

MARKER CODE				



STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE

2020

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. This paper consists of **FOUR SECTIONS** and is out of 70 weighted scores.

SECTION	TOPICS	TOTAL SKILL LEVEL
A	ANIMAL BEHAVIOUR	21
B	GENE EXPRESSION	24
C	BIOTECHNOLOGY APPLICATIONS	8
D	PROCESSES AND PATTERNS OF EVOLUTION	17
TOTAL		70

3. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
4. Use a **BLUE** or **BLACK** ball point pen only for writing. Use a pencil for drawing if required.
5. If you need more spaces for answers, ask the supervisor for extra paper. Write your **Student Enrolment Number (SEN)** on each additional sheet, number the questions clearly and insert them in the appropriate places in this booklet.
6. Check that this booklet contain pages **2-23** in the correct order and that none of the pages is blank.

YOU MUST HAND IN THIS BOOKLET TO THE SUPERVISOR BEFORE YOU LEAVE THE EXAMINATION ROOM.

Skill level 2	
2	
1	
0	
NR	

b) Explain how these adaptations assist in the survival of the anoles.

Skill level 3	
3	
2	
1	
0	
NR	

c) Explain how inter-specific interactions between the anole lizards affect their population number and distribution pattern.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION 2: ORIENTATION AND NAVIGATION

The Pacific Ocean is an important breeding ground for humpback whales. When winter descends on the Antarctic, the average day-time temperature falls to around 20°C. The humpback whale migration begins a journey of over 6,000kms. This journey takes them up the east coast of New Zealand in the waters of the South Pacific and then along the sub-sea volcanic arch that leads to the Tongan group.

These epic humpback whale migrations are integral to their very survival as a species as the waters of the Antarctic are too cold for newly-born calves to survive. So the pregnant females swim all the way to Tonga to give birth in the warm waters and sheltered bays of the Tongan islands.

The whales know the time is approaching for them to leave the Southern Ocean and head north in what is known as one of the world's largest and longest animal migrations.



Figure 2: Migration pathway for humpback whales

Source: <https://idopacificimages.com>

- a) Humpback whales migrate very long distances from their feeding ground in the Antarctic to their breeding area in the South Pacific.

Define **migration**.

Skill level 1	
1	
0	
NR	

- b) Humpback whales do not have the luxury of a smart phone to help them navigate through this vast distance in the open ocean.

Explain how different types of navigation are beneficial for the whale to achieve this long distance migration with great accuracy.

[illegible]

- Describe the features of its biological rhythm as a timing response of humpback whales.

Skill level 2	
2	
1	
0	
NR	

QUESTION 3: INTRASPECIFIC INTERACTION

Wolves are social animals and they instinctively form packs consisting of a pair of breeding wolves and their offspring. On occasion, there may be another wolf that is not part of their lineage accepted into their pack. There is a distinct pecking order in the wolf pack, namely alpha, beta, omega and the rest of the pack. The alpha wolf pairs are usually monogamous with each other, but alpha males have been known to stray with other pack members, especially if they are closely related.



Figure 3: A wolf pack

Source: <http://wolffacts.org/wolf-pack-hierarchy.html>

- a) Define **monogamous mating**.

Skill level 1	
1	
0	
NR	

- b) Wolf packs hold their territory fiercely and mark it with urine and scats, a behaviour called scent-marking.

Describe the difference between **territory** and **home range**.

Skill level 2	
2	
1	
0	
NR	

- c) Discuss how intra-specific interactions in a wolf pack impact on social organization, behaviour and overall survival of the wolf populations.

[illegible]

Skill level 4	
4	
3	
2	
1	
0	
NR	

The diagram below illustrates protein synthesis. Use it to answer the questions that follow:

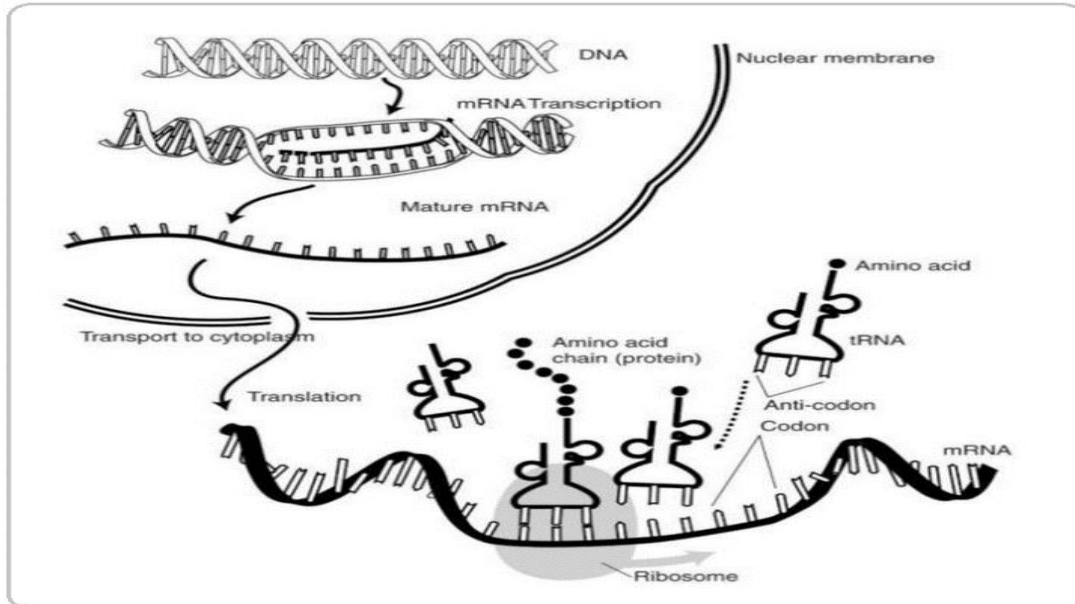


Figure 4: Process of Protein Synthesis

Source: <https://en.ppt-online.org/275671>

- a) Discuss the process of protein synthesis in terms of transcription and translation including the role of DNA (triplets), mRNA (codons), tRNA (anti-codons) and ribosomes.

[illegible]

[illegible]

Skill level 2	
2	
1	
0	
NR	

QUESTION 2: MUTATION

This table shows the 64 codons and the amino acid that each codon codes for.

		Second nucleotide					
		U	C	A	G		
First nucleotide	U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U	
		UUC	UCC	UAC	UGC	C	
		UUA Leu	UCA	UAA STOP	UGA STOP	A	
		UUG	UCG	UAG STOP	UGG Trp	G	
C		CUU Leu	CCU Pro	CAU His	CGU Arg	U	
		CUC	CCC	CAC	CGC	C	
		CUA	CCA	CAA Gln	CGA	A	
		CUG	CCG	CAG	CGG	G	
A		AUU Ile	ACU Thr	AAU Asn	AGU Ser	U	
		AUC	ACC	AAC	AGC	C	
		AUA	ACA	AAA Lys	AGA	A	
		AUG Met	ACG	AAG	AGG	G	
G		GUU Val	GCU Ala	GAU Asp	GGU Gly	U	
		GUC	GCC	GAC	GGC	C	
		GUA	GCA	GAA Glu	GGA	A	
		GUG	GCG	GAG	GGG	G	

Figure 5: mRNA Codon Table

Source: <https://www.nature.com/scitable/topicpage/the-information-in-dna-determines-cellular-function-6523228/>

- a) Define **redundancy** in terms of genetic code.

Skill level 1	
1	
0	
NR	

- b) Explain how redundancy of the genetic code buffers gene mutation.

Skill level 3	
3	
2	
1	
0	
NR	

The diagram below is a karyotype showing the arrangement of chromosome in a female that illustrates mutation on chromosome number 23. Use it to answer the questions that follow:

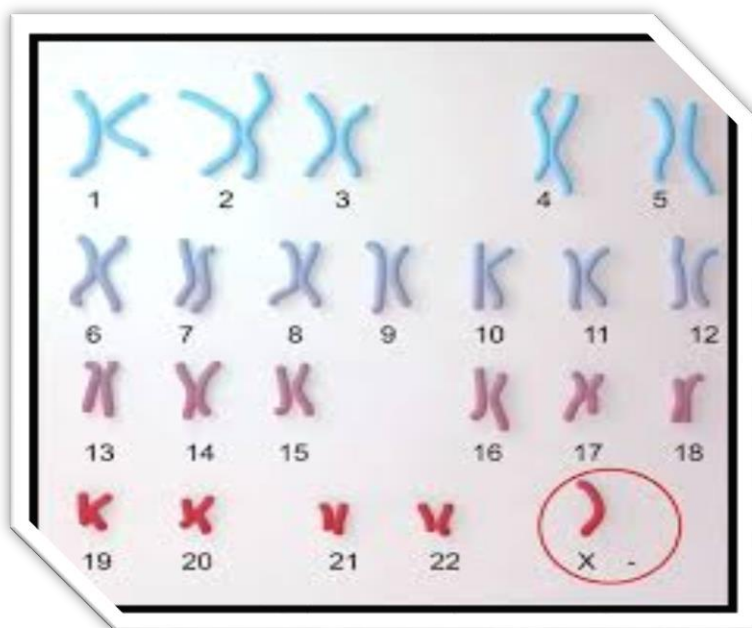


Figure 6: Karyotype showing the arrangement of chromosomes in a female with *Turner's syndrome*

Source: <https://www.picfair.com/pics/05719547-turner-s-syndrome-karyotype-illustration>

- c) Define **chromosomal mutation**.

