Student Number

Exam Choice

2007

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 - 20

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 21 - 27

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

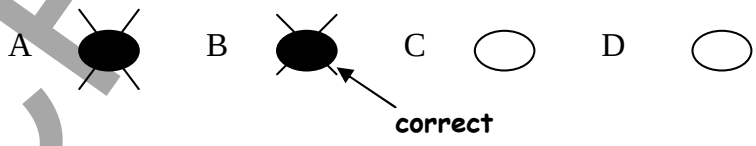
Use the multiple-choice answer sheet.

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

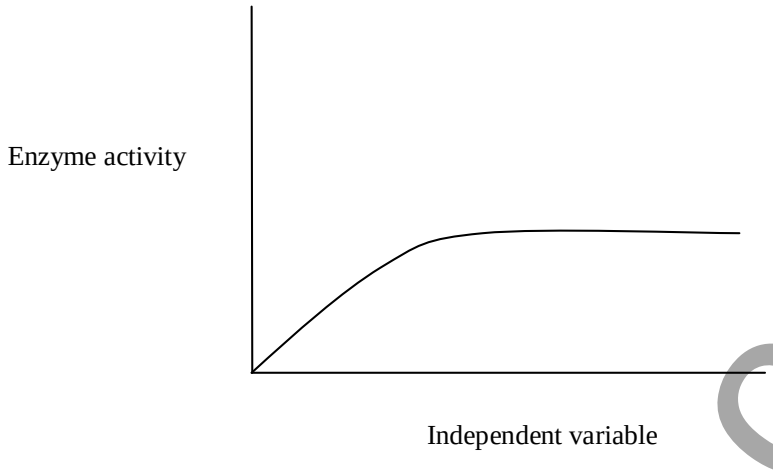
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

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 graph below shows the relationship between an independent variable and enzyme activity.



Which one of the following independent variables has this effect on enzyme activity?

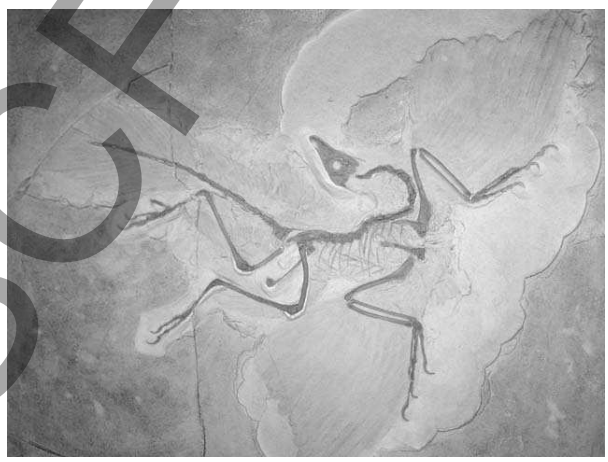
(A) substrate concentration

(B) light intensity

(C) pH

(D) temperature

2. Palaeontologists studying fossils of the bird-like reptile, *Archaeopteryx*, believe that it must have been at least partially endothermic.



Which one of the following features suggests that it was an endotherm?

(A) teeth

(B) feathers

(C) wishbone

(D) it laid eggs

3. Sufferers from Addison's disease are commonly given the synthetic hormone fluorocortisone. This is to compensate for the fact that their adrenal glands are not producing enough aldosterone.

The main effect of fluorocortisone would be to:

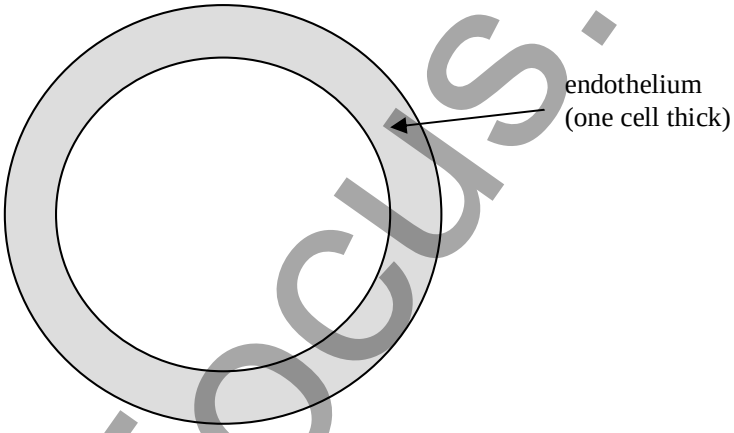
(A) increase permeability of collecting ducts to water.

