**HUMAN BIOLOGY**

**Unit 3 and 4**

**2020**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Time allowed for this paper**

Reading time before commencing work: ten minutes

Working time: three hours

**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: non-programmable calculators approved for use in this 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 | 5 | 5 | 90 | 102 | 50 |
| Section Three Extended answer  Unit 3 | 2 | 1 | 50 | 40 | 20 |
| Unit 4 | 2 | 1 |  |  |  |
|  |  |  |  | **Total** | 100 |

**Instructions to candidates**

1. The rules for the conduct of the Western Australian examinations are detailed in the *Year 12 Information Handbook 2020*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. 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. Only use 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

4. 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.

5. 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.

**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. In a reflex arc,

(a) synapses occur in the white matter of the spinal cord.

(b) sensory neurons bring information out of the central nervous system.

(c) the dorsal root ganglion contains nerve cell bodies of motor neurons.

(d) a stimulus is required in order for the reflex to occur.

2. Endocrine glands found in the central nervous system include the

(a) thymus, pineal gland and hypothalamus.

(b) posterior pituitary and hypothalamus.

(c) pineal gland, anterior pituitary and hypothalamus.

(d) thymus and hypothalamus.

3. Which of the following statements about the nervous and endocrine systems is correct?

(a) The endocrine system transmits messages faster than the nervous system.

(b) Messages in the nervous system are more specific than in the endocrine system.

(c) Messages last longer in the nervous system than they do in the endocrine system.

(d) Messages in both the nervous and endocrine system are chemical in nature.

4. Hypothyroidism

(a) can be treated using synthetic hormones.

(b) results in weight loss.

(c) increases a person’s metabolic rate.

(d) is a result of too much thyroxine being released.

5. When carbon dioxide levels increase in the blood

(a) pH levels decrease.

(b) the acidity of the blood decreases.

(c) rate and depth of breathing decreases.

(d) osmoreceptors are stimulated.

6. Glucose levels in the blood are

(a) increased by insulin.

(b) decreased by adrenalin.

(c) detected by alpha and beta cells.

(d) modulated by the liver.

*Questions 7, 8 and 9 refer to the information below:*

A teacher asked their class to test each other for skin sensitivity by pressing either one or two

pins into the skin of a blindfolded subject’s palm, back of the hand and knee. After each

press, the subject had to decide whether one or two pins had been used. If two pins were

used, they were 2 mm apart.

7. What was the independent variable?

(a) accuracy of the decision about whether 1 or 2 pins were used

(b) distance the two pins were apart

(c) body part that was pressed

(d) skin sensitivity

8. One student pressed too hard on the palm of their subject with one pin and drew blood. What receptors could they have stimulated?

(a) thermoreceptors and touch receptors

(b) touch receptors and pain receptors

(c) chemoreceptors and pressure receptors

(d) osmoreceptors and chemoreceptors

9. The teacher asked the students to make their investigation more reliable. Which of the following activities could have made the investigation more reliable?

(a) apply the same amount of pressure in each press

(b) testing the same body part three times

(c) changing the distance of the two pins each press

(d) testing each body part with an equal number of 1 and 2 pin presses

*Questions 10 and 11 refer to the flowchart below:*

Chemical A Chemical A

DNA of gene of interest

DNA of plasmid

Chemical B

Structure C

Structure C inserted into bacterium

10. Chemical A and chemical B would be, in order,

(a) DNA polymerase and DNA ligase.

(b) restriction enzyme and DNA ligase.

(c) DNA ligase and restriction enzyme.

(d) restriction enzyme and RNA polymerase.

11. All of the following statements about Structure C are true, except one. Which one is incorrect?

(a) Structure C may include more than one piece of DNA of the plasmid.

(b) Structure C may include the gene of interest.

(c) Structure C always includes the gene of interest.

(d) Structure C is a recombinant structure.

