MARKER CODE				

STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE

2018

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 booklet.
2. This paper consists of **FOUR SECTIONS** and is out of 70 Skill Level.

SECTIONS	TOPICS	TOTAL SKILL LEVEL
A	ANIMAL BEHAVIOR	25
B	GENE EXPRESSION	23
C	BIOTECHNOLOGY APPLICATIONS	6
D	PROCESSES AND PATTERNS OF EVOLUTION	21
	TOTAL	**75**

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 space for answers, ask the Supervisor for extra paper. Write your **Student Enrolment Number** (SEN) on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.
6. Check that this booklet contains pages 2-23 in the correct order and that page 23 has been deliberately left blank.

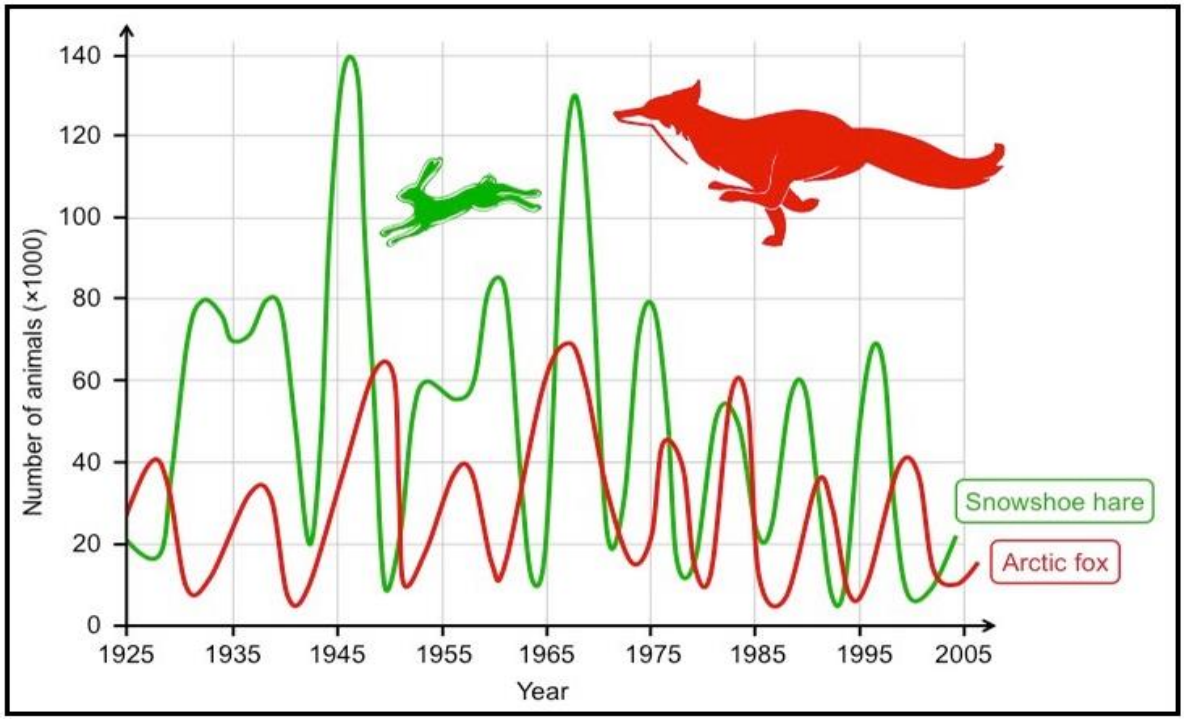
YOU MUST HAND IN THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION

SECTION A: ANIMAL BEHAVIOUR

Question One: Responses to biotic and abiotic environmental factors

a. Snowshoe hares are the primary food of the Arctic Fox. The population cycle of these two species are closely linked. When hares are plentiful, the Arctic Fox eats little else and take a hare only on a daily basis. The Arctic Fox can also prey on small animals and birds when hares are scarce. However, these two food sources do not meet the Arctic Fox's nutritional needs as some Arctic Fox cannot maintain their body fat reserve on this type of diet. They become more vulnerable to cold temperature, starvation and predation. Snowshoe hares eat various ground plants and seedlings.

The population of Snowshoe hare and Arctic fox were estimated each year for some 75 years from the number of animals caught by fur traders. The following graph shows how the size of the Arctic fox and Snowshoe Hare populations in Canada changed over time.



i. Define **interspecific interaction**.

