



ATAR course examination, 2023

Question/Answer booklet

HUMAN BIOLOGY

Place one of your candidate identification labels in this box.
Ensure the label is straight and within the lines of this box.

WA student number: In figures

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In words

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Number of additional
answer booklets used
(if applicable):

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet
Multiple-choice answer sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,
correction fluid/tape, eraser, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store
programmes or text, are permitted in this ATAR course examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.



Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	30	30	40	30	30
Section Two Short answer	6	6	90	107	50
Section Three Extended answer Unit 3	2	1	50	20	20
Unit 4	2	1		20	
Total					100

Instructions to candidates

- The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2023: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.

- Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Section Two: Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens. Wherever possible, confine your answers to the line spaces provided.

Section Three: Consists of two parts each with two questions. You must answer one question from each part. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

- You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.
- Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

See next page

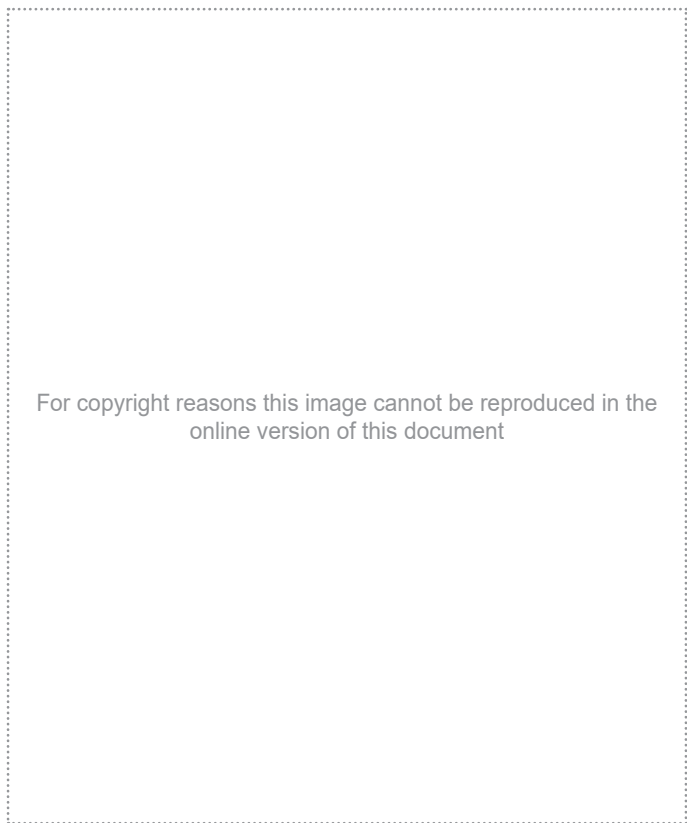
Section One: Multiple-choice**30% (30 Marks)**

This section has **30** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 40 minutes.

1. The difference between grey and white matter found within the spinal cord is that
- (a) white matter contains dendrites of neurons, while grey matter contains cell bodies of neurons.
 - (b) grey matter contains unmyelinated neurons, while white matter contains myelinated neurons.
 - (c) white matter contains cell bodies of neurons, while grey matter contains dendrites of neurons.
 - (d) grey matter contains myelinated neurons, while white matter contains unmyelinated neurons.
2. DNA sequencing provides evidence for evolution by demonstrating
- (a) the degree of similarity of a genome between different species.
 - (b) the shared ancestry of species through similarities in anatomical structure.
 - (c) precisely how and when species evolved from one another.
 - (d) whether species shared the same base pairs in their DNA molecule.
3. Listed below is a series of characteristics found within the primate group.
- I. reduction in olfactory centre of brain
 - II. non-opposable big toe
 - III. bipedal gait
 - IV. flat face
 - V. pentadactyl limb
- Which combination of characteristics makes a hominin different from all other primates?
- (a) I and III only
 - (b) II and III only
 - (c) III, IV and V
 - (d) I, III and IV

Question 4 refers to the diagram shown below.



4. Which of the following structures produce lysozyme to help kill invading pathogens?
- (a) A and B only
 - (b) A, B, C and D
 - (c) A and D only
 - (d) A, B and C only

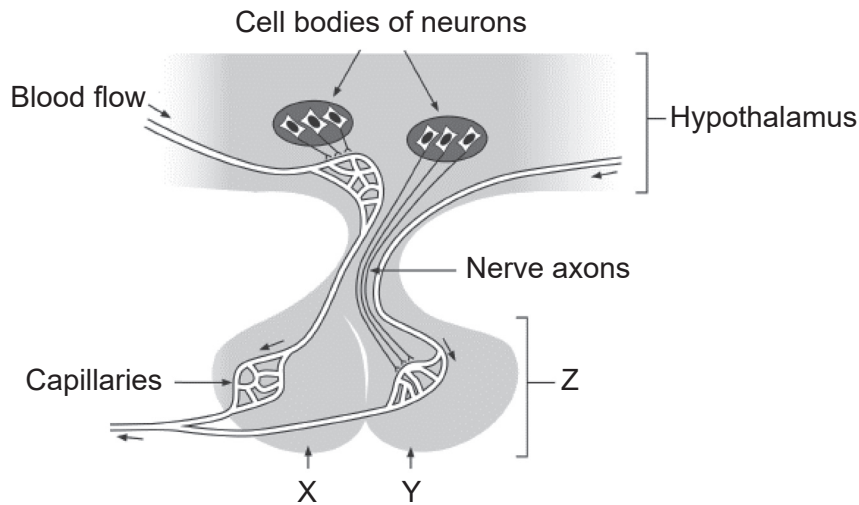
5. The Zika virus is a pathogen readily spread from mosquito bites and sexual intercourse with an infected person. Match correctly the type of transmission each mode represents.

	Mosquito bites	Sexual intercourse
(a)	indirect contact	transfer of body fluids
(b)	disease-specific vector	transfer of body fluids
(c)	disease-specific vector	indirect contact
(d)	transfer of body fluids	direct contact

6. In a polymerase chain reaction, the process by which new nucleotides are added is known as
- (a) priming.
 - (b) denaturation.
 - (c) extension.
 - (d) annealing.

See next page

Questions 7 and 8 refer to the diagram shown below.



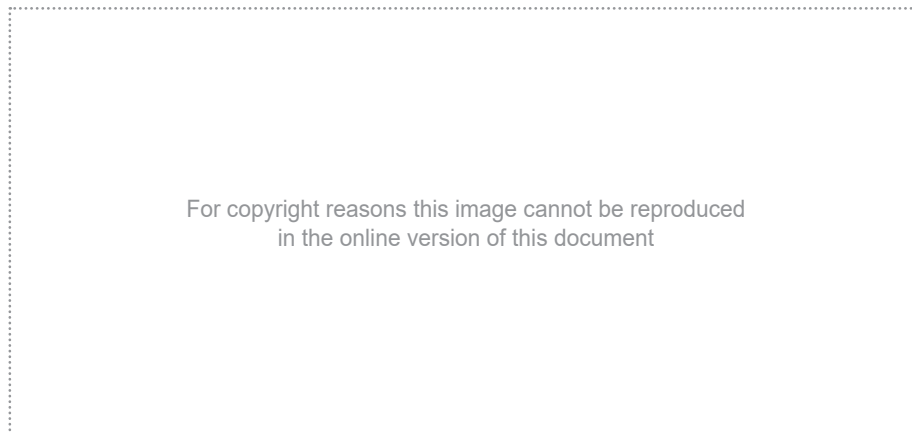
7. Structure Z interacts closely with the hypothalamus to maintain many bodily functions. It consists of two lobes. Which of the following identifies X, Y and Z correctly?

