INSTRUCTIONS TO CANDIDATES:

(To be read out by the external invigilator before the start of the examination)

1. 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)

2. The Answer Booklet is inserted in the centre of this Question Booklet. Take out the Answer Booklet now.
   - Check that there are 15 printed pages in the question booklet and 7 printed pages in the answer booklet.

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

4. 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.

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

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

7. Calculators and rulers are allowed.

8. 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
MULTIPLE CHOICE QUESTIONS

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.

Questions 1 and 2 refer to the following diagram, which shows a generalised plant cell.

**QUESTION 1**
What process occurs in the structure labelled W?
A. aerobic respiration  
B. DNA replication  
C. photosynthesis  
D. protein synthesis  
E. packaging of molecules

**QUESTION 2**
What process occurring in this cell does NOT occur in animal cells?
A. Kreb’s cycle  
B. light reaction  
C. transcription  
D. chemical secretion  
E. glycolysis

**QUESTION 3**
Lymphatic fluid is mainly composed of plasma and
A. white blood cells.  
B. haemoglobin.  
C. antibodies.  
D. water.  
E. proteins.

*HSCE Biology, 2009*
**QUESTION 4**

A human kidney nephron consists of

A. medulla, cortex, collecting duct and bladder.
B. renal artery and vein and associated capillaries.
C. the bladder, ureter and urethra.
D. Bowman’s capsule, convoluted tubules and loop of Henle.
E. metanephridia, nephrostomes, collecting tubules and nephridiopores.

**QUESTION 5**

Saltwater fish maintain their osmotic balance by

A. drinking large amounts of sea water and excreting concentrated urine.
B. secreting salt ions from their gills and excreting large volumes of dilute urine.
C. drinking large amounts of sea water and excreting large volumes of dilute urine.
D. absorbing salt ions through their gills and excreting large volumes of dilute sea water.
E. absorbing both salt and water through their gills and other body surfaces.

**QUESTION 6**

What is the function of the Polar Bodies produced during female mammalian gametogenesis?

A. They develop into ova for the next ovarian cycle.
B. They form the placenta for the developing embryo.
C. They produce the hormones that control the menstrual cycle.
D. They monitor the development of the embryo during the first few weeks and then break down.
E. They have no known reproductive function.

**QUESTION 7**

What is the name of the endocrine gland that produces HGH (Human Growth Hormone)?

A. Thyroid  
B. Pituitary  
C. Adrenal  
D. Pancreas  
E. Thymus

**QUESTION 8**

Blood groups and the ability to roll the tongue are examples of

A. discontinuous variation.  
B. genetic mutations.  
C. polygenic inheritance.  
D. incomplete dominance.  
E. continuous variation.
**QUESTION 9**

A student set up an experiment using a semi permeable membrane as shown below. At the start of the experiment the same amount of water was added to both sides of the membrane. The student then added sucrose to the left side of the membrane as shown in the diagram.

Which of the following best describes what happens next?

A. Water rises to the right of the membrane.
B. The level of water on both sides of the membrane remains unchanged.
C. Water molecules move to the left side of the membrane by osmosis.
D. Water molecules move to the right side of the membrane by passive diffusion.
E. Sugar molecules move to the right side of the membrane by facilitated diffusion.

**Questions 10 and 11 refer to the following diagram.**

**QUESTION 10**

Which of the parts of the plant shown make up the female part of the flower?

A. D, E and F
B. A, C and G
C. A, B and C
D. A, E and H
E. B, D and G

**QUESTION 11**

What is the function of the parts labelled G?

A. to support the petals when they open
B. to attract insects for pollination
C. to produce pollen for dispersal
D. to protect the flower when it is a bud
E. to become the fruit after fertilisation
**QUESTION 12**

An experiment was set up with nine test tubes, each containing the same amount of enzyme, being placed in a water bath at 37°C. Increasing concentrations of glucose solution were placed in tubes 2 to 9, while test tube 1 was given only water. The time taken for the glucose to break down completely in each tube was measured.

The results are shown on the graph below.

![Graph showing rate of glucose breakdown](image)

The results show that the rate of breakdown of glucose increases with the increase in

A. substrate concentration only.  
B. the amount of enzyme only.  
C. temperature only.  
D. substrate concentration and temperature.  
E. substrate concentration and amount of enzyme.