(B) decrease permeability of collecting ducts to water.

(C) increase blood volume and blood pressure.

(D) decrease blood volume and blood pressure.

4. The drawing below shows a section through a structure found in the human body.



Which one of the following structures does this drawing show?

(A) a vein

(B) an artery

(C) a capilliary

(D) a bronchiole

5. Which one of the following organisms would you expect to produce uric acid as its principal nitrogenous waste?

(A) a salt water fish

(B) a fresh water fish

(C) a terrestrial mammal

(D) a terrestrial insect

6. The early embryo of a bird is almost impossible to distinguish from that of a mammal, reptile, fish or any other vertebrate.

The inference that biologists draw from this is that:

(A) vertebrates must be closely related.

(B) mammals must have evolved from reptiles.

(C) convergent evolution has occurred.

(D) adaptive radiation has occurred.

7. Gregor Mendel, the 'father of Genetics', formulated his Laws of Inheritance in the 1860s. However, it wasn't until the early 1900s, well after Mendel's death, that they came to be widely known and accepted.

Which one of the following is the main reason for this?

(A) Mendel wasn't well known to other scientists and he didn't publish his findings in a well-known scientific journal.

(B) Most people at the time of Mendel believed in the literal word of the Bible, and were reluctant to accept something that seemed to contradict it.

(C) As a monk, Mendel suppressed his own findings as he feared they would lend support to the work of Darwin.

(D) Mendel's experiments were very complex and for a long time no-one understood what he had discovered.

8. Spherocytosis is a non sex-linked inherited condition that is determined by a dominant allele.

Which one of the following statements is true?

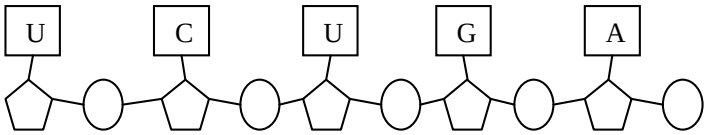
(A) A child of two spherocytosis sufferers must also have the condition.

(B) It is possible for two people without spherocytosis to have a child with the condition.

(C) If one parent has spherocytosis the children will be carriers of the condition but not suffer from it themselves.

(D) If a person has spherocytosis, at least one of their grandparents must have had it as well.

9. The diagram below shows a section of mRNA.



Which one of the following shows the base sequence on the template strand of DNA from which this piece of mRNA was transcribed?

(A) TGTCT

(B) AGACU

(C) TGTCU

(D) AGACT

10. Which one of the following contributes to variation by producing new combinations of alleles on a chromosome?

(A) mitosis

(B) crossing-over

(C) fertilisation

(D) random segregation

11. During the second half of the nineteenth century our understanding of the causes of infectious disease advanced greatly. The two scientists mainly responsible for these advances were:

(A) Pasteur and Koch

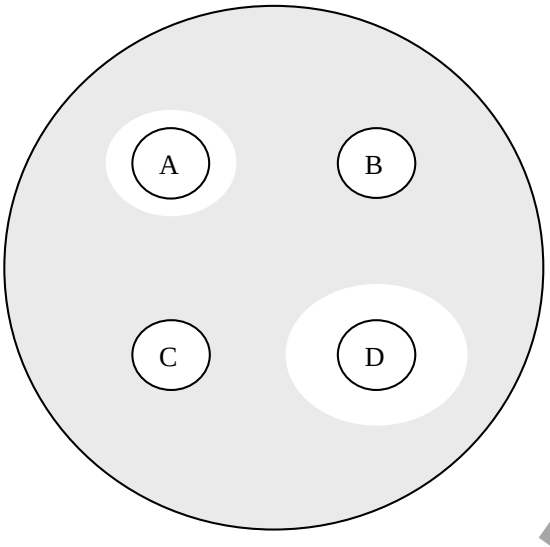
(B) Sutton and Boveri

(C) Laveran and Ross

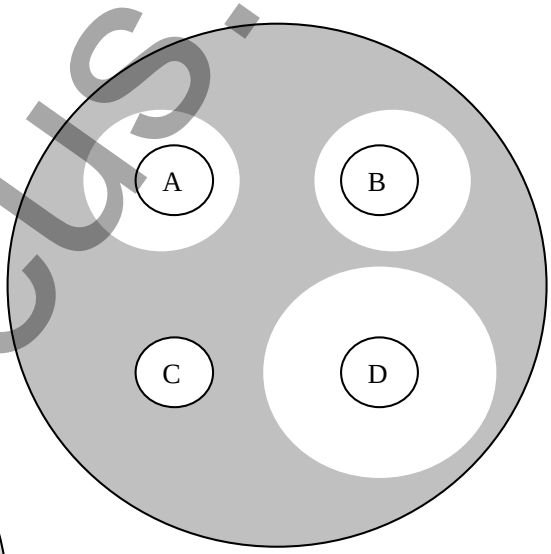
(D) Jenner and MacFarlane Burnet.

12. A patient is suffering from an acute bacterial lung infection. Analysis of sputum reveals three potential pathogens from the patient's lungs. These are each isolated and grown in pure culture with four antibiotic discs present. These discs each consist of filter paper, soaked respectively in antibiotics A, B, C and D.

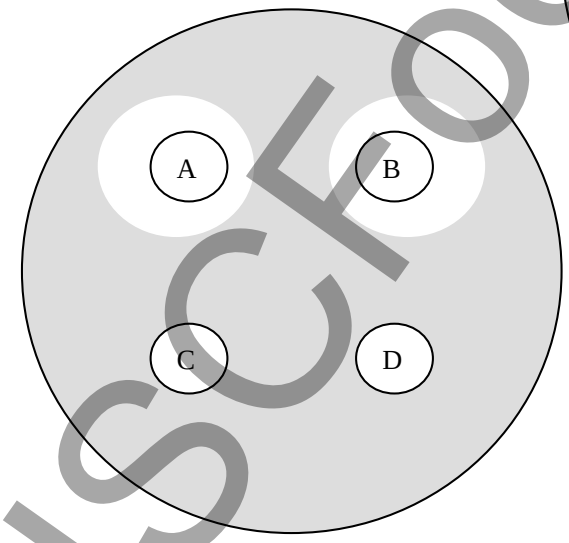
The diagrams below show these three cultures containing the antibiotic discs. The bacterial cultures are grey in colour.



Culture of suspected pathogen X



Culture of suspected pathogen Y



Culture of suspected pathogen Z

The doctors don't know which of the three potential pathogens is causing the disease.

Which one of the four antibiotics should they treat the patient with?

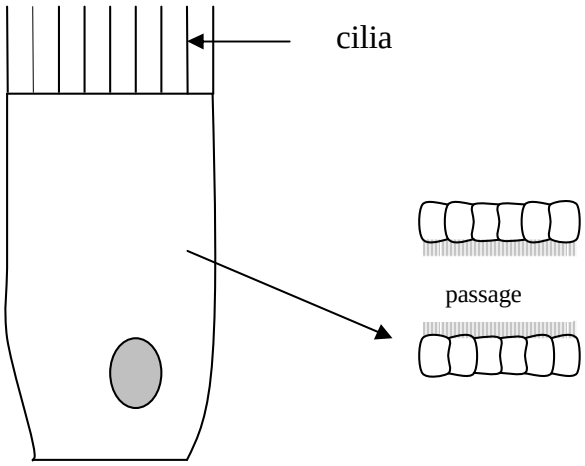
(A) A

(B) B

(C) C

(D) D

13. The diagram below shows a single ciliated epithelium cell and shows how a number of these cells surround a passage in the human body.



Cilia form part of the first line of defence against infection.