	X	Y	Z
(a)	anterior lobe	posterior lobe	pituitary gland
(b)	anterior lobe	posterior lobe	thyroid gland
(c)	posterior lobe	anterior lobe	pituitary gland
(d)	posterior lobe	anterior lobe	thyroid gland

8. A hormone released from structure Y is
- growth hormone.
 - prolactin.
 - thyroxine.
 - oxytocin.
9. Rate and depth of breathing is regulated via the
- medulla sending messages to the external intercostal muscles and diaphragm.
 - hypothalamus sending messages to the internal intercostal muscles and diaphragm.
 - medulla sending messages to the internal intercostal muscles and diaphragm.
 - hypothalamus sending messages to the external intercostal muscles and diaphragm.
10. Chemoreceptors monitor the level of gases in the body and can be found in all areas listed **except** the
- carotid body.
 - aortic arch.
 - nose.
 - brain.

See next page

Questions 11 and 12 refer to the graphic below.

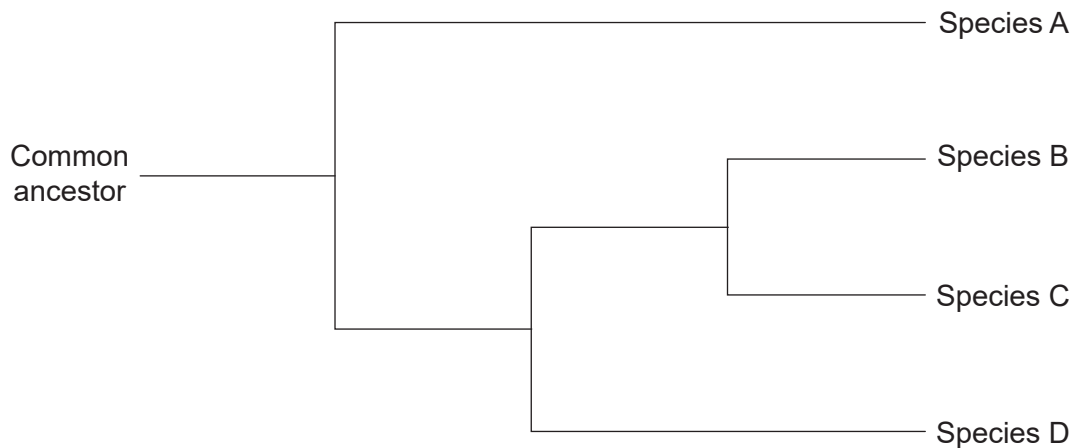


11. This correlation of malaria and occurrence of sickle-cell in Africa is **best** explained by the inference that
- (a) the disease malaria provides a survival advantage to people with sickle-cell anaemia.
 - (b) sickle-cell shaped haemoglobin provides a survival advantage in regions where malaria is prevalent.
 - (c) sickle-cell shaped haemoglobin has evolved because of the high incidence of malaria present in the region.
 - (d) the disease sickle-cell anaemia is less lethal to human populations in regions with a high occurrence of malaria.
12. In the area highlighted on the map for sickle-cell allele, people carrying the allele would be expected to have either sickle-cell trait or sickle-cell anaemia. The difference between these is that
- (a) people affected with sickle-cell trait rarely have symptoms, while people with sickle-cell anaemia do.
 - (b) sickle-cell trait sufferers cannot pass the condition onto their children, while sickle-cell anaemia sufferers can.
 - (c) people with sickle-cell anaemia have a genotype containing at least one allele for sickle-cell, while people with sickle-cell trait have two alleles.
 - (d) sickle-cell trait is fatal to people in areas without the presence of malaria, while sickle-cell anaemia is fatal regardless of the presence of malaria.
13. A blood sample from an area of the body exhibiting inflammation would be
- (a) high in complement proteins, high in histamine, low in heparin and low in tissue fluid.
 - (b) low in complement proteins, low in histamine, low in heparin and high in tissue fluid.
 - (c) low in complement proteins, high in histamine, high in heparin and low in tissue fluid.
 - (d) high in complement proteins, high in histamine, high in heparin and high in tissue fluid.

See next page

14. The polymerase chain reaction process begins by targeting the specific sequence of DNA that is required for amplification. Which of the following is required to indicate the correct starting point for adding nucleotides?
- DNA polymerase
 - RNA polymerase
 - DNA primers
 - DNA ligase

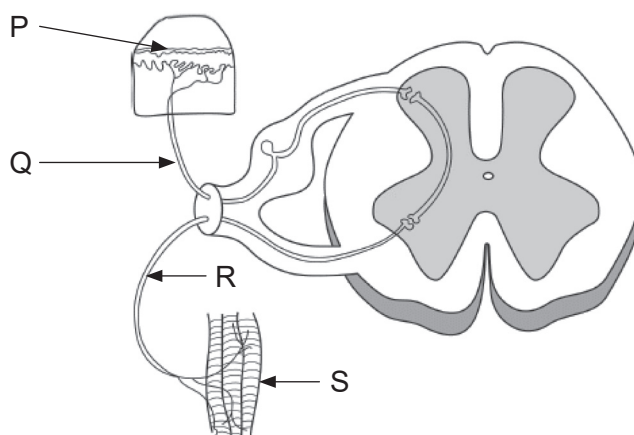
Question 15 refers to the diagram shown below.



15. Which of the following statements **best** describes the similarity in DNA sequences between the shown species?
- Species D and Species B have more similar DNA sequences than Species D and Species C.
 - The DNA sequence is the most similar between Species A and Species D.
 - The DNA sequence is the least similar between Species B and Species C.
 - Species B and Species C share the most similarities in DNA sequence.
16. Many genetic diseases are caused by a defect in just a single allele. The ability to replace a defective allele with a normal or non-defective allele is known as
- gene therapy.
 - cloning.
 - cell replacement therapy.
 - stem cell therapy.
17. How can radioisotopes be used to date volcanic rocks?
- The
- depth of index fossils found below the surface can be measured.
 - amounts of potassium-40 and argon can be measured.
 - amounts of carbon-14 and nitrogen can be measured.
 - depth of rocks below the surface can be measured.

See next page

Questions 18,19 and 20 refer to the diagram shown below.



18. Which of the labels identifies structures Q, R and S correctly?

	Q	R	S
(a)	sensory neuron	interneuron	effector
(b)	motor neuron	sensory neuron	receptor
(c)	sensory neuron	motor neuron	effector
(d)	interneuron	motor neuron	receptor

19. The key difference between structures Q and R is

- (a) R carries impulses towards the central nervous system, while Q carries impulses away from the central nervous system.
- (b) Q carries impulses towards the ganglion, while R carries impulses away from the ganglion.
- (c) Q has only one nerve fibre, while R has two nerve fibres.
- (d) R carries impulses away from the central nervous system, while Q carries impulses towards the central nervous system.

