MARKER CODE				

STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE

2023

BIOLOGY

QUESTION AND ANSWER BOOKLET

Time allowed: 3 Hours

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	STRANDS	TOTAL SKILL LEVEL
ONE	ANIMAL BEHAVIOUR	21
TWO	GENE EXPRESSION	28
THREE	BIOTECHNOLOGY APPLICATIONS	8
FOUR	PATTERNS OF EVOLUTION	13
	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 space 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 pages 22-23 have been deliberately left blank.

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

SECTION ONE: ANIMAL BEHAVIOUR

1. The **actogram** below shows mice exposed for 12 hours light and 12 hours darkness for 14 days. After 14 days, the mice were kept under dark condition and the activity was recorded as shown in the actogram below:

Figure 1: Activity of mice from Day 1 - 14 under 12 hours light:12 hours darkness

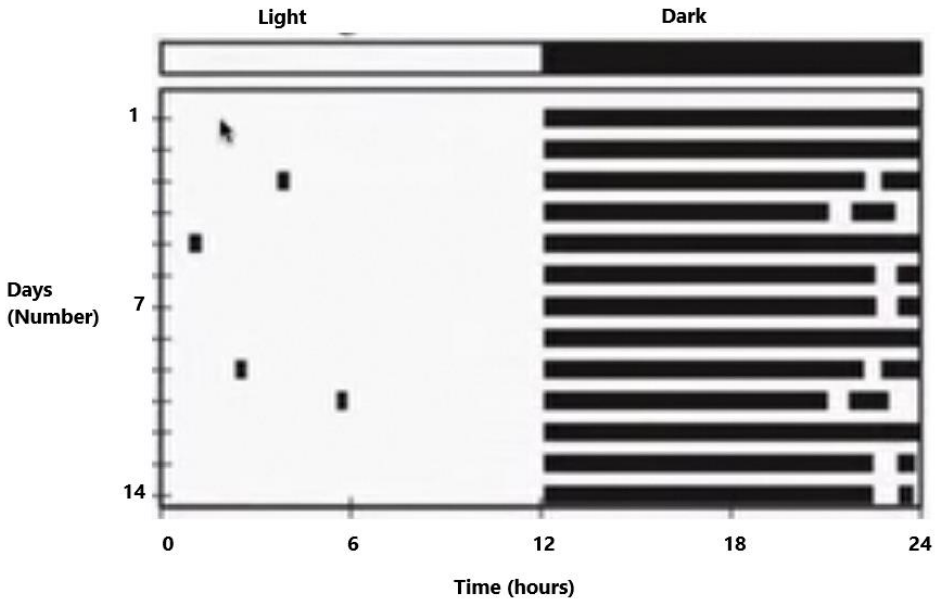
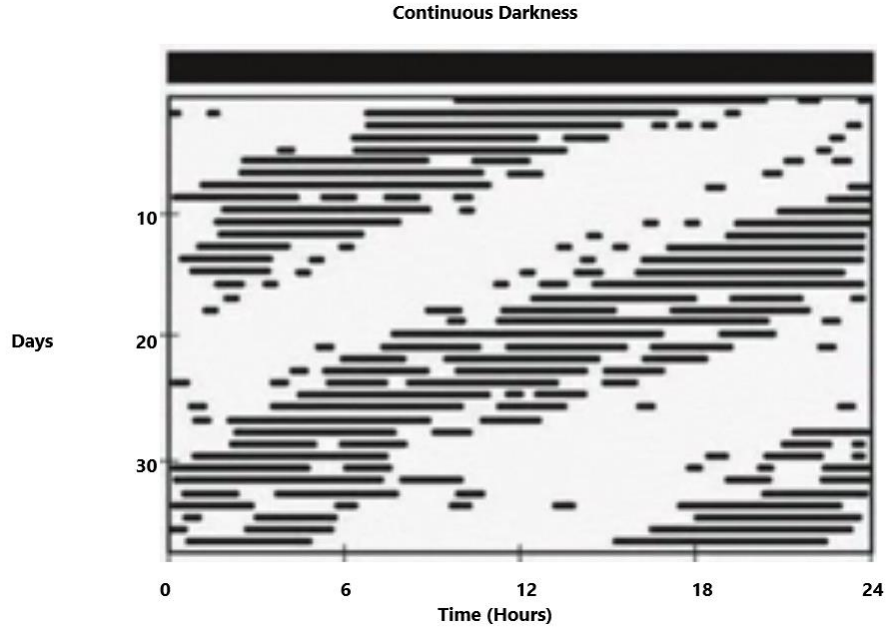


Figure 2: Activity of mice after Day 14 under 24 hours darkness:



Source:*1a-c, Responses to the environment (video) | Khan Academy*

a. Interpret the activities of the mice in **Figure 1** and **Figure 2**.

