



ATAR course examination, 2020

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	8	8	90	110	50
Section Three Extended answer Unit 3	2	1	50	20	10
Unit 4	2	1		20	10
Total					100

Instructions to candidates

- The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2020: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
- 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. 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.

- 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)

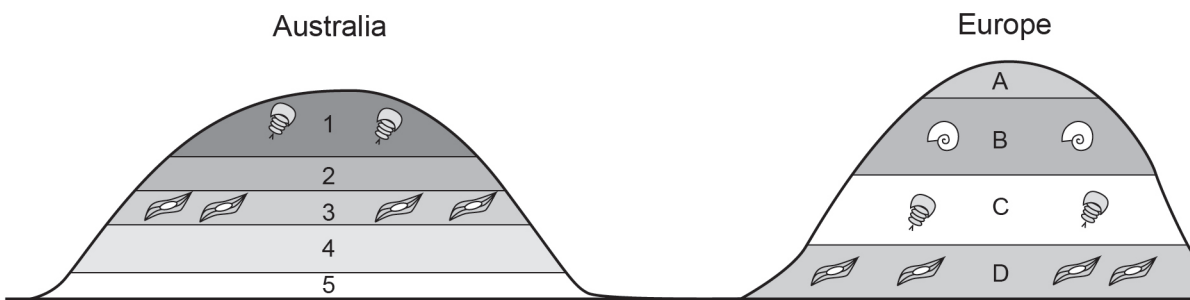
This section has **30** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that 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 target organ for the hormone calcitonin is the

- (a) parathyroid gland.
- (b) adrenal gland.
- (c) bones.
- (d) liver.

Question 2 refers to the following diagram.



2. The two layers which are of similar age are

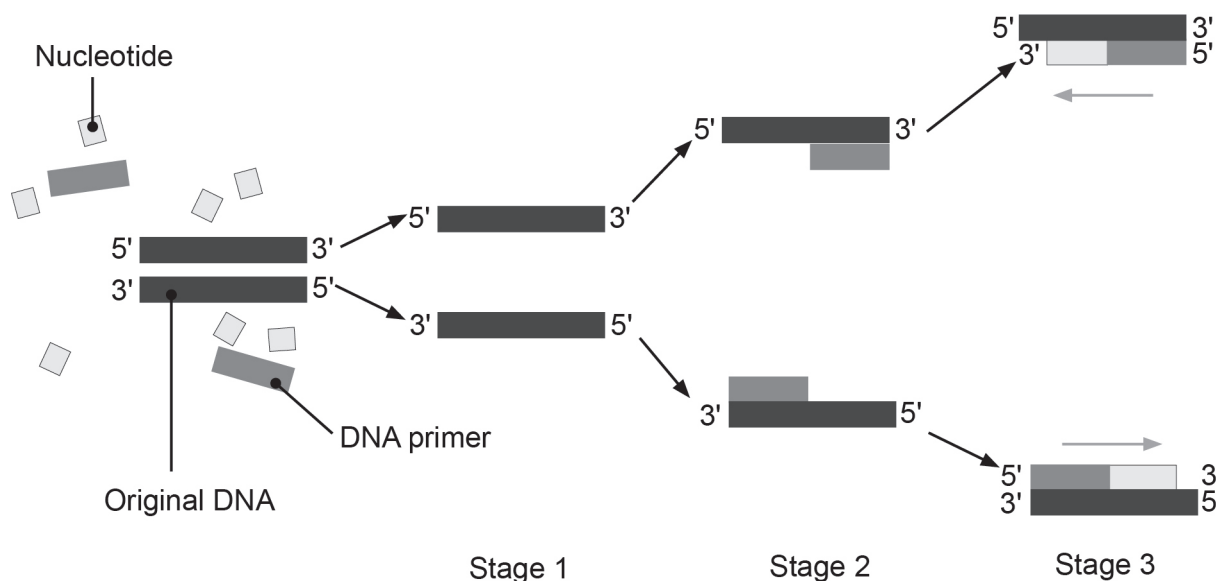
- (a) Australia 2, Europe A.
- (b) Australia 1, Europe C.
- (c) Australia 4, Europe A.
- (d) Australia 3, Europe B.

3. The term 'selectively-advantageous mutation' means the mutation

- (a) provides a survival advantage in a particular environment.
- (b) will always be passed to the offspring.
- (c) is always changing to adapt to new environments.
- (d) provides a benefit to heterozygote individuals in populations.

4. Respiratory acidosis is a disorder whereby the acidity of the blood is high. High acidity of the blood is caused by
- (a) a decrease in carbon dioxide levels, which leads to a decrease in hydrogen ion concentration.
 - (b) an increase in carbon dioxide levels, which leads to an increase in hydrogen ion concentration.
 - (c) an increase in carbon dioxide levels, which leads to a decrease in hydrogen ion concentration.
 - (d) a decrease in carbon dioxide levels, which leads to an increase in hydrogen ion concentration.

Questions 5 and 6 refer to the diagram shown below.



5. The correct names for the three stages shown in the diagram are

	Stage 1	Stage 2	Stage 3
(a)	denaturing	replication	annealing
(b)	elongation	hybridisation	extension
(c)	replication	annealing	extension
(d)	denaturing	annealing	elongation

6. Which of the following describes correctly the temperature changes between Stage 1 and Stage 2 needed for the process to occur?

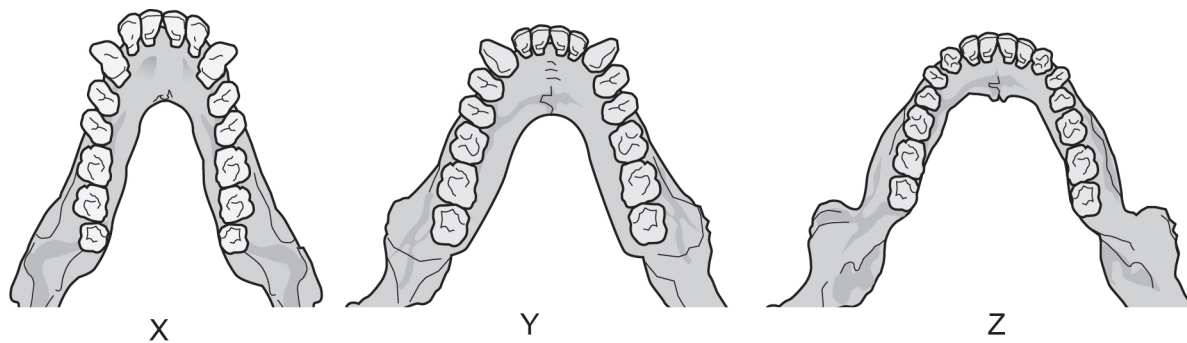
Initial reaction occurs at

- (a) 65 °C and is heated to 96 °C.
- (b) 72 °C and is cooled to 40 °C.
- (c) 96 °C and is cooled to 60 °C.
- (d) 55 °C and is heated to 72 °C.

