Student Number

Exam Choice

2011

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 - 24

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

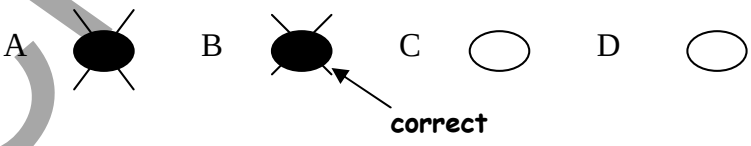
Use the multiple-choice answer sheet.

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

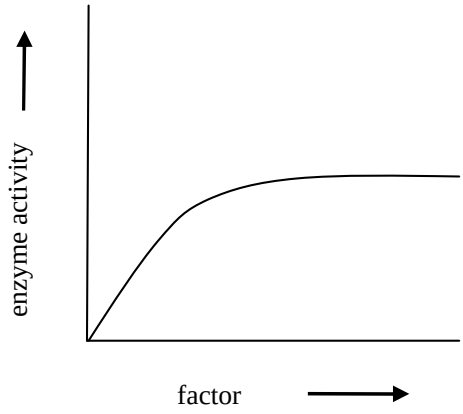
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

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. The graph below shows the effect of a factor on enzyme activity.



The factor is most likely:

(A) pH

(B) temperature

(C) substrate concentration

(D) time

2. Blood contains compounds which act as 'buffers'. Buffers tend to maintain blood pH within narrow limits by counteracting any change that other substances might bring about.

Carbon dioxide, which diffuses from respiring cells as an excretory product into the blood, will normally alter the pH of any solution it is added to.

Choose the row in the table below which describes both the change brought about by carbon dioxide and the action of buffers.

	Effect of carbon dioxide on the pH of a solution	**Action of buffers in the blood**
(A)	increased pH	negative feedback
(B)	decreased pH	negative feedback
(C)	increased pH	positive feedback
(D)	decreased pH	positive feedback

3. Transport of materials through plants occurs in the xylem and phloem.

Which one of the following is an example of active transport?

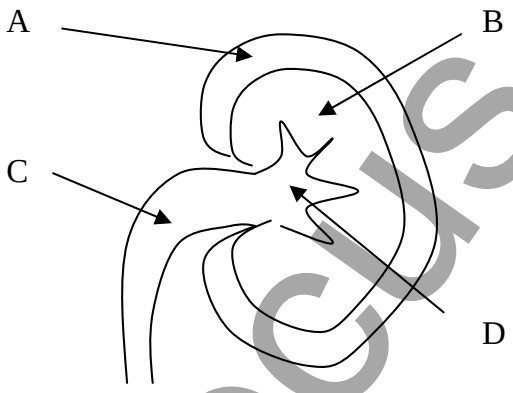
(A) Loading of sugars from photosynthetic cells into the phloem.

(B) Absorption of water from the soil into the xylem of the root.

(C) Unloading of water from the xylem into photosynthetic cells.

(D) Movement of sugars between sieve elements in the phloem.

4. The diagram below shows a mammalian kidney.



Which is the main region associated with reabsorption of water and salts?

(A) A

(B) B

(C) C

(D) D

5. Which one of the following types of organism produces uric acid as its major nitrogenous waste?

(A) Insects

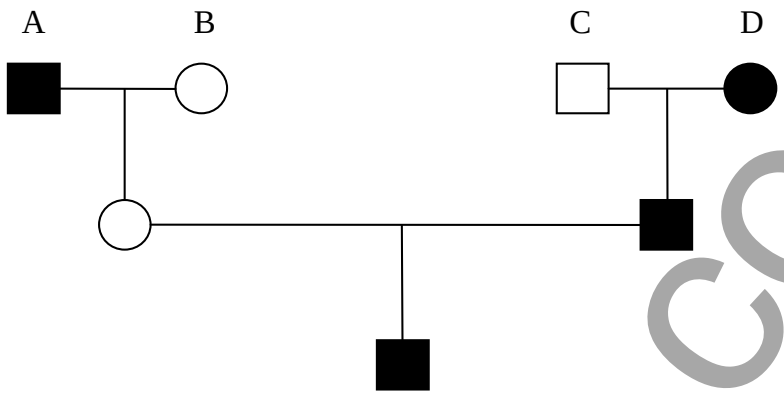
(B) Mammals

(C) Freshwater fish

(D) Marine fish

6. The pedigree diagram below shows the inheritance of the sex-linked condition, red-green colour blindness, in a family.

