

**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	7	7	90	110	50
Section Three Extended answer Unit 3	2	1	50	40	20
Unit 4	2	1			
<b>Total</b>					100

**Instructions to candidates**

- The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2022*. 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 answer 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.

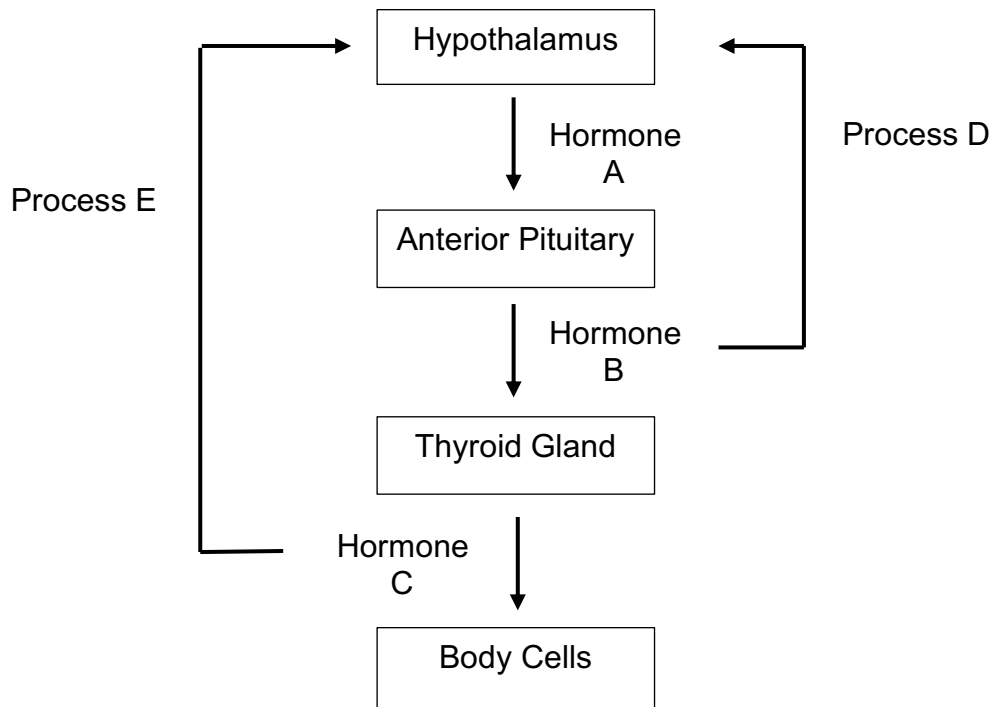
## Section One: Multiple-choice

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.

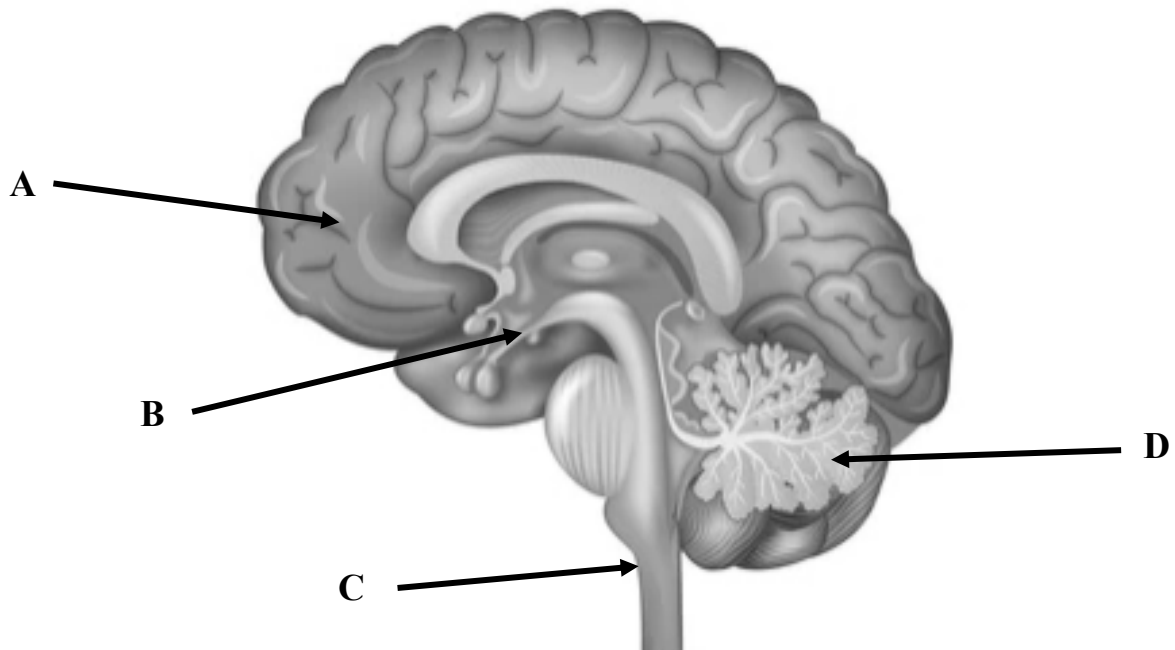
Suggested working time: 40 minutes.

