



Western Australian Certificate of Education Examination, 2011

Question/Answer Booklet

HUMAN BIOLOGICAL SCIENCE

Stage 3

Please place your student identification label in this box

Student Number: In figures

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In words

Time allowed for this paper

Reading time before commencing work: ten minutes

Working time for paper: 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, pencils, eraser, correction fluid/tape, ruler, highlighters

Special items: non-programmable calculators satisfying the conditions set by the Curriculum Council for this course

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 notes or other items of a non-personal nature in the examination room. 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 exam
Section One: Multiple-choice	20	20	30	20	20
Section Two: Short answer	9	9	90	100	50
Section Three: Extended answer	3	2	60	60	30
Total					100

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2011*. Sitting this examination implies that you agree to abide by these rules.
- Answer the questions according to the following instructions.

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

Sections Two and Three: Write answers in this Question/Answer Booklet.

- You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
- Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
 - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
 - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Section One: Multiple-choice

20% (20 Marks)

This section has **20** 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. If you make a mistake, place a cross through that square; do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

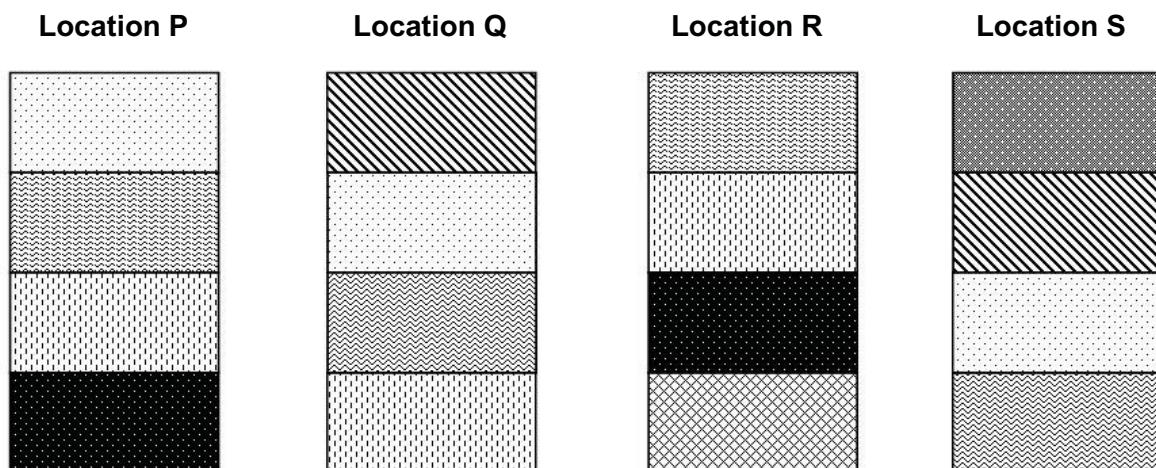
Suggested working time: 30 minutes.

1. Homeostasis is the process that keeps the internal environment constant. As this is a complex process, models to explain how it works have been developed for different aspects of the internal environment. One such model is the 'stimulus-response feedback' model.

Which of the following shows the components of the 'stimulus-response feedback' model in the correct sequence?

- (a) stimulus, receptor, modulator, effector, response, feedback
- (b) stimulus, effector, modulator, receptor, response, feedback
- (c) stimulus, receptor, effector, modulator, response, feedback
- (d) stimulus, effector, receptor, modulator, response, feedback

Question 2 refers to the diagram below, which shows the sequences of rock strata from four locations.



2. Which location appears to have the oldest stratum?

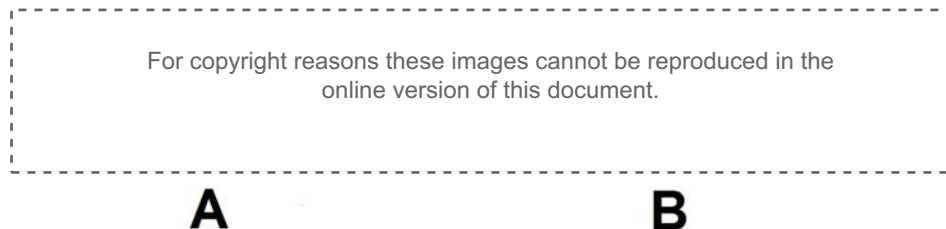
- (a) P
- (b) Q
- (c) R
- (d) S

3. Tay-Sachs is a hereditary disease that occurs in 1 in every 2500 births in the Ashkenazi Jewish population. The incidence of Tay-Sachs in other populations is very low, at around 1 in 500 000 births.

Which of the following is **not** considered a reasonable explanation for this frequency of inheritance?

- (a) Genetic drift: Jewish populations tend to be small and isolated, thus increasing the chance of allele frequency changes.
- (b) Founder effect: original migrating populations carried a high incidence of the allele, which has been maintained over subsequent generations.
- (c) Heterozygote advantage: carriers of the alleles have a survival advantage, so the allele is maintained in the population due to natural selection.
- (d) Late onset condition: sufferers of the disease are not affected until later in life, after they have already reproduced and passed the allele to their offspring.

Question 4 refers to the diagrams below, which represent the bones of the feet of two different primates.

