

Trial Examination 2022

VCE Biology Unit 2

Written Examination

Question and Answer Booklet

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of booklet

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	25	25	25
B	7	7	50
			Total 75

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

No calculator is allowed in this examination.

Materials supplied

Question and answer booklet of 21 pages

Answer sheet for multiple-choice questions

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

At the end of the examination

Place the answer sheet for multiple-choice questions inside the front cover of this booklet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – MULTIPLE-CHOICE QUESTIONS**Instructions for Section A**

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Question 1

An organism's genome consists of

- A. only the genes that code for important body features.
- B. all the genes located on the autosomes.
- C. all the DNA of the genes on all chromosomes.
- D. only the genes of the maternal chromosomes.

Question 2

Which one of the following best describes homologous chromosomes?

- A. a pair of chromosomes of the same length
- B. two chromosomes that have the same centromere position
- C. a pair of chromosomes that have identical alleles
- D. two chromosomes with the same gene loci

Question 3

Each DNA molecule consists of

- A. one chain of nucleotides in a double strand.
- B. four different nitrogenous bases as subunits.
- C. identical bases that pair up between the strands.
- D. a double helix of nucleotide units.

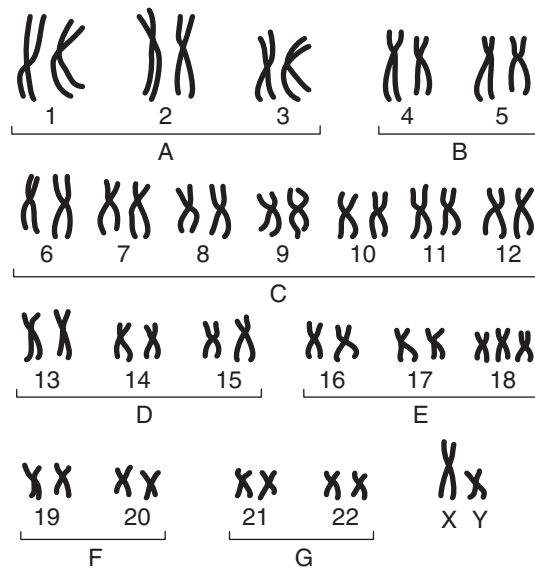
Question 4

Which row in the table shows the inputs and outputs of meiosis and the terms used to describe the chromosome numbers?

	Input	Term for chromosome number of the input into meiosis	Output	Term for chromosome number of the output from meiosis
A.	adult somatic cell	n	sex cell	n
B.	adult gonad cell	$2n$	gamete	n
C.	somatic cell	$2n$	zygote	$2n$
D.	gonad cell	n	sperm or egg	n

Use the following information to answer Questions 5–8.

The following diagram shows a karyotype for an individual with Edward's syndrome.



Question 5

Which one of the following statements is correct?

- A. All chromosomes labelled A–Y are autosomes.
- B. The chromosomes numbered 1–22 are somatic chromosomes.
- C. There are 21 pairs of homologous chromosomes shown in the diagram.
- D. The pair of chromosomes labelled X and Y are sex-linked chromosomes.

Question 6

The chromosome variation shown in the karyotype for Edward's syndrome could be summarised as

- A. $2n - 1$
- B. $2n + 1$
- C. $n + 2$
- D. $n + 3$

Question 7

The term used for a condition such as Edward's syndrome is

- A. aneuploidy.
- B. monoploidy.
- C. polyploidy.
- D. triploidy.

Question 8

Which one of the following processes occurs during meiosis to cause a condition such as Edward's syndrome?

- A. DNA replication
- B. crossing-over and recombination
- C. independent assortment
- D. non-disjunction

Question 9

There are several ways of explaining the concept of epigenetic factors.

Which one of the following does **not** fit into the accepted explanations?

- A. Epigenetic factors affect phenotypic variance.
- B. Epigenetic factors are reversible.
- C. Epigenetic factors act directly to change the DNA nucleotide sequence.
- D. Epigenetic factors include environmental factors and behaviours.

Question 10

Alcohol abuse is a major problem. Scientists have been studying genetic and environmental factors that increase a person's chances of developing an alcohol abuse disorder.

