OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY

2805/05

Mammalian Physiology and Behaviour

Friday	**24 JUNE 2005**	Afternoon	1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
    Electronic calculator
    Ruler (cm/mm)

Candidate Name	Centre Number	Candidate Number

TIME   1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Read the questions carefully before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	12	
2	17	
3	15	
4	15	
5	18	
6	13	
TOTAL	90	

This question paper consists of 20 printed pages and 4 blank pages.

Answer all the questions.

1   The human brain is an organ, protected by the skull. The largest part of the human brain is the cerebrum. The surface of the cerebrum is covered by a highly folded region of tissue, called the cerebral cortex. The cerebrum contains regions of mostly myelinated axons, called white matter, and regions of mostly cell bodies and dendrites, called grey matter.

   (a) Explain why the cerebral cortex is a tissue, whereas the brain is an organ.

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   ....[3]

   (b) Explain the advantage of the cerebral cortex being highly folded.

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   ....

   ....[2]

   (c) Cerebrospinal fluid (CSF) surrounds the brain and fills the central cavities, known as ventricles.
   Suggest **two** functions of CSF.

   1 ....

   ....

   2 ....

   ....[2]

[Turn over

Fig. 1.1 shows the surface of the cerebrum and the location of some of its functions.

front | **middle** | **rear**

somatic motor control area

visual association area (visual memory)

spoken language area

auditory area (hearing)

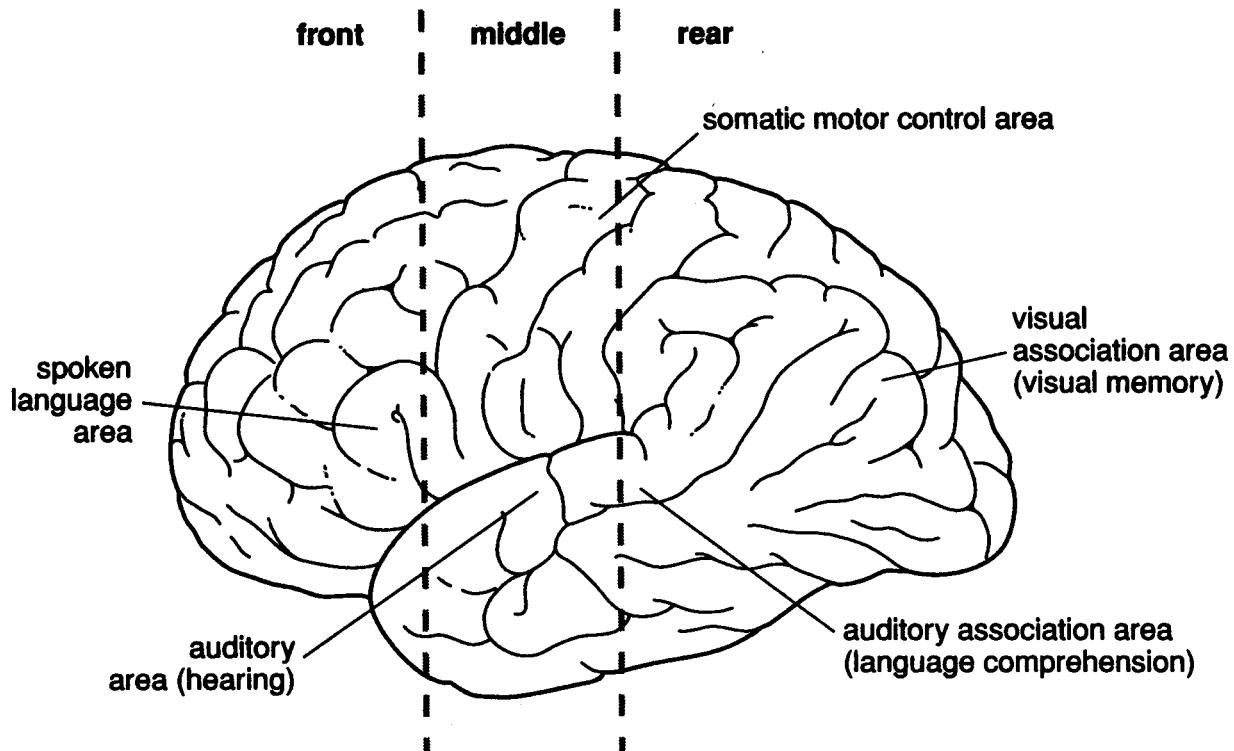auditory association area (language comprehension)