20. If an individual was involved in an accident that cut structure Q, what would be the consequence of this?

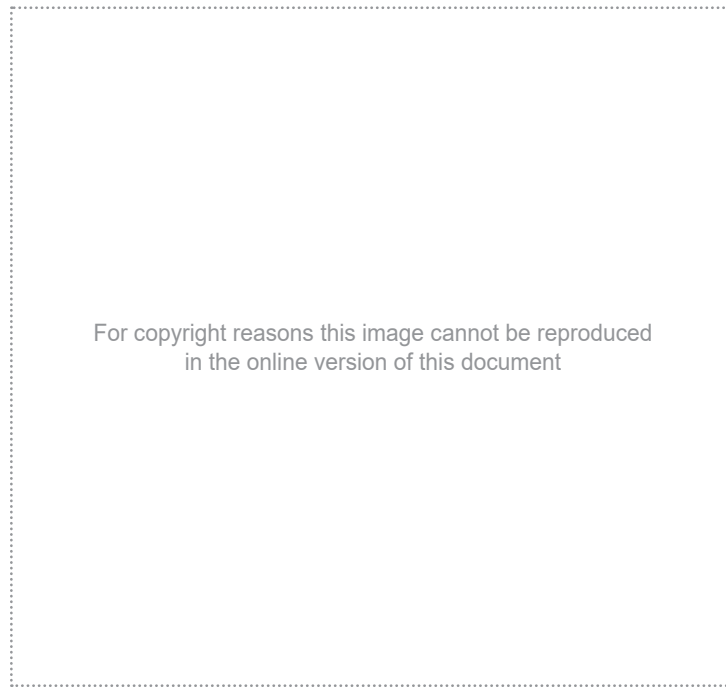
The transmission of impulses from the

- (a) effector to the spinal cord would be affected.
- (b) receptor to the spinal cord would be affected.
- (c) spinal cord to the effector would be affected.
- (d) spinal cord to the receptor would be affected.

21.

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Questions 22 and 23 refer to the diagram shown below.



22. Which of the following matches the name of the stage of the action to the labels shown on the diagram?

	2	3	4	5
(a)	polarisation	depolarisation	repolarisation	resting state
(b)	depolarisation	hyperpolarisation	repolarisation	polarised
(c)	depolarisation	repolarisation	hyperpolarisation	resting state
(d)	polarisation	hyperpolarisation	depolarisation	polarised

23. The stage at which potassium ions flow out of the neuron is

- (a) 1.
(b) 2.
(c) 3.
(d) 4.

24. The statements below relate to cells found in the immune system called lymphocytes.

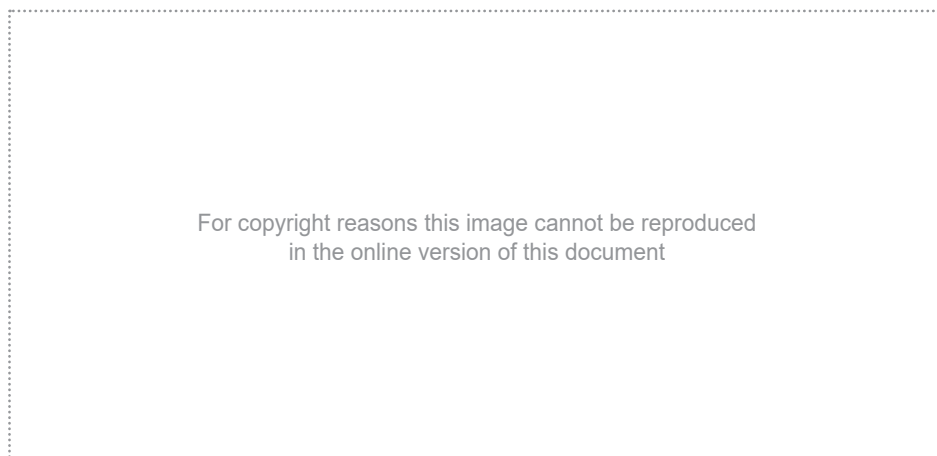
- I. matured in bone marrow
II. produces antibodies
III. matured in thymus gland
IV. release cytokines
V. produce memory cells

Which statements relate specifically to T lymphocytes?

- (a) III, IV and V
(b) I, II and IV
(c) II, III and V
(d) I, IV and V

See next page

Questions 25 and 26 refer to the diagram shown below.



25. The study of rock layers, like those shown in the diagram above, to help date fossils is known as
- (a) correlation.
 - (b) stratigraphy.
 - (c) deposition.
 - (d) superposition.

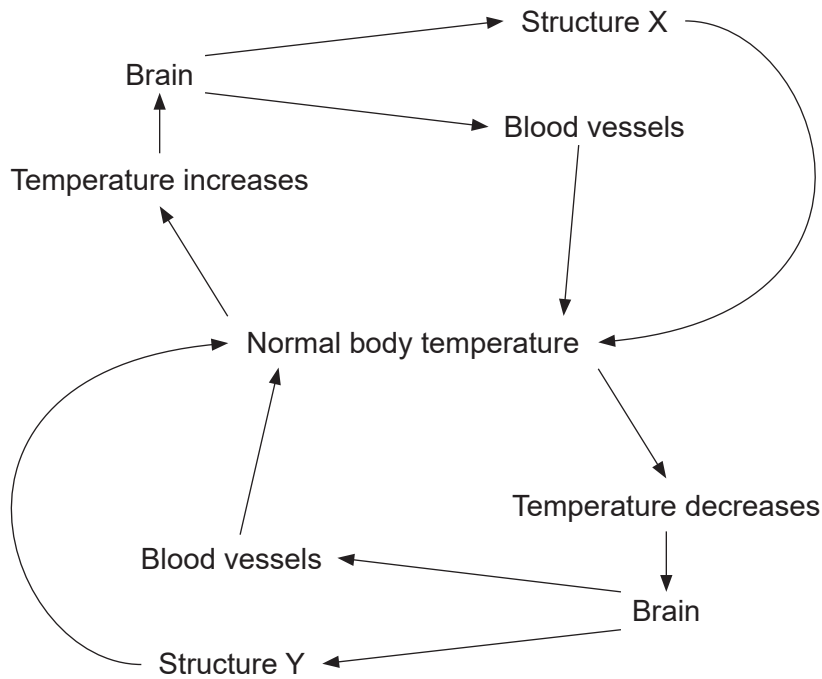
26. Which of the following correctly identifies the youngest and oldest rock layers that can be seen in the diagram above?

	Youngest	Oldest
(a)	G	I
(b)	C	G
(c)	I	G
(d)	G	D

27. Which division of the nervous system is **most** likely to have been damaged if a person has a loss of touch sensations and numbness in their hands?
- (a) autonomic sympathetic
 - (b) afferent parasympathetic
 - (c) efferent autonomic
 - (d) afferent somatic
28. The role of gel electrophoresis in generating a DNA sequence can **best** be described as a process that
- (a) amplifies the DNA sample to ensure enough material is available for sequencing.
 - (b) divides the DNA into singular nucleotide segments so that a sequence can be visible in the gel.
 - (c) separates the different lengths of DNA so one can determine the sequence of nucleotides.
 - (d) magnifies the DNA so one can observe the DNA sequence in the gel.

