TONGA FORM SIX CERTIFICATES
2016
BIOLOGY

QUESTION AND ANSWER BOOKLET

Time allowed: 2 Hours & 15 minutes

INSTRUCTIONS

1. Write your Student Enrolment Number (SEN) on the top right-hand corner of this page.
2. Additional sheets of paper can be obtained from your supervisor if necessary. Write your Student Enrolment Number (SEN) on each addition sheet number the questions clearly and insert them in the appropriate part of your booklet and tie securely.
3. You are expected to apply the principles and knowledge learned from the Biology curriculum taught throughout this academic year.
4. This examination consists of THREE Sections.

<table>
<thead>
<tr>
<th>SECTION</th>
<th>Pages</th>
<th>Total Skill Level</th>
<th>Time</th>
</tr>
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<tbody>
<tr>
<td>A Multiple Choice</td>
<td>2-6</td>
<td>10</td>
<td>30 minutes</td>
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<tr>
<td>B Short Answer</td>
<td>7-24</td>
<td>50</td>
<td>65 minutes</td>
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<tr>
<td>C Extended Response Questions</td>
<td>25-29</td>
<td>15</td>
<td>40 minutes</td>
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<td>29</td>
<td>75</td>
<td>135 minutes</td>
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5. Check that this booklet contains pages 2-31 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR BEFORE YOU LEAVE THE EXAMINATION ROOM.
1. The diagram below illustrates part of a prokaryotic cell.

Which of the following labels correctly match structures O, P, Q, R and S?

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Endoplasmic Reticulum</td>
<td>Cell Membrane</td>
<td>Large Vacuole</td>
<td>Transport tube</td>
<td>Starch Molecules</td>
</tr>
<tr>
<td>B</td>
<td>Endoplasmic Reticulum</td>
<td>Cell Membrane</td>
<td>Nucleus</td>
<td>Transport tube</td>
<td>Ribosomes</td>
</tr>
<tr>
<td>C</td>
<td>Rough ER</td>
<td>Nuclear Membrane</td>
<td>Large Vacuoles</td>
<td>Smooth ER</td>
<td>Starch Molecules</td>
</tr>
<tr>
<td>D</td>
<td>Rough ER</td>
<td>Nuclear membrane</td>
<td>Nucleus</td>
<td>Smooth ER</td>
<td>Ribosomes</td>
</tr>
</tbody>
</table>

Skill level 1

1
0
NR
2. The substances i. – iii. below play a key role in the process of photosynthesis:
   
i. Carbon dioxide and water
   ii. Light and chlorophyll
   iii. Glucose and oxygen

Which equation best represents the process of photosynthesis?

A. \[ 1 \rightarrow 2 \text{ in the presence of } 3 \]
B. \[ 1 \rightarrow 3 \text{ in the presence of } 2 \]
C. \[ 2 \rightarrow 3 \text{ in the presence of } 1 \]
D. \[ 3 \rightarrow 1 \text{ in the presence of } 2 \]

3. The table below shows the number of animals collected from some woodland and the Taxonomic Groups to which they belong:

<table>
<thead>
<tr>
<th>Animal Group</th>
<th>Number in a sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annelids</td>
<td>8</td>
</tr>
<tr>
<td>Arachnids</td>
<td>10</td>
</tr>
<tr>
<td>Insects</td>
<td>80</td>
</tr>
<tr>
<td>Mollusks</td>
<td>40</td>
</tr>
<tr>
<td>Myriapods</td>
<td>7</td>
</tr>
<tr>
<td>Nematodes</td>
<td>15</td>
</tr>
</tbody>
</table>

In total, how many ‘Arthropods’ were collected?

A. 33
B. 97
C. 120
D. 160

4. Statements i. – iv describe the characteristics of enzymes:
   
i. They exist as globular proteins.
ii. They are found on Rough ER.
iii. They fit into specified substrates.
iv. They are inhibited by competitive inhibitors.
Which statements best describe all enzymes?

A.  1 , 2 & 3 only
B.  2 , 3 & 4 only
C.  1 , 3 & 4 only
D.  1 , 2, 3 & 4

5. The diagram below shows a cell organelle present only in plant cells.

The site for **Independent Light Reaction** is correctly identified by which letter?

A.  O
B.  P
C.  Q
D.  R

6. The diagram below shows an experiment using an uncooked potato. The skin of the potato was removed. The potato was cut in the middle and filled with sugar solution as shown in the diagram below.
With reference to ‘OSMOSIS’, which diagram would demonstrate best the definition of osmosis after 24 hours?

![Diagram of osmosis](image)

7. The diagram below illustrates the alimentary canal of a chicken.

![Diagram of alimentary canal](image)

With the assistance of the diagram, which definition correctly matches the process?

A. Absorption – absorb metabolic substances and digested food in the Small Intestine.
B. Ingestion – breaking down of large molecules of food into bolus in the Esophagus.
C. Egestion – reabsorption of water in the Cloaca
D. Digestion – chemical breakdown of food in the Crop.

