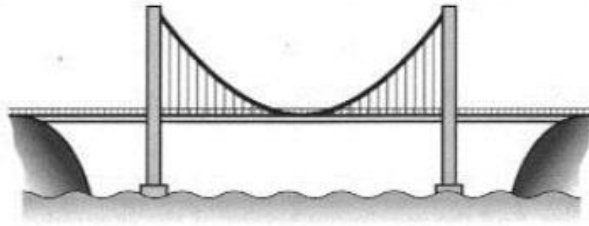


Modelling with Quadratics

- 1 The diagram shows a section of a suspension bridge carrying a road over water.



Problem-solving

For part **a**, make sure your answer is in the context of the model.

The height of the cables above water level in metres can be modelled by the function $h(x) = 0.00012x^2 + 200$, where x is the displacement in metres from the centre of the bridge.

- a** Interpret the meaning of the constant term 200 in the model. (1 mark)
- b** Use the model to find the two values of x at which the height is 346 m. (3 marks)
- c** Given that the towers at each end are 346 m tall, use your answer to part **b** to calculate the length of the bridge to the nearest metre. (1 mark)

- 2 A car manufacturer uses a model to predict the fuel consumption, y miles per gallon (mpg), for a specific model of car travelling at a speed of x mph.

$$y = -0.01x^2 + 0.975x + 16, x > 0$$

- a** Use the model to find two speeds at which the car has a fuel consumption of 32.5 mpg. (3 marks)
- b** Rewrite y in the form $A - B(x - C)^2$, where A , B and C are constants to be found. (3 marks)
- c** Using your answer to part **b**, find the speed at which the car has the greatest fuel efficiency. (1 mark)
- d** Use the model to calculate the fuel consumption of a car travelling at 120 mph. Comment on the validity of using this model for very high speeds. (2 marks)

- 3 A fertiliser company uses a model to determine how the amount of fertiliser used, f kilograms per hectare, affects the grain yield g , measured in tonnes per hectare:

$$g = 6 + 0.03f - 0.00006f^2$$

- a** According to the model, how much grain would each hectare yield without any fertiliser? (1 mark)
- b** One farmer currently uses 20 kilograms of fertiliser per hectare. How much more fertiliser would he need to use to increase his grain yield by 1 tonne per hectare? (4 marks)

- 4 A football stadium has 25 000 seats. The football club know from past experience that they will sell only 10 000 tickets if each ticket costs £30. They also expect to sell 1000 more tickets every time the price goes down by £1.

- a** The number of tickets sold t can be modelled by the linear equation $t = M - 1000p$, where $£p$ is the price of each ticket and M is a constant. Find the value of M . (1 mark)

The total revenue, $£r$, can be calculated by multiplying the number of tickets sold by the price of each ticket. This can be written as $r = p(M - 1000p)$.

- b** Rearrange r into the form $A - B(p - C)^2$, where A , B and C are constants to be found. (3 marks)
- c** Using your answer to part **b** or otherwise, work out how much the football club should charge for each ticket if they want to make the maximum amount of money. (2 marks)