See next page

Questions 29 and 30 refer to the diagram shown below.



29. Structures X and Y **most** likely are

	X	Y
(a)	skeletal muscles	skin
(b)	sweat glands	heart
(c)	heart	sweat glands
(d)	sweat glands	skeletal muscles

30. The relationship between the brain and blood vessels shown in the diagram is **best** explained as the

- (a) hypothalamus sending impulses to cause blood vessels of the skin to constrict when the internal body temperature decreases.
- (b) medulla sending impulses to cause blood vessels of the skin to dilate when the internal body temperature increases.
- (c) hypothalamus sending impulses to cause the blood vessels of the skin to dilate when the internal body temperature decreases.
- (d) medulla sending impulses to cause blood vessels of the skin to constrict when the internal body temperature decreases.

End of Section One

See next page

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Section Two: Short answer

50% (107 Marks)

This section has **six** questions. Answer **all** questions. Write your answers in the spaces provided.

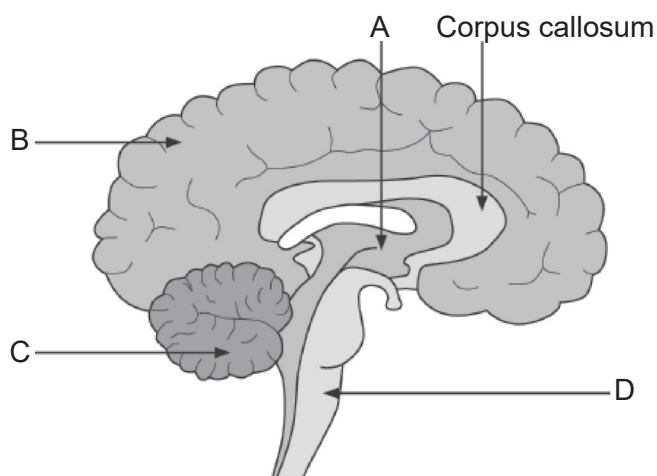
Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 31

(17 marks)

The following question refers to the diagram of the human brain shown below.



- (a) Identify structures A and C. (2 marks)

A: _____

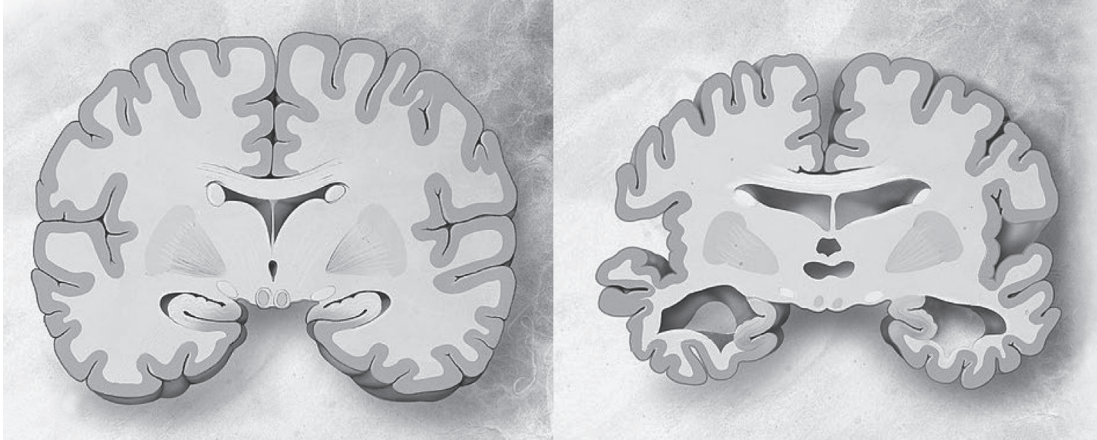
C: _____

- (b) List **two** homeostatic processes that are controlled by structure D. (2 marks)

One: _____

Two: _____

Alzheimer's is a disease of the brain that mostly affects older people. The diagram below shows differences that can be observed when comparing a normal brain to that of an individual suffering from Alzheimer's. One of the main differences that can be observed is the change to the cerebral cortex.



- (c) (i) State the change that has occurred to the cerebral cortex of an Alzheimer's sufferer. (1 mark)

- (ii) Describe how the change to the cerebral cortex has occurred. (2 marks)

Question 31 (continued)

Emerging evidence suggests that Alzheimer's-related brain changes may be produced because of clumping together of proteins and the creation of tangles in-between neurons that disrupt cell functioning and synaptic transmission.

- (d) (i) Define the term 'synapse'. (1 mark)

- (ii) Annotate the diagram below to show the processes involved in the transmission of a nerve impulse across the synapse. Include labels of the parts and stages in the process. (6 marks)

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- (iii) Explain how cell replacement therapy aims to help Alzheimer's sufferers. (3 marks)

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Question 32

(20 marks)

Nocturia is a medical condition that causes sufferers to wake up frequently during the night to urinate. The condition is more common in older people and has several known causes. One known cause of this condition is the decreased production of antidiuretic hormone (ADH) during the night-time hours. Normally ADH production increases at night-time but in elderly people this normal cycle of production can be altered.

A study was undertaken with 20 elderly volunteer patients to investigate the link between ADH and the condition nocturia. Twelve patients experienced severe symptoms of nocturia, and eight patients did not. They were separated into two groups during a 48-hour monitored hospital visit. During this time, their blood levels of ADH and urine output were recorded. At 11 pm on day 2 of the study, the patients with nocturia were treated with desmopressin (synthetic ADH). The patients who did not suffer from nocturia were also treated at 11 pm but received a placebo. A summary of the results of the study are shown below.

Time of collection	Mean urine output (mL)			
	Day 1		Day 2	
	Group 1	Group 2	Group 1	Group 2
8 am to 8 pm	1188	1247	1230	1190
8 pm to 8 am	594	1035	567	658

- (a) Construct an appropriate title for the results table shown above. (2 marks)

- (b) Using the data from the table, identify the name scientists would give to each group in the study. Justify your choice. (4 marks)

- (c) The summary of the results in the table on page 16 only shows the mean urine output per group. Explain why presenting the data with only the mean and not including the median scores can be misleading. (2 marks)

Normally, the release of ADH is determined by the concentration and volume of blood.