Question 1 refers to the diagram below showing homeostatic control of thyroid gland activity.



- Which of the following statements is correct?
  - Hormone A is TSHRF, Hormone B is thyroxine and Process D is positive feedback.
  - Hormone A is TSH, Hormone C is thyroxine and Process D is negative feedback.
  - Hormone B is TSH, Hormone C is thyroxine and Process E is negative feedback.
  - Hormone B is thyroxine, Hormone C is TSH and Process E is positive feedback.
  
- Sara was born with some brain damage that caused her speech to be incoherent even though she understood what was being said to her. Which lobe of the brain was most likely affected to cause these symptoms?
  - Occipital
  - Temporal
  - Frontal
  - Parietal

Questions 3 and 4 refer to the following diagram showing parts of the brain.

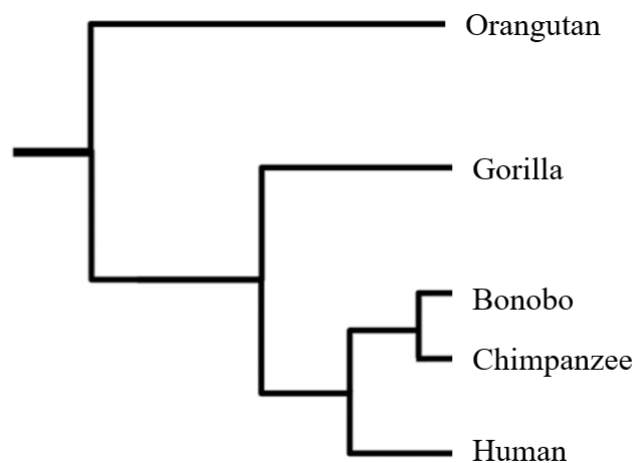


3. The part of the brain responsible for the control of heart rate and respiration, is labeled
- (a) A.
  - (b) B.
  - (c) C.
  - (d) D.
4. Damage to the part of the brain labeled D would result in which of the following symptoms?
- (a) Uncontrollable fever
  - (b) Blood pressure increasing
  - (c) Loss of memory
  - (d) Uncoordinated fine motor movement
5. Which of the following is a correct response to sympathetic stimulation following a scary situation?
- (a) Increased heart rate and pupil constriction
  - (b) Increased rate of digestion and increased blood pressure
  - (c) Pupil dilation and increased blood pressure
  - (d) Relaxation of the bladder and constriction of airways
6. Which of the following processes results in gene pool changes due to a small number of members from an original population moving away and being isolated?
- (a) Founder effect
  - (b) Natural selection
  - (c) Random genetic drift
  - (d) Seasonal migration

7. Speciation occurs due to
- (a) mutations causing disadvantaged individuals to die.
  - (b) some members of the population dying suddenly.
  - (c) emigration occurring over time.
  - (d) mutation, selection pressures and adaptation.
8. Tay Sachs disease
- (a) is caused by an autosomal dominant allele.
  - (b) results in a disorder of lipid metabolism.
  - (c) results in shaking and uncoordinated movements.
  - (d) only exists in Jewish populations.
9. Bioinformatics involves
- (a) the collection, classification, storage, and analysis of large amounts of biochemical information using computers.
  - (b) reading gel electrophoresis banding results.
  - (c) collecting polymerase chain reaction results.
  - (d) creating phylogenetic trees using biochemical data.
10. The technique of recombinant DNA can be used to produce vaccines and hormones.
- This technique will require
- (a) restriction enzymes to cut open bacterial plasmids.
  - (b) the use of a modified virus to insert the useful gene into bacteria.
  - (c) viral plasmids to act as vectors for the useful gene.
  - (d) a ligase to stimulate the cloning of plasmids.
11. Gene therapy is used to
- (a) produce vaccines and hormones such as insulin.
  - (b) reduce the incidence of mutations.
  - (c) replace genes that cause disease with healthy ones.
  - (d) replace unhealthy cells with new ones.