The allele which causes the condition is recessive, and is carried on the X chromosome.



Marcus

From which one of his grandparents did Marcus inherit the allele for colour blindness?

(A) A

(B) B

(C) Either B or D (not possible to determine which)

(D) D

7. Which one of the following best describes the difference between an allele and a gene?

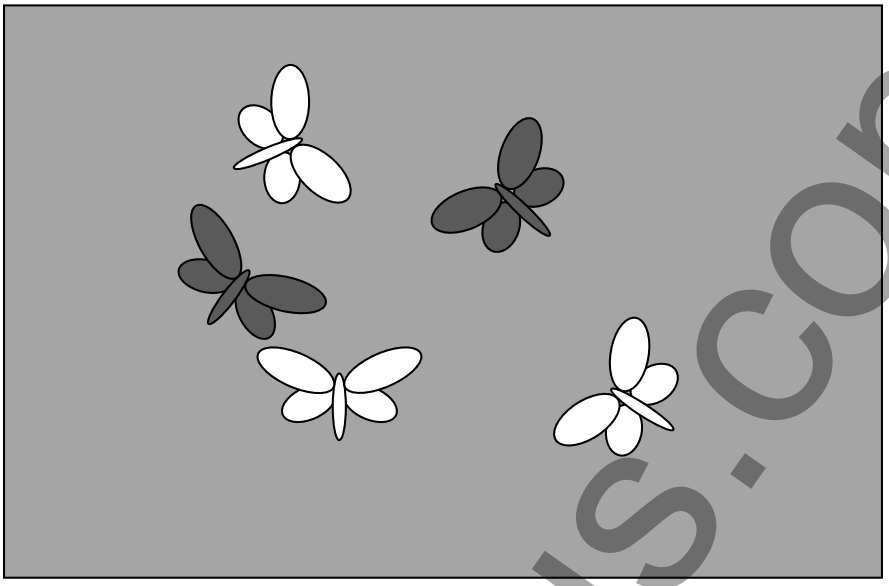
(A) A gene is a section of DNA which codes for a characteristic, its allele is a letter which represents it.

(B) A gene is a section of DNA which codes for a characteristic, an allele is the actual physical appearance of that characteristic.

(C) A gene is a section of DNA which codes for a characteristic, alleles are different versions of that gene.

(D) A gene is a section of DNA which codes for a characteristic, alleles are groups of genes which operate together.

8. One popular way of modelling natural selection is to arrange differently coloured models of an organism against a coloured background, and then seeing whether the relative frequency of each colour type changes as someone 'hunts' them. This can be done with cut-out models or using a computer simulation.



In this example, the selecting agent is:

(A) the colour of the background.

(B) the different coloured butterflies.

(C) the behaviour of the butterflies.

(D) the visually hunting predator.

9. Walter Sutton and Theodore Boveri worked independently on grasshoppers and sea urchins respectively.

Which one of the following advances in our knowledge of genetics is credited to them?

(A) The discovery that the factors of inheritance are carried by the chromosomes.

(B) The discovery of sex-linked inheritance.

(C) The formulation of the 'one gene, one polypeptide' theory.

(D) The discovery of the 'Law of Independent Assortment'.

10. In pea plants, the allele for green pods (G) is dominant over that for yellow pods (g).

A plant breeder crosses two pea plants and obtains the following offspring:

424 plants with green pods : 399 plants with yellow pods

What are the most likely genotypes of the parent plants?

(A) GG x gg

(B) Gg x gg

(C) Gg x Gg

(D) gg x gg

11. The story of the discovery of the double helix structure of DNA illustrates an important principle of the nature of successful scientific practice.

Which one of the following best expresses this principle?

(A) Hypotheses must always be tested by experimentation.

(B) Nobel prizes are never awarded posthumously (after death).

(C) It is essential to protect a research team's scientific secrets.

(D) Effective collaboration between researchers yields the best results.

12. Mimicry is a phenomenon which has been studied by ecological geneticists for many years.

One example is the ichneumon fly, a harmless insect which has a similar colouration to wasps. Potential predators, having learnt to avoid wasps because of their sting, leave the ichneumon flies alone as well.

Many other examples exist of where unrelated species share a similar colour pattern or other feature which deters predators.

Mimicry is an example of:

(A) adaptive radiation.

(B) convergent evolution.

(C) evidence of common ancestry.

(D) punctuated equilibrium.

