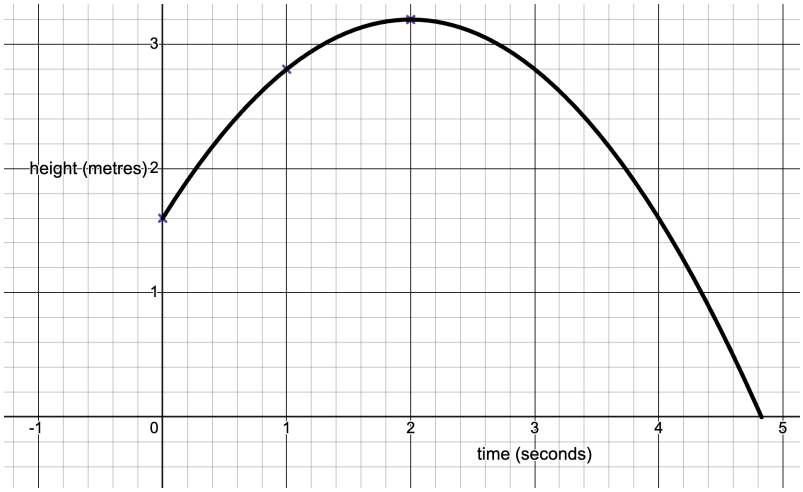
Modelling functions: quadratics and cubics

Name……

1. A basketball player takes a video of her shot. She measures the height of the ball in metres over time in seconds. She gets the following graph:



The basketball passes through the following coordinates:

$A(0,1.6)$, $B(1,2.8)$, $C(2,3.2)$

(a) How high was the basketball when she initially took the shot?

$1.6m$

(b) The motion of the ball can be modelled by the equation $h = at^2 + bt + c$. Find an equation for the height of the basketball, h in terms of time t.

$$1.6 = c$$
$$2.8 = a + b + 1.6$$
$$3.2 = 4a + 2b + 1.6$$
$$a + b = 1.2$$
$$4a + 2b = 1.6$$
$$h = -0.4t^2 + 1.6t + 1.6$$

(c) What was the maximum height reached by the basketball?

$3.2m$

(d) After how many seconds had the basketball hit the floor?

$4.83\ s$

(e) State an appropriate domain for this model.

$0 \leq t \leq 4.83$

2. A baseball player throws a ball and finds that the vertical, y and horizontal distance, x in metres travelled from an origin (0,0) can be given by: $y = -0.3375x^2 + 4.025x + 1.3$.

(a) Find the maximum height reached by the ball.

$13.3m$

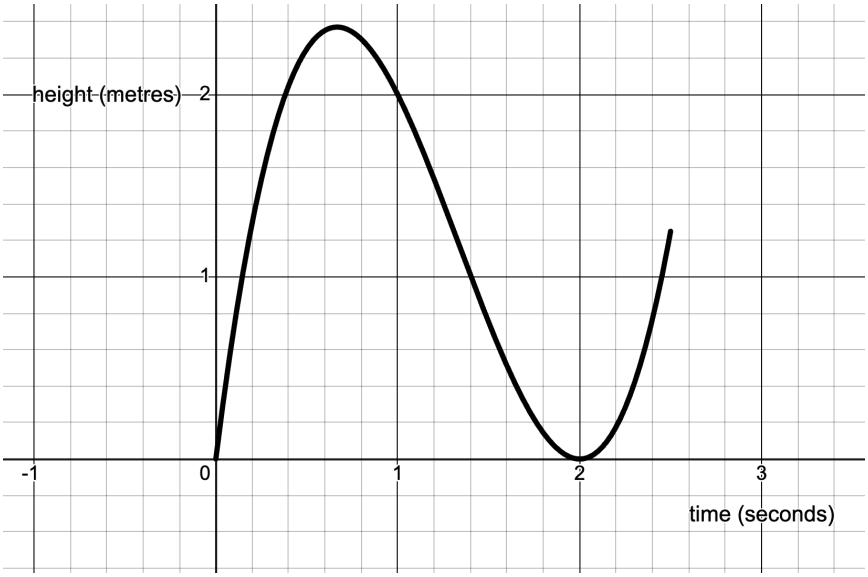
(b) Find the distance travelled by the ball when it hits the floor.

$12.2s$

(c) State an appropriate domain for this model.

$0 \leq t \leq 12.2$

3. A ball is thrown in the air and its height, h in metres is measured over time t, for the first 2.5 seconds. The motion of the ball can be modelled by the equation $h = at^3 - bt^2 + ct$. This is shown below:



The ball passes through the following points $A(1, 2)$, $B(1.5, 0.75)$, $C(1.8, 0.144)$.

(a) Find an equation for the height of the ball, h in terms of time t.

$$2 = a - b + c$$

$$0.75 = 3.375a - 2.25b + 1.5c$$

$$0.144 = 5.832a - 3.24b + 1.8c$$

$$h = 2t^3 - 8t^2 + 8t$$

(b) What was the maximum height reached by the ball?

$$2.37m$$

(c) Explain what is happening to the ball when $t = 2$.

It is hitting the ground (and bouncing)

(d) After how many seconds was the ball 1 metre high?

$$2t^3 - 8t^2 + 8t = 1$$

$$0.145, 1.40, 2.45$$

(e) Why is it not appropriate to use this model to predict the height of the ball after 4 seconds?

A bouncing ball will not keep rising forever – it will fall back to the ground

4. The height, h of a javelin above the ground in metres after t seconds is given by: $h = -4.5t^2 + 9t + 1.7$.

(a) What is the initial height of the javelin?

$1.7m$

(b) After how many seconds has the javelin reached its maximum height?

$1s$

(c) When does the javelin first reach 5 metres in height?

$0.484s$

(d) After how many seconds does the javelin hit the ground?

$2.17s$