Student Number

Exam Choice

2010

TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your student number in the space provided

Total marks – 100

Section I Pages 2 - 23

75 marks
This section has two parts, Part A and Part B

Part A – 20 marks
- Attempt Questions 1-20
- Allow about 35 minutes for this part

Part B – 55 marks
- Attempt Questions 21-30
- Allow about 1 hour and 40 minutes for this part

Section II Pages 25 - 31

25 marks
- Attempt **ONE** Question from Questions 31-35
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 20 marks
Attempt Questions 1-20
Allow about 35 minutes for this part

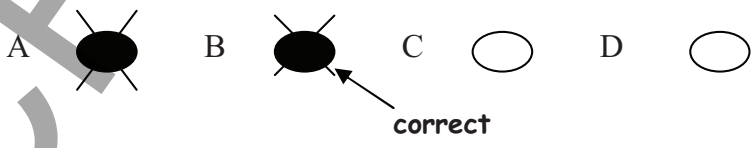
Use the multiple-choice answer sheet.

Select the alternative A,B,C or D that best answers the question. Fill in the response oval completely.

Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

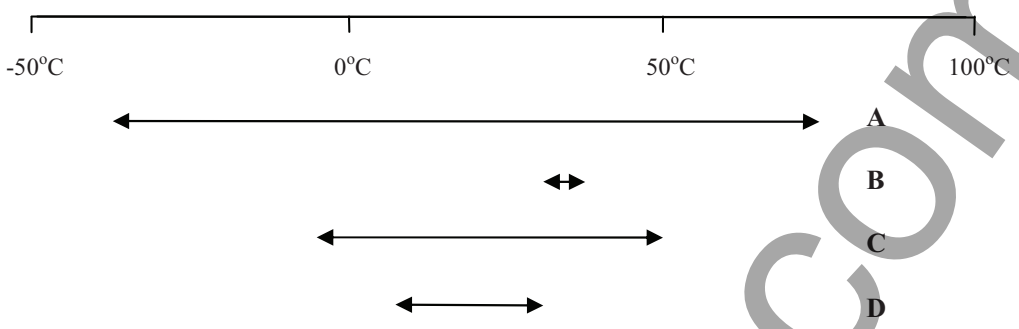
If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



1. Life on Earth can survive over a wide range of environmental temperatures, from frozen ice caps to boiling hot springs.

Individual species, however have more limited ranges.



Which arrow above represents the environmental temperature range that humans can survive in?

(A) A

(B) B

(C) C

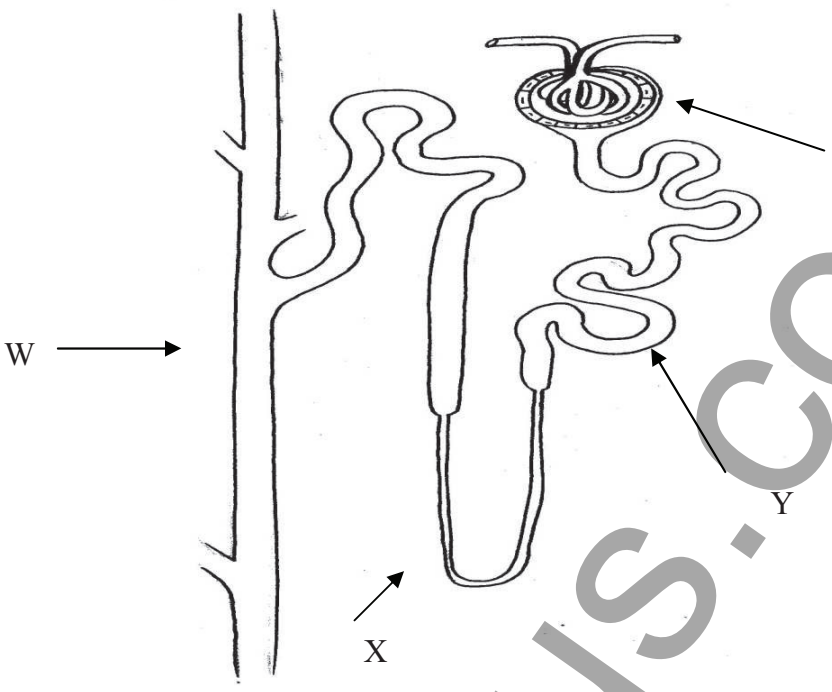
(D) D

2. Many useful products are obtained from donated blood.

Choose the line which correctly matches the products with their uses.

	Plasma	**Red blood cells**	**Platelets**
(A)	To increase the clotting ability of the blood	To increase the immune response against pathogens.	To restore blood volume after injury.
(B)	To boost oxygen carrying capacity of the blood.	To restore blood volume after injury.	To increase the immune response against pathogens.
(C)	To restore blood volume after injury.	To boost oxygen carrying capacity of the blood.	To increase the clotting ability of the blood
(D)	To increase the immune response against pathogens.	To increase the clotting ability of the blood	To boost oxygen carrying capacity of the blood.