One study examined the following two genes.

- PER2 (influences the body's biological clock)
- POMC (plays a role in the stress-response system)

The study used 47 participants who were either moderate, binge or heavy drinkers.

Which one of the following results from the study would support the hypothesis that excessive alcohol consumption is an epigenetic factor?

- A. The binge and heavy drinkers had elevated levels of DNA methylation of the PER2 and POMC genes.
- B. The binge and heavy drinkers had changes in the coding of the PER2 and POMC genes.
- C. The binge and heavy drinkers had no changes in the functioning of the PER2 and POMC genes.
- D. The binge and heavy drinkers had a similar gene expression of the PER2 and POMC genes as moderate drinkers.

Use the following information to answer Questions 11–15.

Blood is divided into groups or types depending on the presence or absence of certain antigens (usually proteins) on the surface of red blood cells. The success of blood and organ transfusions and transplants depends on matching blood types. In some cases, pregnancies may be affected if the blood types of the pregnant parent and the developing baby are incompatible.

The following table shows information about four different blood grouping systems.

Name of blood grouping system	Position of gene/locus on chromosome	Symbols used for alleles of the gene	Additional information
ABO	long arm of chromosome 9	I^A, I^B, i	The $I^A I^B$ genotype results in an AB blood group with both A and B antigens present.
Rh	short arm of chromosome 1	Rh+, Rh–	Rh+ is the dominant trait.
Duffy (Fy system)	long arm of chromosome 1	Fya, Fyb	Fya is the dominant trait.
MN	long arm of chromosome 4	M, N	Both antigens M and N are present in the blood of person with genotype MN.

Question 11

Which one of the following patterns of inheritance is found in all four blood grouping systems listed in the table?

- A. codominance
- B. incomplete dominance
- C. autosomal
- D. sex-linked

Question 12

Around 40% of the Australian population has the blood type O, Rh+. Only 7% has the blood type O, Rh–. Donated O, Rh– blood is in demand as it is the only blood type that can be given to people with any of the different blood groups in transfusions.

Which one of the following parental crosses could **not** produce a child with the blood type O, Rh–?

- A. $ii, Rh-Rh- \times I^A i, Rh+Rh-$
- B. $I^B i, Rh+Rh- \times I^B i, Rh+Rh-$
- C. $I^A i, Rh-Rh- \times I^B i, Rh-Rh+$
- D. $I^A I^B, Rh+Rh- \times ii, Rh-Rh-$

Question 13

If one parent of a child had an $I^A I^B$ MN genotype and the other parent had an $I^A I^A$ NN genotype, the chance of the child having the blood group A N is

- A. $\frac{1}{4}$
- B. $\frac{1}{3}$
- C. $\frac{1}{2}$
- D. $\frac{3}{4}$

Question 14

A man is heterozygous for both the Duffy alleles and the Rh alleles.

The correct notation for the man's genotype is

- A. $\frac{Fya Fyb}{Rh^+ Rh^-}$
- B. $\frac{Fya Rh^-}{Fyb Rh^+}$
- C. $\frac{Fya Rh^+}{Fyb Rh^+}$
- D. $\frac{Rh^+ Rh^-}{Fya Fyb}$

Question 15

A couple has a large family of 12 children. The father is heterozygous for both the Duffy and Rh alleles. The mother is homozygous for Duffy b and Rh $^-$.

Which one of the following is the most likely predicted ratio for the 12 offspring produced by the couple?

- A. 1 : 1 : 1 : 1
- B. 9 : 3 : 3 : 1
- C. 1 : 2 : 2 : 1
- D. 1 : few : few : 1

Question 16

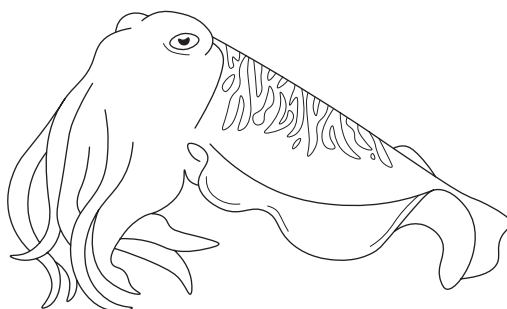
Corals, flatworms and sea stars can reproduce using a process called fragmentation. In fragmentation, the body of an organism divides into several parts, and each part is able to regenerate the rest of the body, producing an entire functioning organism.