**QUESTION 13**

The rate of reaction of a typical human enzyme was compared with the rate of reaction of a typical enzyme taken from bacteria that live in hot springs. The rates of reaction were measured over the same range of temperatures as shown in the following graph.

![Graph comparing human and bacterial enzymes](image)

Which of following conclusions can be drawn from the graphs?

A. The optimal temperature for enzymes for both organisms is about 37°C.  
B. Denatured bacterial enzymes would resume activity if incubated at 40°C.  
C. Enzymes from bacteria that live in hot springs can withstand temperatures up to 100°C.  
D. Human enzymes show their optimum performance between 40 and 50°C.  
E. Both enzymes show similar responses to temperature changes but at different temperature ranges.
QUESTION 14
When pure-breeding red lilies are crossed with pure-breeding white lilies the resulting offspring all have petals which are a mixture of red and white patches. This is an example of

A. incomplete dominance.  
B. double recessive inheritance.  
C. co-dominance.  
D. natural selection.  
E. polygenic inheritance.

QUESTION 15
The following statements summarise the stages in evolution by natural selection, but they are not in the correct order.

1. Some individuals are better suited to that particular environment.  
2. Over time there is an increase in advantageous characteristics in the population.  
3. There is variation within a population, some of which is genetic.  
4. Individuals better suited to the environment are more successful at survival and reproduction.  

The order of statements which best describe natural selection is

A. 4, 1, 3, 2  
B. 3, 1, 4, 2  
C. 3, 4, 2, 1  
D. 2, 3, 1, 4  
E. 1, 4, 3, 2

QUESTION 16
What type of vegetation is found in the biome represented by the climate graph?

A. equatorial rainforest  
B. coniferous forest  
C. tropical grassland with scattered trees  
D. xerophytic (drought resistant) plants  
E. temperate deciduous forest

QUESTION 17
Which line on the graph below shows the population changes for a bird species that lives in a community where resources are abundant allowing the population to increase until the carrying capacity is reached?
QUESTION 18

The table below shows the biomass of six organisms in a community.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Biomass (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>55</td>
</tr>
<tr>
<td>K</td>
<td>10</td>
</tr>
<tr>
<td>L</td>
<td>250</td>
</tr>
<tr>
<td>M</td>
<td>210</td>
</tr>
<tr>
<td>N</td>
<td>3500</td>
</tr>
<tr>
<td>P</td>
<td>75</td>
</tr>
</tbody>
</table>

Which of the following shows a probable food chain from this data?

A.  K → P → M → N
B.  L → N → J → K
C.  N → K → P → L
D.  N → L → J → K
E.  K → N → L → P

QUESTION 19

The types of movement across a plasma membrane are shown at X, Y and Z.

Which line in the table below correctly describes the types of movement shown?

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. active transport</td>
<td>facilitated diffusion</td>
<td>passive diffusion</td>
</tr>
<tr>
<td>B. facilitated transport</td>
<td>passive diffusion</td>
<td>active transport</td>
</tr>
<tr>
<td>C. passive diffusion</td>
<td>active transport</td>
<td>facilitated diffusion</td>
</tr>
<tr>
<td>D. active transport</td>
<td>passive diffusion</td>
<td>facilitated diffusion</td>
</tr>
<tr>
<td>E. facilitated diffusion</td>
<td>active transport</td>
<td>passive diffusion</td>
</tr>
</tbody>
</table>

QUESTION 20

Where in the cell does translation take place during the process of protein synthesis?

A. on the chromosomes
B. in the cytoplasm
C. in the endoplasmic reticulum
D. in the nucleus
E. in the ribosome

END OF SECTION A
SECTION B

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

QUESTION 1
The diagrams below show the structure for both a plant cell and an animal cell.

*Note. The parts are not drawn to the same scale.*

a) Write down the letters from the two diagrams that correspond to the following organelles:
   i. Cell Membrane     ii. Ribosome     iii. Endoplasmic Reticulum (3)

b) State the name and function of the organelles identified by the letters:
   i. G and S     ii. C and N (2)

c) Identify any two structures present in plant cells but not found in animal cells. (2)

d) Briefly describe how a prokaryotic cell differs from the eukaryotic cells shown above. (1)

QUESTION 2
The diagrams below show three methods of seed dispersal.