8. The process of ‘excretion’ plays a significant role in organisms as compared to any other functional system. Why? Because of the need to ____________.

A. release ATP Energy from cells for the body to function.
B. release water through respiration process.
C. remove metabolic wastes in mammals for homeostasis.
D. remove of undigested wastes stored in the human body.
9. The graph below shows changes in the population densities of two animal species living in the same habitat.

The interactions between the two species result in a **competitive exclusion**. What environmental principle does the graph support?

A. Adaptation Rules  
B. Gause's Principle  
C. Ecological Niche Principle  
D. Liebig's Law of Minimum

10. The table below shows some ‘adaptive features’ of some vertebrates. Which description best matches the vertebrates.

<table>
<thead>
<tr>
<th>Adaptive features</th>
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<tbody>
<tr>
<td><strong>Feathers</strong></td>
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<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
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<tr>
<td>C</td>
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<tr>
<td>D</td>
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</tbody>
</table>
SECTION B   SHORT ANSWERS
This section consists of FOUR questions. Each question consists of TEST ITEMS under SKILL LEVEL 2 and 3. ATTEMPT ALL questions in the space provided.

Question 1

1. The diagram below illustrates the stages of “Cellular Respiration”.

![Diagram of Cellular Respiration]

a. With the assistance of the diagram , briefly describe the following headings :
   (Hint : include in your answer at least TWO (2) of the followings : name of the process, site of reaction , products released , reactants, amount of ATP produced )

i. Process 1:
ii. **Krebs Cycle:**

iii. **Electron Transport Chain (ETC)**

2. The diagram below shows the Induced Fit Model of enzyme action:

![Diagram of Induced Fit Model](image)

a. Briefly explain the *model* in terms of *enzyme-substrate activity*. Include in your discussion the names for structures 1, 2, 3.
3. Three enzyme activities were tested, compared and recorded as shown in the graph below:

**Title: Comparison of enzyme activities.**

![Graph showing enzyme activities against temperature](image)

- Examine the graph and explain the reason for the differences seen in the results for the enzymes bound to the gel membrane surface with those immobilized inside the beads and the free-enzymes, between temperature 20 °C and 60 °C.
Question 2

1. The fruit fly *Drosophila melanogaster* is extensively used to study genetics because it is relatively easy to cause mutations in these fruit flies.

- Some mutant fruit flies have very small (vestigial) wings.

- Other mutant fruit flies have dark (ebony) bodies instead of the normal grey body.

In a di-hybrid cross, when fruit flies with normal wings and grey bodies were crossed with fruit flies with vestigial wings and ebony bodies all the offspring had normal wings and grey bodies.

   a. The F₁ hybrid fruit flies (*heterozygous for both traits*) were allowed to interbreed freely. The F₂ fruit flies were sorted and counted. The results are shown below.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Number of fruit flies</th>
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<tbody>
<tr>
<td><strong>Wings</strong></td>
<td><strong>Body</strong></td>
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<tr>
<td>Normal (N)</td>
<td>Grey (G)</td>
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<tr>
<td>Normal</td>
<td>Ebony (g)</td>
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<tr>
<td>Vestigial (n)</td>
<td>Grey</td>
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<tr>
<td>Vestigial</td>
<td>Ebony</td>
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</tbody>
</table>
With the assistance of the information below, complete the blank boxes in punnet square to show the expected F₂ offspring.

*Do not Complete the shaded boxes*

**F₁ Phenotypes** Normal wing, grey body  X  Normal wing grey body

**F₁ Genotypes** Nn Gg  X  Nn Gg

**Gametes** NG, Ng, nG, ng (Use the order stated below)

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<th>NG</th>
<th>Ng</th>
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3. The diagram below shows the stages in a spermatogenesis the production of male sex cell in an animal.

a. Describe the sequence of events occurring in A, B and C. Include in your answer the number of daughter cells, number of chromosomes in the daughter cells and comparisons of number to parent cell.

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Skill level 3

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</table>
b. Briefly explain the *significance event* labelled ‘D’ that determines ‘variation’ caused by structure ‘E’.
Question 3

1. The diagram below illustrates the three main connective tissues found in meristem cells of plants.

   a. Out of the three tissues labelled in the diagram, **vascular tissues** are special. Suggest reasons why in terms of its structure and role in plants.

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   Skill level 2
   
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b. The diagram below shows two types of cell that are found in the vascular tissue:

Explain how the types of cells above contribute to effective functioning of the vascular tissue. Include in your answer the followings: the name of the structure, the significant role of the two cells.

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Skill level 3

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2. The system of ventilation in a bony fish enables water to be passed continuously over the gills whilst the fish is at rest. The diagram below shows three stages of the process of ventilation and gas exchange in fish.

![Diagram of fish ventilation stages]

a. Examine the THREE (3) stages in details and answer the followings questions.

i. Describe the process of ventilation occurring in stages 1 and 2.

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Skill level 2

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iii. Stage 2 shows **two way directions** of arrows. Explain the reason how it contributes to the way of life of fish.