- (d) (i) Identify the type and location of the receptors that detect changes in the blood associated with ADH production. (2 marks)

Type: _____

Location: _____

- (ii) Identify the effector/s targeted by ADH and explain an impact ADH has on the structure/s. (4 marks)

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Question 32 (continued)

- (iii) Describe when and how the thirst reflex plays a role in the homeostasis of blood fluid concentrations. (4 marks)

- (e) ADH is classed as a water-soluble hormone. Outline **two** differences in the mode of action of a water-soluble hormone and a lipid-soluble hormone. (2 marks)

One: _____

Two: _____

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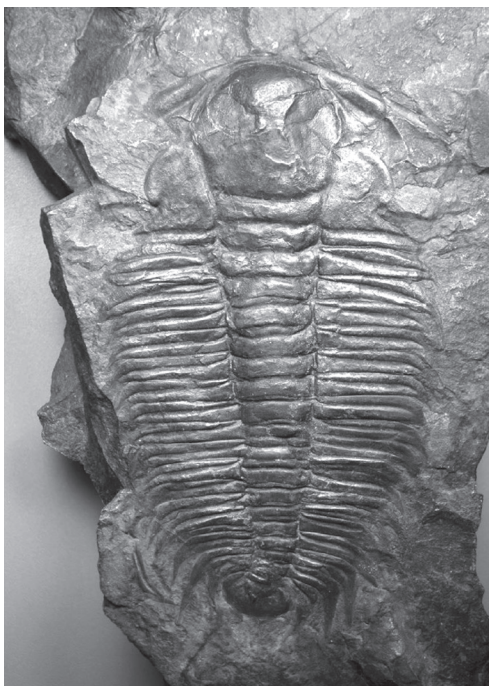
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Question 33

(14 marks)

The following question refers to the image shown below of a trilobite, a group of arthropods that existed on Earth 300 million years ago, before becoming extinct around 250 million years ago.



- (a) The trilobite is considered an index fossil. Complete the table below, to identify **two** features a fossil must have to be considered an index fossil and state why each feature is necessary to meet index fossil requirements. (4 marks)

Feature	Why feature is necessary to meet index fossil requirements

- (b) Describe **two** factors that improve the chances that an organism will become a fossil. (4 marks)

One: _____

Two: _____

- (c) In a stratum that contained trilobite fossils, a modern human skull was also located. Outline **two** ways in which this could have occurred. (2 marks)

One: _____

Two: _____

- (d) Suggest how a scientist would determine an absolute date for an anatomically-modern human. (4 marks)

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Question 34

(21 marks)

Changes to the cranial capacity of skulls are a distinguishing feature for hominin species. The data shown in the table below have been determined by measuring the volume inside the cranium of several fossil specimens.

Average brain size in hominin species	
Hominin species	Brain size (cm ³)
Hominin A	420
Hominin B (<i>Australopithecus africanus</i>)	450
Hominin C	600
Hominin D (<i>Homo erectus</i>)	1000
Hominin E	1350
Hominin F	1450

- (a) State which of the cranial capacities from the table above would belong to, (2 marks)

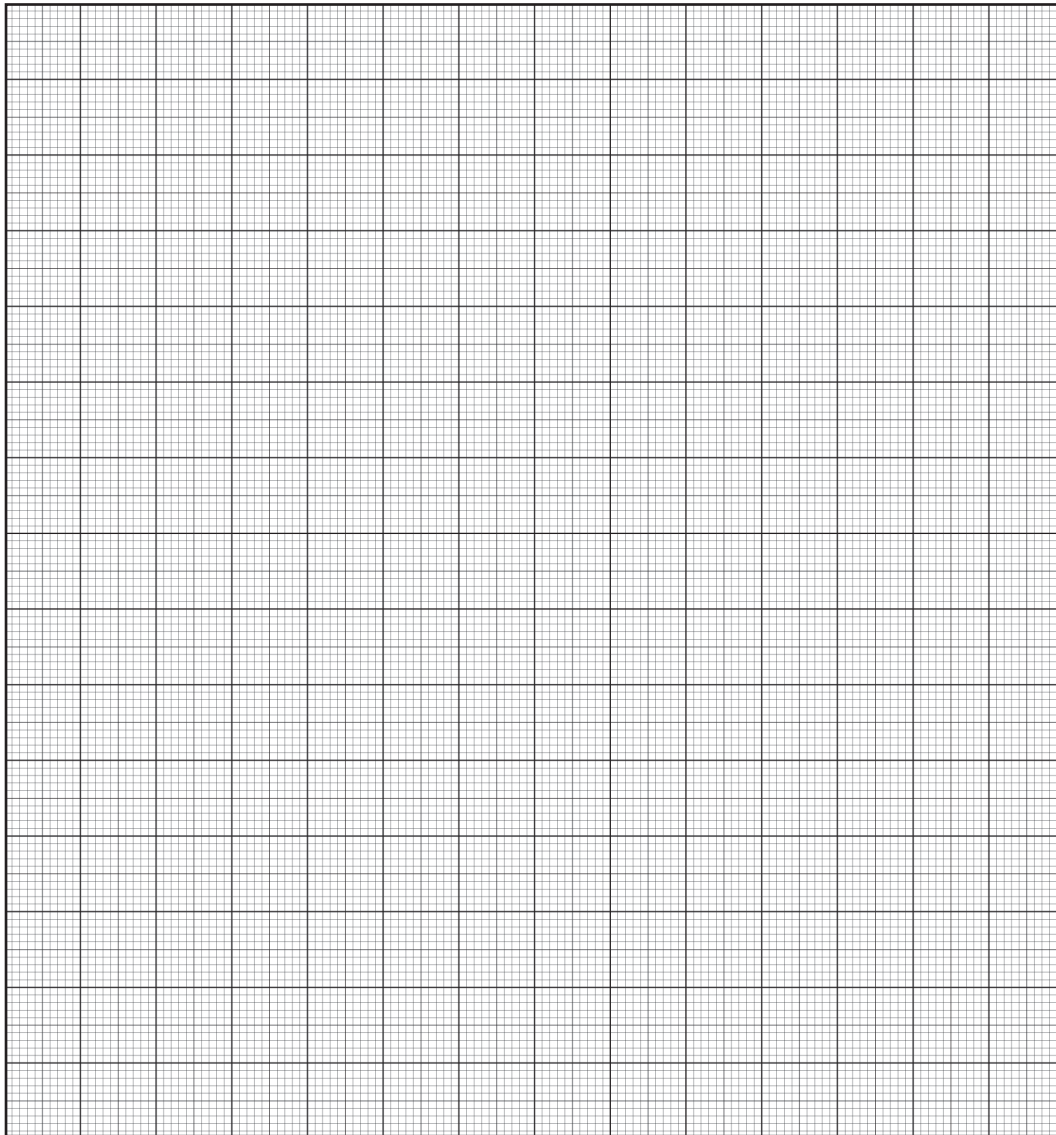
Australopithecus afarensis: _____

Homo habilis: _____

- (b) Determine whether Hominin E is evolutionarily older or younger than Hominin F. Justify your response. (3 marks)

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- (c) Graph the data from the table on page 22 on the grid below. (5 marks)



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid.

- (d) Comment on the evolutionary significance for the increase in brain size shown by the data. (3 marks)

See next page

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Question 34 (continued)

Over 7 million years ago, human ancestors climbed trees and walked on four legs when on the ground. By 1.8 million years ago, our human ancestors had developed long legs and a fully-bipedal gait.

- (e) Complete the table below, comparing skeletal structures as they would have been 7 million years ago to those that had developed by 1.8 million years ago. (6 marks)

Skeletal structure	7 million years ago	1.8 million years ago
Pelvis		
Knees		
Toes		

- (f) Outline **two** ways in which being bipedal helped with hominin survival. (2 marks)

One: _____

Two: _____

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See next page

Question 35

(13 marks)

There are many different theories used to account for why *Homo neanderthalensis* died out around 40 000 years ago, leaving only modern *Homo sapiens* as the living hominin species on Earth today. One of the theories often used to explain why *Homo neanderthalensis* died out is attributed to small population size. Evidence suggests that *Homo neanderthalensis* had a relatively small total population and many small, isolated populations that were not in contact with other groups.

