

Student Name.....



Chemistry Physics Biology
Psychology

VCE BIOLOGY 2001

Written Examination 2

Year 12 Unit 4

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QUESTION AND ANSWER BOOKLET

Structure of Booklet

Time allowed 90 minutes

Section	Number of Questions	Number of Questions to be Answered
A	25	25
B	6	6

Answer Multiple Choice questions by circling the appropriate letter on the answer sheet attached. Use space provided below question in Short Answer section.

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VCE BIOLOGY Answer Sheet

Answer each Multiple Choice question by circling the appropriate letter. Use a pencil. If you make a mistake erase and enter the correct answer. Marks will not be deducted for incorrect answers.

Write your answers to Short Answer Section in the space provided directly below the question.

Multiple Choice

Question 1	A	B	C	D
Question 2	A	B	C	D
Question 3	A	B	C	D
Question 4	A	B	C	D
Question 5	A	B	C	D
Question 6	A	B	C	D
Question 7	A	B	C	D
Question 8	A	B	C	D
Question 9	A	B	C	D
Question 10	A	B	C	D
Question 11	A	B	C	D
Question 12	A	B	C	D
Question 13	A	B	C	D
Question 14	A	B	C	D
Question 15	A	B	C	D
Question 16	A	B	C	D
Question 17	A	B	C	D
Question 18	A	B	C	D
Question 19	A	B	C	D
Question 20	A	B	C	D
Question 21	A	B	C	D
Question 22	A	B	C	D
Question 23	A	B	C	D
Question 24	A	B	C	D
Question 25	A	B	C	D

VCE Biology 2001 Year 12 Exam–Semester 2, Unit 4

Multiple Choice Section

Question 1.

John suffers from Lesch-Nyhan syndrome which is an X-linked recessive trait. It is reasonable to assume that

- A. John's mother would also suffer from Lesch-Nyhan syndrome.
- B. John's father would also suffer from Lesch-Nyhan syndrome.
- C. John inherited Lesch-Nyhan syndrome from his mother.
- D. John inherited Lesch-Nyhan syndrome from his father.

Question 2.

Peter suffers from constitutional thrombopathy which is an X-linked dominant trait. It is reasonable to assume that

- A. Peter's mother would also suffer from constitutional thrombopathy.
- B. Peter's father would also suffer from constitutional thrombopathy.
- C. Peter inherited constitutional thrombopathy from his father.
- D. any sister of Peter would also suffer from constitutional thrombopathy.

The following information relates to Questions 3 to 5.

Figure 1 shows the position of several genes from a small part of autosome 2 in the fruit fly, *Drosophila melanogaster*.

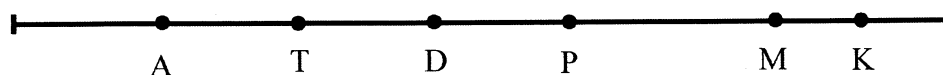


Figure 1

Question 3.

Figure 1 is an example of

- A. a linkage map.
- B. a karyotype.
- C. a gene pool.
- D. the genetic code.

Question 4.

Based on the information in **Figure 1**, which of the following is most likely to occur during egg production in a female fruit fly?

- A. a single crossover between genes A and D.
- B. a double crossover between genes P and T.
- C. no crossover between genes M and K.
- D. a single crossover between genes M and K.

Question 5.

To determine the crossover frequency between any two genes, it would be best to breed

- A. two flies that are heterozygous for both genes.
- B. a fly that is homozygous dominant for both genes with one that is homozygous recessive for both genes.
- C. a fly that is heterozygous for both genes with a fly that is homozygous dominant for both genes.
- D. a fly that is heterozygous for both genes with a fly that is homozygous recessive for both genes.

The following information relates to Questions 6 to 8.

Figure 2 shows part of a molecule found in the nucleus of a cell.

Question 6.

The part labelled M in **Figure 2** is

- A. a phosphate.
- B. a ribose sugar.
- C. a deoxyribose sugar.
- D. an amino acid.

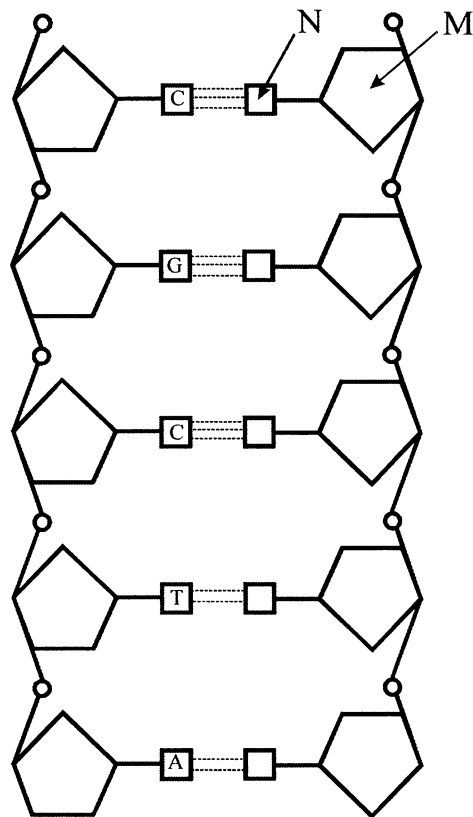


Figure 2

Question 7.