Where in the human body would you expect to find the greatest concentration of these cells?

(A) the digestive system

(B) the urinary system

(C) the respiratory system

(D) the immune system

14. Which type of pathogen consists simply of nucleic acid enclosed in a protein coat?

(A) bacteria

(B) fungi

(C) prions

(D) viruses

15. Antibodies are produced by plasma cells. Which one of the following types of cell gives rise to plasma cells?

(A) red blood cells

(B) phagocytes

(C) T lymphocytes

(D) B lymphocytes

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 (6 marks)

(a) In the space below make a clear labelled drawing of a section of DNA three base pairs long. **3**

(b) Explain how a change in the base sequence of DNA can bring about a change in cell activity. **3**

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Marks

Question 17 (4 marks)

One of the probable consequences of rising sea levels is the occasional inundation of low lying coastal land. This will have an effect on the types of plants which are able to live in these areas.

(a) Explain why conventional crops such as wheat cannot survive if the water they receive is too salty. **2**

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(b) Some flowering plants are able to live with high levels of salinity. Describe one way in which a named species of plant is adapted to live in salty water. **2**

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Question 18 (4 marks)

One of the major functions of blood is the transport of materials around the body.

Complete the table below to identify the forms in which particular substances are transported in the blood, their major source in the body and their major destination. **4**

Substance	Form in which transported	Transported	
		From	To
carbon dioxide			
nitrogenous waste			

Marks

Question 19 (8 marks)

The text boxes below contain information about the disease pertussis (whooping cough).

Causative organism.	The bacterium *Bordetella pertussis*.
Transmission.	-Via respiratory droplets, from human to human. Highly contagious.
Effect on host.	-Toxin mediated disease. (Bacteria attach to respiratory epithelial cells and release a toxin which paralyses the cilia.) - Gives rise to major symptoms: catarrh, followed by 'paroxysmal' cough. - Disease less severe in adults and adolescents, but can lead to death in young children. Particularly < 6 months old. - Death usually results from complications such as pneumonia.
Treatment.	- Antibiotics such as erythromycin.

Epidemiology

During the first half of the twentieth century pertussis was a major cause of death amongst young children in the developed world.

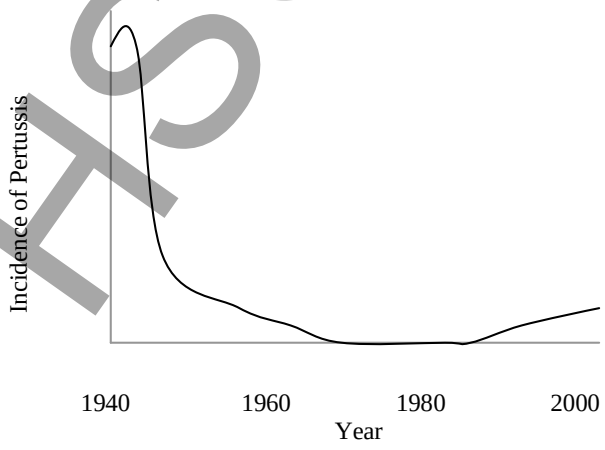
Mass vaccination began in the 1940s and the incidence declined dramatically.

Rare complications with the vaccine have led many parents to choose not to vaccinate their children since the 1980s.

The incidence of the disease is increasing in developed countries again.

In developing countries there has never been a co-ordinated program of mass vaccination against pertussis and it remains a major source of infant mortality. (The W.H.O. estimates 294,000 deaths from pertussis in 2002)

Sketch graph to show trends in incidence of pertussis in the developed world from 1940 to 2005.



Question 19 continues on page 12

Marks

Question 19 (continued)

(a) Explain why infection by *B. pertussis* leads to intense coughing. **2**

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(b) Pertussis is much less serious for adults and adolescents than it is for infants. Suggest why health authorities still see it as a priority to vaccinate previously unvaccinated adults against pertussis. **2**

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(c) Assess the effectiveness of the vaccination programs against pertussis in the developed world. **4**

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Marks

Question 20 (6 marks)

Some Mediterranean communities show a high incidence of the blood disease, Thalassemia.

