Student Number

Exam Choice

2009

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 - 22

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

Part A – 15 marks
- Attempt Questions 1-15
- Allow about 30 minutes for this part

Part B – 60 marks
- Attempt Questions 16-27
- Allow about 1 hour and 45 minutes for this part

Section II Pages 23 - 28

25 marks
- Attempt **ONE** Question from Questions 28 - 32
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 15 marks
Attempt Questions 1-15
Allow about 30 minutes for this part

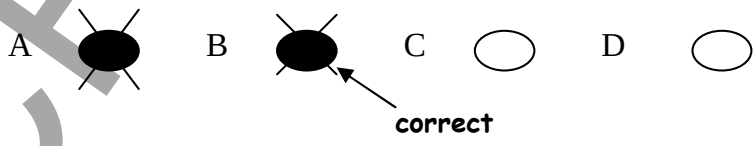
Use the multiple-choice answer sheet.

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. The equation below represents an enzyme mediated reaction.

$$\text{lactose} \xrightarrow{\text{lactase}} \text{galactose + glucose}$$

Which one of the following represents the substrate(s)?

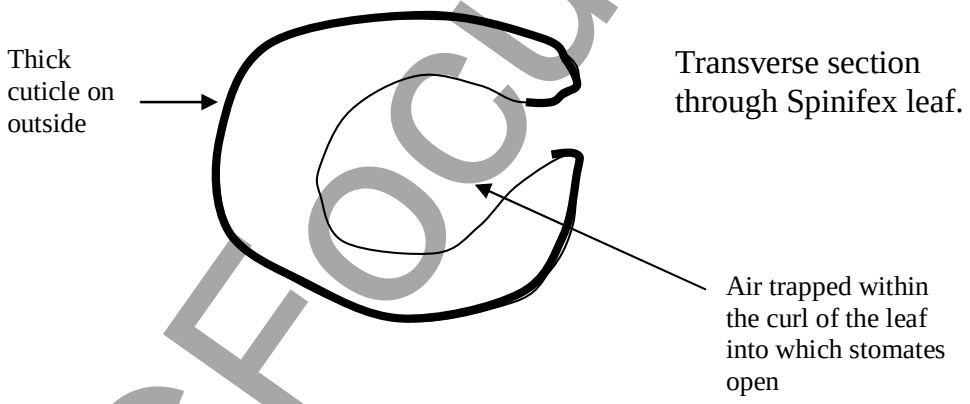
(A) lactose

(B) lactase

(C) galactose and glucose

(D) lactose, galactose and glucose

2. Desert grasses, such as Spinifex, have leaves which are curled. They have thick cuticle on the outside surface and their stomates open into the air space created by the curling of the leaf.



The curled leaf is an adaptive feature which helps to conserve water. Which one of the following explains how it does this?

(A) Curling increases the surface area of the leaf, reducing water loss by evaporation from the stomates.

(B) Water vapour from the air is trapped inside the leaf, condenses and is absorbed.

(C) The air inside the curl is more humid than outside air, reducing water loss by evaporation from the stomates,

(D) Stomates inside the curl are shaded from sunlight, preventing them from opening widely and conserving water.

3. Humans and whales differ in their ability to excrete salt in their urine. The table below shows the volume of urine that each would need to produce to excrete the salt in a litre of sea water (35g)

	Volume of urine needed to excrete 35g of NaCl. (mL)
Human Whale	1350 650

Which one of the following statements is true?

(A) Whale urine is more concentrated than human urine.

(B) Whales store salt, rather than excrete it.

(C) Whale urine is more dilute than human urine.

(D) Whales must need less salt than humans.

4. The table below summarises the ways in which three Australian animals respond to environmental temperatures

Animal	Response to cold temperatures	Response to hot temperatures
X	Shivering to generate heat	Sweating to lose heat by evaporation
Y	Lying in the sun to absorb heat	Moving into the shade to reduce absorption of heat
Z	Vasoconstriction to reduce heat loss by radiation	Vasodilation to encourage heat loss by radiation.

X, Y and Z are most likely to be respectively:

(A) ectotherm, endotherm, endotherm.

