



ATAR course examination, 2022

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

--	--	--	--	--	--	--	--	--	--

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	99	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 2022: 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

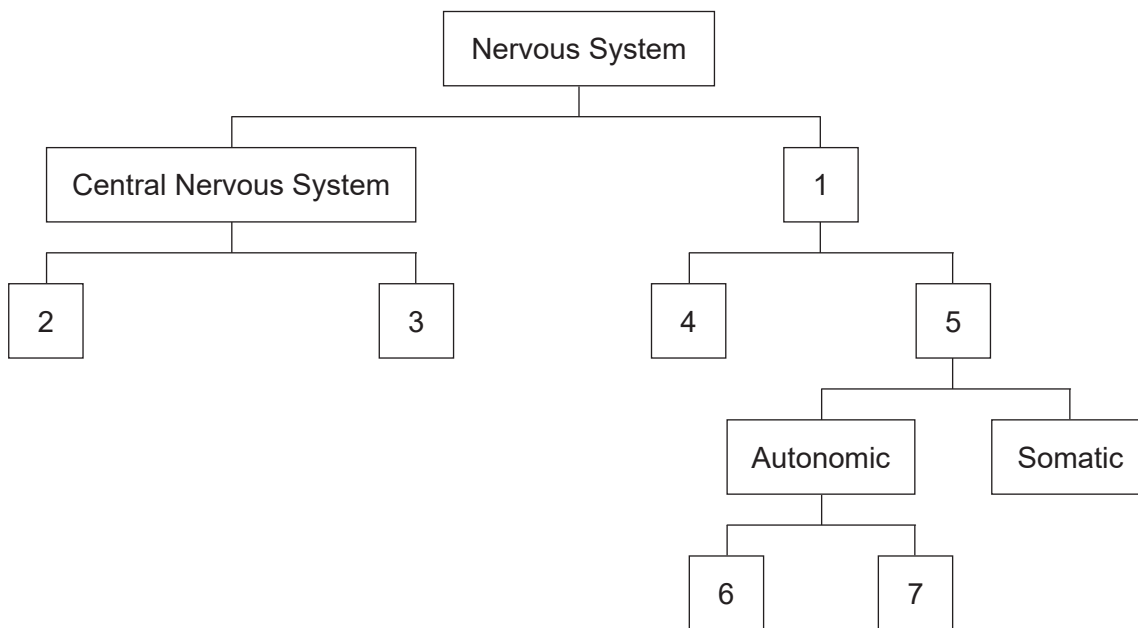
Section One: Multiple-choice

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.

Questions 1 and 2 refer to the diagram shown below, which represents the divisions of the nervous system.



1. Which of the following identifies the numbered components in the diagram correctly?

	2	3	4	5
(a)	brain	spinal cord	afferent	efferent
(b)	voluntary	involuntary	sensory	motor
(c)	visceral	peripheral	efferent	afferent
(d)	spinal cord	brain	voluntary	involuntary

2. The activation of Component 7 results in the constriction of the pupil of the eye. Which of the following would also occur when Component 7 is activated?

- (a) increased sweating
- (b) increased release of glucose from the liver
- (c) decreased heart rate
- (d) decreased secretion of saliva

See next page

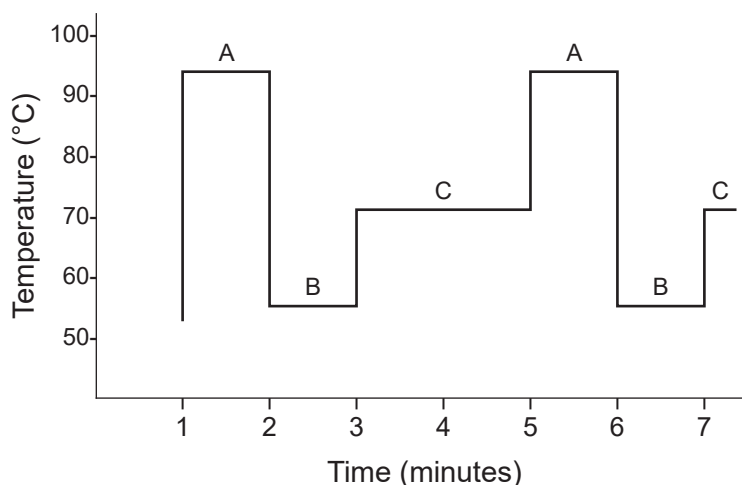
3. Blind people are taught to read Braille (raised marks that create patterns on paper). They do this by running their fingertips over the markings. The pathway the impulse travels from the fingers to the brain includes some of the following components:

- I. touch receptors
- II. connector neuron
- III. motor neuron
- IV. sensory neuron
- V. thalamus to cerebrum
- VI. thalamus to cerebellum.

The correct order of the components in the pathway is

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

Question 4 refers to the diagram shown below, which represents the temperature changes during the polymerase chain reaction (PCR) process.



4. Which of the following identifies the three stages in PCR correctly?

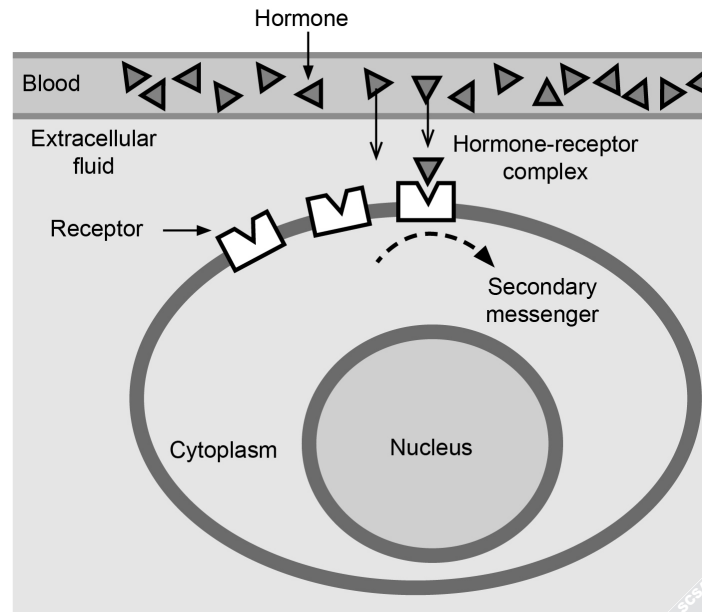
	A	B	C
(a)	denaturing	annealing	extension
(b)	annealing	denaturing	elongation
(c)	denaturing	hybridisation	annealing
(d)	extension	denaturing	annealing

5. A fossil can be defined as a

- (a) preserved trace of an object that can support evolutionary relationships.
- (b) bone that has been preserved and can be dated to show evolutionary relationships.
- (c) buried artefact made by humans that supports human evolutionary relationships.
- (d) preserved trace of a previously living organism that supports evolutionary relationships.