The part labelled N in **Figure 2** is

- A. a nucleotide.
- B. a nitrogen base.
- C. thymine.
- D. uracil.

Question 8.

The part of the molecule shown in **Figure 2**

- A. is replicated.
- B. would be equal to the length of a typical gene.
- C. is held together by hydrogen bonding.
- D. leaves the nucleus during protein synthesis.

The following information relates to Questions 9 to 11.

Figure 3 shows the genetic code as it appears in RNA.

UUU Phenylalanine	UCU Serine	UAU Tyrosine	UGU Cysteine
UUC Phenylalanine	UCC Serine	UAC Tyrosine	UGC Cysteine
UUA Leucine	UCA Serine	UAA Stop	UGA Stop
UUG Leucine	UCG Serine	UAG Stop	UGG Tryptophan
CUU Leucine	CCU Proline	CAU Histidine	CGU Arginine
CUC Leucine	CCC Proline	CAC Histidine	CGC Arginine
CUA Leucine	CCA Proline	CAA Glutamine	CGA Arginine
CUG Leucine	CCG Proline	CAG Glutamine	CGG Arginine
AUU Isoleucine	ACU Threonine	AAU Asparagine	AGU Serine
AUC Isoleucine	ACC Threonine	AAC Asparagine	AGC Serine
AUA Isoleucine	ACA Threonine	AAA Lysine	AGA Arginine
AUG Methionine (start)	ACG Threonine	AAG Lysine	AGG Arginine
GUU Valine	GCU Alanine	GAU Aspartic acid	GGU Glycine
GUC Valine	GCC Alanine	GAC Aspartic acid	GGC Glycine
GUA Valine	GCA Alanine	GAA Glutamic acid	GGA Glycine
GUG Valine	GCG Alanine	GAG Glutamic acid	GGG Glycine

Figure 3

A strand of DNA has the base sequence
CGCTTACCCATT.

Question 9.

This strand of DNA would code for

- A. one amino acid.
- B. two amino acids.
- C. three amino acids.
- D. no amino acids.

Question 10.

Which of the following amino acids is coded for in this sequence?

- A. phenylalanine.
- B. proline.
- C. isoleucine.
- D. asparagine.

Question 11.

The complementary DNA strand to this sequence would be

- A. CGCTTACCCATT.
- B. GCGAATGGGTAA.
- C. GCGAAUGGGUAA
- D. None of the above.

Question 12.

Crossing over would normally occur

- A. in dividing cells of an onion root tip.
- B. during the production of pollen in the anther of a flower.
- C. during prophase of mitosis.
- D. between genes on different chromosomes.

The following information
relates to Questions 13 and 14.

Figure 4 represents a summary
of the process of meiosis.

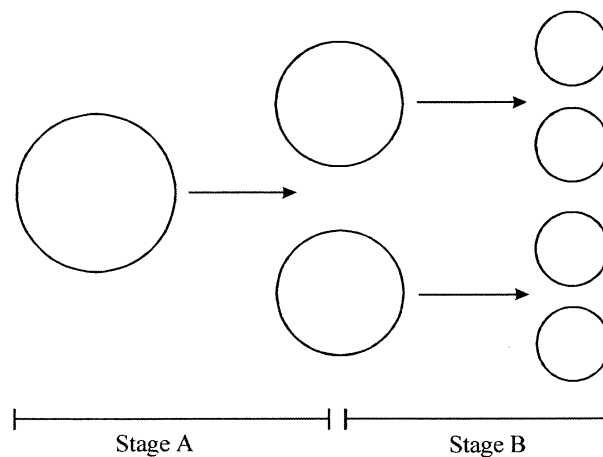


Figure 4

Question 13.

Replication of DNA would occur in

- A. Stage A, but not stage B.
- B. Stage B, but not stage A.
- C. Stages A and B.
- D. neither Stage A nor B.

Question 14.

The four cells at the end of Stage B are

- A. tetraploid.
- B. polyploid.
- C. haploid.
- D. diploid.

Question 15.

Which of the following phenotypic ratios would be expected in the F₂ generation when a monohybrid cross is performed involving a gene showing intermediate inheritance?

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

Question 16.

A sample of organic matter was taken from a mammoth tusk found preserved in a Siberian glacier. The sample was found to contain only 25% of its original Carbon-14 content. The half life of Carbon-14 is approximately 5,700 years. From this information it can be concluded that the mammoth tusk is

- A. about 5,700 years old.
- B. about 11,400 years old.
- C. over 40,000 years old.
- D. between 1,000 and 2,000 years old.

Question 17.

The polymerase chain reaction is used to

- A. cut DNA at precise points.
- B. make multiple copies of a segment of DNA.
- C. insert foreign DNA into another organism.
- D. separate different sized fragments of DNA.

Question 18.

