MARKER CODE				

STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE

BIOLOGY

2017

QUESTION and ANSWER BOOKLET

Time allowed: 3 Hours

INSTRUCTIONS:

1. Write your **Student Enrolment Number (SEN)** on the top right-hand corner of this booklet.
2. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
3. If you need more space for answers, ask the Supervisor for extra paper. Write your SEN on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.

	Pages	Weighting
SECTION A **Animal Behaviour**	2-6	19
SECTION B **Gene Expression**	7-11	22
SECTION C **Biotechnology Application**	12-14	12
SECTION D **Processes and Patterns of Evolution**	15-19	22
TOTAL	**19 Pages**	**75**

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Check that this booklet contains pages 2-19 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

SECTION A: ANIMAL BEHAVIOUR

Question 1: Ecological Niche

The picture below shows a **Wolf spider,** which is a member of the family **Lycosidae.** Wolf spiders have excellent adaptation to be robust, agile hunters. They have excellent eyesight and live mostly in solitude and hunt alone, and do not spin webs. Wolf spiders rely on camouflage to hide them in the leaf litter where they roam.

Figure 1: Wolf spider

a. Define adaptation.

_____

_____

_____

Skill level 1	
1	
0	
NR	

b. Describe the structural adaptation of the wolf spider.

_____

_____

_____

Skill level 2	
2	
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Question 2: Orientation and Navigation

The female silk moth releases a pheromone called pombykol which induced the male silk moth to fly in the direction of the female in order to mate with her.

a. Define the orientation features of this female silk moth behavior.

Skill level 2	
2	
1	
0	
NR	

Each year, the monarch butterflies (*Danaus plexippus*) migrate from central and eastern North America, to a forest region in Central Mexico. The butterflies that leave the northern regions breed on the way South, and then die. The migration cycle is completed over a number of generation.

b. Describe the navigation features of the monarch butterflies.

Skill level 2	
2	
1	
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c. Discuss how this migration is beneficial for the monarch butterflies.

Skill level 3	
3	
2	
1	
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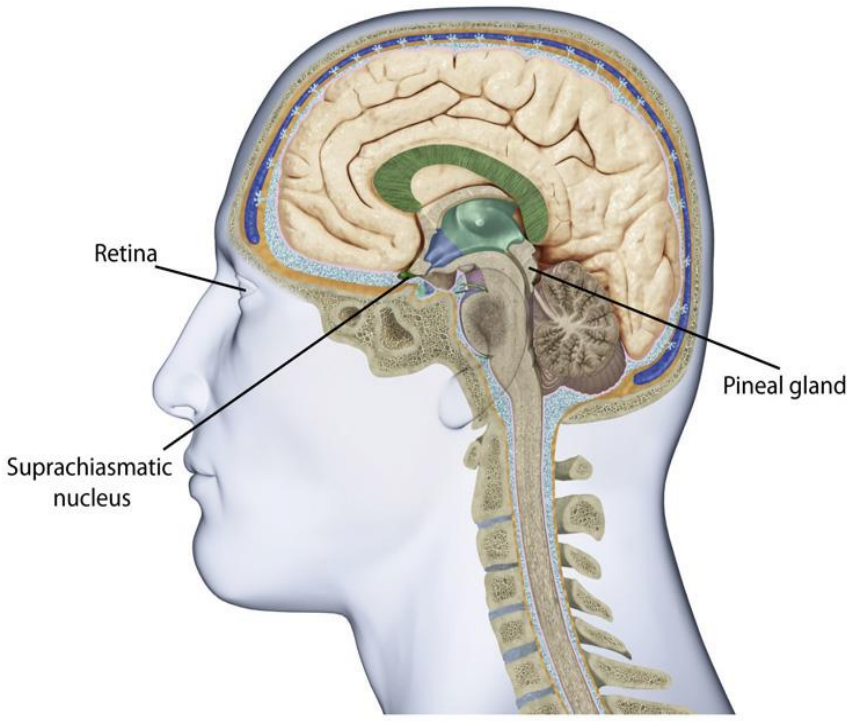
Question 3: Timing Responses

Humans have a master circadian clock in our brain.

Figure 2: The human brain



Describe how the biological clock in our brain provides endogenous control of the circadian rhythms.

Skill level 2	
2	
1	
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Question 4: Responses to biotic environmental factors

Lions are sociable creatures and live together in prides, consist related females and a coalition of males.

Figure 3: Pride of lions

a. Explain the advantages of lions living in groups.

