INSTRUCTIONS TO CANDIDATES:
(To be read out by the external invigilator before the start of the examination)

The Biology Examination is divided into two parts:

SECTION A: Multiple-Choice - (20 x 1 mark questions)
SECTION B: Short-Answer - (10 x 8 mark questions)

The Answer Booklet is inserted in the centre of this Question Booklet. Take out the Answer Booklet now.

Check that there are 12 printed pages in the question booklet and 7 printed pages in the answer booklet.

Write your name, school name and your candidate number on the front cover of your answer booklet.

For each question in SECTION A (multiple-choice) choose the best answer by writing the letter A or B or C or D or E in the space provided on the ANSWER GRID provided.

If you decide to change an answer, make your correction as shown below so that it is clear to the markers what your final answer is. Do NOT use correction fluid on your answer sheet.

For each question in SECTION B (short-answers) work out the answer and write the answer in the space provided in the ANSWER BOOKLET.

Write your answers in BLUE or BLACK ink (pen or biro).

Calculators and rulers are allowed.

Hand in the question paper, the Answer Booklet and the papers used for rough work at the end of the examination.

DO NOT WRITE ON THIS QUESTION PAPER

ANSWERS WRITTEN ON THE QUESTION PAPER WILL NOT BE MARKED. WRITE ANSWERS NEATLY IN THE SPACES AS PROVIDED ON THE ANSWER SHEET.

THE PENALTY FOR CHEATING OR ASSISTING OTHERS TO CHEAT IN NATIONAL EXAMINATIONS IS NON-CERTIFICATION.

DO NOT TURN OVER THE PAGE AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.
SECTION A (Questions 1 to 20)

Write the answers to your questions in the answer BOOKLET by writing the correct alternative, A, B, C, D or E only. Answers written on this question paper will not be marked.

QUESTION 1

The information below shows characteristics (I – VIII) of roots in plants

I. outgrowths of root epidermal cells
II. are approximately 15cm long
III. help anchor plant in soil
IV. absorb water from soil
V. are abundant on very old roots
VI. limited to the tip of plant roots
VII. life span is greater than 1 week
VIII. do not become roots

Which list below has only those characteristics that best describe *root hairs*?

A. I, III, IV, VI, VIII
B. I, II, IV, V, VI
C. I, III, IV, VI, VII
D. I, II, IV, VI, VII, VIII
E. All the listed characteristics (I-VIII)

QUESTION 2

Mitochondria and chloroplasts share structural and functional similarities. Which of the following do both these organelles have in common?

A. generate ATP
B. create complex molecules
C. contain their own DNA
D. are found inside vacuoles
E. are surrounded by a cell wall

QUESTION 3

A simple reflex arc in human is made up of five (5) distinct phases in a sequential order:

I. effector organ response
II. intermediate nerve fibre transmission
III. sensory nerve fibre transmission
IV. motor nerve fibre transmission
V. sensory receptor receiving stimulus

The correct sequence of events when a person responds to the stimulus of touching a hot metal object is

A. V – III – II – IV – I
B. I – II – III – IV – V
C. III – V – IV – II – I
D. V – II – III – IV – I
E. V – III – IV – II – I

QUESTION 4

It is said that the ecosystems in estuaries and coral reefs are relatively high in productivity per unit area compared to the deep seas. Which of the following reasons best explains the high productivity rates?

A. higher concentrations of phosphate
B. higher concentrations of nitrite
C. lower concentrations of ammonia
D. higher concentrations of nitrate
E. lower concentrations of chloride
QUESTION 5
Which one of these descriptions best characterises the biome, Taiga?
A. occurs along coastlines with temperate climate
B. northern forests with coniferous trees that retain needle-like leaves all year
C. open, windswept and boggy landscapes
D. soil ice persists throughout all seasons
E. mild but seasonal climates with plentiful rain

QUESTION 6
Which two parameters most directly influence the location of biomes?
A. altitude and latitude
B. latitude and temperature
C. temperature and precipitation
D. precipitation and altitude
E. precipitation and latitude

QUESTION 7
Which of the following groups can have both decomposers and autotrophic members?
A. fungi
B. plants
C. bacteria
D. protozoa
E. phytoplankton