3. The diagram below shows a nephron from a mammalian kidney.



Identify the part which is targeted by ADH

(A) W

(B) X

(C) Y

(D) Z

4. Humans produce urea as their main nitrogenous waste.

Which statement below best summarises why it is advantageous for humans to excrete urea, as opposed to any other nitrogenous waste?

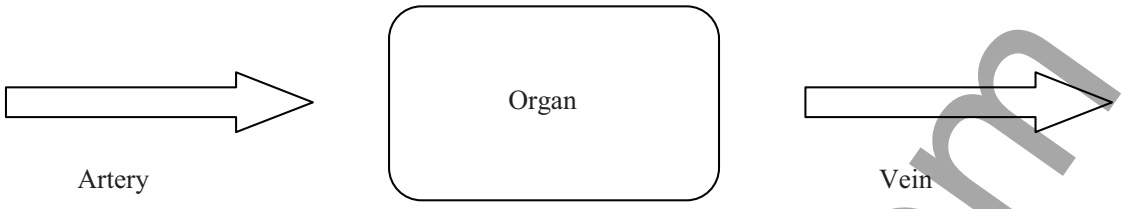
(A) Urea requires no energy to produce and no water to excrete.

(B) Urea is highly toxic and requires a lot of water to excrete, but is the 'cheapest' nitrogenous waste to produce in terms of energy.

(C) Urea requires a lot of energy to produce, but very little water to excrete.

(D) Urea requires moderate amounts of energy to produce and moderate amounts of water to excrete.

5. Samples of blood were taken from the artery flowing into an organ, and from the vein flowing from it.



Relative levels of some dissolved substances found in the blood samples are given in the table below.

	Artery	**Vein**
Bicarbonate ions	***low***	***high***
Glucose	***low***	***high***

Identify the organ.

(A) lungs

(B) small intestine

(C) kidney

(D) brain

6. Which one of the following responses might you expect an ectotherm to make to low temperatures?

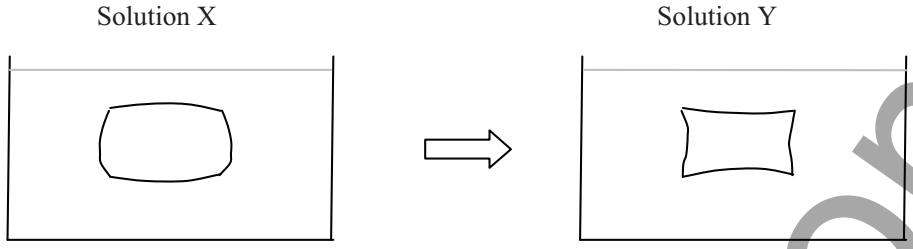
(A) Lie in the sun to absorb heat.

(B) Shiver to generate body heat through muscular activity.

(C) Constrict peripheral blood vessels to minimise heat loss.

(D) Raise fur to trap heat.

7. The diagram below represents a unicellular organism which has been moved from one solution to another.



Which one of the following offers the best explanation for what has happened?

(A) Solution Y is more concentrated than X. The cell has lost water by osmosis.

(B) Solution Y is less concentrated than X. The cell has lost water by osmosis.

(C) Solution Y is more concentrated than X. The cell has lost salts by diffusion.

(D) Solution Y is less concentrated than X. The cell has lost salts by diffusion.

8. In pea plants, tall stems (T) are dominant over short stems (t).

Which one of the punnet squares below shows a cross between a tall and a short pea plant?

(A)

	T	**T**
T	*TT*	*TT*
t	*Tt*	*Tt*

(B)

	T	**t**
t	*Tt*	*tt*
t	*Tt*	*tt*

(C)

	T	**t**
T	*TT*	*Tt*
t	*Tt*	*tt*

(D)

	t	**t**
t	*tt*	*tt*
t	*tt*	*tt*

9. Erwin Chargaff was a scientist whose findings were of great importance in developing a model of the structure of DNA.

He put forward Chargaff's rule, which says that while the amounts of the bases differs between sections of DNA, the ratio of Adenine to Thymine is always 1:1, as is the ratio of Cytosine to Guanine.

What aspect of the structure of DNA did this reveal to Watson and Crick?