Skill level 1	
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ii. Describe how this interspecific interaction controls the population of the Snowshoe Hare.

Skill level 2	
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iii. Discuss how interspecific interactions impact the overall survival of the Arctic fox and the Snowshoe hare populations.

Skill level 4	
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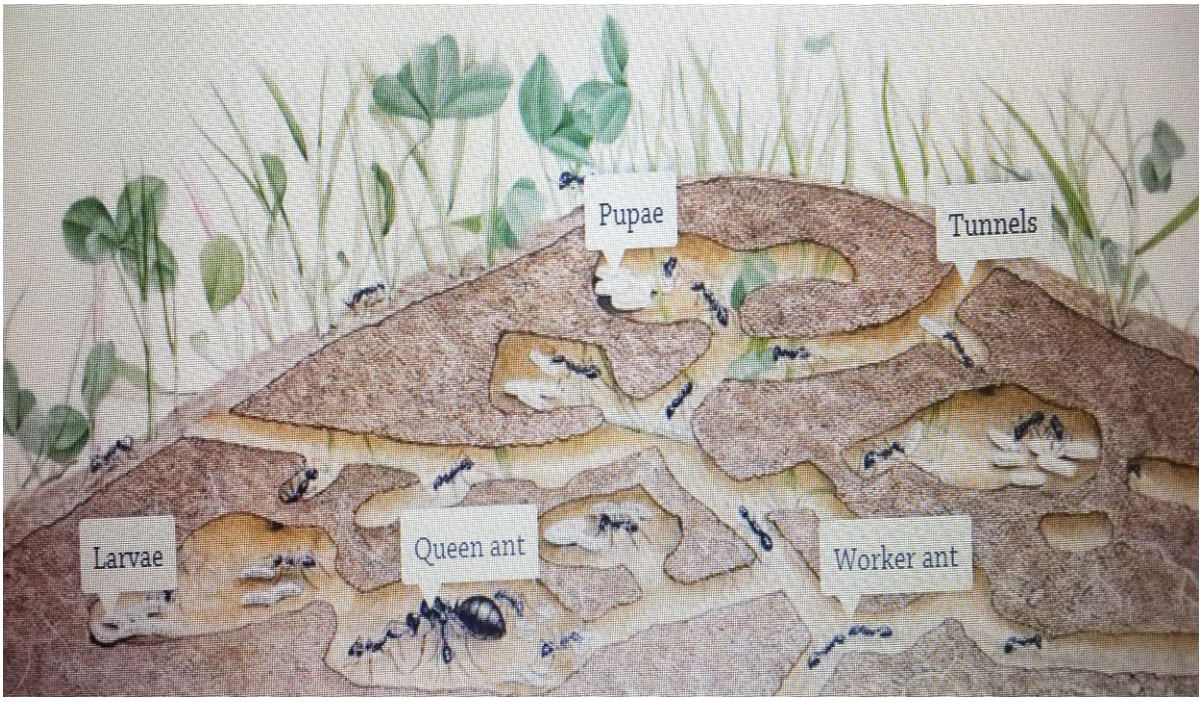
b. Ants are highly social animals that form tightly knit colonies, as shown in the illustration below:



i. Discuss how intraspecific interactions in ants have an impact on the social organization, behaviour and overall survival of ants populations.

Skill level 4	
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ii. Explain the disadvantage of intraspecific interactions in relation to the cooperative behaviour in ants.

Skill level 3	
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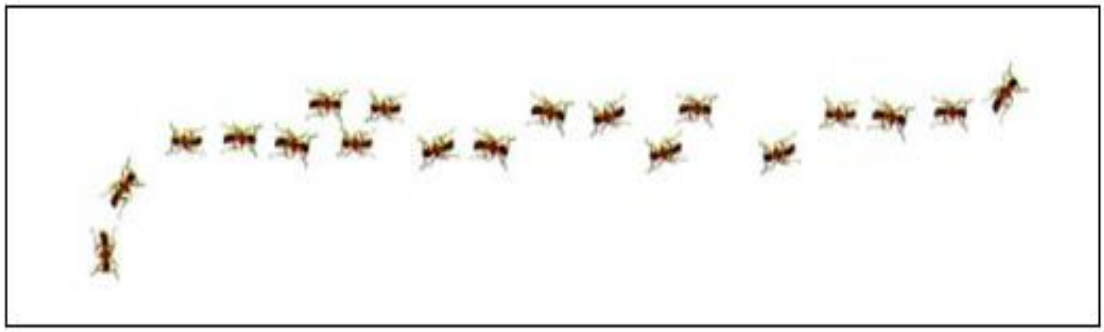
iii. Ants are often seen in trails, following each other to a feeding site as shown below:



Describe the navigating features of ants that enable it to find their way to their nesting site.

