Lisachem Materials

Chemistry Physics Biology
Psychology

VCE BIOLOGY 2004 Written Examination 2 Year 12 Unit 4

Time allowed 90 minutes
Total Marks 75

QUESTION AND ANSWER BOOKLET
Structure of Booklet

Section	Number of Questions	Number of Questions to be Answered
A	25	25
B	7	7

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

Lisachem Materials
PO Box 721 Bacchus Marsh Victoria 3340
Tel: (03) 5367 3641 Fax: (03) 5367 7383
Email: Lisachem@bigpond.net.au

Student Name.....

VCE Biology 2004 Year 12 Trial Semester 2
Student 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 2004 Year 12 Trial exam Semester 2

Multiple Choice Section

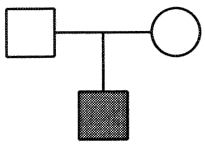
Question 1.

In a diploid organism, such as a mouse,

A. mitosis produces diploid gametes.
B. mitosis produces haploid gametes.
C. meiosis produces diploid gametes.
D. meiosis produces haploid gametes.

Question 2.

The following pedigree is for a genetic disorder controlled by a single gene. Shaded individuals are affected. Geneticists suspect that a gene that shows an autosomal recessive mode of inheritance controls the disorder.

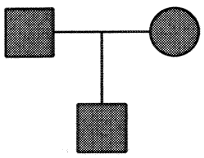


The couple plan to have a second child. Which one of the following possibilities for the second child would confirm that an autosomal recessive gene controls the disorder?

A. a son that has the disorder.
B. a son that does not have the disorder.
C. a daughter that has the disorder.
D. a daughter that does not have the disorder.

Question 3.

The following is a pedigree for a trait known to be located on the X chromosome. Shaded individuals are affected.

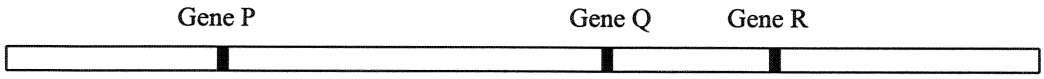


The couple plan to have a second child. Which one of the following possibilities for the second child would confirm that the trait also has a dominant mode of inheritance?

A. a son that has the trait.
B. a son that does not have the trait.
C. a daughter that has the trait.
D. a daughter that does not have the trait.

Use the following information to answer Questions 4 and 5.

The diagram below shows the linkage relationships between three genes. A fourth unlinked gene, called gene S, is found on a different chromosome.



Question 4.

For these four genes, the greatest number of crossover events would be expected to occur between

A. genes P and Q.
B. genes P and R.
C. genes Q and R.
D. gene S and any one of the three linked genes.

Question 5.

Which of the following crosses could be used to determine the linkage distance between genes Q and R?

A. RrQq	x	RrQq
B. RRqq	x	rrQQ
C. RrQq	x	rrqq
D. RRQQ	x	rrqq

Question 6.

A small strand of DNA was extracted from a mammoth found frozen in a Siberian glacier. Multiple copies of this strand were made using the polymerase chain reaction. In this technology, the production of these copies of DNA would

A. be sufficient to reconstruct the complete genome of the mammoth.
B. require the use of restriction enzymes to initiate DNA replication.
C. require the same amounts of guanine, adenine, cytosine and thymine.
D. involve the repeated heating of the DNA to make it single stranded.

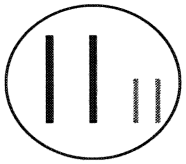
Question 7.

Many diabetics now use insulin produced by bacteria. This insulin would have been made by

A. inserting bases into the gene for bacterial insulin so that it was more like the DNA of human insulin.
B. inserting the gene for human insulin into a bacterial plasmid and allowing the bacteria to express this gene.
C. removing the entire DNA from a culture of bacteria and inserting multiple copies of the DNA that codes for human insulin.
D. cultivating normal bacteria in a medium that contained all the necessary amino acids to manufacture human insulin.

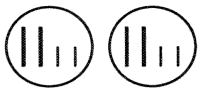
Question 8.

The diagram at right represents the chromosomes found in the zygote of a species of mammal.

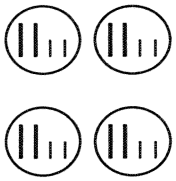


Which of the following best represents the daughter cells after one mitotic division?

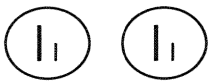
A.



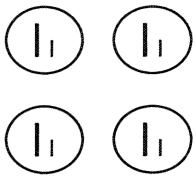
B.



