



VCE BIOLOGY 2005 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.

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Student Name.....

VCE Biology 2005 Year 12 Trial Exam Unit 4

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 2005 Year 12 Exam Unit 4

Multiple Choice Questions

Question 1.

Which of the following is an example of a phenotype?

- A. A dog that has the genetic makeup to produce a brown coat.
- B. A cat that is deaf.
- C. A horse that is pure breeding for black coat colour.
- D. A cold climate that favours the development of a thick coat of fur.

Question 2.

Which of the following is an example of a genotype?

- A. A man who is colour blind.
- B. A plant that has one allele for red flowers and another allele for white flowers.
- C. A population of lizards where the allele frequency for a striped body pattern is 70% and the allele frequency for a plain body pattern is 30%.
- D. A brown dog that has one brown parent and one black parent.

Question 3.

Table 1 details the number of chromosomes found in four cells. Two of the cells came from the same species while the other two cells came from two other species.

Table 1

Cell	Number Of Chromosomes
One	42
Two	26
Three	21
Four	28

The two cells from the same species would be

- A. Cell One and Cell Two.
- B. Cell One and Cell Three.
- C. Cell Three and Cell Four.
- D. Cell Two and Cell Three.

Question 4.

A gene on the human Y chromosome controls whether or not ears are hairy. A woman whose father had hairy ears married a man with hairless ears. Their first child is a son. The probability that he will have hairy ears is

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

Question 5.

The gene controlling the ABO blood group in humans has three alleles. The alleles producing blood types A and B are codominant over the allele producing the recessive blood type O. See below.

I^A – produces Blood type A

I^B – produces Blood type B

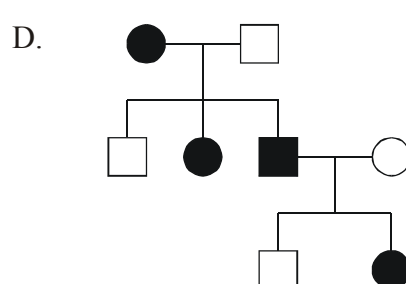
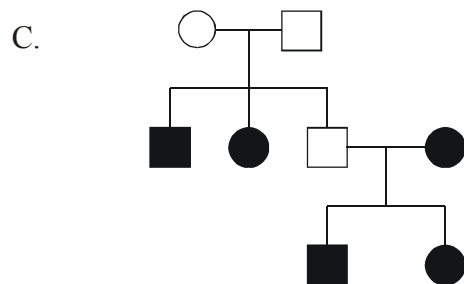
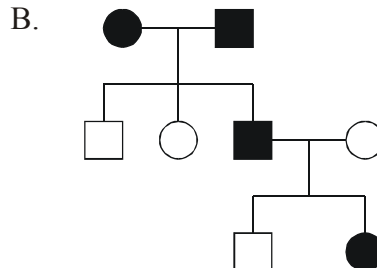
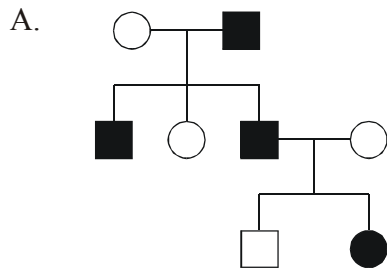
i – produces Blood type O

A man of unknown blood type had three children with a woman who was blood type O. Two of the children had blood type A and one child had blood type B. From this it can be concluded that the man had blood type

- A. AB
- B. A
- C. B
- D. O

Question 6.

Which of the following pedigrees is consistent with an X-linked dominant mode of inheritance. (Shaded individuals have the trait).



Question 7.

A germ line cell in the testes of a male mammal underwent meiosis. The amount of DNA in each of the four cells produced was measured and is shown in Table 2.

Table 2

Cell	Amount of DNA (picograms)
1	3.61
2	3.62
3	3.49
4	3.48

The cell(s) most likely to contain a Y chromosome

- A. are Cells 1 and 2.
- B. are Cells 3 and 4.
- C. is Cell 1 only.
- D. is Cell 3 only.

The following information relates to Questions 8 to 11.