- (a) Identify **two** effects a small population has on a gene pool that can reduce the chance of species survival. (2 marks)

One: _____

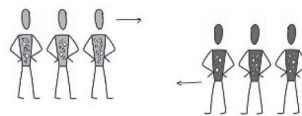
Two: _____

- (b) If *Homo neanderthalensis* populations were isolated, then barriers to gene flow must have existed. Name and outline **one** type of barrier to gene flow. (2 marks)

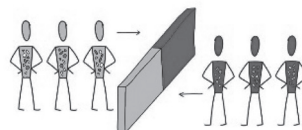
Another theory used to explain the extinction of *Homo neanderthalensis* is associated with disease. Scientific models have demonstrated that *Homo neanderthalensis* and modern *Homo sapiens* carried diseases unique to one another. This created an invisible disease barrier that deterred the mixing of the species into the other's territory. There must have been a narrow contact zone on the edges of the territories, where minimal contact did occur. This situation lasted over tens of thousands of years with modern *Homo sapiens* slowly building immunity to the *Homo neanderthalensis* diseases. However, *Homo neanderthalensis* seems to have not been able do the same. The result is that modern *Homo sapiens* could break through the disease barrier, invading the territory and eventually replacing *Homo neanderthalensis*.

The image below represents the theory.

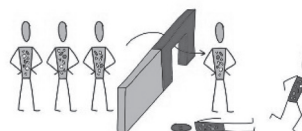
Neanderthals and modern humans each evolve immunity to different pathogens.



Disease generates a barrier.



Modern humans overcome disease barrier, expand to Neanderthal regions, and spread diseases.



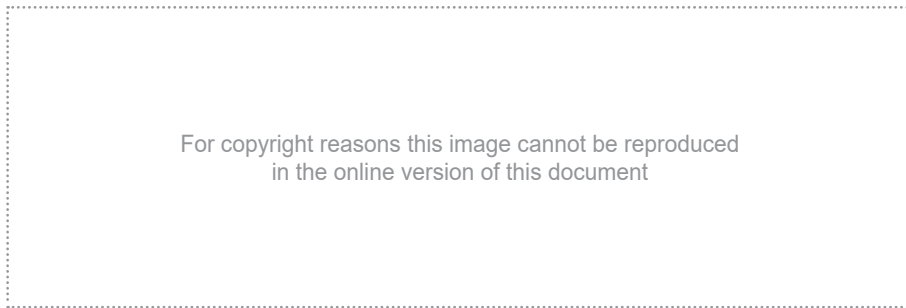
Key	
	Modern Humans
	Neanderthals

See next page

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- (c) Explain how the theory outlined implies that natural selection occurred in the process of *Homo sapiens* replacing *Homo neanderthalensis*. (3 marks)

The following question refers to the tool diagrams shown below.



- (d) Determine which of the tools shown above is the best example of one that belonged to *Homo neanderthalensis*. Name the tool culture associated with this type and species. (2 marks)

- (e) Outline **two** trends that are evident in the manufacturing techniques of tools from early hominins to modern *Homo sapiens* and state what each of these trends indicate about changes in lifestyle. (4 marks)

One: _____

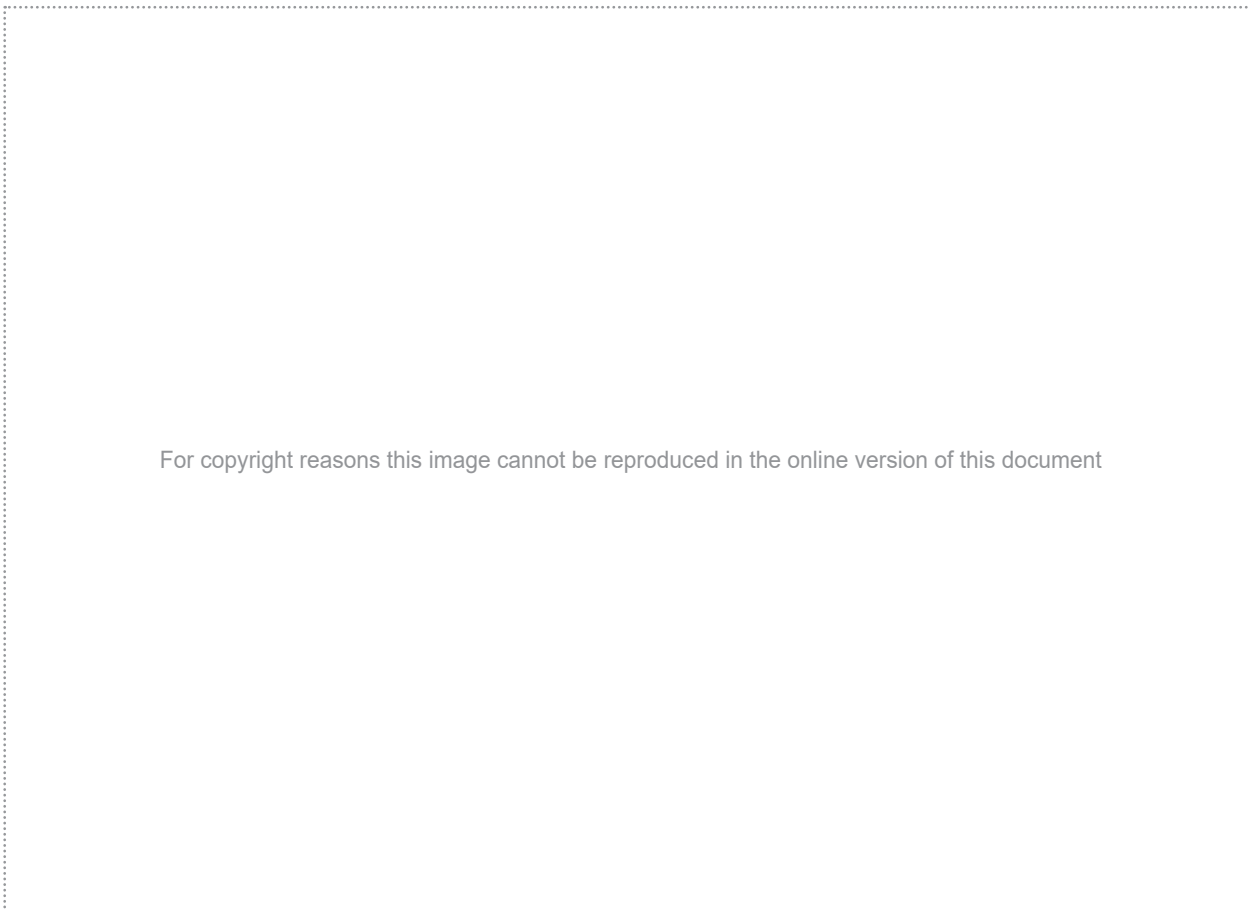
Two: _____

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Question 36

(22 marks)

The following question refers to the diagram shown below which depicts the three processes involved in the body's third line of defence against disease that enhance another process labelled Y.