C.



D.



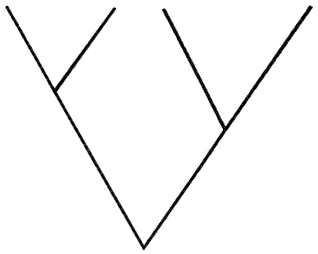
Question 9.

The table below shows the number of base differences that occur in the DNA of the cytochrome b gene in four populations of lizards belonging to the genus, *Gallotia*.

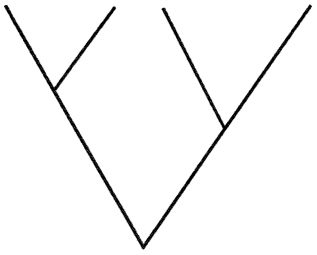
Population	Palma	Tenerife	Gomera	Hiero
Palma				
Tenerife	8			
Gomera	17	19		
Hiero	19	21	4	

A phylogenetic tree based on this data would be best represented as

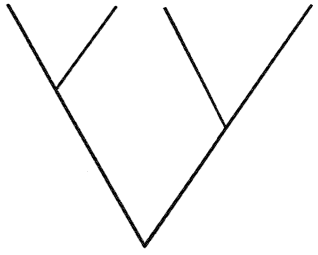
A. Gomera Hiero Palma Tenerife



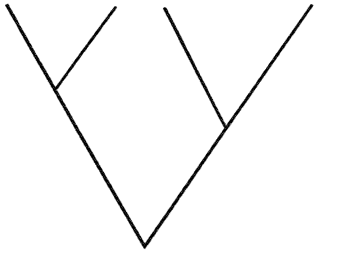
B. Tenerife Palma Hiero Gomera



C. Tenerife Palma Gomera Hiero



D. Hiero Tenerife Gomera Palma



Question 10.

Mexican hairless dogs are an unusual breed. They possess one copy of a dominant lethal allele. Embryos that are homozygous for the lethal allele die early in development. Heterozygous dogs are hairless while homozygous recessive dogs possess hair. If a breeder crossed two Mexican hairless dogs, he would expect

A. all the offspring to be hairless.
B. all the offspring to have hair.
C. fifty percent of the offspring to have hair and fifty percent to be hairless.
D. two thirds of the offspring to be hairless and one third to have hair.

Use the following information to answer Questions 11 and 12.

In humans, the Rhesus factor is a characteristic of red blood cells and can be either positive or negative. Two alleles control this trait, with the Rh positive phenotype being dominant over the Rh negative phenotype. A second gene, unlinked to the Rhesus factor gene, causes albinism. In this gene, the normal phenotype is dominant over the albino phenotype. The alleles for these two genes are shown below.

+	Rh positive	N	Normal skin
–	Rh negative	n	albino

The table below shows the phenotypes of a mother and her two children, both born to the same father.

Mother	Rh negative, albino
First Child	Rh negative, normal skin
Second Child	Rh positive, albino

Question 11.

The phenotype of the father would be

A. Rh negative, albino.
B. Rh negative, normal skin.
C. Rh positive, albino.
D. Rh positive, normal skin.

Question 12.

The genotype of the father would be

A. – – NN
B. + – Nn
C. + + NN
D. – – Nn

Question 13.

The template strand of a human gene was analysed. The table below shows the proportions of each of the four nitrogen bases it contained.

Nitrogen Base	Proportion (%)
Adenine	28
Thymine	30
Cytosine	20
Guanine	22

The complementary strand of DNA for this human gene would contain

A. 28% Adenine, 30% Thymine, 20% Cytosine, 22% Guanine.
B. 30% Adenine, 28% Thymine, 22% Cytosine, 20% Guanine.
C. 22% Adenine, 20% Thymine, 30% Cytosine, 28% Guanine.
D. 20% Adenine, 22% Thymine, 28% Cytosine, 30% Guanine.

Question 14.

Synthesis of mRNA typically occurs

A. in the nucleus.
B. at the ribosomes.
C. in the cytoplasm.
D. in the endoplasmic reticulum.

Question 15.

A human autosomal gene has two alleles that show intermediate inheritance. For this gene, it would be expected that there would be

A. three different genotypes and three different phenotypes.
B. three different genotypes and two different phenotypes.
C. two different genotypes and three different phenotypes.
D. two different genotypes and two different phenotypes.

Question 16.