(B) endotherm, ectotherm, endotherm.

(C) endotherm, endotherm, endotherm.

(D) endotherm, ectotherm, ectotherm.

5. Which one of the following correctly lists the forms in which carbon dioxide, lipids and oxygen are carried in the blood?

(A) carbonate ions, fatty acids, haemoglobin

(B) hydrogen carbonate ions, fatty acids and glycerol, oxyhaemoglobin.

(C) carbonic acid, cholesterol, oxyhaemoglobin.

(D) carbonate ions, glycerol, haemoglobin.

6. Stomates are structures found on the leaves of ferns, coniferous plants and flowering plants. Their structure and mode of action is very similar in all of these groups

They control water loss from the leaf and the movement of gases between the outside of the plant and air spaces within the leaf.

The presence of stomates in all these groups is a result of:

(A) common ancestry.

(B) convergent evolution

(C) divergent evolution

(D) adaptive radiation

7. Artificial insemination is a modern reproductive technology that is widely used in agriculture.

The sperm of a selected animal is collected and used to fertilise a large number of females.

Which one of the following is the main advantage to farmers of this technology?

(A) It reduces the genetic diversity in an agricultural species.

(B) It ensures that all offspring are identical to the high quality male.

(C) It can allow for the production of more vigorous offspring by mixing sperm from several different males.

(D) It allows for the production of offspring with desired characteristics.

8. In his book 'Darwin's Island', Steve Jones points out that 20% of the men of North West Ireland have identical Y chromosomes. This is evidence that they are all descended from the same male ancestor, and Jones names a fifth century warlord, 'Niall the Hostage Taker' as that ancestor.

Of all the human chromosomes, only the Y chromosome can be passed on unchanged from generation to generation.

Why?

(A) The Y chromosome does not undergo mutation.

(B) The Y chromosome does not undergo meiosis.

(C) The Y chromosome does not undergo crossing over.

(D) The Y chromosome does not segregate randomly.

9. Polydactyly is the possession of an extra finger or toe. It is determined by a dominant allele.

If a woman is polydactyl, but her father isn't, which one of the following must be true?

(A) Her mother must be polydactyl.

(B) Her mother or father must be a carrier, but not show the trait.

(C) All of her children will be carriers, but not show the trait.

(D) Her children will all be polydactyl.

10. The development of theories of evolution has always been influenced by the social and political factors of the time.

Which one of the following is a factor which influenced Darwin in delaying the publication of his theory?

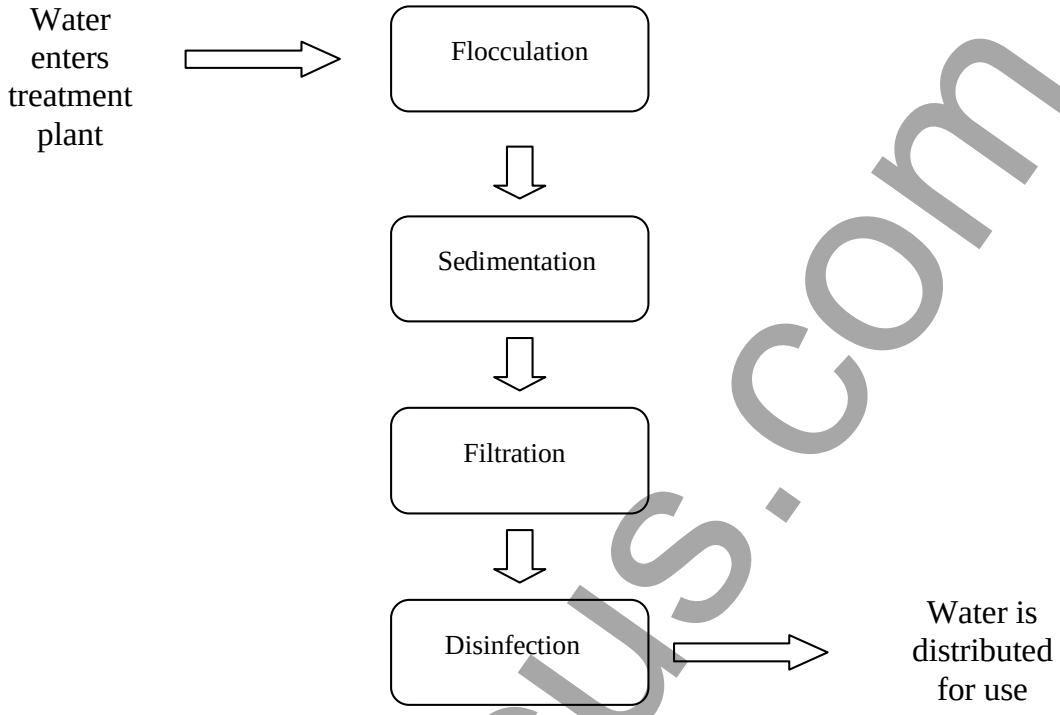
(A) The great majority of society accepted the biblical version of creation, so his theory would provoke great controversy.