12. Which of the following statements provides support for evolution using comparative studies of anatomy?
- (a) Closely related species share more endogenous retroviruses than species more distantly related.
  - (b) The structure of ubiquitous proteins such as cytochrome-c are common in many species.
  - (c) Comparisons of mitochondrial DNA indicate a common ancestor for most species.
  - (d) In vertebrates, the pentadactyl limb displays a common pattern that is modified to suit its use and environment.
13. An example of natural passive immunity is
- (a) antibodies being produced as a result of being exposed to COVID-19.
  - (b) antibiotics being used to treat a COVID-19 infection.
  - (c) antibodies being injected via a COVID-19 vaccine.
  - (d) antibodies to COVID-19 being passed via breast milk.
14. An evolutionary trend in the primates can be described as
- (a) a decrease in cranial capacity.
  - (b) an increase in digit mobility.
  - (c) an increase in prognathism.
  - (d) an increase in teeth size and number.

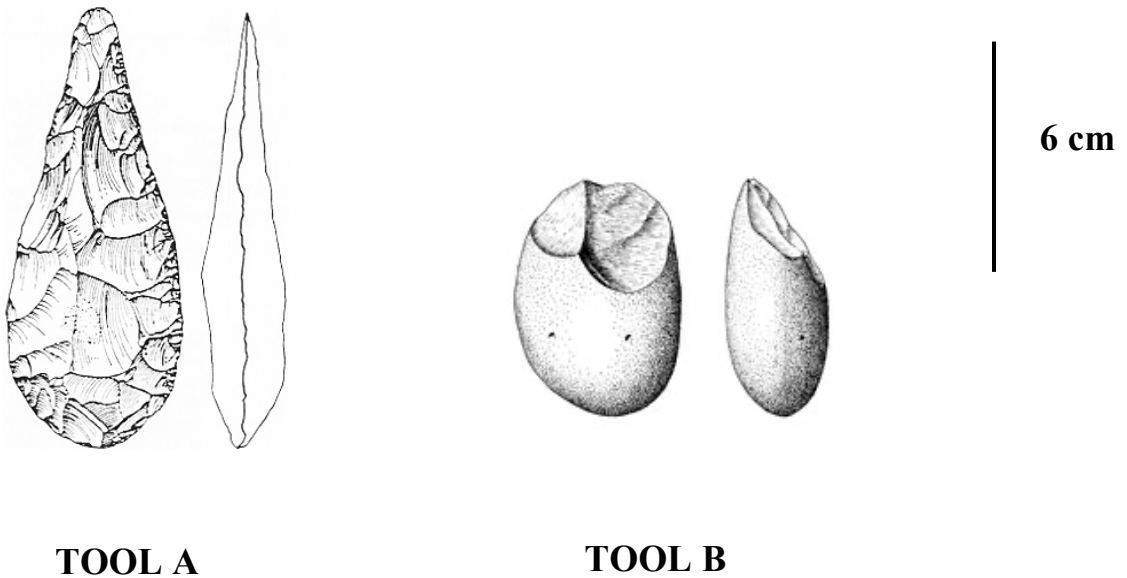
Question 15 refers to the simple phylogenetic tree for primate evolution shown below.



15. According to the phylogenetic tree shown above, which of the following statements is true?
- (a) Gorillas are more closely related to orangutans than they are related to bonobos.
  - (b) Chimpanzees and humans are the most closely related species on the tree.
  - (c) Gorillas are as closely related to bonobos as they are to chimpanzees.
  - (d) Humans are more closely related to chimpanzees than they are to bonobos.