A biologist carried out the following cross:

$$\begin{array}{c} \underline{AB} \\ ab \end{array} \times \begin{array}{c} \underline{AB} \\ ab \end{array}$$

Which of the following genotypes contains a recombinant gamete?

- A. \underline{AB}
AB
- B. \underline{AB}
ab
- C. \underline{ab}
ab
- D. \underline{AB}
Ab

Question 19.

A centromere

- A. is one half of a replicated chromosome.
- B. joins two chromatids together.
- C. is a rod-shaped structure that lies just outside the nucleus of animal cells.
- D. is a rod-shaped structure that lies just outside the nucleus of plant cells.

The following information relates to Questions 20 and 21.

Primitive genera belonging to the subfamily, Proteoideae, are distributed widely in the southern hemisphere. See **Figure 5**.

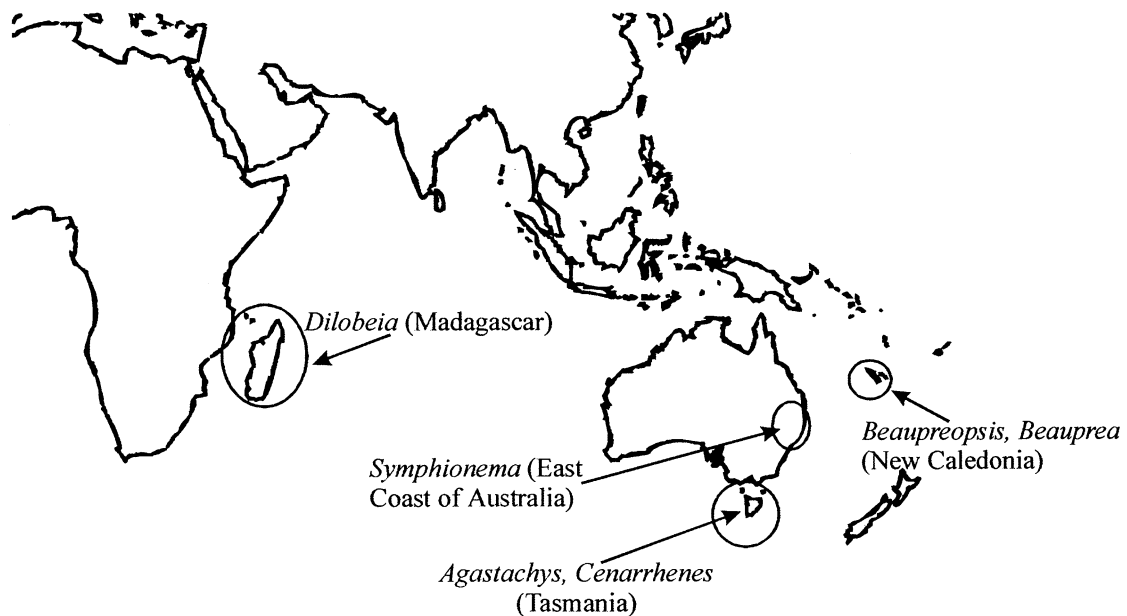


Figure 5

Question 20.

Which of the following would be the most accurate scientific explanation for the distribution of these plants?

- A. Seeds from an ancestral species have been dispersed by ocean currents and have evolved separately on different landmasses.
- B. Wind blown pollen enabled an ancestral species to colonise new landmasses.
- C. An ancestral species existed in Gondwana before it broke up into the landmasses of the southern hemisphere.
- D. Seed-eating birds have dispersed seeds from an ancestral species to the different landmasses.

Question 21.

Figure 6 shows the haploid number of some of the genera in this subfamily.

Genus	Haploid Number
Agastachys	13
Beauprea	11
Dilobeia	24
Symphionema	10

Figure 6

The ancestral species of the four genera shown in **Figure 6** is believed to have had a haploid number of 14. Which genus is most likely to have resulted from a polyploid event?

- A. Agastachys.
- B. Beauprea.
- C. Dilobeia.
- D. Symphonema.

The following information relates to Questions 22 and 23.

Collared lizards favour areas that have been recently burnt. In many areas, the natural fire cycle has been changed as a result of less frequent wildfires. In these areas, a single large population of these lizards is often reduced to a number of smaller populations. See **Figure 7**.

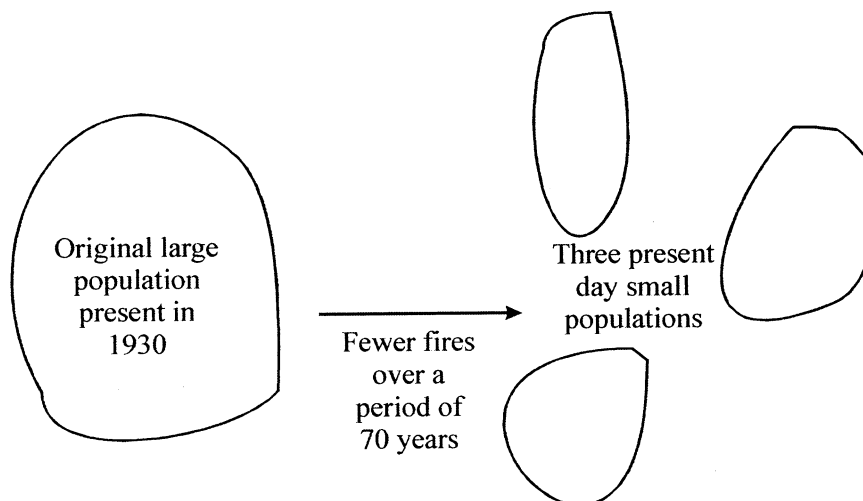


Figure 7

Question 22.