(B) He was not well known in scientific circles, so other scientists would be unlikely to accept his ideas.

(C) Alfred Russel Wallace had proposed a different theory, which was supported by influential scientists, so he wanted to be sure of his evidence.

(D) Sea travel was very slow. It took him many years to return home from the Galapagos Islands.

11. The flow diagram below shows the sequence of events that occur in a treatment plant to make water fit to drink.



Which one of these processes actually kills pathogens?

(A) Flocculation

(B) Sedimentation

(C) Filtration

(D) Disinfection

12. Which one of the following types of cells gives rise to the cells which produce antibodies?

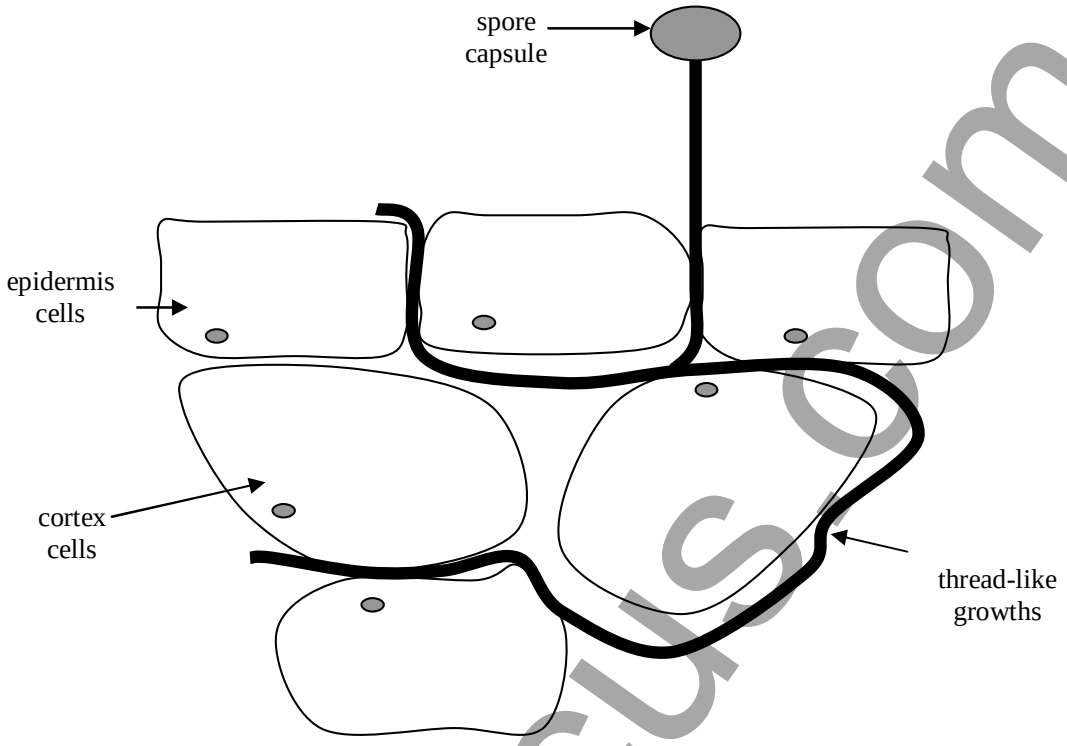
(A) T lymphocytes

(B) B lymphocytes

(C) phagocytes

(D) antigens

13. The drawing below is of a section through a pear, showing the thread-like growths and spore capsule of a plant pathogen.