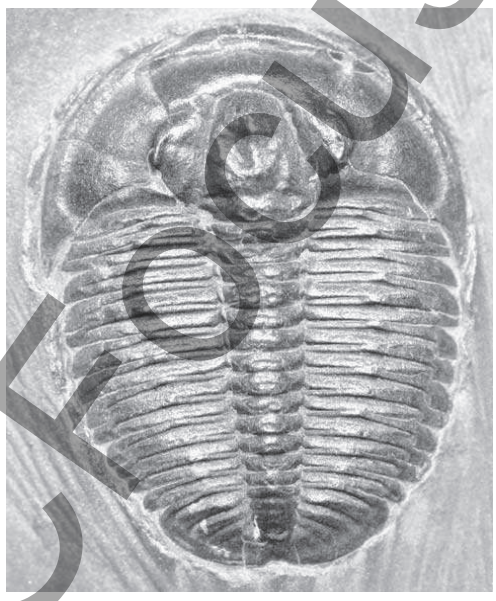
(A) Its helical shape.

(B) The distance between its two chains.

(C) Its X-ray crystal shape.

(D) The complementary nature of its bases.

10. The photograph below is of a fossil trilobite, an extinct invertebrate.



The fossil record of trilobites shows that species remain essentially the same for millions of years until they are 'suddenly' replaced by new species.

There is a lack of trilobite fossils which show transition between the different species.

Which one of the following mechanisms are these observations most consistent with?

(A) Punctuated equilibrium

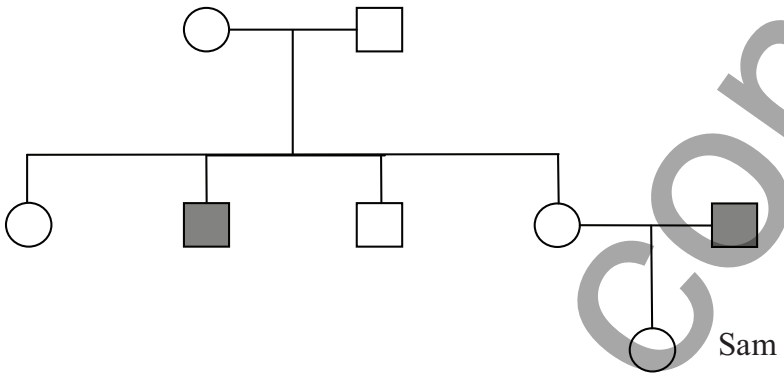
(B) Adaptive radiation

(C) Convergent evolution

(D) Divergent evolution

11. The pedigree diagram below shows the inheritance of a sex-linked characteristic in a family.

Males are denoted by squares and females by circles; sufferers are shaded.



The allele for the characteristic (X^n) is carried on the X chromosome.

What is Sam's genotype?

(A) $X^n X^n$

(B) $X^N X^n$

(C) $X^N X^N$

(D) $X^N Y$

12. Which one of the following could result in a change to a population by natural selection?

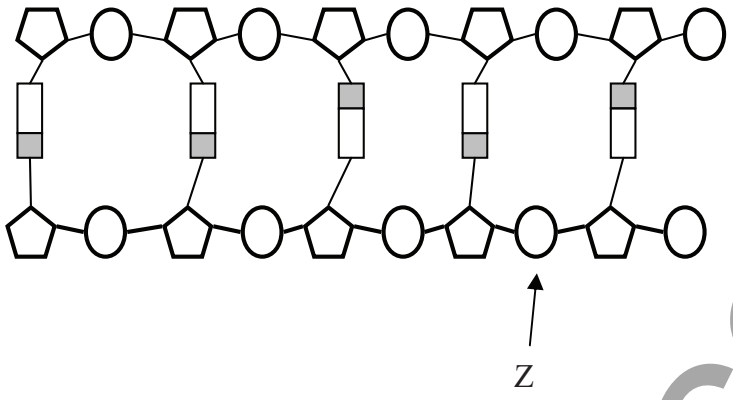
(A) A cyclone destroys 95% of a cloned population of banana plants.

(B) A disease arises in kangaroos which only affects individuals who are beyond their reproductive years.

(C) A predatory fish with good eyesight is introduced into the habitat of a species of fish which has a variety of colour types.

(D) A flood indiscriminately kills all the individuals in a population who just happen to be on low ground at the time.

13. The diagram below represents part of a DNA molecule.



Identify the component labelled Z.

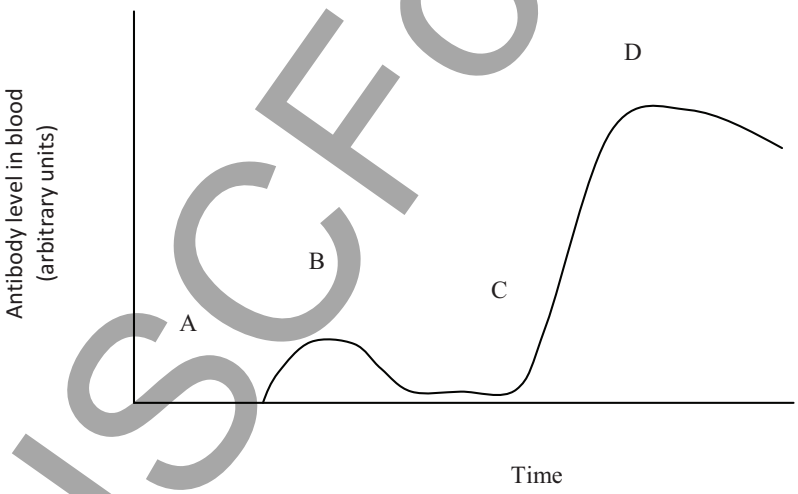
(A) Phosphate

(B) Nucleotide

(C) Base

(D) Sugar

14. The graph below illustrates the primary and secondary immune response.



At which point is the second dose of antigen received?

