Modelling With Quadratic Functions Exam Questions (Suitable For All Exam Boards)

Q1

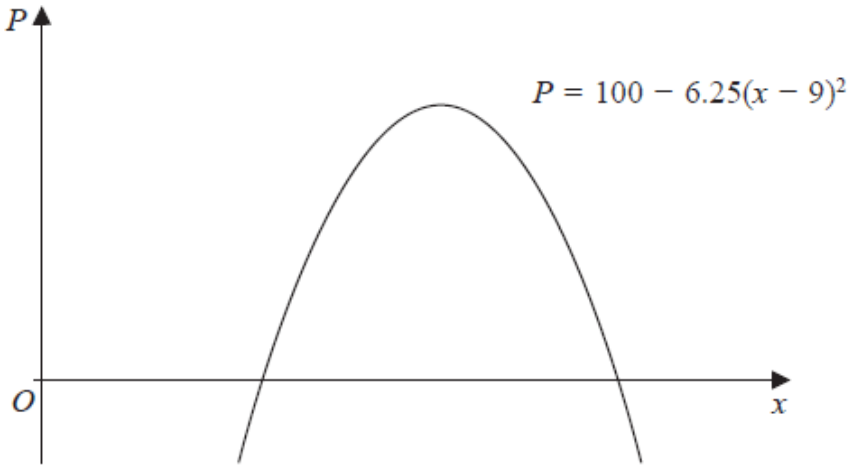

Figure 1

A company makes a particular type of children's toy.

The annual profit made by the company is modelled by the equation

$$P = 100 - 6.25(x - 9)^2$$

where P is the profit measured in thousands of pounds and x is the selling price of the toy in pounds.

A sketch of P against x is shown in Figure 1.

Using the model,

(a) explain why £15 is not a sensible selling price for the toy.

(2)

Given that the company made an annual profit of more than £80 000

(b) find, according to the model, the least possible selling price for the toy.

(3)

The company wishes to maximise its annual profit.

State, according to the model,

(c) (i) the maximum possible annual profit,

(ii) the selling price of the toy that maximises the annual profit.

(2)

Q2

A company started mining tin in Riverdale on 1st January 2019.

A model to find the total mass of tin that will be mined by the company in Riverdale is given by the equation

$$T = 1200 - 3(n - 20)^2$$

where T tonnes is the total mass of tin mined in the n years after the start of mining.

Using this model,

(a) calculate the mass of tin that will be mined up to 1st January 2020,

(1)

(b) deduce the maximum total mass of tin that could be mined,

(1)

(c) calculate the mass of tin that will be mined in 2023.

(2)

(d) State, giving reasons, the limitation on the values of n.

(2)

Q3

A ball is thrown from the top of a cliff. The height h, in metres, of the ball above the ground level after t seconds is modelled by the function $h(t) = 115 + 12.25t - 4.9t^2$

a Give a physical interpretation of the meaning of the constant term 115 in the model.

(1)

b Write $h(t)$ in the form $A - B(t - C)^2$, where A, B and C are constants to be found.

(3)

c Using your answer to part **b**, or otherwise, find, with justification

i the time taken after the ball is thrown for it to reach ground level **(3)**

ii the maximum height of the ball above the ground and the time after which this maximum height is reached. **(2)**

Q4

John and Paul are carrying out an experiment.

The table shows their results for x and y.

x	0	2	3	4
y	4	0	0.25	0

Paul proposes that the relationship should be modelled by $y = k(x-2)(x-4)$. This is shown in Fig. 10.