See next page

Questions 6 and 7 refer to the diagram shown below, which represents a hormonal action.

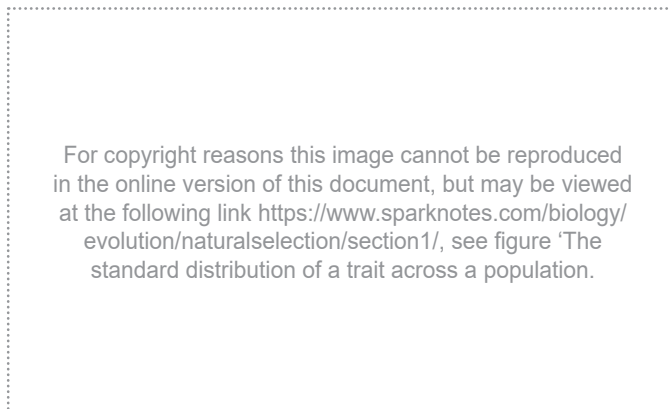


6. The hormonal action shown in the diagram is **best** described as
- water soluble, as the hormone-receptor complex will enter the nucleus and act on the DNA molecule.
 - lipid soluble, as the hormone diffuses across the cell membrane to attach to a receptor inside the cell.
 - lipid soluble, as the secondary messenger will enter the nucleus and act on the DNA molecule.
 - water soluble, as the hormone binds to a receptor on the outside of the cell membrane to form a hormone-receptor complex.
7. Which of the following is a correct comparison between a hormonal mode of transmission (like the one shown in the diagram) and neural transmission?
- speed of transmission can be faster
 - duration of the message can be long-lasting
 - the message is only short lived in the cell
 - nature of the transmission is electrochemical
8. A study measured the concentration of antidiuretic hormone (ADH) in the blood of 100 healthy elderly volunteers at 4-hourly intervals throughout a 24-hour period. ADH secretion normally increases at night. The expected increase in ADH levels during the night was not seen in 80% of the group. Why would these lower levels of ADH result in the volunteers needing to empty their bladders more than once during the night?
- Low ADH levels
- do not allow rapid eye movement (REM) sleep to occur, so the volunteers are awake more often.
 - reduce the ability of the bladder to hold large volumes of urine.
 - stimulate the kidney to filter blood faster and create more urine.
 - decrease the amount of water reabsorbed from kidney tubules.

See next page

9. Which of the following lists includes only relative dating methods?
- (a) index fossils, radiocarbon dating, correlation of rock strata
 - (b) stratigraphy, correlation of rock strata, index fossils
 - (c) radiocarbon dating, stratigraphy, principle of superposition
 - (d) principle of superposition, stratigraphy, potassium argon dating

Question 10 refers to the graph shown below, which represents the distribution of one human trait and the direction of influence a selection pressure could have on that trait.



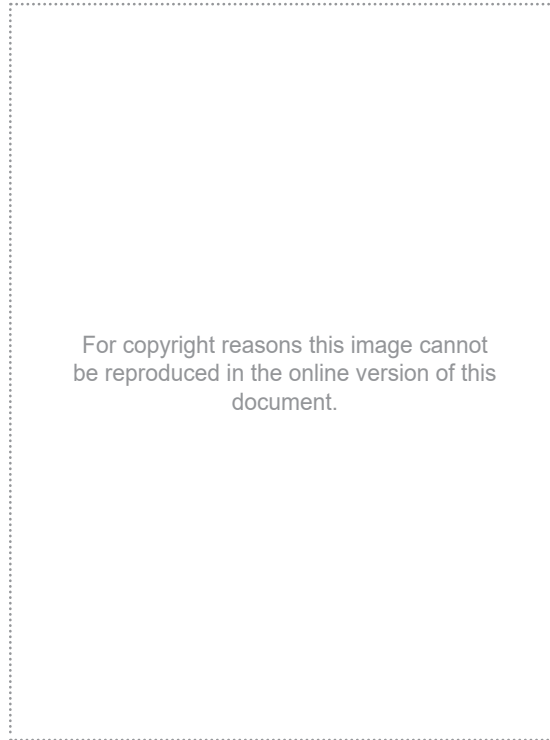
10. As a result of the selection pressure, which of the following graphs would be the expected new distribution of the trait after several generations?

<p>(a)</p> <p style="text-align: center;">For copyright reasons these images cannot be reproduced in the online version of this document, but may be viewed at the following link https://www.sparknotes.com/biology/evolution/naturalselection/section1/, see figures 'The effect of ... selection on trait distribution.</p>	<p>(b)</p> <p style="text-align: center;">For copyright reasons these images cannot be reproduced in the online version of this document, but may be viewed at the following link https://www.sparknotes.com/biology/evolution/naturalselection/section1/, see figures 'The effect of ... selection on trait distribution.</p>
<p>(c)</p> <p style="text-align: center;">For copyright reasons these images cannot be reproduced in the online version of this document, but may be viewed at the following link https://www.sparknotes.com/biology/evolution/naturalselection/section1/, see figures 'The effect of ... selection on trait distribution.</p>	<p>(d)</p> <p style="text-align: center;">For copyright reasons these images cannot be reproduced in the online version of this document, but may be viewed at the following link https://www.sparknotes.com/biology/evolution/naturalselection/section1/, see figures 'The effect of ... selection on trait distribution.</p>

11. Which of the following is the **best** description of gene therapy?
- (a) mutating the sequence of a particular gene to produce variation
 - (b) replacing a healthy gene with a defective gene
 - (c) transferring a gene from one species into the genome of another species
 - (d) replacing a defective gene with a functional one

See next page

Questions 12 and 13 refer to the diagram shown below, which represents an immune response.



12. The type of immune response illustrated in the diagram is **best** described as
- cell mediated immunity triggered by an intercellular antigen.
 - cell mediated immunity triggered by an extracellular antigen.
 - antibody mediated immunity triggered by an extracellular antigen.
 - antibody mediated immunity triggered by an intercellular antigen.

13. X, Y and Z are known as

	Process X	Cell Y	Product Z
(a)	lysis	helper T cell	cytokines
(b)	phagocytosis	macrophage	plasma cells
(c)	phagocytosis	helper T cell	antibodies
(d)	exocytosis	plasma cell	cytokines

14. If a geneticist is studying the amino acid sequence of haemoglobin, they are **most** likely looking for the possibility of
- sickle cell anaemia or thalassemia.
 - Tay-Sachs disease or thalassemia.
 - thalassemia or malaria.
 - malaria or sickle cell anaemia.