This method of reproduction is an advantage because

- A. asexual reproduction has occurred.
- B. all members of the species will survive.
- C. there is increased diversity in the species.
- D. there is a greater chance of the survival of the species.

Use the following information to answer Questions 17 and 18.

The diagram below shows an Australian giant cuttlefish. Australian giant cuttlefish are only found in the waters of southern Australia. They inhabit reef and sea grass areas.



Australian giant cuttlefish have many adaptations, including:

- a beak to help subdue their prey and defend themselves against predators and rivals
- the ability to flatten their bodies to make themselves look bigger
- showing two dark 'eye spots' on their backs and a black ring around their mantle/covering
- a specialised hollow cuttlebone that helps them maintain buoyancy and move up and down by adjusting the levels of gas and liquid in its chamber
- highly specialised skin that varies in colour and texture by using muscle contraction to change the pigment and iridescence to match their surroundings.

Question 17

Which one of the following shows the description and type of an adaptation that would most benefit young, small cuttlefish that need to frighten predators?

	Description of adaptation	Type of adaptation
A.	skin changing colour and texture	structural
B.	ability to flatten body	behavioural
C.	beak to attack the predator	physiological
D.	hollow cuttlebone for attack	structural

Question 18

Australian giant cuttlefish are active during the day and night. They congregate in large numbers from mid-May to July for the breeding season.

The physiological adaptation that is most beneficial to a cuttlefish's survival during daylight hours is

- A. its ability to change its buoyancy to move closer to a mate.
- B. a beak to attract mates during breeding season.
- C. mass migration during the breeding season to a central area.
- D. the contraction of the muscles around coloured skin cells to change its colour for camouflage.

Use the following information to answer Questions 19 and 20.

Ferrets are a type of weasel. They are nocturnal and feed on rat-like prairie dogs, often living among the burrows of these rodents. Due to habitat loss and the poisoning and shooting of the black-footed ferret by farmers in the southern states of America, the species was thought to be extinct. In 1981, scientists found seven black-footed ferrets in the wild, including some males and some females, and were able to start a captive breeding program. These seven ferrets produced a population of thousands of ferrets that have since been released into sites in America, Canada and Mexico.

Question 19

The method of reproduction used by the seven ferrets is

- A. regeneration.
- B. asexual reproduction.
- C. sexual reproduction.
- D. propagation.

Question 20

The major problem with a captive breeding program is that the descendants of the original ferrets have

- A. reduced genetic diversity, which reduces their chance of producing offspring.
- B. a lack of genetic diversity, which reduces the chances of the survival of the species.
- C. a high increase in genetic diversity, which means the population size is too high.
- D. a constant amount of genetic diversity, which improves the chances of individual survival.

Question 21

Lizards drop their tails as a defence mechanism when they feel threatened by a predator. The lost tail wriggles and whips around on the ground, distracting the predator to allow the lizard to escape.

Which one of the following statements is correct?

- A. This is a behavioural adaptation.
- B. This reduces the lizard's chances of survival.
- C. This has no effect on the lizard as it no longer needs a tail.
- D. This is an example of fragmentation.

Use the following information to answer Questions 22–25.

In 2021, it was announced that scientists had cloned a black-footed ferret. Material for the reproductive cloning process was taken from the frozen remains of Willa, a ferret that died in 1988. The process produced a cloned female ferret named Elizabeth Ann. Elizabeth Ann is a genetic copy of Willa.

Question 22

The material that was taken from Willa's frozen remains for the reproductive cloning process was the DNA contained in the

- A. somatic cells.
- B. ovary tissue.
- C. egg cells.
- D. sperm cells.

Question 23

Using a mild electric shock, a cell containing Willa's DNA was fused with an donor egg that had its nucleus removed. The fused cell was then grown into a ball of cells in a culture medium.