Skill level 2	
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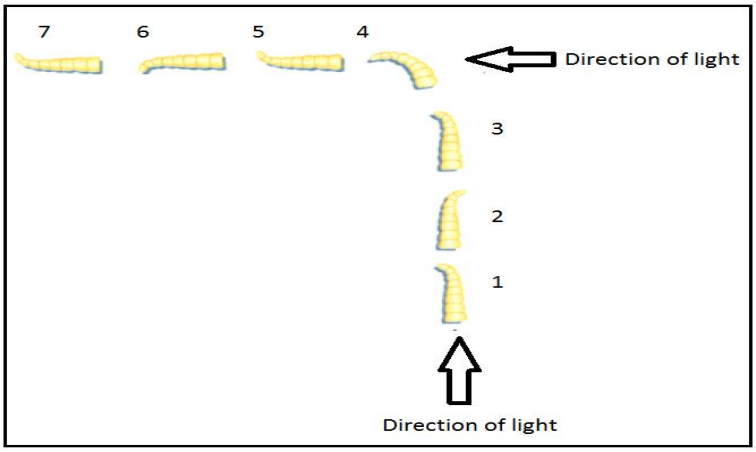
Question Two: Orientation

a. Some animals display innate behaviours. As green bottle fly maggots (*Phaenicia sericata*) crawl, they turn their heads, comparing the light intensity from each side. They always turn towards the darker side, taking them away from light.



Maggots response to light stimulus

i. Describe the orientation features displayed by the maggots.

Skill level 2	
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ii. Explain how the maggots benefit from this type of orientation response.

Skill level 3	
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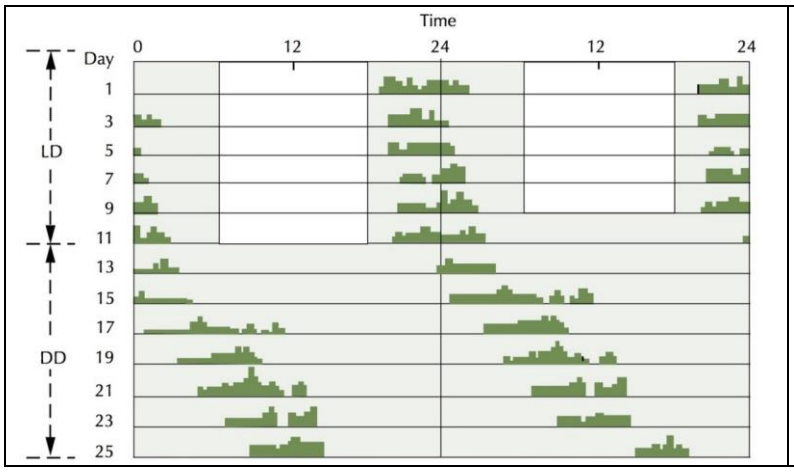
Question Three: Timing Responses

a. Tree weta ***(Hemideina thoracica)*** is a large, flightless nocturnal grasshopper, illustrated below. They are up to 40 mm long and live in holes in trees. They emerge from their holes at sunset and forage for food and return to their holes before sunrise.

The chart below shows the activity of a Weta kept in a laboratory at 20°C. From Day 1 – Day 11, the Weta was exposed to 12 hours of light, followed by 12 hours of darkness. From Day 12, it was kept in constant darkness.



i. Describe the biological rhythm of the weta shown on the graph.

Skill level 2	
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ii. Describe the interpretation of actograms for the weta's activity.

Skill level 2	
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SECTION B: GENE EXPRESSION

Question One: DNA Structure and Replication

a. Define **genome**.