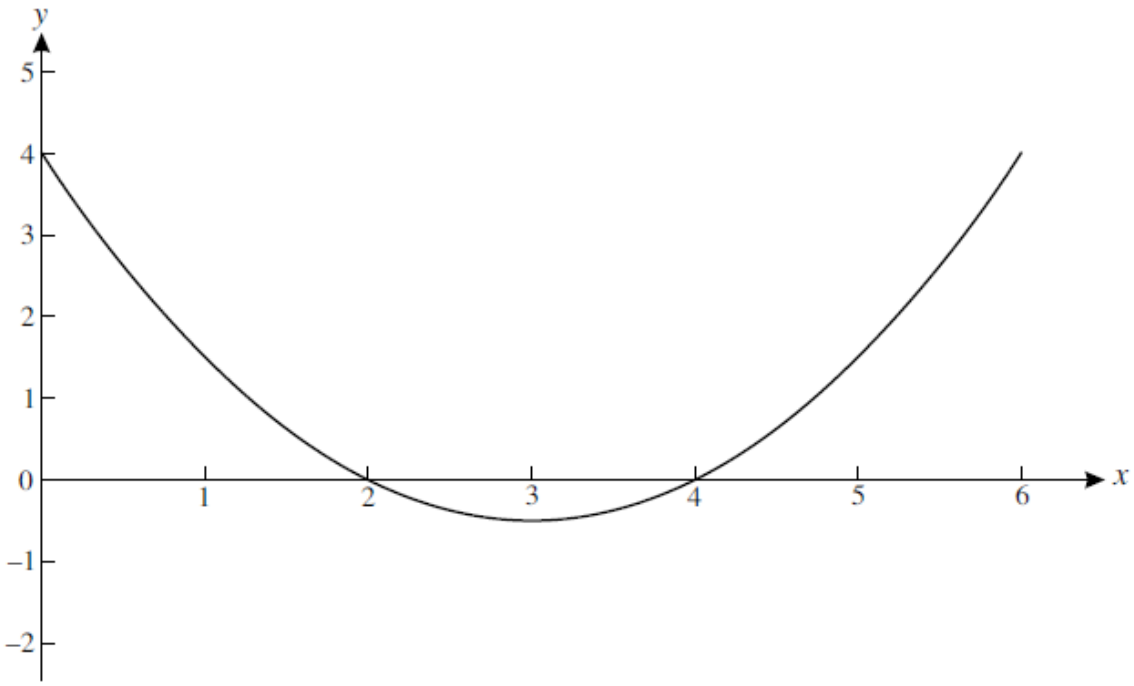

Fig. 10

(i) Find the value of k for which the points (0, 4), (2, 0) and (4, 0) satisfy this equation. **[2]**

John proposes a different model, using $y = c(x-2)^2(x-4)$.

(ii) Find the value of c for which the points (0, 4), (2, 0) and (4, 0) satisfy this equation. **[2]**

(iii) Which is the better model for John and Paul's results? Give a reason for your answer. **[2]**

Q5

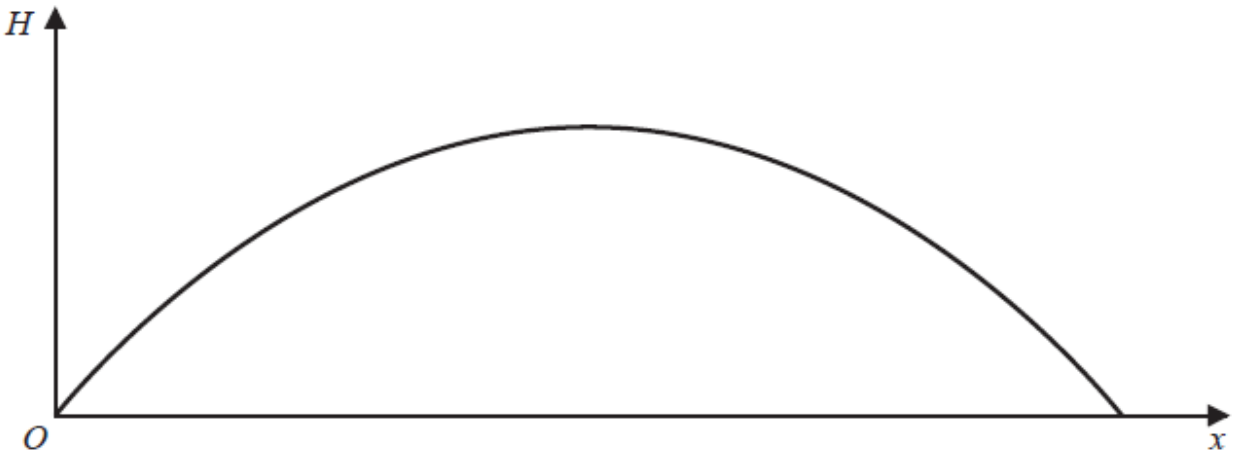

Figure 1

Figure 1 is a graph showing the trajectory of a rugby ball.

The height of the ball above the ground, H metres, has been plotted against the horizontal distance, x metres, measured from the point where the ball was kicked.

The ball travels in a vertical plane.

The ball reaches a maximum height of 12 metres and hits the ground at a point 40 metres from where it was kicked.

(a) Find a quadratic equation linking H with x that models this situation.

(3)

The ball passes over the horizontal bar of a set of rugby posts that is perpendicular to the path of the ball. The bar is 3 metres above the ground.

(b) Use your equation to find the greatest horizontal distance of the bar from O.

(3)

(c) Give one limitation of the model.

(1)