This plant pathogen is most likely a:

(A) bacterium

(B) worm

(C) scale insect

(D) fungus

14. Which pair of scientists are chiefly responsible for the development of our ideas about the nature of infectious disease?

(A) Watson and Crick

(B) Darwin and Wallace

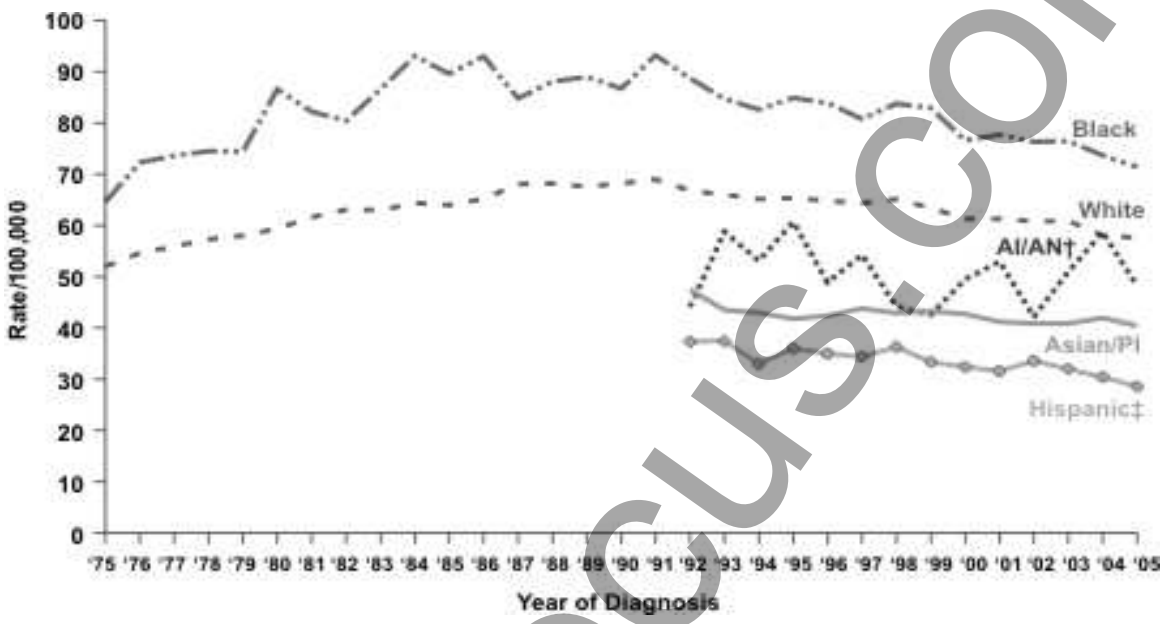
(C) Fleming and MacFarlane Burnet

(D) Pasteur and Koch

15. The graph below shows data from the US centre for Disease Control and Prevention.

It shows the incidence (in cases per 100,000 people) of cancer in different races of people living in the USA.

Essentially, it shows the highest rate in African Americans, followed successively by European Americans, Native Americans, Asian and Pacific Islander Americans, and finally Hispanic Americans.



Which one of the following could **NOT** be a reason for these different rates?

(A) Different rates of cigarette smoking between ethnic groups.

(B) More effective health monitoring, and hence diagnosis, in some ethnic groups compared to others.

(C) Much larger populations of African and European Americans than the other groups.

(D) Greater genetic predisposition to lung cancer in some ethnic groups compared to others.

