

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.

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2 .....

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[2]

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

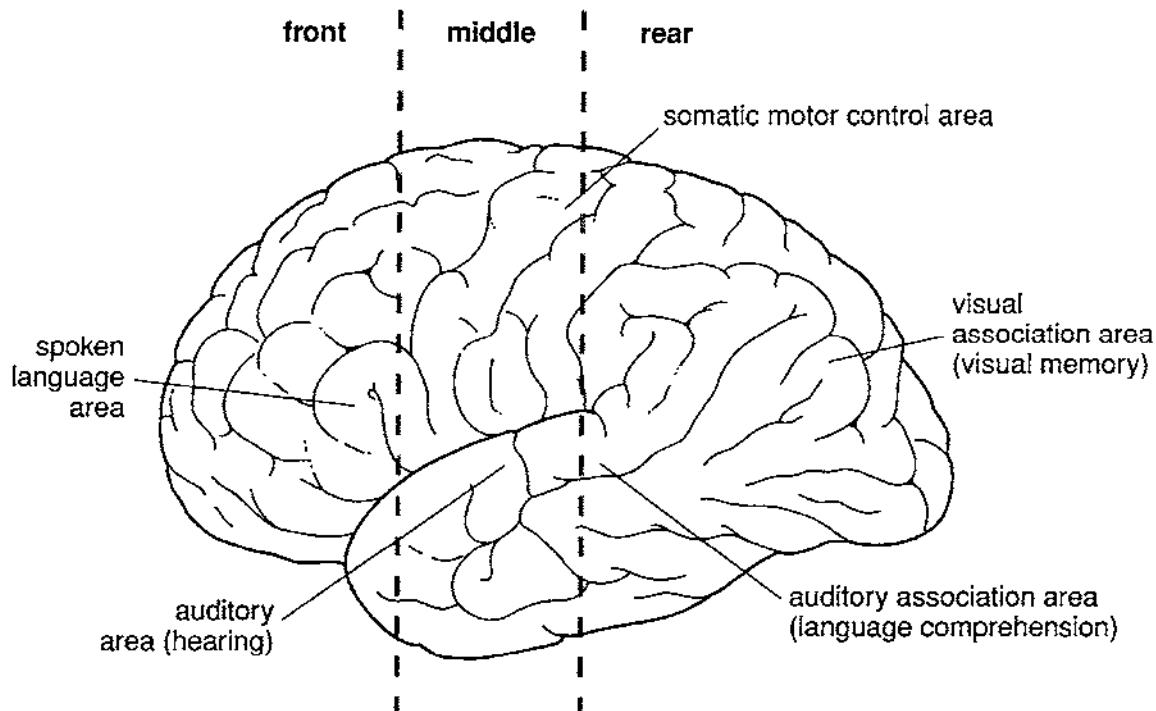


Fig. 1.1

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

control of the autonomic nervous system	<input type="checkbox"/>
coordination of posture	<input type="checkbox"/>
planning a task	<input type="checkbox"/>
control of heart rate	<input type="checkbox"/>

[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

	mean total amount of white and grey matter as a percentage of cerebrum volume	
region of cerebrum	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.

-[4]

[Total: 12]

- 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.