QUESTION 8
An organism’s _________ is determined by its _______________.
A. genotype; phenotype
B. phenotype; genotype
C. alleles; phenotype
D. F₁ generation; alleles
E. phenotype; F₁ generation

QUESTION 9
A population of 100 feral (wild) deer in the Western Province has an annual birth rate of 50% and death rate of 20%. The carrying capacity of their range is 200 deer. What is the rate of growth for the deer population?
A. 0.7
B. 0.5
C. 0.3
D. 0.2
E. 0.1

QUESTION 10
Which of the following provides the best information to support the theory of evolution?
A. climate change
B. plate tectonics
C. possession of limbs
D. historical documents
E. fossil evidence

QUESTION 11
In the monohybrid cross, Ww x ww, where W is round and dominant and w is wrinkled and recessive. What is the expected phenotypic ratio of the F₁ offspring?
A. 3 round: 1 wrinkled
B. 1 round: 3 wrinkled
C. 4 round: 0 wrinkled
D. 0 round: 4 wrinkled
E. 1 round: 1 wrinkled
**QUESTION 12**

Below lists some of the various cell components found in living organisms:

1. nucleus  
2. mitochondrion  
3. vacuole  
4. cell wall  
5. ribosome  
6. cell membrane  
7. DNA  
8. chloroplast

Which list below contains only those cellular components found in both plant and animal cells?

A. 2, 3, 4, 6 & 8  
B. 1, 2, 5, 6 & 7  
C. 1, 2, 3, 5, & 6  
D. 2, 1, 5, 6, & 8  
E. 2, 5, 7, 3 & 8

**QUESTION 13**

Advantages of internal fertilization over external fertilization include

I. ensuring that male gametes come into close proximity to female gametes.
II. protection of gametes from predation or other harmful environmental factors.
III. increased likelihood of desiccation of gametes.

Which of the above are TRUE?

A. I only  
B. II only  
C. III only  
D. I and II only  
E. I, II and III

**QUESTION 14**

Air moves into the lungs when the air pressure in the lungs is __________________ than the air pressure outside of the lungs. This occurs when the muscles of the diaphragm _______________.

A. lower, relax  
B. higher, relax  
C. lower, contract  
D. higher, contract

**QUESTION 15**

Of the following, which blood vessel does not carry oxygenated blood?

A. pulmonary vein  
B. pulmonary artery  
C. renal artery  
D. carotid artery  
E. hepatic artery

**QUESTION 16**

All statements below relate to HIV (human immunodeficiency virus) and AIDS (acquired immune deficiency syndrome).

Determine the statement that is NOT correct about this important medical disease.

A. AIDS is caused by HIV  
B. HIV compromises the host immune system  
C. HIV infects immune-system cells  
D. HIV is a direct killer by itself  
E. HIV treatment is an active field of research
**QUESTION 17**

Data in the table below indicates an evolutionary relationship for five species of animals.

<table>
<thead>
<tr>
<th>Species</th>
<th>Canine Teeth</th>
<th>Preferred Food</th>
<th>Forelimb</th>
<th>Nails/foot</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat</td>
<td>Yes</td>
<td>Insect</td>
<td>Wing</td>
<td>5</td>
<td>Fur</td>
</tr>
<tr>
<td>Mouse</td>
<td>No</td>
<td>Plant</td>
<td>Leg</td>
<td>4</td>
<td>Fur</td>
</tr>
<tr>
<td>Robin</td>
<td>-</td>
<td>Insect</td>
<td>Wing</td>
<td>4</td>
<td>Feather</td>
</tr>
<tr>
<td>Rat</td>
<td>No</td>
<td>Plant</td>
<td>Leg</td>
<td>4</td>
<td>Fur</td>
</tr>
<tr>
<td>Shrew</td>
<td>Yes</td>
<td>Insect</td>
<td>Leg</td>
<td>5</td>
<td>Fur</td>
</tr>
</tbody>
</table>

Humans are more closely related to shrews than mice. This means that

A. humans descended directly from shrews.
B. humans and shrews have legs.
C. shrews and mice don’t have canines.
D. humans and shrews have a more recent common ancestor than humans and mice.
E. humans and mice have a more recent common ancestor than humans and shrews.

**QUESTION 18**

Nitrogenous waste excretion is an animal’s way to remove the breakdown products of which type of food.