Section I (continued)

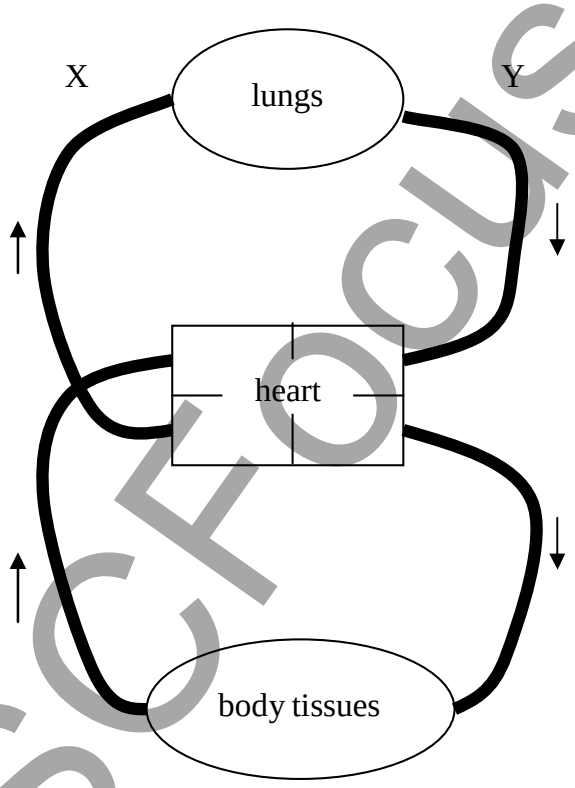
Part B – 60 marks
Attempt Questions 16 – 27
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 16 (4 marks)

The drawing below is a simplified version of the human circulatory system. Arrows indicate the direction of blood flow.



(a) Account for one difference in the composition of the blood at X and Y. **2**

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Question 16 continues on page 11.

Marks

Question 16 (continued)

(b) One important function of a circulatory system is the removal of metabolic wastes. **2**

Using an example, explain why it is important that metabolic wastes are removed.

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Question 17 (4 marks) **4**

Quarantine measures exist to prevent the spread of disease into Australia.

Justify TWO measures that you would expect AQIS (the Australian Quarantine and Inspection Service) to take in response to the recent swine flu outbreak in Mexico and North America.

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Marks

Question 18 (7 marks)

Duchenne Muscular Dystrophy (DMD) is a degenerative disease of the muscles. Sufferers progressively lose muscular control, they are normally wheelchair bound by the age of twelve and rarely live beyond twenty.

The gene for the production of the muscle protein dystrophin is found on the X chromosome. One allele of this gene codes for the protein, leading to normal muscle development. The other, which is recessive, produces no protein, leading to the development of the condition.

(a) Like all sex-linked conditions, Duchenne Muscular Dystrophy is found predominantly in males.

i. Explain why such sex-linked conditions occur most frequently in males. **2**

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ii. Explain why female cases of DMD are even more unlikely than female cases of other sex-linked conditions such as colour-blindness. **2**

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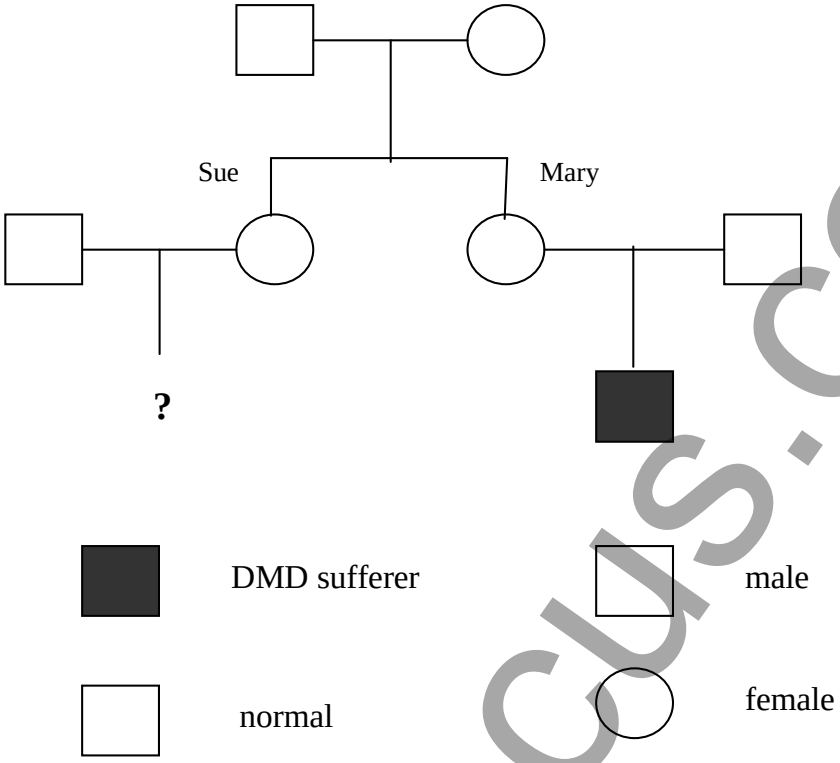
Question 18 continues on page 13.

