Complete the square for the quadratic relations

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

$$y = \underbrace{x^2 - 2x + 1}_{} - 1 + 5$$

$$y = (x-1)^2 + 4$$

$y = 3x^2 - 30x + 71$

$$y = 3(x^2 - 10x + 25 - 25) + 71$$

$$y = 3(x^2 - 10x + 25) - 75 + 71$$

$$y = 3(x-5)^2 - 4$$

5.2 Maxima and Minima

Ex. 1 The path of a basketball shot can be modelled by the equation
$h = -0.09d^2 + 0.9d + 2$ where h is the height of the basketball in metres and d is the horizontal distance of the ball from the player in metres.

a. What is the maximum height reached by the ball?

$$h = -0.09d^2 + 0.9d + 2$$
$$h = -0.09(d^2 - 10d + 25 - 25) + 2$$
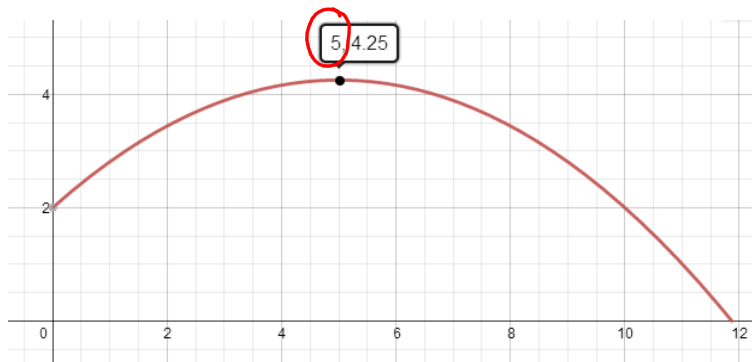$$h = -0.09(d^2 - 10d + 25) + 2.25 + 2$$
$$h = -0.09(d-5)^2 + 4.25$$

Vertex $(5, 4.25)$
↑
Max height

∴ Maximum height was 4.25m

b. How far is the ball from the player when it reaches maximum height?

5, 4.25

The ball is 5m from the player.

Ex. 2   The parabolic flight of an aircraft used to simulate weightlessness can be modelled by the quadratic equation:

$h = -10t^2 + 300t + 9750$

where h is the altitude of the aircraft in metres and t is the time in seconds, since weightlessness was achieved. Determine:

a. the maximum altitude reached by the aircraft.

$h = -10t^2 + 300t + 9750$

$h = -10(t^2 - 30t + 225 - 225) + 9750$

$h = -10(t^2 - 30t + 225) + 2250 + 9750$

$h = -10(t - 15)^2 + 12000$

$V(15, 12000)$

b. the number of seconds the aircraft takes to reach its maximum altitude after weightlessness is achieved.

$\therefore$ Max altitude is 12000m

15 seconds

$h = -10t^2 + 300t + 9750$

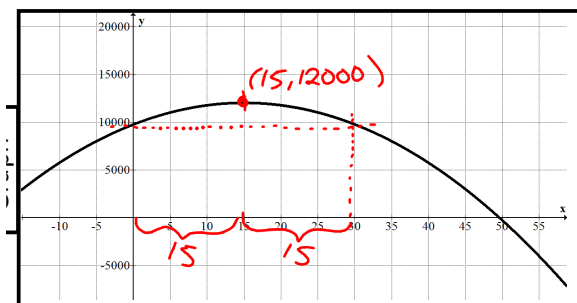c. the altitude of the aircraft when weightlessness is first achieved.

Sub in t = 0

$h = -10(0)^2 + 300(0) + 9750$

$h = 9750$

$\therefore$ Altitude was 9750 m

d. the number of seconds the simulation of weightlessness lasts, if weightlessness is lost at the same altitude as it is achieved.
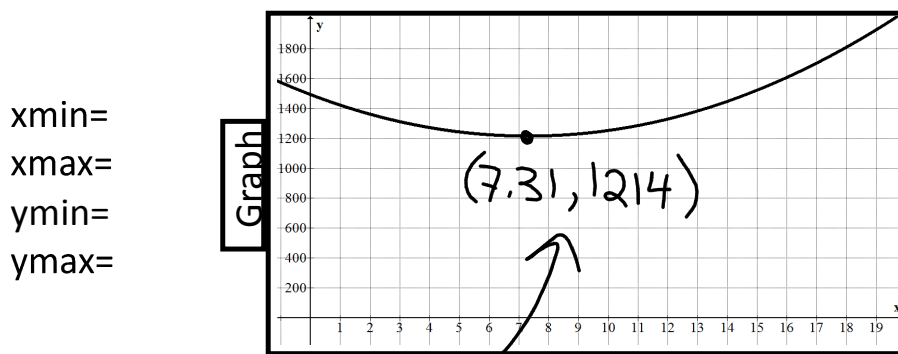

(15, 12000)

$\therefore$ It will take 30 seconds

x

3

Use a graphing calculator or software.

Ex. 3   The world production of gold is represented by G = 5.2t^2 - 76t + 1492, where G is the number of tonnes of gold and t is the number of years since 1970.
(ie. t= 5 represents 1975 etc.)

a)   Graph the given equation. Adjust the window so you can see the vertex.

xmin=
xmax=
ymin=
ymax=

Graph

(7.31, 1214)

b)   Determine the vertex.

c)   When was the minimum amount of gold mined?

$t = 7.31$
(years since 1970)

∴ Minimum was in 1977

d)   What was the least amount of gold mined in one year?

1214 tonnes

FBUHL

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