See next page

7. Which of the following correctly lists features associated with the evolutionary trend in primates and hominins relating to locomotion?
- (a) broader pelvis, increased number of arches in the feet, shorter arm length and opposability of the thumb
 - (b) narrower pelvis, opposability of the thumb, longer arm length and increased number of curves in the spine
 - (c) decreased number of curves in the spine, decreased number of arches in the feet, shorter arm length and narrower pelvis
 - (d) non-opposable big toe, increased number of curves in the spine, increased number of arches in the feet and broader pelvis
8. Type 2 diabetes is a condition whereby a person can
- (a) produce glucagon but their cells do not respond to it.
 - (b) produce insulin but their cells do not respond to it.
 - (c) no longer produce insulin.
 - (d) no longer produce glucagon.
9. Eloise wanted to investigate the effect of temperature changes on the basal metabolic rate of rats. According to the *Australian code of practice for care and use of animals for scientific purposes, eighth edition 2013*, she must follow the principles of the 3Rs for the ethical and humane care of the animals. Which of the following is **not** one of the 3Rs?
- (a) Replacement – that wherever possible one should use alternative approaches that do not use animals.
 - (b) Reduction – one should use the smallest number of animals possible to achieve the aims and statistical design requirements.
 - (c) Refinement – one should modify methodology to minimise harm to the animals.
 - (d) Repetition – one should repeat the investigative approach to ensure consistent results.

Questions 10 and 11 refer to the diagram shown below.

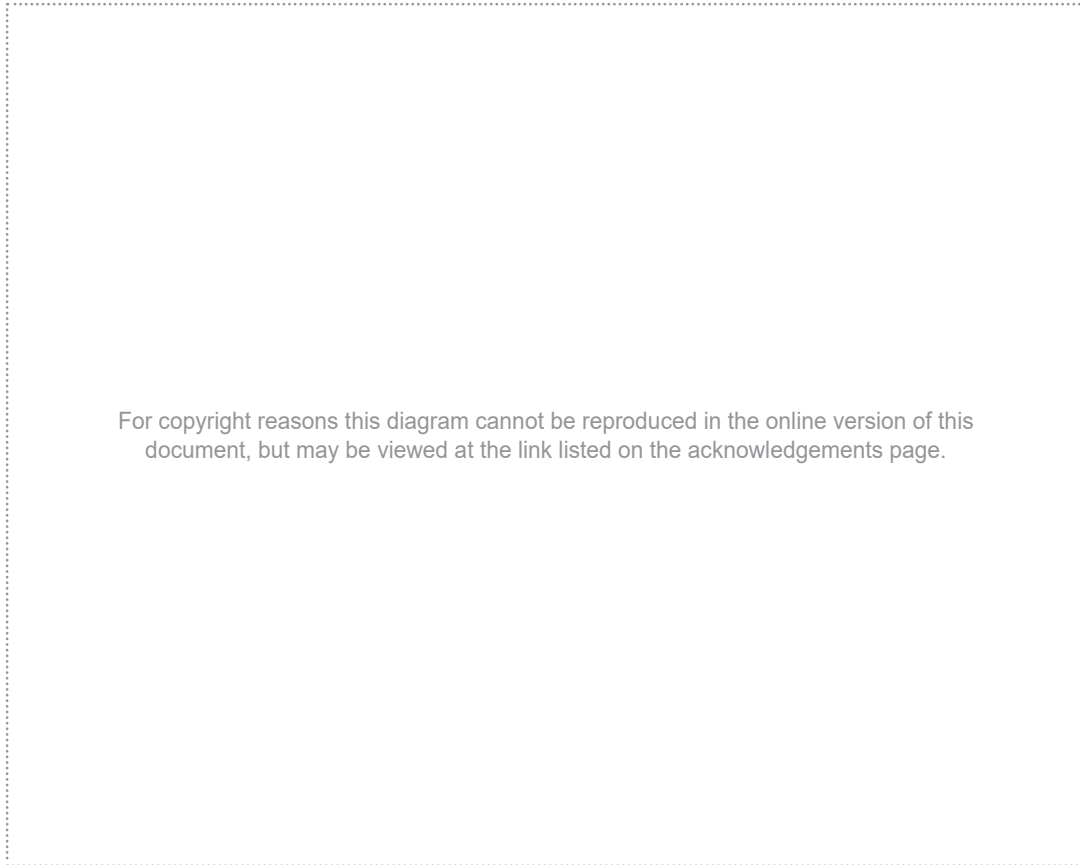


10. Which of the following is true?

Jaw

- (a) Y is the least parabolic and most likely belongs to an Australopithecine.
 - (b) Z is the most parabolic and most likely belongs to a modern human.
 - (c) X is the most parabolic and most likely belongs to an ape.
 - (d) Z is the least parabolic and most likely belongs to a modern human.
11. A scientist found a lower jaw specimen that looked almost exactly like jaw X. Together with this jawbone, the scientist found other bones, including part of the pelvis. What characteristic would you expect the pelvis to have?
- (a) short from top to bottom and narrow
 - (b) broad and long from top to bottom
 - (c) long from top to bottom and narrow
 - (d) short from top to bottom and broad

Questions 12–14 refer to the diagram shown below.



12. The control centre in the feedback loop is located in the

- (a) hypothalamus.
- (b) thermoreceptors.
- (c) cerebrum.
- (d) medulla.

13. Which of the following identifies correctly the receptors and effectors?

	Receptors X	Effectors X	Receptors Y	Effectors Y
(a)	hot thermoreceptors	skin arterioles and sweat glands	cold thermoreceptors	skin arterioles and voluntary muscles
(b)	cold thermoreceptors	central blood vessels and sweat glands	hot thermoreceptors	central blood vessels and voluntary muscles
(c)	hot thermoreceptors	skin arterioles and voluntary muscles	cold thermoreceptors	central blood vessels and sweat glands
(d)	cold thermoreceptors	central blood vessels and voluntary muscles	hot thermoreceptors	skin arterioles and sweat glands

See next page

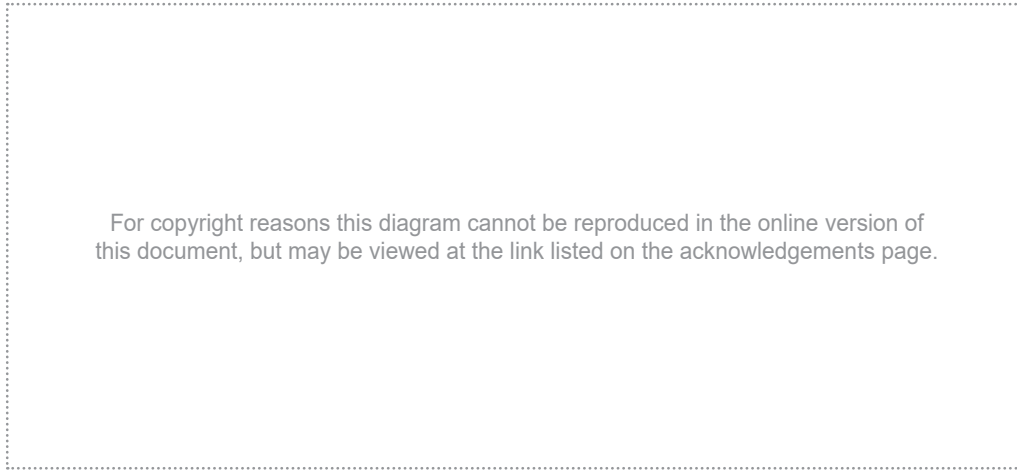
14. Which of the following is a behavioural activity that would increase response Y?
- (a) laying down on the ground and spreading one's arms
 - (b) piloerection (hairs standing up) on the arms and legs
 - (c) drinking warm liquids and eating a warm meal
 - (d) moving to stand in the shade, away from direct sunlight
15. Which one of the following statements explains correctly why fossils younger than 100 000 years cannot be dated with the potassium argon method?
- (a) Rocks younger than 100 000 years have too much argon-40 for accurate dating to be undertaken.
 - (b) The half-life of potassium-40 is long and there is not enough argon-40 to measure until 100 000 years.
 - (c) The normal proportion of potassium-40 to argon-40 in the rock specimens is not known before 100 000 years ago.
 - (d) Before 100 000 years there is no argon-40 found in the rock specimens for dating.
16. The data below refer to heights of individuals in a Year 12 Human Biology class.