Skill level 3	
3	
2	
1	
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Hawks are aggressive and will always battle with neighbors over resources. Doves are passive and will never fight with neighbors over resources.

Figure 4 : Hawk

Figure 5 : Dove

If a population of 100% doves is unstable, a mutation caused the introduction of a single hawk. On the other hand, if a population of 100% hawks is also unstable, a mutation caused the introduction of a single dove.

b. Discuss the impact of interactions between the hawk and the dove on the overall survival of these birds populations.

Skill level 4	
4	
3	
2	
1	
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NR	

SECTION B: GENE EXPRESSION

Question 1: DNA Structure and Replication

Explain the importance of structure and replication of DNA for gene expression.

Skill level 3	
3	
2	
1	
0	
NR	

Question 2: Protein structure, function and synthesis.

A human being has 20,000 to 25,000 genes located on 46 chromosomes (23 pairs). These genes are known, collectively, as the human genome.

a. Define genome.

Skill level 1	
1	
0	
NR	

b. Describe the main functions of proteins in the body.

Skill level 2	
2	
1	
0	
NR	

Question 3: Mutations

Scientists estimate that every one of us has between 5 and 10 potentially deadly mutations in our genes. Since there is only one copy of the bad gene, these diseases don't manifest.

a. Define genetic mutation.

Skill level 1	
1	
0	
NR	

b. Discuss how marriage between close relatives can possibly cause gene mutations.

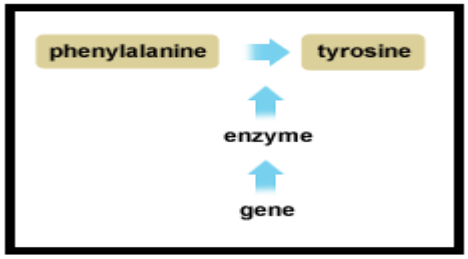
Skill level 3	
3	
2	
1	
0	
NR	

Question 4: Metabolic pathways

Phenylketonuria (commonly known as PKU) is an inherited disorder that increases the levels of phenylalanine in the blood obtained through the diet.

The diagram below represents part of the normal metabolic pathway involving the amino acid **phenylalanine** within human cells. The gene controls the synthesis of the enzyme and the enzyme converts the amino acid phenylalanine to **tyrosine**.

Figure 6: Metabolic Pathway



a. Describe the features of the part of the metabolic pathway shown in the diagram above.

Skill level 2	
2	
1	
0	
NR	

b. If a gene mutation occurs, discuss the effects on the enzyme control of metabolic pathway illustrated above.

Skill level 3	
3	
2	
1	
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NR	

Question 5: Gene – gene interaction

In pumpkins, *Cucurbita pepo* there are 3 types of fruit colour, White, Yellow and Green.

Figure 7: Cucurbita Pepo

The colour of the fruit is governed by 2 pair of genes, '**W**' for White dominant and '**Y**' for its recessive. White is found dominant over yellow as well as green colour. When yellow is crossed with green, yellow is found to be dominant.

a. Describe the features of this gene-gene interaction if a white pumpkin is crossed with a yellow one.

Skill level 2	
2	
1	
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NR	

b. Give the genotypes that can produce a green colour from this cross.

Skill level 2	
2	
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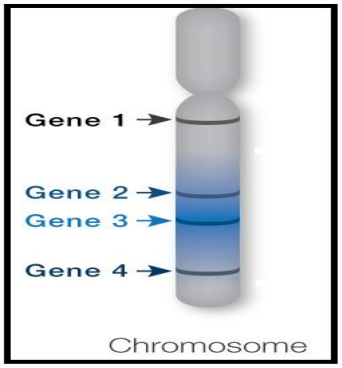
Question 6: Linkage and sex linkage

The diagram below shows chromosomes with linked and unlinked genes:

Figure 8: Chromosome



a. Define 'link genes' using the chromosome illustrated above.

Skill level 1	
1	
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A **tortoiseshell** cat is one with black and orange patches. One of several genes controlling fur color is located on the X chromosome. The gene has two versions, or alleles. One form of the gene codes for orange fur (X^B) and is dominant over the other form codes for black fur (X^b).

Figure 9: Tortoiseshell cat

b. Describe the inheritance of tortoiseshell colour in male cats.