Which of the following crosses would produce the greatest proportion of homozygous offspring?

A. CCAA x CcAa.
B. CcAa x ccaa.
C. CCaa x ccAA.
D. CCaa x CCaa.

Question 17.

In humans, the expected proportion of sperm that carry an X chromosome is

A. 0 %.
B. 25 %.
C. 50 %.
D. 100 %.

Question 18.

Ratites are flightless birds found in Africa, South America, New Guinea, New Zealand and Australia. The reason they are mainly found in the southern hemisphere and not the northern hemisphere is that

A. there was no suitable habitats for ratites in the northern hemisphere.
B. ancestral ratites evolved in Gondwana at a time when it was isolated from the northern super continent of Laurasia.
C. ratites were able to cross the shallow oceans that separated southern hemisphere landmasses but couldn't cross the deeper oceans that separated northern hemisphere landmasses.
D. there was very little competition from mammals in the southern hemisphere but very strong competition from mammals in the northern hemisphere.

Refer to the following information to answer questions 19 to 20.

Off the coast of South America, are two small islands called island M and island N. A species of lizard, native to the mainland of South America, colonized island M about three hundred years ago. This happened when a storm carried a small number of lizards on floating vegetation to the island. The lizards also colonized island N about 50 years ago when another violent storm occurred. The table below shows the size of the present day populations of these lizards on the mainland and islands M and N. Included in the table is the frequency of five alleles (a to e) of a gene from these lizards.

	Size of Population	Frequency of allele (%)				
		a	**b**	**c**	**d**	**e**
Mainland Population	Greater than 100,000	25	30	22	14	9
Population on island M	500	35	10	0	0	55
Population on island N	350	5	55	25	10	5

Question 19.

Which of the following is the most probable explanation for the high frequency of allele 'e' in the population on island M when compared to the mainland population?

A. Founder effect in the population on island M.
B. Genetic drift in the mainland population.
C. Migration of lizards from island N to island M.
D. Reduced reproductive success in individuals that carry the 'e' allele.

Question 20.

Which of the following statements can be concluded from the data?

A. Some of the lizards that colonised island N came from the mainland.
B. Some of the lizards that colonised island N came from island M.
C. On island N, lizards that have the 'b' allele in their genotype are better adapted than lizards that lack this allele in their genotype.
D. The 'b' allele would be expressed in more than half the lizards on island N.

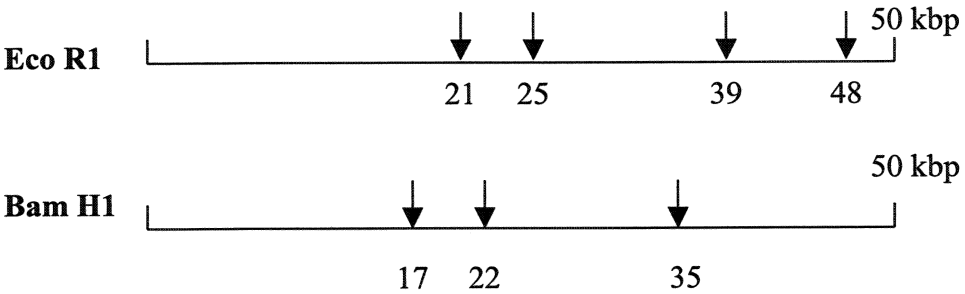
Question 21.

Artificial selection has been responsible for the

A. extinction of native marsupials in Australia.
B. evolution of unique species on isolated islands.
C. large number of breeds seen in the domestic cat.
D. adaptive radiation of finches on the Galapagos Islands.

Use the following information to answer Questions 22 to 25.

Eco R1 and Bam H1 are two different restriction enzymes that are widely used in biotechnology. The arrows in the diagram below show the sites where each restriction enzyme cuts a sample of viral DNA.



Question 22.

According to the diagram, the restriction enzyme

A. Eco R1 would cut the viral DNA into 4 segments.
B. Bam H1 would cut the viral DNA into 4 segments.
C. Bam H1 would cut the viral DNA more times than Eco R1.
D. Eco R1 would cut at the same base sequence as Bam H1.

Question 23.

The longest fragment of viral DNA cut using Eco R1 would be

A. 21 kbp in length.
B. 25 kbp in length.
C. 39 kbp in length.
D. 48 kbp in length.

Question 24.

The shortest fragment of viral DNA cut using Bam H1 would be

A. 5 kbp in length.
B. 13 kbp in length.
C. 15 kbp in length.
D. 17 kbp in length.

Question 25.