Height (cm)	Number of people
140–149	2
150–159	6
160–169	10
170–179	8
180–189	3
190–199	1

The **best** graph to represent this data would be

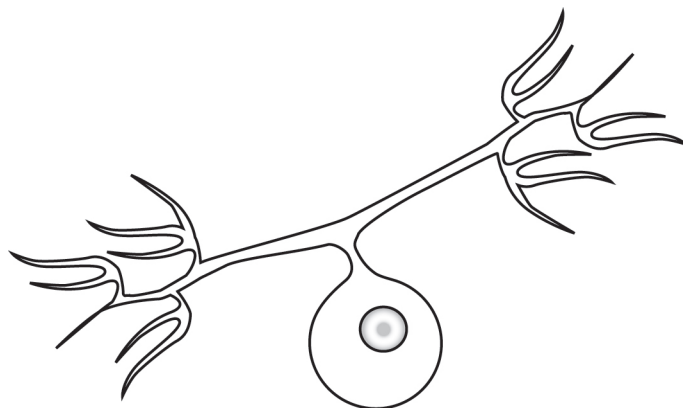
- (a) column.
- (b) line.
- (c) scatterplot.
- (d) histogram.

Question 17 refers to the diagram shown below.



17. The embryos above provide evidence of evolution. Which of the following statements best describes the evolutionary process?
- (a) Embryos go through similar stages of development because they have evolved from a common ancestor.
 - (b) Similarity of the embryos demonstrate that all the species must belong to the same genus.
 - (c) Embryos show similar developmental stages because they develop into similar adult organisms.
 - (d) Common ancestors must have had a tail and gill slits in their adult form, so all the embryos still retain the characteristics.
18. Which of the following would involve studying vestigial organs and homologous structures to determine evolutionary relationships?
- (a) comparative studies of embryology
 - (b) comparative genomics
 - (c) comparative anatomy
 - (d) comparative studies of DNA

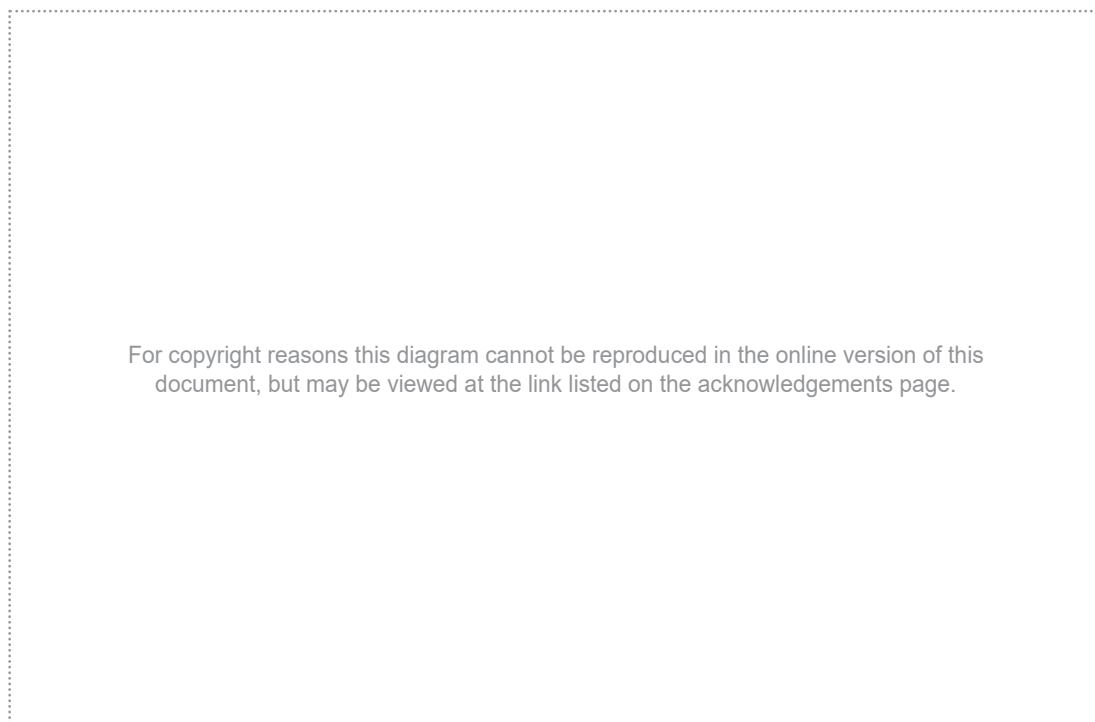
Question 19 refers to the diagram shown below.



19. The neuron illustrated would be classified correctly as
- (a) motor.
 - (b) sensory.
 - (c) connector.
 - (d) multipolar.
20. Antibiotics are ineffective against viruses because viruses
- (a) keep changing their external protein coat.
 - (b) are able to disguise themselves in the host cell membrane.
 - (c) are not living cells and thus do not metabolise.
 - (d) can change antibiotics into useful food substances.
21. A pharmacist has been given the option of providing four generic versions of a drug prescribed by a doctor. Which of the following treatment courses would have the **lowest** cost?
- (a) Drug A costs \$25.00 for 28 tablets. The standard dose is one tablet twice a day for seven days.
 - (b) Drug B costs \$30.00 for 100 tablets. The standard dose is one tablet four times a day for 14 days.
 - (c) Drug C costs \$25.00 for 28 tablets. The standard dose is one tablet twice a day for five days.
 - (d) Drug D costs \$20.00 for 14 tablets. The standard dose is one tablet per day for five days.

See next page

Questions 22 and 23 refer to the diagram below.



22. The correct terms for W, X, Y, Z are

	W	X	Y	Z
(a)	glucagon	beta cells	insulin	alpha cells
(b)	insulin	beta cells	glucagon	alpha cells
(c)	glucagon	alpha cells	insulin	beta cells
(d)	insulin	alpha cells	glucagon	beta cells

23. The liver releases glucose into the blood to increase the blood sugar level. The glucose was produced via the process of

- (a) glycogenolysis.
- (b) gluconeogenesis.
- (c) glycogenesis.
- (d) glucogenolysis.