16. Which of the following is **not** a function of mast cells during inflammation?
- (a) Mast cells release histamine to increase blood flow to the area.
  - (b) Mast cells phagocytose debris to produce pus.
  - (c) Mast cells produce heparin to prevent clotting.
  - (d) Mast cells act to attract macrophages and leucocytes to the infection site.
17. During the cell-mediated immune response, T lymphocytes
- (a) enter bone marrow before generating plasma cells and memory cells.
  - (b) may produce cytokines to attract macrophage cells.
  - (c) will produce specific antibodies to deactivate foreign antigens.
  - (d) mature in the thymus before becoming phagocytes.
18. A comparison between the cranial fossils of *Homo habilis* and *Homo erectus* would show that
- (a) *Homo habilis* had a larger cranial capacity than *Homo erectus*.
  - (b) *Homo habilis* had a larger forehead than *Homo erectus*.
  - (c) *Homo habilis* had a more prognathic face than *Homo erectus*.
  - (d) *Homo habilis* had a more central foramen magnum than *Homo erectus*.
19. A student examining the fossilised spinal column of a bipedal primate would observe
- (a) robust lumbar vertebrae and a cervical curvature.
  - (b) slight lumbar vertebrae and a thoracic curvature.
  - (c) slight lumbar vertebrae with a lumbar curvature.
  - (d) robust lumbar vertebrae with no spinal curvatures.
20. Neurotransmitters
- (a) are released from the synaptic terminal when potassium ions increase.
  - (b) will diffuse across a synaptic cleft and stimulate receptors on a dendrite.
  - (c) are chemicals that transmit a nerve impulse from a dendrite to an axon terminal.
  - (d) move across the neurilemma to generate saltatory conduction.
21. A comparison between hormone action and nerve action will show that hormones
- (a) are more specific in their action than nerves.
  - (b) act to slow body functions whilst nerve action speeds body functions.
  - (c) influence target cells in the short-term but nerve action is longer lasting.
  - (d) are chemical in nature whilst nerves combine chemical and electrical processes.

Questions 22 and 23 refer to the hominin tools shown below.



**TOOL A**

**TOOL B**

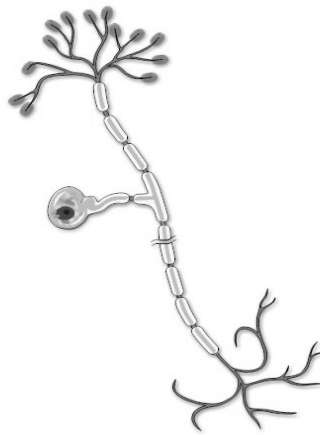
22. Which of the following statements is correct?
- (a) Tool A is associated with *Homo neanderthalensis* as part of the Magdalenian tool culture.
  - (b) Tool B is associated with *Homo habilis* as part of the Oldowan tool culture.
  - (c) Tool A and Tool B are associated with the Australopithecines as part of the Acheulian tool culture.
  - (d) Tool A and Tool B are associated with *Homo sapiens* as part of the Mousterian tool culture.
23. Which of the following statements is correct?
- (a) Tool A coincides with the emergence of fire.
  - (b) Tool B would be found alongside tools of bone and antler.
  - (c) These tools can be dated to an absolute age using radiocarbon dating.
  - (d) In terms of relative dating, Tool A is older than Tool B.
24. Genetic mutations can be considered necessary for evolution because they
- (a) are lethal and reduce the number of harmful genes.
  - (b) always provide a selective advantage.
  - (c) promote breeding between species.
  - (d) provide new alleles that may enhance survival.

25. During DNA replication, a base or series of bases may fail to be copied to the new DNA strand.

This would be termed

- (a) a deletion mutation.
  - (b) an insertion mutation.
  - (c) a translocation mutation.
  - (d) an addition mutation.
26. Hyperthyroidism will cause
- (a) bulging eyes and weight loss and can be treated with thyroxine tablets.
  - (b) irritability and rapid heart rate and can be treated with radioactive iodine.
  - (c) cold intolerance and weight gain and can be treated with surgery.
  - (d) tiredness and depression and can be treated with beta blockers.
27. The parathyroid gland produces a hormone that will affect
- (a) calcium levels in bones.
  - (b) sodium levels in the blood.
  - (c) carbon dioxide levels in the blood.
  - (d) body temperature.

Question 28 refers to the illustration of a neuron presented below.



28. This type of neuron would be located in the
- (a) dorsal root of a spinal reflex arc.
  - (b) association area of the frontal lobe of the cerebral cortex.
  - (c) efferent pathway of the somatic nervous system.
  - (d) descending motor tracts of the autonomic nervous system.



29. A person experiencing Parkinson's disease would exhibit symptoms such as
- (a) a vague memory and difficulty with language.
  - (b) poor muscle coordination and greater muscle tone.
  - (c) impaired posture and tremors in their limbs.
  - (d) reduced metabolism and increased irritability.
30. It is hoped that Parkinson's Disease could be treated with cell replacement therapy.
- Cell replacement therapy requires
- (a) the modification of bacterial plasmids and their implanting into patients.
  - (b) the copying of genes from cells functioning normally.
  - (c) a source of undifferentiated stem cells or developed cell lines.
  - (d) a close relative to act as a donor of normal cells.

**End of Section One**

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**Section Two: Short answer**

**50% (110 Marks)**

This section has **seven** 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.