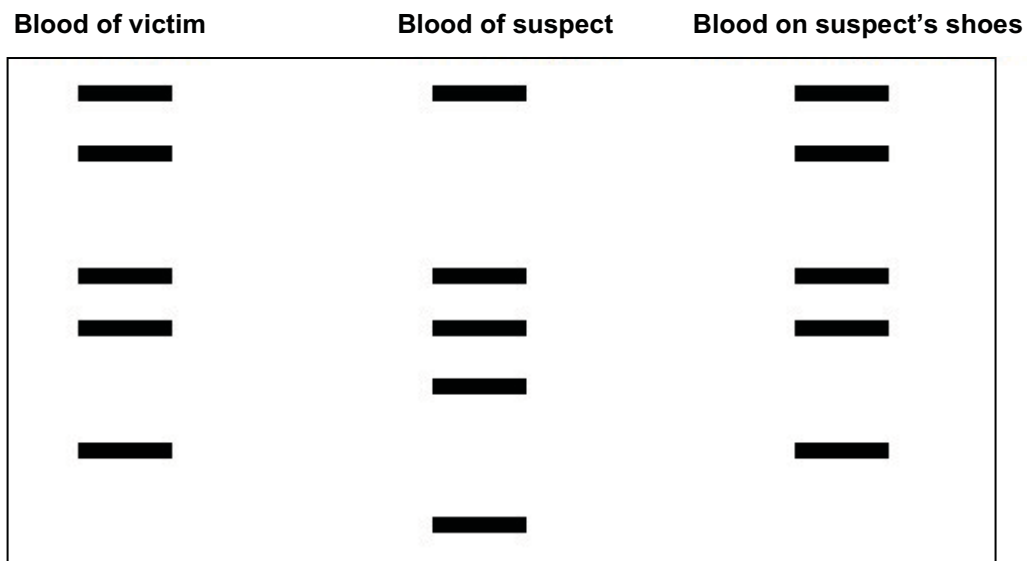


4. Which one of the following is correct?
- (a) A belongs to a hominin as it has a smaller heel bone.
 - (b) B belongs to a hominin as it has a non-opposable first toe.
 - (c) A belongs to a hominin as it has a transverse arch.
 - (d) B belongs to a hominin as it has less bones in the foot.
5. The Dunkers are a small religious group that moved from Germany to Pennsylvania, in the United States of America, in the 1700s. They mostly choose to marry only the members of their own community. Today, the Dunkers are genetically different from other populations, including those in Germany.

Which of the following are the most likely explanations for the genetic uniqueness of the current Dunker population?

- (a) natural selection and mutation
 - (b) natural selection and genetic drift
 - (c) barriers to gene flow and genetic drift
 - (d) barriers to gene flow and speciation
6. A patient who has been diagnosed with diabetes is told by the doctor to monitor his glucose intake and adopt a healthy lifestyle. He is not prescribed insulin injections. The type of diabetes he has is
- (a) type 1.
 - (b) juvenile.
 - (c) type 2.
 - (d) insulin dependent.

Question 7 refers to the diagram below.



7. The diagram above shows DNA fingerprints produced as evidence in a case in which a man is suspected of committing murder. It can be concluded from the information provided in the diagram that the suspect was at the scene of the crime because the

- (a) blood on the suspect's shoes matches that of the victim.
- (b) suspect's DNA and the blood on his shoes matches that of the victim.
- (c) suspect's DNA does not match that of the victim.
- (d) blood on the suspect's shoes does not match his own DNA.

8. The spray-on skin developed by Dr Fiona Wood is a medical innovation that is used in the treatment of burns victims. The treatment allows replacement skin to be grown and ready for use in only five days, increasing the chances of recovery for burn victims requiring skin grafts. This type of regenerative medicine is known as

- (a) gene therapy.
- (b) tissue engineering.
- (c) genetic probe.
- (d) bionic skin.

9. The following statements relate to primate evolutionary trends.

- (i) an increase in the relative size of the cerebral cortex
- (ii) a shift from reliance on sight to olfaction
- (iii) an increase in the mobility of digits
- (iv) a lengthening of the gestation period
- (v) a decrease in the dependence of offspring on parents
- (vi) a reduction in the number of teeth

Which of the above statements are correct?

- (a) (i), (ii), (iii) and (vi)
- (b) (i), (iii), (iv), and (vi)
- (c) (ii), (iii), (iv) and (v)
- (d) (i), (iii), (v) and (vi)

Questions 10–11 refer to the following information.

The inheritance of human ABO blood groups is determined by three alleles, I^A , I^B and i . A man has group B and his mother has group O. He married a woman with group AB.