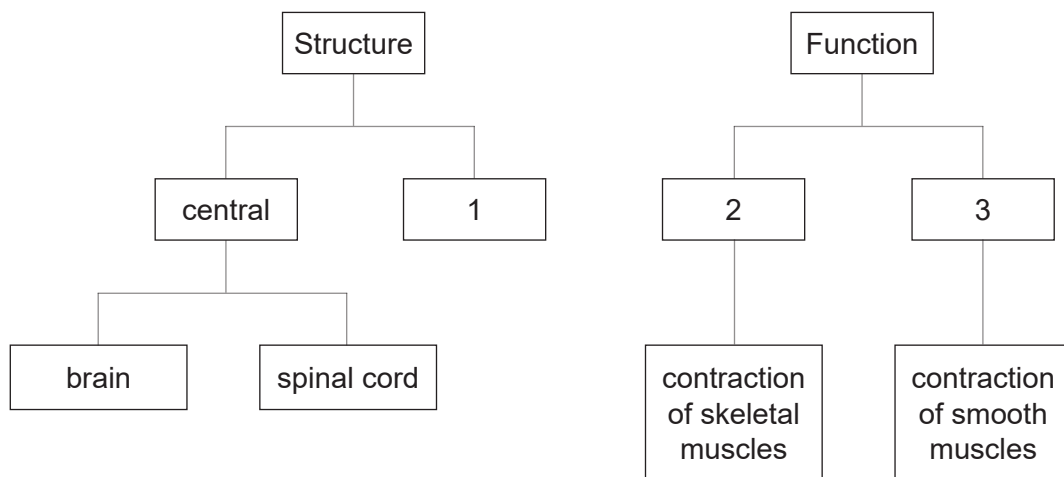
24. A key component of cell-mediated immunity is the body's production of

- (a) antigens.
- (b) antibodies.
- (c) memory B cells.
- (d) killer T cells.

See next page

25. Which field of research would be **best** described as involving the comparison of genetic sequences of two species to establish the degree of evolutionary relatedness?
- (a) bioinformatics
 - (b) comparative biochemistry
 - (c) comparative genomics
 - (d) palaeontology

Question 26 refers to the diagram below.



26. The diagram shows two separate ways in which we can classify the nervous system. Which row correctly identifies numbers 1, 2 and 3?

	1	2	3
(a)	peripheral	somatic	autonomic
(b)	somatic	autonomic	peripheral
(c)	autonomic	peripheral	somatic
(d)	peripheral	autonomic	somatic

27. Target cells respond to specific hormones as a result of
- (a) nucleic acid binding sites in the membrane and cytoplasm.
 - (b) specific binding sites on enzymes found in the cytoplasm.
 - (c) carbohydrate receptors in the plasma membrane.
 - (d) protein receptors in the plasma membrane and cytoplasm.

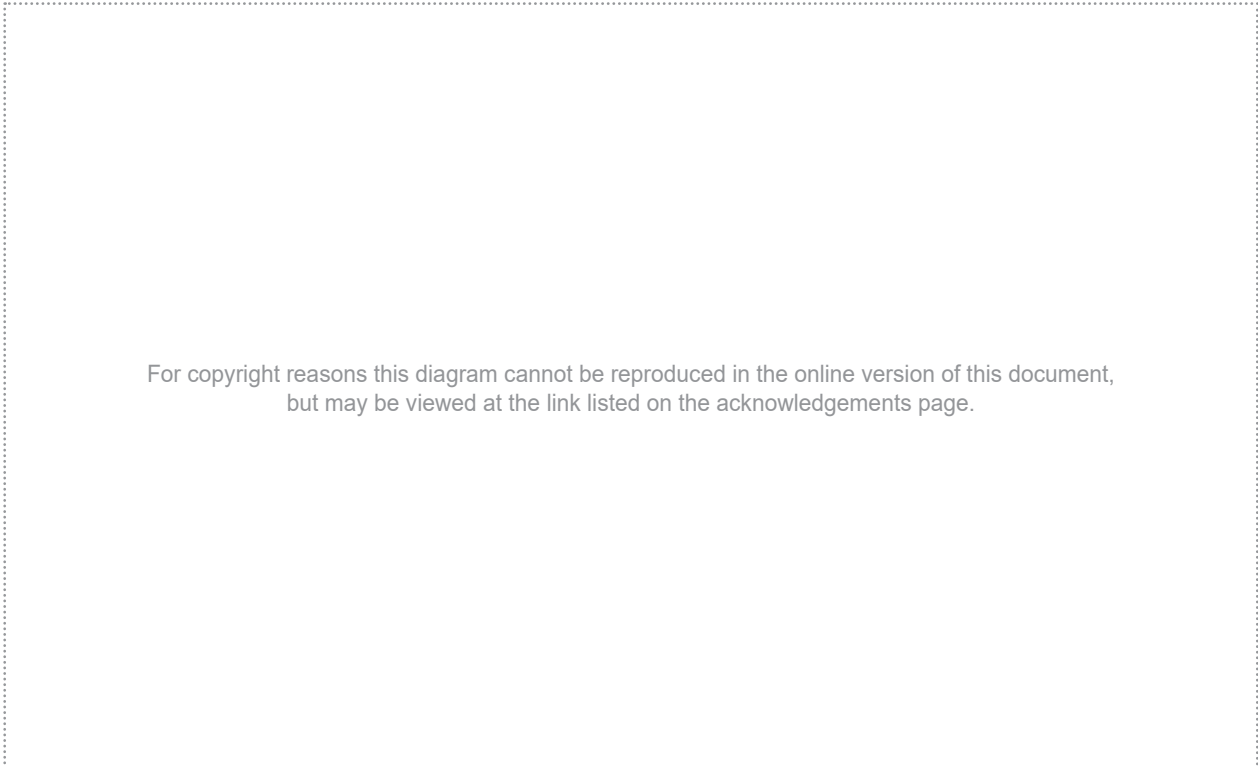
28. The following is a list of statements associated with fossils and fossil formation.

- I. Specimens need to be protected from decay by micro-organisms.
- II. Fossils may be destroyed by human activity and earth movements.
- III. Archaeologists may be looking in the wrong place.
- IV. Specimens need to be buried rapidly.
- V. Fossils need to be left undisturbed for a long time.

Which of the statements are correct reasons for it being difficult to locate fossils?

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

Question 29 refers to the diagram shown below. Note: fossil skulls are not to scale.



29. The most likely species of each fossil skull is

	X	Y	Z
(a)	Chimpanzee	<i>Australopithecus afarensis</i>	<i>Australopithecus africanus</i>
(b)	<i>Paranthropus robustus</i>	<i>Australopithecus africanus</i>	<i>Homo habilis</i>
(c)	Chimpanzee	<i>Paranthropus robustus</i>	<i>Australopithecus afarensis</i>
(d)	<i>Paranthropus robustus</i>	<i>Australopithecus afarensis</i>	<i>Homo habilis</i>

See next page

Question 30 refers to the information shown below.

GEOLOGICAL TIME SCALE					
Eon	Era	Period	Epoch	Present	
Phanerozoic	Cenozoic	Quaternary	Holocene	0.01	
			Pleistocene	1.6	
		Tertiary	Neogene	Pliocene	5.3
				Miocene	23.7
				Oligocene	36.6
				Eocene	57.8
			Paleogene	Paleocene	66.4
				Cretaceous	144
				Jurassic	208
				Triassic	245
	Paleozoic	Permian	286		
		Pennsylvanian	320		
		Mississippian	360		
		Devonian	408		
		Silurian	438		
		Ordovician	505		
		Cambrian	570		
		Precambrian	Proterozoic	2500	
	Archean		3800		
Hadean	4550				

Age in millions of years before present

30. Primates are believed to have first evolved around 60 million years ago. Ancestral humans are believed to have first evolved around 6 million years ago. According to the geological time scale, primates and ancestral humans first appear in
- (a) the same era but different epochs.
 - (b) different eras but the same time periods.
 - (c) the same era, period and epoch.
 - (d) different eras, periods and epochs.