Skill level 3	
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b. The genetically controlled **circadian rhythm** in the mice does not follow a 24 hour cycle.
Define 'circadian rhythm'.

Skill level 1	
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2. Wolves are considered one of the most social animals in the world that live in complex social structures called **packs**. This **intra-specific interactions** consist of up to 20 individuals connected with blood ties and emotional bonds with their group members. Every pack has four main ranks, namely the Alpha, Beta wolves, Mid-ranked wolves and the Omega wolves.

Figure 3: Intraspecific competition amongst wolves

***Source:** ENVI 6 community ecology FINAL (slideshare.net)*

a. Define 'intra-specific interaction'.

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Skill level 1	
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b. Describe the competitive behavior shown by the wolves in **Figure 3**.

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Skill level 2	
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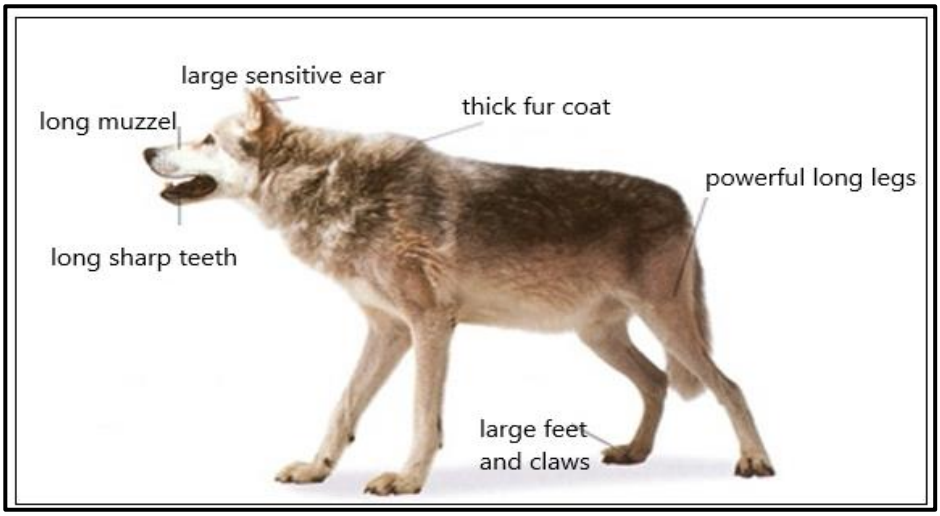
c. Wolves have many adaptations as shown below:

Figure 4: Adaptations of wolves



Source: ***Physical Characteristics (50webs.com)***

Explain how **TWO** (2) structural adaptations shown in **Figure 4** assist in the survival of wolves.

Skill level 3	
3	
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d. Discuss how the intra-specific interactions of wolves impact the social organization, behavior and overall survival of wolf populations.

Skill level 4	
4	
3	
2	
1	
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NR	

e. By nature, wolves are very **territorial** animals. They can have a home range from 33 to 6,200 km^2 but it depends on the type of wolf and where they reside.

i. Define 'home range'.

Skill level 1	
1	
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ii. Explain the advantages and disadvantages of wolves having a territory.

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Skill level 3	
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3. White Storks (*Ciconia ciconia*) migrate from Europe when it is winter to Central Africa and as far as South Africa to spend winter and return to Europe in the spring for breeding. Some take an Eastern route through Turkey to Africa as White Storks rely on the uplift of **air thermals** to soar and glide the long distances of their annual migration. They avoid crossing the long distance flight above the Mediterranean sea since air thermals do not form over water.