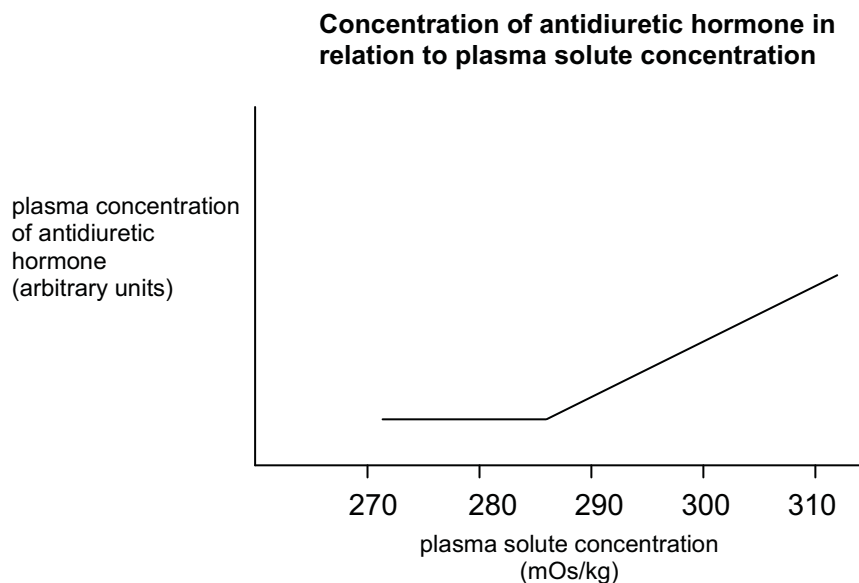
10. What possible genotypes could their children have?

- (a) $I^B I^B$, $I^A I^B$, ii
- (b) $I^B i$, $I^B I^B$, ii
- (c) $I^B I^B$, $I^A I^A$, $I^A I^B$, $I^A i$
- (d) $I^B I^B$, $I^A i$, $I^A I^B$, $I^B i$

11. What possible phenotypes could their children have?

- (a) groups A, B and O
- (b) groups A, B, and AB
- (c) groups A and AB
- (d) groups A, B, AB and O

Question 12 refers to the graph below.



12. Antidiuretic hormone is important in controlling water balance. The graph shows changes in the concentration of antidiuretic hormone as plasma solute concentration changes.

The change in antidiuretic hormone in the blood plasma at 285 mOs/kg was due to

- (a) an increase in osmotic pressure in the cells.
- (b) a decrease in the solute concentration of the plasma.
- (c) an increased intake of water into the cells.
- (d) a decrease in blood pressure in the plasma.

Question 13 refers to the diagram below, which shows three different types of muscle.



13. Based on the information shown in the diagram, which of the following names each type of muscle correctly.

	Type X	Type Y	Type Z
(a)	cardiac	skeletal	smooth
(b)	skeletal	cardiac	smooth
(c)	smooth	cardiac	skeletal
(d)	skeletal	smooth	cardiac

14. The pelvis, femur and knee joint of hominins assist them to walk bipedally.

Which of the following enables this to happen?

- (a) The femurs produce a carrying angle as a consequence of a wider pelvis.
- (b) Weight transmission falls inside the femur to the knee joint.
- (c) The femur is lengthened to raise the centre of gravity of the body.
- (d) The hip sockets are close together to increase stability.

See next page

Question 15–16 refer to the diagram below, which represents protein synthesis.

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but may be viewed at
<http://faculty.irsc.edu/FACULTY/TFischer/bio%201%20files/protein%20synthes%20overview.jpg>

15. Where in the cell does the transcription stage of the process occur?

- (a) ribosomes
- (b) cytoplasm
- (c) nucleus
- (d) mitochondria

16. During the translation stage, structure X binds with another structure to determine the type of amino acid formed.

Which of the following names structure X and the structure that binds to it correctly?

	Structure X	Structure that binds to structure X
(a)	codon of mRNA	anticodon of tRNA
(b)	anticodon of mRNA	codon of tRNA
(c)	codon of tRNA	anticodon of mRNA
(d)	anticodon of tRNA	codon of mRNA

17. Which of the following is a series of events that leads to the formation of two separate species?
- (a) variation, natural selection, isolation, speciation
 - (b) natural selection, isolation, speciation, variation
 - (c) isolation, variation, speciation, natural selection
 - (d) variation, isolation, natural selection, speciation

Questions 18–19 refer to the diagram below, which shows the structure of the cell membrane.

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18. Structure X
- (a) produces energy for cell membrane function.
 - (b) prevents pathogens passing through the cell membrane.
 - (c) allows the transport of ions across the membrane.
 - (d) actively transports lipids across the membrane.
19. Structure Y is a
- (a) glycoprotein.
 - (b) phospholipid.
 - (c) hydrophobic tail.
 - (d) carbohydrate.

Question 20 refers to the diagram and information shown below.

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www.vcaa.vic.edu.au/vce/studies/biology/pastexams/2003_biol2.pdf

20. Which of the following enzymes cut the plasmid and attach the inserted genes respectively?
- (a) restriction enzyme and DNA polymerase
 - (b) DNA polymerase and DNA ligase
 - (c) DNA ligase and DNA polymerase
 - (d) restriction enzyme and DNA ligase

End of Section One

See next page

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Section Two: Short answer**50% (100 Marks)**

This section has **nine (9)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
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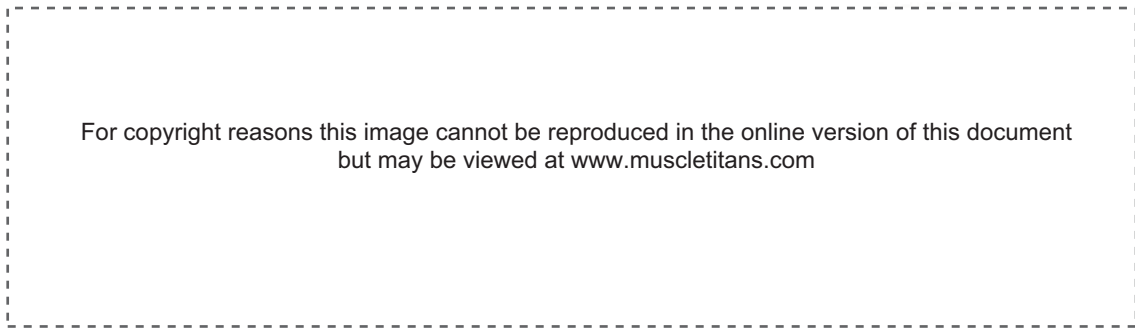
Suggested working time: 90 minutes.