Fig. 1.1

(d) The following is a list of the functions of the brain. Put a tick (✓) in the box next to the function performed by the cerebrum.

control of the autonomic nervous system ☐

coordination of posture ☐

planning a task ☐

control of heart rate ☐   [1]

(e) Hydrocephalus is a disease in which children produce a large volume of CSF, which accumulates, putting pressure on the brain and causing damage to neurones. Table 1.1 shows how hydrocephalus affects the total amount of white and grey matter within the cerebrum.

Table 1.1

region of cerebrum	mean total amount of white and grey matter as a percentage of cerebrum volume	
	unaffected children	children with hydrocephalus
front	88.8	90.7
middle	90.4	85.3
rear	90.7	84.0

Children with hydrocephalus show the following features:

- poor understanding of written and spoken words
- loss of fine motor skills
- poor memory of objects
- normal hearing
- normal speech production.

Explain, using information from Fig.1.1 and Table 1.1, the features seen in children with hydrocephalus.

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....[4]

[Total: 12]

[Turn over

2 Fig. 2.1 is a diagram showing four types of cell in a gastric gland of the stomach wall. These cells are involved in the secretion of gastric juice.
Some of the stages in controlling the release of gastric juice are shown in Fig. 2.1.
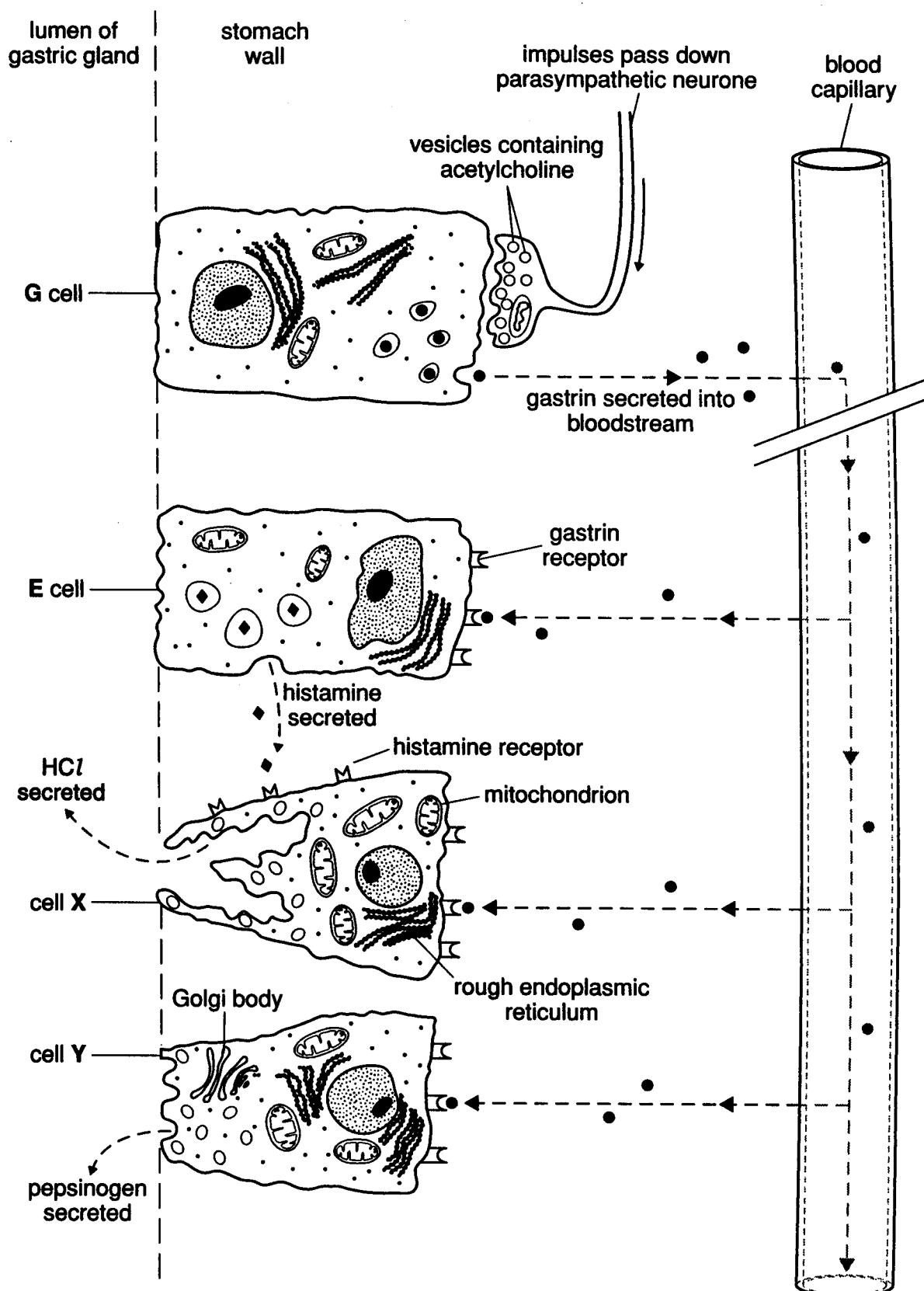
Fig. 2.1