Skill level 1	
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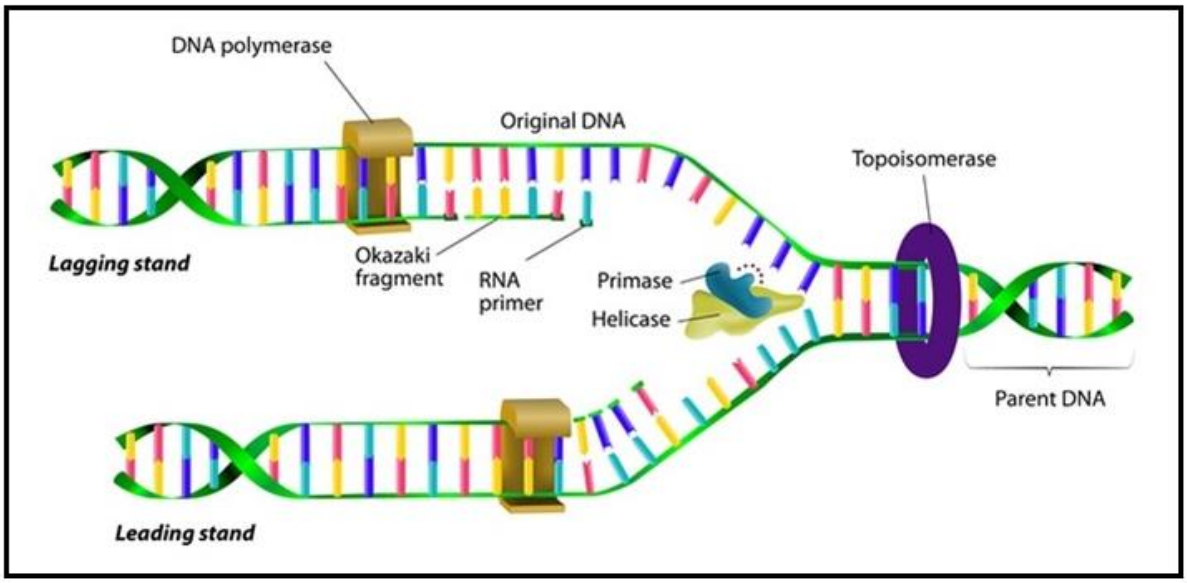
b. The diagram below illustrates the process of DNA replication:



Discuss the process of DNA replication.

Skill level 3	
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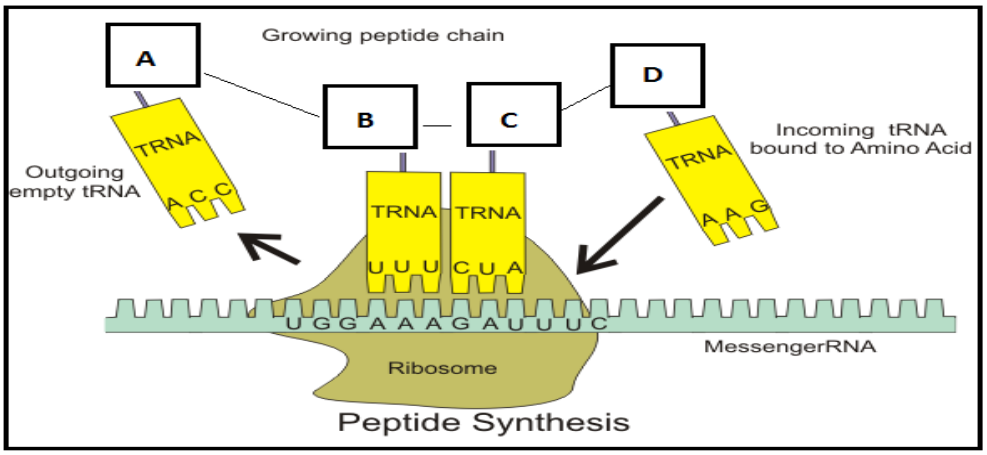
Question Two: Protein structure, function and synthesis.

a. The diagram below illustrates part of the process of protein synthesis:



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i. Describe the main process in protein synthesis that is illustrated above.