If the DNA was cut using a mixture of Eco R1 and Bam H1, the number of fragments of viral DNA produced would be

A. four.
B. five.
C. eight.
D. nine.

Short Answer Section

Question 1.

Tay-Sachs disease is caused by the complete absence of a vital enzyme called hexosaminidase A (Hex-A). Without Hex-A, a lipid called GM2 ganglioside accumulates in cells, particularly the nerve cells of the brain. This accumulation causes irreversible damage to these cells. This process begins in early pregnancy, with symptoms becoming apparent when the child is several months old. Children with typical Tay-Sachs disease usually die early in childhood. Tay-Sachs disease is controlled by a gene on chromosome 15 that codes for the production of Hex-A. If one normal allele is present, the body produces enough Hex-A to prevent the abnormal build-up of the GM2 ganglioside lipid.

a. From the information given, state why Tay-Sachs disease can be regarded as

i. an autosomal disorder.

_____

_____

(1 mark)

ii. a recessive disorder.

_____

_____

_____

(1 mark)

b. Describe the steps involved in the manufacture of the enzyme, Hex A, by the normal allele.

_____

_____

_____

_____

_____

_____

(2 marks)

A large number of mutations are known to cause Tay-Sachs disease. Several of these are described below.

Mutation 1 - in the 210th amino acid, glutamine replaces arginine.

Mutation 2 - a deletion of a codon for phenylalanine due to a mutation in one of the exons of the gene.

Mutation 3 - an insertion of 4 bases in one of the exons of the gene.

Mutation 4 - codon 180 altered from UAC to UAG.

Part of the genetic code as it appears in m-RNA is shown below.

CAA Glutamine	CGU Arginine
CAG Glutamine	CGC Arginine
UUU Phenylalanine	CGA Arginine
UUC Phenylalanine	CGG Arginine
UAC Tyrosine	AGA Arginine
UAG STOP	AGG Arginine

Use this genetic code to answer parts c to d.

c. Describe a one base codon change that could cause Mutation 1.

_____

_____

(1 mark)

d. What change to the DNA of a normal allele could bring about Mutation 2?

_____

_____

(1 mark)

Each of the four mutations affects the length of the protein produced. Some produce a protein of the **same** length, others cause the protein to be **shorter** than normal while others cause the protein to be **longer** than normal. For other mutations, the length of the protein is **uncertain**.

e. Fill in the table below, indicating how each of the four mutations would affect the length of the protein. For each mutation, indicate whether the protein formed will be the **same** in length, **longer** in length, **shorter** in length or whether its length is **uncertain** compared to the normal protein.

Mutation	**Effect on Protein Length** *(same, longer, shorter, uncertain)*
1	
2	
3	
4	

(2 marks)

Total = 8 marks

Question 2.

Lentils are seeds grown in many parts of the world as a food source. The seeds come in a wide variety of colours and patterns. One variety produces seeds that are spotted while another produces seeds that are dotted. When pure-breeding spotted lentils (L^SL^S) are crossed with pure-breeding dotted lentils (L^DL^D), the F_1 hybrids are both spotted and dotted. **See Figure 1.**

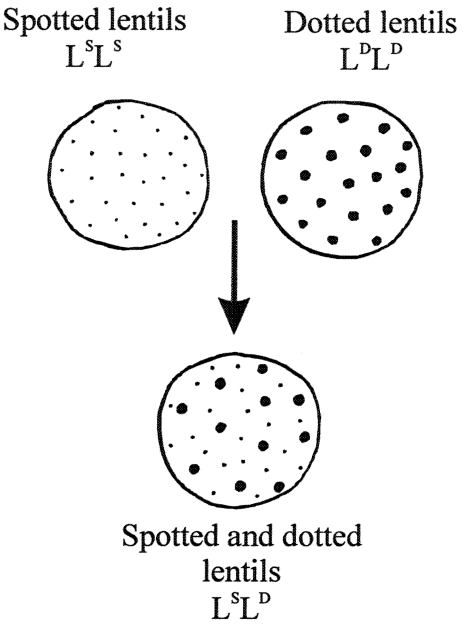


Figure 1

a. What is the relationship between the allele for spotted lentils and the allele for dotted lentils? Justify your answer.

_____

_____

_____

(2 marks)

b. A third allele '*l*' is responsible for the formation of clear seeds and is known to be recessive to both the L^S and L^D alleles. A geneticist crossed spotted lentils carrying the '*l*' allele with dotted lentils that also carried the '*l*' allele. What phenotypes and in what proportion would you expect in the offspring?