(a) Name:

cell **X** ....[5]..

cell **Y** ....

one other component of gastric juice, secreted by cells in a gastric gland, which is **not** shown in Fig. 2.1.

....[3]

(b) (i) Cells of type **X** have many mitochondria.
Explain how the large number of mitochondria in cells of type **X** is related to the function of these cells.

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....[2]

(ii) Describe the role of the Golgi body in cell **Y**.

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....[2]

(c) Describe, **using only the information in Fig. 2.1**, the sequence of events leading to the release of hydrochloric acid.

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....[5]

[Turn over

(d) Hydrochloric acid can damage cells of the stomach wall, leading to the formation of an ulcer.

Suggest how certain antihistamine drugs, which have a similar shape to the histamine molecule, reduce the incidence of ulcers.

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....[2]

(e) Pepsin is an endopeptidase enzyme, which catalyses hydrolysis reactions.
Explain what is meant by

endopeptidase;

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....

hydrolysis reactions.

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....[3]

[Total: 17]

3 Fig. 3.1 shows two types of vertebrae from the vertebral column of a mammal, shown to the same scale.

thoracic vertebra
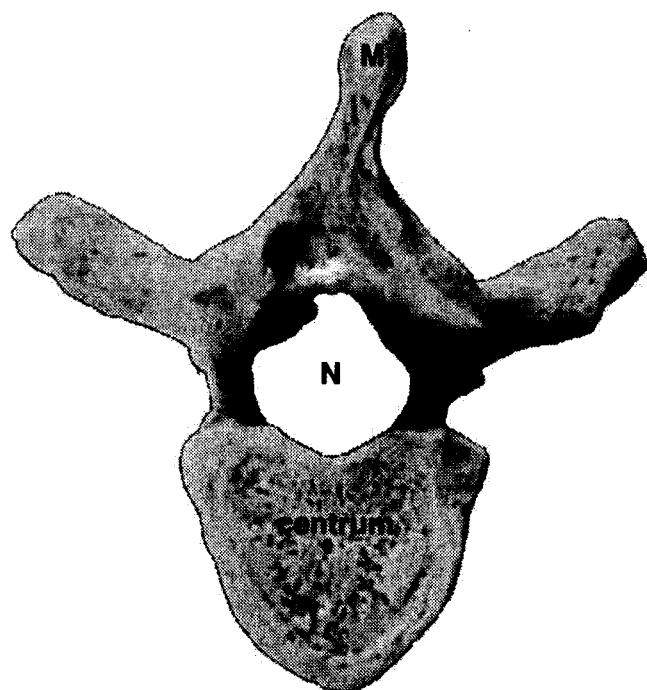
lumbar vertebra
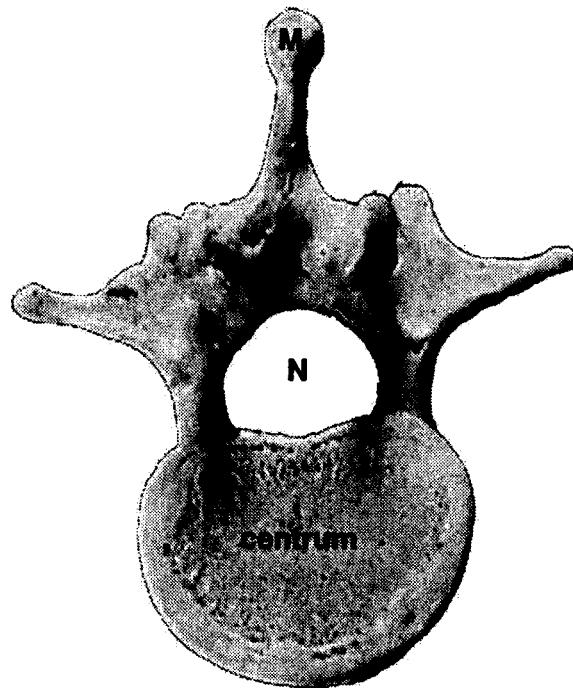
Fig. 3.1

(a) Name **M** and **N** and describe **one** function of each.

M ....

function ....

....

N ....

function ....

....[4]

(b) State why the centrum in the lumbar vertebra is larger than that in the thoracic vertebra.

....

....[1]

(c) Label a transverse process and an articular process **on the lumbar vertebra in Fig. 3.1.** Use the letters **T** and **A** as follows:

T – transverse process

A – articular process   [2]

(d) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Osteoarthritis and osteoporosis are two diseases that affect the mammalian skeleton.

Describe the **differences** in causes and symptoms of these two diseases.

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....[7]

Quality of Written Communication [1]

[Total: 15]