There are two recognised forms of the disease, a severe and a mild form called Thalassemia major and Thalassemia minor respectively.

The disease has a genetic basis. The table below shows some of the possible outcomes of crosses between people with the different forms of the disease.

Parent phenotypes	Possible offspring phenotypes
major x major	major
normal x normal	normal
major x normal	minor

(a) A couple who both have Thalassemia minor have 4 children.

- Their oldest child, a boy, has Thalassemia major.
- Their next 2 children, both girls, have Thalassemia minor and normal blood respectively.
- Their youngest, a boy called Marc, has Thalassemia minor.
- Marc is married to Anna who has normal blood.

Draw a pedigree diagram in the box below to display this information. **3**

Question 20 continues on page 14

Marks

Question 20 (continued)

(b) What advice would you give Marc and Anna on the chance of their first child having either Thalassemia major or minor? Justify your answer. **3**

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Question 21 (4 marks)

With reference to a named example that you have studied, assess the benefits to society of hybridisation within a species. **4**

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Question 22 (6 marks)

Pectinase is an enzyme which is used commercially in the production of fruit juice. It catalyses the breakdown of the cell walls of the fruit to both turn fruit pulp into juice and to make cloudy juice clear.

Outline a procedure you could follow to investigate the effect of pH on the activity of pectinase. **6**

In your answer make sure you include:

- a hypothesis
- a list of equipment needed
- a step by step method
- one safety procedure
- the measures you should take to ensure that your results are valid and reliable

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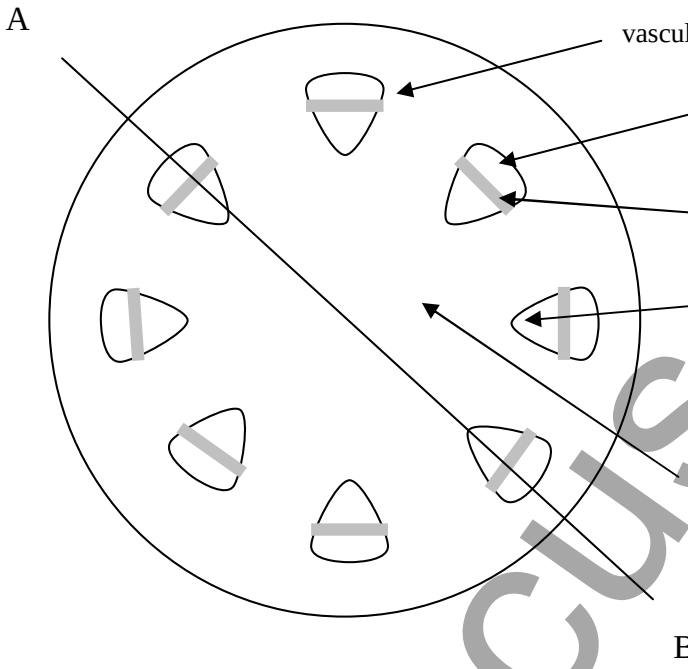
Marks

Question 23 (5 marks)

The drawing below is of a transverse section through a young stem. It is a map diagram, it shows no individual cells, just tissue types.



(a) In the space below, draw a map diagram of a longitudinal section of the stem above along the axis A-B. Label all tissues. **2**

Question 23 continues on page 17

Marks

Question 23 (continued)

(b) Explain how water is transported from the roots to the leaves in the xylem. **3**

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Question 24 (3 marks)

Complete the table below to explain how each of the measures mentioned reduces the risk of infectious disease. **3**

Public health measure	**The reason why this practice reduces the risk of infectious disease.**
Treating drinking water with chlorine	
Washing hands after using the toilet	
Discarding food that has passed its use-by date	

Marks

Question 25 (6 marks)

Many viruses, such as the one which causes the common cold, have high mutation rates.

Describe fully how the human immune system defends the body from a viral pathogen such as the cold virus, and explain why this protection is not long lasting in the case of a virus with a high mutation rate such as the common cold. **6**

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Marks

Question 26 (4 marks)

The text below was taken from a paper by Robyn Condor Broyles written in 1997 on the topic of punctuated equilibrium.