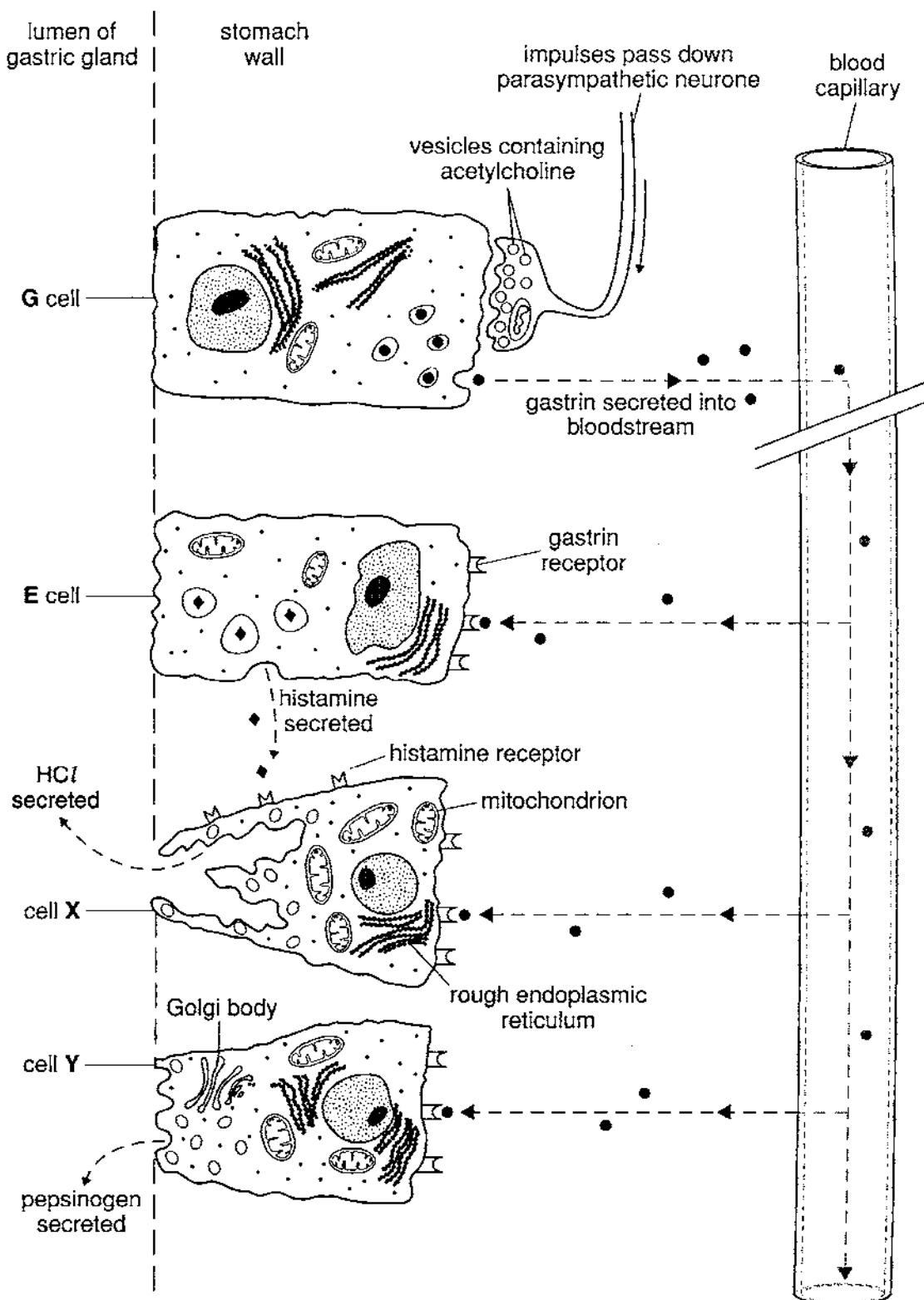


Fig. 2.1

- (a) Name:

**cell X** .....

cell Y .....

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

[31]

- (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.

[2]

cribe, using only the information in Fig. 2.1, the sequence of events leading to

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

- (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.