A. proteins
B. lipids
C. carbohydrates
D. fats
E. minerals

**QUESTION 19**

Which of these statements is **true** about the male hormone, testosterone?

A. promotes facial hair growth   B. is controlled by the hypothalamus
C. it is secreted by Leydig cells   D. causes deepening of voice at puberty.
E. stimulates secretion of LH from the pituitary gland

**QUESTION 20**

Which of the following is an example of ovoviviparity?

A. honeybees lay soft eggs within the hive
B. sharks hatch from shells held within the female’s body
C. birds hatch from eggs laid within a nest
D. kittens obtain nourishment from the mother through a placenta
E. eggs are released into the water, where they may be fertilized
Section B

Write your answer to the questions in the spaces provided in your answer booklet.

QUESTION 21

The figure illustrates the results/data obtained from an experiment showing the survival counts of individuals of two protists, *Didinium* and *Paramecium*, over a one-week period in a glass tank.

![Graph showing survival counts of *Didinium* and *Paramecium* over a one-week period.]

**a)**
(i) Describe the *Paramecium* numbers on Day 1 compared to *Didinium*. (1)

(ii) Give the most possible explanation as to why the *Paramecium* numbers and the *Didinium* numbers are what they are on Day 3? (1)

(iii) What kind of an ecological relationship can be seen in this set-up? (1)

(iv) The levels of both populations at Day 5 onward are declining. Explain why it is not possible for both or either populations to regain their numbers after this time. (1)

**b)**
(i) Name a hormone produced by the gland labelled X in the diagram below? (1)

(ii) What is the name of the gland marked Y? (1)

(iii) To what body system do all the glands in the above diagram belong? (1)

(iv) The Central Nervous System is made up of the brain and the __________. (1)
**QUESTION 22**

![Graph showing temperature and carbon dioxide concentrations from 1958 to 2006](image)

**a)** The figure above shows a steady increase in temperature and carbon dioxide concentrations monitored from 1958 to 2006, from a monitoring station on Mt. Loa Volcano on the island of Hawaii. These results support the global warming hypothesis.

(i) Give one reason for the steady rise in atmospheric CO$_2$ in that 48 year period. (1)

(ii) Carbon dioxide is often called a greenhouse gas because its effects are similar to that of a greenhouse. Explain how CO$_2$ produces the ‘greenhouse’ effect? (2)

(iii) Name one other greenhouse gas. (1)

**b)** A problem facing many lakes is eutrophication. In this process plant growth increases dramatically and leads to lakes filling in and becoming marshes and bogs prematurely. You wish to design an experiment to test eutrophication. You obtain four aquaria; add 3 *Hydrilla* plants to each and some clean water. To the first aquarium you add no fertilizer. To the other three aquaria you add 1 g/L, 5 g/L and 10 g/L fertilizer. You place the four aquaria under lights and measure the mass of the plants in the aquaria every week for three weeks.

(i) What is the dependent variable in your experiment. (1)

(ii) What is the independent variable in your experiment. (1)

(iii) Which of the variables is controlled? (1)

(iv) In addition to filling in lakes, why is eutrophication a biological concern? (1)
QUESTION 22

This diagram shows the trophic levels in Lake Kopiago, in three different types of pyramid.

(a) What makes the photosynthetic plankton important at the bottom of all the pyramids? (1)

(b) Why does the bottom trophic level in A. have the greatest energy levels? (1)

(c) The width of the boxes on the pyramid of numbers is proportional to the numbers of individuals present in the various trophic levels. From pyramid C, explain why the population in the bottom trophic level is far greater than all the other trophic levels? (2)

(d) What does the pyramid of biomass represent? (2)

(e) Why does the energy decrease towards the top of the pyramid? (2)

QUESTION 24

(a) (i) Name the cells that control the opening and closing of stomata. (1)

(ii) What process allows the water to enter the roots? (1)

(iii) Name the process by which water is evaporated from the leaves of plants? (1)

(iv) A water potential gradient from the roots to the shoots enables the movement of water from the bottom of the plant to the top. What type of water potential gradient is created by evaporation in the leaves? (1)
b)  (i) In which part of the human circulatory system does the actual exchange of gases take place? (1)
(ii) Organisms with a closed circulatory system usually have thicker arteries than veins. Why do the arteries have thick smooth muscle tissue compared to veins? (1)
(iii) Name the type of lymphocyte which is primarily responsible for killing infected, mutated, or transplanted cells. (1)
(iv) When a human has swollen lymph nodes just under the armpits due to infected sores around the fingers, what does that imply is occurring in the lymph nodes? (1)

**QUESTION 25**

The diagrams below (A, B, C & D) illustrate the gas exchange systems in four representative members of the Animal Kingdom.