12. Mary was driving her father’s car for the first time and was a little worried as it was much larger than what she was used to driving. She noticed that her heart was beating faster than normal, her mouth was dry, and her palms were sweating. Which of the following statements is correct?

(a) Cortisol is making her feel stressed.

(b) Her parasympathetic nervous system increased her heart rate.

(c) Her sympathetic nervous system is active.

(d) Noradrenalin has made her mouth dry.

13. Which of the following statements about Type I and Type II diabetes is correct?

(a) Type I typically occurs much later in life than Type II diabetes.

(b) Type I can be treated with modifications in lifestyle while Type II requires insulin injections.

(c) Symptoms for people with Type I are less severe than for those with Type II diabetes.

(d) People with Type I can’t produce insulin while people with Type II can’t produce enough insulin.

*Question 14 refers to the following information.*

Immunity is offered in all the following situations:

i) being given antivenom for a snake bite received in the bush

ii) Human papilloma virus (HPV) injection given to all 13 year olds

iii) breastfeeding

iv) being given an injection after contracting tetanus

v) catching a cold from your friend

14. Which of these situations would result in artificial passive immunity?

(a) i) only

(b) ii) and iv) only

(c) i) and iii) only

(d) i), ii), and iv) only

15. Vaccines

(a) are given to someone who currently has the disease.

(b) are mostly given in one large dose rather than a few smaller doses.

(c) can only be injected.

(d) must be attenuated in order to prevent someone developing the disease.

16. Which of the following are non-specific internal mechanisms of defence?

(a) phagocytosis and the lymphatic system

(b) T cells and fever

(c) B cells and lysozyme

(d) mucous membranes and cilia

17. Mutagens

(a) are always carcinogenic.

(b) reduce the number of alleles for a gene in a population.

(c) do not affect the amount of variation in a population.

(d) increase the risk of mutations occurring.

18. A skull was found that had a smooth cranium with a capacity of 450cc, large brow ridges and a large degree of prognathism. This skull could be

(a) *Australopithecus africanus*.

(b) *Homo habilis*.

(c) *Homo neanderthalensis*.

(d) *Paranthropus robustus*.

19. Tool cultures have changed markedly over time. Which of the following is **not** a trend seen in tool cultures over time?

(a) Number of chips taken off the core increases over time

(b) Size of chips taken off the core decreases over time

(c) More of the core was shaped over time

(d) Materials used to make tools became less diverse over time

20. *Homo neanderthalensis*

(a) is typically found in Africa.

(b) was alive around 300,000 years ago.

(c) had a smaller cranial capacity than modern humans.

(d) produced portable and mural art.

21. A fossil site rich in hominin specimens and the remnants of fire, hand axes, and shelters was found. This fossil site could **not** have been of

(a) *Homo neanderthalensis.*

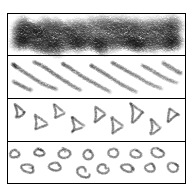
(b) *Homo erectus.*

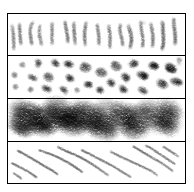
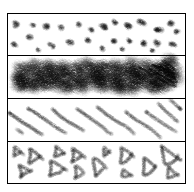
(c) *Homo habilis.*

(d) Cro magnon.

*Questions 22 and 23 refer to the information below.*

Core samples were collected from a variety of places and are shown below.

 Core X Core Y Core Z



Layer 1

2

3

4

Layer 1

2

3

4

Layer 1

2

3

4

22. The best name for the method of dating fossils in the three cores is



(a) absolute dating.

(b) index fossils.

(c) potassium argon dating.

(d) stratigraphy.

23. Which of the following statements is correct?

(a) Core X layer 1 is older than Core X layer 3.

(b) Core Y layer 2 is younger than Core Z layer 1.

(c) Core X layer 4 is the youngest layer of all the layers in the three cores.

(d) Core Y layer 4 is the same age as Core X layer 2.