- (a) Identify the processes that can be seen at X and Y. (2 marks)

X: _____

Y: _____

- (b) Describe how the first three processes in the diagram enhance the process at Y. (2 marks)

- (c) Explain why one antibody is unable to protect the human body effectively. (3 marks)

Vomiting and diarrhoea are symptoms of both Rotavirus and Salmonella infections. The pathogen responsible for causing each infection is different.

- (d) (i) Complete the table below outlining **two** structural differences between them. (4 marks)

	Rotavirus (virus)	Salmonella (bacteria)
One		
Two		

- (ii) Identify which pathogen in part (d)(i) could be treated effectively with antibiotics and outline **two** ways in which antibiotics are effective against this pathogen. (3 marks)

Pathogen: _____

One: _____

Two: _____

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Question 36 (continued)

There are numerous infections that can be prevented with a vaccination.

- (e) Australia provides a free vaccination schedule for children, yet some families choose to not vaccinate their children. Suggest **two** reasons why this may be the case. (2 marks)

One: _____

Two: _____

- (f) Explain how vaccines produce immunity to a pathogen. (6 marks)

End of Section Two

See next page

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Section Three: Extended answer**20% (40 Marks)**

This section contains **four** questions. You must answer **two** questions.

Questions 37 and 38 are from Unit 3. Questions 39 and 40 are from Unit 4. Answer **one** question from Unit 3 and **one** question from Unit 4.

Responses could include clearly labelled diagrams with explanatory notes; lists of points with linking sentences; clearly labelled tables and graphs; and annotated flow diagrams with introductory notes.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 50 minutes.

Unit 3

Choose **either** Question 37 **or** Question 38.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 32–37. When you have answered your first question, turn to page 38 and indicate on that page the second question you will answer.

Question 37**(20 marks)**

Homeostatic processes involve both nerves and hormones in the maintenance of many bodily functions, such as blood glucose levels.

- (a) Define homeostasis and describe how a negative feedback model contributes to the maintenance of bodily functions. (13 marks)
- (b) Explain the role the adrenal glands play in maintaining blood glucose levels. (7 marks)

or

Question 38**(20 marks)**

Changes to the amount of thyroxine being released from the thyroid gland can have major impacts on the functioning of the body.

- (a) Name each of the disorders that may lead to an over-secretion or under-secretion of thyroxine; describe how the over-secretion or under-secretion impacts on the body; and explain how each disorder can be treated. (12 marks)
- (b) Explain the role of the liver in the maintenance of blood glucose levels. (8 marks)

See next page

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Unit 4

Choose **either** Question 39 **or** Question 40.

Indicate the question you will answer by ticking the box next to the question. Write your answer on the pages provided.

Question 39**(20 marks)**

A mutation is a permanent change in the DNA code. Lactase persistence is the ability to digest lactose (the sugar found in milk) in adults. This ability is attributed to a mutation that became present in various gene pools between 2000 and 20 000 years ago. Only about 35% of the world's adults possess the mutation today and can effectively digest lactose.

- (a) Identify and describe the type of mutation that would be responsible for lactase persistence, considering that it has been maintained within the gene pool. Compare this type of mutation to mutations that are not passed to future generations. (5 marks)
- (b) Point mutations can alter the DNA code in a number of ways, one of these being a frameshift mutation. Explain what a frameshift mutation is and describe **two** other ways point mutations can alter the DNA code. (6 marks)
- (c) In farming populations, the allele frequency for lactase persistence can be as high as 96% whereas in non-farming populations the frequency is only 20%. Explain how natural selection could be responsible for this difference in allele frequency. (9 marks)

or

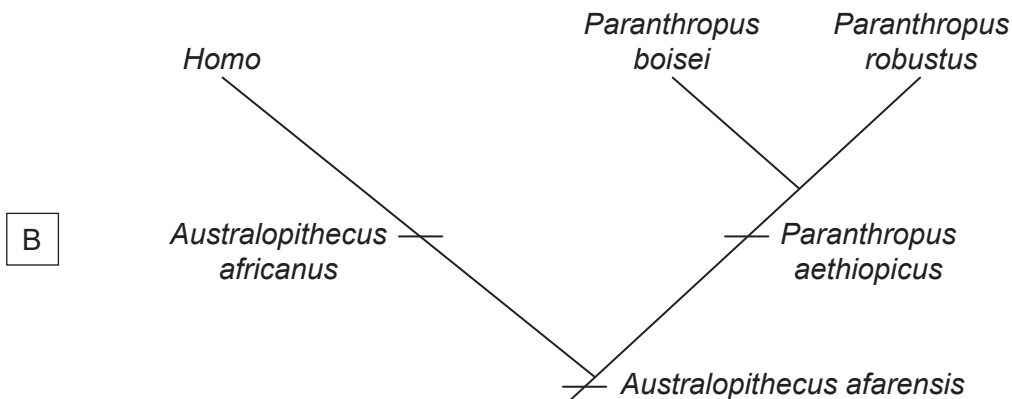
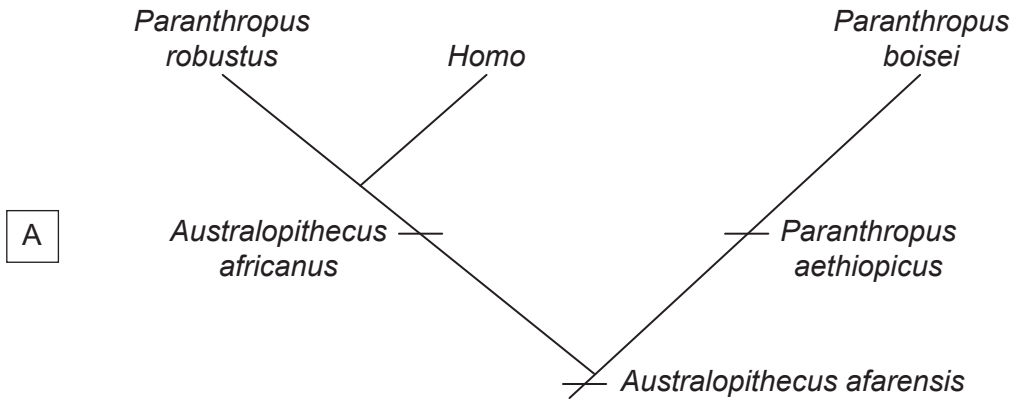
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Question 40

(20 marks)

Phylogenetic trees are essential tools used in understanding evolutionary pathways. Below are two possible phylogenetic trees for hominin evolution.