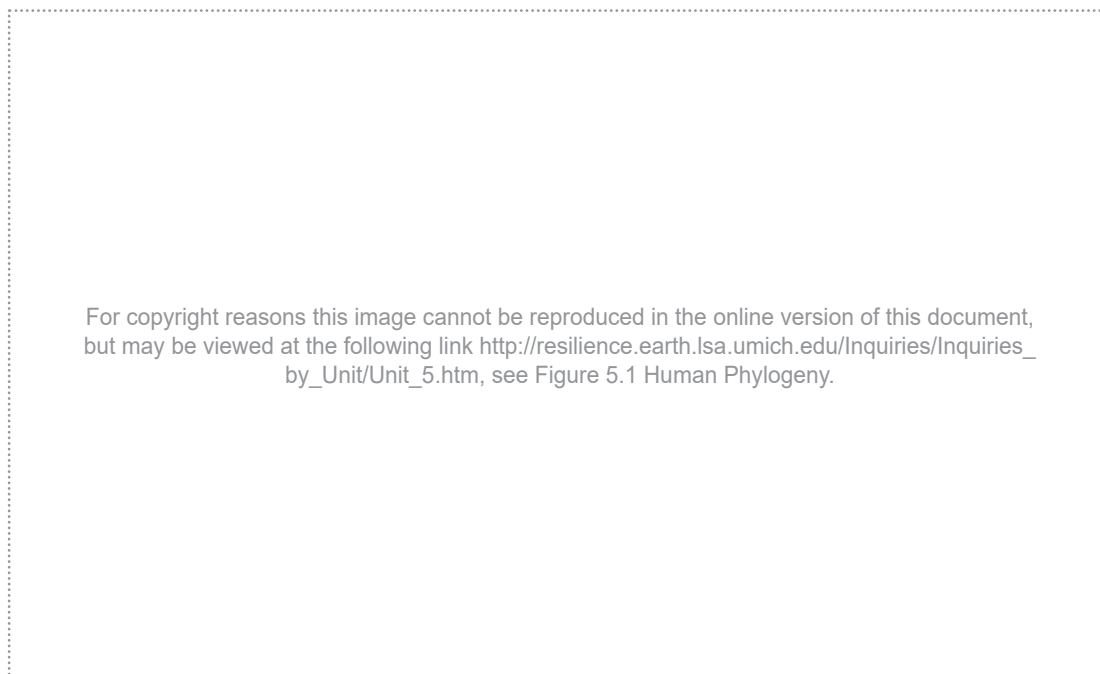
See next page

15. Which of the following statements concerning the regulation of blood gases is true?

The respiratory centre in the

- (a) hypothalamus detects the increase in blood pH and sends impulses to the respiratory muscles via efferent nerves.
- (b) medulla oblongata detects the decrease in blood pH and sends impulses to the respiratory muscles via efferent nerves.
- (c) medulla oblongata detects the increase in blood pH and sends impulses to the respiratory muscles via afferent nerves.
- (d) hypothalamus detects the decrease in blood pH and sends impulses to the respiratory muscles via afferent nerves.

Question 16 refers to the diagram shown below, which represents one possible phylogenetic tree associated with humans.



16. According to the phylogenetic tree, the closest evolutionary relationship between *Homo sapiens* and a non *Homo* species is the

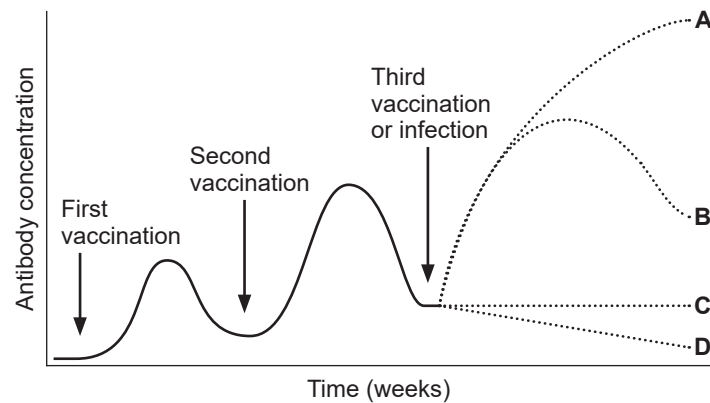
- (a) Eastern Gorilla.
- (b) Eastern Chimpanzee.
- (c) *Homo habilis*.
- (d) Bonobo.

17. The single, long process of a neuron that delivers signals, is termed a/an

- (a) axon.
- (b) axon terminal.
- (c) Schwann cell.
- (d) dendrite.

See next page

Questions 18 and 19 refer to the diagram shown below, which represents changes in antibody concentrations over many weeks.



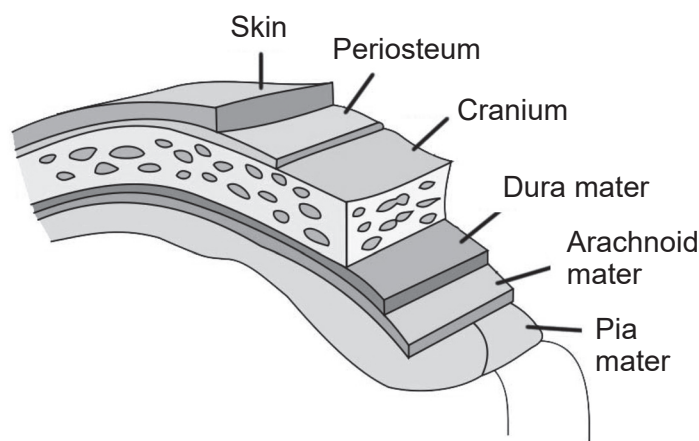
18. Which of the dotted lines shown above **best** indicates the level of antibodies after a third vaccination or infection?
- (a) A
(b) B
(c) C
(d) D
19. The **best** explanation for the change in the level of antibodies found after the second vaccination is that
- (a) killer T cells were activated quickly to seek out the antigen.
(b) the antigen reactivated plasma cells to produce antibodies rapidly.
(c) memory cells rapidly stimulated production of antibodies.
(d) B lymphocytes were already primed and ready to produce antibodies.
20. Natural selection is often referred to as 'survival of the fittest'. Which of the following is the **best** definition for 'fittest' as used in this statement?
- (a) the ability of an organism to survive and reproduce
(b) adaptations that produce favourable traits
(c) selective breeding to promote favourable traits
(d) heritable traits that will be passed on to offspring
21. Which of the following distinguishes correctly between the *Paranthropus* and *Australopithecus* genera?

	<i>Paranthropus</i>	<i>Australopithecus</i>
(a)	long, wide pelvis	short, narrow pelvis
(b)	long, prognathic snout	flat face with no prognathism
(c)	larger cranium with evidence of a sagittal crest	smaller cranium with no evidence of a sagittal crest
(d)	S shaped spinal column with large lumbar vertebrae	C shaped spinal column with large cervical vertebrae

See next page

22. Fever plays an important role in humans' defence against disease. This role is **best** described as
- specific immunity, which destroys invading pathogens directly.
 - non-specific immunity, which helps to speed up the immune response.
 - specific immunity, which activates the killer T cells and helper T cells.
 - non-specific immunity, which helps to neutralise pathogens at the entry site.