(A) A

(B) B

(C) C

(D) D

15. Choose the row of the table below which correctly compares the structure of the three types of pathogens listed.

	protozoan	bacterium	fungus
(A)	No distinct nucleus. Single chromosome floating in cytoplasm.	Distinct nucleus. Membrane bound organelles. Cell wall.	Consisting of just nucleic acid held inside a protein coat.
(B)	Distinct nucleus. Membrane bound organelles. Cell wall.	Consisting of just nucleic acid held inside a protein coat.	Distinct nucleus Membrane bound organelles. No cell wall.
(C)	Distinct nucleus Membrane bound organelles. No cell wall.	No distinct nucleus. Single chromosome floating in cytoplasm.	Distinct nucleus. Membrane bound organelles. Cell wall.
(D)	Consisting of just nucleic acid held inside a protein coat.	Distinct nucleus Membrane bound organelles. No cell wall.	No distinct nucleus. Single chromosome floating in cytoplasm.

16. Which one of the following is the best reason to limit your intake of antibiotics?

(A) You might develop immunity to the antibiotic.

(B) The antibiotic might cause an imbalance in your normal bacterial microflora.

(C) Some people are allergic to antibiotics.

(D) Antibiotics are ineffective against viruses.

17. Which one of the following defence adaptations relies upon the release of histamine to stimulate blood flow to the area and encourage flow of fluid from the capillaries into the tissues?

(A) inflammation response

(B) phagocytosis

(C) lymph system

(D) cell death to seal off pathogen

18. A healthy person is someone who:

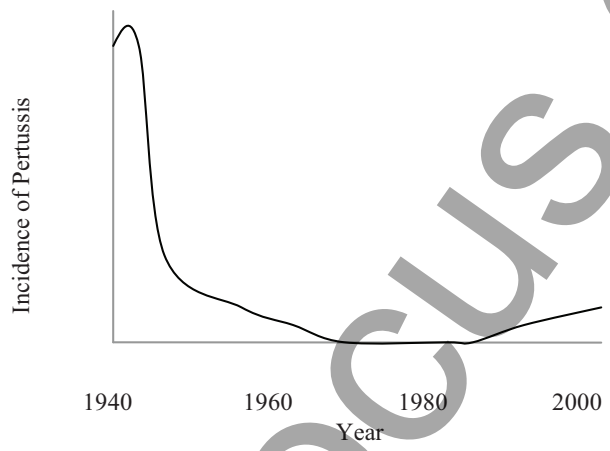
(A) has a strong immune system.

(B) eats a balanced diet, avoiding substances which are harmful in excess.

(C) functions well physically, emotionally and spiritually.

(D) is free of disease.

19. Examine the graph below, which shows the incidence of the disease ***Pertussis*** (Whooping Cough) in developed countries, since 1940.



In which decade did mass vaccination against ***Pertussis*** begin?

(A) 1930's

(B) 1940's

(C) 1950's

(D) 1980's

20. An antibody is:

(A) anything which stimulates an immune response.

(B) a micro-organism which causes disease.

(C) a medication which targets bacteria.

(D) a protein made by plasma cells.

Section I (continued)

Part B – 55 marks
Attempt Questions 21 - 30
Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 21 (3 marks)

Swine flu, caused by the H1N1 virus, has concerned health authorities around the world since it first appeared in 2009.

In Australia, a number of public health strategies were discussed, and some were implemented.

Complete the table below to explain how each of these strategies would help to reduce the spread of the virus. **3**

Public Health Measure	How it reduces the spread of the virus.
Quarantine checks at airports and other points of entry.	
Closing sports grounds, theatres and other venues where large numbers of people meet	
Mass vaccination.	

Marks

Question 22 (8 marks)

There are many homeostatic mechanisms operating within the body. One of these controls blood glucose levels.

The normal blood glucose level is 90mg of glucose / 100mL of blood. Receptors in the pancreas detect deviations from this level and stimulate the release of one of two hormones.

