

The challenges of size

Question Paper

Level	GCSE
Subject	Biology (Gateway Science)
Exam Board	OCR
Topic	Scaling Up
Sub-Topic	The challenges of size
Booklet	Question Paper

Time Allowed: 38 minutes

Score: /31

Percentage: /100

2 (a) Look at the table about some different animals.

It shows the mean (average) mass, heart rate and life span.

It also shows the mean (average) number of heart beats in a life time, in billions.

(1 billion = 1 thousand million.)

Animal	Mass in g	Heart rate per minute	Life span in years	Life time heart beats in billions
hamster	60	450	3	0.7
chicken	1 500	275	15	2.2
cat	2 000	150	15	1.2
pig	150 000	70	25	0.9
horse	1 200 000	44	40	0.9
whale	120 000 000	20	80	0.8

(i) Look at the information in the table.

What patterns can you see between mass, heart rate and life span?

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(ii) The ‘heart beat hypothesis’ states that:

‘every animal has a similar number of heart beats in its life time’.

Discuss whether or not the information in the table supports the ‘heart beat hypothesis’.

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(iii) This table shows data for humans.

Animals	Mass in g	Heart rate per minute	Life span in years	Life time heart beats in billions
human	90 000	60	70	2.2

Do humans fit the patterns shown by the other animals?

Explain your answer.

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(b) Scientists have made a four-year study of over 31 000 heart disease patients from around the world.

The scientists compared patients with high rates (greater than 78 beats per minute) with patients with low heart rates (58 or fewer beats per minute).

They found that the patients with high heart rates had:

- a 39% greater chance of having a heart attack
- a 77% greater chance of dying from a heart attack.

(i) This study will be important for doctors.

Explain why.

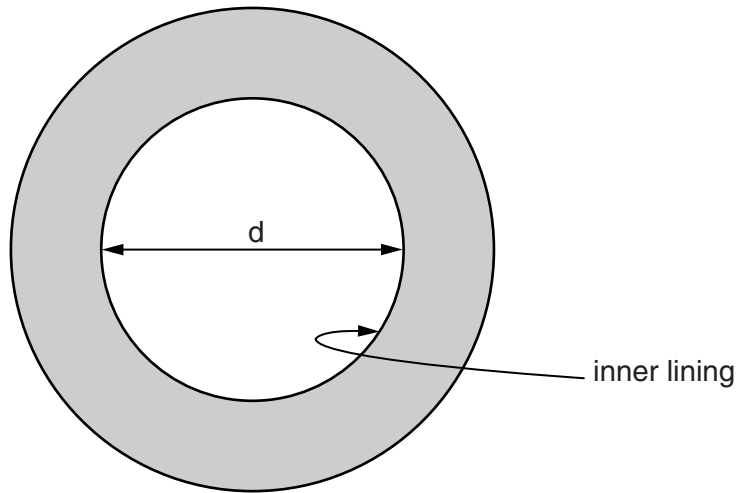
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(ii) Describe any limitations in the data.

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- 4 (a) The diagram represents a section through the human small intestine.

The magnification of the diagram is $\times 4$.



- (i) Use the diagram to find out the actual diameter (d) in a real section.

diameter = cm

[1]

- (ii) The length (l) of a human's small intestine is 550 cm.

Work out the total surface area of the inner lining.

Assume the lining is a smooth cylinder.

Use the formula: $\text{area} = \pi \times d \times l$

($\pi = 3.14$)

surface area = cm^2

[2]

- (iii) The actual surface area of a human's small intestine is always much greater than the answer produced using the formula in (a)(ii).

Explain why.

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(b) Scientists have measured the actual surface area in the small intestine of rats.

They measured the surface area in non-pregnant female rats.

They also measured the surface area in female rats that were feeding their young on breast milk.

The table shows their results.

	Average length of small intestine in cm	Average actual surface area of lining in cm ²
Non-pregnant rats	100	570
Breast-feeding rats	100	970

Suggest an explanation for the scientists' results.

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[Total: 7]