As a result of the change to the natural fire cycle,

- A. genetic drift in collared lizards would be expected to increase.
- B. genetic drift in collared lizards would be expected to stay the same.
- C. genetic diversity in collared lizards would be expected to increase.
- D. collared lizards would be less prone to extinction.

Question 23.

According to **Figure 7**,

- A. gene flow between collared lizards would have been greater in 1930 compared to the present.
- B. in another few hundred years, there will be more than one species of collared lizard in this area.
- C. geographical barriers for the collared lizard would be permanent.
- D. collared lizards are easily killed by wildfires.

The following information relates to Questions 24 and 25.

Fanconi Anaemia (FA) is a rare autosomal recessive disorder that causes anaemia, birth defects and cancer. FA has a very high incidence in the Afrikaner population of South Africa. Pedigree analysis of 12 present day Afrikaner families with FA revealed they could all be traced back to a French couple who migrated to South Africa in 1688.

Question 24.

The high incidence of FA in the Afrikaner population is probably due to a

- A. population bottleneck.
- B. founder effect.
- C. series of recent mutations.
- D. chromosomal trisomy

Question 25.

It would be reasonable to conclude that

- A. the French couple both suffered from FA.
- B. marriages between first or second cousins is likely to have occurred.
- C. the type of mutation causing FA is likely to be different in the 12 Afrikaner families.
- D. FA would appear in all generations of an affected Afrikaner family.

Short Answer Section

In 1875, Charles Darwin wrote of a Hindu family “*in which ten men, in the course of four generations, were furnished with only four small and weak incisor teeth and with eight posterior molars. The men affected have very little hair on the body and become bald early in life. They also suffer much during hot weather from excessive dryness of the skin. It is remarkable that no instance has occurred of a daughter being affected though they transmit the tendency to their sons: and no case has occurred of a son transmitting it to his sons*”

The condition described by Darwin is now known as X-linked ectodermal dysplasia.

Question 1.

a. From the information given, indicate whether this disorder is dominant or recessive. _____ (1 mark)

b. i. Explain why females can transmit the disorder to their sons even though they are unaffected. Use appropriate alleles in your answer.

(2 marks)

ii. Explain why affected males are unable to transmit the disorder to their sons. Use appropriate alleles in your answer.

(2 marks)

It is now known that the normal version of the gene codes for a protein that forms part of the cell membrane. The protein, known as ectodysplasin-A, contains a series of 19 triplet repeats of the form, *Glycine, A, B*, where A and B represent other amino acids.

c. How many nucleotides would be needed to code for a triplet such as *Glycine, Serine, Histidine*?

(1 mark)

Geneticists studying this gene have identified a range of mutations that result in X-linked ectodermal dysplasia. In one family, a point mutation was identified that resulted in the substitution of the amino acid histidine for arginine. In this mutation, the reading frame of the gene was kept intact.

d. i. What is a point mutation?

(1 mark)

ii. Describe how such a mutation could result in the substitution of histidine for arginine.

(2 marks)

iii. From the information given for this family, would you expect any other changes in the sequence of amino acids in ectodysplasin - A? Justify your answer.

(2 marks)

Total = 11 marks

Question 2.

Squash plants produce edible fruits that come in a range of colours. Three of these colours are white, yellow and green. Two genes on separate chromosomes control the expression of these colours. In the first gene, white fruit is dominant to non-white fruit and has the allelic symbols:

A - white fruit a – non-white fruit

Yellow and green fruits are only produced if the recessive allele of the first gene is expressed. A second gene is responsible for determining whether fruits will be green or yellow. It has the allelic symbols:

B–yellow fruit b - green fruit

a. Write down a genotype which would give the following fruit colours.

i. White _____

ii. Yellow _____

iii. Green _____

(1 + 1 + 1 = 3 marks)

- b. A cross was carried out between two plants, each with a genotype of AaBb. Use a Punnett Square to determine the expected ratio of phenotypes in the offspring. Show all working.

(4 marks)

- c. A farmer wished to establish a pure-breeding line of squash plants that only produced white fruit. From your Punnett Square in Part b, write down two different genotypes that would be pure-breeding for white fruit over many generations.

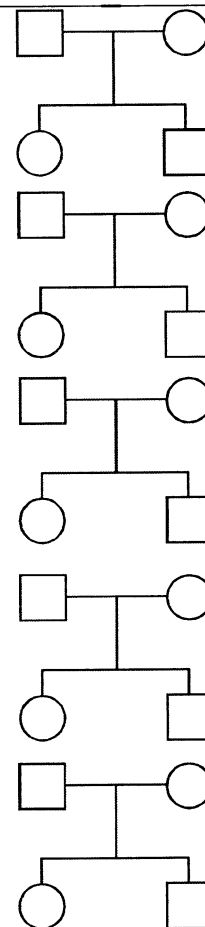
(1 mark)

Total = 8 marks

Question 3.