Marks

Question18 (continued)

(b) Use the pedigree below to help you answer this question. **3**



Mary and her husband have just had a son with DMD.

Mary's sister, Sue, is pregnant with her first child, shown by ultrasound to be a boy.

Assess the likelihood of this child having DMD.

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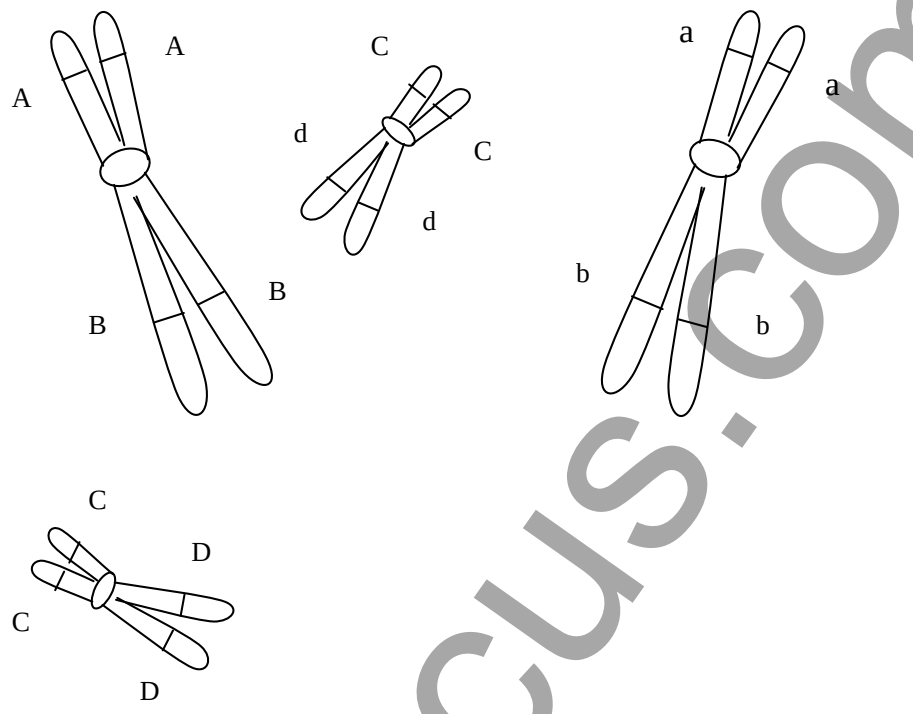
Marks

Question 19 (6 marks)

The drawing below shows two pairs of homologous chromosomes early in meiosis.



The positions of 4 genes are indicated.

(a) State this organism's genotype for these four genes **1**

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(b) Name an organ in the human body where meiosis occurs. **1**

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Question 19 continues on page 15.

Marks

Question 19 (continued)

(c) In the space provided below, make a series of at least three drawings to show the chromosomes on the previous page proceeding through meiosis. **4**

It should be clear from your drawings how random segregation and crossing over work together to produce variation between gametes.

Your last drawing should show four gametes, and the alleles present in each should be indicated.

Marks

Question 20 (4 marks)

The statement below appeared in a magazine recently.

> Antibiotics, once thought to be the wonder drug of the twentieth century, are now showing themselves to be more of a problem than a help.

Discuss this statement. **4**

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Marks

Question 21 (8 marks)

Read the information below about the effect of temperature on the survival of larval reef fish.