Question 21**(8 marks)**

- (a) Complete the table below, describing key differences between how the nervous and endocrine systems control homeostasis in the body. **(4 marks)**

Function	Nervous	Endocrine
Speed (reaction time)		
Transmission		

The following parts of the question refer to the diagrams below, which represents different nervous pathways.



(b) Which diagram represents a somatic nervous pathway? (1 mark)

(c) What would be found in the region labelled ganglion on diagram B? (1 mark)

(d) Other than what is shown in the diagrams, describe **one (1)** structural or chemical characteristic that would differ between the nervous pathways A and B. (2 marks)

Question 22

(12 marks)

- (a) Name the type of inheritance that controls skin colour in humans. (1 mark)

- (b) Explain how this type of inheritance results in the large variation in skin colour evident in human populations. (3 marks)

- (c) As well as genetic factors, the environment can affect skin colour greatly. What is found in skin that controls how light or dark the skin will be due to the effect of the environment? (1 mark)

- (d) Explain why a person living nearer the equator could have darker skin than a person living nearer the North Pole, even though they have the same genetic code for skin colour. (3 marks)

Structural genes, such as those that control skin colour, code for the manufacture of particular proteins. Other types of genes can influence the production of proteins and, as such, the expression of the structural genes.

(e) Describe the role of the following genes in the expression of structural genes.

(i) Regulator gene (2 marks)

(ii) Promoter gene (2 marks)

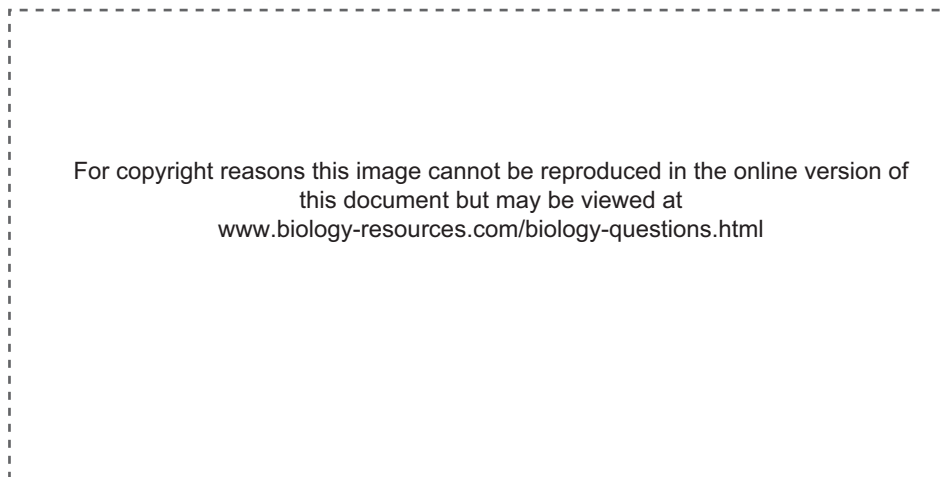
Question 23**(11 marks)**

(a) Complete the table below.

(4 marks)

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Part (b) of this question refers to the diagram below, which shows the bones and muscles of the arm.



(b) (i) Provide the name given to the point where the muscle is attached to the bone, as indicated by the letter S. (1 mark)

(ii) Assuming that bone Q remains stationary, what will the muscles P and R do when bone T moves in the direction shown in the diagram? (2 marks)

P: _____

R: _____

(c) Bionic limbs and artificial joints are medical technologies that can be used to treat different medical issues.

Distinguish between a bionic limb and an artificial joint and outline a medical issue for which each is used. (4 marks)

	Bionic limb	Artificial joint
What is it?		
Medical Issue		

Question 24

(15 marks)

One of the major risk factors in cardiovascular disease is hypertension (high blood pressure). It has been controlled by the use of various drugs and by the maintenance of a healthy lifestyle. A method of prevention has now been trialled using a new drug called CYT006-AngQb. A clinical trial was carried out with 72 patients suffering from hypertension. Half of the patients were injected with 300µg of the new drug and half were injected with 300µg of a placebo. Three months after the injection, the blood pressure of the patients was taken over a 24-hour period, from 8am one day to 8am the next day.

Below is a table comparing the average systolic blood pressure for both groups of patients over the 24-hour period.