13. Tissue culture is a commonly used technique for producing plants in horticulture.

Undifferentiated cells are extracted from the meristem tissue of a particularly good specimen and cultured in a medium. From the resulting group of cells a new plant grows.

Tissue culture is an example of:

(A) cloning.

(B) artificial pollination.

(C) hybridisation.

(D) artificial insemination.

14. When investigating microbes in food or water you would probably have cultured them on a medium in a petri dish.

What is the role of that medium?

(A) To prevent contamination by microbes from outside.

(B) To ensure that any pathogenic organisms that develop can be controlled.

(C) To provide the microbes with a source of food.

(D) To provide a background against which microbial colonies can clearly be seen.

15. *Candidiasis*, or thrush, is a fungal infection which can occur in the female reproductive tract and in the intestine.

One of the factors which can trigger it is taking large amounts of antibiotics.

This is because:

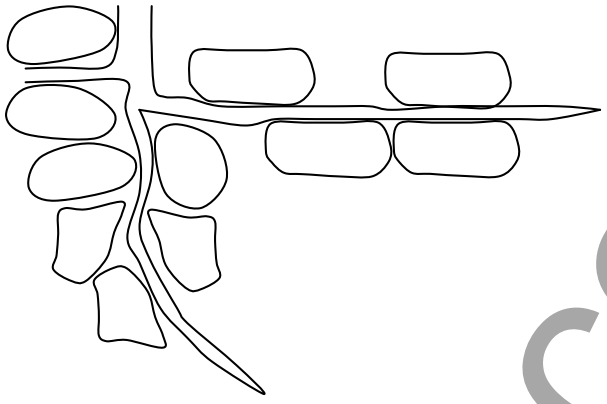
(A) the *Candida* pathogen actually feeds on antibiotics.

(B) overuse of antibiotics weakens the body's immune system, making it susceptible to opportunistic infections like *Candida*.

(C) antibiotics kill the natural bacterial flora which normally outcompete *Candida*, allowing it to become a major infection.

(D) Antibiotic resistant strains of *Candida* evolve very quickly.

16. The diagram below shows the blind-ending system of tubes which drains fluids from the tissues of the body, ensuring that pathogens are transported to sites where they can be dealt with.



These tubes are part of:

(A) the inflammatory response.

(B) the lymphatic system.

(C) phagocytosis.

(D) the body's mucous membranes.

17. In 1880 Alphonse Laveran discovered a micro-organism (*Plasmodium*)in the blood of a group of malaria sufferers. It wasn't present in the blood of healthy people.

In 1897 Ronald Ross was able to show that *Plasmodium* could be transferred to mosquitoes and reproduce inside them.

By now it was strongly suspected that Plasmodium was the causative pathogen of malaria.

Which one of the following steps would be required by Koch's postulates to definitively identify *Plasmodium* as the pathogen?

(A) *Plasmodium* would have to be shown to stimulate the production of antibodies in a susceptible host.

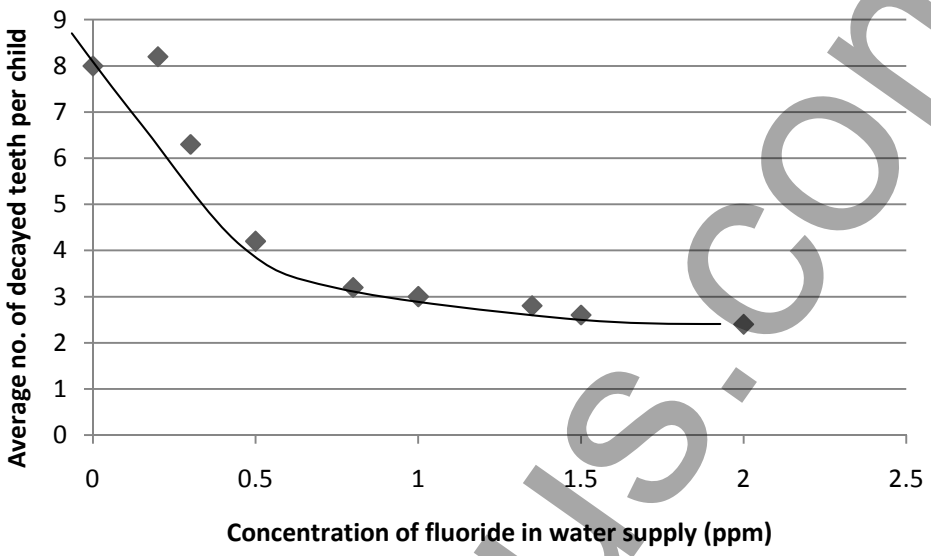
(B) It would have to be shown that *Plasmodium* could be transferred from mosquitoes to humans and cause malaria.