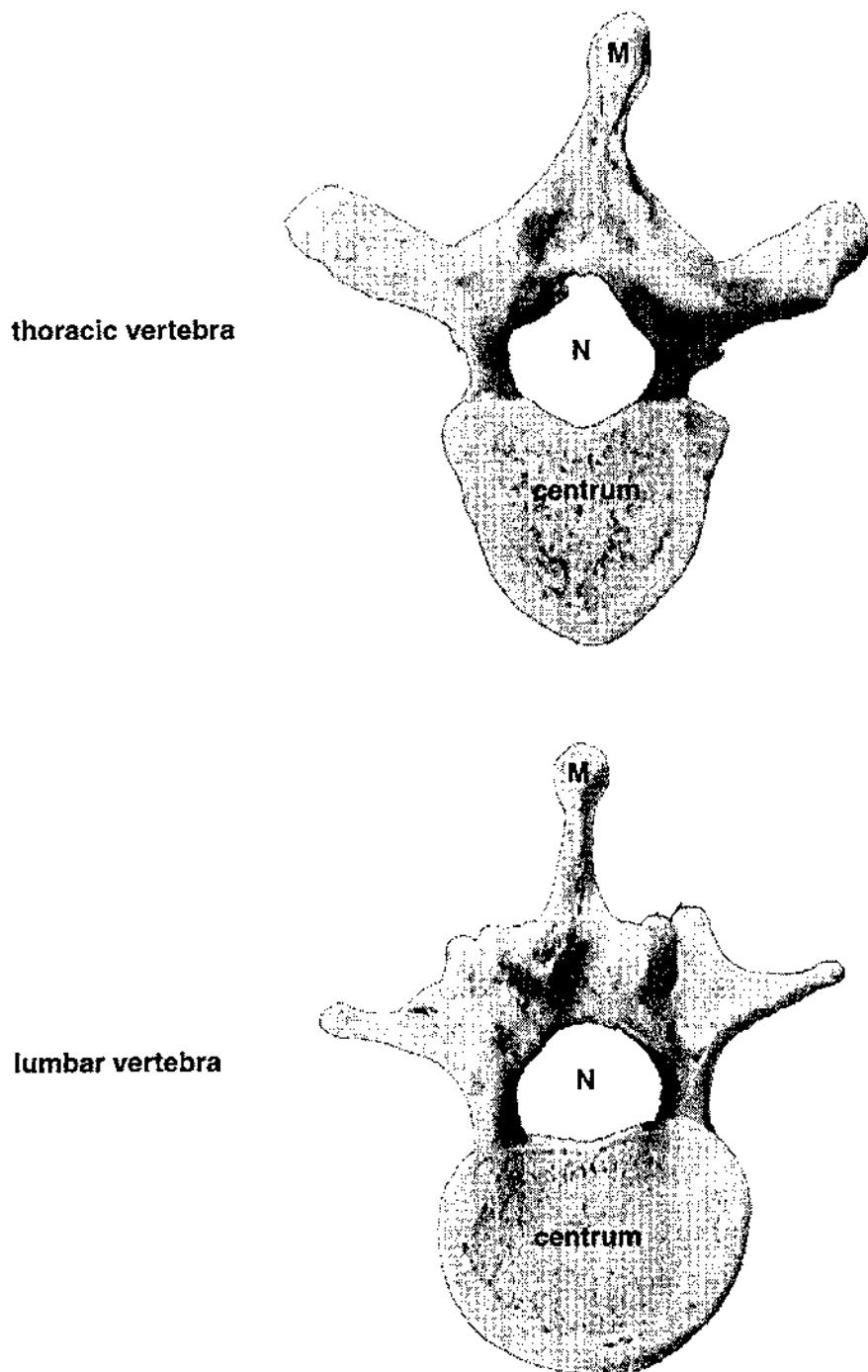


Fig. 3.1

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

**M** .....

function .....

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**N** .....

function .....

..... [4]

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

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..... [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.

[7]

### Quality of Written Communication [1]

[Total]: 15]

- 4 (a) During winter, the brown bear, *Ursus arctos*, 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.

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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]

- (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.

