HUMAN BIOLOGICAL SCIENCE
STAGE 3 DRAFT SAMPLE EXAMINATION

Section 7 of the WACE Manual: 2008 outlines the policy on WACE examinations.

Further information about the WACE Examinations policy can be accessed from the Curriculum Council website at http://www.curriculum.wa.edu.au.

The purpose for providing a sample examination is to provide teachers with an example of how the course will be examined. Further fine-tuning will be made to this sample in 2008 by the examination panel following consultation with teachers, measurement specialists and advice from the Assessment, Review and Moderation (ARM) panel.

2008/24018

Western Australian Certificate of Education, Draft Sample External Examination

Question/Answer Booklet

HUMAN BIOLOGICAL SCIENCE

WRITTEN PAPER
STAGE 3

Please place your student identification label in this box

Student Number: In figures | | | | | | | | |

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
A separate multiple-choice answer sheet
This question/answer booklet

To be provided by the candidate
Standard items: Pens, pencils, eraser or correction fluid, ruler, highlighter

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	Suggested working time (minutes)	No. of questions available	No. of questions to be attempted	Marks available
Section One: Multiple-choice	30	20	ALL	40
Section Two: Short Answer	100	10	ALL	100
Section Three: Extended Answer	50	4	2	60
			Total marks	200

Instructions to candidates

1. Please ensure you attach your **student identification label** in the box on page 1, as well as write your **student number** in the spaces provided.

2. The rules for the conduct of Curriculum Council examinations are detailed in the *Student Information Handbook*. Sitting this examination implies that you agree to abide by these rules.

Section One: Answer **all** questions, using a 2B, B or HB pencil, on a separate Multiple Choice Answer Sheet. DO not use a ballpoint or ink pen.

Section Two: Answer in the spaces provided in this Question/Answer Booklet. DO not answer this section in the section in the Standard Answer Book. A blue or black ballpoint or ink pen should be used.

Section Three: Write your answers in the Standard Answer Book. Your writing or printing must be LEGIBLE. Use a blue or black ballpoint pen (not pencil) for this section.

3. Answers may be presented in a combination of different ways provided they communicate your ideas effectively. You may choose to :

- Present a clearly labelled diagram
- Write notes besides a clear diagram
- Write lists of points, with sentences that link them
- Write concisely worded sentences
- Use some other appropriate way to present ideas.

4. At the end of the examination your Question/Answer Booklet should be attached to the front of the Standard Answer Book/s with the paper binder provided.

Section One––Multiple-choice *[40 marks]*

Mark your answers to Questions 1-20 on the **SEPARATE MULTIPLE-CHOICE ANSWER SHEET,** using a 2B, B or HB pencil.

Select the correct alternative in each of the following questions.

Suggested working time: 30 minutes

Question 1

The secretion of digestive juices in the stomach occurs in three steps.

First, secretion of digestive juice begins when we see, smell or taste food.
Second, when food gets to the stomach it stimulates secretion of digestive juice.
Third, when food in the stomach is partly digested there is a decrease in the secretion of digestive juice.

If the nerve to the stomach is cut, the first step no longer occurs but the second and third steps continue. This shows that secretion of digestive juice in the stomach is controlled by:

(a) nerves
(b) hormones
(c) both nerves and hormones
(d) neither nerves or hormones.

Question 2
You are driving at night when suddenly you see the lights of a car coming straight at you on the wrong side of the road.
Which of the following reactions would be triggered in your body?

(a) the dilation of the pupil of the eye
(b) increase activity of the digestive system
(c) constriction of the blood vessels in the muscles
(d) decrease in the depth and rate of breathing.

Question 3
Researchers compared the survival rates of people subjected to temperatures beyond the normal tolerance range for humans. People whose temperature was raised above normal by 6–7^{o}C for some time almost always died. Those who had been immersed in icy water causing their temperature to decrease by 6–7^{o}C usually survived.

This is because:

(a) the metabolic rate can not keep up with the body requirements at high temperatures due to the denaturation of enzymes
(b) low temperatures reduce the water output and effects of dehydration allowing the body to return to normal quickly
(c) the metabolic rate at high temperatures produces large amounts of wastes that can not be removed therefore producing a toxic effect on cells
(d) heat transfer to a cold person is much more efficient than heat transfer from a hot person.

Question 4
When blood glucose levels change in a normal person, hormones are secreted to return the levels to normal.

Which of the following would not affect the homeostatic control of blood glucose?

(a) high intake of sugary drinks to quench thirst on a hot day
(b) decrease in the amount of insulin caused by a tumour on the pancreas
(c) damage to the pancreatic duct caused by a high fat diet
(d) reduction of blood flow to the pancreas caused by a blood clot.