(C) All mosquitoes carrying Plasmodium would have to display symptoms of malaria.

(D) Any drug which was effective against malaria in humans would have to be equally effective in mosquitoes.

18. The graph below summarises the results of an epidemiological study of the effects of fluoride in drinking water on the incidence of tooth decay.

A large number of thirteen year old children were surveyed in towns with naturally occurring levels of fluoride in their water supplies.



Over a thousand children were surveyed in each town.

Why is it important to survey such large numbers of people in epidemiological studies such as this?

(A) It makes the results more precise.

(B) To make sure that at least some of the people have consumed town water.

(C) So that the survey also acts as a Public Health Initiative, and informs a large number of people.

(D) It increases the statistical validity of the data.

19. In April 2010 an outbreak of the plant disease 'Myrtle rust' was detected at a nursery in NSW. This was its first occurrence in Australia.

It affects some native plant species and has already spread to areas of bush on the Central Coast.

It is a fungal disease and is spread by spores transported by people or animals which have come in contact with it.

Which one of the following measures would you expect to be most effective in preventing it from spreading further?

(A) Banning the sale of native plants by nurseries.

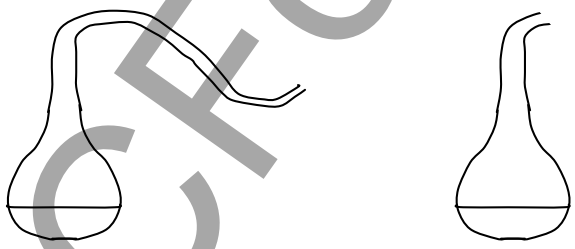
(B) Inspecting all plant material at points of entry into Australia.

(C) Prohibiting entry by people or vehicles into infected areas.

(D) Discouraging the planting of native plants in gardens.

20. Louis Pasteur performed a famous experiment in which he sterilised the nutrient broth in two swan necked flasks.

He then broke the neck off one of them and found that the broth in the broken flask became infected with microbes, but the broth in the other flask remained clear and uninfected.



The main conclusion that Pasteur drew from this experiment was that:

(A) microbes arise by spontaneous generation.

(B) all disease and decay is caused by microbes.

(C) microbes can be destroyed by heating

(D) microbes travel through the air.

Section I (continued)

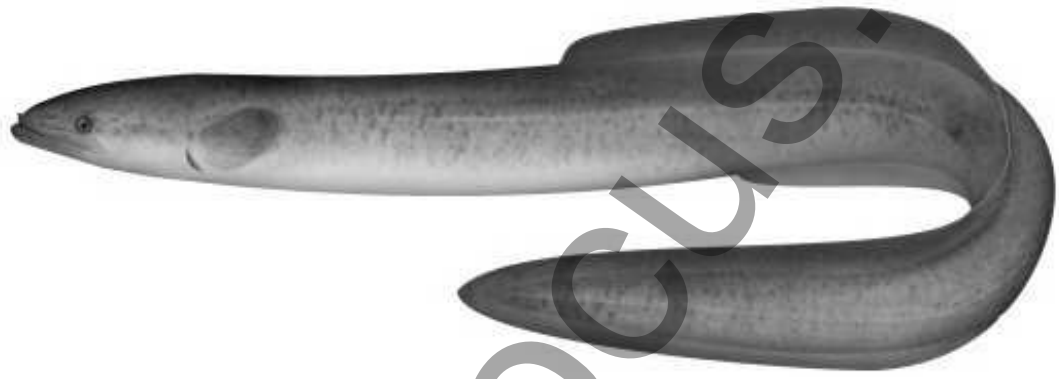
Part B – 55 marks
Attempt Questions 21 - 30
Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 21. (5 marks)

The longfin eel, *Anguilla reinhartdii*, is common in the coastal rivers of Eastern Australia.



It spends most of its life living in freshwater, but in order to breed it undertakes an extraordinary marine journey to its breeding grounds in the ocean near New Caledonia.

(a) Explain why this transition from fresh to salt water would make maintaining enantiostasis difficult. **3**

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Question 21 continues on page 13.