End of Section One

See next page

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Section Two: Short answer

50% (110 Marks)

This section has **eight** 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

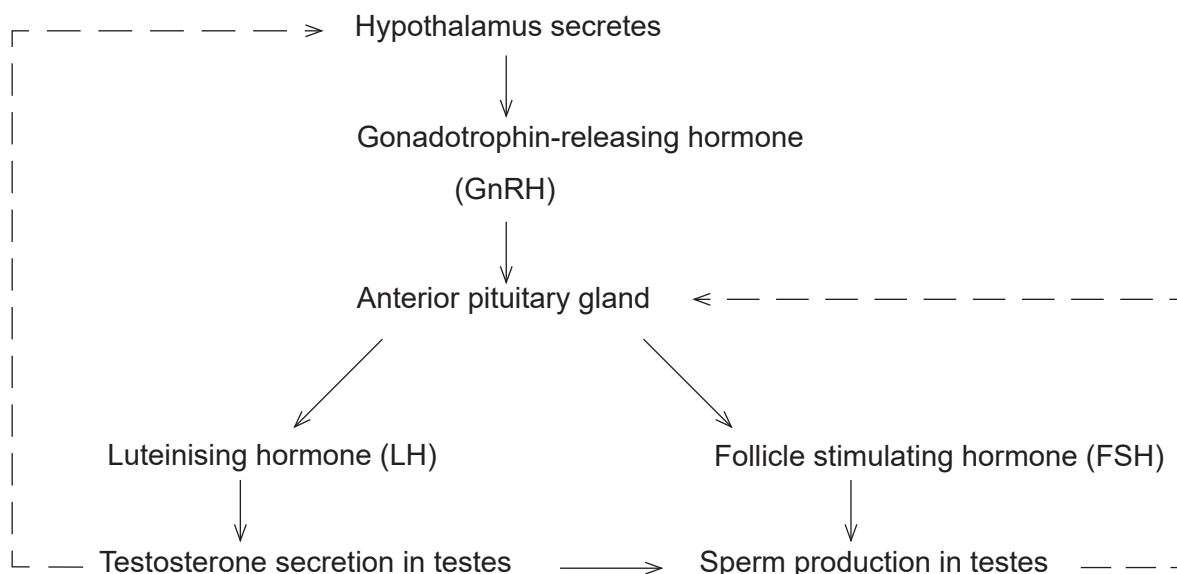
(10 marks)

The nervous system and endocrine system often work together to ensure homeostasis is maintained within the human body.

- (a) Hormones differ from nerves in their mode of action. In relation to the mode of transmission and response time, state how a hormonal response is different from a nervous response. (2 marks)

Mode of transmission:

Response time:



See next page

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The following questions refer to the diagram on page 16 showing the hormonal control of the male testes.

- (b) (i) The dotted lines on the diagram indicate negative feedback. Outline what is meant by the term negative feedback. (1 mark)

- (ii) Describe the role of the receptor in a feedback loop. (2 marks)

- (c) Identify the following components shown in the diagram on page 16. (2 marks)

Control centre: _____

Effector: _____

- (d) If a tumour began to affect the functioning of the anterior pituitary by inhibiting the production of LH and FSH, explain the impact this would have on the fertility of the affected male. (3 marks)

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Question 32

(12 marks)

Botulism is a communicable disease caused by a toxin produced by the bacterium known as *Clostridium botulinum*. Symptoms of the disease can include muscle weakness, blurred vision, trouble in speaking, vomiting and diarrhoea.

- (a) Botulism is classified as a bacterium. List **three** structural characteristics of a bacterium. (3 marks)

One: _____

Two: _____

Three: _____

- (b) Botulism can be transmitted in many ways. For each of the mechanisms listed below outline how it can spread the pathogen. (3 marks)

Droplet transmission:

Direct contact with infected bodily fluid:

Contamination of food or water:

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The symptoms associated with botulism are caused by the bacterial toxin blocking the release of acetylcholine from nerve endings.

- (c) (i) Acetylcholine is a neurotransmitter. State its role in nervous transmission. (1 mark)

- (ii) Explain how transmission across a synapse normally occurs. (5 marks)

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Question 33

(16 marks)

Central diabetes insipidus (CDI) is a condition that results in polyuria, an excessive production of urine. To diagnose CDI, a water retention test is conducted. The patient is allowed fluids overnight, then they are not allowed any fluids for eight hours. The patient's weight, urine volume and urine concentration are recorded hourly. After a certain amount of time, the patient is given a dose of desmopressin, a synthetic form of antidiuretic hormone (ADH). Their urine volume and concentration are then monitored and recorded for a further two to four hours. Below is a table showing the urine volume and concentration results for a patient suspected of having CDI.

Time (hrs)	Urine volume (mL)	Urine concentration (mOsmkg ⁻¹)
0	220	-
1	550	150
2	500	170
3	600	160
4	550	160
5	400	160
6	410	220
7	10	310
8	120	350

- (a) Graph these results on the grid provided 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.

See next page

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Question 34

(15 marks)

Opponents of the sport of boxing are often concerned with the incidence of traumatic brain injury that occurs among individuals who box on a regular basis. Punches that force the head up and back may cause damage to the cerebellum, as the brain is squashed up against the back of the skull.

- (a) (i) List **three** structures that would normally assist in protecting the brain against injury. (3 marks)

One: _____

Two: _____

Three: _____

- (ii) Suggest **two** symptoms a boxer might display if the cerebellum was damaged. (2 marks)

One: _____

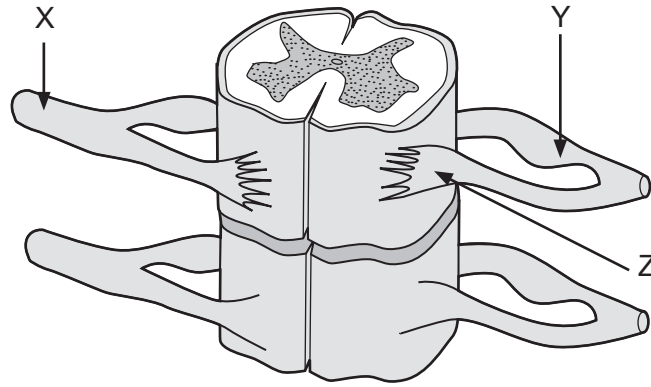
Two: _____

Muhammad Ali, a former boxer, developed Parkinson's disease. Although not conclusively linked to his boxing career, in his case it was associated with head trauma.

- (b) (i) Describe the cause of Parkinson's disease. (2 marks)

- (ii) Describe how cell replacement therapy could be used to treat Parkinson's disease. (2 marks)

The following questions refer to the diagram below, which shows a cross section of the spinal cord.