Skill level 1	
1	
0	
NR	

- d) The type of chromosome mutation shown in the diagram above is monosomy which is one example of aneuploidy.

Explain the effect of this monosomy chromosome mutation on gene expression.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION 3: METABOLIC PATHWAYS

Metabolic pathways are typically organised into chains or cycles of enzyme-catalysed reactions such as glycolysis and Krebs cycle, as illustrated below. Use it to answer the questions that follow:

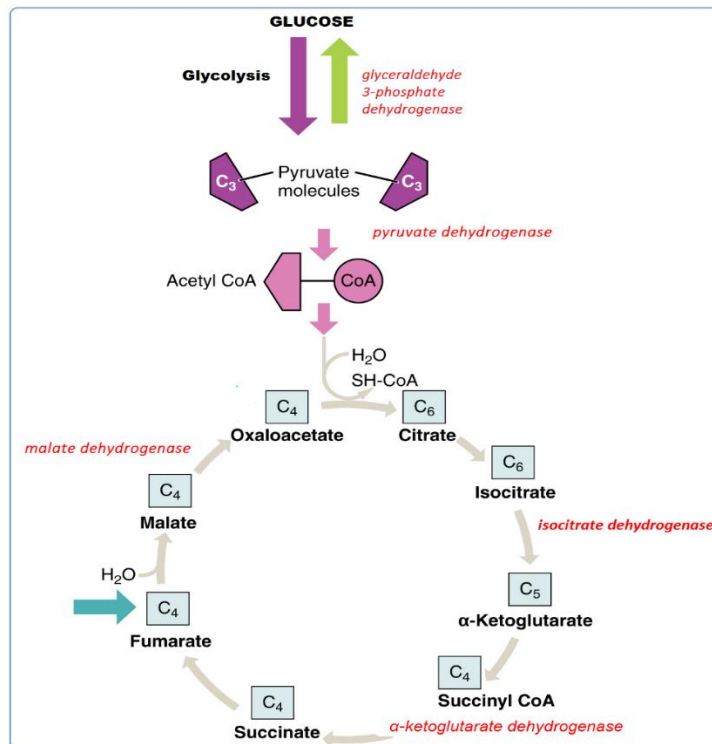


Figure 7: Glycolysis and Krebs cycle

Source: <https://opentextbc.ca/anatomyandphysiology/chapter/24-4-protein-metabolism/>

- a) Identify the substrate and the products of the glycolysis pathway shown above:

Skill level 1	
1	
0	
NR	

- b) Analyze the reactions in the Krebs cycle and the enzymes involved in the metabolic pathways.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION 4: GENE INTERACTION

In sweet pea (*Lathyrus odoratus*), two varieties of white flowering plants were seen. Each variety bred true and produced white flowers in successive generations. When two such white varieties of sweet pea were crossed, the offspring were found to have purple coloured flowers in F_1 . When F_1 offspring were self-crossed, the results illustrate complementary gene-gene interaction, as shown in the punnet square below. Use it to answer the questions that follow.

F1 Generation:

CcPp
(Purple Colour)

F1 Self-cross:

F1 x F1 CcPp X CcPp
(Purple Colour) (Purple Colour)

F1 Gametes:

CP Cp cP cp X CP Cp cP cp

F2 Generations: Refer to Punnet Square below:

X	CP	Cp	cP	cp
CP	CCPP	CCPp	CcPP	CcPp
Cp	CCPp	CCpp	CcPp	Ccpp
cP	CcPP	CcPp	ccPP	ccPp
cp	CcPp	Ccpp	ccPp	ccpp

- a) Describe the features of complementary genes as illustrated by the cross above.

Skill level 2	
2	
1	
0	
NR	

b) Describe the relationship between **phenotype** and **genotype**.

Skill level 2	
2	
1	
0	
NR	

QUESTION 5: LINKED GENES

In cats, one of several genes controlling fur colour is located on the X chromosome of the sex chromosome. The gene has two versions, one form codes for orange fur (X^B) and the other form codes for black fur (X^b). A cat inheriting one copy of each gene ($X^B X^b$) has a patchwork of orange and black coat, known as tortoiseshell.



Figure 8: A tortoiseshell female cat

Source: <https://letstalkscience.ca/educational-resources/stem-in-context/science-behind-calico-cats-colours>

Describe how the inheritance of a tortoiseshell colour in a female cat illustrates sex-linkage.

Skill level 2	
2	
1	
0	
NR	

SECTION C: BIOTECHNOLOGY APPLICATIONS

QUESTION 1: TRANS-GENESIS

Recombinant DNA technology is the joining together of **DNA** molecules from two different species. The recombined **DNA** molecule is inserted into a host organism to produce new genetic combinations that are of value to science, medicine, agriculture, and industry.