Many single gene disorders have different modes of inheritance. Read the following information carefully and shade each pedigree as instructed.

- a
- i. In the pedigree opposite, shade in **two** individuals that make the pedigree **consistent** with Y-linked inheritance.
 - ii. In the pedigree opposite, shade in **one** individual that makes the pedigree **consistent** with X-linked dominant inheritance.
 - iii. In the pedigree opposite, shade in **three** individuals that makes the pedigree **consistent** with X-linked recessive inheritance.
 - iv. In the pedigree opposite, shade in **one** individual that produces a pedigree that **must** be due to autosomal recessive inheritance.
 - v. In the pedigree opposite, shade in **two** individuals that produce a pedigree that **must** be due to autosomal dominant inheritance.



Total = 5 marks

Question 4.

The greenish warbler, *Phylloscopus trochiloides*, is a songbird from Asia that has an unusual geographic distribution. It is believed that an ancestral population of this species originated south of the Himalayas in Asia. This ancestral population then extended its range northward on both the eastern and western sides of the Himalayas. These two northward expansions then came into contact again in Siberia. See **Figure 8**.

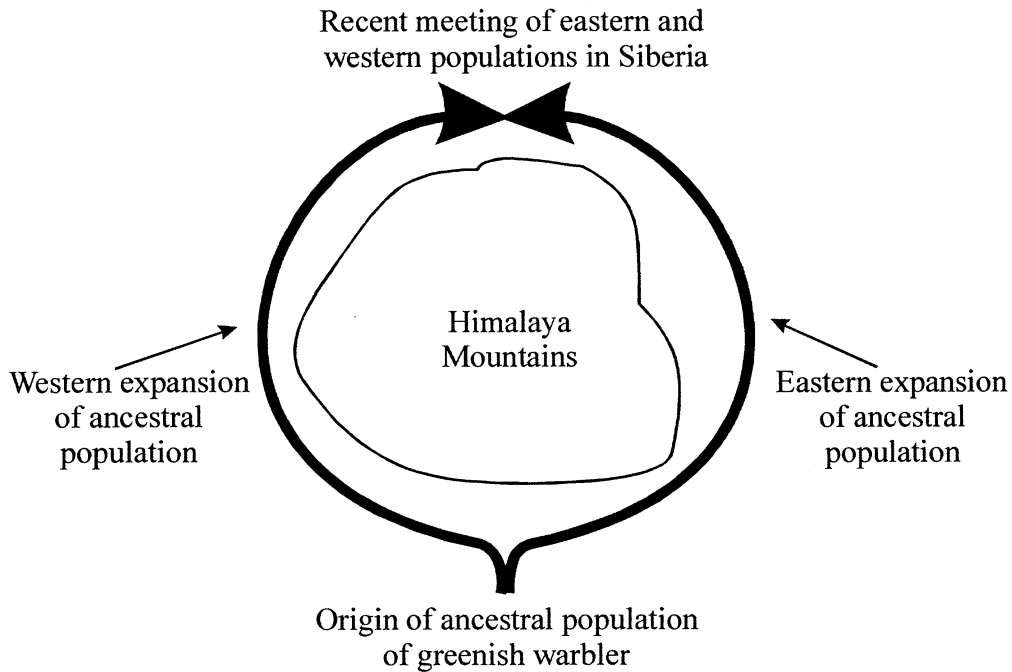


Figure 8

Adjacent populations of this species interbreed where they come into contact. However, in Siberia, where the western population meets the eastern population, interbreeding does not occur.

Refer to Figure 8.

- a. Biologists regard the greenish warbler as a 'ring species'. Suggest why this term is used.

(1 mark)

- b. From the information given so far, suggest why biologists would have difficulty in classifying the greenish warbler.

(1 mark)

Biologists analysed the songs from seven different populations of this species. They measured the frequency and length of each song. The results of this investigation are shown in **Figure 9**. The location of each population is shown in the inset