Time (24 hours)	Systolic Blood Pressure (mmHg)	
	<i>Patients treated with the new drug</i>	<i>Patients treated with the placebo</i>
8 am	145	160
12pm (midday)	138	150
4pm	142	150
8pm	140	150
12 am (midnight)	125	130
4am	132	135
8am	140	160

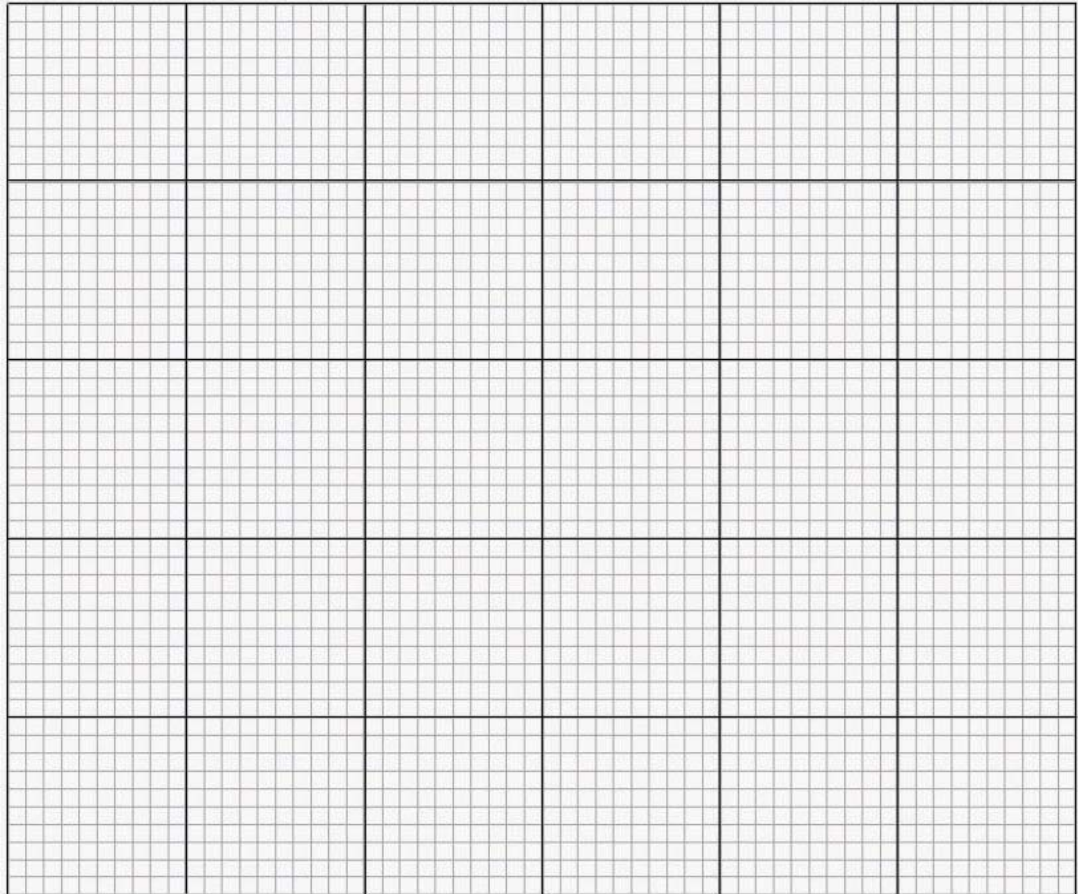
- (a) Suggest a hypothesis for this experiment. (1 mark)

- (b) Describe **two (2)** variables that were controlled in the experiment. (2 marks)

- (c) What is the purpose of a placebo? (1 mark)

- (d) Graph the results in the table on the grid provided below. You may use pencil. (5 marks)

If you wish to have a second attempt at the graph, the grid is repeated at the end of this Question/Answer Booklet. Indicate clearly on this page if you have used the second grid and cancel the working on the grid on this page.



- (e) (i) At which time of the day was the new drug most effective? (1 mark)

- (ii) At which time of the day was the new drug least effective? (1 mark)

- (iii) Suggest a reason for the difference between (e) (i) and (ii)? (1 mark)

- (f) If a person has normal blood pressure, homeostatic mechanisms are preventing it from reaching levels that are too high. The process is controlled by centres in the medulla oblongata that receive nerve impulses from baroreceptors in some arteries.

Explain how centres in the medulla oblongata work to prevent hypertension. (3 marks)

Question 25

(7 marks)

Thomas underwent a series of medical tests and was found to have low calcium ion levels in his blood due to a hormonal imbalance.

- (a) Which hormone would normally increase in the blood when blood calcium ion levels are low? (1 mark)

- (b) For the hormone described in part (a), there are several effectors in the body, one of which is bone. Identify **one (1)** other effector in the body and describe the response of that tissue and/or organ to low blood calcium ion levels. (2 marks)

- (c) Describe how low blood calcium ion levels could affect Thomas's bone composition and muscle contraction. What problem could result from these changes? (4 marks)

	Bone composition	Muscle contraction
Changes caused by low calcium ion levels		
Problem resulting from the changes		

- (b) Using the information from the graph, describe **two (2)** differences between the responses to the first and second exposures. (2 marks)

- (c) What cell type is present at the beginning of the second exposure but not at the beginning of the first exposure? (1 mark)