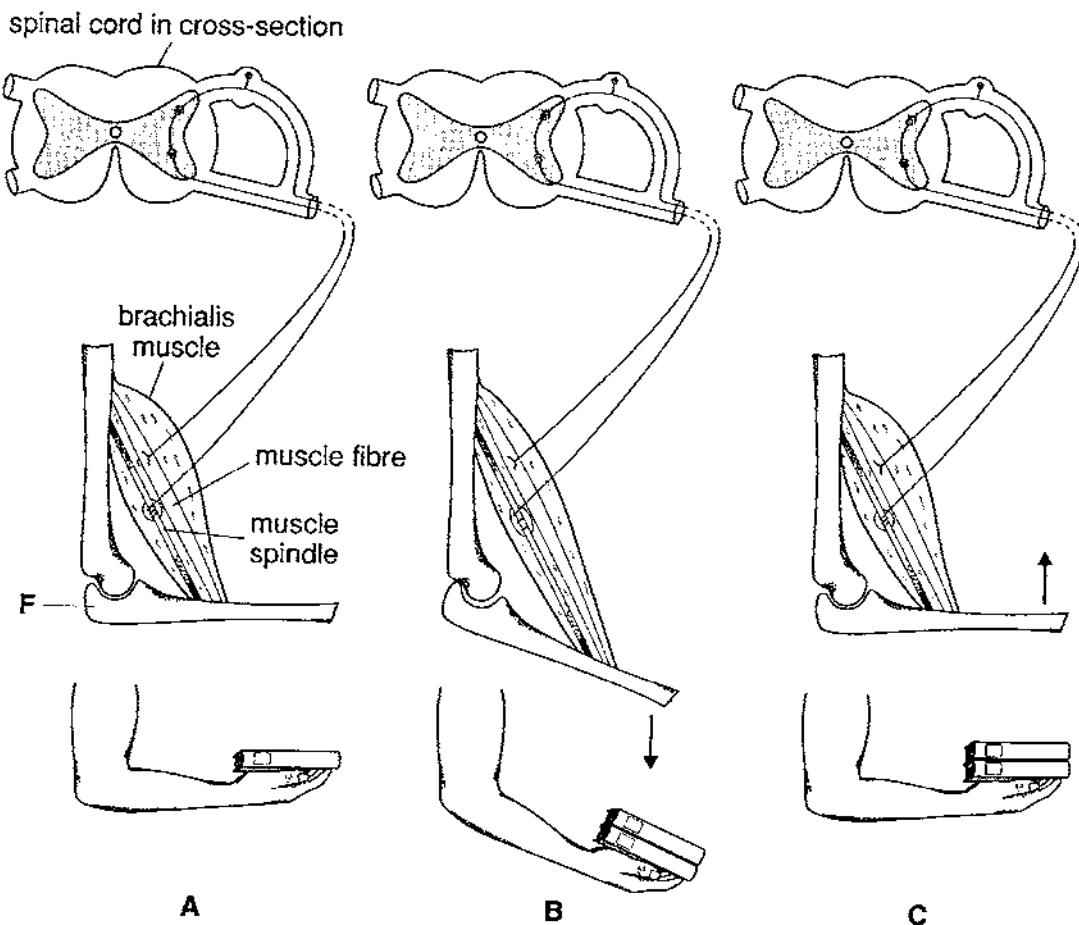


Fig. 5.1

- (a) Name bone F.

..... [1]

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

[3]

[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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[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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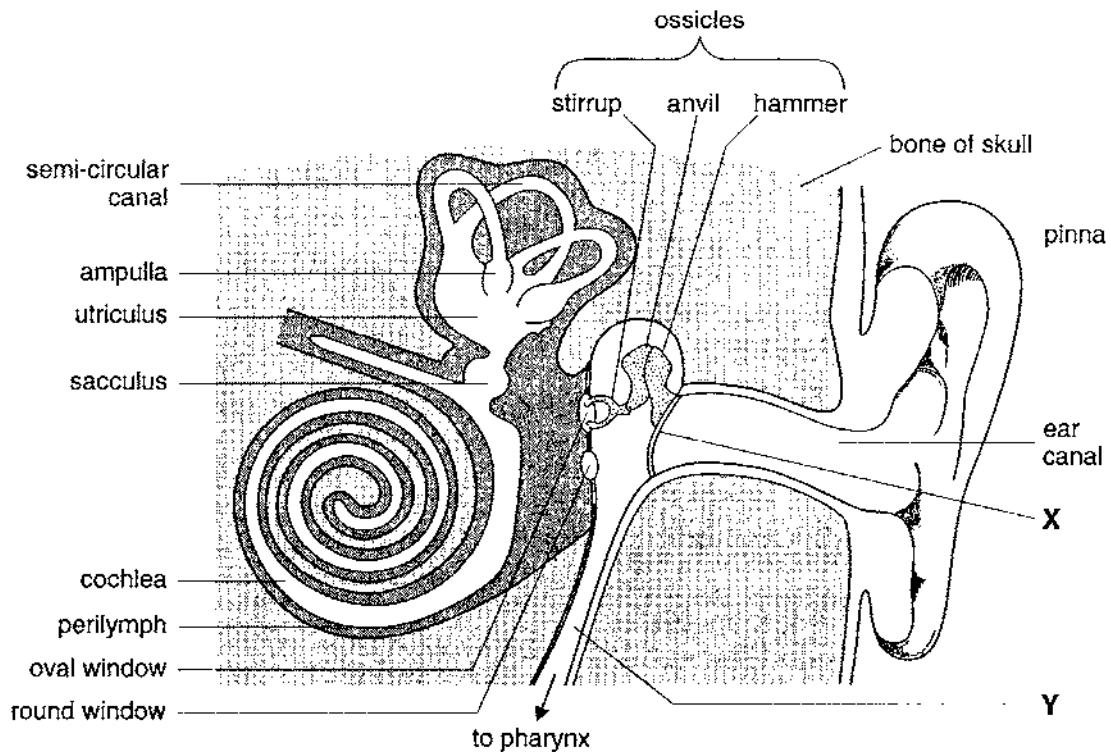
*higher rate of oxygen consumption.*