Skill level 2	
2	
1	
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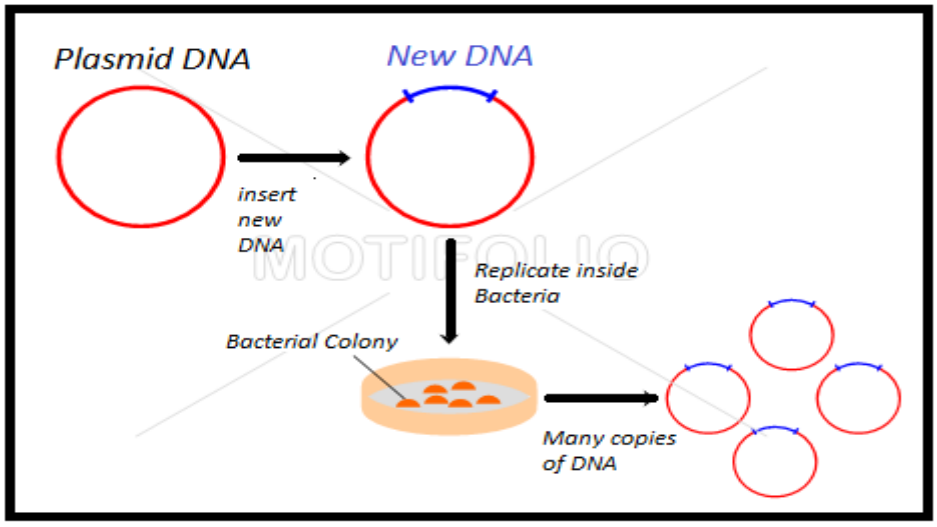
SECTION C: BIOTECHNOLOGY APPLICATIONS

Question 1: Gene Cloning

The diagram below illustrates the process of gene cloning.

Figure 10: Molecular Cloning



a. Define gene cloning.

Skill level 1	
1	
0	
NR	

b. Explain the medical advantages of using bacterial plasmids to produce multiple copies of the desired gene.

Skill level 3	
3	
2	
1	
0	
NR	

c. Discuss potential advantages of gene cloning using sound arguments and specific examples.

Skill level 4	
4	
3	
2	
1	
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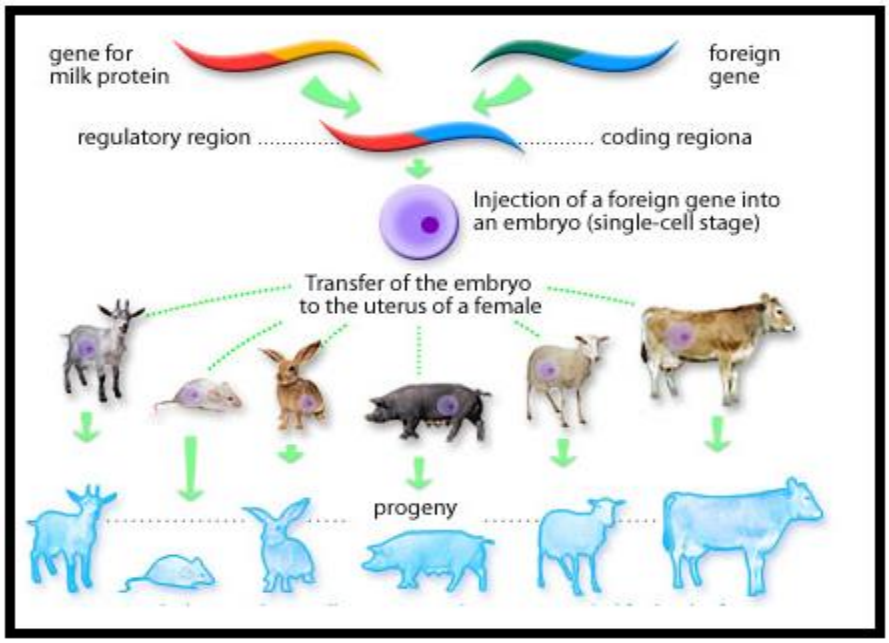
Question 2: Transgenesis and DNA Profiling

The diagram below illustrates the process of transgenesis process in producing transgenic animals that produce milk containing the protein coded for by the foreign gene.

Figure 11: Transgenesis process



a. Define trans-genesis as illustrated in the above diagram.

Skill level 1	
1	
0	
NR	

b. Discuss the applications and impact of DNA profiling.