24. Which of the following correctly matches the tool industry, hominin species and key features of the industry?

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tool industry** | **Hominin species** | **Key features** |
| (a) | Solutrean | *Homo sapiens* | Willow leaf blades made of bone |
| (b) | Oldowan | *Homo erectus* | Cores flaked with a few large chips |
| (c) | Acheulean | *Homo erectus* | Hand axes shaped on both sides |
| (d) | Aurignacian | *Homo neanderthalensis* | Blade tools created using a chopping action |

*Questions 25 and 26 refer to the photograph below.*

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25. As a primate, the orang-utan shares a number of features with humans, although there are differences due to the DNA nucleotide sequences in each species. Which of the following is true?

(a) Humans have more mobile digits than orang-utans

(b) Orang-utans have a more reduced sense of smell than humans

(c) Orang-utans are specialised for bipedal locomotion



(d) The cerebral cortex of humans is smaller than that of the orang-utan

26. As a pongid, the orang-utan

(a) has a medial condyle the same size and shape as their lateral condyle.

(b) has a centralised foramen magnum.

(c) would have two arches in each foot and an opposable big toe.

(d) has a pelvis that is short and broad.

27. Random genetic drift

(a) can occur in large populations that have been isolated from each other.

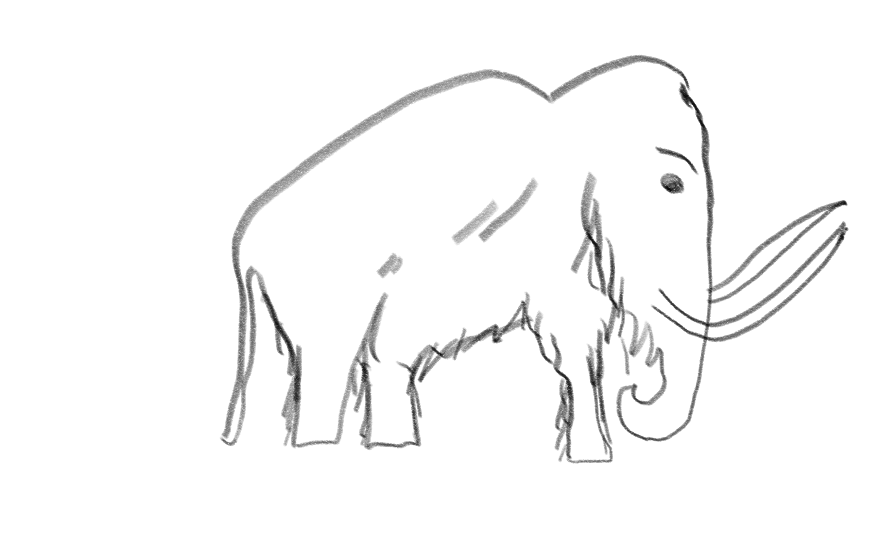
(b) usually occurs in small populations that lack gene flow.

(c) shows a directional change in alleles over time in a population.

(d) results in a selective advantage becoming more common in the population.

*Question 28 refers to the image below.*





28. This image of a woolly mammoth was found in the Rouffignac cave in France and has been dated at around 20,000 years. Which dating method would have provided this information?

(a) potassium argon

(b) carbon 14

(c) stratigraphy

(d) index fossils

29. An artefact

(a) is any preserved trace of a previously living organism.

(b) would include a kitchen-midden and faeces.

(c) would include footprints and tools.

(d) is any human made object.

30. The comparison of the leg structure of different vertebrates, showing reduced functionality in some parts, supports the theory of evolution through

(a) homologous structures.

(b) vestigial structures.

(c) transition fossils.

(d) comparative embryology.

**End of Section One**

**Section Two: Short answer 50% (102 Marks)**

This section has **five** 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 (14 marks)**

The genetic condition thalassemia is caused by a mutation that occurs in roughly 3% of the global population. It has been found that there are two main types of thalassemia: alpha thalassemia and beta thalassemia.