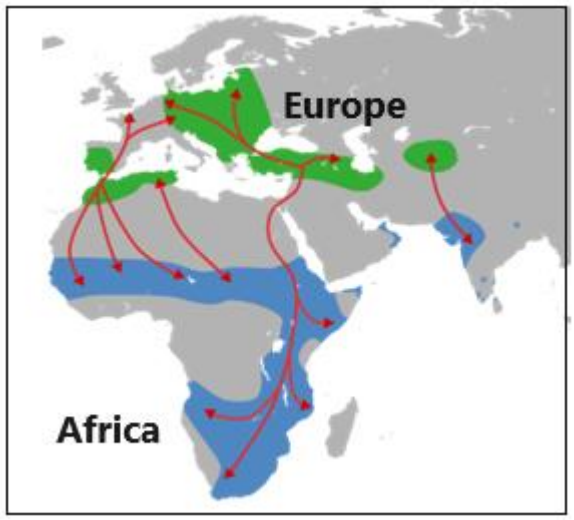
The migratory route and a flock of migrating White Storks are shown below:

Figure 5: Flock of migrating White Stork

Source:

Flock Of White Stork Ciconia Ciconia In Flight On Migration Tarifa Spain Photo -

Figure 6: Migratory route of White Stork



Source: ***WhiteStorkMap - White stork - Wikipedia***

Explain how different types of navigation used by White Storks is beneficial for the bird.

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Skill level 3	
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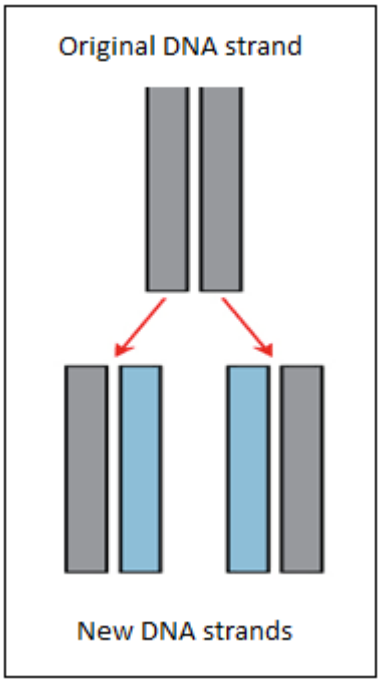
SECTION TWO: **GENE EXPRESSION**

1. The diagram below shows a model of DNA strand. After DNA replication, the new DNA strands are referred to as **semi-conservative**.

Figure 7: DNA Replication



Source: ***Mode of DNA replication: Meselson-Stahl experiment (article) | Khan Academy***

Explain why the DNA replication is considered semi-conservative.

Skill level 3	
3	
2	
1	
0	
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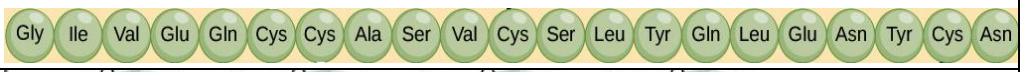
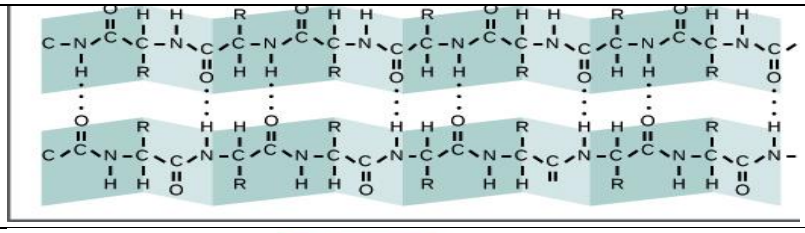
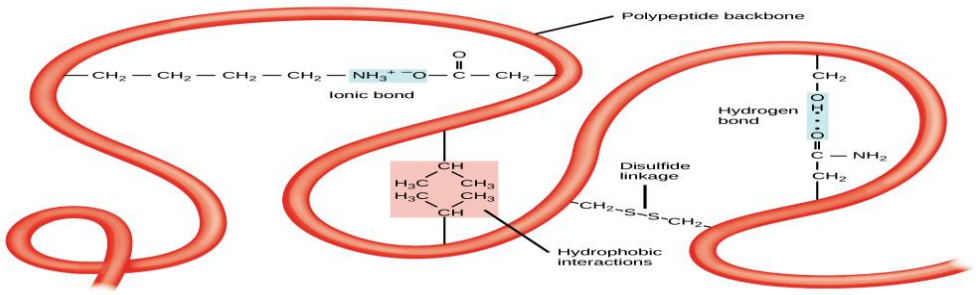
2. The diagram below shows the **different structures** of **Protein**. Use it to answer the questions that follow:

Figure 8: Types of protein structures

	Diagram
Primary Structure	
Secondary Structure (Beta pleated sheets)	
Tertiary Structure	

Source: ***Protein structure: Primary, secondary, tertiary & quatrenary (article) | Khan Academy***

a. Explain how the structure of protein (primary, secondary, tertiary) supports its function.