(2 marks)

In radishes, colour and shape are under the control of separate genes, each with two alleles that show incomplete dominance. Colour may be red (R^1R^1), purple (R^1R^2) or white (R^2R^2) while shape can be long (L^1L^1), oval (L^1L^2) or round (L^2L^2).

(c) Plants that were heterozygous for both genes were crossed. Use a Punnett Square to answer the following:

i. How many different phenotypes would you expect in the offspring?

_____ (1 mark)

ii. Which phenotype would be most common in the offspring?

_____ (1 mark)

iii. What proportion of the offspring would be homozygous for both traits?

_____ (1 mark)

iv. What proportion of the offspring would have the same genotype as their parents?

_____ (1 mark)

Total = 8 marks

Question 3.

Madagascar is home to distinctive animals called tenrecs. They are small mammals, related to shrews, moles and hedgehogs that are adapted to feed on small invertebrates. Madagascar, together with India, broke away from Africa more than 100 million years ago - well before the evolution of most modern mammals. It is believed that ancestral tenrecs reached Madagascar by "rafting" on floating mats of vegetation across the Mozambique Channel from mainland Africa. About 65 million years ago, new groups of mammals evolved in mainland Africa and dominated that continent. Most of these new groups of mammals never reached Madagascar. Today, only three species of tenrecs are found in mainland Africa. In Madagascar, more than 25 species are found.

a. What term describes the evolution of tenrecs into a large number of species in Madagascar?

_____

(1 mark)

b. Describe the importance of the Mozambique Channel in the evolution of tenrecs.

_____

_____

_____

(1 mark)

c. Explain why tenrecs were able to evolve into a large number of species in Madagascar.

(2 marks)

d. Some tenrecs have evolved echolocation to navigate in the dark, similar to the method used by bats. Explain why the evolution of echolocation in both groups is an example of convergence.

(1 mark)

Total = 5 marks

Question 4.

Between genes on any pair of chromosomes are long stretches of DNA that do not code for any protein. Parts of these non-coding regions consist of multiple repeats of a particular DNA sequence. These multiple repeats are known as microsatellites.

a. How would a non-coding region described above differ from an intron?

(2 marks)

One microsatellite consists of multiple repeats of the four nucleotides: guanine, adenine, thymine and adenine (GATA). Any individual has two copies of this microsatellite and the number of GATA repeats varies greatly between individuals. An individual might have 12 repeats for one allele and 15 for the other allele. The genotype of such an individual could be represented as $(GATA)_{12}(GATA)_{15}$.

b. The GATA repeats of this microsatellite can also be regarded as CTAT repeats. Explain why.

(1 mark)

Figure 2 shows the separation by electrophoresis of microsatellite alleles in 6 individuals.

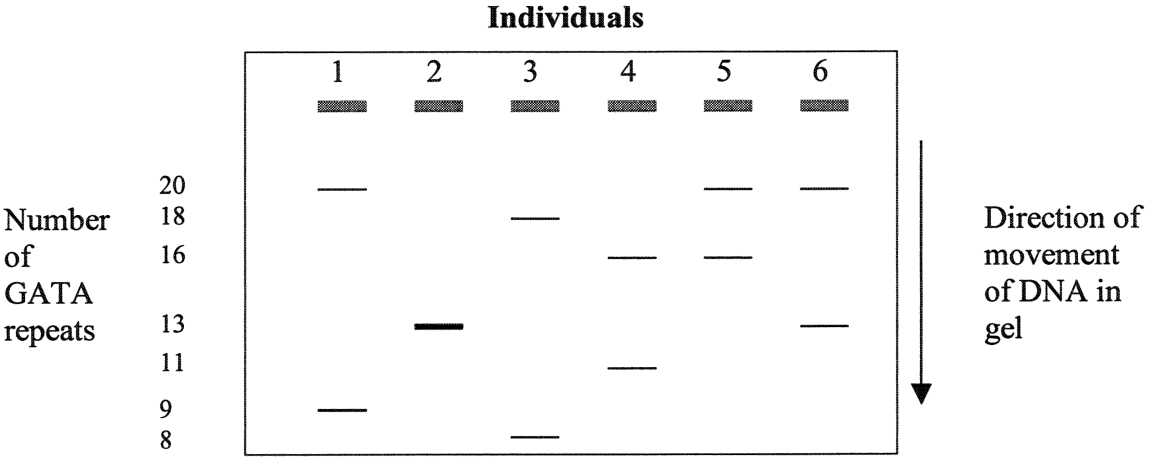


Figure 2

c. i. Write down the genotype of individual 6.