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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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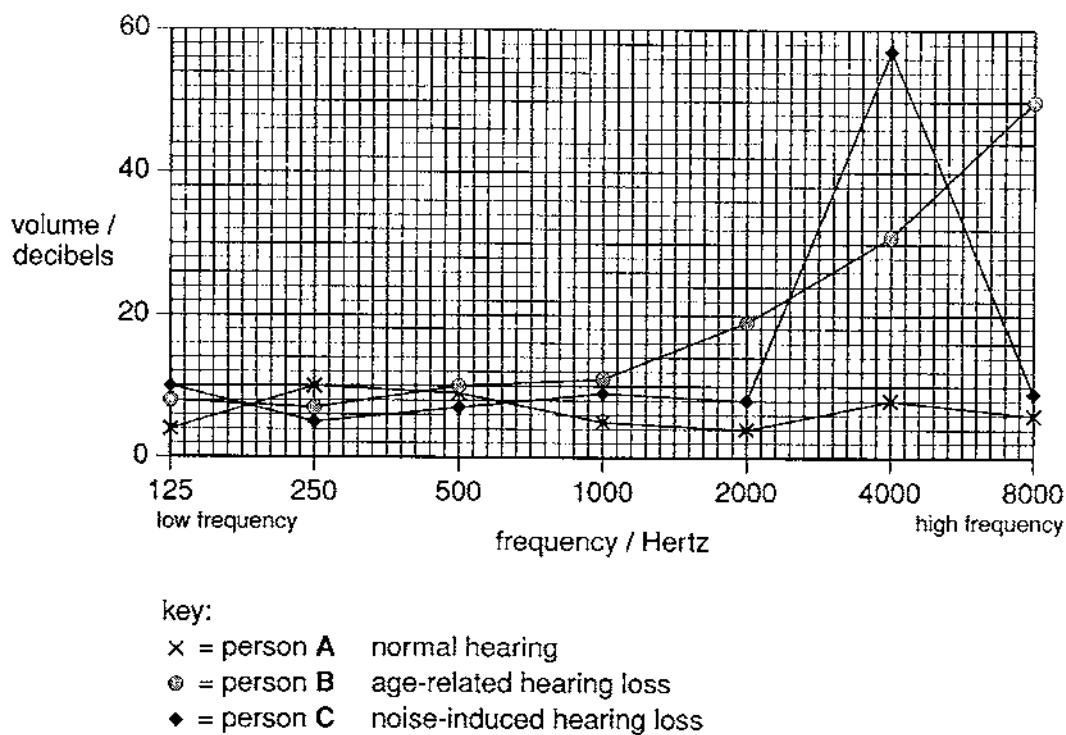
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..... [2]

- (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.



**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**

# **Mark Scheme 2805/05**

## **June 2005**

*Nummalian Physiology and Behaviour*

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	= alternative and acceptable answers for the same marking point
	:	= separates marking points
	NOT	= answers which are not worthy of credit
	R	= reject
	( )	= words which are not essential to gain credit
	ecf	= (underlining) key words which <b>must</b> be used to gain credit
	AW	= alternative wording
	A	= accept
	ora	= or reverse argument

Question	Expected Answers	Marks
1 (a)	(cortex is group of), specialised / similar / same, <u>cells</u> / <u>neurones</u> ; performing, similar / same / named, function ; brain is made of, more than one / different <u>tissue(s)</u> ; carrying out more than one function / AW ;	max 3
(b)	large(r) surface area ; idea of more cells / neurones (in given space) ; idea of more 'processing power' / AW ;	max 2
(c)	'shock absorber' / mechanical protection ; removes (excess) heat / cools the brain ; supplies oxygen ; supplies (named) nutrient ; removes, (named) waste / carbon dioxide ; ref to osmoregulation ; AVP ; (e.g. ref to macrophages or white blood cells)	R protection unqualified max 2
(d)	<u>planning a task</u> ;	1
(e)	accept ' <i>white and grey matter</i> ' for neurones throughout	
1	idea of largest, loss of neurones / damage, in <b>rear</b> of brain ;	
2	explains poor understanding of words / poor memory of objects ;	
3	(some / less) damage / loss of neurones, in <b>middle</b> (region) ;	
4	affecting motor control ;	
5	(but) not affecting hearing ;	
6	no damage / increase in neurones, in <b>front</b> (region) ;	
7	speech (production) unaffected ;	
8	ref to paired figures / manipulated figures ;	max 4