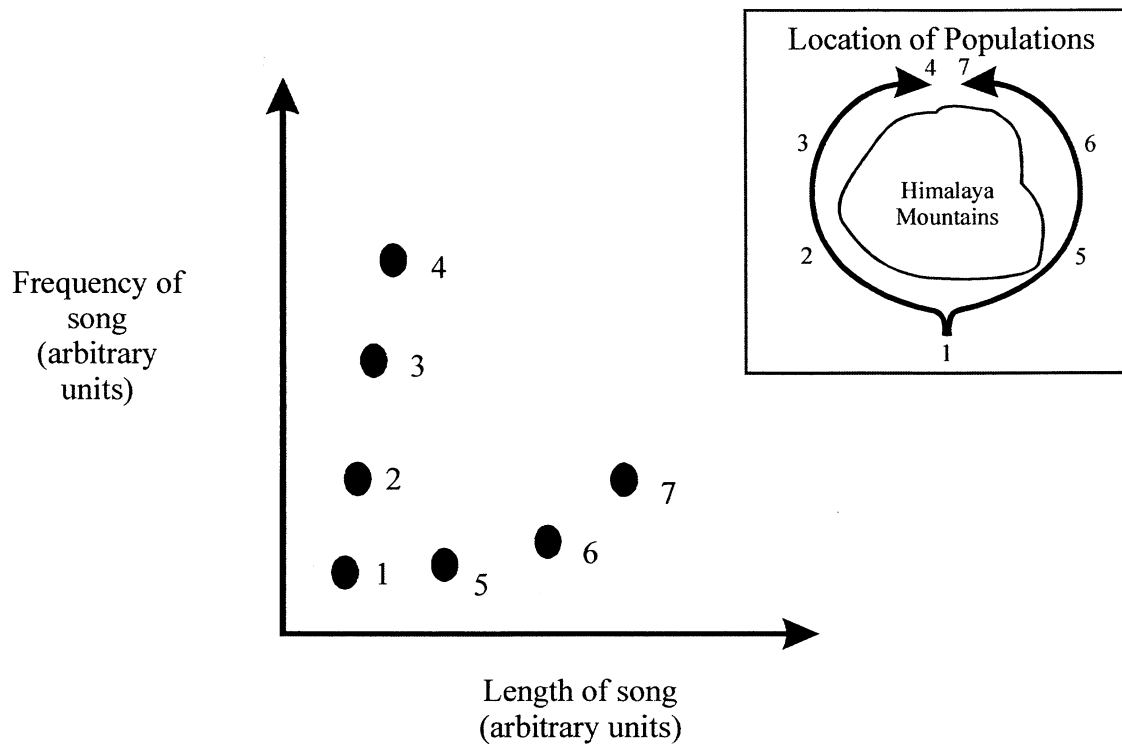


Figure 9

- c. Why would biologists be interested in studying the songs made by various populations of this species?

(1 mark)

- d. Explain how the results shown in **Figure 9** support the observation that:
- adjacent populations interbreed.

(1 mark)

- eastern and western populations do not interbreed in Siberia.

(1 mark)

- e. Biologists regard ring species as valuable because ‘they show all the steps that happen during the process of speciation’. Explain what the biologists meant by this statement.

(3 marks)

Total = 8 marks

Question 5.

‘River dolphins’ (See **Figure 10**) are found in large river systems in India, China and South America. They are adapted to freshwater conditions and have a large number of common traits. They have a long snout and a flexible neck. Their eyes are reduced in size and one species, the Ganges River dolphin, lacks eye lenses and is virtually blind. It relies on echolocation to find its way about in the murky waters of its natural habitat.

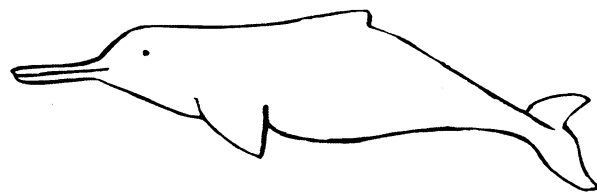


Figure 10

a. Define the term adaptation.

(1 mark)

b. Explain how natural selection could bring about the evolution of vestigial eyes in the Ganges River dolphin.

(4 marks)

c. Traditionally, biologists have classified all river dolphins as closely related species. This has been based on their similar structural features. Explain why this approach is not always accurate in determining evolutionary relationships.

(2 marks)

Figure 11 shows the relationship between river dolphins, marine dolphins and whales based on a recent analysis of their DNA.

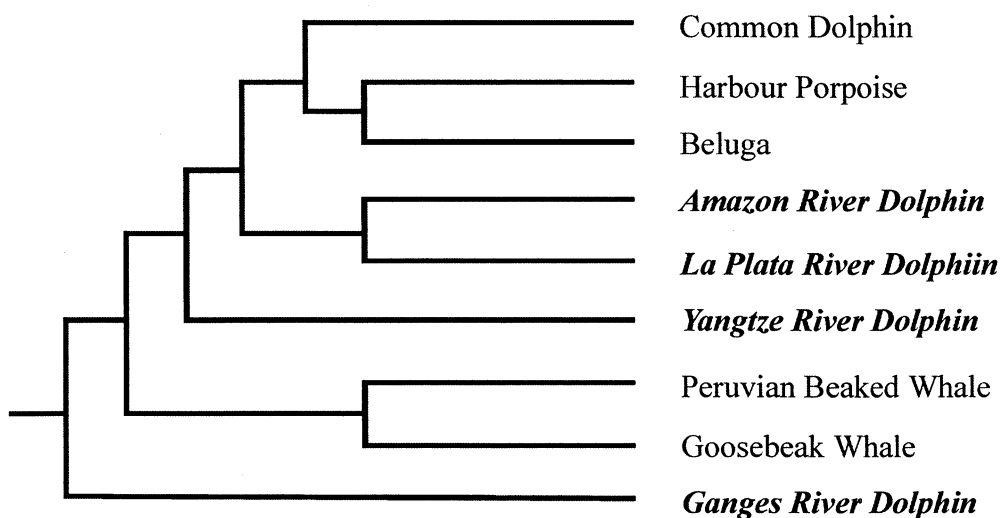


Figure 11

d. i. What sort of diagram does **Figure 11** represent?

