Exponentials and Logarithms 2

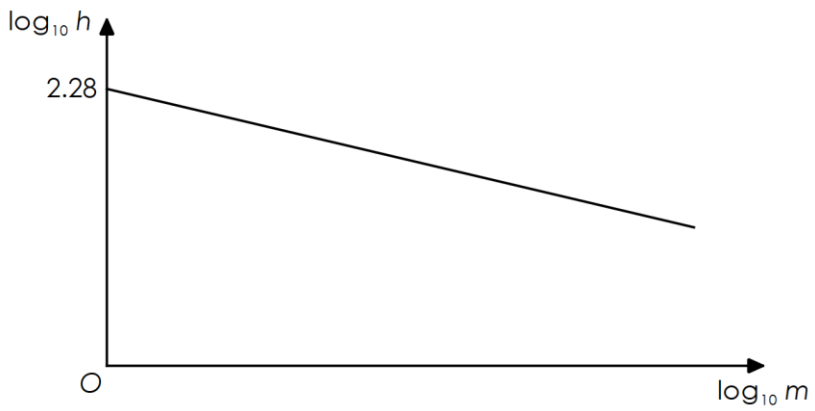

Figure 1

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

The line meets the vertical $\log_{10} h$ axis at 2.28 and has a gradient of -0.175

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

(3 marks)

A particular mammal has a mass of 4 kg and a resting heart rate of 153 beats per minute.

b. Comment on the suitability of the model for this mammal.

(3 marks)

c. With reference to the model, interpret the value of the constant p.

(1 mark)

a. Comparing the graph to $y = mx + c$

$$\log_{10} h = -0.175 \log_{10} m + 2.28$$

which leads to

$$h = 10^{-0.175\log_{10} m + 2.28} \text{ and } h = 10^{2.28} \times m^{-0.175}$$

1 mark

So:

$$p = 10^{-0.175}$$
$$= 191$$

1 mark

$$q = -0.175$$

1 mark

b. Substitute m = 4 into $h = 191 \times m^{-0.175}$

$$h = 191 \times 4^{-0.175}$$

1 mark

$$= 150$$

1 mark

which is reasonably accurate to 2 significant figures, so a suitable model.

1 mark

c. p would be the resting heart rate in bpm of a mammal with a mass of 1kg.

1 mark