Skill level 3	
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b. Explain how might a change in either nucleic acid DNA or RNA can impact the primary, secondary and tertiary protein structure.

Skill level 3	
3	
2	
1	
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c. Discuss possible causes of **ONE** (1) specific type of gene mutation learnt in class.

Skill level 4	
4	
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2	
1	
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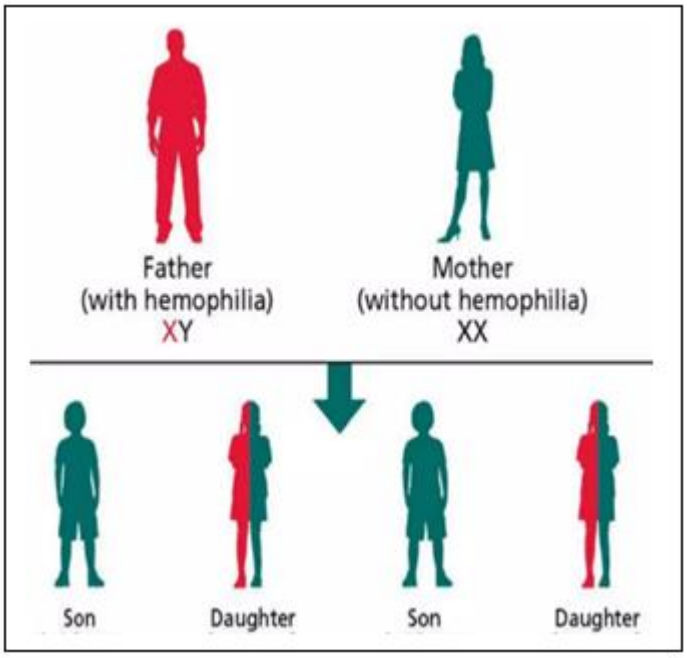
3. The diagram below shows the inheritance of **haemophilia**, a sex-linked recessive disorder in a family. The father has haemophilia and the mother does not have it.

Figure 9: Inheritance of haemophilia



Sources: ***Haemophilia Inheritance***

a. Define 'sex-linked genes'.

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Skill level 1	
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b. Describe how haemophilia is inherited by the children.

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Skill level 2	
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4. The genes responsible for causing genetic disorders in humans are mainly **pleiotropic**.

a. Describe the features of pleiotropy as a gene-gene interaction.

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Skill level 2	
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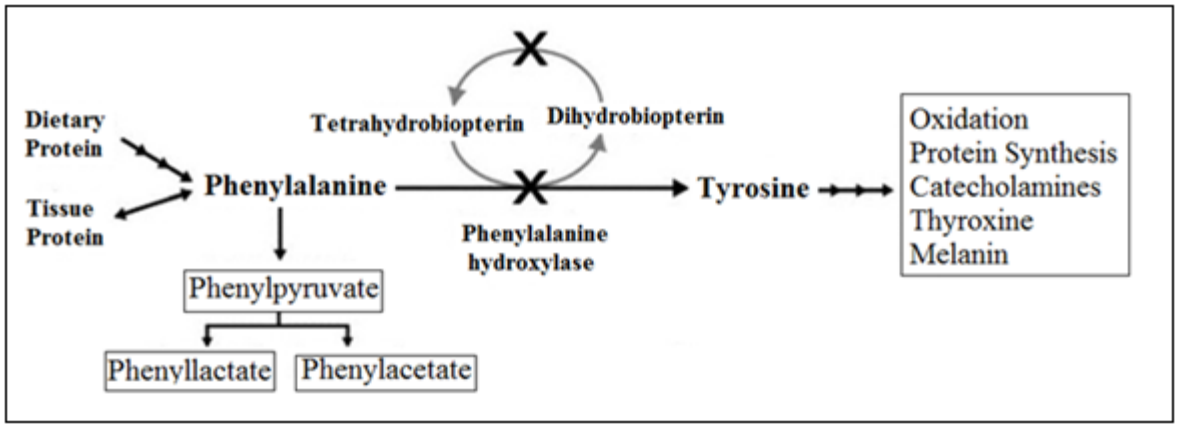
b. **Phenylketonuria, or PKU,** is a disease resulting from pleiotropy. The metabolic pathway for PKU is shown below:

Figure 10: PKU metabolic pathway



Source: ***Pleiotropy: Definition, Functions, Examples - Embibe***

i. Define metabolic pathway.

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Skill level 1	
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ii. Identify the substrate and the products of the PKU metabolic pathway.

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Skill level 1	
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iii. Analyze the chemical reactions and enzymes involved in the PKU metabolic pathway.

Skill level 3	
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5. Describe gene aneuploidy using Turners Syndrome as an example.

Skill level 2	
2	
1	
0	
NR	

6. Explain how the incomplete dominance contribute to variations and survival of organism.

Skill level 3	
3	
2	
1	
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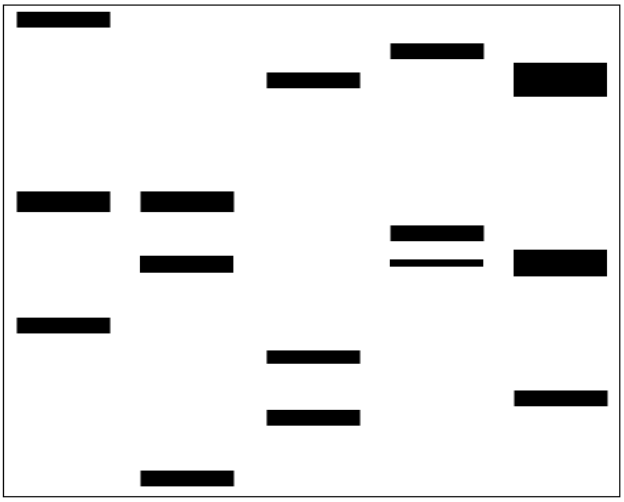
SECTION THREE: BIOTECHNOLOGY APPLICATIONS

1. In the human genome, there is a small amount of DNA that is unique to individuals. By cutting a sample of DNA into fragments and separating the fragments by size, it is possible to make a characteristic profile of DNA bands for individuals as shown below:

Figure 11: DNA bands



Source: ***Gel Electrophoresis and DNA Fingerprinting – MHCC Biology 112: Biology for Health Professions (pressbooks.pub)***

a. List the techniques of creating DNA profiles.

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Skill level 2	
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b. Describe the process of the formation of DNA profiles using the technique gel electrophoresis.

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Skill level 2	
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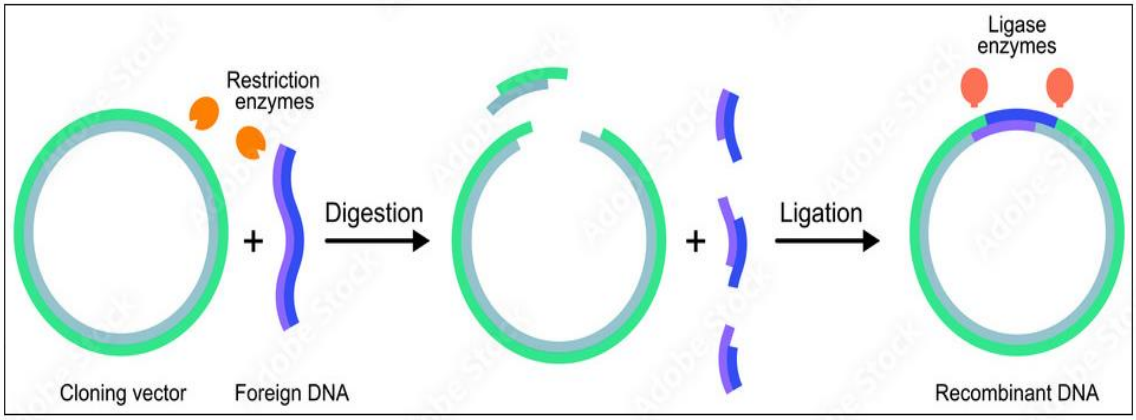
2. Gene cloning is the process in which a gene of interest is located and copied (cloned) out of all the DNA extracted from an organism. A bacterial plasmid is used as a cloning vector in the process, as shown in the diagram below:

Figure 12: Recombinant DNA



Sources:*Molecular Illustration Of Gene Cloning. From Plasmid to Recombinant DNA. Vector Illustration. Stock Vector | Adobe Stock*

a. State the function of a ligase enzyme.