_____

(1 mark)

ii. Which individual is homozygous for this microsatellite? Justify your answer.

_____

_____

_____

(1 mark)

iii. Five of the individuals come from the one family and one is unrelated. Which individual is most likely unrelated? Justify your answer.

_____

_____

_____

(1 mark)

Microsatellites are also useful in determining the genetic variation in different populations of a species. Table 1 shows the results of an investigation into five isolated populations of wallabies from Eastern Australia.

Table 1

Population	Population Size	Frequency of microsatellite alleles (%)				
		$(GATA)_{20}$	$(GATA)_{18}$	$(GATA)_{16}$	$(GATA)_{14}$	$(GATA)_{12}$
1	280	20	35	15	14	16
2	260	74	5	10	7	4
3	150	59	0	22	12	7
4	100	66	34	0	0	0
5	100	1	88	0	9	2

Refer to Table 1 to answer parts d and e.

d. i. What genotype would you expect to be the most common in Population 2?

_____

(1 mark)

ii. Which population would be most prone to the loss of diversity from genetic drift? Justify your answer.

(2 marks)

e. Population 4 is from a coastal island and displays the least genetic diversity. Many individuals show deformities due to inbreeding.

i. What is inbreeding?

(1 mark)

ii. Why does inbreeding often cause deformities?

(1 mark)

iii. Biologists that studied the five populations of wallabies wanted to reduce the problem of inbreeding in Population 4. Describe how this could be achieved.

(1 marks)

Total = 12 marks

Question 5.

Salamanders are amphibians that are characterized by the presence of a tail throughout their lives. Like most amphibians, the larval stage lives in water and breathes using gills. The adult stage lives on land and breathes air. **Figure 3** shows an example of a fossilized salamander from China. The fossil was one of many thousands found in a layer of fine volcanic ash that had formed after an eruption millions of years ago. Some of the other salamander fossils also show the impressions of soft tissues, such as skin, eyes and gills.

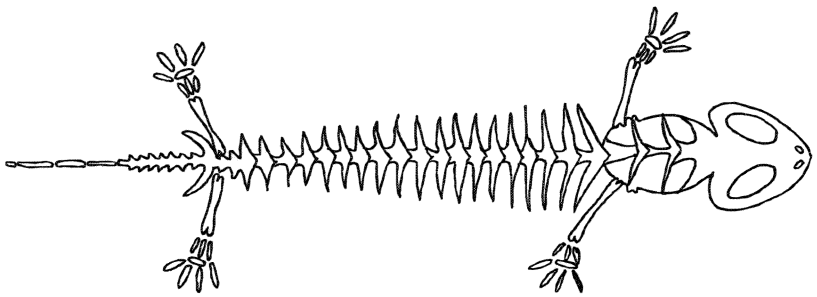


Figure 3

a. i. What is a fossil?

_____

_____

_____

(1 mark)

ii. Fossils are not commonly found in volcanic rocks. In what type of rocks are fossils usually found?

_____

(1 mark)

iii. Why are soft tissues rarely fossilised?

_____

_____

_____

(1 mark)

iv. Explain how the fossilisation process at this site has allowed the preservation of soft tissue impressions.

_____

_____

_____

_____

_____

(2 marks)

Radioisotopic dating was carried out on the layer of volcanic ash that contained the fossils. **Figure 4** shows the decay rate of the radioisotope used to date the fossils.

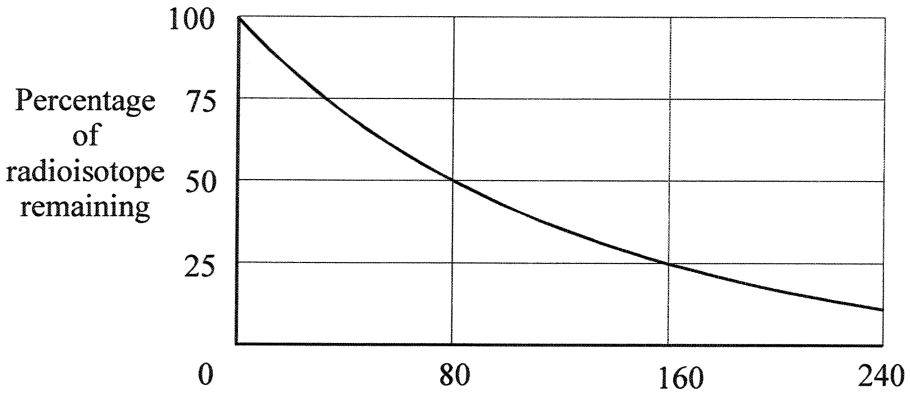


Figure 4

Refer to Figure 4 to answer part b.

b. The ash sample containing the fossils still retained 25% of the original radioisotope.

i. What is the age of the salamander fossils?