[Total: 12]

Question	Expected Answers	Marks
(a)	X = oxyntic / parietal ; Y = chief / peptic ; A zymogen lipase / mucus / water / (Castle's) intrinsic factor / $\text{HCO}_3^-$ ;	3
(b) (i)	aerobic respiration / supply ATP / supply energy ; R produce energy (for) active transport / pumping ; of hydrogen ions / protons ; exocytosis ;	max 2
(ii)	modification / processing / idea of change in structure, of protein ; packaging / making vesicles ; of, pepsinogen / inactive enzyme / precursor ; R protein or pepsin	max 2
(c)	1 impulses along, parasympathetic / motor, neurone / axon ; A vagus 2 vesicles move towards membrane ; 3 release of acetylcholine ; 4 (causes) release of gastrin (from G cell) ; 5 gastrin, enters capillary / carried in blood / AW ; 6 gastrin binds to receptors on E cell : 7 (causes) histamine release ; 8 histamine / gastrin, binds to receptors on, cell X / oxyntic cell / parietal cell ;  9 exocytosis of, ACh / gastrin / histamine ; 10 diffusion between cells of, histamine / gastrin / ACh ;	max 5
(d)	idea of complementary shape ; bind to / blocks, (histamine) receptors / histamine binding site ; less / no, secretion of HCl ;	max 2
)	<i>endopeptidase</i>  breaks / hydrolyses, peptide bond ; within, polypeptide / protein ; A 'breaks up into smaller pieces'  <i>hydrolysis</i>  breaking of, suitable named bond ; using / adding, water ;	max 3

[Total: 17]

- 3 (a) **M** = neural spine / neural process ; attachment of, ligaments / muscles ; **R** articulates  
**N** = neural canal / neural channel / foramen ; protects / allows passage of, spinal cord ; **R** spine 4
- (b) support greater, load / weight ; *comparative statement* 1
- (c) **T** correctly labelled ;  
**A** correctly labelled ; 2
- (d) **C1** to **C14** to max 5
- C1** osteoarthritis affects cartilage ;  
**C2** osteoporosis affects bone ;
- C3** osteoarthritis due to 'wear and tear' on joints ; **A** ref to 'load bearing'  
**C4** vigorous use / overuse, of joints ;  
**C5** ref to, sport / dance / lifting job ; **A** relevant activity  
**C6** more cartilage breakdown than replacement ;  
**C7** less, collagen / glycoprotein ;
- C8** osteoporosis due to loss of bone, mass / density ;  
**C9** idea of osteoclasts more active than osteoblasts ;
- C10** loss of calcium phosphate / demineralisation ;  
**C11** ref to, menopause / low oestrogen ;  
**C12** diet low in, calcium / vitamin D ;  
**C13** bone density less than 648 mg cm<sup>-3</sup> ;  
**C14** AVP ; e.g. smoking / steroid use
- S1** to **S6** to max 3
- S1** pain during movement in osteoarthritis ;  
**S2** reduced mobility (of joint / limb) ;  
**S3** inflammation of joint ;
- S4** (increased chance of) fractures in osteoporosis ;  
**S5** immobility ;  
**S6** pain qualified ; e.g. sciatica ;  
**S7** AVP ; max 7
- QWC – legible text with accurate spelling, punctuation and grammar ;** 1

[Total: 15]