Question 23 refers to the diagram shown below, which represents the layers around the brain.



23. Referring to the layers around the brain as shown in the diagram, where is cerebrospinal fluid found?
- between the periosteum and the cranium
 - under the pia mater layer
 - between the cranium and the dura mater
 - within the arachnoid mater layer
24. Cell replacement therapy for the treatment of Parkinson's disease involves the
- injection of adult stem cells to replace neurons in the brain that have been damaged by the build-up of plaque.
 - differentiating of stem cells into dopamine-signalling neurons and transplanting them into a patient's brain to replace dying neurons.
 - patient's own neurons being extracted with the DNA inside the cells then altered and the cells reinserted into the patient's body.
 - extraction of non-functioning neurons and replacing them with new cells that have the correct gene and can function normally.
25. A scientist used the potassium-argon dating method to determine the age of a sample. This type of dating involves comparing the amount of
- Argon-40 and Potassium-40 to the remaining Calcium-40.
 - Potassium-41 remaining in the sample to the amount of Argon-41.
 - Argon-40 in the sample to the remaining amount of Potassium-40.
 - Argon-40 and Calcium-40 to the remaining Potassium-41.

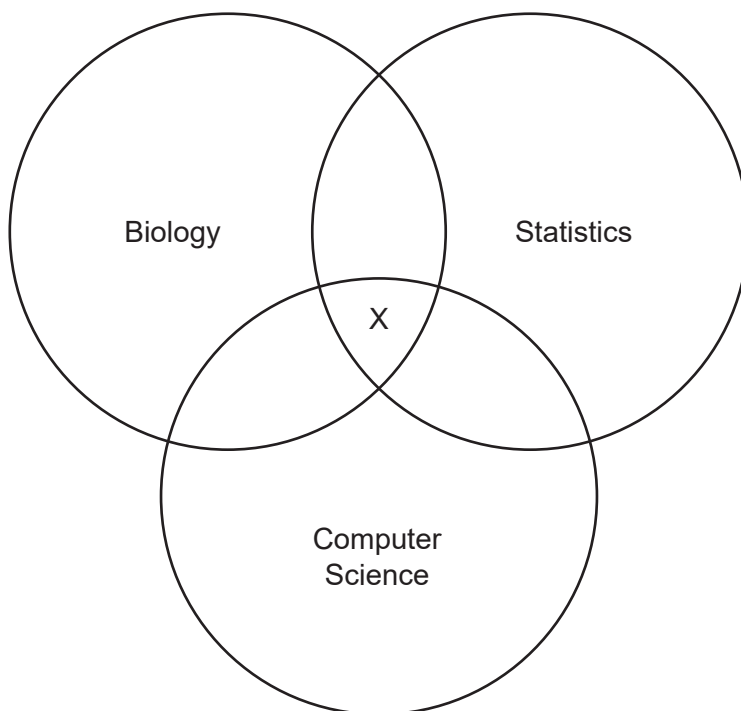
See next page

26. Which of the following is the **key** difference between adrenaline and insulin?

Insulin

- (a) is secreted in response to a chemical stimulus, while adrenaline secretion is controlled by a nerve impulse.
- (b) controls blood sugar concentrations, while adrenaline helps regulate temperature.
- (c) is secreted by the pancreas, while adrenaline is secreted by the kidneys.
- (d) is a water-soluble hormone, while adrenaline is a lipid-soluble one.

Question 27 refers to the diagram shown below, which represents an area of study related to Human Biology.



27. The area of study shown as X is **best** described as

- (a) comparative genomics.
- (b) biotechnology.
- (c) comparative biochemistry.
- (d) bioinformatics.

28. An interbreeding population of hominids became geographically separated by a mountain range, forming two isolated groups, Y and Z. The two groups were subjected to different environmental selection pressures for many generations. After 1000 years, individuals from each group met up and formed a new group.

Which of the following observations would indicate that Y was a different species to Z?

- (a) they failed to produce fertile children
- (b) their physical appearance was markedly different
- (c) the DNA sequence in their haemoglobin gene was different
- (d) Group Z had a survival advantage over Group Y

See next page

29. Which of the following lists endocrine glands that are **not** controlled directly by the hypothalamus?

- (a) pituitary, thymus, adrenal medulla
- (b) thymus, pancreas, adrenal cortex
- (c) parathyroid, pancreas, adrenal medulla
- (d) pancreas, thyroid, pituitary

30. Which of the following is a correct comparison between bacterial and viral pathogens?

	Bacterial	Viral
(a)	infected patients can be treated with vaccines	infected patients can be treated with antivirals
(b)	are very small and can only be seen through an electron microscope	are small but some can be seen without a microscope
(c)	infection is caused by bacterial cells multiplying or toxins within the body of the host	infection is caused by invading a host cell and creating multiple copies of itself
(d)	all bacteria found in nature are harmful to humans	some viruses are helpful to humans and not disease causing

End of Section One

See next page

Section Two: Short answer**50% (99 Marks)**

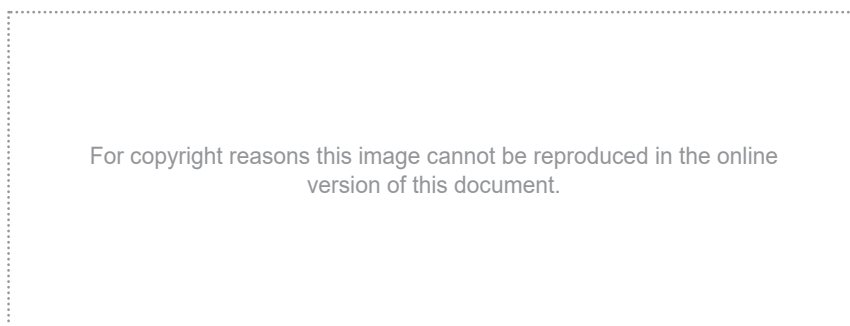
This section has **six** questions. Answer **all** questions. Write your answers in the spaces provided.

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**(18 marks)**

The following question refers to the diagram below, which shows a neuron.



- (a) Identify the type of neuron shown in the diagram. (1 mark)

- (b) List **two** features of the neuron that can be used to distinguish it from other types of neurons found in the human body. (2 marks)

One: _____

Two: _____

- (c) State the function of the structure labelled as X. (1 mark)

Question 31 (continued)

The function of nerves is to transmit electrical impulses.

- (d) Contrast the transmission of nerve impulses in myelinated and unmyelinated neurons. (4 marks)

Some local anaesthetics work by interfering with the sodium ion channels in the membrane of a neuron.

- (e) (i) Describe the role of sodium channels found within a neuron's cell membrane. (2 marks)

- (ii) If a local anaesthetic works by blocking the sodium channels, describe how this would affect the conduction of an action potential. (2 marks)

A study using rats looked at the impact of local anaesthetics on blocking the release of calcium ions at an axon terminal.

