Applications of Quadratic Functions

A football is kicked straight up in the air. Its height is modeled by the following equation:

$$h = -5(t - 0)(t - 4)$$ ← factored form

$$y = -5(x-0)(x-4)$$

where

- **h is the height of the football in metres.**
- **t is the time after the football was kicked in seconds.**

a) What was the height of the football 1 second after it was kicked?

Set $t=1$

$h = -5(1-0)(1-4)$

$= -5(1)(-3)$ → $= 15$m

b) What are the t-intercepts?

0 & 4

c) Expand the equation to express it in standard form.

$h = -5(t-0)(t-4)$

$= -5(t^2 - 4t - 0t + 0)$

$= -5(t^2 - 4t + 0)$

$h = -5t^2 + 20t + 0$ (0 is the h-int)

standard form

d) What is the h-intercept?

0

e) Determine the vertex of the above function.

$4 + \frac{6+2}{2}$

Vertex

$t = \frac{0+4}{2}$

$t = 2$

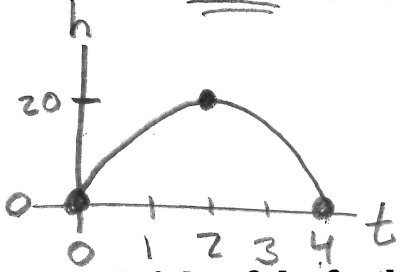
$h = -5(2-0)(2-4)$

$= -5(2)(-2)$

$h = 20$

∴ vertex is $(2, 20)$ t, h

f) Use the above information to sketch a graph of height vs. time.



g) What was the maximum height of the football and when did it reach this height?

The football reached a maximum height of 20m after 2 seconds.

h) For how long was the football airborne?

The football was airborne for 4 seconds.

Homework

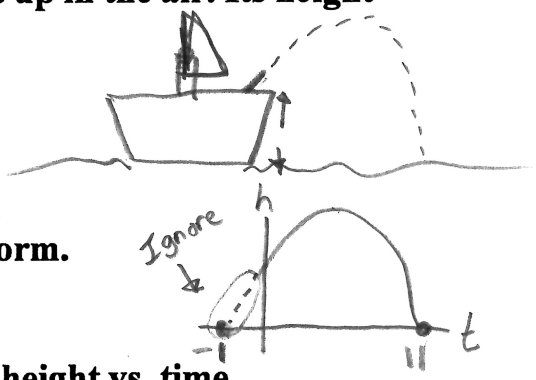
1. A football is kicked straight up in the air. Its height is modeled by the following equation:

$$h = -5(t - 0)(t - 8)$$

a) **What was the height of the football 1 second after it was kicked?**
b) **What are the t-intercepts?**
c) **Expand the equation to express it in standard form.**
d) **What is the h-intercept?**
e) **Determine the vertex of the above function.**
f) **Use the above information to sketch a graph of height vs. time.**
g) **What was the maximum height of the football and when did it reach this height?**
h) **For how long was the football airborne?**

2. A flare is launched from the deck of a ship straight up in the air. Its height *above the water* is modeled by the following equation:

$$h = -5(t + 1)(t - 11)$$



a) **What are the t-intercepts?**
b) **Expand the equation to express it in standard form.**
c) **What is the h-intercept?**
d) **Determine the vertex of the above function.**
e) **Use the above information to sketch a graph of height vs. time.**
f) **What was the maximum height of the flare and when did it reach this height?**
g) **For how long was the flare airborne?**
h) **How high is the deck above the water ?**
Hint: t=0 when the flare is the same height as the deck.

Homework

1. a) set $t = 1$

$h = -5(1-0)(1-8)$

$= -5(1)(-7)$

$= 35m$

b) t-ints: 0 & 8

c) $h = -5(t-0)(t-8)$

$= -5(t^2 - 8t - 0t + 0)$

$= -5(t^2 - 8t + 0)$

$= -5t^2 + 40t - 0$

d) h-int: 0

e) vertex

$t = \frac{(0)+(8)}{2}$ $\quad h = -5(4-0)(4-8)$

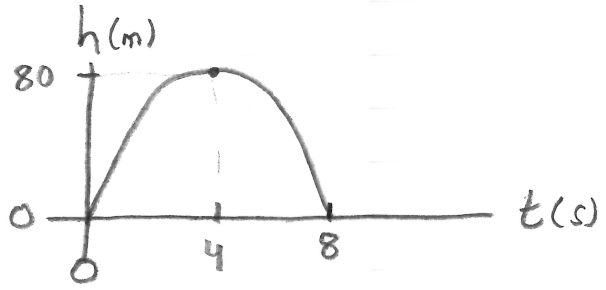
$= -5(4)(-4)$

$= \frac{8}{2}$ $\quad h = 80$

t, h

$t = 4$ $\quad \therefore$ The vertex is $(4, 80)$

f)



g) The football reached a maximum height of 80m after 4 seconds.

h) The football was airborne for 8 seconds.

2. a) t-ints: -1 & 11

b) $h = -5(t+1)(t-11)$

$= -5(t^2 - 11t + 1t - 11)$

$= -5(t^2 - 10t - 11)$

$h = -5t^2 + 50t + 55$

c) h-int: 55

d) <u>vertex</u>

$t = \frac{(-1)+(11)}{2}$

$= \frac{10}{2}$

$= 5$

$h = -5(5+1)(5-11)$

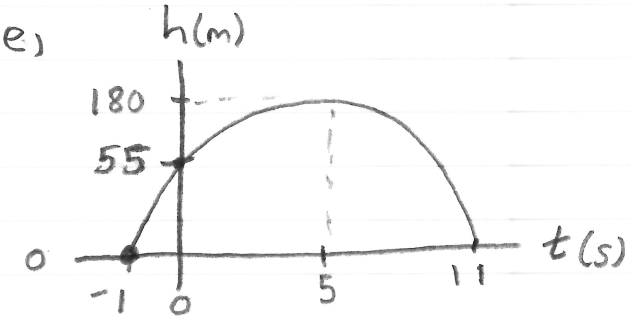
$= -5(6)(-6)$

$= 180$

$\therefore$ The vertex is $(5, 180)$

t h

e)



f) The flare reached a maximum height of 180m after 5 seconds.

g) The flare was airborne for 11 seconds.

h) The deck of the ship is 55m of the water.