- (a) Recall the evidence that phylogenetic trees illustrate. (4 marks)
- (b) Compare the information about hominin evolution that can be deduced from what is depicted in the two phylogenetic trees. (10 marks)
- (c) Explain how the inclusion of the terms 'Homo', 'Australopithecus' or 'Paranthropus' in a species provides information about hominin evolution and identify the skull feature that distinguishes a *Paranthropus* specimen from the others. (6 marks)

End of questions

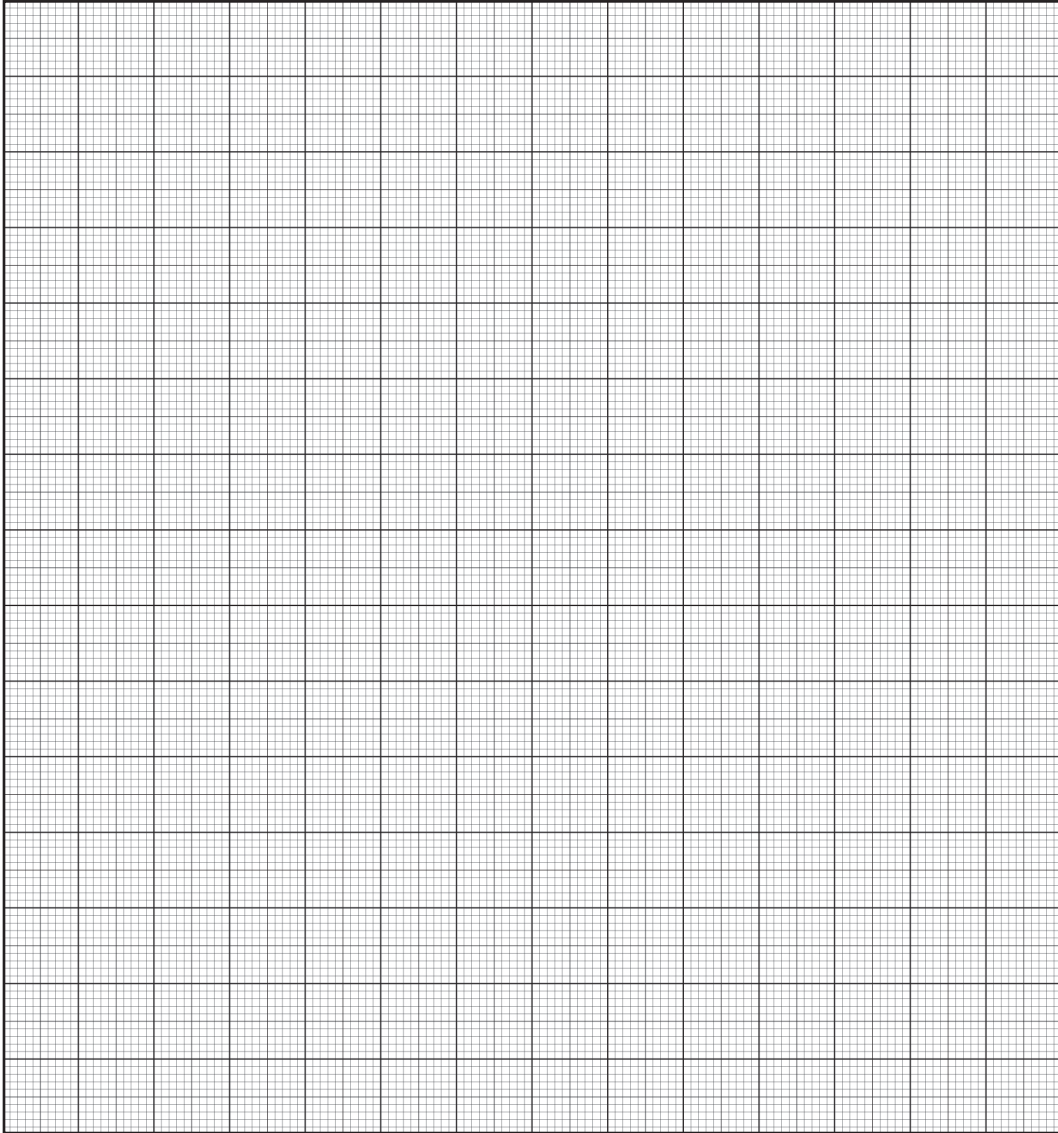
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Supplementary page

Question number: _____

22 horizontal lines for writing the answer.

Spare grid for Question 34(c)



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ACKNOWLEDGEMENTS

- Question 4** Adapted from: Coloring pages. (2017). [Diagram of human body and organs]. Retrieved June, 2023, from <https://clipart-library.com/clipart/19-RidRM5b5T.htm>
- Questions 7–8** Adapted from: OCR. (2008). Fig. 4.1 [Diagram]. In *Advanced GCE Human Biology exam 2867: Genetics, Homeostasis and Aging* (p.12).
- Questions 11–12** Adapted from: *Correlation Between Sickle Cell Allele and Malaria* [Diagram]. (n.d.). Retrieved April, 2023, from https://uvmgg.fandom.com/wiki/Sickle_cell_disease
- Questions 18–20** Adapted from: Lawson, R. (2007). *Spinal Nervous Pathway Unlabelled* [Diagram]. Retrieved April, 2018, from https://wikieducator.org/File:Spinal_nervous_pathway_unlabelled.JPG
- Question 21** Adapted from: Evolution Library. (n.d.). [...]. Retrieved May, 2023, from https://www.pbs.org/wgbh/evolution/library/06/3/l_063_03.html
- Questions 22–23** Adapted from: Molecular Devices. (n.d.). [Graph of action potential]. Retrieved April, 2023, from <https://www.moleculardevices.com/applications/patch-clamp-electrophysiology/what-action-potential>
- Questions 25–26** Adapted from: gchurch. (n.d.). [...] [Diagram]. Retrieved April, 2023, from [https://www.purposegames.com/worksheet/...](https://www.purposegames.com/worksheet/)
- Question 31(c)** Adapted from: Alzheimer's Disease Education and Referral Center. (2008). *Alzheimer's Disease Brain Comparison* [Diagram]. Retrieved April, 2023, from https://commons.wikimedia.org/wiki/File:Alzheimer%27s_disease_brain_comparison.jpg
- Question 31(d)** Adapted from: A Level Biology Student. (n.d.). *Synapse* [Illustration]. Retrieved April, 2023, from <https://alevelbiologystudent.weebly.com/135-synapses.html>
- Question 33** St. John, J. (2007). *Paradoxides Minor Fossil Trilobite (Jince Formation, Middle Cambrian; Jince Area, Bohemia, Czech Republic) 1* [Photograph]. Retrieved April, 2023, from <https://www.flickr.com/photos/jsjgeology/15269685292/>
Used under Creative Commons Attribution 2.0 Generic licence.
- Question 34(e)** Adapted from: Blaxland, B., & Dorey, F. (2020). *Walking on Two Legs – Bipedalism*. Retrieved May, 2023, from <https://australian.museum/learn/science/human-evolution/walking-on-two-legs-bipedalism/#:~:text=About%20seven%20million%20years%20ago,that%20helped%20them%20climb%20trees>

Question 35

Paragraph 2 information from: Than, K. (2019). *Stanford Scientists Link Neanderthal Extinction to Human Diseases*. Retrieved May, 2023, from <https://news.stanford.edu/2019/11/07/new-theory-neanderthal-extinction/>

Adapted from: Chen Wong, V. (n.d.). [Infographic of disease transmission between modern humans and Neanderthals]. Retrieved May, 2023, from <https://news.stanford.edu/2019/11/07/new-theory-neanderthal-extinction/>

Diagram X and Y from: Hanson, M. (1991). *Apes & Ancestors* (1st ed.). Longman Paul Limited, p. 77, 81, 85, 88.

Question 36

Adapted from: [Graphic of processes in body's third line of defence]. (2005). Retrieved May, 2023, from <https://www.austincc.edu/apreview/EmphasisItems/Inflammatoryresponse.html>

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