(a) (i) Define the term mutation. (1 mark)

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(ii) Two main types of mutations are somatic and germ line. Explain which type of mutation thalassemia is. (2 marks)

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(b) Name a population typically affected by thalassemia. (1 mark)

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(c) State three symptoms people with the intermediate form of alpha thalassemia and beta thalassemia would have in common. (3 marks)

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(d) Thalassemia is a condition that provides a heterozygote advantage to malaria.

(i) What is the term given to how malaria is transferred? (1 mark)

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(ii) Explain the term heterozygote advantage using the example of thalassemia. (2 marks)

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(iii) Name one other condition that provides a similar advantage to malaria. (1 mark)

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(e) People who suffer repeated infection by malaria show reduced symptoms with each subsequent infection, which is commonly referred to as “seasoning.” Explain how seasoning would reduce the symptoms shown by people with repeated infections by malaria. (3 marks)

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**Question 32 (20 marks)**

Since the beginning of January until the end of March, an outbreak of coronavirus (COVID-19) saw more than 700,000 infected and more than 33,000 die from the disease globally. Originating in Wuhan city in China, the coronavirus was believed to have first infected people in a seafood wholesale market, causing sufferers to experience breathing difficulties, fever, coughing and shortness of breath. Current estimates are that the incubation period is up to 14 days, with most asymptomatic (showing no symptoms) until 5-6 days after infection.

(a) A person with coronavirus experiences most symptoms in their respiratory system. Describe the external defence mechanisms of the respiratory system and suggest how they are believed to assist the body to defend itself against disease. (6 marks)

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(b) (i) Given a person is asymptomatic for up to 5-6 days after infection, explain how this could have affected the incidence of the disease. (2 marks)

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(ii) What measures could an individual put in place in order to reduce their chance of catching the disease? (2 marks)

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(iii) A number of mechanisms were put into place by governments as a result of the increasing numbers of infections. China restricted all movements in or out of Wuhan, cruise liners held their passengers on board in their rooms and people who had travelled internationally were asked to not attend school or work for 14 days after their return home.

Explain how it is believed these measures will affect the number of people with the disease. (2 marks)

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(c) Researchers in Queensland have been working on a vaccine for the coronavirus since its outbreak.

(i) Why could this not be a toxoid vaccine? (1 mark)

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(ii) Explain why a sub-unit vaccine could be used as a potential vaccine against coronavirus. (3 marks)

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(iii) What type of immunity would be provided by a vaccine against coronavirus? (2 marks)

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(iv) State one economic and one sociocultural reason why some people may not want their child vaccinated against coronavirus. (2 marks)

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**Question 33 (32 marks)**

A fossil specimen of a young woman was found in a cave in China that showed characteristics of both Neanderthals and Denisovans (another fossil group). A small amount of DNA was retrieved from her bones and analysed using DNA electrophoresis.

(a) Describe the conditions required for the young woman to be fossilised. (4 marks)

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(b) Name the process that would have multiplied the amount of DNA found in her bones and briefly explain what would occur in each stage. (7 marks)

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(c) DNA electrophoresis was conducted in order to compare her DNA to a sample of pure Neanderthal DNA and a sample of pure Denisovan DNA from other sites.

(i) What would all three DNA samples have been treated with prior to being placed in the agarose gel? (1 mark)

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(ii) Explain why and how the DNA moves across the gel during the electrophoresis process. (3 marks)

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The results of the DNA electrophoresis are shown below:

Young woman

Neanderthal

Denisovan

(iii) Draw an arrow in the box on the diagram above to show the direction that DNA would move during the process of gel electrophoresis. (1 mark)

(iv) Draw a circle around one lane of DNA on the image above. (1 mark)

(v) Explain what the results on the agarose gel shows about the young woman. (2 marks)

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(d) These three specimens as well as *Homo sapiens* were studied in order to determine the evolutionary relationships between the specimens. The table below shows a portion of the amino acid sequence for the same gene from each specimen.