The embryo was most likely placed into

- A. the original female donor.
- B. a surrogate of a different species.
- C. another female of the same species.
- D. a female egg donor of a different species.

Question 24

Which one of the following would **not** be a valid use of reproductive cloning technology in the future?

- A. bringing back extinct species that have been lost from the Earth
- B. helping to improve an endangered species' chance of survival
- C. increasing populations of threatened species by increasing genetic diversity
- D. modifying the genome of organisms to increase their genetic resistance

Question 25

The ecological role of ferrets in American ecosystems is similar to that of Northern brown bandicoots living in the bushland and rainforest ecosystems of north and eastern Australia. In recent years, the population numbers of this protected bandicoot species have declined and their distribution areas have been reduced.

This is due to

- A. being hunted for food by humans.
- B. loss of habitat due to urbanisation.
- C. poisoning and shooting by humans.
- D. the introduction of feral goats to kill bandicoots.

END OF SECTION A

SECTION B**Instructions for Section B**

Answer **all** questions in the spaces provided.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1 (8 marks)

DNA is found in the chromosomes of cells. Depending on the species and the location within the cell, these chromosomes may be linear or circular. Some cells also contain small circular DNA molecules known as plasmids. The following table contains information about the DNA of nine different species, including their genome size and the number and location of their chromosomes. If they contain any plasmids, this is also recorded.

Name of species	Genome size (number of base pairs)	Chromosome number and their location
<i>Salmonella</i> bacteria	4.94 million	1 chromosome 2 plasmids
yeast	12.6 million	32 in nucleus 1 mitochondrial
mushroom	33.49 million	26 in nucleus 1 mitochondrial
salamander (amphibian)	116.6 billion	20 in nucleus 1 mitochondrial
zebra fish	1.68 billion	50 in nucleus 1 mitochondrial
human	3.27 billion	46 in nucleus 1 mitochondrial 1 chloroplast
chilli plant	3.22 billion	24 in nucleus 1 mitochondrial 1 chloroplast
corn/maize	2.14 billion	20 in nucleus 1 mitochondrial 1 chloroplast
wheat	12 billion	44 in nucleus 1 mitochondrial 1 chloroplast

- a. i. Based on the information in the table, outline the relationship between genome size and chromosome number for these species.

1 mark

- ii. Why is the genome size much larger than the chromosome number for all the species shown in the table?

1 mark

The salamander (amphibian) has the greatest genome size of all the species shown. In a Biology class, Wendy stated that this is because the salamander is more complex than the zebra fish, which has a genome size of 1.68 billion. David disagreed with her.

- b.** Who is correct? Justify your answer. 1 mark

- c.** Corn/maize and the salamander (amphibian) both have the same nuclear chromosome number, yet they are completely different types of organisms. 1 mark
- Why is this the case?

- d. i.** There is no information for chromosome location in *Salmonella* bacteria shown in the table. 1 mark
- Suggest a possible reason for this.

- ii.** The table shows three chromosome locations for wheat, but only two chromosome locations for zebra fish. 1 mark
- Suggest a possible reason for this.

- e. i.** Based on the information given in the table, write the diploid number for a mushroom. Use the correct notation. 1 mark

- ii.** Based on the information given in the table, write the haploid number for a zebra fish sperm. Use the correct notation. 1 mark

Question 2 (10 marks)

a. Meiosis is a type of cell division.

i. During meiosis, four daughter cells result from only one parent cell.

How does this occur?

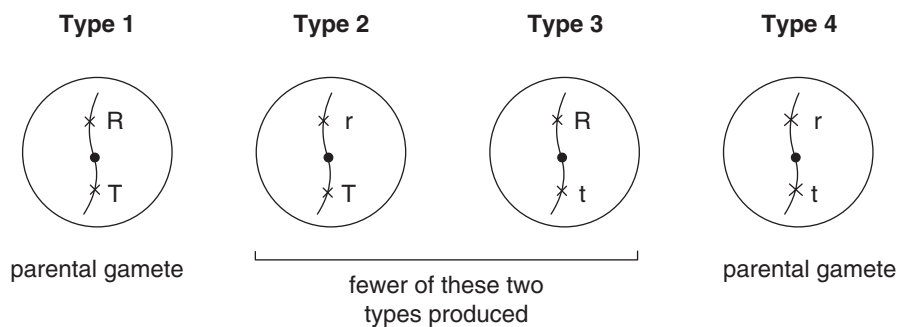
1 mark

ii. The amount of DNA in a human gonad cell before meiosis is 6.4 picograms (pg), yet the four gametes each contain 3.2 picograms.