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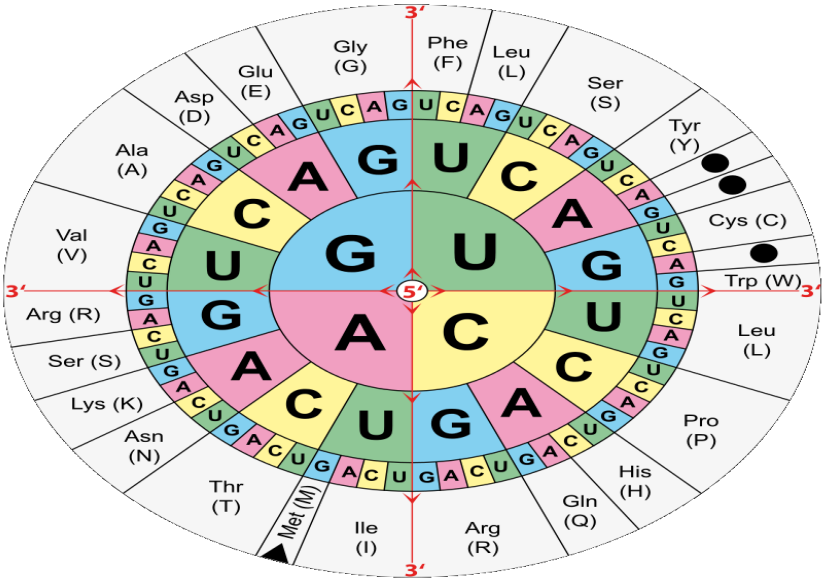
ii. Use the chart below to identify the amino acid labeled **B** produced in the peptide synthesis process above.



Skill level 1	
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iii. Describe the structure of the primary protein produced by the growing peptide chain.

Skill level 2	
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Question Three: Mutations

Skill level 1	
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a. Define **linked genes.**

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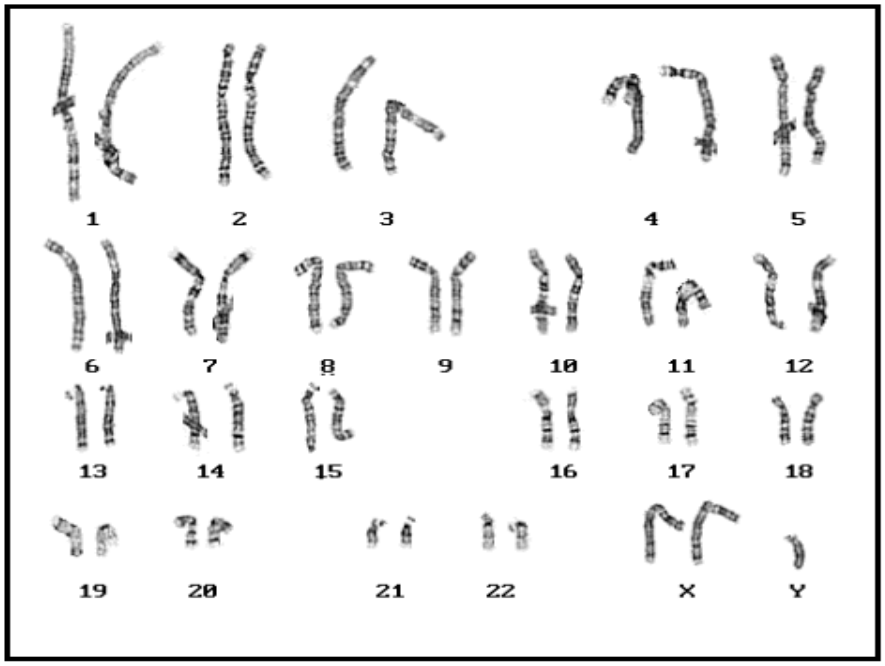
b. The karyotype below shows a type of chromosome mutation known as Klinefelter's syndrome.



Explain the cause of this chromosome mutation.