Question 5
Neurotransmitters work at the neuromuscular junctions and synapses. Anaesthetics work either to block the effect or the production and release of neurotransmitters. Some people claim that they have been 'awake' during surgery despite the use of anaesthetics. The medical attendant is not able to detect if someone is 'awake' under anaesthetics from their monitors and the normal procedures.

The different reactions to anaesthetics could be due to:

(a) the blocking of neurotransmitters in motor neurons, but not sensory neurons
(b) anaesthetics affecting synapses but not the neuromuscular junctions
(c) the peripheral nervous system reacting differently to the anaesthetics than the central nervous system
(d) different types of neurotransmitters in some people do not respond as expected to anaesthetics.

Question 6

For copyright reasons this question cannot be reproduced in the online version of this document.

Question 7
Human evolution shows developments in physical characteristics do not all occur at the same time. Which of the following is supported by evidence from the fossil record?

(a) the S-shaped vertebral column occurred before the development of the flatter face
(b) the sloping forehead was replaced by the flat face
(c) teeth reduced in size before the increase in the cranial capacity
(d) the S-shaped vertebral column developed before the development of the arches in the feet.

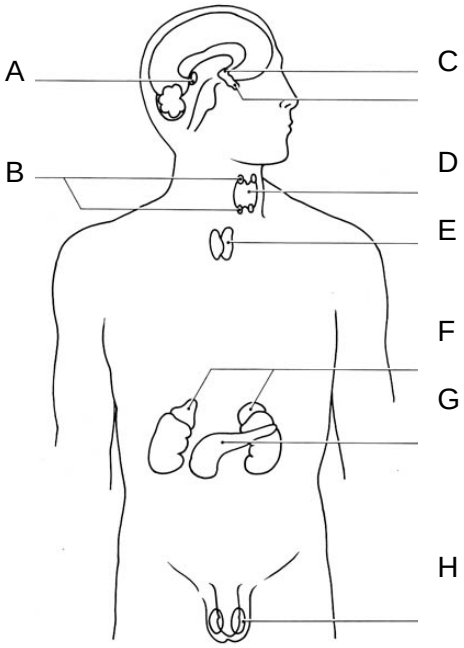
Question 8
A commentator on the radio was overheard saying that the samples of stone tools found at a site in East Africa associated with the earliest Hominin fossils, had been sent for radiocarbon testing.

What is wrong with the commentator's statement?

(a) radiocarbon dating can only be carried out on organic materials not stone tools
(b) the fossils in East Africa are in deposits containing high levels of radioactive materials so this dating technique does not work
(c) the amount of carbon breakdown is not enough to be detected by even the most sensitive instruments
(d) radiocarbon dating is only useful on materials that are older than the fossils found at this site.

This space has been left blank intentionally

In question 9 and 10, refer to the diagram below which shows the location of certain endocrine glands in the human body.



[Adapted from: University of Portsmouth, n.d.]

Question 9
Which of the following is correct?

(a) B and D are essential for normal growth and development
(b) F influences the production of hormones from D
(c) C produces hormones that affect all of the other glands shown in the diagram
(d) G has a feedback affect on C.

Question 10
There are cases where endocrine glands fail to function properly whether due to age, disease or trauma.

Which of the following is true when the gland fails to function?

(a) G causes low blood sugar levels leading to low blood pressure in older women
(b) H reduces urine production causing increased fluid retention in older man
(c) D causes a person to have a low body temperature, a slow heart rate and have a tendency to gain weight
(d) D increases the activity of osteoclasts increasing the release of calcium ions from bone tissue into the blood.

Question 11
Organ transplant patients are given drugs to minimise the rejection of transplanted organs. These drugs work by:

(a) inhibiting the production of enzymes by the transplanted organ that lead to rejection
(b) suppressing the immune response that recognises 'foreign' molecules on the transplanted organs
(c) acting as antibiotics so that bacteria are killed before causing infections in transplanted organs
(d) promoting the repair of the blood vessel connections between the transplanted organ and the host body.

Question 12
In the ABO blood group system a single gene with three alleles determines the antigens a person has on their red blood cells.

I^A and I^B are co-dominant:
I^A —causes production of antigen A
I^B —causes production of antigen B.

i is recessive to both I^A and I^B
i - does not cause production of either antigen A or antigen B.

In one family, each of the four children had a different blood group. Their mother was group A and their father was group B.

Which of the following correctly shows the genotypes of the children's parents?

	Mother's genotype	Father's genotype
(a)	I^AI^A	I^BI^B
(b)	I^AI^B	I^AI^B
(c)	I^Ai	I^Bi
(d)	ii	I^AI^B

[Adapted from: Tertiary Institutions Service Centre, 2007]

Question 13

At the end of a marathon race a runner's body is dehydrated.