Skill level 1	
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b. Explain the medical advantages of using bacterial plasmids in gene cloning.

Skill level 3	
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SECTION FOUR: PATTERNS OF EVOLUTION

1. Among the evolutionary processes that interfere in the gene pool of populations, altering their genetic constituent involving mutation, migration (with gene flow), natural selection and genetic drift;

   a. State the role of mutation in producing variation.

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Skill level 1	
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   b. Describe how mutation produces variation.

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Skill level 2	
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NR	

   c. Describe the features of genetic drift.

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Skill level 2	
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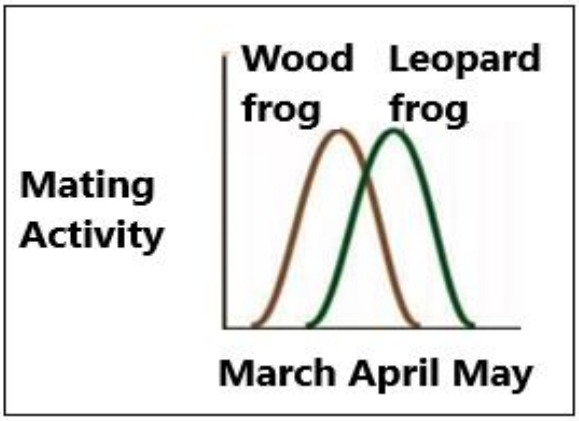
2. The graph below shows the mating activities for Wood frog and Leopard frog. Use it to answer the question that follow:

Figure 13: Pre-zygotic mechanism



Source: ***Biology 16 3 the process of speciation[1] | PPT (slideshare.net)***

Describe the features of the pre-zygotic isolating mechanism shown by the mating activities of the Wood frog and Leopard frog.

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Skill level 2	
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3. Describe the features of hybrid inviability.

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Skill level 2	
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4. Study the pictures in **Figure 14** below and use it to answer the question that follow:

Figure 14: Convergent evolution

Source: ***Convergent Evolution | Introduction & Examples (ibiologia.com)***

Describe the features of convergent evolution as shown by the organisms in the **Figure 14** above.

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Skill level 2	
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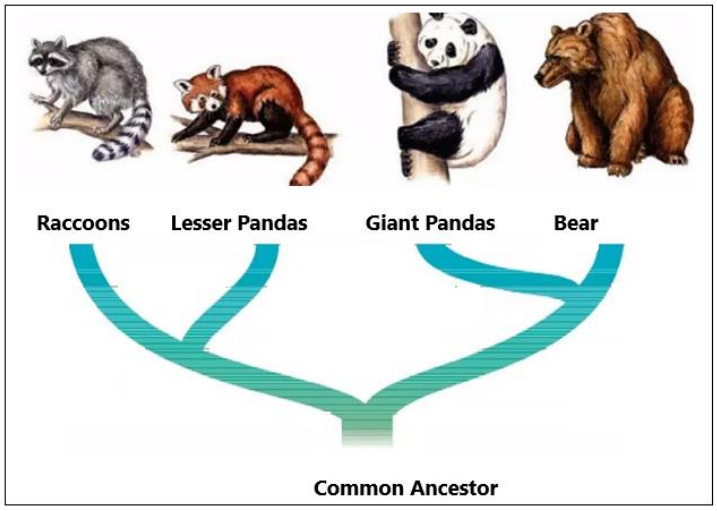
5. The animals shown in the picture **Figure 15** below, illustrates a result of **divergent evolution**.

Figure 15: Divergent evolution



Source: ***7th Grade Life Science - Evolution (slideshare.net)***

Describe the features of divergent evolution as illustrated in **Figure 15** above.

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