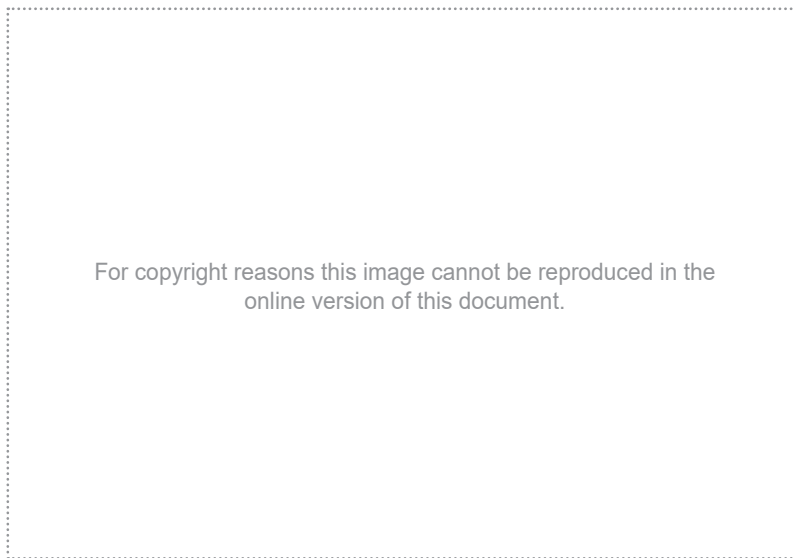
- (f) Explain how this would lead to pain signals from affected parts of the body not reaching the brain. (6 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 32

(21 marks)

The following question refers to the diagram shown below, which represents various skull and teeth profiles.



The diagram depicts four skull specimens with graphics of the relative brain sizes and teeth profiles that belong to each of the skulls. Note: the teeth profiles do not necessarily match the skulls and brain sizes shown above them.

- (a) Identify the names of the **two** types of mammalian teeth that are shown in the teeth profile part of the diagram. (2 marks)

One: _____

Two: _____

- (b) State the letter of the tooth profile that matches correctly the skull as shown in the diagram. (2 marks)

Skull 2: _____

Skull 4: _____

- (c) Using the diagram on page 16, identify **three** hominid evolutionary trends shown in the jaws and teeth. (3 marks)

One: _____

Two: _____

Three: _____

- (d) Explain how an index fossil can be used to date another fossil. (3 marks)

- (e) '*Homo sapiens* could, in a future setting, be an excellent example of an index fossil. All other known hominin species would be poor index fossils.' Justify this statement. (3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 32 (continued)

Gaps in the fossil record could potentially mean that our current conclusions about evolutionary pathways are flawed.

- (f) (i) One reason why gaps in the fossil record exist is that conditions for fossil formation are very specific. Complete the table below, describing each specific condition needed for fossil formation. (4 marks)

Condition	Description of condition for fossil formation
Soil type	
Specimen to be fossilised	
Micro-organisms	
Exposure to atmosphere	

- (ii) Apart from the conditions listed in part (f)(i), describe **two** other reasons why gaps in the fossil record exist. (4 marks)

One: _____

Two: _____

Question 33**(9 marks)**

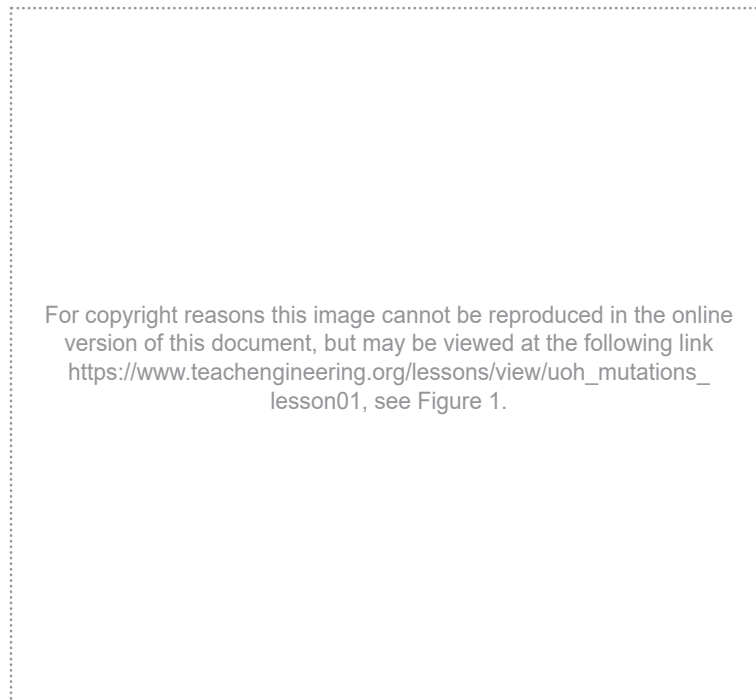
Congenital insensitivity to pain is a genetic condition that affects the ability of the body to detect pain stimuli. The condition affects the sodium channels of the pain receptors that transmit messages to the brain and spinal cord.

- (a) State **one** specific location in the body where pain receptors are found. (1 mark)

Congenital insensitivity to pain is caused by a mutation to the SCN9A gene.

- (b) Distinguish a gene mutation from a chromosomal mutation. (2 marks)

The following question refers to the diagram below, which represents different types of mutations.



- (c) The mutation to the SCN9A gene is classified as a substitution mutation. Identify which of the three mutations shown above (X, Y or Z) is a substitution mutation and state how the substitution mutation alters the genome. (2 marks)

See next page

Question 33 (continued)

- (d) To examine the SCN9A mutation in patients, DNA sequencing needs to be carried out. For the following bacterial enzymes, state the biotechnological technique they are used in and describe their role in that technique. (4 marks)

Restriction enzymes: _____

DNA polymerase: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

This page has been left blank intentionally

See next page

Question 34

(22 marks)

Researchers were interested in trialling a new antibiotic for golden staph (*Staphylococcus aureus*), a common bacterium that is resistant to many commonly used antibiotics. The current treatment is an intravenous course of the antibiotic Vancomycin. A new antibiotic, Trishillin, has the advantage that it can be taken orally.

The researchers set up 1200 Petri dishes with nutrient agar and inoculated these with a resistant strain of golden staph. Five hundred of these were treated with various concentrations of Trishillin, the other 500 dishes were treated with various concentrations of Vancomycin.