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3. The diagram below shows the blood flows through the hepatic portal vein from some body organs to the liver. Use the diagram to answer the questions that follow:

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Pancreas
hepatic portal vein
spleen
colon
Small intestine
liver
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b. Blood in the hepatic portal vein is deoxygenated. Describe why the 'blood' in the hepatic portal vein is deoxygenated rather than being oxygenated?

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b. One of the liver’s function is to maintain blood sugar level. Using information from the diagram only, explain the role of the Liver IF the sugar level is LOW.

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5. Circulatory systems is classified into ‘**open OR closed systems and single OR double systems**’. In Tonga, most animals fall into one or more of the categories in diagram A and B.

![Diagram A and B]

a. By naming **ONE** system (*either diagram A or B*) explain with example of an organism how it functions for the survival of the organism in its habitat?

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</table>
6. The diagram below illustrates the changes in a human ovary during the first part of the menstrual cycle and after the fertilization of an egg.

**Diagram Description**

- **Day 1**: Follicle
- **Day 10**: Development of follicle
- **Day 14**: Ovulation
- **Day 15**: Ovulated follicle

**Question**

a. Describe the possible events occurring at day 14, day 15 and that after day 15 that may lead to development of the embryo. Include in your answer, names of A, B & C.

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**Skill Level**

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</table>
b. Explain the effects of estrogen and progesterone hormones on day 1 - day 15 and after.
Question 4
1. The diagram below shows seven unknown species of *Arachnid*.

![Diagram of Arachnids]

1.a Abdomen with a tail *Abelieilia dicranotarsis*
1.b Abdomen without a tail Go to 2
2.a Legs much longer than abdomen and celathorax Go to 3
2.b Legs not longer than abdomen and celathorax Go to 4
3.a Hairs on the legs *Tegenaria domestica*
3.b No hairs on the legs *Odielus spinosus*
4.a Celathorax or abdomen segmented *Chelifer tuberculatus*
4.b Celathorax or abdomen unsegmented Go to 5
5.a Abdomen and celathorax are the same size *Poecilotheria regalis*
5.b Abdomen is larger in size than celathorax Go to 6
6.a Body covered with hairs *Tyroglyphus longior*
6.b Body not covered in hairs *Ixodes hexagonus*
a. Use the dichotomous key provided to identify the following species.

i. **Unknown Species B:**

________________________________________________________________
________________________________________________________________
________________________________________________________________

ii. **Unknown Species G:**

________________________________________________________________
________________________________________________________________
________________________________________________________________

b. Give the *genus name* for *organism E* and suggest a reason for your answer?

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Skill level 2

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Skill level 2

2
1
0
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c. Explain how the ‘*adaptations of an organism*’ relate to the followings concepts:

1. Gause’s principle.
2. An organism’s niche.
3. Liebig’s law.

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Skill level 2

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SECTION C  EXTENDED RESPONSE QUESTIONS

This section consists of THREE compulsory questions. Each question is worth 5 marks i.e. Skill Level 1 and skill level 4.

Marks will be given to answers that show clear, accurate expressions of ideas in a logical and cohesive manner. Marking criteria is provided at the end of the questions.

Question 1.C

“Anaerobic Respiration is also known as “Incomplete reaction” OR “Fermentation reaction”. With supported examples, write one summary definition for the terms and discuss how the process of anaerobic respiration contributes to commercial productions. Use the marking criteria to guide your answer.

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Assessors Use Only

<table>
<thead>
<tr>
<th>Summary Definition</th>
<th>Discussions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 1 Summary Definition</td>
<td>2.1 Reactant &amp; Product for the reaction if occurred in plants 2.2 Fermentation process to show the production commercial examples 1 &amp; 2</td>
</tr>
</tbody>
</table>

<table>
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<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 2</th>
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</table>
Question 2.C

*Genetic Modification Organisms (GMO) is the ‘popular study’ nowadays. Scientists argue that GMO’s have strong impact on species especially its phenotype.*

From your knowledge of the application of genetics, define the term phenotype and explain one advantage and one disadvantage of GMO globally. Include an example of local GMO species in your discussion.
## Definition of Phenotype

<table>
<thead>
<tr>
<th>Definition of Phenotype</th>
<th>Discussions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Advanced of GMO</td>
<td>2.2</td>
</tr>
<tr>
<td>Disadvantage of GMO</td>
<td>Example of GMO</td>
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</table>

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</table>
Question 3.C

Discuss the alternation of generations in **ferns as compared those in angiosperms**, in terms of:

1. definition of sporophyte and gametophyte generations in terms of sexual and Asexual reproduction / presence of spores or seeds.
2. Whether the gametes are haploid or diploid (N) or (2N)
3. The dependent mechanism for fertilization
4. How new organisms are dispersed using either spores or seeds

In addition to your discussion, the metabolic waste (gas) released from angiosperms & ferns during daylight.
### Metabolic waste released in daytime

### Discussions (Comparison of Ferns and Angiosperms)

<table>
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<th>LEVEL 1</th>
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