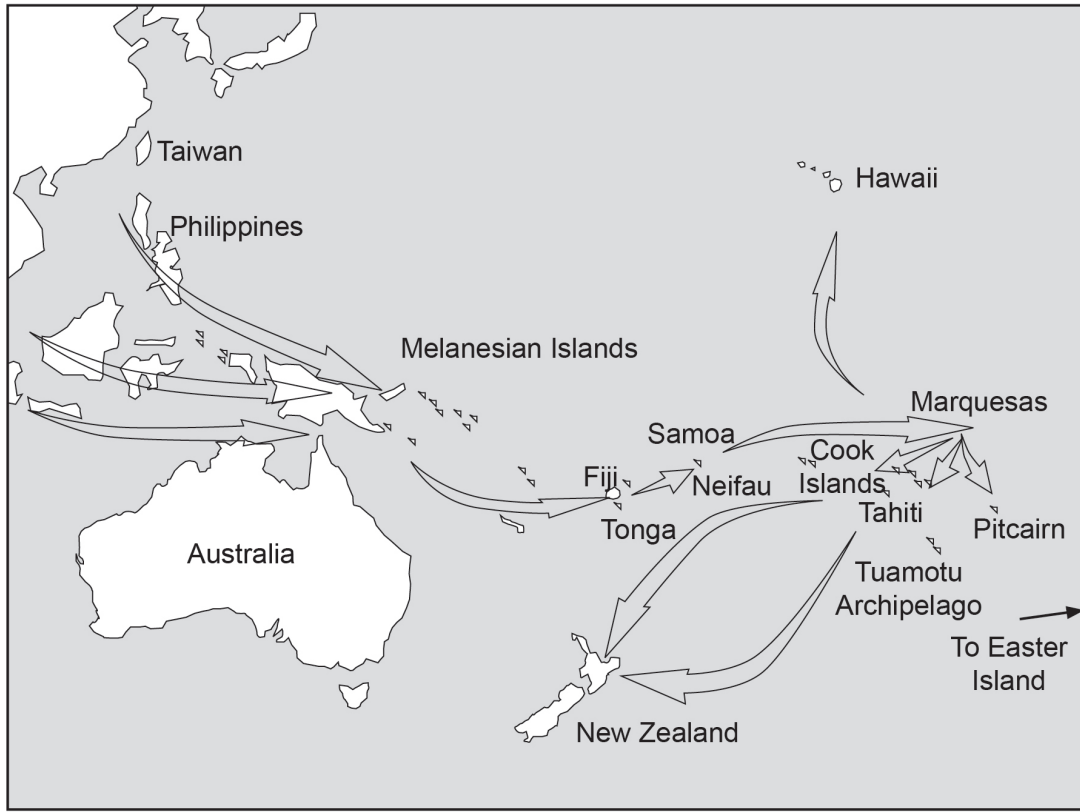
- (c) (i) If 'X' is injured, it can lead to paralysis of part/s of the body and loss of sensation, depending on how high up the spinal cord the injury is. Why does this occur? (2 marks)

- (ii) If Y is damaged, there will be a loss of feeling, but movement can still occur. Injury to Z leads to paralysis, but there will still be a sense of feeling. Explain why this difference occurs. (4 marks)

Question 35

(12 marks)

The image below depicts a possible settlement pattern for the previously uninhabited Polynesian islands.



(a) In relation to the following, describe the effect on the gene pools each time a small group of people settle onto a new Polynesian island.

(i) Gene flow: (2 marks)

(ii) Impact of selection pressures on alleles: (3 marks)

See next page

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Recent genetic studies have indicated that modern-day Polynesians are descendants of people who lived on the island of Taiwan, off the coast of China, approximately 5000 years ago. In one study, the DNA from the skeletons of four ancient Polynesian women, dated between 2300 to 3100 years ago, was analysed. An absolute date for the skeletons was calculated using radiocarbon dating.

- (b) (i) Identify **two** reasons why radiocarbon dating was an appropriate method for determining the age of the Polynesian skeletons. (2 marks)

One: _____

Two: _____

- (ii) Describe how radiocarbon dating works to determine the age of a fossil. (3 marks)

- (c) A fossil of a human skeleton was found in Australia. Can the Polynesian fossil be used to provide a relative date for the Australian skeleton? Provide a reason for your answer. (2 marks)

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Question 36

(16 marks)

Thalassemia is a genetically inherited disorder that affects the haemoglobin of blood. Two types of thalassemia are alpha (α) and beta (β). One of the treatments of both types of thalassemia involves drugs that are administered to help remove excess iron from the blood. A research team wanted to investigate the effectiveness of the different modes of delivery of these drugs.

The team set up an investigation to compare the drugs in injectable form with the orally ingested form. The team conducted their investigation on a sample of 53 beta (β) thalassemia sufferers. The participants were divided into four groups. The participants in each group had daily treatments lasting one month. The groups were:

- Group A – 14 participants who received the injectable drug
- Group B – 13 participants who received an inactive injectable drug
- Group C – 13 participants who received the orally ingested drug
- Group D – 13 participants who received an inactive oral drug.

- (a) Propose an hypothesis for the study described above. (1 mark)

- (b) Why were both groups B and D required for this study? (3 marks)

- (c) Identify a variable that was controlled in the study. (1 mark)

See next page

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- (d) Describe the data the researchers would need to collect and when they should collect the data. (3 marks)

- (e) Outline the cause of alpha (α) and beta (β) thalassemia and identify what makes each type of thalassemia different. (3 marks)

- (f) Alpha (α) and beta (β) thalassemia display the same inheritance pattern but can have differing effects on the gene pool of a population. Justify this statement. (5 marks)

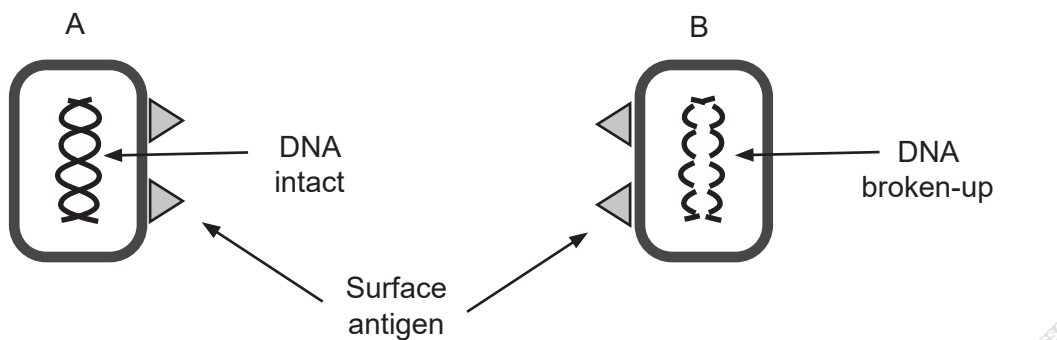
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Question 37

(12 marks)

The measles vaccine is normally given to children at 12 months and 18 months of age and is found in a combined vaccine that protects against measles, mumps and rubella (MMR vaccine). The measles vaccine is created using live attenuated microorganisms.

The figure below shows a disease-causing microorganism (A) and an attenuated version of the same microorganism (B).



(a) (i) What type of immunity would the measles vaccine provide? (1 mark)

(ii) Suggest why a vaccine containing B would provide immunity to microorganism A. (4 marks)

Most children have antibodies to measles in their blood stream at birth. The concentration of these antibodies decreases quite quickly after birth. Between the ages of 6–12 months the concentration is low enough to make these children the most susceptible to measles.