Marks

Question 21 (continued)

(b) Outline one mechanism employed by salt water fish to maintain water balance. **2**

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Question 22. (3 marks)

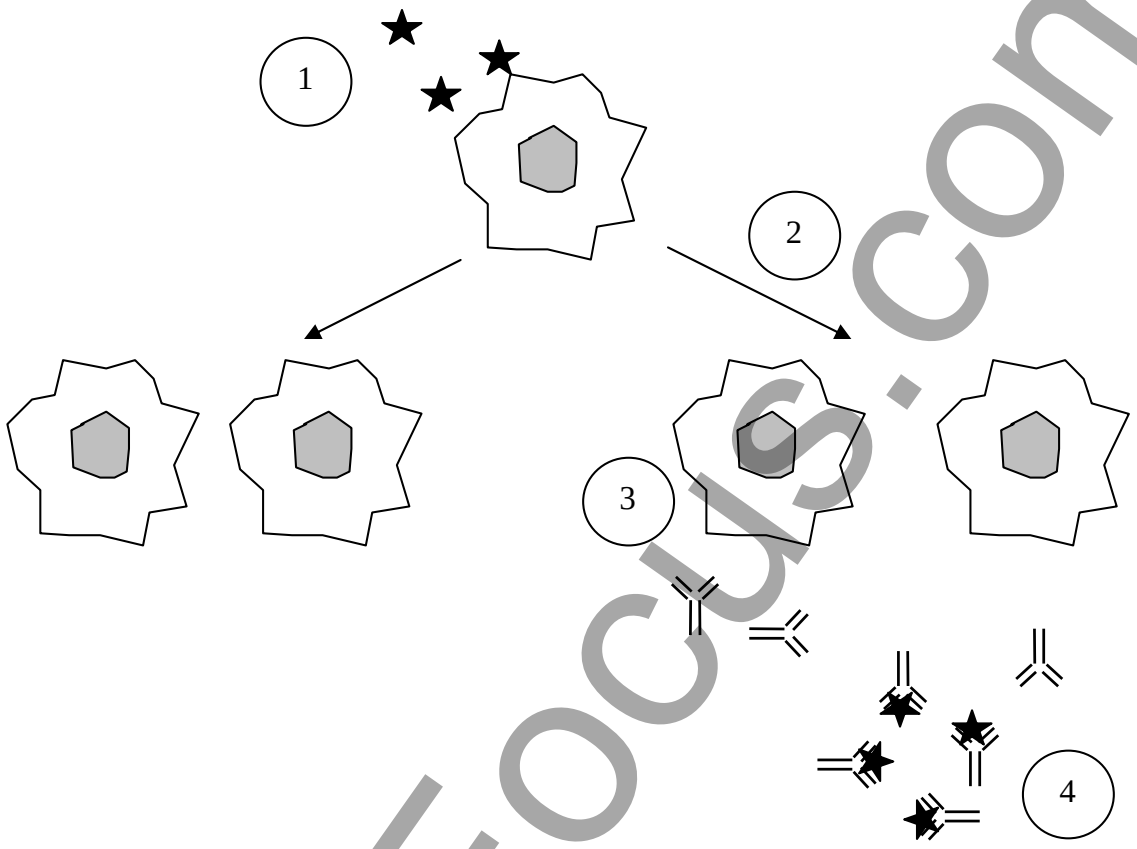
Complete the table below to distinguish between the pathogenic organisms listed, and name a disease caused by each. **3**

Pathogen	**Distinguishing biological characteristic**	**Example of disease caused by this pathogen**
Prion		
Virus		
Protozoan		

Marks

Question 23. (6 marks)

The diagram below represents part of the process involved in the response of the immune system to antigens in the body fluids. (Not all types of cells are shown in this simplified version)



(a) Label the following structures on the diagram: **2**

- Memory B lymphocyte
- Plasma cell
- Antigen
- Antibody

Question 23 continues on page 15.

Marks

Question 23 (continued)