How does this occur?

1 mark

b. During meiosis, one pair of homologous chromosomes underwent crossing over and recombination between the two gene loci R and T. The following diagram shows the four resulting gametes. In a large sample, there were fewer gametes of type 2 and type 3. Type 1 and type 4 are referred to as parental gametes.



Draw the pair of homologous chromosomes that produced the four gametes as the chromosomes would have appeared at the beginning of prophase 1. Show the correct letter at each gene locus.

2 marks

Students were asked to draw a testes cell from a male parent organism with the genotype EeGg when it is undergoing early anaphase I of meiosis. If no further information about the genotype of the organism was provided, this could be drawn in several different ways, as shown in Figure 1 and Figure 2.

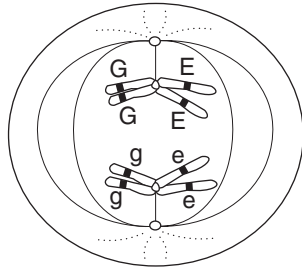


Figure 1

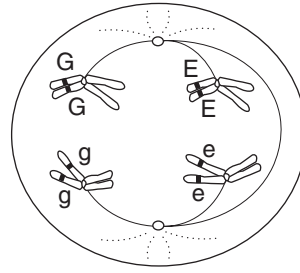


Figure 2

- c. Identify the difference between the gene loci on Figure 1 and Figure 2 and give the term used to describe that difference.

2 marks

Figure 3 and Figure 4 show two ways in which the cell could be correctly drawn.

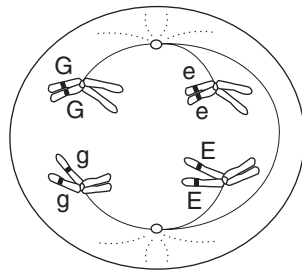


Figure 3

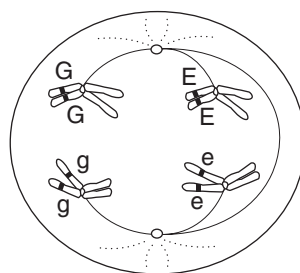


Figure 4

- d. Identify the difference between the gene loci on Figure 3 and Figure 4 and name the process that causes that difference.

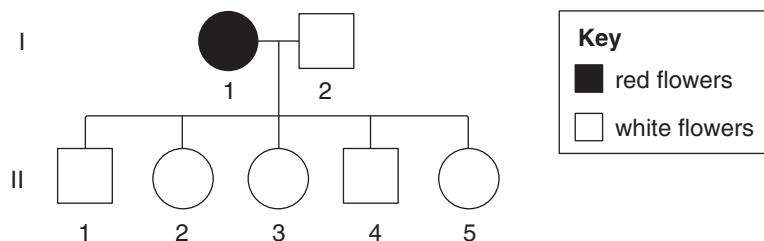
2 marks

- e. Explain the benefit to a species if the process named in **part d.** occurs.

2 marks

Question 3 (6 marks)

The incomplete pedigree shows a cross between two plants, one with red flowers and one with white flowers, and the five offspring they produced. The colour of the flowers of the offspring has **not** been shown.



- a. i. What phenotype(s) would the offspring have if the pattern of inheritance of flower colour is incomplete dominance? 1 mark

- ii. Give a reason for your answer to **part a.i.** 1 mark

- b. i. What phenotype(s) would the offspring have if the pattern of inheritance of flower colour is codominant inheritance? 1 mark

- ii. Allocate allele symbols for the two flower colours if flower colour is inherited as a codominant trait and use those symbols to write the genotypes for the phenotype(s) given in **part b.i.** 1 mark

- c. In another type of plant, the pattern of inheritance of red flower colour is completely dominant to white. However, a plant that produces red flowers could have one of several genotypes for red colour.