4 **(a)** During winter, the brown bear, *Ursus arctus*, enters a long period of inactivity. Whilst inactive, the brown bear undergoes various physiological changes, for example a decrease in core body temperature and a decrease in resting heart rate. There are also changes in the brown bear's metabolism of protein and lipids.

Explain the role of the autonomic nervous system in achieving a decrease in resting heart rate.

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....[3]

During periods of inactivity, the brown bear reabsorbs all urea molecules from the filtrate in its kidneys and from the bladder. Urea is then transported in the bloodstream to the large intestine. Bacteria in the large intestine convert urea to ammonia and carbon dioxide, which diffuse back into the blood. When the ammonia reaches the liver, it is converted into amino acids. These newly produced amino acids are then used to synthesise proteins in the body, especially in the liver and muscle cells.

(b) Name **two** plasma proteins that will be produced by the liver.

1 ....

2 ....[2]

(c) Describe the **similarities** and **differences** between the metabolism of nitrogen-containing compounds in inactive brown bears, **as described in the passage**, and in humans.

similarities

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differences

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....[5]

The blood plasma cholesterol concentration of inactive brown bears rises to twice the concentration found in normally active bears and in humans. However, brown bears do not suffer any of the cardiovascular diseases associated with high cholesterol concentrations in humans, as their liver produces a protective substance, which prevents these diseases from developing.

(d) Explain the importance of cholesterol in the metabolism of mammals.

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....[3]

[Turn over

(e) Suggest how the protective substance produced by their liver prevents brown bears developing cardiovascular diseases.

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....[2]

[Total: 15]

5 When a book is held in the hand, as shown in Fig. 5.1 **A**, there is a constant load. The muscles of the upper arm contract to produce a force that opposes the load, so maintaining the position of the hand.

Muscle spindles are a type of stretch receptor, which detect changes in the length of muscles.