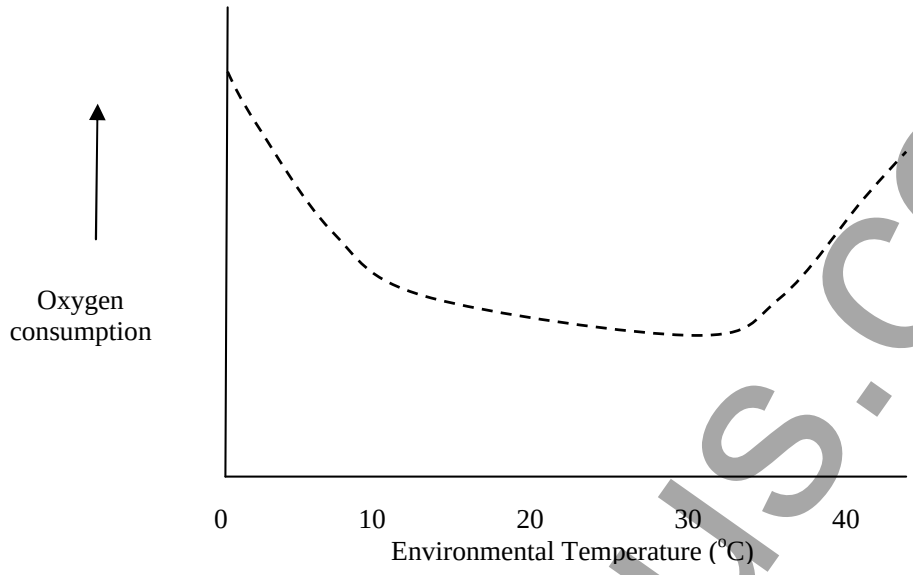
(b) Complete the table below to describe the processes indicated by the numbers 1-4. **4**

Number	Description of process
1	
2	
3	
4	

Marks

Question 24. (4 marks)

The graph below shows how the oxygen consumption of an endothermic mammal changes in response to environmental temperature.



(a) Explain the relationship between oxygen consumption and environmental temperature shown in the graph. **3**

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(b) Add a line to the graph to show how you would expect an ectothermic animal's oxygen consumption to change with environmental temperature. **1**

Question 25. (9 marks)

The boxes below contain information about the Human Papilloma Virus (HPV) and its association with cancer of the cervix in women.

The Human Papilloma Virus (HPV) has a large number of strains which cause warts in humans.
Some of these strains are sexually transmitted pathogens which cause warts of the genital region in both sexes.
Transmission is by skin contact, so condoms only provide limited protection.
Many people are infected without realising it. The pathogen lies dormant and only erupts into warts occasionally.
In healthy individuals the immune system will combat the infection and overcome it. People with genital warts eventually recover from them, but are highly infectious to sexual partners while they are infected.
Some strains of HPV have been shown to cause changes to the DNA of the cells lining the cervix. This can lead to cervical cancer.

From *Wikipedia*

Rates of Infection
Genital HPV infection is the most widespread sexually transmitted infection in the world.
It is estimated that 75-80% of sexually active Americans will be infected by at least one strain of HPV during their lifetime.
At any given time around 25% of women aged 14-59 are infected by at least one strain.

From *Dunne, E. et al. 2007.* In the Journal of the American Medical Association.

Cervical Cancer
Worldwide there are around 473,000 new cases of cervical cancer annually.
Each year there are 235,500 deaths from the condition.
Cervical cancer is the fifth most deadly cancer in women in the US.

From The National Cervical Cancer Coalition (USA) website.

HPV vaccines
Two vaccines have been developed and approved for use against HPV. Each is effective against the two strains of HPV which are responsible for 70% of all cervical cancer cases.
In Australia, vaccination programs for school girls were introduced in 2007.
Three doses of the vaccine are administered, spread over about six months.

From the HPV page of the Australian Government Department of Health and Aging website.

Question 25 continues on page 18.

Marks

Question 25 (continued)

(a) Describe how you would assess the four information boxes for reliability and relevance **2**

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(b) Health authorities are concerned that some girls are having the first vaccination, but then missing one or both of the others.

Explain why the three vaccinations give greater protection than just one or two. **3**

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Question 25 continues on page 19.

Marks

Question 25 (continued)

(c) Australian health authorities, and those of many other countries, have adopted a policy of aiming to vaccinate all girls of secondary school age through a free vaccination program. The vaccine is also available to boys, but there is no national program of vaccinating boys, and parents wishing to vaccinate their sons have to pay a fee.

Assess this approach from a public health point of view. **4**

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Question 26 (3 marks) **3**

Explain why homeostasis is essential to the maintenance of optimal metabolic function.