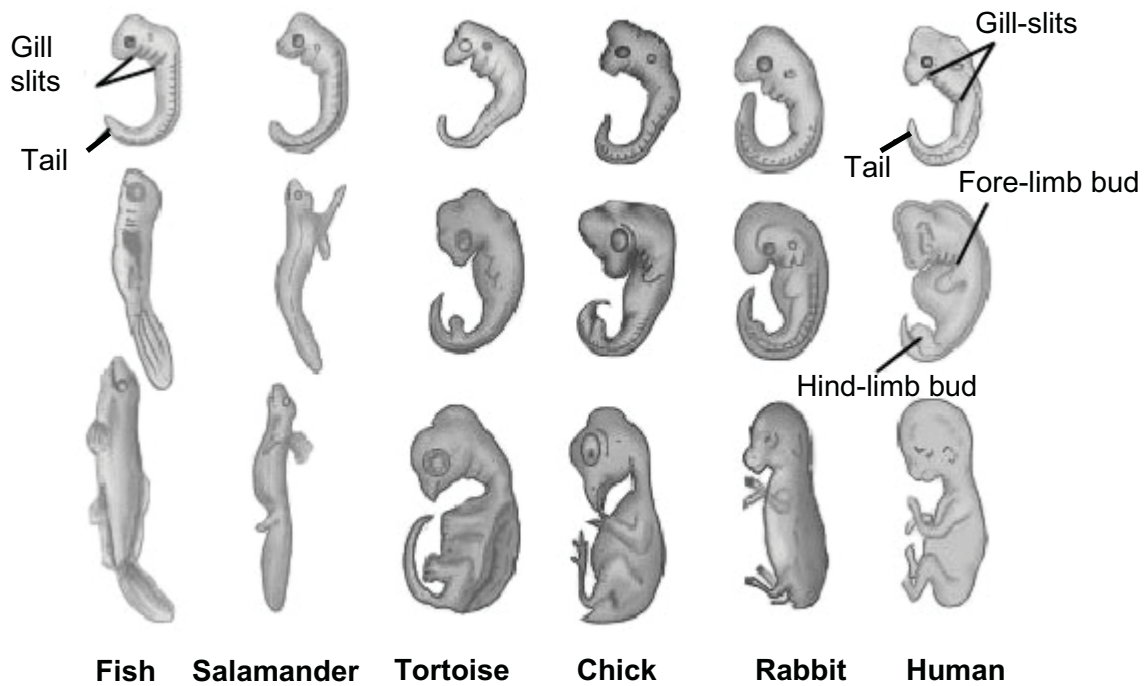
- (d) This graph represents active immunity. Describe **three (3)** ways in which this differs from passive immunity. (3 marks)

- (e) Name and describe **one (1)** type of immune response apart from antibody production that is involved in fighting pathogens. (4 marks)

Question 27

(11 marks)

Parts (a) and (b) of this question refer to the diagram below.



(a) Name and describe the specific type of study shown above used to provide evidence for evolution. (2 marks)

(b) Using the diagram above, explain the evolutionary relationship of the human to the rabbit compared with the human to the fish. (2 marks)

(c) Explain how the study of DNA can provide evidence for evolution. (2 marks)

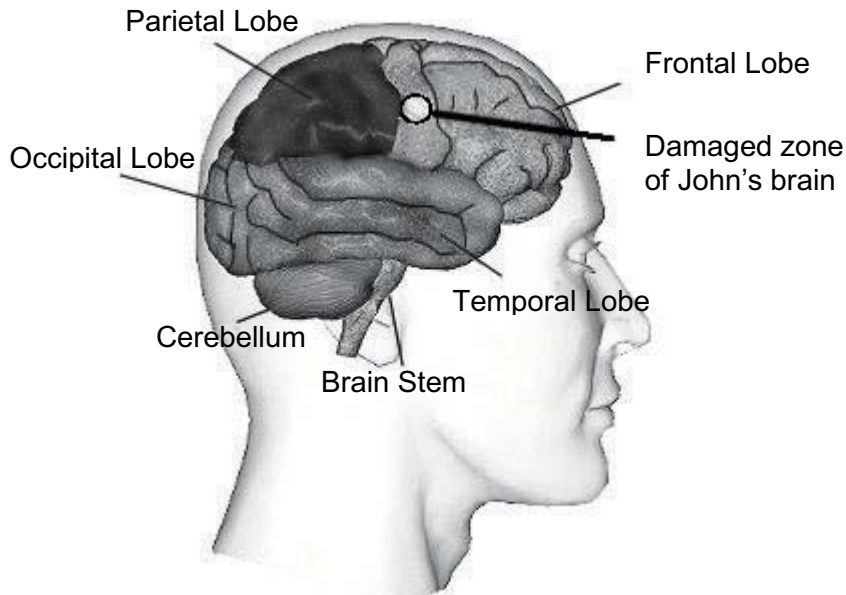
(d) When DNA is being used in the study of evolution, how can the polymerase chain reaction (PCR) technique be useful? (2 marks)

(e) The Human Genome Project has provided more supporting evidence for the theory of evolution by providing a better comparison between the DNA of modern humans and extinct hominin species. Explain how the Project could also help to treat genetically-inherited diseases. (3 marks)

Question 28

(11 marks)

John was involved in a serious motorcycle accident. He failed to take a corner and was thrown head first into a brick retaining wall next to the road he was travelling on. In the hospital emergency department, it was noted that the right side of his brain had been damaged, as shown in the diagram.