Table 1: Amino acid sequence for one gene

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Amino acid sequence in one gene** | | | |
| Young woman | ile | trp | cys | his |
| Neanderthal | glu | val | iso | ser |
| Denisovan | ile | asn | ala | his |
| *Homo sapiens* | ile | trp | cys | phe |

(i) Name one gene on which this comparison could have been made. (1 mark)

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(ii) According to the table of amino acid sequence data above, who is most closely related to the young woman? (1 mark)

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(iii) The scientists also studied the DNA of this amino acid sequence. Would comparative DNA or comparative proteins provide more accurate data about their relationship? Justify your answer. (2 marks)

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(iv) Construct a phylogenetic tree using the amino acid sequence data in the table above. (3 marks)

(e) Describe the differences between aspects of the culture and tools associated with Neanderthals and *Homo erectus*. (6 marks)

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**Question 34 (14 marks)**

 E F

A B

D

C

G

(a) Name the structures labelled: (3 marks)

A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

C \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) What is the stimulus for an action potential to cross the synapse? (1 mark)

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(c) Dopamine is a neurotransmitter in the efferent nerve pathways of the central nervous system. It is involved in many body functions, including: alertness, a “feel good” mood and motor control. When a person takes cocaine, dopamine cannot be taken out of the synapse to be transported back into the presynaptic neuron.

(i) Which way are messages transmitted in efferent nerve pathways? (1 mark)

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(ii) State one effect of dopamine not being removed from the synapse. (1 mark)

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(iii) Parkinson’s is a neurodegenerative condition characterised by a lack of dopamine. Briefly describe how cell replacement therapy could be utilised to

treat Parkinson’s. (2 marks)

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(d) The brain uses approximately 20% of all the glucose available in the body. By referring to the labels used in the image shown previously, explain why this is the case. (3 marks)

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(e) Complete the table showing the effect of an injury to different brain structures. (3 marks)

|  |  |
| --- | --- |
| **Structure** | **Effect of an injury** |
|  | Inability to control fine motor movements |
|  | Body temperature unable to be regulated |
| Cerebrum |  |

**Question 35 (22 marks)**

In 2001, Pat Rafter suffered from extreme cramps and lost the semi-final in the Australian

Tennis Open to Andre Agassi. After testing, it was found Rafter sweats twice as much as other

people in the same conditions.

(a) (i) What hormone, produced by the hypothalamus, would be released as a result of the volume of sweat lost? (1 mark)

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(ii) Describe and explain the effect of this hormone on its target cells. (2 marks)

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(b) (i) Pat Rafter was initially told to drink more water during his tennis matches in order to prevent dehydration. Explain why drinking more water would have made his problem worse. (3 marks)

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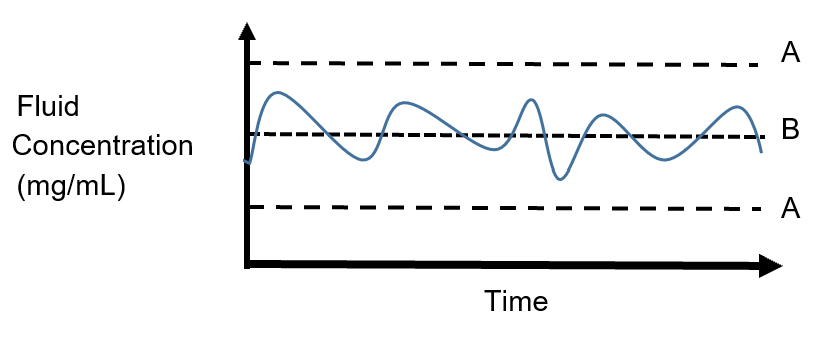
(ii) Name the hormone that would be produced after consuming large amounts of water and state one behavioural mechanism Pat Rafter could take in order to minimise the effect of his heavy sweating. (2 marks)

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(c) A graph of Pat Rafter’s fluid concentration during normal activity is shown below.