_____ (1 mark)

ii. Should the four species of river dolphins be classified together as a separate group? Justify your answer.

(2 marks)

Total = 10 marks

Question 6.

Littorina saxatilis is a common sea snail found on rocky shores in western Europe. It lives in large numbers in the surf zone of coastal beaches and is also found higher up in the drier, splash zone. See **Figure 12**.

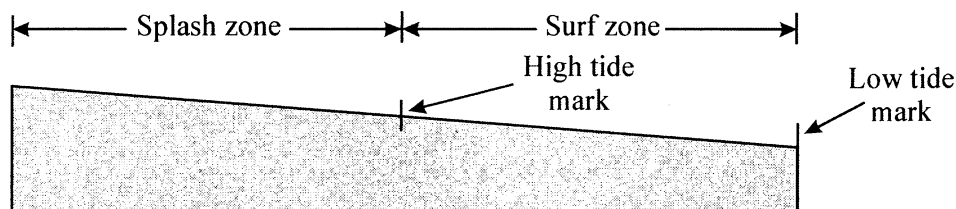


Figure 12

Biologists wished to see if there were any genetic differences between snails in the surf zone and those in the splash zone. To do this, they analysed a gene that has two alleles (A1 and A2)

and compared the frequency of each allele in both the surf zone and splash zone. Their results are shown in **Figure 13**.

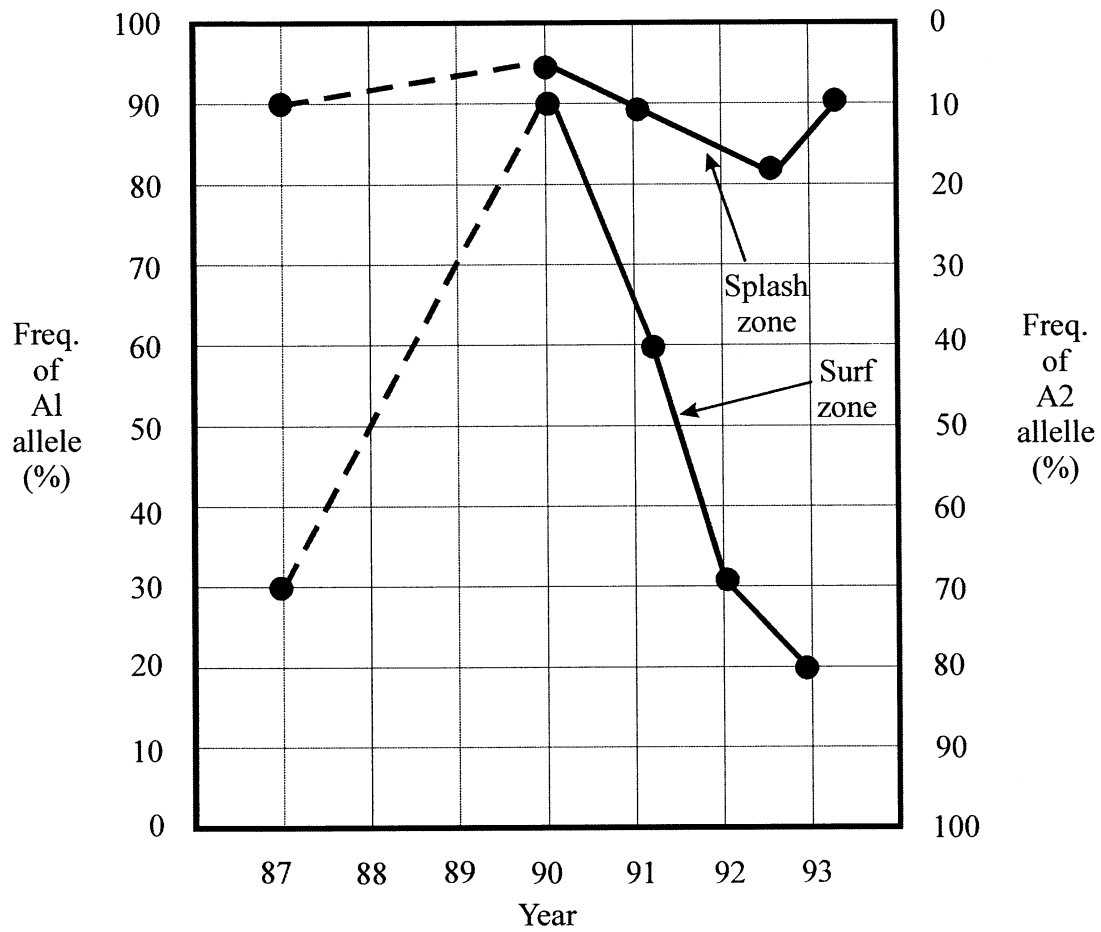


Figure 13

a. What environmental variable was being investigated by the biologists?