When a second book is placed in the hand, as shown in Fig. 5.1 **B**, the load increases. This stretches the muscle spindle resulting in an almost immediate increase in the contraction of the muscles of the upper arm, to maintain the position of the hand, as shown in Fig. 5.1 **C**.

spinal cord in cross-section
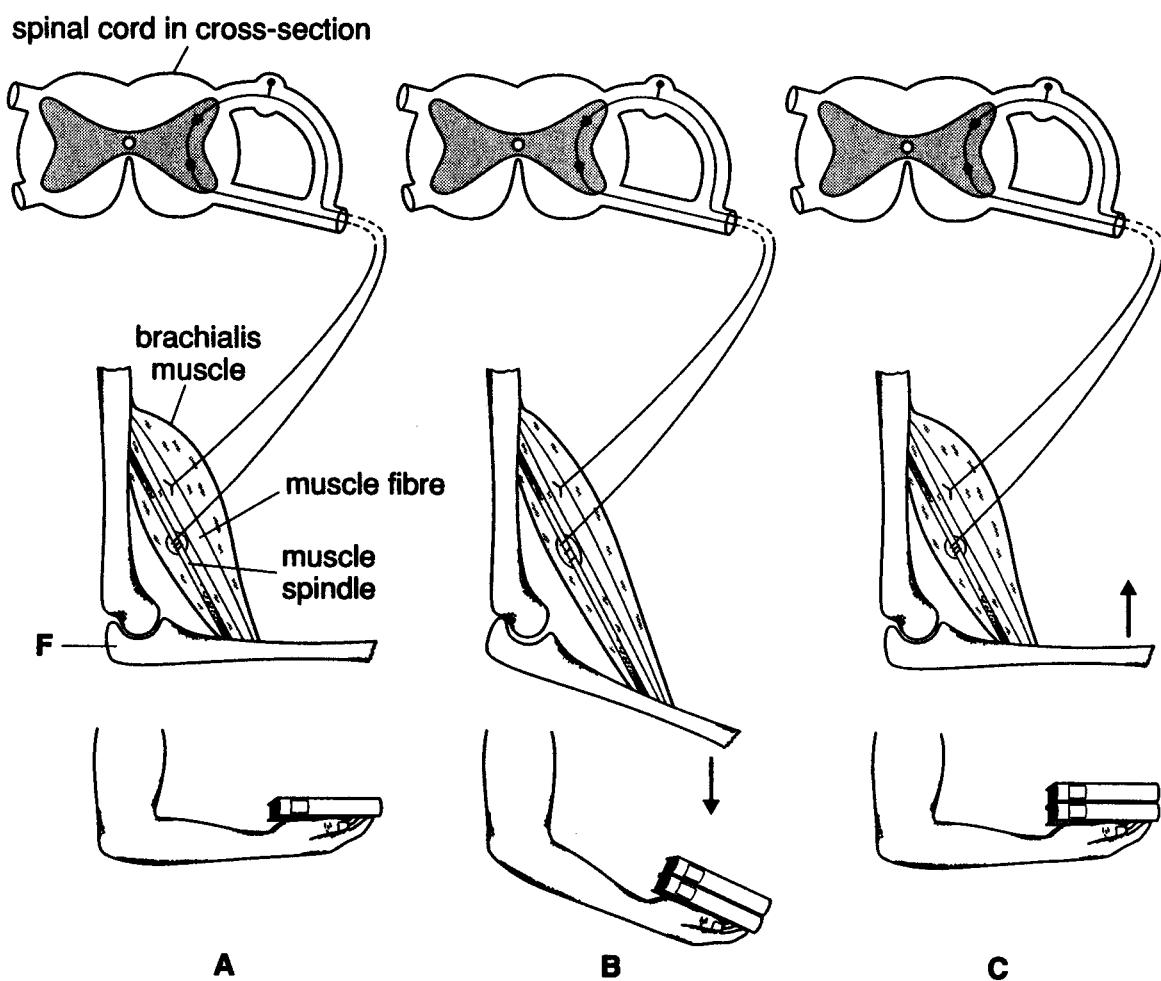
brachialis
muscle

muscle fibre

muscle
spindle

F

A

B

C

Fig. 5.1

(a) Name bone **F**.