In tomatoes, a gene on Chromosome One controls plant height. A second gene on Chromosome Eleven controls leaf shape. The two genes each show the typical dominant/recessive pattern as indicated below.

Gene 1 (Plant Height)

T - tall plants

t - dwarf plants

Gene 2 (Leaf Shape)

N - normal leaves

n - broad leaves

Question 8.

Which of the following crosses would produce a 9:3:3:1 phenotypic ratio in the offspring?

- A. ttnn x TtNn
- B. TtNn x Ttnn
- C. TtNn x TtNn
- D. ttNN x TtNn

Question 9.

A plant breeder had a tall tomato plant with normal leaves. He crossed it with a dwarf tomato plant with broad leaves. Table 3 shows the phenotypes and frequency of the offspring produced.

Table 3

Phenotype	Number
Tall plant, Normal leaves	48
Tall plant, Broad leaves	51
Dwarf plant, Normal leaves	0
Dwarf plant, Broad leaves	0

It would be reasonable to conclude that the genotype of the tall, parental plant with normal leaves is

- A. TtNn
- B. TTNN
- C. TtNN
- D. TTNn

Use the following additional information to answer Questions 10 and 11.

A third gene in tomato plants found on Chromosome One affects the texture of the fruit. In this gene, smooth fruit (S) is dominant over hairy fruit (s). A dwarf plant that produced hairy fruit was crossed with a tall plant that produced smooth fruit. The latter plant was heterozygous for both traits. The offspring produced are shown in Table 4.

Table 4

Phenotype	Number
Tall plant with smooth fruit	2
Tall plant with hairy fruit	48
Dwarf plant with smooth fruit	48
Dwarf plant with hairy fruit	2

Question 10.

The genotype of the heterozygous parental plant is best represented as

- A. $\frac{Ts}{tS}$
- B. $\frac{TS}{ts}$
- C. $\frac{Tt}{Ss}$
- D. $\frac{ts}{ts}$

Question 11.

From the data given in Table 4, it can be concluded that the gene for plant height is

- A. linked to the gene for fruit texture and 2 map units separate the genes.
- B. linked to the gene for fruit texture and 4 map units separate the genes.
- C. not linked to the gene for fruit texture.
- D. linked to both the gene for fruit texture and the gene for leaf shape.

The following information relates to Questions 12 to 15.

Figure 1 shows part of a DNA molecule from a human gene. Some parts have been labelled.

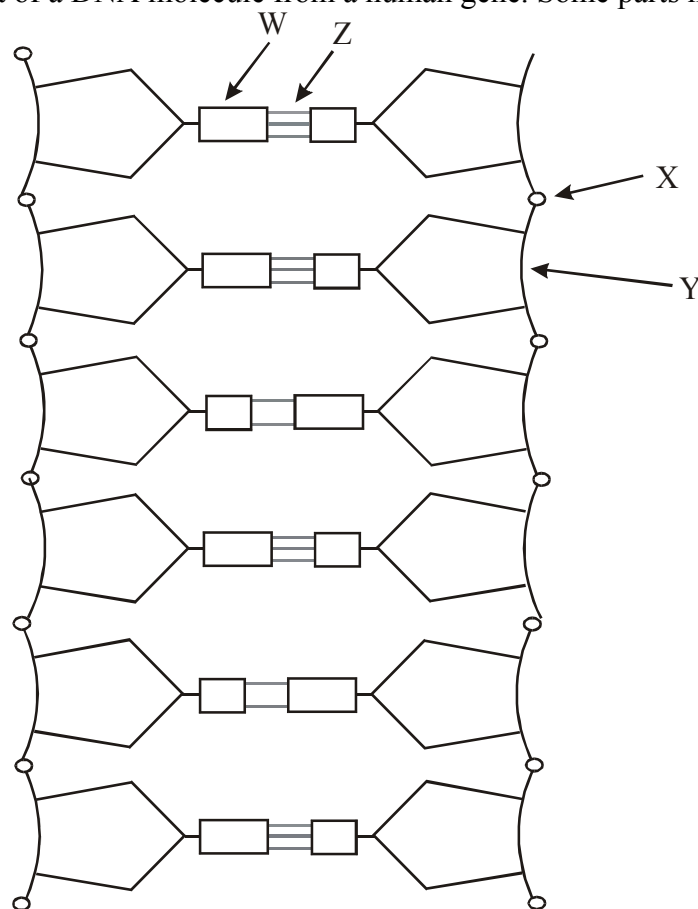


Figure 1

Question 12.