In it she refers to Richard Dawkins, currently one of the most highly regarded evolutionary biologists, and Niles Elderidge and Stephen Jay Gould, the two biologists who put forward the theory of punctuated equilibrium.

> Dawkins argues that punctuated equilibrium is not a "new" theory. Evolution under punctuated equilibrium occurs gradually, as it was assumed to do under Darwinism before punctuated equilibrium was proposed. Dawkins notes that Elderidge and Gould are "truly as gradualist as anybody else". Their theory merely proposes that the rate of evolution varies. According to Dawkins, this conclusion arises out of common sense; no biologist ever claimed that the speed of evolution has never varied. Dawkins says that "It isn't true that Darwin believed evolution proceeded at a constant rate", and implies that neither has any serious evolutionist since his time.
>
> Broyles R.C. 1997 Punctuated Equilibrium www.geocities.com/ginkgo100/pe.html -

Discuss Dawkins' suggestion that punctuated equilibrium and gradualism are essentially one and the same thing. **4**

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Marks

Question 27 (4 marks)

Describe the role of the lymph system in the defence of the body against disease.

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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.

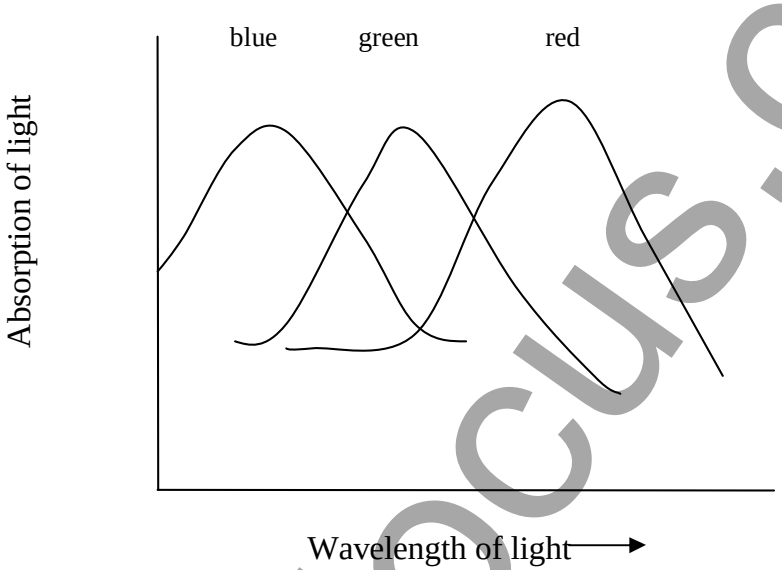
Marks

Question 28 --- Communication (25 marks)

(a) (i) Outline the function of the Eustachian tube. **1**

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

(b) The graph below shows the wavelengths of light absorbed by the three types of opsins in human cone cells.



(i) Explain how the three types of cone cell ensure colour vision across the whole spectrum. **2**

(ii) Outline the physiological cause of red-green colour blindness in humans. (Genetic details are not required) **2**

(iii) Contrast the use of colour vision in humans with that of another named species. Account for this difference in terms of the arrangement of cones. **4**

(c) Describe how modern technologies have been used to correct deficiencies in hearing and eyesight and assess the impact of these technologies on human society. **7**

Question 28 continues on page 23

Marks

Question 28 (continued)

(d) (i) Outline the chain of events that occurs when a neurone transmits a signal. **3**

(ii) Using a specific example, outline how the correct interpretation of sensory signals by the brain is essential for the coordination of behaviour. **3**

Marks

Question 29 --- Biotechnology

(a) (i) Name the process by which the genetic code is transferred from DNA to RNA. **1**

(ii) Compare the structure of DNA and RNA. **3**

(b) (i) Outline the events that led to the use of micro-organisms for the manufacture of yoghurt and cheeses. **3**

(ii) Describe changes that have occurred in a species of grain or animal as a result of domestication. **2**