![Diagram A: Single Cell Organisms](image)

![Diagram B: Insects](image)

![Diagram C: Fish](image)

![Diagram D: Mammals](image)

a)  (i) What important aspect of the numerous alveoli found in the mammalian gas exchange systems is responsible for efficient and maximum exchange of gases? (1)
(ii) Fish have external gills. Name one disadvantage of having external gills? (1)
(iii) Name an advantage the single celled organisms have over the multicellular organisms with respect to gas exchange. (1)
(iv) What other system in the mammalian body operates with the respiratory system to bring about efficient gas exchange for the entire body’s needs? (1)

b)  The graph shows the number of open stomata on various days of the week.

![Graph: Average stomatal openings/cm² in hibiscus leaves](image)

(i) On average, how many stomatal openings were there in a 15 cm² area of leaf on Thursday? (1)
(ii) Name three climatic factors that may have contributed to the lowest reading on Tuesday? (3)
QUESTION 26
Figures A and B illustrates the evidence of natural selection on beak shape of a species of ground finch which feeds on plant seeds.

![Image of Figures A and B]

a) (i) What factor is responsible for the change in beak shape observed in Figure A? (1)
(ii) Provide possible explanations to the changes observed in the beak shape in Figure A. (2)
(iii) What type of relationship is shown by Figure B? (1)
(iv) Is the relationship between beak depth and climate heritable between offspring and parents? Explain your answer. (2)

b) Define the term **natural selection**. (2)

QUESTION 27
a) Study this figure that shows a part of the human digestive system.

![Image of Human Digestive System]

(i) Name structure R of the human digestive system. (1)
(ii) Name the organ where structure Q is coming from. (1)
(iii) Name the substance, crucial to digestion in humans, which is produced by the organ from which structure Q is coming. (1)
(iv) What is the primary function of the large intestine? (1)
(v) Name structure U and name one digestive enzyme secreted by this structure. (2)

b) Distinguish between the terms **digestion** and **absorption**. (2)
QUESTION 28

Figures A and B illustrate birth control through sterilization procedures as performed in human males and females, respectively.

A. Male sterilization procedure
b) Tubal ligation is the removal of female reproductive portions. Name the comparable procedure in males.

(ii) Name the respective reproductive tubes operated on in each sex, and describe what actually is done to effect reproductive sterilizations.

b) Explain the difference between self-fertilization and asexual reproduction in plants, in relation to genetic variability.

C) Name a field where asexual reproduction of plants is utilised for human commercial purposes.

QUESTION 29

A. Short hair is due to a dominant gene (H) in rabbits, and long hair to its recessive allele (h). A cross between a shorthaired female and a longhaired male produces a litter of one longhaired and seven shorthaired offspring.

(i) What are the genotypes of the parents?

(ii) What phenotypic ratio was expected in the offspring generation?

(iii) How many of the eight offspring were expected to be longhaired?

(iv) What is the pattern of inheritance?

B. The figure shows the correlation between maternal age and the incidence of a genetic condition known as Down syndrome.

(i) Explain what the graph is revealing?

(ii) Is the genetic condition inherited, that is, passed from a mother to offspring? Explain your answer.
QUESTION 30

A. The diagram shows one type of response movement (tropism) by a plant seedling.

(i) Name the type of tropism illustrated by the diagram, and the plant hormone responsible for causing the bending effect. (2)

(ii) With the help of the diagram and the answers given above, provide an explanation as to why the plant is bending towards the stimulus. (2)

B. Geotropism or gravitropism is the response of plants to gravity.

What is the respective term when:

(i) shoots grow upwards? (1)
(ii) roots grow downwards? (1)

C. Name the following types of tropism:

(i) Leaf tendrils growing towards a support when they come into contact. (1)
(ii) Roots grow towards a source of water in dry soil. (1)

END OF EXAMINATION