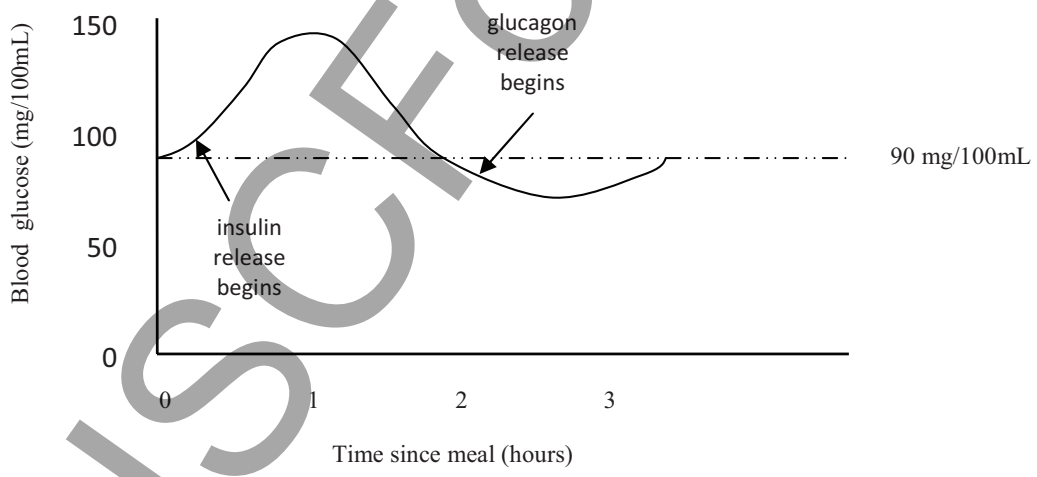
Insulin is secreted by β cells in the pancreas. It moves glucose out of the blood and into the tissues, where it can be used in respiration or stored as glycogen.

Insulin lowers blood glucose levels.

Glucagon is secreted by α cells in the pancreas. It stimulates the breakdown of glycogen in the liver to make glucose, and the release of this glucose into the blood.

Glucagon raises blood glucose levels.

The graph below shows how blood glucose levels can vary after eating a meal.



(a) Identify the stimulus for the release of glucagon. **1**

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Question 22 continues on page 14.

Marks

Question 22 (continued)

(b) Show how the control of blood glucose levels is an example of negative feedback. **3**

(c) Type I diabetes is an example of an autoimmune disease.

The immune system attacks the β cells of the pancreas, preventing insulin production.

Describe the normal immune response to foreign cells and explain how the response which causes type I diabetes is a malfunction. **4**

(N.B. The β cells of the pancreas and the B lymphocytes of the immune system are completely different cells, and should not be confused.)

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Marks

Question 23 (6 marks)

Outline the major steps in the development of our knowledge about the causes of malaria, and assess the extent to which it was made possible by the earlier work of Pasteur and Koch. **6**

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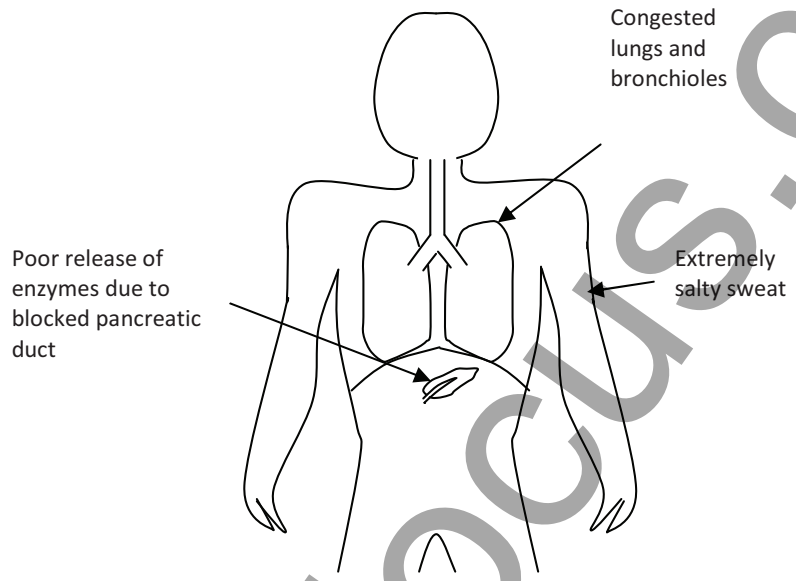
Marks

Question 24 (6 marks)

Cystic fibrosis (CF) is a common inherited disease.

Sufferers are unable to produce an enzyme which has a role in the transport of materials across membranes in the body. This leads to an imbalance of chloride ions across these membranes, resulting in a build up of thick mucus.

Some effects of CF are shown below.