- (b) (i) State the term given to the type of immunity described above. (1 mark)

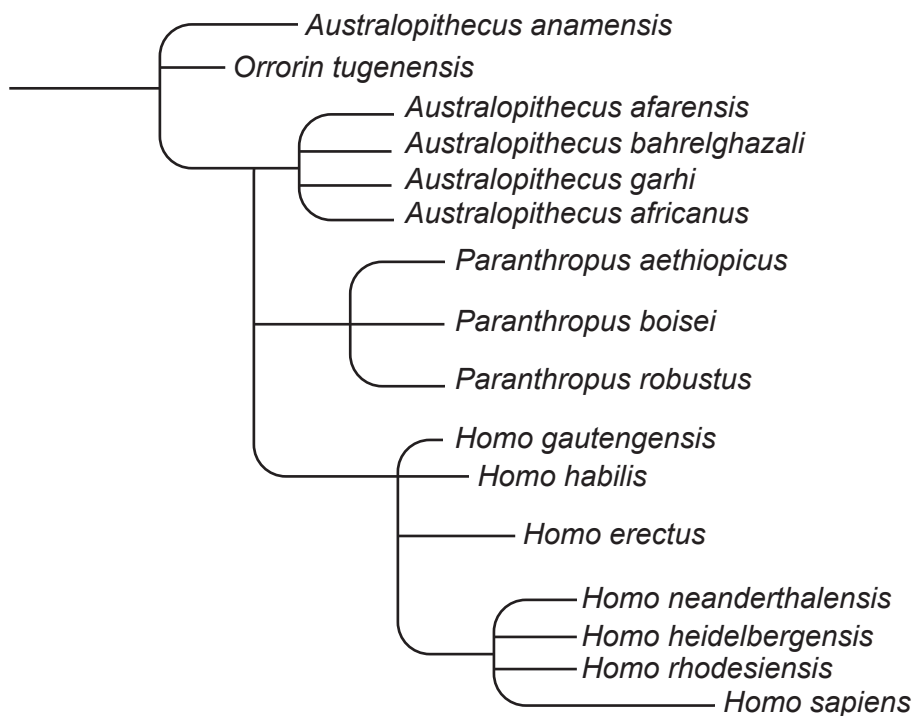
- (ii) Describe how antibodies to measles are present in babies at birth. (2 marks)

- (c) If a child under the age of 12 months contracted measles, would it be necessary for them to still be immunised with the MMR vaccine? Provide a reason for your answer. (4 marks)

Question 38

(17 marks)

The following questions refer to the phylogenetic tree shown below.



Complete the following, using the data provided in the phylogenetic tree.

- (a) (i) Identify the organism that **most** recently shared a common ancestor with *Australopithecus anamensis*. (1 mark)

- (ii) Select which of the following hominins is **most** distantly related to modern humans: *Australopithecus afarensis* or *Paranthropus boisei*. (1 mark)

- (b) Explain how evidence from DNA sequencing can be used to construct a phylogenetic tree. (3 marks)

Homo heidelbergensis had a cranial capacity around 1280 cc. This is much closer to the size of modern humans than *Homo neanderthalensis*. Many researchers believe *Homo heidelbergensis* is in fact the common ancestor to both modern humans and *Homo neanderthalensis*.

- (c) In the space below, redraw the phylogenetic tree on page 30 showing *Homo heidelbergensis* as the common ancestor to modern humans and *Homo neanderthalensis* and *Homo rhodesiensis* as more distantly related to the other three *Homo* species on the same branch. (3 marks)

(Note: You do **not** need to draw the whole tree. Only draw the section of the tree associated with the species stated above.)



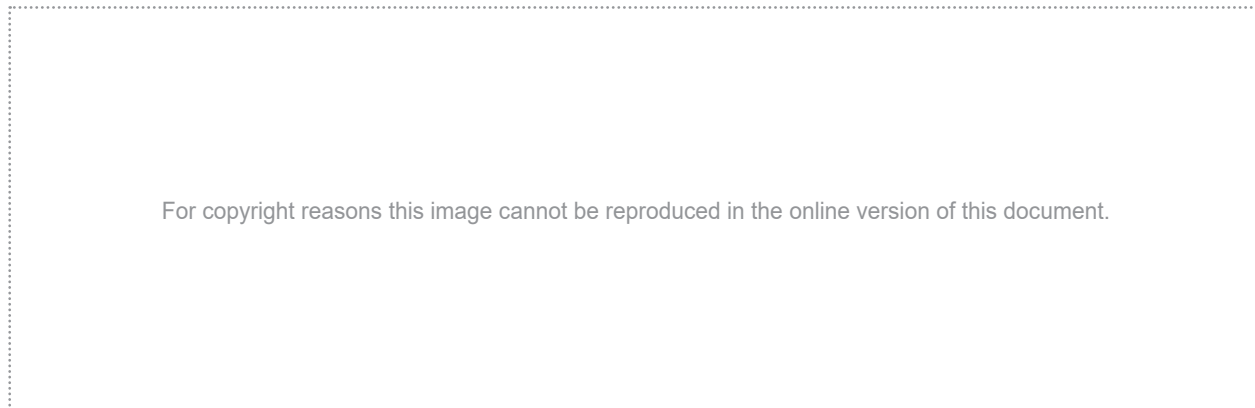
- (d) State **two** features of a typical *Homo neanderthalensis* skull that distinguish it from modern humans. (2 marks)

One: _____

Two: _____

Question 38 (continued)

Tools created by some of the hominins mentioned in the phylogenetic tree on page 30 are shown below. Note: these tools are not drawn to scale.



(e) (i) Rearrange the tools I to IV in order from oldest to youngest. (1 mark)

(ii) The tools display a trend in tool manufacture. State this trend and what it implies about the changes to hominin lifestyle. (2 marks)

(iii) Identify which tool was **most** likely to be made first by *Homo erectus*. (1 mark)

(iv) How would hominins have manufactured tool III? (3 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 39 and 40 are from Unit 3. Questions 41 and 42 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 39 **or** Question 40.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 35–39. When you have answered your first question, turn to page 40 and indicate on that page the second question you will answer.

Question 39**(20 marks)**

A man arrived home feeling unwell. His partner took him to the doctor when he started suffering a fever, sweats and chills. The patient was given an antibiotic to take every day for the following 10 days. The doctor stressed the importance of completing the course of antibiotics even when he started to feel better.

- (a) Describe the physiological mechanisms that cause fever. (8 marks)
- (b) Explain how different antibiotics can be used to treat infections. (8 marks)
- (c) Explain why the doctor stressed that the full course of antibiotics needed to be taken. (4 marks)

Question 40**(20 marks)**

Production of the human growth hormone (hGH) is controlled by a gene. Lack of this hormone leads to dwarfism in humans.

- (a) hGH is released from the pituitary gland. State from which lobe of the pituitary this hormone is secreted and explain the relationship between this lobe of the pituitary gland and the hypothalamus. (6 marks)
- (b) hGH is a water-soluble hormone. Explain how hGH enters and affects the functioning of its target cell. (6 marks)
- (c) Dwarfism can be treated using synthetically produced hGH. Explain how hGH could be produced using recombinant DNA technology. (8 marks)

See next page

Unit 4

Choose **either** Question 41 **or** Question 42.

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

Question 41**(20 marks)**

Many scientists propose that one day humans could colonise and live on Mars. This idea presents numerous challenges to human survival. One such challenge focuses on genetics and evolutionary processes.