DNA has an overall negative charge. The part of DNA that is most responsible for this negative charge is labelled

- A. W
- B. X
- C. Y
- D. Z

Question 13.

The overall negative charge of DNA is most useful to genetic engineers since it allows it to be

- A. cut by restriction enzymes.
- B. separated into two strands when heated.
- C. added to plasmids.
- D. separated by gel electrophoresis.

Question 14.

The section of DNA was analysed and found to contain 2 thymine bases. It would be expected that there would also be

- A. 4 bases of adenine, 2 bases of guanine and 4 bases of cytosine.
- B. 2 bases of adenine, 2 bases of guanine and 2 bases of cytosine.
- C. 2 bases of adenine, 4 bases of guanine and 4 bases of cytosine.
- D. 4 bases of adenine, 4 bases of guanine and 2 bases of cytosine.

Question 15.

The section of DNA analysed was from an intron. It would be expected that this section of DNA would

- A. not code for any amino acids.
- B. code for one amino acid.
- C. code for two amino acids.
- D. code for six amino acids.

Question 16.

When comparing transcription and DNA replication, it is accurate to say that

- A. the products of both transcription and DNA replication are double stranded molecules.
- B. DNA replication occurs in the nucleus while transcription occurs in the cytoplasm.
- C. the products of both transcription and DNA replication contain information required to build proteins.
- D. both processes require a supply of the nucleotides guanine, cytosine, adenine and thymine.

Question 17.

In recombinant DNA technology, genes from one organism can be transferred to another by the use of a vector. One frequently used vector is a small, circular chromosome from a bacterium called a plasmid. Foreign DNA comprising several genes can be inserted into a plasmid. Multiple copies of the plasmid can then be made and bacteria are then exposed to the plasmids. Some of these bacteria may then take up the plasmid containing the foreign DNA.

One of the genes usually inserted into the plasmid is a gene for antibiotic resistance. Which of the following best explains why this particular gene is inserted?

- A. The antibiotic resistance gene allows the bacteria to produce large amounts of useful antibiotics.
- B. The antibiotic resistance gene allows biologists to distinguish between bacteria that have taken up the plasmid and those that have not.
- C. The antibiotic resistance gene allows the other genes inserted into the plasmid to be expressed.
- D. The antibiotic resistance gene cannot be separated from the other genes because they are too closely linked.

The following information relates to Questions 18 and 19.

Platypus have a diploid number of 52. In most mammals, a pair of X chromosomes results in a female and one X and one Y chromosome results in a male. In the platypus, however, both males and females have 10 sex chromosomes. See below.

Females: X X X X X X X X X X

Males : X Y X Y X Y X Y X Y

Question 18.

In platypus, it would be reasonable to assume that meiosis results in

- A. some eggs containing both X and Y chromosomes.
- B. some sperm containing both X and Y chromosomes.
- C. some eggs containing YYYYYY chromosomes.
- D. some sperm containing YYYYYY chromosomes.

Question 19.

The number of autosomes in a sperm cell from a platypus would be

- A. 42.
- B. 21.
- C. 25.
- D. 50

Question 20.

Figure 2 shows several breeds of dog that have been domesticated from wolves



Figure 2.

The breeds of dog shown in Figure 2 are a result of

- A. divergent evolution.
- B. adaptive radiation.
- C. artificial selection.
- D. gene cloning.

Refer to the following information to answer Questions 21 to 22.

Trilobites are an extinct group of arthropods. They possessed an exoskeleton covering the body surface that was broken up into various segments. To allow growth, trilobites regularly shed their exoskeletons. Their fossils have been found worldwide and they have been classified into about nine orders and over 15,000 species. Most were marine animals that obtained their food by filtering mud. Figure 3 shows an aspect of the evolution of trilobites.