....[1]

(b) Explain why the response shown in Fig. 5.1 is a reflex.

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....[3]

(c) In this question, one mark is available for the quality of use and organisation of scientific terms.

Outline the sequence of events that occurs between the stretching of muscle spindles and the increased contraction of the brachialis muscle.

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[Turn over

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....[8]

Quality of Written Communication [1]

(d) Muscle fibres may become torn and damaged.

Damaged muscle fibres have an increased messenger RNA (mRNA) concentration and a higher rate of oxygen consumption, **at rest**, than undamaged muscle fibres.

Explain these observations:

increased mRNA concentration;

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higher rate of oxygen consumption.

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....[5]

[Total: 18]
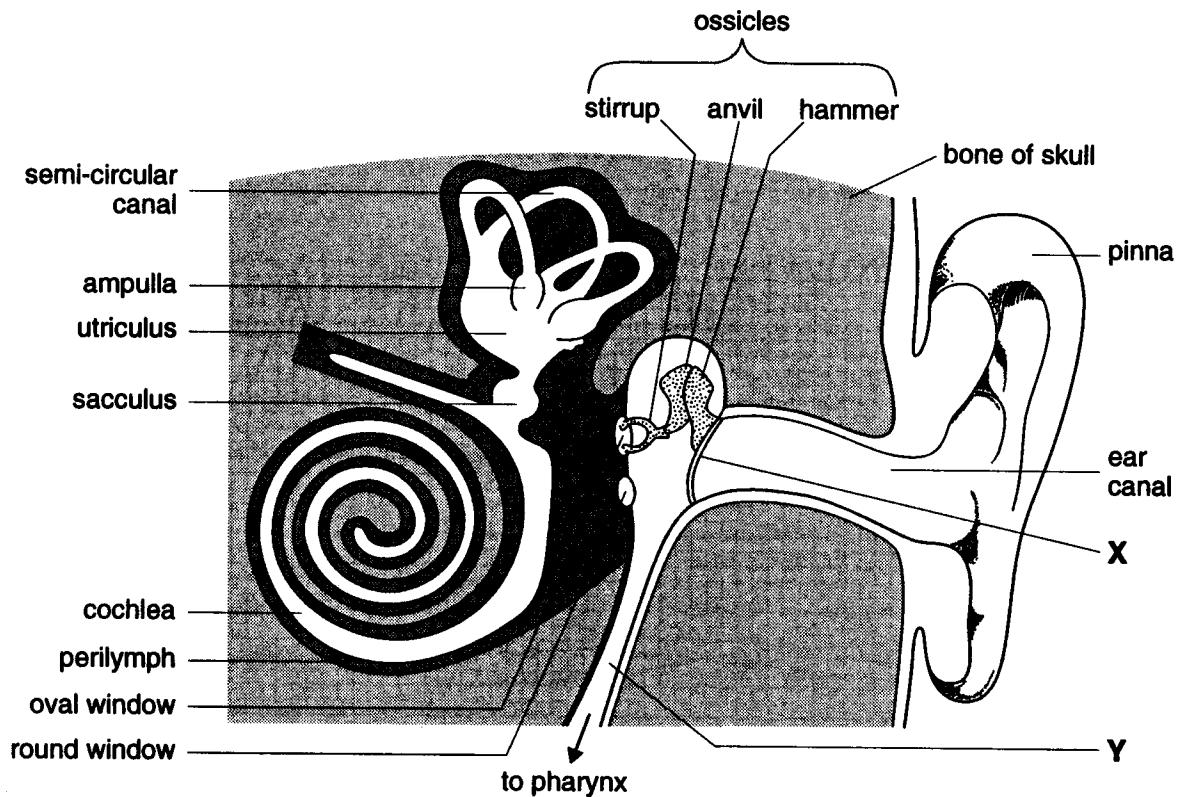
6   Fig. 6.1 shows the main structures of the human ear.