How does the body control the two hormones, ADH and aldosterone, to help to re-establish normal water balance?

(a) ADH is released and aldosterone is inhibited.
(b) ADH is inhibited and aldosterone is released.
(c) Both ADH and aldosterone are released.
(d) Both ADH and aldosterone are inhibited.

[From: Board of Studies New South Wales, 2007]

Question 14

For copyright reasons this question and diagram cannot be reproduced in the online version of this document.

[Adapted from: Tertiary Institutions Service Centre, 2003]

Question 15

What chemical in the plasma (cell) membrane forms channels and carriers?

(a) cholesterol
(b) carbohydrate
(c) nucleic acid
(d) protein.

Question 16

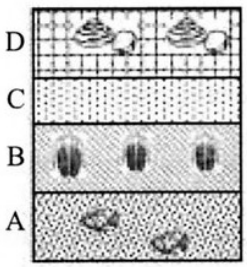
The part of the brain associated with thought and reasoning is the:

(a) cerebellum
(b) medulla oblongata
(c) cerebrum
(d) hypothalamus.

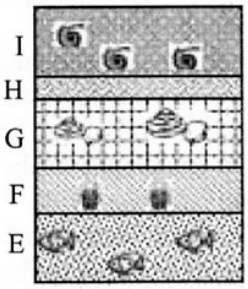
Question 17
The types of joints affected by a person whose left shoulder and neck was damaged in a car accident would be:

(a) synovial, gliding and fibrous
(b) gliding, pivot, synovial and cartilaginous
(c) fibrous, cartilaginous and pivot
(d) synovial and fibrous only.

Question 18
The diagrams below show strata of sedimentary rocks from two different places.



Rock strata from location 1.



Rock strata from location 2.

Based on the sequence of rock strata in the two locations it could be concluded that the fossils in layer:

(a) I are younger than those in layer D
(b) A are younger than those in layer E
(c) B are the same age as those in layer G
(d) F are older than those in layer E.

[Adapted from: Tertiary Institutions Service Centre, 2007]

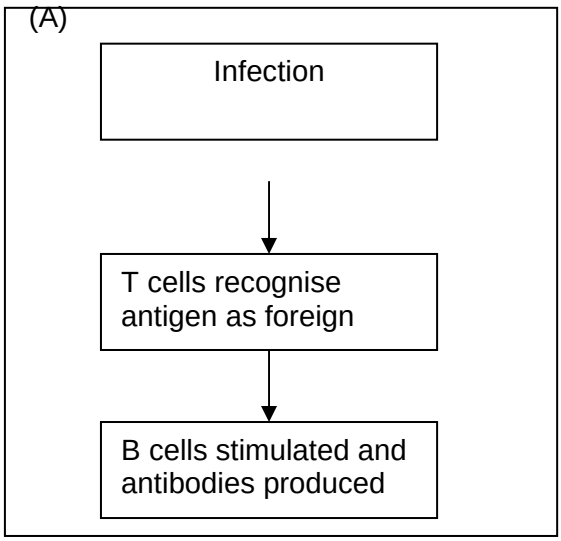
Question 19

For copyright reasons this question cannot be reproduced in the online version of this document.

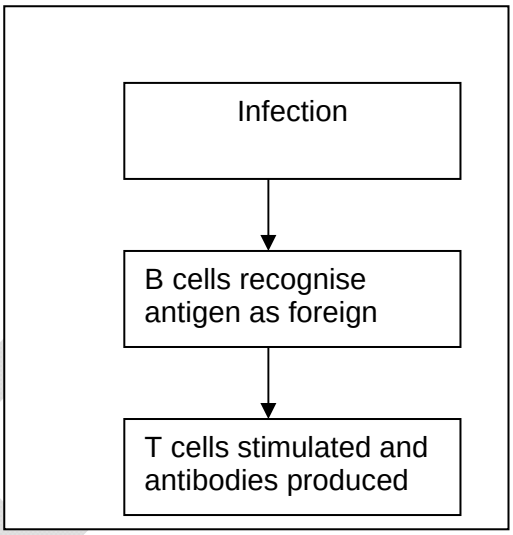
[Adapted from: Tertiary Institutions Service Centre, 2003]

Question 20
Which flow chart correctly shows an interaction between B and T lymphocytes during an immune response ?