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Skill level 3	
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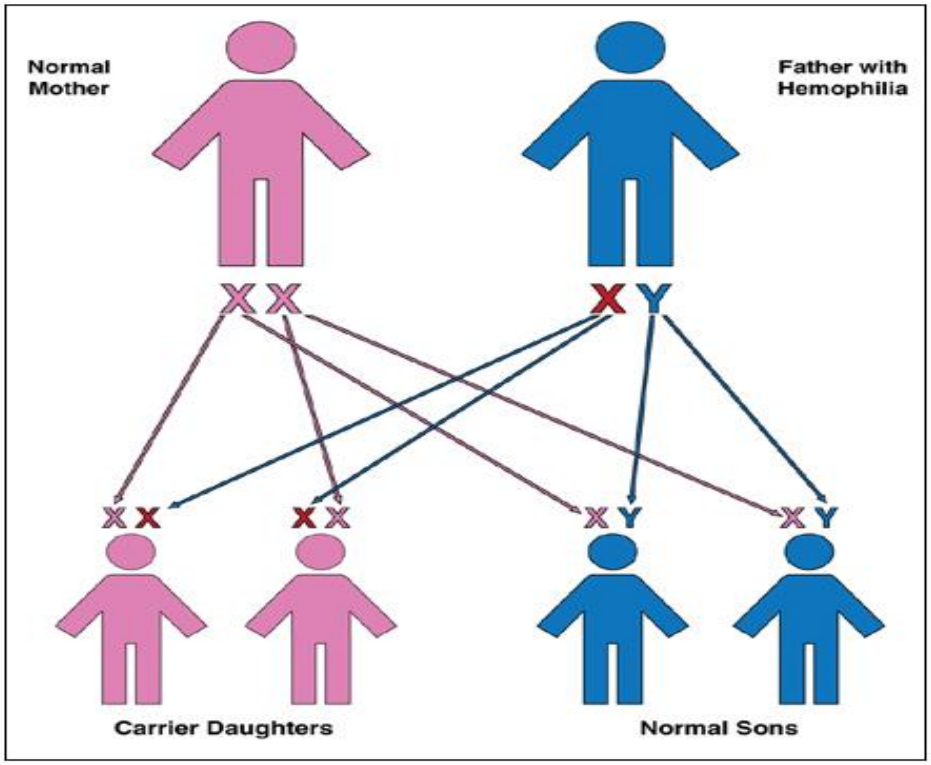
c. Hemophilia is an X chromosome linked condition and a rare disorder where a person's blood clots very slowly or not at all.



Describe the process of inheritance of haemophilia illustrated in the diagram above.

Skill level 2	
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Question Four: Mendelian Inheritance

Phosphofructokinase (PFK) is an enzyme that is important for production of energy from sugar sources in all cells of the body, especially red blood cells and muscle cells. Lack of this enzyme causes a range of effects including weakness and muscle cramps, discolored urine, anemia and jaundice. In Spaniels, a breed of dog of Spanish origin, this disease is inherited as an autosomal recessive condition.

A DNA-based genetic test uses this information to identify dogs that are affected, carrier or normal. The table below shows the expected results from breeding dogs of each genetic status for inherited recessive diseases:

Parent Genotype 1	**Parent 2 Genotype**		
	Normal	**Carrier**	**Affected**
Normal	All = Normal	Half = Normal Half = Carriers	All = Carriers
Carrier	Half = Normal Half = Carriers	One Quarter = Normal Half = Carriers One Quarter = Affected	Half = Carriers Half = Affected
Affected	All = Carriers	Half = Carriers Half = Affected	All = Affected

Explain how the type of crosses above contribute to variations and survival of the Spanish dogs.

Skill level 3	
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Question Five: Gene – gene interaction

a. In chickens, comb shape is determined by two interacting genes (R/r and P/p). The resulting comb shape is shown in the table below:

 single	 walnut	 rose	 pea
When both genes are homozygous recessive, **rrpp,** a single comb is produced. *(rrpp)*	A walnut comb is produced when at least one dominant **R** allele and at least one dominant **P** allele are present. *(R- P-)*	A rose comb is produced when at least one dominant **R** allele is present and the second gene is homozygous recessive, **pp.** *(R- pp)*	A pea comb is produced when the first gene is homozygous recessive, **rr** and at least one dominant **P** allele is present. *(rr P-)*

i. Describe the features of epistasis for a mating between a walnut comb and single comb chicken.

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Skill level 2	
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ii. Explain the significance of this gene-gene interaction for the survival of an animal species.