(i)  
(ii)  
(iii)

a. For each method shown, state the agent of dispersal and describe the adaptations shown by
   the fruit to ensure successful seed dispersal. (3 x 2 marks each – 6)

b. Explain fully why seeds need to be dispersed away from the parent plant. (2)
**QUESTION 3**

The diagrams below represent pollination, fertilisation and development of the embryo from the zygote in plants.

![Diagram of pollination, fertilisation, and embryo development](image)

a. (i) Name the type of nuclear division by which haploid gametes are produced by the anthers and the ovary. (1)

(ii) What is the significance of this process in sexual reproduction? (2)

(iii) What does the ovary generally become after the ovule (egg) has been fertilised? (1)

b. Self incompatibility is the ability of some plant species to reject their own pollen in favour of pollen from another, less-closely related, individual.

Give two reasons why self-incompatibility is an advantage for these plants? (2)

c. Describe two methods by which plants may reproduce asexually. (2)

**QUESTION 4**

a. List two characteristics of respiratory surfaces. (2)

b. (i) Write down the chemical equation for cellular respiration. (1)

(ii) In what form is the energy produced by cellular respiration stored and what substance? (2)

c. In humans undergoing strenuous exercise, the body temporarily uses anaerobic respiration to produce energy.

(i) Name the toxic by-product of anaerobic respiration in humans. (1)

(ii) Describe two ways in which anaerobic respiration is used for commercial purposes. (2)
QUESTION 5

1a Star-shaped ................................................................. 2
1b Not star-shaped ............................................................. 6
2a Arms touching each other near body .................................. 3
2b Arms completely separate at body ...................................... 5
3a Five arms .................................................................. 4
3b More than five arms ...................................................... Crossaster papposus
4a Arm length about half total radius of the animal .................. Asterina gibbosa
4b Arm length much more than half of the total radius of the animal ... Asterias rubens
5a Five arms ................................................................ Ophiothrix fragilis
5b More than five arms ...................................................... Ophiothrix muttans
6a Body spherical or heart-shaped, covered in spines ................. 7
6b Body cylindrical shaped, without spines ............................... Cucumaria normani
7a Body heart-shaped, with weak spines .................................. Spatangus purpureus
7b Body spherical, with long spines ........................................ Echinus esculentus

A

![Image of A]

B

![Image of B]

C

![Image of C]

D

![Image of D]

a) Study the dichotomous key and diagrams below.
   (i) Name the Kingdom and Phylum to which all these organisms belong? (1)
   (ii) Which of the organisms shown is most probably Asterina gibbosa? (1)
   (iii) What are the genus and species names of specimen D? (1)
   (iv) What characteristic do these organisms share with other phyla such as the Mollusca, Annelida and Arthropoda but not the Pisces or the Aves? (1)

b) State one difference and one similarity between the Archaebacteria and the Eubacteria. (2)

c. (i) How do the gymnospermae and angiospermae differ from the rest of the plant Kingdom? (1)
   (ii) How do the angiosperms differ from the gymnosperms? (1)
QUESTION 6

The map below shows the geographical extent of one of the world’s major biomes. The graph is taken from a station towards the southern edge of this biome.

a. Name the biome shown and describe the physical and climatic characteristics found there. (2)

b. Using named examples, describe two physiological adaptations of animals that allow them to survive in this biome. (2)

c. Using named examples, describe two behavioural adaptations shown by animals that help them to survive in this biome. (2)

d. Describe the vegetation of this biome, showing how it is adapted to its environment. (2)
QUESTION 7

a. The two graphs below show the growth of two species of the protozoan (single-celled animal) *Paramecium* when grown separately and when grown together in the same culture medium.

(i) What type of population growth occurs between day 1 and day 6 when the populations are grown separately? (1)

(ii) What is the maximum level of population growth called? (1)

(iii) Suggest two factors that limit population growth after day 10. (1)

(iv) Explain the pattern of growth shown by the two species when grown together in the same culture. (1)

b. The diagram and two graphs below show the growth of two barnacle species in the intertidal zone of a rocky shore.