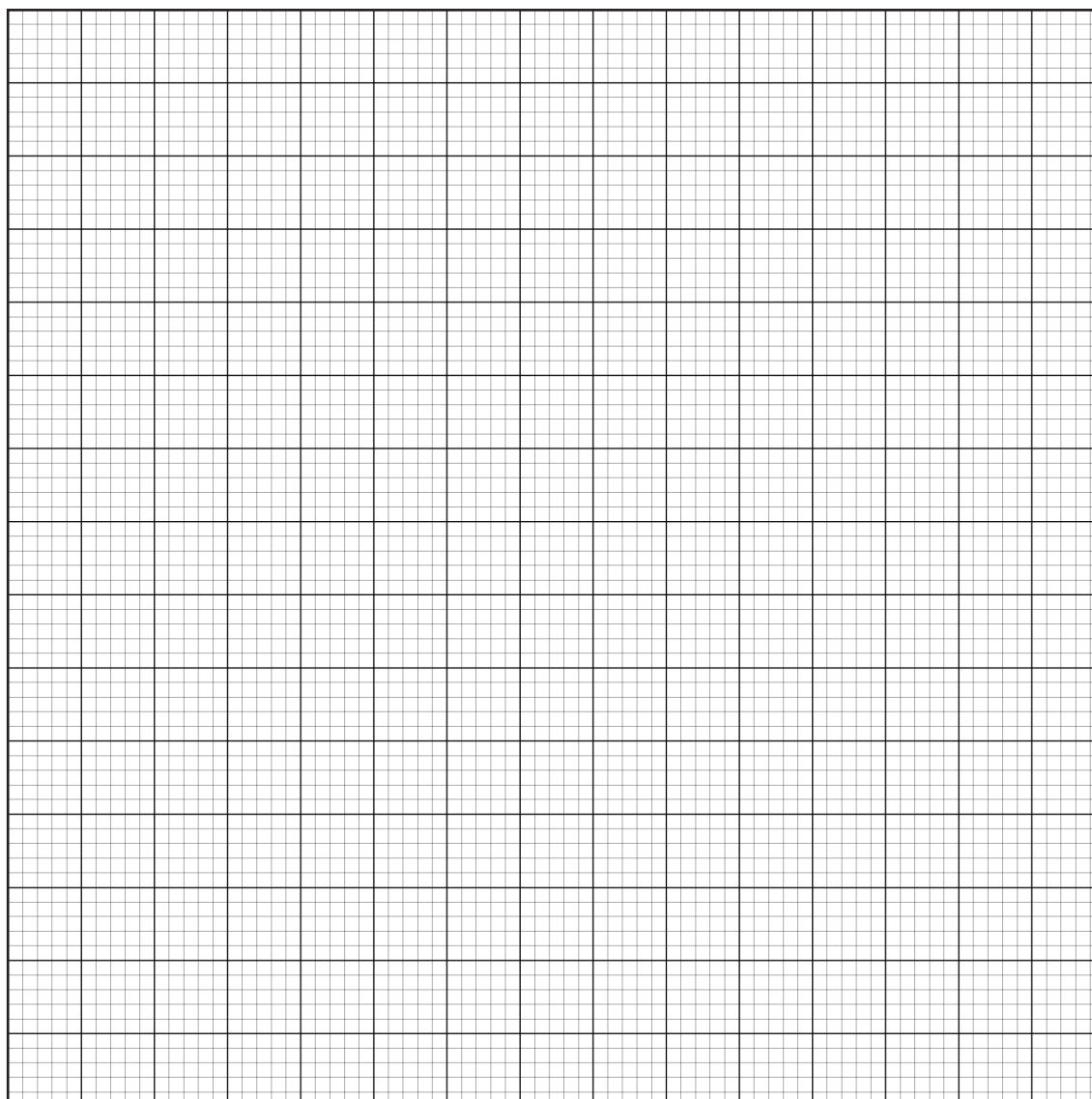
All dishes were cultured under identical conditions and the number of bacterial colonies was counted after 48 hours. The data are shown below.

Antibiotic	Dosage (mg kg ⁻¹)	Number of colonies detected
Trishillin	0	28
	15	16
	30	7
	45	1
	60	0
	75	0
Vancomycin	0	30
	5	25
	10	19
	20	2
	25	0
	30	0

(a) State a hypothesis for this investigation. (2 marks)

(b) Determine whether the investigation had a control. Justify your response. (3 marks)

- (c) On the grid below, graph the number of colonies for each antibiotic dosage. (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) Using your graph, estimate the number of colonies you would expect if a 15 mg kg^{-1} dosage of Vancomycin had been tested. (1 mark)

- (e) Explain why the researchers cultured the Petri dishes under identical conditions except for the variation in antibiotics. (2 marks)

See next page

Question 34 (continued)

- (f) Explain why the researchers used 100 Petri dishes for each antibiotic concentration rather than 10. (2 marks)

- (g) Antibiotics are divided into two types on the basis of their mode of action. These are known as bactericidal and bacteriostatic. Explain how **each** type of antibiotic acts on bacterial cells. (4 marks)

Bactericidal: _____

Bacteriostatic: _____

Researchers are also interested in the possibility of producing a synthetic vaccine to treat golden staph.

- (h) (i) Identify a biotechnological technique that could be used to create a synthetic vaccine. (1 mark)

- (ii) Explain the role of a transgenic organism, or genetically-modified organism, in the process identified in part (h)(i). (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

This page has been left blank intentionally

See next page

Question 35

(16 marks)

In December 2021, Perth recorded four consecutive days of temperatures above 40 °C, the most ever for December.

When subjected to extreme heat, the human body needs to employ numerous mechanisms to maintain body temperature within an appropriate range.

- (a) (i) Complete the table below by identifying **two** different effectors, the physiological mechanism that each would employ when operating in the hot conditions and how these mechanisms help to maintain body temperature. (8 marks)

	Effector One	Effector Two
Name of the effector	(1 mark)	(1 mark)
Physiological mechanism for hot conditions	(1 mark)	(1 mark)
How the mechanism helps to maintain body temperature	(2 marks)	(2 marks)

See next page

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

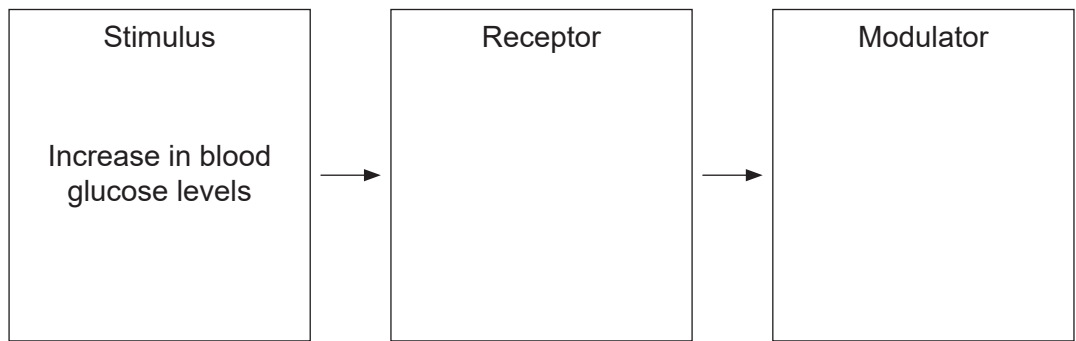
- (ii) Identify **two** behavioural mechanisms that a person could use to maintain body temperature in these hot conditions. (2 marks)

One: _____

Two: _____

One popular dieting trend in 2021 was known as the 16:8 intermittent fasting technique. This involves people fasting (not consuming any kilojoules) for 16 hours a day and then eating normally for the remaining eight hours of the day.

