$$

$$x_1 = 1.366m$$

$$\text{or } x_1 = -0.366 \Delta = b^2 - 4ac$$

$$\begin{aligned} a &= -2 \\ b &= 2 \\ c &= 1 \end{aligned}$$

Question: A dolphin jumps out of the ocean and its trajectory is described by $f(x) = -0.5(x-6)^2 + 8$. Flipper (height as a function of distance)
 An evil dolphin hunter shoots a bullet at George
 The bullet's trajectory: $F(x) = 0.5x + 1$
 How high was the dolphin when it got hit by the bullet on the way down?

find $f(x)$

use substitution, comparison or elimination to find it.

point of intersection between the 2 functions: (x, y)

① $y = -0.5(x-6)^2 + 8$
 ② $y = 0.5x + 1$

Step ①: Comparison: isolate y's and put right sides equal to each other

$$0.5x + 1 = -0.5(x-6)^2 + 8$$

Step ②: Bring x's together so you must evaluate

$$0.5x + 1 = -0.5(x-6)(x-6) + 8$$

$$0.5x + 1 = -0.5(x^2 - 12x + 36) + 8$$

$$0.5x + 1 = -0.5x^2 + 6x - 18 + 8$$

$$0.5x + 0.5x^2 + 1 - 6x + 10 = 0$$

$$0.5x^2 - 5.5x + 11 = 0$$

$$ax^2 + bx + c = 0$$

x cannot be isolated so use quad formula to solve!

$a = 0.5$ $\Delta = b^2 - 4ac$
 $b = -5.5$ $\Delta = (-5.5)^2 - 4(0.5)(11)$
 $c = 11$ $\Delta = 8.25$

$$x = \frac{-b \pm \sqrt{\Delta}}{2a}$$

$$x_1 = \frac{-(-5.5) + \sqrt{8.25}}{2(0.5)}$$

$$x_2 = \frac{5.5 - \sqrt{8.25}}{1}$$

the distance

$$x_1 = 8.37$$

$$x_2 = 2.63$$

Step ③: Find the y by subbing x into one of the original equations!

$$y = 0.5x + 1$$

$$y = 0.5(2.63) + 1$$

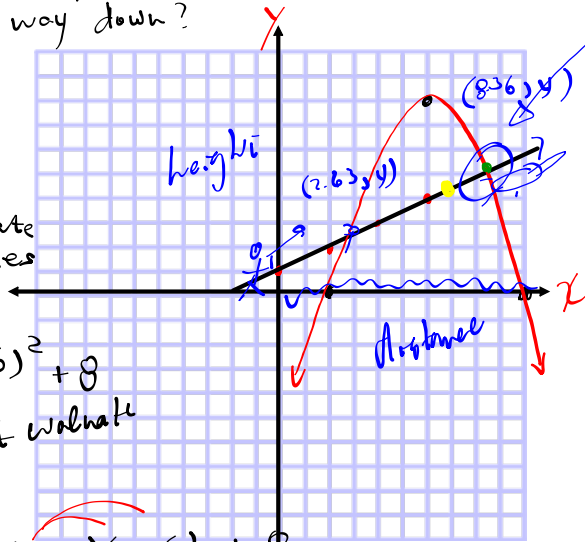
$$y = 2.315$$

or

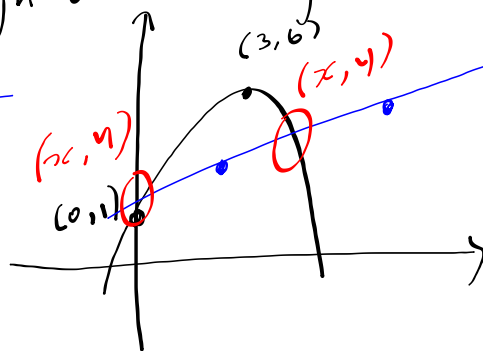
$$y = 0.5(8.37) + 1$$

$$y = 5.185$$

∴ the dolphin got hit at a height of 5.185 m.



A dog named Duke jumps off a ledge one meter high to catch a frezbee. The dog reaches a max height of 6m, 3m away from the ledge. The frezbee is at a height of 2m, 2.5m away from the ledge and then at a height of 3m, 7.5m away from the ledge. If the dog follows a parabolic trajectory, and the frezbee a linear trajectory, how high was the dog when he caught the frezbee?

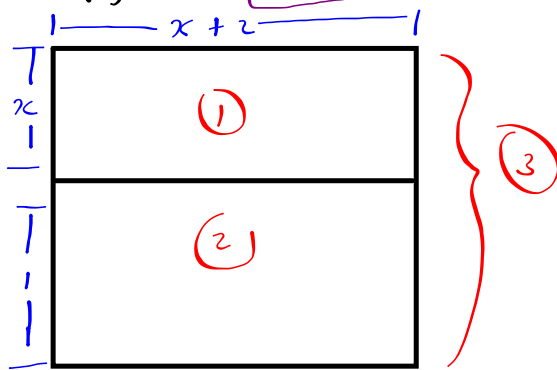


2 equations
 $y = mx + b$
 $y = a(x-h)^2 + k$

A_3 is 3 times the Area of ~~(1)~~.

$$A_3 = 3A_2$$

Find x!



$$A_1 = l \cdot w$$

$$A_2 = l \cdot w$$

$$A_3 = l \cdot w$$

$$A_1 = (x+2) \cdot x$$

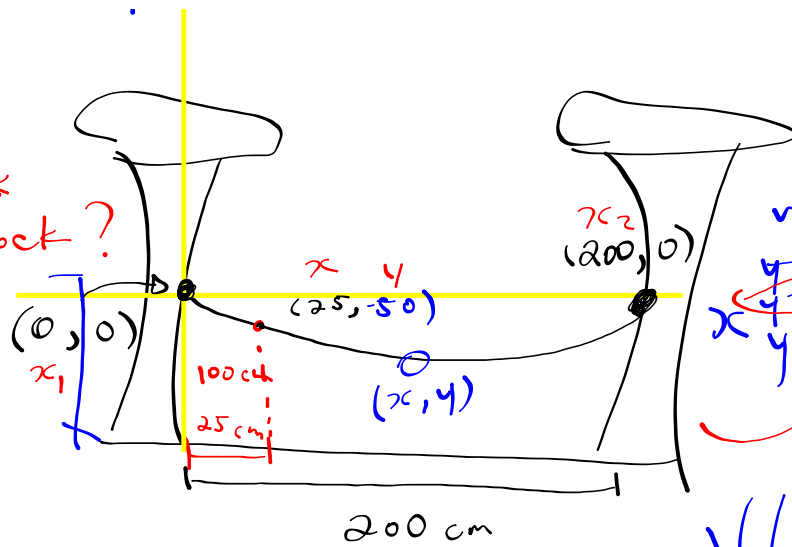
$$A_2 = (x+2) \cdot 1$$

$$A_3 = (x+2)(x+1)$$

...

How high is the lowest point of the hammock?

The hammock is tied 150 cm above ground



we need the equation!
 $y = a(x-x_1)^2 + k$
 $y = a(x-x_1)(x-x_2)$
 $y = ax^2 + bx + c$
 $x = \left(\frac{-b}{2a}, \frac{-\Delta}{4a} \right)$