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**Question 31**

**(22 marks)**

The Rapid Antigen Test (RAT) for COVID-19 uses technology that investigates the presence of the COVID-19 viral antigen in the mucosa of the nose. This test can detect the antigen whether or not the person has symptoms of the disease. Health authorities throughout the world have encouraged people to become vaccinated against the disease, and to have a booster vaccine to protect against severe symptoms and possible death.

- (a) Define the term 'antigen'. (1 mark)

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- (b) State **two** differences between viruses and bacteria. (4 marks)

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- (c) State the type of immunity that vaccination provides. (2 marks)

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- (d) Explain how the vaccine causes the production of antibodies against COVID-19. (5 marks)

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- (e) Explain why a booster vaccination might be necessary to provide protection against the disease. (4 marks)

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One of the symptoms of COVID-19 is fever, resulting in very high body temperature for prolonged periods.

- (f) Explain how a fever that lasts more than 24 hours may be harmful to the body. (3 marks)

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**Question 31** (continued)

The incidence of other diseases such as influenza, gastroenteritis and chlamydia have decreased during the COVID-19 pandemic.

(g) Provide **three** possible reasons for the decrease in incidence of these diseases.

(3 marks)

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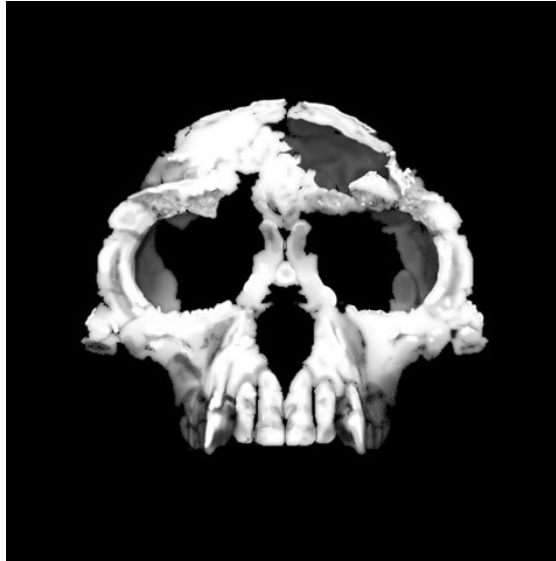
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## Question 32

(18 marks)

*Ardipithecus ramidus* or Ardi was discovered in 1994 in Ethiopia in Eastern Africa. The fossil is one of the most complete fossils found to date, including the skull (shown below), teeth, pelvis, hands and feet. It is dated at 4.4 million years old.



- (a) Describe **two** features of the skull that distinguish it from *Homo sapiens*. (2 mark)

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It is thought that Ardi walked upright like a chimp on land but was able to swing through trees and move quadrupedally when arboreal.

- (b) Describe **three** likely structural features of the pelvis fossil associated with Ardi. (3 marks)

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- (c) Describe **two** likely structural features of the foot fossil associated with Ardi. (2 marks)

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- (f) Provide **two** reasons for the decrease in size of the teeth of *Homo erectus*. (2 marks)

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Following an accident involving the severing of a large blood vessel, haemorrhaging may occur. This will cause a decrease in blood volume.

- (d) Name a different hormone from that referred to in (a) and (b) that would be secreted to maintain blood volume and describe how it works. (4 marks)

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When someone has suffered a traumatic incident, they often hyperventilate as a response to pain and shock. This occasionally results in the person suffering from apnoea, or cessation of breathing, and causing them to faint.

- (e) Explain why apnoea may occur when a person hyperventilates. (5 marks)

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Question 34

(17 marks)

A researcher wanted to measure the effect of administering growth hormone to rats over a period of six weeks following their birth.

He took 10 rats following birth and randomly separated them into two groups. Group A were administered daily, intravenous injections of growth hormone whilst Group B were administered daily, intravenous injections of a saline solution (placebo). He weighed them after 1 week and then at 3 weeks and 6 weeks following their birth.

The mass of each rat is shown in the table below.

