2.6 Applications of Quadratics

Ex 1 A football player kicks a ball off of a football tee. The height of the ball, h, in metres after t seconds can be modelled using the formula: $h=-5t^2+20t$

a) What is the maximum height of the ball?

$h=-5(t^2-4t+4-4)$

$=-5(t-2)^2+20$

↑ MAX HEIGHT

∴ Max height is 20m

b) What is the initial height of the ball?

@ $t=0$

$h=0$ ∴ Initial is height is 0m

c) When does the ball hit the ground?

① Factor

② Use symmetry

① $h=-5t^2+20t$

$=-5t(t-4)$

$t=0$ & $t=4$

∴ Ball landed after 4s.

d) When is the ball more than 10 m above the ground?

Set $h=10$

$10=-5t^2+20t$

$0=-5t^2+20t-10$

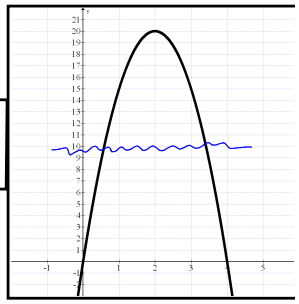
$=-5(t^2-4t+2)$

$=-5(\ldots\ldots ?$

Cannot factor

USE QUAD FORMULA

Graph



$a=1$

$b=-4$

$c=2$

$t=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$

$=\dfrac{4\pm\sqrt{16-4(1)(2)}}{2(1)}$

$=\dfrac{4\pm\sqrt{8}}{2}$

$=\dfrac{4\pm2\sqrt{2}}{2}$

$=2(2\pm\sqrt{2})$

$=2\pm\sqrt{2}$

$t=2+\sqrt{2}$ & $t=2-\sqrt{2}$

$\doteq 3.4$ $\doteq 0.6$

$=2\pm\sqrt{2}$

∴ The ball is above 10m between 0.6s & 3.4s

Mar 5-4:49 PM

Ex 2 Playing Football on Mars

The force of gravity on Mars is less than half that on Earth. A ball thrown upward can be modelled using $h = -2t^2 + 15t + 2$ where h is the height in m and t is the time in seconds.

a) What is the initial height of the ball?

2m

b) What is the maximum height of the ball?
When does the ball reach its maximum height?

Graph

$h = -2\left(t^2 - \frac{15}{2}t + \frac{225}{16} - \frac{225}{16}\right) + 2$

$h = -2\left(t^2 - \frac{15}{2}t + \frac{225}{16}\right) + \frac{225}{8} + 2$

$= -2\left(t - \frac{15}{4}\right)^2 + \frac{241}{8}$

$V\left(\frac{15}{4}, \frac{241}{8}\right)$

3.75 → 30.125

∴ The ball reaches max height of 30.125m @ 3.75s

c) When does the ball hit the ground?

$h = -2t^2 + 15t + 2$

Can't factor - Use QUAD

$t = \frac{-15 \pm \sqrt{15^2 - 4(-2)(2)}}{2(-2)}$

$= \frac{-15 \pm \sqrt{241}}{-4}$

$\doteq -0.1$ & $t \doteq 7.6$

∴ landed @ 7.6s.

d) When is the ball more than 20 m above the ground?

Set $h = 20$

$20 = -2t^2 + 15t + 2$

$0 = -2t^2 + 15t - 18$

$0 = (-t+6)(-2t+3)$

$= -(t-6)(-2t+3)$

$t = 6$ $t = \frac{3}{2}$

$\frac{-2}{12}$ $\frac{-2}{3}$

$-\frac{1}{6}$ $-\frac{2}{3}$

e) If the same ball was thrown upward on the Earth, describe how the relationship/equation will change?

More gravity → not reach as high and sooner

f) The force of gravity on Jupiter is much greater than on the Earth. If the same ball was thrown upward on Jupiter, how would you expect the relationship to change?

Even more gravity → even greater effects.

Oct 3-8:47 AM

Ex. 3 Money, Money, Money

A study of the finances of Dominion Motors has shown that the profit of the company can be described by:

$$P = -2(n - 200)^2 + 450\,000$$

Where P represents the profit and n represents the number of cars sold.

a) What is the maximum profit?

Vertex (y-value)

b) How many cars have to be sold to reach the maximum profit?

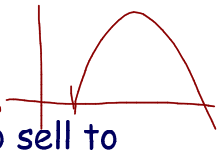
Vertex (x-value)

c) If they sell no cars what happens to their profit?

If n=0 .... profit is ....? Sub n=0

P = 370 000

(NOT REALISTIC)

should be ⇒ 

d) What is the minimum number of cars they need to sell to make a profit?

.... zero .....

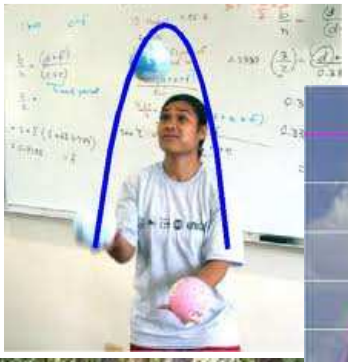
P =

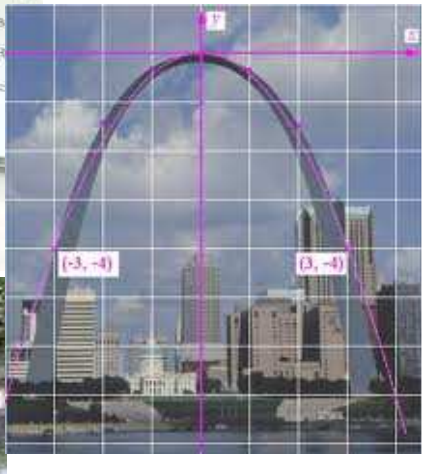
Graph

e) Is there ever a point when they could sell too many cars?

Yes. At x-int

HOMEWORK
-Handout 2.6





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