- (b) (i) Complete the flow diagram below to show how blood glucose would be regulated during the eight hours of normal eating during the diet. (2 marks)



- (ii) During the 16-hour fasting stage, which hormone associated with blood glucose regulation would be present in high concentrations? (1 mark)

- (iii) Using your understanding of blood glucose regulation, propose how this type of dieting could help achieve weight loss. (3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Consider the following hypothetical situation: An isolated island had a population of 300 people, 10 of which were colour blind. After 150 years, the island had a population of 400 people, none of whom were colour blind.

- (c) (i) If colour blindness did provide a survival advantage to this population, identify the name of the process that would provide the **best** explanation for the change in the population over time. (1 mark)

- (ii) Justify your response to part (c)(i). (3 marks)

End of Section Two

See next page

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)**

Two unrelated patients; X and Y, visited the same neurosurgeon. The patients had very similar names, and both had a form of brain damage. The neurosurgeon asked Patient X to complete a point-to-point movement test, where the index finger touches the nose and then touches the outstretched finger of the neurosurgeon. He was also asked to walk across the room while the neurosurgeon observed his stability. Patient X found this very strange, as these tests were not what he normally experienced. He has a benign growth below the hypothalamus, reducing levels of thyroid-stimulating hormone. When Patient X questioned this, the neurosurgeon realised he had mixed up the two patients and mistakenly thought he was seeing Patient Y.

- (a) Using the information above, identify the part of the brain damaged in both patients (X and Y), describe the role of these parts in normal body functioning and describe the effects damage to these structures would have on both patients. (12 marks)
- (b) Describe how the hypothalamus and pituitary work together to achieve their main function. (8 marks)

or

See next page

Question 38**(20 marks)**

Mumps is a disease caused by a RNA virus. Patients with mumps experience a variety of symptoms, which could include painful and swollen glands in the neck. Mumps is transmitted via droplets.

- (a) Identify and describe **four** external defence mechanisms found in the human body that could help prevent the entry of the mumps pathogen. (8 marks)
- (b) Immunisation against mumps can be achieved with vaccination. Distinguish between the terms 'immunisation' and 'vaccination'. Explain how vaccines provide immunity to pathogens and outline **four** different types of vaccines available. (12 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

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)**

Fossil remains of the *Homo naledi* were found in a cave system in South Africa in 2013. They showed that this species had a combination of both primitive and modern features. The fossil evidence also showed that there was a distinct separation of upper body features adapted for living in trees (arboreal life) and lower body features adapted for bipedalism.

A reconstruction of the fossil remains into a complete skeleton and a scan of the footprint from this hominin are shown below.



Image of a computer reconstruction
of *Homo naledi* skeleton



Homo naledi footprint
(not shown to scale)

- (a) Describe how the features of *Homo naledi* shown above support the idea that this hominin was both bipedal and arboreal. (12 marks)
- (b) Explain the relationship between bipedalism, increasing cranial capacity and tool use seen in the hominin group. (8 marks)

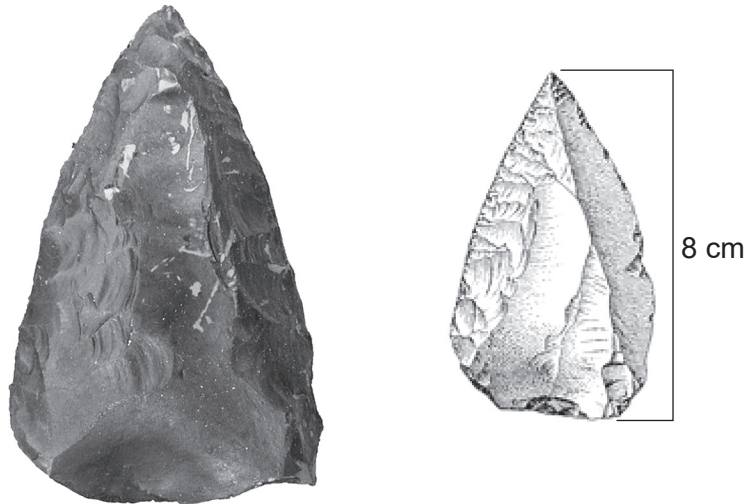
or

See next page


Question 40
(20 marks)

A paleontologist came across a tool artefact during a dig at a location in Europe. During the dig, detailed notes, drawings and photographs were recorded for detailed analysis later.

A photograph and sketch of this tool are shown below.



- (a) Identify the tool culture and the name of the hominin that produced the tool. Describe how the tool would have been manufactured. (6 marks)
- (b) Parts of a fossilised skull and jaw were extracted from the site in the rock stratum directly below the artefact. Identify and describe the techniques that could be used to give this fossil both a relative and an absolute date. (9 marks)
- (c) Outline **five** features the paleontologist would be looking for in the skull if they assumed the fossil belonged to the hominin that manufactured the tool shown in the photograph. (5 marks)