(iii) Explain how the organic compound citric acid can be produced through fermentation. **3**

(c) Assess the potential of recombinant DNA technology to influence society. **7**

(d) (i) Outline the process used in a named example of aquaculture. **2**

(ii) Discuss the advantages and disadvantages associated with the use of this product. **4**

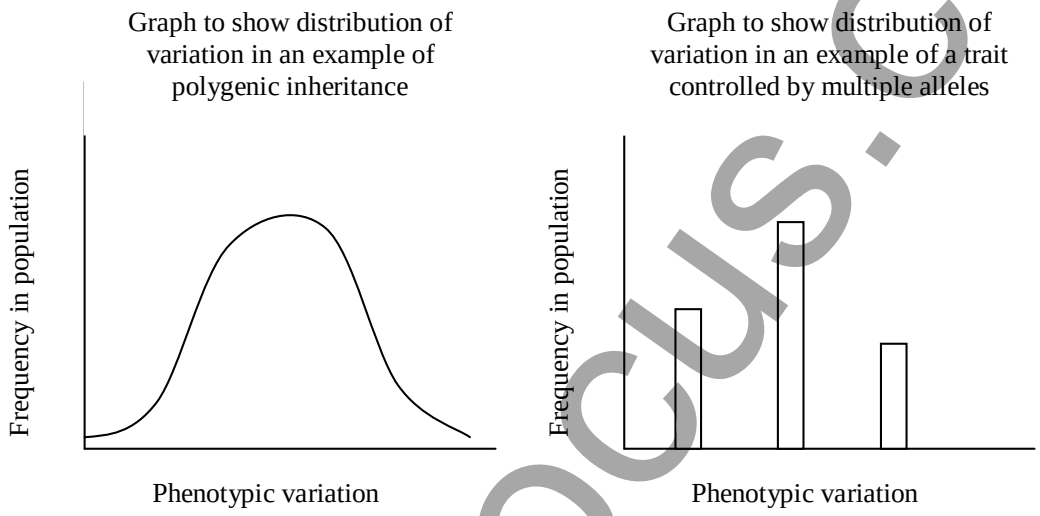
Marks

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

(a) (i) Name an example of a haploid human cell. **1**

(ii) Describe how DNA can repair itself. **3**

(b) The graphs below show the distribution of variation in a population as a result of two different mechanisms of inheritance.



(i) Give an example of each type of inheritance. **2**

(ii) Explain why each type of inheritance gives this pattern of variation. **4**

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

(d) (i) Distinguish between base substitution and frame shift mutations in terms both of what they are and their effect on the polypeptides produced. **4**

(ii) Using a named example of selective breeding, show how a series of changes have brought about an outcome which is favourable to humans. **4**

Marks

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

(a) (i) Outline one cultural change that occurred as humans moved from living in forests to open grasslands. **1**

(ii) Explain one effect of this change on human evolution. **3**

(b) The picture below is of a lemur. A type of prosimian.

(i) Compare the features of the prosimians with those of the more advanced primates. **4**

(ii) Explain how DNA-DNA hybridisation could be used to show the evolutionary relationships between lemurs and other primates. **4**

(c) Outline TWO different views of human evolutionary relationships and assess the evidence supporting them. **7**

(d) (i) Analyse the evolutionary significance of a specific human polymorphism. **4**

(ii) Distinguish between polymorphism and clinal gradation. **2**

Marks

Question 32 --- Biochemistry (25 marks)

(a) (i) Identify a factor which affects the rate of photosynthesis. **1**

(ii) Name the TWO main products of photosynthesis and outline their importance to life on earth. **3**

(b) (i) Make a drawing of a chloroplast, indicating the thylakoids and the stroma. **4**

(ii) Identify the site of the light reaction. **1**

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

(c) Evaluate the impact of technological advances on our understanding of photosynthesis. **7**

(d) (i) Show how the work of a named seventeenth or eighteenth century scientist contributed to the understanding that plant growth is not just due to soil and water. **3**

(ii) Explain how the work of Engelmann led to the description of the action spectrum of photosynthesis. **3**

End of Paper