(a) Describe one symptom that CF sufferers might show as a result of one of the effects shown above. **1**

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(b) CF sufferers experience an excessive build up of mucus on their mucous membranes. Outline the defensive role of mucus in healthy individuals. **1**

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Question 24 continues on page 17

Marks

Question 24 (continued)

(c) CF is caused by a recessive allele. Another inherited disorder, Huntington's disease, is caused by a dominant allele and severely affects the nervous system.

Using appropriate diagrams and symbols, explain why these two diseases would have different patterns of inheritance within a family. **4**

Question 25 (3 marks)

Enzymes have very specific requirements for effective function.

Complete the table below to describe how each factor affects enzyme function. **3**

Factor	Effect on enzyme function
Temperature	
pH	
Substrate concentration	

Marks

Question 26 (5 marks)

Recent press reports have highlighted 'cancer clusters' in the Hunter Valley of NSW. Groups of people, living in the same neighbourhood, have developed various cancers.

Local doctors have questioned whether there might be a local reason for this, and some people have pointed to exposure to dust from nearby coal mines as a possible cause.

Describe an epidemiological study that could be conducted to try to discover whether there is a local cause. **5**

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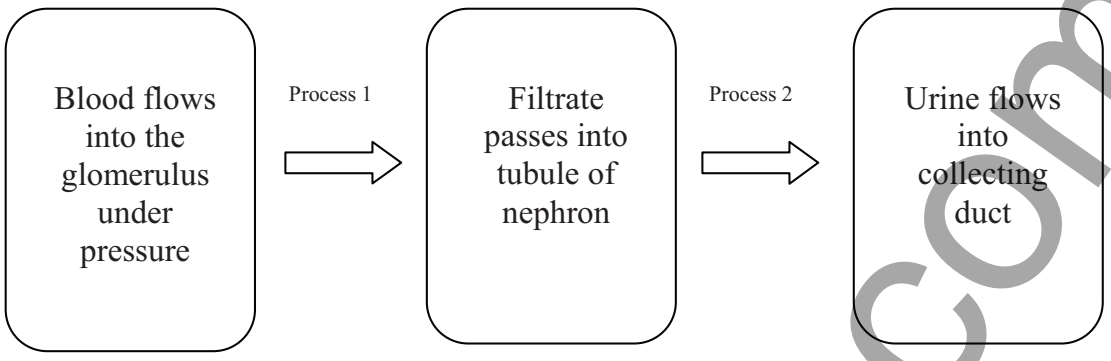
Marks

Question 27 (4 marks)

The diagram below summarises the function of the nephron of the kidney.



(a) Identify the two processes and complete the table below. **3**

	Name of Process	**Description of Process**
Process 1		
Process 2		

(b) Identify one difference in composition between blood flowing into the kidney and blood leaving the kidney. **1**

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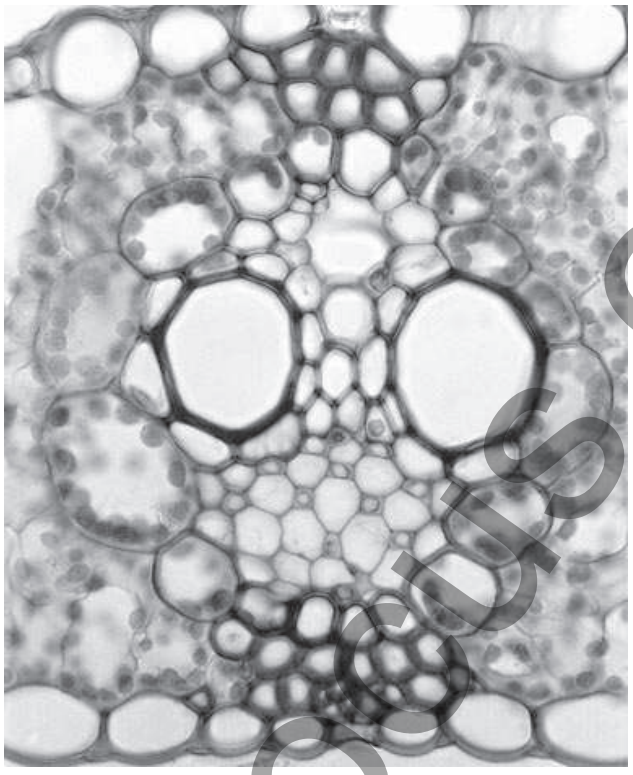
Marks

Question 28 (4 marks)

The photomicrograph below shows a transverse section through the vascular bundle of a plant.



(a) Label the xylem and phloem on this photomicrograph. **1**

(b) Outline one current theory to explain how materials are transported in the phloem. **3**

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Marks

Question 29 (9 marks)

Read the article below about Bt crops.

> Bt crops have been produced by extracting genetic material from a bacterium, *Bacillus thuringiensis*, and inserting it into the DNA of various crop plants. The bacterial genes make the crop plants inedible to insect pests, greatly reducing the need for pesticides.
> So far, Bt strains of cotton, maize, potatoes and several other commercially important crops have been developed.