	Rat Number	Mass at 1 week (g)	Mass at 3 weeks (g)	Mass at 6 weeks (g)
<b>Group A</b>	1	10	60	190
	2	12	64	189
	3	10	59	185
	4	15	66	191
	5	12	71	187
	Average	<b>11.8</b>	<b>64</b>	<b>188.4</b>
<b>Group B</b>	6	6	35	123
	7	8	43	134
	8	7	38	119
	9	8	45	132
	10	6	39	136
	Average	<b>7</b>	<b>40</b>	<b>128.8</b>

(a) Suggest a hypothesis for this experiment. (2 marks)

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(b) Identify the dependent variable in the experiment. (1 mark)

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(c) Identify the control group and explain why this group was included. (3 marks)

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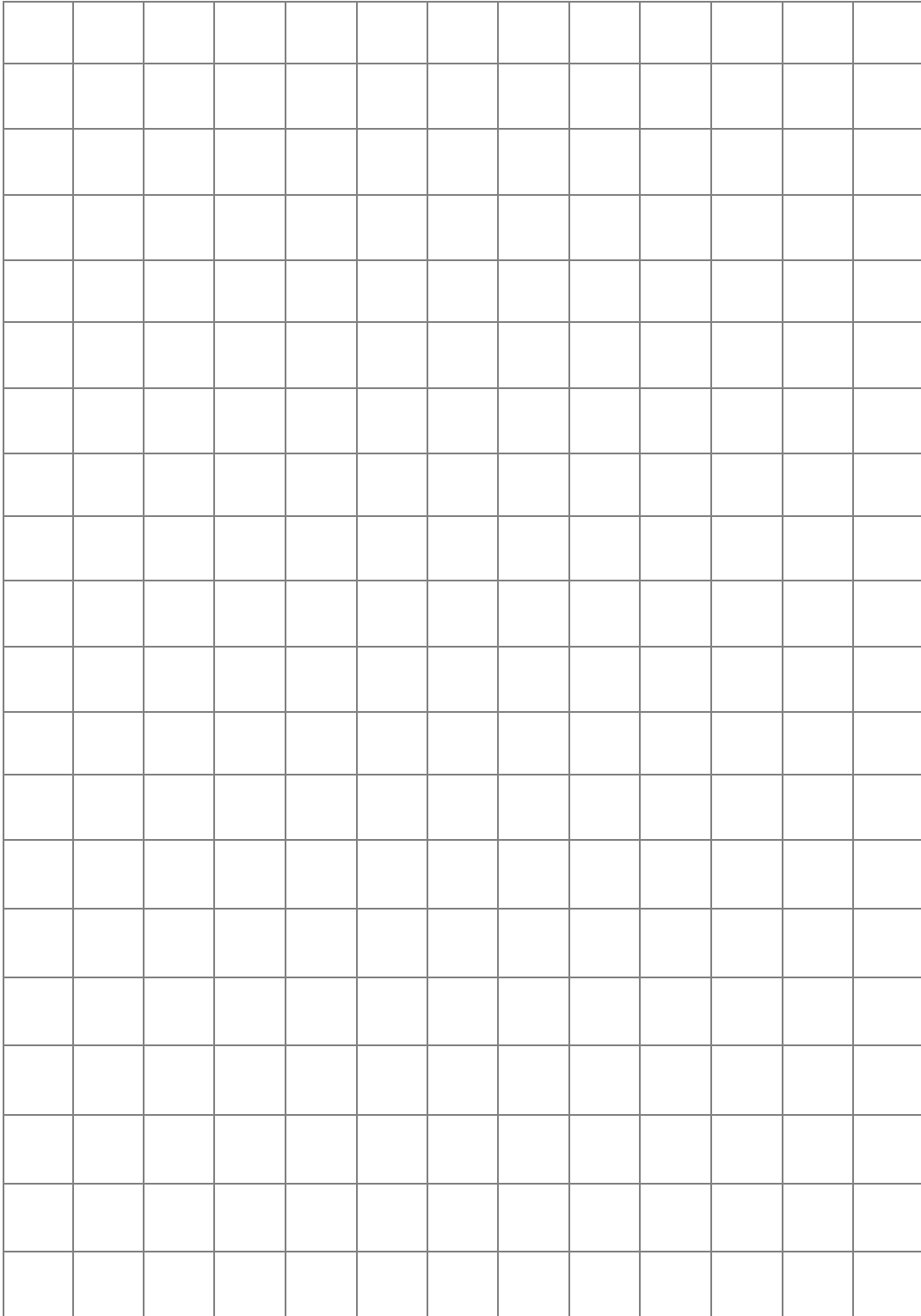
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(d) Graph the average results in the grid provided here.

(6 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 clearly indicate that you have redrawn it on the spare page.

**Question 34** (continued)

(e) Describe **three** variables that should have been controlled by the researcher. (3 marks)

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(f) Write a conclusion for these results. (2 marks)

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**Question 35****(13 marks)**

Comparative studies of DNA and proteins provide biochemical evidence for evolution. In order to make comparisons of DNA and amino acid sequences of different species, the DNA must be extracted, copied and the fragments separated.

(a) Describe the process of PCR.