The Ambon Damselfish (*Pomacentrus amboinensis*) is a bright yellow fish which is seen in large groups darting in and out of the coral. In many parts of the Barrier Reef it is one of the most colourful and abundant fish.

Marine biologists are concerned that many common fish like the Ambon Damselfish (below) are threatened by global warming.

Pomacentrus amboinensis

Summer sea temperatures (^{o}C)

25 26 27 28 29 30 31

Ambon Damselfish hatch out from their eggs during the summer. At this time sea temperatures vary between 25 and 31^{o}C.

Marine Biologist Monica Gagliano, quoted in Cosmos Online, says that as temperature increases, fewer of the Ambon Damselfish larvae survive. Only about half of them survive at 31^{o}C.

Gagliano admits that fish species have survived temperature changes in the past, but she points out that these have occurred over long periods of time, while sea temperatures are expected to increase by 1-3^{o}C before the end of the century.

Question 21 continues on page 18.

Marks

Question 21 (continued)

(a) So far the relationship between sea temperature and larval survival rate has only been investigated in a few species. Other species may not be susceptible.

Describe an experimental investigation that could be performed to test the following hypothesis **5**

As water temperature increases, the survival rate of larval coral trout decreases.

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Question 21 continues on page 19.

Marks

Question 21 (continued)

(b) Explain how, through natural selection, fish have survived rising sea temperatures in the past. **3**

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Question 22 (4 marks)

Metabolic processes are controlled by enzymes.

(a) Outline a simple model that explains why enzymes are substrate specific. **2**

(b) Describe the effect of temperature on enzyme activity. **2**

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Marks

Question 23 (3 marks)

Describe TWO mechanisms by which the body seeks to prevent the entry of pathogens. **3**

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Question 24 (4 marks)

Sufferers from Addison's disease produce insufficient aldosterone and need to take hormone replacements such as hydrocortisol to make up the deficiency. **4**

Outline the role of aldosterone in maintaining homeostasis in a healthy individual.

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Marks

Question 25 (4 marks)

In 1994 a new species of tree was discovered in canyons of the Wollemi National Park, only about 100 km from Sydney

Study of this small population of trees has shown very little genetic diversity. They seem to be reproducing asexually.

Discuss the implications of the small population size and low genetic diversity of the Wollemi pine for its continued survival. **4**

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Question 26 (4 marks)

Describe how a named technology allows blood oxygen levels to be monitored, and assess its importance in medical care. **4**

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Marks

Question 27 (8 marks)

Using examples, evaluate the impact of developments in our knowledge about the nature of infectious disease and the body's response to it, on the development of effective treatments and controls. **8**

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Section II

25 marks
Attempt ONE question from Questions 28-32
Allow about 45 minutes for this section

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

Marks

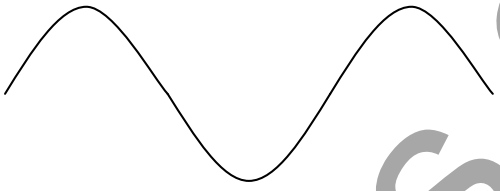
Question 28 --- Communication (25 marks)

(a) (i) Name a receptor which is used in communication. **1**

(ii) Sketch a graph to represent an action potential, and explain why not all stimuli generate one. **3**

(b) The diagram below shows two waves produced on a CRO in response to two different sounds.

A



B

(i) Which wave has the highest pitch? Justify your answer. **2**

(ii) Describe the relationship between the wave length and the frequency of a wave. **1**

(iii) Describe, in order, the structures and energy changes involved when the energy of a sound wave is transmitted from the external ear to the auditory nerve. **4**

(c) With reference to vision defects, explain how modern technology can restore normal vision, and assess the impact of this on society. **7**

(d) During your study of this Option you performed a first hand investigation of a mammalian eye.