(i) What type of feedback model is shown in the graph above? (1 mark)

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(ii) During normal activity, Pat Rafter stays between the lines marked A on the graph. What do these lines represent? (1 mark)

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(iii) What does the line marked B on the graph represent? (1 mark)

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(d) Thermoregulation relies on both hormonal and nervous control. Describe how

temperature can be regulated using both hormonal and nervous controls. (6 marks)

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(e) The scientists investigating Pat Rafter’s problem chose three other tennis players to compare Pat against. Pat and the other players were weighed before and after their games in one tournament. Games were timed so that they could calculate the water loss per hour. The tournament ran over 5 days and the players had varying levels of success, with one making it to the grand-final.

(i) Name one variable the scientists controlled. (1 mark)

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(ii) Name one potentially uncontrolled variable and explain the effect of this on the experiment. (2 marks)

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A lab assistant was asked to create the table of results for the experiment, which is shown below.

Title: Weight loss

|  |  |  |  |
| --- | --- | --- | --- |
|  | Body weight | | |
| Subject | Before game | After game | Average |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |

(iii) Identify two (2) errors the lab assistant has made in constructing the table. (2 marks)

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**End of Section Two**

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

This section contains **four (4)** questions.

Questions 36 and 37 are from Unit 3. Questions 38 and 39 are from Unit 4. Answer **one (1)** question from Unit 3 and **one (1)** from Unit 4.

Use a black or blue pen for this section. Only graphs and diagrams may be drawn in pencil. Responses can include: labelled diagram with explanatory notes; lists of points with linking sentences; labelled tables and/or graphs; and/or annotated flow diagrams with introductory notes.

Supplementary pages for the use of planning/continuing an answer to a question have been 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 36 **or** Question 37. Indicate the question you will answer by ticking the box next to the question. Write your answer on the pages provided.

**Question 36 (20 marks)**

1. Cortisol and ADH have different effects on cells due to the fact they belong to different categories of hormones. Compare and contrast the action of water soluble and lipid soluble hormones and describe how cortisol and ADH affect their target cells. (14 marks)
2. Explain how bioinformatics and gene therapy could be used to combat diabetes mellitus. (6 marks)

**Question 37 (20 marks)**

1. Describe how the resting potential of the neuron membrane is maintained and use the all or none response to explain how stimulation of the same nerve cell could result in two different outcomes. (10 marks)
2. The body undertakes two specific immune responses once an antigen has breached its external defences and entered blood or other extracellular fluids. Compare and contrast the two specific responses of the body. (10 marks)

Question number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Unit 4**

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 the pages provided.

**Question 38 (20 marks)**

People who have red blood cell Duffy antigen negativity lack the antigen receptor on the haemoglobin molecule that normally allows malaria to invade our red blood cells. 97% of West and Central Africans have this mutation for Duffy negativity, making them resistant to malarial infection. African Pygmies are 100% Duffy negative.

(a) Discuss how this mutation may have come about. (7 marks)

(b) Explain how, over an extended period of time, the West and Central African populations came to be resistant to malaria. (10 marks)

(c) Using the concept of gene flow, explain why the African Pygmies are 100% Duffy negative. (3 marks)

**Question 39 (20 marks)**

Earlier this year, scientists uncovered the remains of a new human species, *Homo luzonensis* in the Philippines. It shared features of its hands and feet with *Australopithecus africanus*, although other features such as its dentition and degree of prognathism were more closely aligned with modern hominins.

(a) Describe the features *Homo luzonensis* would have shared with *Australopithecus africanus* and those it would have shared with more modern hominins and suggest why these features might have been an advantage to *Homo luzonensis*. (11 marks)

(b) In a cave nearby, a number of stone tools were found which were dated at 700,000 years. Name and describe the specific dating technique that would have been used in this instance, giving reasons why this method would have been appropriate. (9 marks)

**End of Questions.**

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