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Skill level 3	
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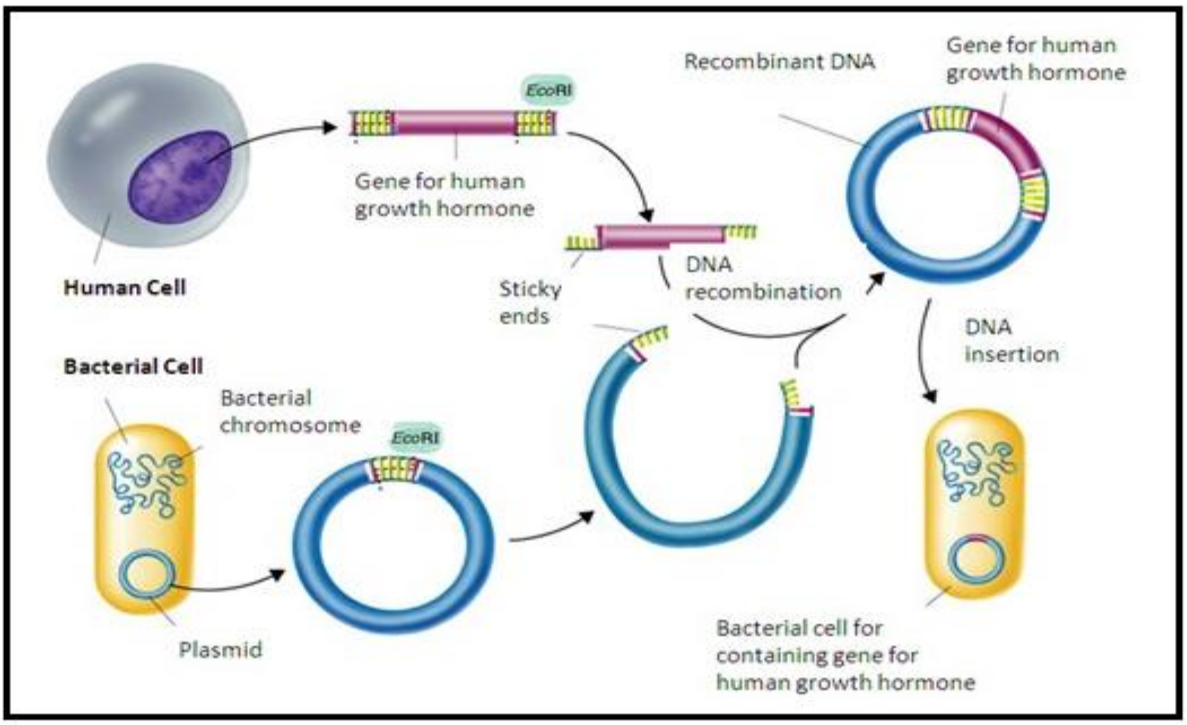
SECTION C: BIOTECHNOLOGY APPLICATIONS

Question One: Gene Cloning

a. In the past, people breed organisms with desired traits by selective breeding. Today, the genes can be inserted into cells to produce organisms with those same desired traits by genetic engineering, as illustrated below:



i. State the purpose of using bacterial plasmids to produce multiple copies of the desired gene.

Skill level 1	
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ii. Describe the formation of recombinant DNA using techniques of restriction enzymes and ligation.

Skill level 2	
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iii. DNA profiling is a technique by which individuals can be identified and compared via their respective DNA profiles. Discuss the applications and impact of DNA profiling in forensic investigations.

Skill level 3	
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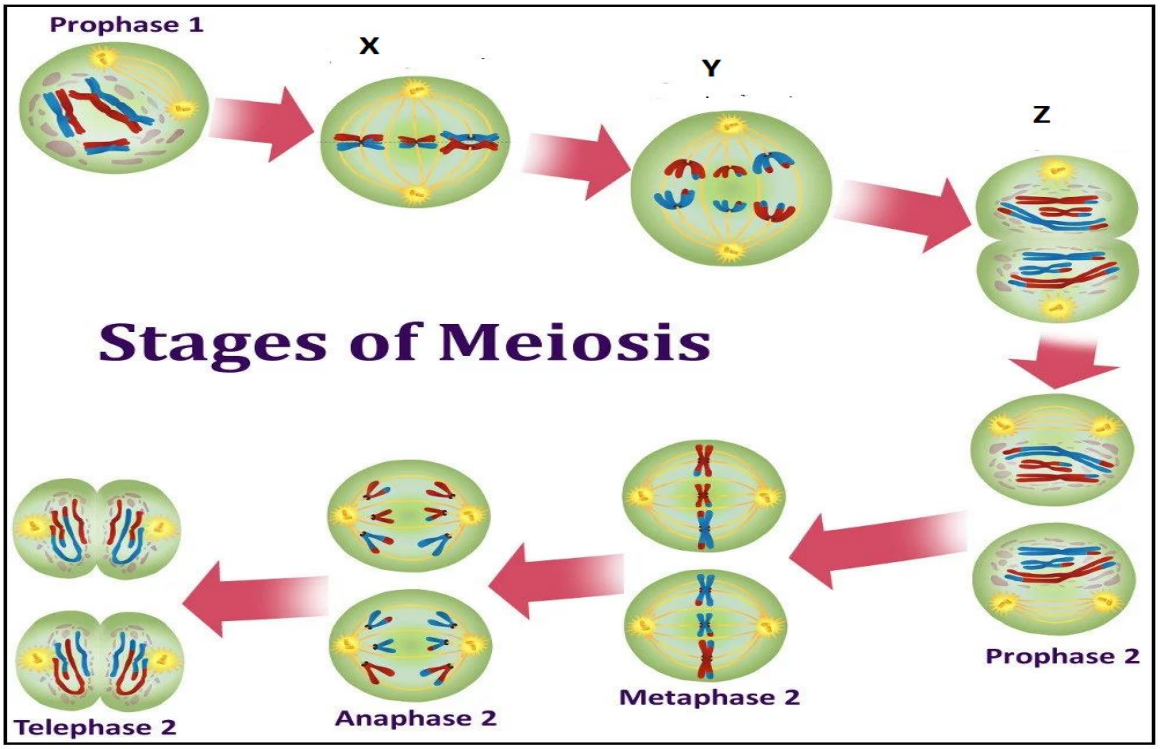
SECTION D: PROCESSES AND PATTERNS OF EVOLUTION