- i. Name a cross that could be used to determine the genotype of the plant that produces red flowers. 1 mark

- ii. How would the cross named in **part c.i.** determine the genotype? 1 mark

Question 4 (8 marks)

Glucose-6-phosphate dehydrogenase (G6PD) deficiency is a condition inherited as an X-linked recessive disorder, usually affecting males of African and Mediterranean descent. G6PD deficiency results in a form of haemolytic anaemia in which red blood cells break down. Although the protein coded for by the G6PD gene is produced, the condition is not shown unless it is triggered by certain medications, stress, infections and/or foods; the disease is commonly called 'favism' as it is triggered by chemicals that are found naturally occurring in fava beans. Over 400 million people globally have the condition. All mutations that cause G6PD deficiency are on the long arm of the X chromosome, Xq28.

- a. Based on the information above, allocate appropriate allele symbols for G6PD deficiency and unaffected conditions. Use the correct notation. 1 mark

- b. Outline whether a male could be a carrier of the G6PD gene. 1 mark

- c. If a female carrier had a child with an unaffected male, what is the chance of them having a male child that may show symptoms of G6PD deficiency? Show all working in the spaces provided. 3 marks

Parental cross _____

Gametes

Chance of male child with G6PD deficiency _____

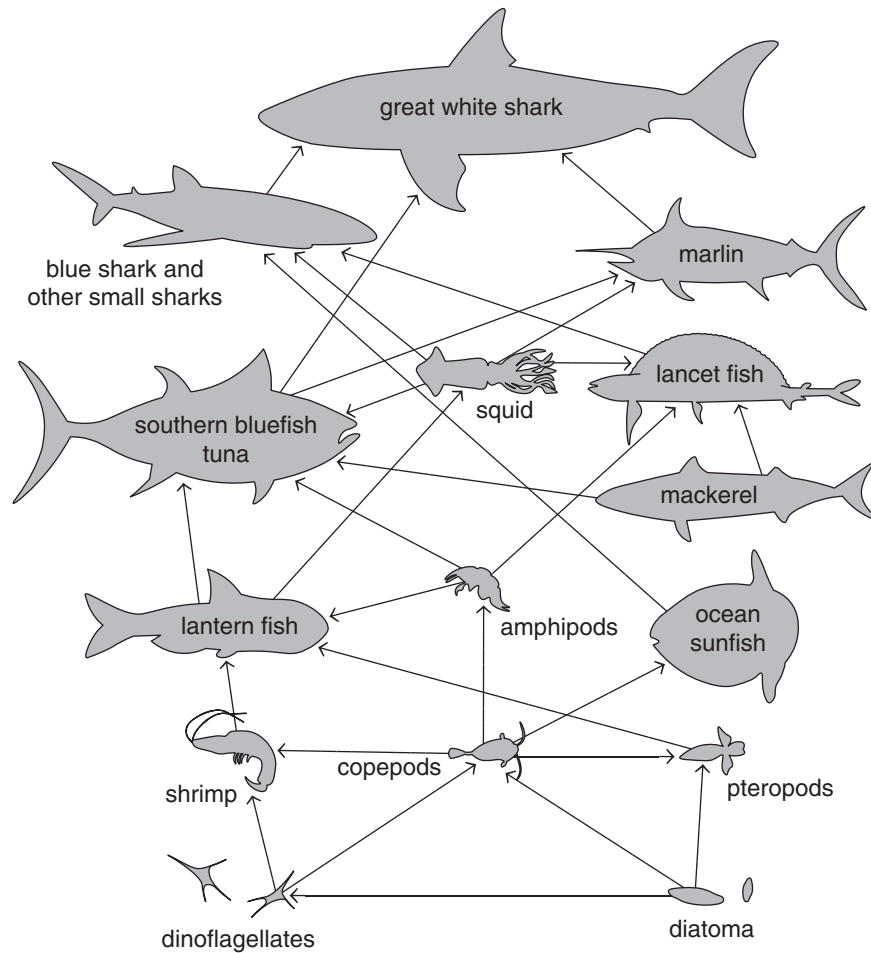
- d. Identify the genotype and conditions that could result in a female symptomatic for G6PD deficiency. 2 marks

- e. Outline whether the factors that trigger the symptoms of the G6PD condition could be considered epigenetic factors.