- (a) Name and describe the main function of the area indicated as the damaged zone of John's brain. (2 marks)

- (b) Describe how **one (1)** body function will be affected by this injury. (2 marks)

- (c) During John’s examination, the neurologist used the terms ‘white matter’ and ‘grey matter’. Distinguish between white and grey matter in terms of structure and location in the brain. (4 marks)

	White matter	Grey matter
Structure		
Location in the brain		

- (d) While in hospital, John was also diagnosed with Parkinson’s disease.

- (i) State the effect of Parkinson’s disease on the brain. (1 mark)

- (ii) Describe **two (2)** symptoms of Parkinson’s disease. (2 marks)

Question 29

(10 marks)

(a) When hyperventilation occurs, a person breathes faster and more deeply than normal.

(i) What effect would this have on the level of carbon dioxide in the blood?

(1 mark)

(ii) Where in the brain would this change in carbon dioxide level be detected?

(1 mark)

(b) A girl had the pH levels in her blood taken immediately before and after swimming 500 metres in a pool. The results showed a drop in pH from 7.4 to 7.3.

What caused this drop in pH to occur?

(3 marks)

(c) Describe **three (3)** steps that need to occur so that more oxygen can be delivered to skeletal muscles when they become very active during exercise.

(3 marks)

(d) When oxygen levels are extremely low, they have an effect on the regulation of breathing. Provide **two (2)** diseases or environmental situations in which this would happen.

(2 marks)

Section Three: Extended answer

30% (60 Marks)

This section contains **three (3)** questions. You must answer **two (2)** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

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

Suggested working time: 60 minutes.

Question 30**(30 marks)**

- (a) During the biological evolution of hominins from the earliest australopithecines to early *Homo sapiens*, there were also significant cultural advances, including tool cultures and changing lifestyles.

Describe these advances with reference to the particular hominin groups of australopithecines, *Homo habilis*, *Homo erectus* and early *Homo sapiens*.

- (i) Tool cultures, including manufacture and uses (8 marks)
- (ii) Changing lifestyles (8 marks)
- (b) Early *Homo sapiens* were in existence at a time that enables us to determine the date of their remains using carbon-14 dating. Explain how carbon-14 dating determines the age of fossil remains and describe **two (2)** of its limitations. (8 marks)
- (c) If you have a large number of fossil skulls from various hominin groups, trends from more primitive to more advanced can be seen.

Describe **six (6)** features of the hominin skull and the trends you would see in these features that would determine the order of the fossils, from least to most advanced.

(6 marks)

Question 31

(30 marks)

- (a) Human skeletal muscle is activated by a complex relationship between nervous stimuli and the processes inside the muscle fibre.
- (i) Describe the transmission of a nerve impulse at the neuromuscular junction. Include an outline of the structures and chemicals involved in the process. (7 marks)
- (ii) The sliding filament model is used to suggest how muscle contraction occurs. Explain how this model works. (7 marks)
- (b) Describe the pathway taken by a nerve impulse in a spinal reflex arc and explain **three (3)** ways in which it is considered to be a protective mechanism. (8 marks)
- (c) Sarah was listening to her iPod™ and not paying attention to the traffic as she walked home from school. She didn't hear the car behind her as she stepped off the footpath. The driver of the car sounded the horn and screeched to a halt, just missing her.

Describe **four (4)** beneficial ways that Sarah's body may have responded to this frightening situation and how these responses would have been advantageous for her. (8 marks)