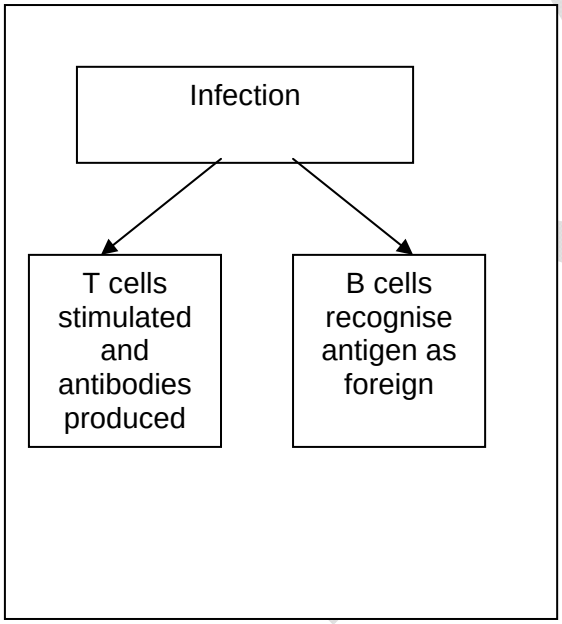
(A)



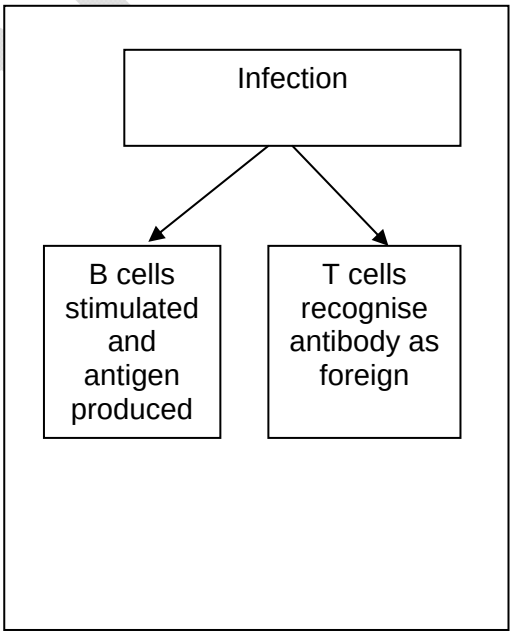
(B)



(C)



(D)



[Adapted from: Board of Studies New South Wales, 2007]

END OF SECTION ONE

SEE NEXT PAGE

Section Two–Short Answer *[100 Marks]*

Answer **ALL** questions in Section Two. Answer in the spaces provided.

Suggested working time: 100 minutes

Question 21

A scientist was investigating the effectiveness of a newly developed drug, *Neurogen* and its ability to improve recovery from nerve cell injury. The experiment was performed as described.

Nerve cells were placed into culture medium (a solution containing nutrients to keep the cells alive and help them grow). An equal number of nerve cells (in culture medium) were transferred into thirty test tubes and maintained under constant temperature and oxygen levels. Ten of the test tubes received no treatment, ten tubes received a large, single dose of *Neurogen* and the remaining ten tubes had a series of smaller doses of *Neurogen* added each week until week 8. The total amount used in the series of small doses was the same as the single large dose. The treatment started at the end of week 2 of the investigation.