1 mark

Question 5 (12 marks)

The following diagram shows a food web of some of the major species that reside in the waters of the Great Australian Bight.



Many of the species found in the waters of the Great Australian Bight have unique adaptations.

a. Using your knowledge and the information above, complete the table below.

4 marks

Organism/ Species	Adaptation and adaptive advantage	Type of adaptation
great white shark		structural
blue shark	They migrate in a long, looping pattern to the tropical Indian Ocean then return to the Great Australian Bight to forage for food each year.	
southern bluefin tuna and mackerel	They are 'warm-blooded' and can regulate their body temperature by endothermy, retaining the body heat they generate when swimming.	
shrimp		structural

- b.** Sharks have lived for about 450 million years on Earth. They have survived five major extinctions, which wiped out 75–96% of life on the Earth. However, in the last 100 years, they have been facing the threat of extinction.

- i.** The great white shark eats many species but is not eaten alive by any other species shown on the food web.

Given their position in the food web, what term can be applied to the great white shark?

1 mark

- ii.** Healthy oceans need sharks as a ‘keystone species’.

Explain what this term means and what may happen to the ecosystem of the Great Australian Bight if the number of sharks is drastically reduced.

2 marks

Great white sharks are ovoviviparous, which means the baby shark grows in an egg that hatches inside the mother and, soon after, the young shark is born.

- c. i.** Do great white sharks reproduce sexually or asexually? Justify your response.

1 mark

- ii.** The great white shark is a threatened species.

Explain which method of reproduction (sexual or asexual) would be more advantageous to the survival of the species.

2 marks

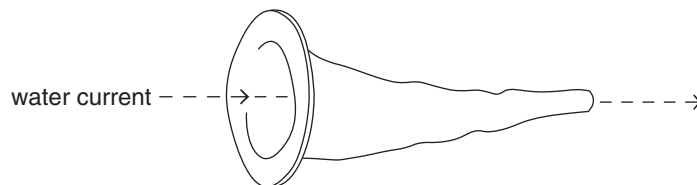
- d.** Scientists have found that female scalloped hammerhead sharks (*Sphyrna lewini*) have given birth without mating with a male.

i. What is the name for this form of asexual reproduction? 1 mark

- ii.** Assume the haploid number for a scalloped hammerhead shark is $n = 36$.
How many chromosomes would be found in the somatic cells of a scalloped hammerhead shark offspring produced by the type of reproduction named in **part d.i.**? 1 mark

Question 6 (6 marks)

The Wadawurrung People of south-western Victoria traditionally caught eels as a food source. When the flowering of several species occurred, including stringybark eucalypts and coastal banksias, the Wadawurrung People would know to set traps for the short-fin eels that started their migration down the rivers to the sea. Eel traps are long cone-shaped devices, woven from river reeds and spear grass, that feature a large opening and a small hole in one end, as shown in the diagram below. Smaller eels can pass through the small hole.



- a. i.** Outline the relationship between the flowering of stringy barks and the availability of the eels as a food resource. 1 mark

- ii.** What is the importance of the shape of the eel trap in terms of the long-term survival of the short-fin eel species? 1 mark

- iii.** Students discussed the eel traps in a Biology class. Piv stated that the practice would be considered an interdependent relationship between the flowering stringybarks and the eels. Roza disagreed and stated that it is an interdependent relationship between the eels and the local people.

Who is correct? Justify your response. 1 mark

- b.** The traditional land management practices of Australia's First Nations peoples have sustained the environment for tens of thousands of years. One of these practices involves the use of fire to burn a selected area, which encourages rapid regeneration and abundant new growth.

- i.** Outline a structural adaptation of a plant species that would help them to survive the fire and rapidly regenerate as a result. 1 mark

- ii.** Explain how the abundant new growth would be beneficial for Australia's First Nations peoples when hunting animals as a food resource. 2 marks

END OF QUESTION AND ANSWER BOOKLET