**(6 marks)**


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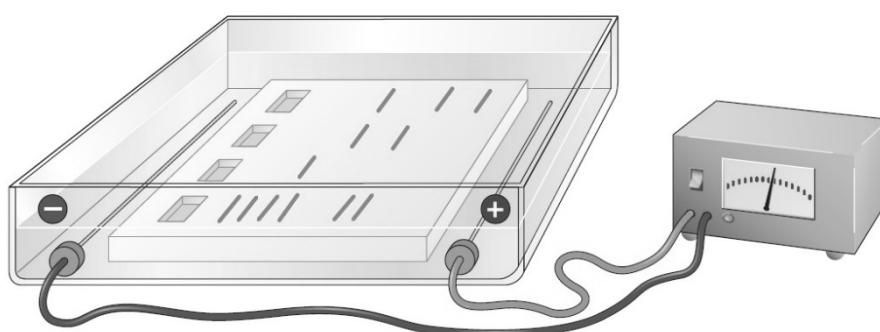


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The following diagram shows the equipment used to separate DNA fragments.



(b) Name the method depicted in the diagram.

**(1 mark)**


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Question 35 (continued)

(c) Explain how the method shown in the diagram works to separate the DNA. (4 marks)

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(d) State **two** uses for this method of comparing DNA. (2 marks)

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**Question 36**

**(11 marks)**

(a) Define mutation.

(1 mark)

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(b) Describe what is meant by non-disjunction and provide an example of a condition caused by non-disjunction. (2 marks)

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(c) Explain why a germline mutation would have a greater effect on changes in allele frequencies in the gene pool compared with a somatic mutation. (4 marks)

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Gene flow is essential for changes to the gene pool.

(d) Name and describe **two** barriers to gene flow between human populations. (4 marks)

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The pituitary gland secretes many hormones and, despite being referred to as the “master gland”, is controlled by the hypothalamus.

- (b) Describe the relationship between the anterior pituitary and the hypothalamus. (3 marks)

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- (c) Describe how positive feedback control systems are different to negative feedback. (2 marks)

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**End of Section Two**

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

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

Questions 38 and 39 are from Unit 3. Questions 40 and 41 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.

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**Unit 3**

Choose **either** Question 38 **or** Question 39.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 30–34. When you have answered your first question, turn to page 36 and indicate on that page the second question you will answer

**Question 38****(20 marks)**

The nervous system is controlled by the brain and spinal cord that send impulses to all parts of the body via nerve cells or neurons.

- (a) Name the **three** types of neurons that enable a spinal reflex to occur and describe the functions of each. (6 marks)
- (b) Neurons in the peripheral nervous system are mostly myelinated.  
Describe the transmission of an impulse along an unmyelinated neuron and explain the difference between impulses travelling along an unmyelinated compared with a myelinated neuron. (10 marks)
- (c) Explain what is meant by the “all or none” response when referring to nerve impulses. (4 marks)

**Question 39****(20 marks)**

Perth has recently had, what is claimed to be, the “hottest summer on record”.

- (a) Explain the physiological responses to high environmental temperatures that enable a person to maintain homeostasis. (10 marks)
- (b) Describe **two** behavioural responses to the heat and explain how the responses work to maintain normal body temperature. (4 marks)

Doug decided to go the beach to cool down in the water. The café that he usually bought snacks from was closed due to COVID-19 restrictions. He was quite hungry as he didn't have any breakfast and was hoping to buy lunch following his swim.

- (c) Explain how Doug's blood glucose levels would remain within a normal range. (6 marks)













**Unit 4**

Choose **either** Question 40 **or** Question 41.

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

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**Question 40****(20 marks)**

In 2021, archaeologists discovered fossils of a human skull and jawbone at a site outside of Ramla in Israel. The bones were dated to be between 120,000 to 140,000 years old and were classified as being from an unknown ancient human. This ancient human appeared to live alongside Neanderthals and shared their neanderthal cultural lifestyle.

- (a) Describe the features that would be expected in these skull and jawbone fossils, classified as human. (6 marks)
- (b) Describe the **most** likely tool culture and lifestyle of these humans, living at this time. (7 marks)
- (c) Describe the carbon-14 method of dating organic materials and explain why this dating method could not be used to date the skull and jawbone. (7 marks)

**Question 41****(20 marks)**

According to modern theories, evolution has taken place over long periods of time as a result of natural selection.

- (a) Describe the process of natural selection resulting in the evolution of species, providing a human example of natural selection that has given rise to the various forms living throughout the world. (8 marks)

There are many types of evidence for evolution, including anatomical and biochemical.