Graph 1 shows the distribution of the two species when they grow together on the same rock and Graph 2 their distribution if they are grown separately.

(i) What type of niche do the arrows labelled P and Q represent in Graph 1? (1)

(ii) Explain why the distribution of Chthamalus increases when grown alone (as shown by the arrow labelled ‘T’ in graph 2). (1)

(iii) Suggest one environmental factor that limits the distribution of Balanus into the upper intertidal zone. (1)

c. What type of competition is demonstrated by the two examples above? (1)
QUESTION 8

a. Refer to the diagram below.

(i) On the answer sheet, write the names of the molecules labelled P, Q and R.  

(ii) Which three molecules make up a nucleotide?

b. (i) How and where is messenger RNA formed?

(ii) What is the function of transfer RNA?

b. (i) How and where is messenger RNA formed?

(ii) What is the function of transfer RNA?

(c. In normal human brain cells the PRNP gene found on chromosome 20 codes for the membrane protein PrPc. The genetic Creutzfeldt-Jacob disease (CJD) is caused by a mutation in DNA base triplet 200 of the PRNP gene, as shown below.

<table>
<thead>
<tr>
<th>DNA base triplet number</th>
<th>normal PRNP gene</th>
<th>mutated PRNP gene</th>
</tr>
</thead>
<tbody>
<tr>
<td>199</td>
<td>TGG</td>
<td>TGG</td>
</tr>
<tr>
<td>200</td>
<td>CTC</td>
<td>TTC</td>
</tr>
<tr>
<td>201</td>
<td>CAA</td>
<td>CAA</td>
</tr>
</tbody>
</table>

mRNA Codon | Amino acid
-------------|-------------
ACA, ACC, ACG, ACU | Threonine
AAA, AAG | Lysine
CAA, CAG | Glutamine
CUA, CUC, CUG, CUU | Leucine
GAA, GAG | Glutamic acid
UGG | Tryptophan
UUC, UUU | Phenylalanine
UUG, UUA | Leucine

(i) Write the normal mRNA codons for DNA base triplets numbers 199, 200 and 201.

(ii) State the amino acid substitution that would occur because of this mutation in base triplet 200.
**QUESTION 9**

a. (i) What is the main purpose of mitosis? (1)

b. The diagram shows one stage of meiosis.
   (i) What stage is represented by the diagram? (1)
   (ii) Describe, in detail, what is occurring in the diagram and explain how these processes are an evolutionary advantage. (3)

![Diagram of meiosis](image)

C. Coat colour in mice is under the control of a single gene with two alleles. Many crosses between yellow-coated mice and mice with grey coats gave the following results. *The mice with grey coats were known to be homozygous.*

<table>
<thead>
<tr>
<th>Parental Cross</th>
<th>yellow x grey</th>
</tr>
</thead>
<tbody>
<tr>
<td>First generation</td>
<td>50% yellow : 50% grey</td>
</tr>
</tbody>
</table>

(i) Using Y for the dominant allele and y for the recessive, state the genotypes of the F₁ yellow mice and the F₁ grey mice. (1)

(ii) What would be the expected proportion of yellow to grey mice if the F₁ yellow mice were repeatedly crossed with each other? (1)

(iii) Biologists who repeated these crosses however discovered that the actual ratio of yellow to grey mice was 2 yellow for every 1 grey offspring.

Suggest a reason for this apparent anomaly. (1)
QUESTION 10

a. The evolutionary theories of Lamarck and Darwin are quite different. However, there is one determining factor that they both understood as being important.

Briefly name and describe this main factor that is the basis of evolutionary theory and describe how Darwin and Lamarck interpreted it differently. (4)

b. The diagram shows the variety of finches that Darwin discovered on the various islands of the Galapagos.

Briefly explain the mechanism by which Darwin suggested they had become so different, yet all descending from a common mainland ancestor. (2)

c. The diagram shows how animals have in Australia have become similar to animals elsewhere in the world despite being geographically separated and having different reproductive mechanisms. Name the type of evolution that has occurred and briefly explain why the animals have become so similar in form. (2)