> The bacterium *Bacillus thuringiensis* was first discovered in 1901 and its toxic proteins were extracted and used as an insecticide in the 1920's.
> The first genetically modified Bt plants, Bt cotton, were produced in 1985.

> Problems with Bt use.
> Insect pests typically evolve resistance to conventional pesticides and can be expected to eventually do the same with Bt crops.

Sources: www.bio.davidson.edu *and Wikepedia*

(a) Identify the type of compound which is toxic to insects in Bt plants. **1**

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(b) Explain how insect pests might evolve a resistance to Bt. **2**

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Question 29 continues on page 22

Marks

Question 29 (continued)

(c) Assess the implications of the development of Bt crops for society and the environment. **4**

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(d) Explain why some people object to developments of this sort on ethical grounds. **2**

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Marks

Question 30 (7 marks)

Interpretation of evidence from DNA analysis, supported by geological evidence, has led some biologists to believe that the human population fell to between 3,000 and 10,000 individuals about 75,000 years ago.

The six billion humans on Earth today show great phenotypic diversity (variety), and yet they are all descended from this small group of survivors.

Assess the roles of mutation, meiosis, sexual reproduction and natural selection in contributing to this diversity. **7**

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Section II

25 marks
Attempt ONE question from Questions 31-35
Allow about 45 minutes for this section

Answer in a writing booklet. Extra writing booklets are available.

Pages

Question 31 Communication …… 26-27

Question 32 Biotechnology ……..28

Question 33 Genetics: The Code Broken? ……...29

Question 34 The Human Story ……30

Question 35 Biochemistry ……31

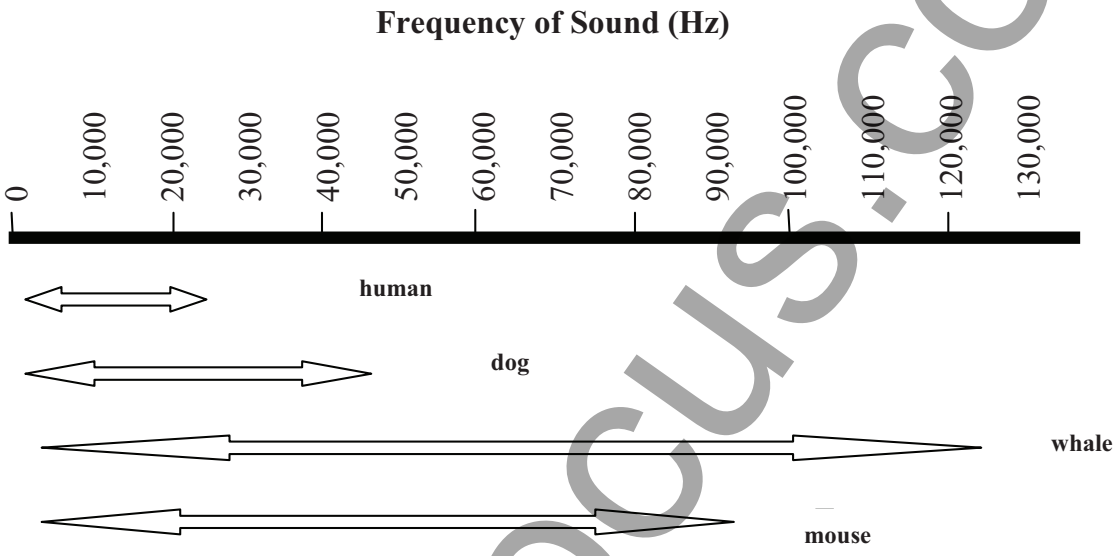
Marks

Question 31 --- Communication (25 marks)

(a) i. Name the type of cell which transmits a nervous impulse. **1**

ii. Explain why not all stimuli generate a nervous impulse. **3**

(b) The diagram below compares the auditory range of four species of mammal.



i Account for the differences between the range of humans and one other of the animals shown here, in terms of their requirements. **2**

ii. Compare the method used by humans to produce sound with those of a named insect. **3**

iii. Explain how the structure of the human ear drum is related to its function. **2**

Question 31 continues on page 27.

Question 31 (continued)

(c) Australian researchers have developed a prototype of a 'bionic eye' which is intended for general release in 2013. It consists of a camera mounted on a pair of glasses which sends information to a processor, which can be in the wearer's pocket. A wire then leads directly from the processor, into the eye and is implanted in the retina.

Part of the press release of Bionic Vision Australia reads:

> *"The device.....captures visual input and transforms it into electrical signals that directly stimulate surviving neurons in the retina. The implant will enable recipients to receive 98 points of light in the visual field which the brain can then reconstruct into an image."*

The bionic eye is often described as the visual equivalent of the cochlear implant.