Fig. 6.1

(a) Name structures **X** and **Y** and state their roles.

X ....

role ....

....

Y ....

role ....

....[4]

(b) Muscles are attached to the auditory ossicles. When the ear detects very loud sounds, these muscles are stimulated to contract. Suggest **one** advantage of this.

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....[2]

(c) Hearing tests were carried out on three people. Each person was exposed to individual sounds of different frequencies. Each sound was delivered at an increasing volume until the person indicated that they could hear the sound.

The results of these hearing tests are shown in Fig. 6.2.

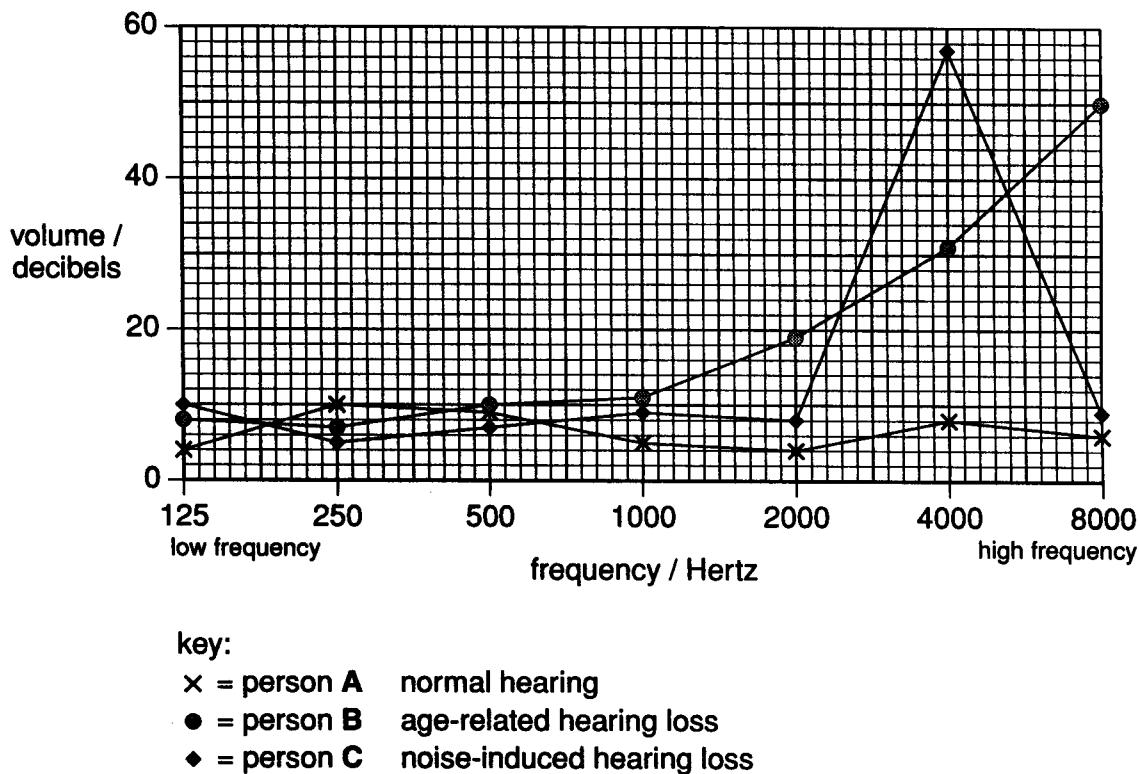Each plotted point indicates the **lowest volume** of each frequency of sound that could be heard by each person.

key:

✗ = person **A**   normal hearing
● = person **B**   age-related hearing loss
◆ = person **C**   noise-induced hearing loss

Fig. 6.2

(i) Using data from Fig. 6.2, compare the results of the hearing tests for persons **A**, **B** and **C**.

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....[3]

(ii) Explain the reason for the hearing loss shown by person **C**.

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....[2]

(iii) Suggest **two** factors that should be controlled when the hearing tests are carried out, in order to collect valid data.

1 ....

2 ....[2]

[Total: 13]

END OF QUESTION PAPER