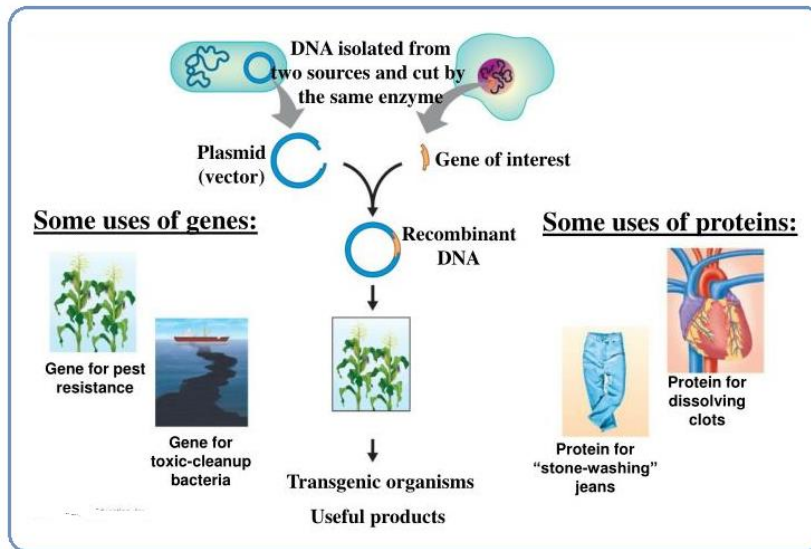


Figure 9: Recombinant DNA

Source: <https://www.slideserve.com/katoka/recombinant-dna-technology>

- a) State the purpose of using bacteria plasmid.

Skill level 1	
1	
0	
NR	

- b) Describe how recombinant DNA is formed using techniques of restriction enzymes and ligation.

Skill level 2	
2	
1	
0	
NR	

Skill level 3	
3	
2	
1	
0	
NR	

[illegible]

Skill level 3	
3	
2	
1	
0	
NR	

c) Describe how mutation produces variation.

Skill level 2	
2	
1	
0	
NR	

QUESTION 2: GENE POOL

- a) List the factors that affect allele frequency.

[illegible]

Skill level 2	
2	
1	
0	
NR	

- b) Explain how the *founder effect* and *bottle neck* act as special cases of genetic drift in contributing to changes in the gene pool.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION 3: SPECIATION

Speciation is the process by which new species form. It occurs when groups in a species become reproductively isolated and diverge.

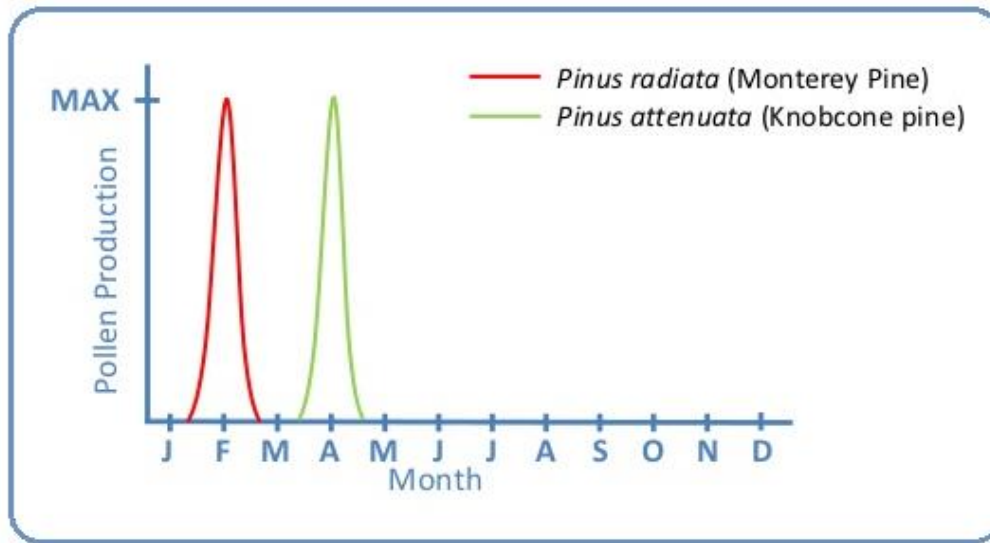


Figure 12: Graph showing months of pollen production in species of Pines

Source: <https://www.slideshare.net/diverzippy/bioknowledgey-presentation-on-103-gene-pools-and-speciation-ahl>

Describe the features of the type of pre-zygotic isolating mechanism shown by the two species of pine in the graph above.

Skill level 2	
2	
1	
0	
NR	