Compare these two devices in terms of their methods of action, their effectiveness as substitutes for normal vision or hearing and their implications for society. **7**

(d) Hyperopia and myopia are conditions that arise as a result of parts of the eye not functioning optimally.

i. Describe how this less than optimal functioning leads to each condition. **3**

ii. Using diagrams, show how lenses can be used to correct both myopia and hyperopia. **4**

Marks

Question 32 --- Biotechnology (25 marks)

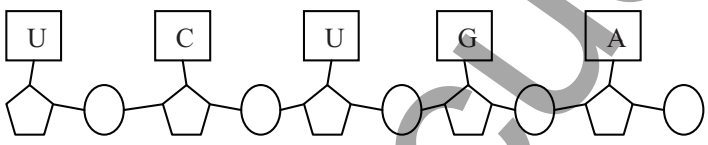
(a) i. Explain why selective breeding can be regarded as a form of biotechnology. **2**

ii. Outline some of the key events that led to the use of yeast for alcohol production. **2**

iii. Biotechnology is a field which attracts much debate on ethics. **3**

Outline the main ethical arguments for and against a named biotechnology.

(b) The diagram below shows a section of mRNA



i. Give the base sequence of the template strand of the DNA molecule from which it has been transcribed. **1**

ii. Outline the roles of mRNA and tRNA, and explain the significance of their base sequences. **4**

(c) "New technologies arise from advances in scientific knowledge."

Discuss this statement with reference to advances in industrial fermentation processes. **7**

(d) i. Outline the procedures involved in transferring genetic material to a bacterial host. **3**

ii. Discuss the use of DNA vectors in the production of multicellular transgenic organisms. **3**

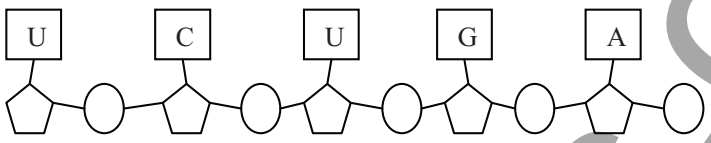
Marks

Question 33 --- Genetics, The Code Broken? (25 marks)

(a) i. Explain what is meant by gene linkage. **1**

ii. Explain why a frame shift mutation is more likely to disrupt gene function than a base substitution. **4**

(b) The diagram below shows a section of a messenger RNA molecule.



i. Give the sequence of bases on the template strand of DNA from which this mRNA molecule was transcribed. **1**

ii. Describe the role of mRNA in gene expression. **2**

iii. Describe how DNA can repair itself. **3**

(c) "All advances in Science rely upon the work of past scientists."

With reference to TWO modern advances in genetic technology show how these technologies have been made possible by previous developments or discoveries. **7**

(d) i. Explain how two parents of blood group A and B respectively can produce a child with blood group O. **3**

ii Name an example of a characteristic which is under polygenic control and explain why such characteristics show a gradation of phenotypes, rather than a few distinctly different phenotypes. **4**

Marks

Question 34 --- The Human Story (25 marks)

(a) i. Name the species considered by most authorities to be the first member of the genus *Homo*. **1**

ii. Explain how the work of a named scientist has increased our knowledge of human evolution. **4**

(b) The diagram below shows a spider monkey. Spider monkeys are forest dwelling monkeys, native to South America.

i. Outline TWO primate characteristics that it shows. **2**

ii. Draw up a table to compare the spider monkey, a typical prosimian such as a lemur, and a human, in terms of hand/foot structure, shape of head, and stance. **4**

(c) Human evolution and cultural development are interrelated. Advances in one trigger advances in the other.

Discuss this statement as it applies to specific advances. Refer to both past effects, and potential future effects in your answer. **7**

(d) i. Explain why analysis of mitochondrial DNA reveals information about human evolution that analysis of chromosomal DNA would not. **2**

ii. There is far greater genetic diversity within the human species than there is within any of our close great ape relatives. Explain why, giving at least TWO good reasons. **3**

iii. Anthropologists use both relative and absolute methods of dating fossils. Describe one of each. **2**

Marks

Question 35 --- Biochemistry (25 marks)

(a) i. Give the average size of a chloroplast. **1**

ii. Draw a chloroplast and label the sites of light absorption and the Calvin cycle. **4**

(b) i. Describe the techniques of homogenisation and centrifugation and assess their importance as research tools in biochemistry. **4**

ii. Explain how it was shown that the oxygen released by photosynthesis originates from water. **3**

(c) "All advances in Science rely upon the work of past scientists." **7**

Discuss this statement as it applies to the field of biochemistry.
Refer to the work of at least three scientists in your answer.

(d) i. Explain how the structure of ATP allows it to perform its role in biological reactions. **3**

ii. Outline the role of ATP in the light reactions of photosynthesis. **3**