(i) Justify one safety measure that you adopted during this investigation. **1**

(ii) Relate the structure of one of the features you observed to its function. **2**

(iii) Describe how we perceive colour. **4**

Marks

Question 29 --- Biotechnology (25 marks)

(a) (i) Name one animal species which has been subjected to artificial selection for agricultural purposes. **1**

(ii) Discuss the ethical issues associated with a named example of biotechnology. **3**

(b) (i) Explain how a change in technology or scientific knowledge has modified a traditional use of biotechnology. **4**

(ii) Outline the events that led to the use of yeast in the manufacture of bread. **3**

(c) With reference to applications of biotechnology in medicine, assess implications of either the products or the processes for human society. **7**

(d) During your study of this Option you performed a first hand investigation to extract DNA from a suitable source.

(i) Justify one safety measure that you adopted during this investigation. **1**

(ii) For one part of the procedure that you followed, explain how it aided in the extraction process. **2**

(iii) Outline the steps involved in the synthesis of a protein, starting with DNA. **4**

Marks

Question 30 --- Genetics: The Code Broken? (25 marks)

(a) (i) Name an example of an agricultural species which has been the subject of selective breeding. **1**

(ii) Describe an example of the action of transposable genetic elements (transposons) in a named species. **2**

(b) In pea plants, the allele for tall stems is dominant over that for short stems, and the allele for round seeds is dominant over that for wrinkled seeds.

Tall stem, Round seeds	X	Short stem, Round seeds
TtRr		***ttRr***

(i) For the cross shown above, determine the expected phenotype ratios of the offspring. **2**

(ii) Long before technology allowed specific genes to be located on a chromosome, it was realised that the gene for ABO blood groups is on a different chromosome to that for Rhesus factor. **2**

Explain how geneticists could tell this.

(iii) Using an example of a characteristic under polygenic control, explain the distribution of phenotypes which this type of inheritance produces. **3**

(c) Assess the potential impacts of the Human Genome Project on society. **7**

(d) During your study of this Option you performed a first hand investigation to construct a model of DNA.

(i) Justify TWO aspects of the structure of your model. **2**

(ii) Use an example to show how analysis of genes provides evidence of evolutionary relationships. **3**

(iii) Explain why the timing of gene expression is important in the development of the embryo. **3**

Marks

Question 31 --- The Human Story (25 marks)

(a) (i) Name a fossil hominid. **1**

(ii) Outline TWO major differences between the members of the genus ***Homo*** and their ancestors. **2**

(b) The photograph below shows the left foot of a gorilla.

(i) Compare the structure of the gorilla's foot to that of a human, and relate these differences to the different modes of life of the two species. **4**

(ii) Explain how a named cultural development in humans acted as a selecting agent in the subsequent evolution of humans. **3**

(c) Assess the potential of increased population mobility and modern medicine to affect future human evolution. **7**

(d) During your study of this Option you used information from secondary sources to model karyotype analysis.

(i) Describe one difference between the karyotype of humans and the other great apes. **1**

(ii) Explain how the concept of a 'molecular clock' is used to date the time at which two species diverged. **3**

(iii) Describe an example of a human polymorphism and explain how it might have come about. **4**

Marks

Question 31 --- Biochemistry (25 marks)

(a) (i) Name the substance that is the source of the oxygen produced during the light dependent reaction. **1**

(ii) Explain why the Calvin cycle is called the light independent reaction. **2**

(b) Our knowledge about plant growth developed during the 17th and 18th centuries.

(i) With reference to the work of TWO scientists of that time, show how advances in knowledge were dependent on the work that had gone before. **4**

(ii) The technology available to scientists at that time was very simple. **3**

Show how one named piece of modern technology (other than technology associated with microscopy) would have greatly assisted one named scientist of that time.

(c) One inevitable consequence of the use of fossil fuels is the build up of atmospheric CO_2, leading to climate change. **7**

Justify research into photosynthesis as a means of addressing this problem through such measures as:

- reducing fossil fuel use,
- reducing atmospheric CO_2 levels.

(d) During your study of this Option you performed a first hand investigation to extract pigments from leaves.

(i) Justify one safety measure that you adopted during this investigation. **1**

(ii) Explain the significance of the difference in function of photosystems I and II. **3**

(iii) With reference to an example, describe how radioactive isotopes can be used to trace biochemical pathways. **4**