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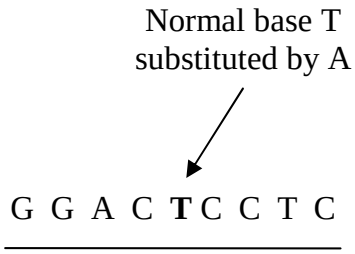
Marks

Question 27 (8 marks)

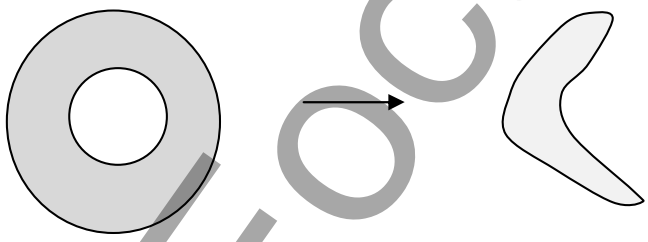
Sickle Cell Anaemia is an example of an inherited disease which has a relatively high frequency in West Africa.

Its cause is a gene mutation on chromosome 11. One base in the gene which codes for one of the haemoglobin proteins in the red blood cell has been replaced.

Thymine (T) has been replaced by adenine (A).



The resulting haemoglobin molecule causes red blood cells to lose their shape and become sickle-shaped. (see below)



(a) Construct a flow chart to show how this change in DNA sequence leads to a change in red blood cell shape. **3**

Question 27 continues on page 21.

Marks

Question 27 (continued)

(b) The allele for the normal haemoglobin protein and the mutated allele that leads to sickle-cell anaemia are co-dominant.

Explain how this allows for three different phenotypes. (Normal, mild sickling and severe sickling) **3**

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(c) People with a sickling condition often suffer from fatigue (tiredness) and are generally less active than other people. **2**

Suggest why this might be.

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Marks

Question 28 (6 marks)

Brine shrimps are salt water invertebrates which live in salt lakes and calm inlets. They are key species in many food chains.

As levels of atmospheric carbon dioxide increase, some of this CO_2 dissolves in the sea. This has the effect of making sea water more acidic.

There is great concern that the change in pH of seawater will affect the survival of marine organisms.

Propose a hypothesis and design an experiment to investigate the effect of the pH of seawater on the hatching rate of brine shrimp eggs. **6**

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Marks

Question 29. (3 marks)

Many of the world's fish species are declining in numbers as the pressure of commercial fishing increases.

One phenomenon that fisheries scientists have noticed in a number of such species, is a reduction in breeding age. (ie. The fish are starting to reproduce at a younger age than they once did).

Outline how an evolutionary biologist, such as Darwin, would explain this change. **3**

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Question 30. (8 marks)

Reproductive technologies and genetic engineering are changing agriculture to the extent that no-one should go hungry in the future.

Discuss this statement. **8**

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Continue your answer on page 24.

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.

Marks

Question 31 --- Communication (25 marks)

(a) (i) Name a receptor found in the human body **1**

(ii) Explain how humans detect the direction of a sound. **3**

(b) The diagrams below show how the fields of view of a human's and a dog's two eyes overlap.

Dogs also have more rods than humans, only two types of cone and a lower density of cones in the central area of their retina.

From the information above, explain the implications of these differences for dog vision in contrast to human vision. **6**

(c) Technology has allowed people with failing eyesight and hearing to continue to use these senses.

For EACH of these senses choose ONE technology and compare them in terms of their mode of operation, limitations and impact on society. **7**

(d) (i) Explain how a nervous impulse is transmitted along a nerve cell. **4**

(ii) Outline the difference between a nerve and a nerve cell. **1**

(ii) Describe how the Organ of Corti functions to allow us to perceive sounds of different frequencies. **3**

Marks

Question 32 --- Biotechnology (25 marks)

(a) (i) Name the gas produced during fermentation. **1**

(ii) Explain why strain isolation is important, and describe one classical method used to isolate strains in the mid twentieth century. **3**

(b) (i) Archaeological evidence suggests that people have used cheese for nearly 10,000 years.

Describe how the technique of cheese production was probably first discovered. **2**

(ii) Describe the changes produced by selective breeding in the development of a named agricultural plant species. **3**

(c) Biotechnology has revolutionised both the way we fight disease and produce food.