_____ (1 mark)

b. In 1987, what was the frequency of the

i. A1 allele in the surf zone? _____ (1 mark)

ii. A2 allele in the surf zone? _____ (1 mark)

In 1988, a toxic algal bloom killed all the surf zone snails. Splash zone snails, however, survived.

- c. Suggest why splash zone snails were not killed by the algal bloom.

(1 mark)

- d. By 1990, the surf zone had a large population of snails again. What is the likely source of these snails? Justify your answer by referring to **Figure 13**.

(2 marks)

Refer again to Figure 13.

- e. Which allele (A1 or A2) appears to be favoured by natural selection in the surf zone? Justify your answer.

(2 marks)

Total = 8 marks

END OF TASK

Suggested Answers

Multiple Choice Section

1 C	6 C	11 B	16 B	21 C
2 A	7 B	12 B	17 B	22 A
3 A	8 C	13 A	18 D	23 A
4 C	9 C	14 C	19 B	24 B
5 D	10 D	15 D	20 C	25 B

Short Answer Section

Question 1.

- a. Recessive (1).
- b. i. If X^A is normal and X^a is affected, then carrier females will have the genotype $X^A X^a$ (1). Such a female can transmit the disorder to a son if she passes on the X^a allele (1).
- ii. Affected males would have the genotype $X^a Y$ (1). Any son of an affected male must receive the Y chromosome and not the affected allele (1).
- c. Nine (1).
- d. i. A point mutation involves a change to one nucleotide only (1).
- ii. The point mutation would change the sequence of bases in the DNA (1). This would alter the mRNA that is transcribed, resulting in the substitution of histidine for arginine (1).
- iii. No (1) since the information states that the reading frame is kept intact (1).

Question 2.

- a. i. Any one of the following (1). AABB, AABb, AAbb, AaBB, AaBb, Aabb.
- ii. Any one of the following (1). aaBB, aaBb.
- iii. Any one of the following (1). aabb.
- b.

	AB	Ab	aB	ab
AB	AABB (w)	AABb (w)	AaBB (w)	AaBb (w)
Ab	AABb (w)	AAbb (w)	AaBb (w)	Aabb (w)
aB	AaBB (w)	AaBb (w)	aaBB (y)	aaBb (y)
ab	AaBb (w)	Aabb (w)	aaBb (y)	aabb (g)

Correct gametes (1).

Correct genotypes in Punnett Square (1).

Correct phenotypes in Punnett Square (1).

Correct Ratio: 12 white: 3 yellow: 1 green (1).

- c. Any two of the following (1). AABB, AABb, AAbb.

Question 3.

- a. i. Both males should be shaded (1).
- ii. Mother should be shaded (1).
- iii. Both males and daughter should be shaded (1).
- iv. Daughter should be shaded (1).
- v. Both parents should be shaded (1).

Question 4.

- a. The term describes the ring-shaped distribution of the greenish warbler (1).
- b. Adjacent populations of the greenish warbler are able to interbreed but there is no interbreeding in Siberia where the western and eastern populations meet (1).
- c. Many bird species use song to attract a mate of the same species (1).
- d. i. The songs of adjacent populations are relatively similar in song frequency and length of song (1).
- ii. The songs of the eastern and western populations in Siberia differ significantly in song frequency and length of song (1).
- e. The present day population of greenish warblers south of the Himalayas is similar to an ancestral species (1). This population then diverged on either side of the Himalayas which acted as a geographical barrier (1). When the two populations came into contact again in Siberia, they were unable to interbreed (1).

Question 5.

- a. Any feature of an organism that increases its chances of survival (1).
- b. The ancestral species that gave rise to the Ganges River Dolphin showed variation in the development of its eyes (1). In the muddy waters of its habitat, eyes served little purpose (1). Those individuals with some reduction in the development of their eyes were slightly favoured and more likely to survive and reproduce (1). Over millions of years, this selection pressure resulted in the vestigial eyes of the modern day Ganges River Dolphin (1).
- c. As a result of convergent evolution (1) distantly related species may appear very similar due to evolving in similar habitats (1).
- d. i. Phylogenetic tree (1).
- ii. The four species should not be classified as a separate group (1) since Figure 11 shows that some species of river dolphins are more closely related to other species that are not river dolphins (1). *eg. The Amazon river dolphin and the La Plata river dolphin are more closely related to the common dolphin/harbour porpoise/beluga than they are to the other two species of river dolphin.*

Question 6.

- a. Degree of exposure to seawater, (i.e. surf zone versus splash zone) (1).
- b. i. 30% (1).
- ii. 70% (1).
- c. Splash zone snails were not killed as they were not covered by the algal bloom (1).
- d. The surf zone had been colonised by snails (or their offspring) from the splash zone (1). This is likely since the frequency of the A1 allele in the surf zone in 1990 was very similar to that of the splash zone snails (1).
- e. A2 appears to be favoured by natural selection in the surf zone (1) since its frequency increased from 10% to 80% between 1990 and 1993 (1).