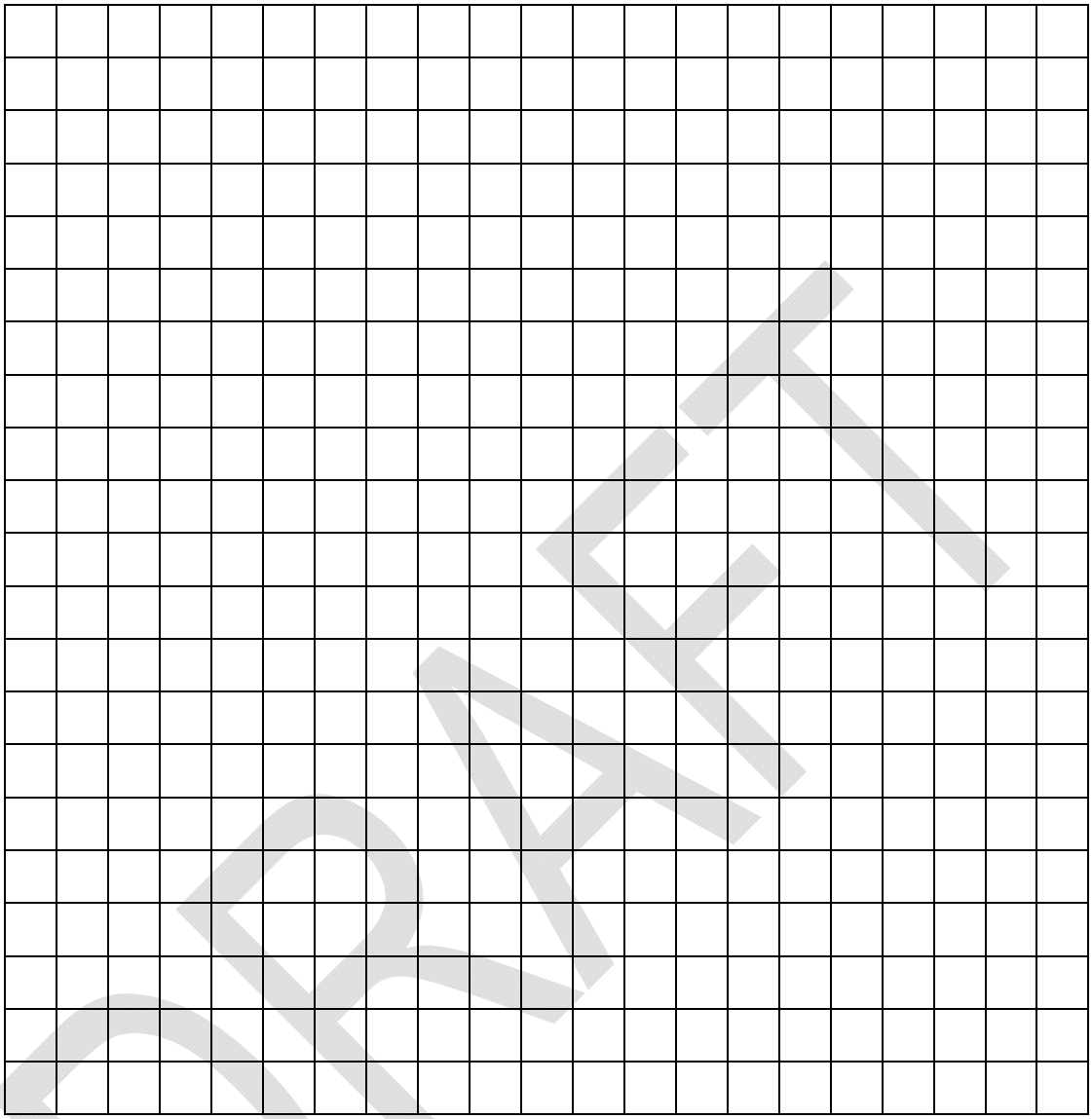
At the end of each week one test tube was selected from each treatment and the growth of nerve axons in the test tubes was measured. The results are shown in the table below.

Table 1: Growth of nerve axons with different treatments

Time (weeks)	Treatment A No treatment	Treatment B Single large dose of Neurogen	Treatment C Series of small doses of Neurogen
0	0.01	0.02	0.01
1	0.04	0.06	0.05
2	0.05	0.07	0.08
3	0.10	0.15	0.21
4	0.12	0.30	0.35
5	0.15	0.45	0.50
6	0.16	0.55	0.65
7	0.18	0.56	0.80
8	0.19	0.58	1.00
9	0.20	0.58	1.15
10	0.21	0.59	1.20

(a) Draw an appropriate graph to represent the results in Table 1.

[5 marks]



(b) State a possible conclusion from this experiment.

[2 marks]

_____

_____

_____

(c) Discuss two (2) possible sources of error in this experiment and make suggestions as to how the reliability of the results could be improved.

[4 marks]

(d) Explain why measurements were taken for two weeks before treatments were given.

[2 marks]

(e) The last dose for treatment C was given at the beginning of week 8. What would be expected to happen to axon growth over the next few weeks? Explain the reasons for your answer.

[4 marks]

Question 22

Human blood-calcium concentrations are under homeostatic control. When the concentration of calcium in the blood begins to fall the parathyroid gland releases parathyroid hormone. This hormone stimulates bone cells called osteoclasts to break down bone and release calcium into the blood.

When the concentration of calcium rises in the blood, specialised cells associated with the thyroid gland release the hormone calcitonin. Calcitonin acts on bone and increases the amount of calcium that is deposited into bone.

(a) In the space below, draw a diagram of the feedback mechanisms described above.

[8 marks]

(b) Research findings have indicated that low oestrogen levels are directly linked to osteoporosis (the loss of calcium and other minerals from the bone), causing a decrease in bone mass. This makes the bones brittle and easy to fracture.

Explain how low oestrogen levels would affect the secretion of calcitonin and parathyroid hormone.

[2 marks]

(c) Describe how daily calcium supplements could help older women reduce the risk of osteoporosis in terms of the flow chart.

[2 marks]

(d) Vitamin A is used to treat some skin conditions and many women use vitamin A preparations to promote 'younger looking skin'. One of the hazards of using vitamin A is that it stimulates the actions of osteoclasts.

Refer to the flow chart and explain how this would affect the blood calcium level.