_____

(1 mark)

ii. What is the half-life of the radioisotope used?

_____

(1 mark)

Total = 7 marks

Question 6.

In North America, trophy hunters shoot bighorn sheep (*Ovis canadensis*) for their impressive horns. Trophy hunters tend to target males with larger horns that can be mounted and then displayed on a wall. A study was done on a population of bighorn sheep that had been subjected to trophy hunting over the last thirty years. **See Figure 5.**

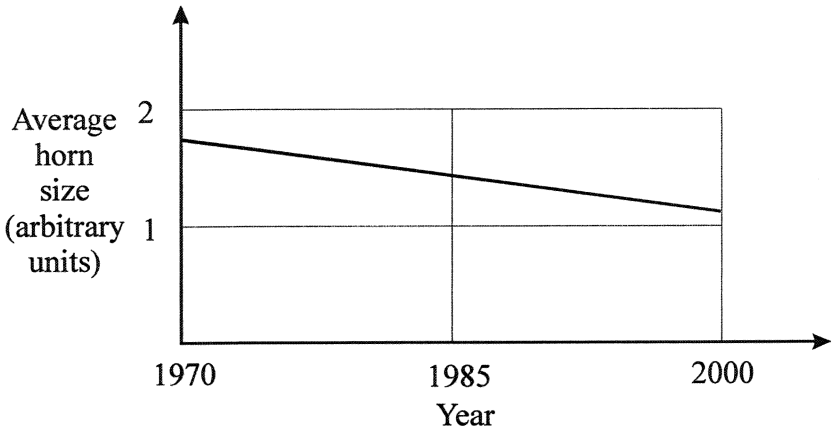


Figure 5

a. What conclusion can be drawn from **Figure 5**?

_____

_____

_____

(1 mark)

b. In this experiment there was also a control group. How would the control group differ from the experimental group?

_____

_____

_____

(1 mark)

c. What is the selective agent that has brought about the change in the experimental group?

_____

(1 mark)

d. i. Horn size in bighorn sheep is influenced by many genes. What term describes the inheritance of such a trait?

_____

(1 mark)

ii. Apart from genetic influences, what else might influence horn size in these sheep?

_____

(1 mark)

Total = 5 marks

Question 7.

Figure 6 is a photograph of a fossil hominid skull from Africa. This species is believed to be a direct ancestor of modern humans.

Figure 6

a. Briefly describe two changes that occurred to the skull in the evolution of this hominid to modern humans.

1. _____

_____

2. _____

_____

(2 marks)

b. The hominid in the photograph walked on two legs. What term describes this characteristic?

_____

(1 mark)

c. What feature of the skull can be used to determine whether a fossil primate walked upright? Explain your answer.

_____

_____

_____

_____

_____

(2 marks)

Total = 5 marks

End of Task

Suggested Answers VCE Biology 2004 Trial Exam Semester 2,

Multiple Choice Section

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D	C	B	B	C	D	B	A	A	D	D	B	B	A	A

16	17	18	19	20	21	22	23	24	25
D	C	B	A	A	C	B	A	A	C

Short Answer Section

Question 1.

a. i. Tay-Sachs disease is autosomal since it is controlled by a gene on chromosome 15 (1).

ii. Tay-Sachs disease is recessive since only one copy of the normal allele is sufficient to prevent the disease (1).

b. In the nucleus, the DNA coding for Hex-A is transcribed to form m-RNA (1). The m-RNA then leaves the nucleus and is translated to produce Hex-A at the ribosomes (1).

c. Mutation 1 could be caused by the second base in the codon (CGA or CGG) being changed from G to A (1).

d. Mutation 2 could be brought about by a deletion in the DNA of AAA or AAG (1).

e.

Mutation	Effect on Protein Length *(same, longer, shorter, uncertain)*
1	Same
2	Shorter
3	Uncertain
4	Shorter

Four correct (2 marks).
Three or Two correct (1 mark).
One or none correct (0 marks).