Skill level 3	
3	
2	
1	
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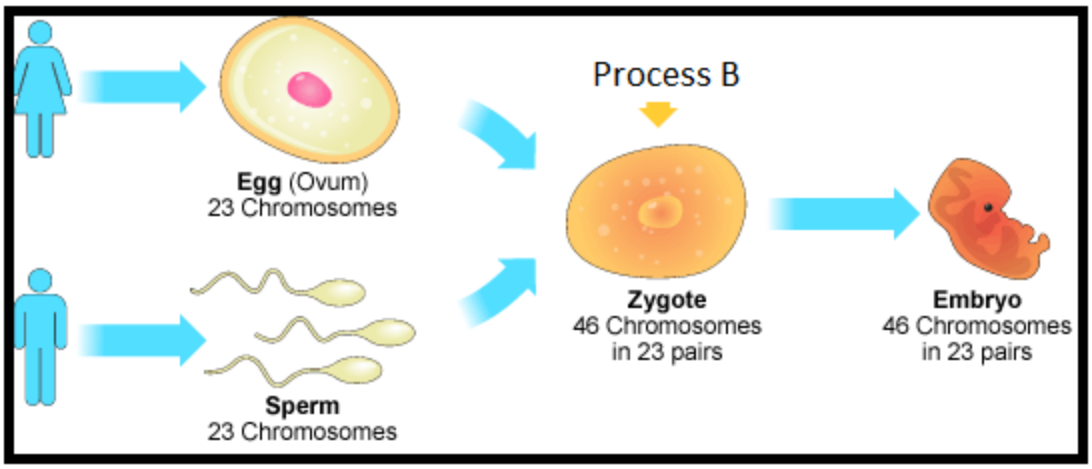
NR	

SECTION D: PROCESSES AND PATTERNS OF EVOLUTION

Question 1: Variation

Humans reproduce through sexual reproduction, as illustrated in **Figure 12**.

Figure 12: Meiosis



a. Describe the role of **Process B** in sexual reproduction in producing variation.

Skill level 2	
2	
1	
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NR	

b. Discuss the importance of variation in evolution, giving specific examples.

Skill level 4	
4	
3	
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Question 2: Natural Selection

One of the most prominent examples of artificial selection finding its way into our entertainment is the selective breeding of race horses.

Figure 13: Artificially bred race horses

a. Define artificial selection in horses.

Skill level 1	
1	
0	
NR	

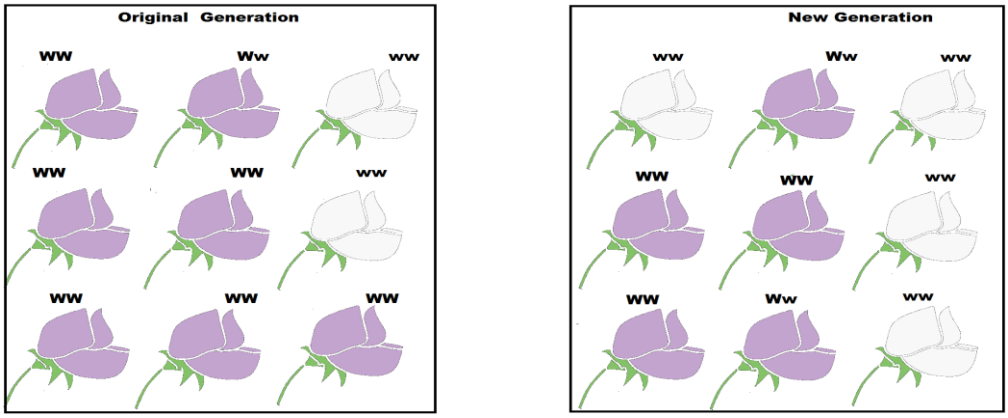
b. Explain the impact of artificial selection in the selective breeding of race horses.

Skill level 3	
3	
2	
1	
0	
NR	

Question 3: Gene pool and allele frequency

Flower colour in pea plants is controlled by a gene. This gene comes in a white allele, **w**, and a purple allele, **W**. Each pea plant has two gene copies, which may be the same or different alleles. When the alleles are different, one—the **dominant** allele, **W**—may hide the other—the **recessive allele**, **w**. A plant's set of alleles, called its **genotype**, determines its **phenotype**, or observable features, in this case flower color.

Figure 14: Original and New Generation of pea plant flowers



a. With reference to this population of pea flowers, define gene pool.

Skill level 2	
2	
1	
0	
NR	

b. Describe how allele frequency contribute to the gene pool.

Skill level 2	
2	
1	
0	
NR	

c. Calculate allele frequency of the original generation of pea flowers using Hardy-Weinberg Rule.

Skill level 2	
2	
1	
0	
NR	

d. Explain how genetic drift influences changes in the pea flowers population gene pool.

Skill level 3	
3	
2	
1	
0	
NR	

Question 4: Speciation

Explain the effect of geographical isolation on pre-zygotic isolating mechanism.

Skill level 3	
3	
2	
1	
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