For EACH of medicine and food production, choose ONE biotechnology and compare them in terms of the details of the processes, their limitations and their impacts on society. **7**

(d) (i) Use diagrams to show the role of restriction enzymes and ligases in the production of recombinant DNA. **3**

(ii) Explain how DNA analysis can be used to help solve crime. **3**

(iii) Explain why the issue of DNA technology provokes ethical debate. **3**

Marks

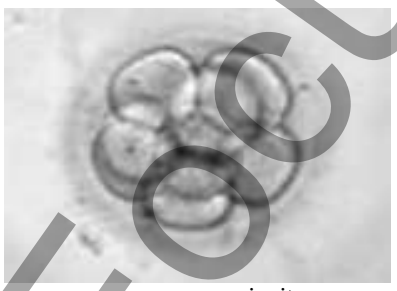
Question 33 --- Genetics, The Code Broken? (25 marks)

(a) (i) Explain the terms *haploid* and *diploid*. **1**

(ii) Determine the possible genotypes and phenotypes of the children in a cross between the following two parents: **4**

	Man	Woman
ABO blood group	Group A I^Ai	Group B I^Bi
Rhesus blood group	Rh+ Dd	Rh- dd

(b) The photograph below shows a human embryo three days after fertilisation. At this stage it consists of a small group of undifferentiated cells.



invitro.com

(i) Describe the role of gene cascades in the subsequent development of the embryo. **4**

(ii) Explain how analysis of homeotic genes can provide evidence for evolutionary relationships. **3**

(c) Gene cloning and whole animal cloning are technologies which were undreamt of a few years ago.

Compare the two technologies in terms of the processes involved, their limitations and their potential impacts on society. **7**

(d) (i) Distinguish between somatic and germ line mutations in terms of their potential to affect the future evolution of a species. **2**

(ii) Describe a current use of gene therapy to treat a named disease. **4**

Marks

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

(a) (i) Describe an example of a clinal gradation found in humans **1**

(ii) Describe how it might have evolved **3**

(b) Flying foxes are a group called the megabats. They share some anatomical similarities with the insect-eating microbats, but are also quite distinct in certain ways.

For many years there was disagreement amongst biologists about the evolutionary relationships of megabats. Some considered them to be most closely related to microbats, and to be correctly classified. While others thought that they might really be flying primates, and their similarity to microbats to be a product of convergent evolution.

(i) Identify one primate-like feature visible in the photograph of the flying fox above. **1**

(ii) In recent years, DNA sequencing has satisfied most biologists that the two groups of bats are correctly classified as close relatives. Megabats are not flying primates.

Explain how DNA sequencing can be used to resolve such issues. **4**

Question 34 continues on page 30.

Marks

Question 34 (continued)

(c) There is some debate about the future direction of Human evolution.

Choose TWO factors influencing human society today, explain how each has the potential to cause evolutionary change and assess the implications of each for the population. **7**

(d) (i) Referring to specific fossil hominids, describe the evidence for the evolution of upright stance before the evolution of large brain capacity. **3**

(ii) Explain how the upright stance of early hominids might have contributed to the evolution of a greater brain capacity. **3**

(iii) Assess the importance of language to human cultural development. **3**

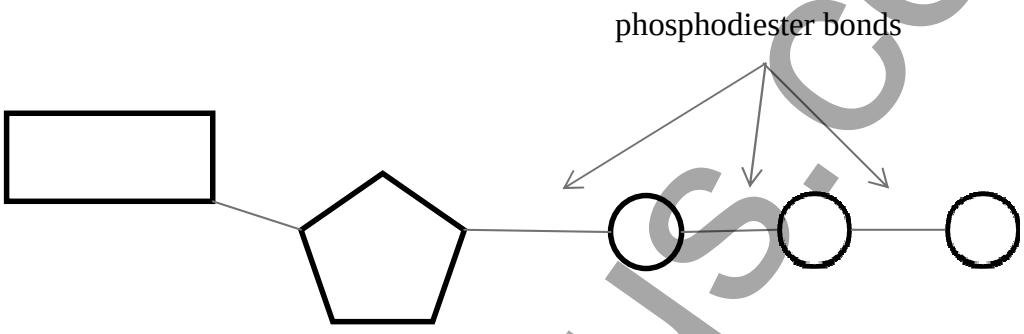
Marks

Question 35 --- Biochemistry (25 marks)

(a) (i) Name the process by which cells can be broken up to allow study of their cell fractions. **1**

(ii) Describe how Englemann discovered the action spectrum of photosynthesis. **3**

(b) The diagram below shows the structure of ATP.



(i) Explain the role of the phosphodiester bonds. **2**

(ii) Describe the process of ATP synthesis. **3**

(c) Explain how radioactive tracers have been used in the investigation of TWO aspects of photosynthesis.
Evaluate their contribution to our knowledge of the process. **7**

(d) (i) Make a labelled drawing of a chloroplast. **3**

(ii) Identify TWO structures or substances found within the stroma and outline their roles in the chloroplast. **3**

(iii) Compare the sizes, shapes and distribution of chloroplasts in algae and terrestrial angiosperms. **3**