- (b) Describe evidence for evolution based on **two** named comparative anatomy studies. (6 marks)

Evidence for evolution has relied on the discovery of fossils.

- (c) Describe the process of fossilization and explain why more intact fossils are not found. (6 marks)

**End of questions**









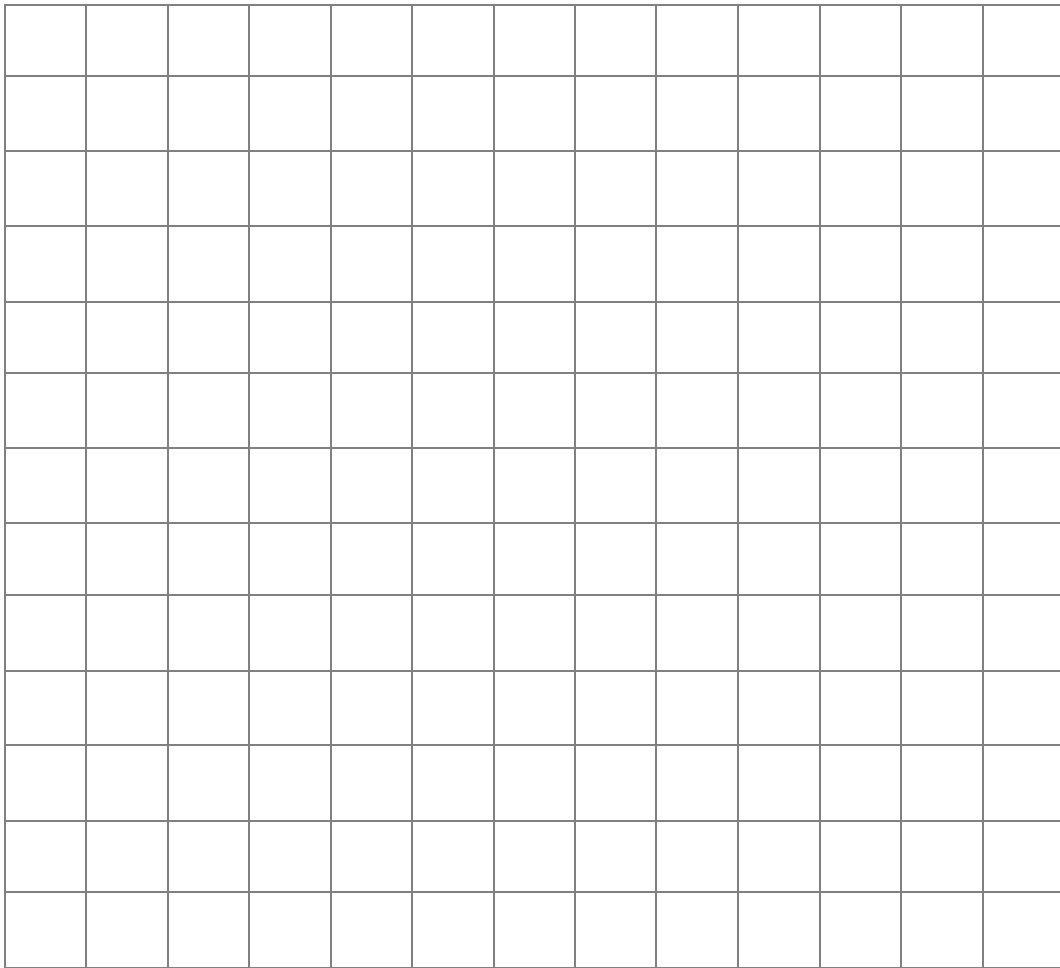








Spare grid



**ACKNOWLEDGEMENTS**

- Question 3 & 4      Human Brain Detailed Illustration Beautiful Colorful. Retrieved April 2022, from <https://www.shutterstock.com/image-vector/human-brain-detailed-illustration-beautiful-colorful-283189766>.
- Question 28        The Nervous System and the Cockroach. Retrieved April 2022, from <https://www.sutori.com/en/story/the-nervous-system-and-the-cockroach--zqT5cch46ErGa36A85UUv7vx>
- Question 32        Zanclean Skull. Retrieved April 2022, from <https://www.flickr.com/photos/keeseey/4119873547>.
- Question 35        Elettroforesi.jpg. Retrieved April 2022, from <https://commons.wikimedia.org/wiki/File:Elettroforesi.jpg>.
- Question 37        Hormone. Retrieved April 2022, from <https://en.wikipedia.org/wiki/Hormone>.