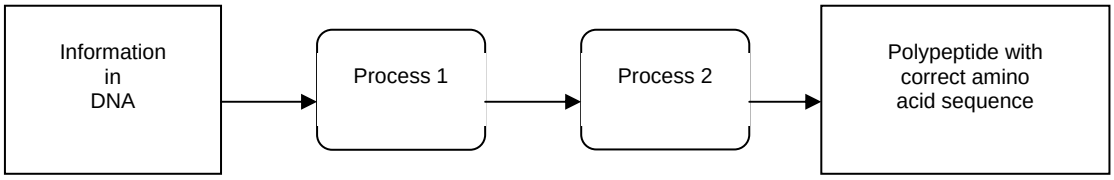
[2 marks]

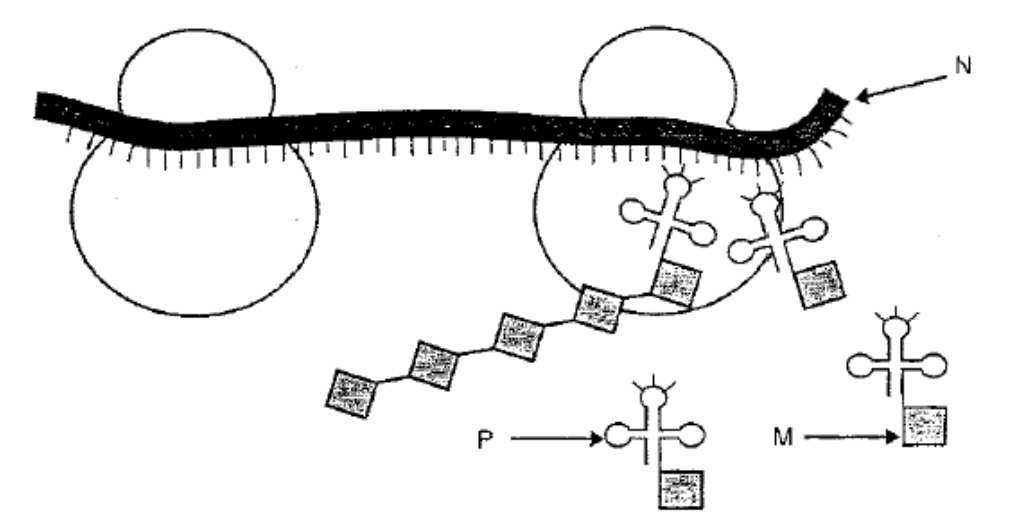
Question 23

[Adapted from: Victorian Curriculum and Assessment Authority, 2004]

For copyright reasons this question and graph cannot be reproduced in the online version of this document, but may be viewed at http://www.vcaa.vic.edu.au/vce/studies/biology/pastexams/biology12002.pdf (p. 16).

Question 24
Refer to the following flow chart showing protein synthesis:





(a) Which process does the above diagram represent? (Process 1 or 2) Name the process.
[2 marks]

_____

(b) Structures P and N in the above diagram are different forms of the same molecule. Identify and name these two structures.
[2 marks]

_____

_____

(c) Describe the functions of P and N in the process named in (a).
[4 marks]

_____

_____

_____

_____

Question 25

In a remarkable experiment conducted in 1775, two men walked into an open brick oven in which the air was dry and had been heated to 127°C. After 20 minutes they emerged unharmed.

(a) Where are the body's thermoreceptors located?

[1 mark]

_____

_____

(b) What two responses to the high temperatures would occur in the skin of the men in the oven?

[2 marks]

_____

_____

(c) The men's breathing rates increased during the time in the oven. Give one reason why this would happen.

[2 marks]

_____

_____

(d) How would dry air have helped the men's survival?

[2 marks]

_____

_____

Question 26
Use the inheritance of ABO blood group to explain each of the following:

(a) Co-dominance

[2 marks]

(b) Recessiveness

[2 marks]

(c) Autosomal inheritance

[2 marks]

(d) Multiple alleles

[2 marks]

Question 27

(a) Populations in different geographical areas appear to have a common hair and skin colour. For example, Asians have predominantly black hair and dark skin. Scandinavians have mainly blond hair and fair skin. Using your understanding of evolutionary mechanisms, explain one way such differences may have arisen in different populations.

[2 marks]

(b) In the 1930s, a scientific research team, following in the footsteps of early European explorers, arrived at an isolated island in the middle of the Pacific Ocean. It was the southernmost island of a widespread chain of islands. Most of the population on this island were Melanesian but had blond hair. This surprised the researchers, as similar populations on the other islands in the chain had the characteristic dark hair common to most Melanesians.

Describe TWO possible genetic mechanisms that could account for the hair colour of the population on the isolated island being different from other Melanesian populations.

[4 marks]

Question 28

Biotechnology now plays an important role in the production of synthetic hormones. Recombinant DNA technology provides the technique currently used to manufacture hormones like human insulin.