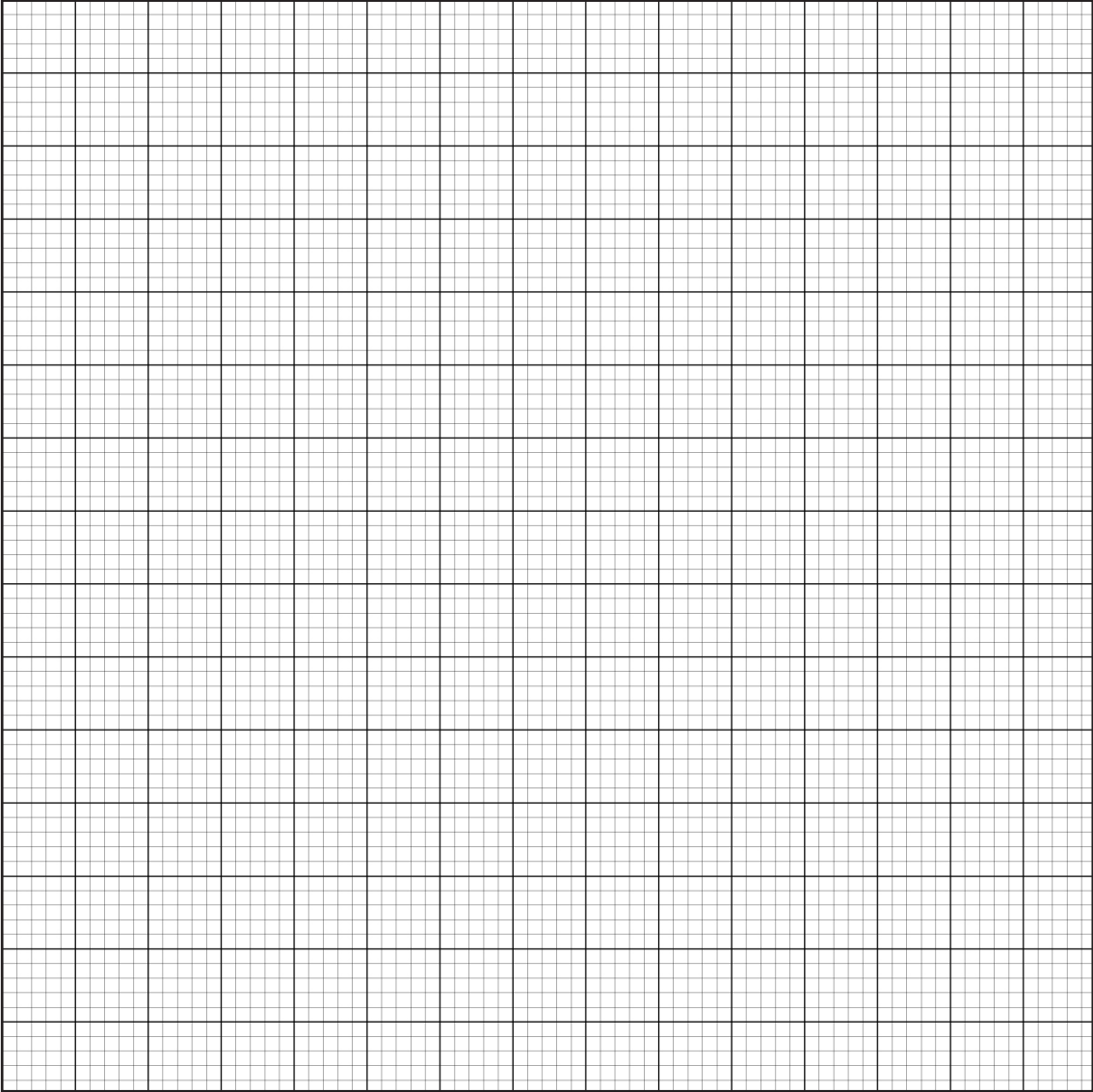
DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Spare grid for Question 34(c)



DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

ACKNOWLEDGEMENTS

- Question 10** First image adapted from: [...] [Graph]. (n.d.). Retrieved May, 2022, from <https://www.sparknotes.com/biology/evolution/naturalselection/section1/>
Image (a) adapted from: [...] [Graph]. (n.d.). Retrieved May, 2022, from <https://www.sparknotes.com/biology/evolution/naturalselection/section1/>
Images (b) & (d) adapted from: [...] [Graph]. (n.d.). Retrieved May, 2022, from <https://www.sparknotes.com/biology/evolution/naturalselection/section1/>
Image (c) adapted from: [...] [Graph]. (n.d.). Retrieved May, 2022, from <https://www.sparknotes.com/biology/evolution/naturalselection/section1/>
- Questions 12, 13** Adapted from: Dr. Samantha. (2019). [...] [Diagram]. Retrieved May, 2022, from <https://www.differencebetween.com/difference-between-cell-mediated-and-antibody-mediated-immunity/>
- Question 16** Adapted from: Stearns, S., & Hoekstra, R. (2005). *Evolution: An introduction* (2nd ed.) [Diagram of human phylogeny]. Oxford University Press, p. 481, fig. 19.1. Retrieved May, 2022, from http://resilience.earth.lsa.umich.edu/Inquiries/Inquiries_by_Unit/Unit_5.htm
- Question 23** Jones, O. (2021). Fig 1 - *Overview of the meninges and their relationship to the skull and brain* [Diagram]. Retrieved May, 2022, from <https://teachmeanatomy.info/wp-content/uploads/Overview-of-the-Meninges-of-the-Brain.jpg>
- Question 31** Adapted from: Gorton, N. (2012). *Myelinated unmyelinated neurons* [Diagram]. Retrieved June, 2022, from https://commons.wikimedia.org/wiki/File:Myelinated_unmyelinated_neurons.PNG
- Question 32** Adapted from: Nature Education. (2012). *Figure 2: Anatomical comparisons of apes, early hominins, australopithecus, homo erectus and humans* [Diagram]. Retrieved May, 2022, from <https://www.nature.com/scitable/knowledge/library/overview-of-hominin-evolution-89010983/>
- Question 33(c)** Adapted from: Zelisko, M. (2015). *Figure 1*. [...] [Diagram]. Retrieved May, 2022, from https://www.teachengineering.org/lessons/view/uoh_mutations_lesson01
- Question 39** Left image: Hawks, J. (n.d.). [Image of simulation of homo naledi full skeletal structure]. Retrieved May, 2022, from <https://www.americanscientist.org/article/the-latest-on-homo-naledi>
Right image adapted from: Bennett, M. R., Harris, J. W. K., Richmond, B. G., et al. (2009). [Image of Homo naledi footprint] (p. 1197). *Science*, 323(5918) Retrieved May, 2022, from <https://www.newscientist.com/article/mg20126984-100-fossil-footprints-reveal-our-modern-walk-in-the-making/>

Question 40

Adapted from: Guérin, N. (2020). [...] *tool 1 form Syria (University of Zurich)* [Photograph]. Retrieved May, 2022, from [https://commons.wikimedia.org/wiki/File:\[...\]_tool_1_form_Syria_\(University_of_Zurich\).JPG](https://commons.wikimedia.org/wiki/File:[...]_tool_1_form_Syria_(University_of_Zurich).JPG) Used under the Creative Commons Attribution-Share Alike 3.0 Unported licence.

Right image adapted from: De Mortillet, G., & De Mortillet, A. (1903). (Planch XII) – 84) [Line drawing of prehistoric tool]. *Musée préhistorique*. Schleicher frères. Retrieved May, 2022, from [https://upload.wikimedia.org/wikipedia/commons/9/90/\[...\]_Wellcome_M0015182.jpg](https://upload.wikimedia.org/wikipedia/commons/9/90/[...]_Wellcome_M0015182.jpg)

This document – apart from any third party copyright material contained in it – may be freely copied, or communicated on an intranet, for non-commercial purposes in educational institutions, provided that it is not changed and that the School Curriculum and Standards Authority (the Authority) is acknowledged as the copyright owner, and that the Authority's moral rights are not infringed.

Copying or communication for any other purpose can be done only within the terms of the *Copyright Act 1968* or with prior written permission of the Authority. Copying or communication of any third party copyright material can be done only within the terms of the *Copyright Act 1968* or with permission of the copyright owners.

Any content in this document that has been derived from the Australian Curriculum may be used under the terms of the Creative Commons [Attribution 4.0 International \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) licence.

An *Acknowledgements variation* document is available on the Authority website.