- (a) If in the future a group of 50 humans was selected to colonise Mars, over time this group could be at risk of becoming an example of the Founder Effect and, potentially, speciation. Justify this statement by explaining how the evolutionary mechanisms of both the Founder Effect and speciation could apply to this scenario. (13 marks)
- (b) If this hypothetical group of 50 humans was to colonise Mars, it would be advisable to obtain DNA sequences of the individuals as part of the selection process. Define the term 'DNA sequencing' and name and explain the method by which a DNA sequence is obtained today. (7 marks)

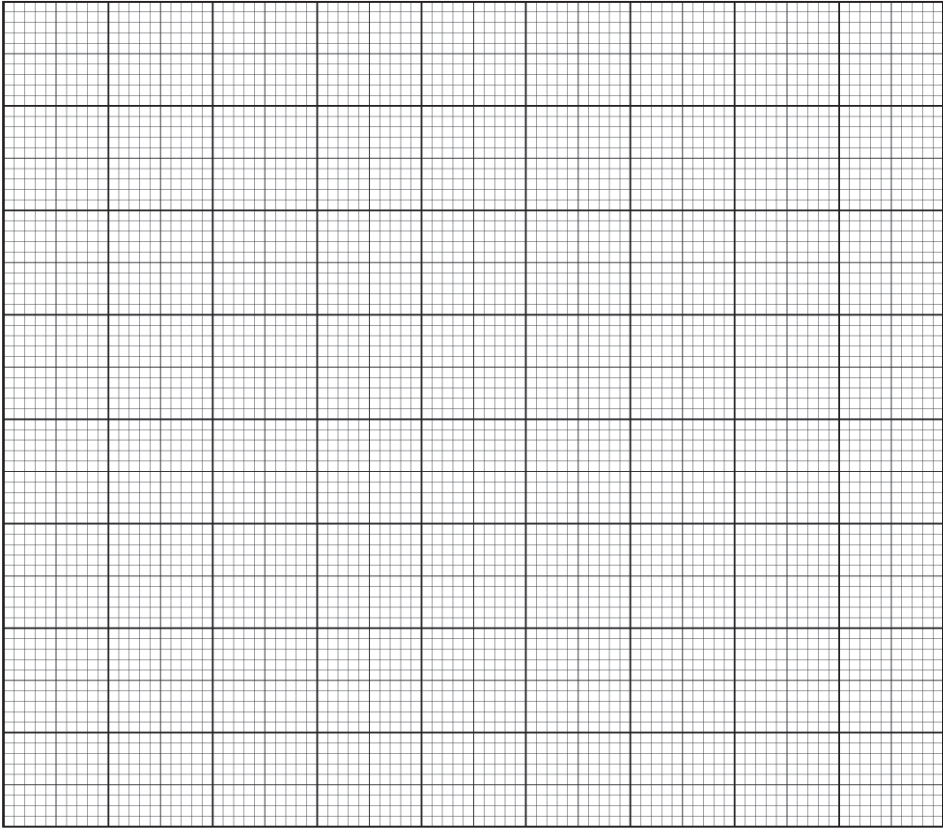
Question 42**(20 marks)**

Species of the genus *Homo* do not possess the powerful jaw muscles commonly found in the genera *Australopithecus* and *Paranthropus*. According to the fossil record, this decrease in the size of jaw muscles coincided with changes in brain size. Scientists have discovered that both the reduction in the size of the jaw muscles and the change in brain size occurred due to mutations.

- (a) Describe the various types of mutations, identify the causes and describe how they can occur. (15 marks)
- (b) Explain how the example of the evolution of the unique hominin jaw illustrates the importance of mutations to evolution. (5 marks)

End of questions

Spare grid



ACKNOWLEDGEMENTS

- Question 2** Adapted from: Merck, J. (2003). [Sedimentation and ... diagram]. Retrieved May, 2020, from <https://www.geol.umd.edu/~jmerck/geol342/lectures/18.html>
- Questions 5–6** Adapted from: GA International. (n.d.). [Polymerase chain reaction diagram]. Retrieved May, 2020, from <https://blog.labtag.com/a-brief-history-of-pcr-and-its-derivatives/>
- Question 9** Information from: National Health and Medical Research Council. (2013). Section 1: Governing principles. In *Australian code for the care and use of animals for scientific purposes* (8th ed.). Canberra: National Health and Medical Research Council. Retrieved May, 2020, from <https://www.nhmrc.gov.au/about-us/publications/australian-code-care-and-use-animals-scientific-purposes>
- Questions 10–11** Adapted from: Zihlman, A. L. (1982). *The human evolution coloring book* (1st ed.). New York: Harper & Row, p. ... : The ape that would be human, fig. Lower jaw.
- Questions 12–14** Adapted from: [Feedback loop diagram]. (n.d.). Retrieved May, 2020, from https://utssportandsociety.files.wordpress.com/2015/04/homeostasis_negative_feedbacks1315428467622.png
- Question 17** Adapted from: *Embryological evidence of evolution* [Diagram]. (n.d.). Retrieved May, 2020, from <http://botanystudies.com/5-main-evidences-of-evolution/>
- Question 19** Adapted from: Haas, J. (2012). *Neurons uni bi multi pseudouni* [Diagram]. Retrieved May, 2020, from https://commons.wikimedia.org/wiki/File:Neurons_uni_bi_multi_pseudouni.svg
Used under a Creative Commons Attribution-Share Alike 3.0 Unported (CC BY-SA 3.0) licence.
- Questions 22–23** Adapted from: Norman, J. (2016). [Blood glucose control diagram]. Retrieved May, 2020, from <https://www.endocrineweb.com/conditions/diabetes/normal-regulation-blood-glucose>
- Question 29** Adapted from: [Hominid skulls diagram]. (n.d.). Retrieved May, 2020, from <https://i.pinimg.com/originals/f1/6d/5f/f16d5f6357541c3039d4ddef2394f89.jpg>
- Question 34(c)** Adapted from: Lawson, R. (2007). *Anatomy and physiology of animals the spinal cord* [Diagram]. Retrieved May, 2020, from https://commons.wikimedia.org/wiki/File:Anatomy_and_physiology_of_animals_The_spinal_cord.jpg
Used under a Creative Commons Attribution 3.0 Unported (CC BY 3.0) licence.

- Question 35** Adapted from: Stojanoski, N. (2011). *Polynesian migration mk* [Diagram]. Retrieved from https://upload.wikimedia.org/wikipedia/commons/archive/d/da/20161219231931%21Polynesian_Migration_mk.svg
Used under a Creative Commons Attribution 3.0 Unported (CC BY 3.0) licence.
- Question 35(b)** First paragraph information from: Skoglund, P., Posth, C., Sirak, K., et al. (2016). Genomic insights into the peopling of the Southwest Pacific. *Nature*, 538 (7624), pp. 510-513. Retrieved May, 2020, from <https://www.nature.com/articles/nature19844>
- Question 38** Adapted from: OpenStax. (2018). *Hominin phylogeny* [Diagram]. Retrieved May, 2020, from https://cnx.org/resources/b7293a9e4781e0971bf9f4e77473f707eb420182/Figure_29_07_03.jpg
Used under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.
- Question 38(e)** Image I adapted from: Hanson, M. (1991). *Apes & ancestors* (1st ed.). Auckland: Longman Paul, p. 81, fig. 82.
Image II adapted from: Hanson, M. (1991). *Apes & ancestors* (1st ed.). Auckland: Longman Paul, p. 85, fig. 85.
Image III adapted from: Hanson, M. (1991). *Apes & ancestors* (1st ed.). Auckland: Longman Paul, p. 88, fig. 90.
Image IV adapted from: Hanson, M. (1991). *Apes & ancestors* (1st ed.). Auckland: Longman Paul, p. 77, fig. 79.

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