

3.4 Problem Solving

Ex 1 Factored form A

The height of a rocket is given by the function

$$h(t) = -4.9(t+2)(t-5)$$

where $h(t)$ is the height in meters and t is the time in seconds.

Which do I answer first?

Determine when the rocket should hit the ground.

Zeros! $t = -2$ & $t = 5$ \therefore The rocket hits the ground after 5s
inadmissible

What was the initial height of the rocket?

y-int $\left(\begin{array}{l} - \text{expand to std form} \\ \text{OR} \\ - \text{Sub in } t=0 \end{array} \right) \rightarrow h(0) = -4.9(0+2)(0-5)$
 $= -4.9(2)(-5)$
 $= 49$

\therefore Rocket's initial height is 49m

When does the rocket reach the maximum height?

x-value of vertex (axis of symm) $t = \frac{-2+5}{2}$
 $= 1.5$

\therefore Max occurs at $t = 1.5$ sec

What is the maximum height of the rocket?

y-value of vertex $\left(\begin{array}{l} - \text{convert to std} \\ \text{convert to vertex} \\ - \text{Sub in axis of symm} \end{array} \right)$

$$h(1.5) = -4.9(1.5+2)(1.5-5)$$

$$= 60.025$$

\therefore Max height is 60.025m

State the domain and range as it applies to the situation.

$$D = \{0 \leq t \leq 5, t \in \mathbb{R}\}$$

$$R = \{0 \leq h(t) \leq 60.025, h(t) \in \mathbb{R}\}$$

Ex 2 Vertex form \star

The height of football that has been thrown is modelled by the equation:
 $h(t) = -4(t - 2)^2 + 17$ where $h(t)$ is the height in meters and time t is in seconds

Which do I answer first?

What is the maximum height of the ball?

When does the ball reach the maximum height? } Vertex

Vertex(2,17) The ball reached a max height of 17m @ 2 seconds

What was the initial height of the ball?

Sub in $t=0$
 $h(0) = -4(0-2)^2 + 17$ \therefore Initial height was 1m
 $= -4(4) + 17$
 $= -16 + 17$
 $= 1$

Determine when the ball should hit the ground.

Need to find $h(t) = 0$
 $0 = -4(t-2)^2 + 17$
 $-17 = -4(t-2)^2$
 $\frac{17}{4} = (t-2)^2$
 $\pm\sqrt{\frac{17}{4}} = t-2$
 $\pm\sqrt{\frac{17}{4}} + 2 = t$

$t = \sqrt{\frac{17}{4}} + 2$
 ≈ 4.06

$t = -\sqrt{\frac{17}{4}} + 2$
 ≈ -0.06
inadmissible

\therefore The ball reaches the ground at 4.06 seconds

For how long will the ball be at or above a height of 9 m?

Need to find $h(t) = 9$ picture it

$9 = -4(t-2)^2 + 17$
 $-8 = -4(t-2)^2$
 $2 = (t-2)^2$
 $\pm\sqrt{2} = t-2$
 $\pm\sqrt{2} + 2 = t$

$t = \sqrt{2} + 2$
 ≈ 3.41

$t = -\sqrt{2} + 2$
 ≈ 0.59

time above 9m
 $= 3.41 - 0.59$
 $= 2.82$

\therefore The ball was at or above 9m for 2.82 seconds

State the domain and range as it applies to the situation.

$D = \{0 \leq t \leq 4.06 \mid t \in \mathbb{R}\}$
 $R = \{0 \leq h(t) \leq 17 \mid h(t) \in \mathbb{R}\}$

Practice: Handout 3.4

