

Question 2

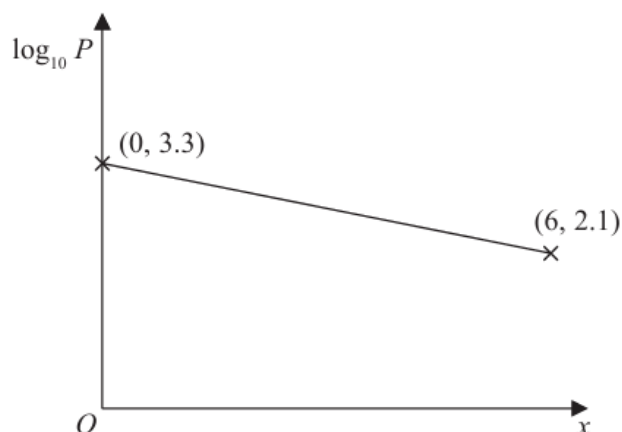


Figure 2

A chimney emits smoke particles.

On a particular day, the concentration of smoke particles in the air emitted by this chimney, P parts per million, is measured at various distances, x km, from the chimney.

Figure 2 shows a sketch of the linear relationship between $\log_{10} P$ and x that is used to model this situation.

The line passes through the point $(0, 3.3)$ and the point $(6, 2.1)$

(a) Find a complete equation for the model in the form

$$P = ab^x$$

where a and b are constants. Give the value of a and the value of b each to 4 significant figures.

(4)

(b) With reference to the model, interpret the value of ab

(1)

Question 11

The owners of a nature reserve decided to increase the area of the reserve covered by trees.

Tree planting started on 1st January 2005.

The area of the nature reserve covered by trees, A km², is modelled by the equation

$$A = 80 - 45e^{ct}$$

where c is a constant and t is the number of years after 1st January 2005.

Using the model,

- (a) find the area of the nature reserve that was covered by trees just before tree planting started.

(1)

On 1st January 2019 an area of 60 km² of the nature reserve was covered by trees.

- (b) Use this information to find a complete equation for the model, giving your value of c to 3 significant figures.

(4)

On 1st January 2020, the owners of the nature reserve announced a long-term plan to have 100 km² of the nature reserve covered by trees.

- (c) State a reason why the model is not appropriate for this plan.

(1)

Question 12

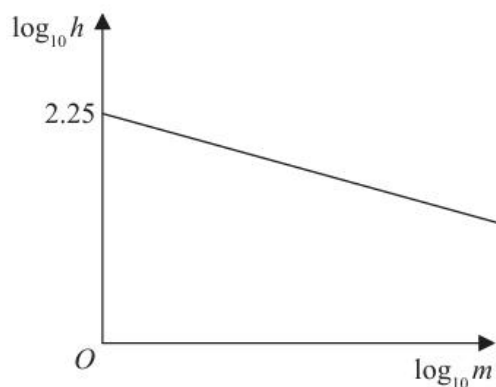


Figure 2

The resting heart rate, h , of a mammal, measured in beats per minute, is modelled by the equation

$$h = pm^q$$

where p and q are constants and m is the mass of the mammal measured in kg.

Figure 2 illustrates the linear relationship between $\log_{10} h$ and $\log_{10} m$

The line meets the vertical $\log_{10} h$ axis at 2.25 and has a gradient of -0.235

- (a) Find, to 3 significant figures, the value of p and the value of q . (3)

A particular mammal has a mass of 5 kg and a resting heart rate of 119 beats per minute.

- (b) Comment on the suitability of the model for this mammal. (3)
- (c) With reference to the model, interpret the value of the constant p . (1)

Question 14

The temperature, $\theta^\circ\text{C}$, of a cup of tea t minutes after it was placed on a table in a room, is modelled by the equation

$$\theta = 18 + 65e^{-\frac{t}{8}} \quad t \geq 0$$

Find, according to the model,

- (a) the temperature of the cup of tea when it was placed on the table, (1)
- (b) the value of t , to one decimal place, when the temperature of the cup of tea was 35°C . (3)
- (c) Explain why, according to this model, the temperature of the cup of tea could not fall to 15°C . (1)

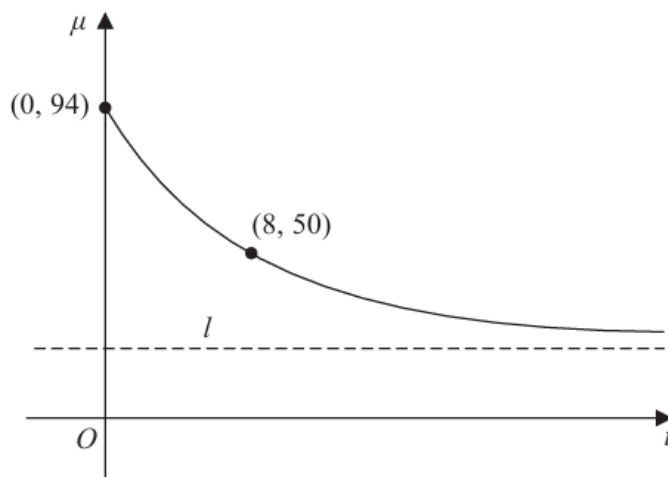


Figure 2

The temperature, $\mu^\circ\text{C}$, of a second cup of tea t minutes after it was placed on a table in a different room, is modelled by the equation

$$\mu = A + Be^{-\frac{t}{8}} \quad t \geq 0$$

where A and B are constants.

Figure 2 shows a sketch of μ against t with two data points that lie on the curve.

The line l , also shown on Figure 2, is the asymptote to the curve.

Using the equation of this model and the information given in Figure 2

- (d) find an equation for the asymptote l . (4)