For copyright reasons this diagram cannot be reproduced in the online version of this document.

The diagram (left) represents the process of recombinant DNA technology used to produce human insulin.

(a) Name structures A, B, C and D in the table below and state each structure's role in the production of insulin. *[8 marks]*

	Name of structure	Role in recombinant DNA process
A		
B		
C		
D		

(b) What risks and benefits are associated with recombinant DNA technology for a patient requiring insulin?

[4 marks]

Question 29

The following questions refer to a reflex arc.

(a) When the skin is stimulated, such as when burnt by a hot object, people react before they are consciously aware of the pain. Explain why you are unable to consciously control a reflex action.

[2 marks]

(b) Explain why the nerve impulse can travel in only one direction in a reflex arc.

[2 marks]

(c) For copyright reasons this question cannot be reproduced in the online version of this document, but may be viewed at http://www.vcaa.vic.edu.au/vce/studies/biology/pastexams/Biology12003.pdf (p. 16, q. 3c). *[2 marks]*

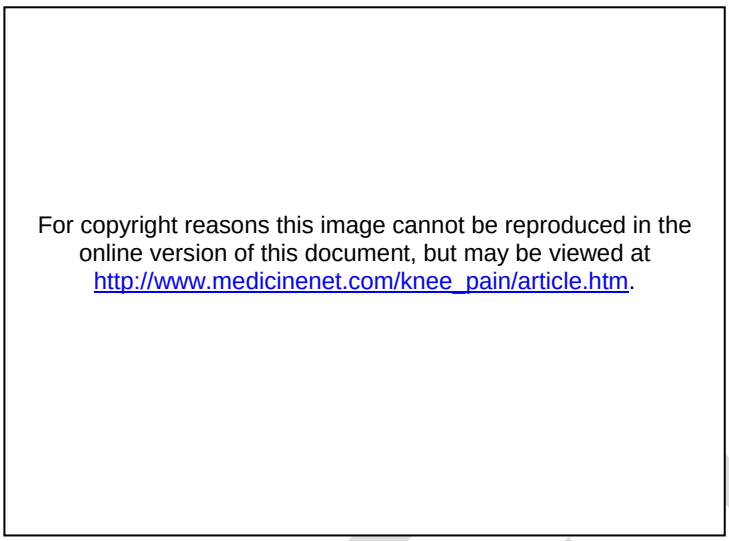
[Adapted from: Victorian Curriculum and Assessment Authority, 2003]

(d) How can ageing affect the myelin sheath and the functioning of the nervous system?

[2 marks]

Question 30 ***12 marks***

Figure 20: Normal knee joint



[Diagram from: MedicineNet Inc., n.d.]

(a) Describe how the structure of the knee joint allows flexion and extension but not rotation.

[2 marks]

(b) Explain how the tissues forming the following structures are suited to their function in the joint.

(i) Tibia:

[2 marks]

(ii) Cruciate ligament:

[2 marks]

(c) Osteoarthritis is the most common joint disorder and by the age of about 70 years affects most people to some degree. Osteoarthritis can begin with abnormal cells in the cartilage that produce collagen. This causes the cartilage to crack, forming tiny cavities in the bone beneath the cartilage.

Explain **three** different possible types of technologies that can be used to treat osteoarthritis.
[6 marks]

END OF SECTION TWO

Section Three––Extended response *[60 marks]*

Answer Question 32 and ONE other question from Question 33, 34 or 35.

Answers can be supported by:
- a flow chart
- well annotated diagrams
- tables
- a well described list of dot points.

Suggested working time: 50 minutes

Question 32 (Compulsory) ***[30 marks]***

A researcher working for a pharmaceutical company developed an anti-inflammatory related compound ('Drug X') which showed promise in the treatment of arthritis. Anti-inflammatory compounds reduce swelling and make movement at arthritic joints easier and less painful. Tests on mice indicated that the compound was far more powerful than other similarly acting arthritis drugs presently on the market.

The pharmaceutical company already has another arthritis drug, '*Arthramat* on the market. The effectiveness of *Arthramat* is limited if not taken at the first signs of immobility and pain in the joints.

(a) Using the above information design an investigation to compare the effectiveness of 'Drug X' and *Arthramat.*

Ensure you consider the following:
- variables
- hypothesis
- pre-testing
- methodology to allow ethical and safe data collection
- measures to achieve reliability and to reduce errors.

The compound was developed from an anti-inflammatory compound found in a flatworm that inhabits the coral reefs in northern Australia. Researchers identified the gene coding for the active protein in the compound. Using biotechnological techniques, a culture of bacteria was developed that produced the protein. The protein was purified and used in the drug tested on arthritic mice.