Question	Expected Answers	Marks
4 (a)	ref parasympathetic NS / AW ; sympathetic NS less active / AW ; more impulses in vagus nerve / less impulses in accelerator nerve ; more acetylcholine / less noradrenaline ; effect on SAN ;	max 3
(b)	any two of fibrinogen ; R fibrin prothrombin ; R thrombin albumin ; A albumen (named) globulin ; R immunoglobulin or antibodies AVP ; e.g. transferrin	max 2
(c)	similarities	
1	production of urea ;	
2	urea transported in blood ;	
3	urea filtered from blood ;	
4	synthesis of proteins from amino acids ;	
	<i>differences (assume refs are to brown bears unless otherwise stated)</i>	
5	amino acids synthesised from ammonia ;	
6	<u>all</u> urea reabsorbed ;	
7	from kidney <u>and</u> bladder ;	
8	urea converted to ammonia by <u>bacteria</u> ;	
9	AVP ; e.g. (humans) less tolerant to high ammonia (in blood)	max 5
(d)	component of cell membranes / AW ; ref to, mechanical stability / impermeability / fluidity ; ignore rigidity production of, steroid hormone / named hormone ; production of vitamin D ; production of bile salts ;	max 3
(e)	increases high density lipoproteins (HDLs) ; reduces low density lipoproteins (LDL) ; prevents, deposition of cholesterol / plaques / atherosclerosis ;	max 2

[Total: 15]

Question	Expected Answers	Marks
5 (a)	ulna ;	1
(b)	rapid / almost immediate / AW ; automatic / no conscious thought / does not involve brain ; (co-ordinated by) spinal cord / (only) three neurones involved ; no learning / innate / Instinctive / AW ;	max 3
(c)	1 depolarisation of spindle ; 2 generator / receptor, potential ; 3 ref to threshold ; 4 action potential / impulse ; 5 sensory neurone ; 6 synapse with, relay / intermediate, neurone ; 7 exocytosis of, neurotransmitter / ACh ; A description of exocytosis 8 diffusion (of neurotransmitter / ACh) across cleft ; 9 action potential in motor neurone ; 10 to, end plate / neuromuscular junction ; 11 binding of transmitter to <u>receptors</u> (on sarcolemma) ; 12 depolarisation of sarcolemma / AW ; 13 spreads down T-tubules ; A T-tubes 14 calcium ions released from, sarcoplasmic reticulum / SER / cisternae ; 15 calcium ions bind to troponin ; 16 tropomyosin moves ; 17 exposes myosin binding site (on actin) ; 18 ref to, sliding filaments / cross-bridges / ratchet mechanism ; 19 AVP ; e.g. sarcomere shortens / ATPase involved	max 8
	<b>QWC – clear well organised, using specialist terms ;</b>	1
	<i>award the QWC mark if four of the following are used in correct context</i>	
	depolarisation                    T-tubules	
	threshold                        sarcoplasmic reticulum	
	synapse                          troponin	
	sarcolemma                     tropomyosin	
(d)	1 proteins needed for repair / AW ; 2 more transcription of, DNA / genes ; 3 more translation ; 4 protein synthesis ; 5 named protein ; e.g. actin / myosin / troponin / tropomyosin	
	<i>ignore all refs to muscle contraction</i>	
	6 more <u>aerobic</u> respiration ; 7 so more, energy released / ATP produced ; 8 (energy required for) condensation / anabolic, reactions ; 9 (energy required for) formation of peptide bonds ; 10 (energy required for) formation of extra mRNA ;	max 5

[Total: 18]

Question	Expected Answers	Marks
6 (a)	X = tympanum / tympanic membrane / eardrum ; passes vibrations to, ossicles / malleus / hammer ;  Y = Eustachian, tube / canal ; equalises pressure (on either side of tympanum) ;	4
(b)	prevent damage to ossicles ; prevent damage to, cochlea / organ of Corti / sensory hair cells ;	2
(c) (i)	1 little difference / similar results, up to 1,000 (Hz) ; R no difference 2 no, loss of hearing / increase in volume of test sounds, for person A ; 3 increasing, hearing loss / volume of test sounds, for person B (above 1,000Hz) ; 4 large, hearing loss / increase in volume of test sound, for person C at <u>4,000</u> (Hz) ; 5 quote fig(a) with both units ;	max 3
(ii)	loud / damaging, sound was of, one frequency / 4 000 Hz ; (causes) damage to / loss of, stereocilia / hair cells ; in (only) one region ; of, basilar membrane / organ of Corti / hair cells ;	max 2
(iii)	(testing) apparatus ; background noise / no background noise ; time of day ; same number of tests at each frequency ; same range of frequencies ; AVP ; e.g. alertness of patient R gender, age	max 2

[Total: 13]