Question 1: Variation

a. The diagram below shows stages of meiosis.



i. List the stages of meiosis represented by letters X, Y and Z.

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Skill level 1	
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ii. Meiosis is a source of variation for sexually reproducing organisms. Discuss the importance of variation in evolution, using an example.

Skill level 4	
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Question Two: Natural Selection

a. Describe the main ideas of the theory of natural selection as proposed by Darwin.

Skill level 2	
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b. The diagram below shows a peacock showing its tail to attract the female peacock.

Explain **sexual selection** as a special case of natural selection.

Skill level 3	
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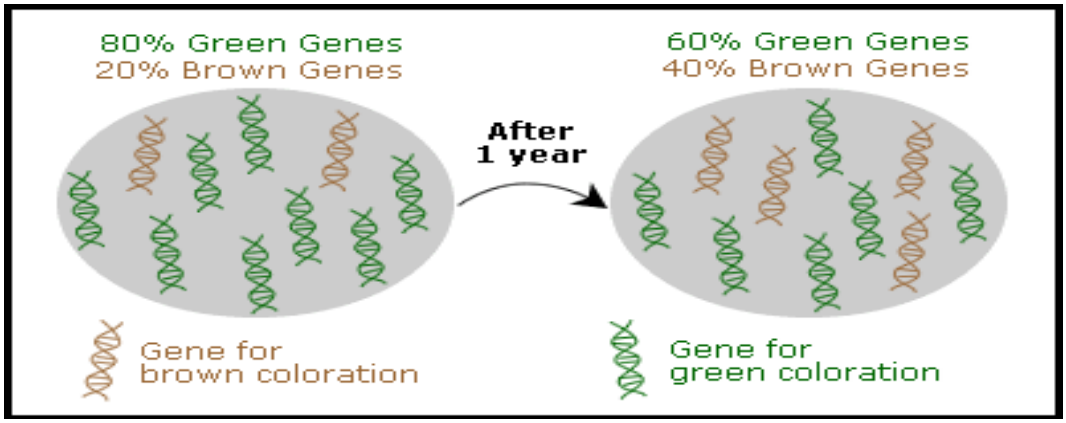
Question Three: Gene pool and allele frequency

a. To study micro-evolution, an investigation was carried out on beetles where a sample was collected and determined that 80% of the genes in the population were for green coloration and 20% of them were for brown coloration. The next year, another sample was collected and found a new ratio of 60% green genes to 40% brown genes. This is illustrated in the diagram below:



i. Define **genetic drift**.

Skill level 1	
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ii. Describe the factors that affect allele frequency.

Skill level 2	
2	
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iii. Describe how allele frequency contributes to the gene pool.

Skill level 2	
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Question Four: Speciation

a. It is difficult to distinguish between the eastern meadowlark (*Sturnella magna*) and the western meadowlark (*Sturnella neglecta*) based on their appearance alone but then their mating calls are quite distinct. The whistle-like call of the eastern meadowlark can be easily distinguished from the flute-like call of its western cousin.

i. Explain the effect of this behavioural reproductive isolation on pre-zygotic isolating mechanism.

Skill level 3	
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ii. Explain how **divergent evolution** occurs.

Skill level 3	
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