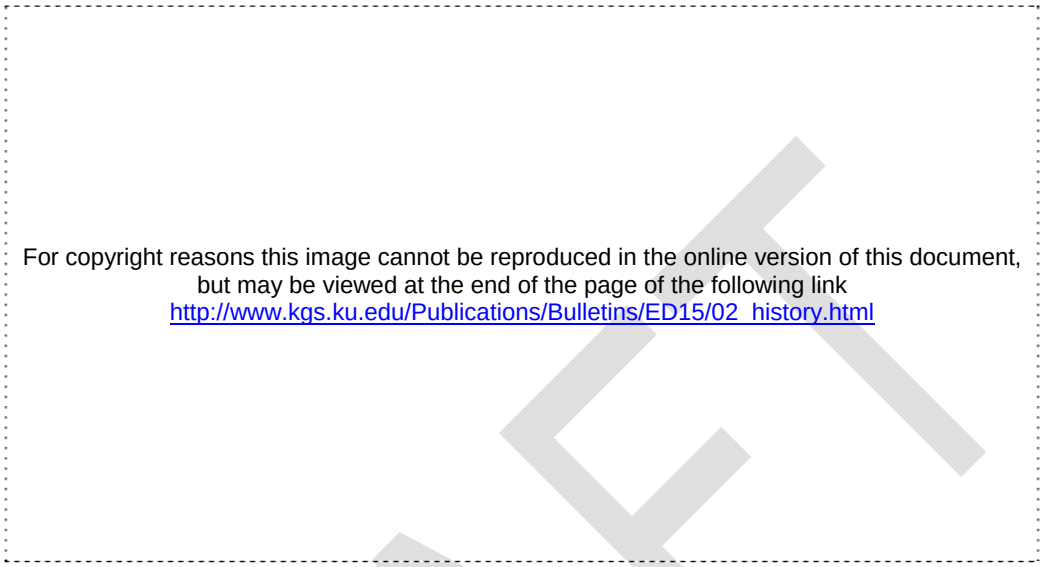
(b) Outline some possible risks, ethical issues, and benefits of using this new drug in the treatment of arthritis in humans.

Choose ONE question only from Questions 33, 34 or 35.

Question 33 ***[30 marks]***

The skulls below show the evolutionary sequence of hominin skulls from the oldest, *A. afarensis* to the current, *H. sapiens*.

Figure 20 Hominin skulls



[Image from: Hennings, 1999]

(a) Identify five evolutionary physical changes that are evident from the diagram when the skulls are compared. Suggest ONE reason for each change.

[10 marks]

(b) Describe 4 cultural evolutionary changes that resulted from the development of the hominins represented above.

[8 marks]

(c) List and describe 2 techniques that scientists would have used to assist them in differentiating and classifying these fossil skulls.

[12 marks]

OR

Question 34 ***[30 marks]***

Ageing in humans is associated with changing functions of the musculoskeletal and nervous systems.

(a) Outline medical technologies used in the treatment of the changing functions caused by ageing in either the:

[20 marks]

i **musculoskeletal system**
(refer to treatments of osteoporosis and osteoarthritis)

OR

ii **nervous system**
(refer to Parkinson's disease and Alzheimer's disease)

(b) Select one medical technology outlined to state ethical issues, risks, and benefits to the patient.

[10 marks]

OR

Question 35 ***[30 marks]***

Through recent advancements in human biology, specific resistance mechanisms of the body can be stimulated by the use of vaccines that are produced artificially. Also enhancing the body's defence are artificially produced (monoclonal) antibodies that can provide treatment for infections and cancer and for the prevention of tissue rejection after transplantation.

(a) Vaccines promote two different types of immunity—passive and active.
Explain the differences in the body's response to the two different types of immunity.

[10 marks]

(b) Outline the processes involved in the production of monoclonal antibodies

[10 marks]

(c) What are the risks and benefits of using monoclonal antibodies for individuals and populations?

[10 marks]

Tick to indicate the question you have chosen to answer :

33	
34	
35	

SEE NEXT PAGE

SEE NEXT PAGE

END OF PAPER

ACKNOWLEDGEMENTS

SECTION ONE

Question 6 Adapted from: Tertiary Institutions Service Centre. (2003). *Western Australian Universities' Foundation Program examination: Human Biology 2003*. East Perth, WA: Tertiary Institutions Service Centre, p. 4.

Questions 9 & 10 Diagram adapted from: University of Portsmouth. (n.d.). *Endocrine system: Key diagram: Male*. Retrieved September, 2007, from http://www.sci.port.ac.uk/rad/anatomy/012/001.htm.

Question 12 Adapted from: Tertiary Institutions Service Centre. (2007). *Western Australian Universities' Foundation Program examination: Human Biology 2007*. East Perth, WA: Tertiary Institutions Service Centre, p. 11.

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