Question 2.

a. The alleles are co-dominant (1) since both are fully expressed in the heterozygous genotype (1).

b. Phenotypes are spotted and dotted, spotted, dotted and clear (1).
Proportion of phenotypes is 25%, 25%, 25%, 25% (1).

Gametes	L^D	*l*
L^S	$L^S L^D$ (spotted and dotted)	L^S *l* (spotted)
l	L^D *l* (dotted)	*ll* (clear)

c. i. Nine phenotypes (1).
ii. Purple, Oval (1).
iii. 25% would be homozygous for both traits (1).
iv. 25% would have the same genotype as their parents (1).

Gametes	$R^1 L^1$	R^1L^2	R^2L^1	$R^2 L^2$
$R^1 L^1$	$R^1R^1L^1L^1$ (Red, Long)	$R^1R^1L^1L^2$ (Red, Oval)	$R^1R^2L^1L^1$ (Purple, Long)	$R^1R^2L^1L^2$ (Purple, Oval)
R^1L^2	$R^1R^1L^1L^2$ (Red, Oval)	$R^1R^1L^2L^2$ (Red, Round)	$R^1R^2L^1L^2$ (Purple, Oval)	$R^1R^2L^2L^2$ (Purple, Round)
R^2L^1	$R^1R^2L^1L^1$ (Purple, Long)	$R^1R^2L^1L^2$ (Purple, Oval)	$R^2R^2L^1L^1$ (White, Long)	$R^2R^2L^1L^2$ (White, Oval)
$R^2 L^2$	$R^1R^2L^1L^2$ (Purple, Oval)	$R^1R^2L^2L^2$ (Purple, Round)	$R^2R^2L^1L^2$ (White, Oval)	$R^2R^2L^2L^2$ (White, Round)

Question 3.

a. Adaptive radiation (1).

b. The Mozambique Channel isolated the tenrecs from other mammals that may have colonised Mozambique (1).

c. On Madagascar, there was very little competition from other mammals (1). As a consequence, tenrecs were able to evolve into a large number of different species that occupied different niches (1).

d. Echolocation in bats and tenrecs is an example of convergence since both groups evolved the trait independently due to similar selection pressures (1).

Question 4.

a. Introns are non-coding regions within a gene (1) whereas microsatellites are non-coding regions that are not part of a gene (1).

b. GATA repeats can also be regarded as CTAT repeats since CTAT is the complementary base sequence to GATA (1).

c. i. $(GATA)_{20}(GATA)_{13}$ (1).
ii. Individual 2 is homozygous since both alleles consist of 13 GATA repeats (1).
iii. Individual 3 is unrelated since the two alleles he/she possesses are not shared by any of the other 5 individuals (1).

d. i. $(GATA)_{20}(GATA)_{20}$ (1).
ii. Population 5 would be most prone to loss of diversity from genetic drift (1) since it has a small population size and two alleles that have a very low frequency (1).

e. i. Inbreeding refers to the crossing of two individuals that are closely related (1).
ii. Inbreeding often causes deformities since it increases the likelihood of rare recessive traits being expressed in the offspring (1).
iii. The problem of inbreeding in Population 4 could be reduced by introducing some wallabies from another population, such as Population 1 (1).

Question 5.

a. i. A fossil is any object that provides evidence of the former existence of life (1).
ii. Sedimentary rocks (1).
iii. Soft tissues are rarely fossilised because they decompose rapidly after the organism dies (1).
iv. When the volcano erupted, the organisms were immediately covered by volcanic ash (1). The ash that covered them was also very fine and enabled impressions of their soft tissues to be preserved after they decayed (1).

b. i. The fossils are 160 million years old (1).
ii. The half-life of the radioisotope is 80 million years (1).

Question 6.

a. Trophy hunting has caused a reduction in the average horn size of bighorn sheep (1).

b. The control group would be one that has been protected from trophy hunting for the past thirty years (1).

c. The selective agent is trophy hunting (1).

d. i. Polygenic inheritance (1).

ii. Environmental influences (1)

Question 7.

a. Any two of the following (2).

- Reduction in the size of the canine teeth
- Increase in the size of the cranium/brain case
- Reduction in the size of the brow ridges
- Greater development of the chin
- Reduction in the projection of the upper and lower jaws

b. Bipedalism (1).

c. The position of the foramen magnum can be used to determine if the primate walked upright (1). If the foramen magnum is located towards the centre of the skull, it can be concluded that the primate walked upright (1).