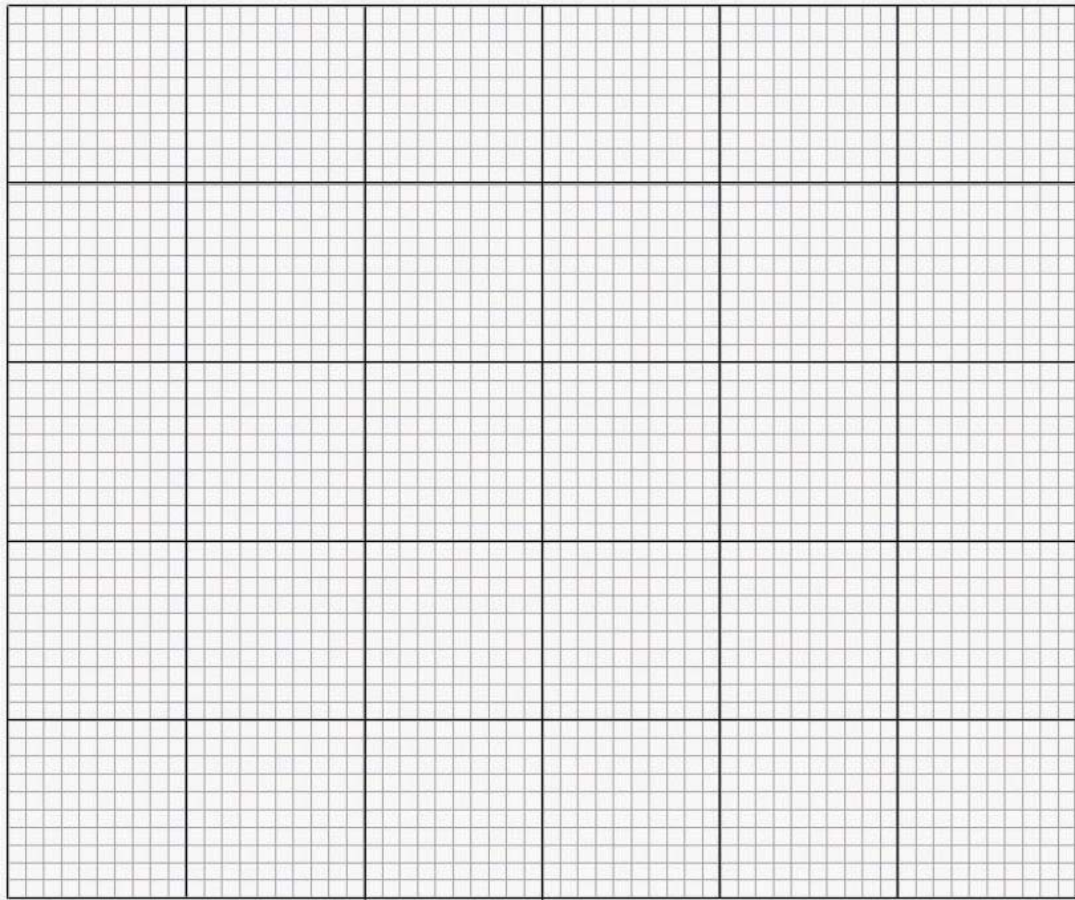
Question 32

(30 marks)

- (a) Mrs Jones had been feeling unwell for some months and was not able to cope with everyday activities. She had noticed that her neck was getting thicker, preventing her from buttoning her shirts. She visited her doctor, who after a physical examination and blood tests, diagnosed low thyroid activity, or hypothyroidism.
- (i) Imagine you are Mrs Jones's doctor and are explaining how the thyroid gland works. Provide a description of the thyroid hormone feedback loop. (8 marks)
- (ii) Later that week, Mrs Jones is talking with her friends about her medical experience. A friend mentions that one of her family members has a thyroid disease. The doctor called it 'hyperthyroidism, or Graves' disease'.
- Compare and contrast Mrs Jones's hypothyroidism with hyperthyroidism (Graves' disease). For each condition outline **two (2)** causes, **two (2)** signs or symptoms and **one (1)** treatment. (10 marks)
- (b) Glucose is required in the body cells for the production of energy during cellular respiration. To maintain glucose levels in a cell, negative feedback mechanisms are necessary for more glucose to be released into the bloodstream and to enter the cell.

Identify, name the source and describe the role of **three (3)** hormones in increasing glucose levels in the bloodstream. (12 marks)

End of questions



ACKNOWLEDGEMENTS

Section One

- Question 4** Diagram adapted from: Newton, T.J., & Joyce, A.P. (1995). *Human perspectives*, Book 2. (3rd ed.). Sydney: McGraw-Hill, p. 97.
- Question 13** Diagram adapted from: *Muscles lecture outline* (chapter 12), IPHY3430-200. (2008, February 19). Retrieved March, 2011, from www.colorado.edu/intphys/Class/IPHY3430-200/010muscles.htm.
- Question 15–16** Diagram adapted from: Fischer, T. (2008, March 15). *Protein synthesis overview*. Retrieved February, 2011, from <http://faculty.irsc.edu/FACULTY/TFischer/bio%201%20files/protein%20synthes%20overview.jpg>.
- Question 18–19** Diagram adapted from: *Plasma membrane structural components*. (n.d.). Retrieved March, 2011, from <http://micro.magnet.fsu.edu/cells/plasmamembrane/images/plasmamembplasmamemb1.jpg>.
- Question 20** Diagram from: Victorian Curriculum and Assessment Authority. [VCAA]. (2003). *Biology: Written examination 2* (Question 4, p. 16). Retrieved February, 2011, from www.vcaa.vic.edu.au/vce/studies/biology/pastexams/2003_biol2.pdf.

Section Two

- Question 21** Diagram adapted from: *Muscle Titans* (2011, 2 April). [Web log message]. Retrieved June, 2011, from www.muscltitans.com.
- Diagram adapted from: *I found the cure* [Website]. (2010, July 15). Retrieved July, 2011, from www.ifoundthecure.com.
- Question 23(a)** Diagrams adapted from: *Joints*. (n.d.). Retrieved March, 2011, from <http://ovrt.nist.gov/projects/vrml/h-anim/joint1C.gif>.
- Question 23(b)** Diagrams adapted from: MacKean, D. (n.d.). *Biology GCSE & IGCSE question bank with exercises and discussions: 17*. Retrieved March, 2011, from www.biology-resources.com/biology-questions.html.
- Question 27** Diagram adapted from: *Notes for zoology*. (2009, September 26). Retrieved March, 2011, from www.cssforum.com.pk/css-optional-subjects/group-d/zoology/14536-notes-zoology-16.html.
- Question 28** Diagram adapted from: *CEU course: Brain anatomy and function*. (n.d.). Retrieved March, 2011, from www.neuroskills.com/edu/ceufunction1.shtml.

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