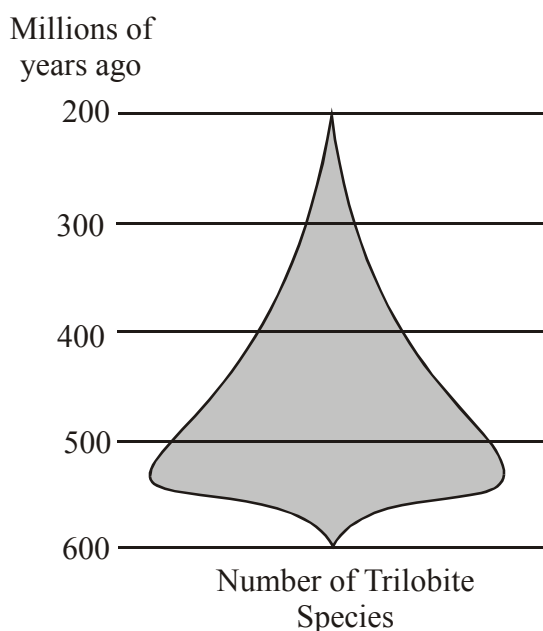


Figure 3

Question 21.

According to Figure 3, there was an adaptive radiation of trilobites between

- A. 600 and 500 million years ago.
- B. 500 and 400 million years ago.
- C. 400 and 300 million years ago.
- D. 300 million years ago and the present day.

Question 22.

Which of the following is the best reason that explains why trilobites are common in the fossil record?

- A. They were filter feeders.
- B. They had bodies that were segmented.
- C. They possessed an exoskeleton that was regularly shed.
- D. There was a large number of different species.

Question 23.

Figure 4 shows the evolution of true seals based on mitochondrial DNA analysis.

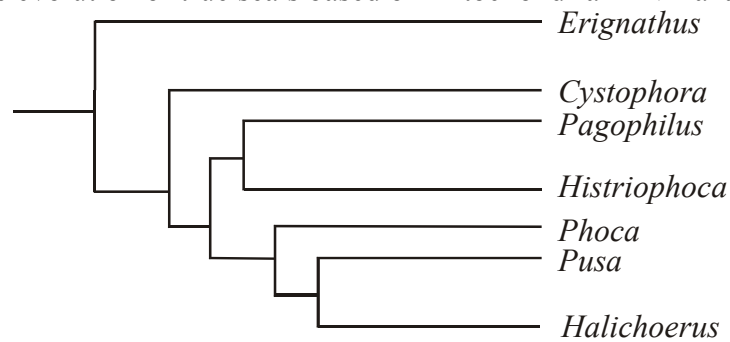


Figure 4

Of the following pairs, which would show the greatest degree of DNA hybridisation?

- A. *Pagophilus* and *Histiophoca*.
- B. *Erignathus* and *Cystophora*.
- C. *Phoca* and *Pusa*.
- D. *Halichoerus* and *Erignathus*.

Question 24.

Some plant species exist as clones that are unable to reproduce sexually. In many of these species, reproduction occurs through vegetative structures, such as rhizomes or bulbs. In a population of such a species, it would be expected that any variation in the offspring would be due to

- A. mutation.
- B. crossing over.
- C. recombination.
- D. new combinations of genes arising as a result of different sperm fertilizing different eggs.

Question 25.

In a wild population of budgerigars, the allele associated with albinism is recessive and extremely rare. One reason for this is that albino birds are more likely to be caught by predators, such as hawks.

In a wild population of budgerigars, it would be expected that the allele for albinism would most commonly occur in birds that

- A. are homozygous for albinism.
- B. are heterozygous for albinism.
- C. are homozygous for the normal condition.
- D. lack important nutrients in their diet.

Short Answer Section

Question 1.

Creutzfeldt-Jacob disease (CJD) was first described in the 1920s. It is a rare disease that causes degeneration of the brain. Its symptoms include progressive dementia and seizures, with death usually occurring within one year of the onset of symptoms. The disease is believed to be caused by an abnormal form of a protein in the brain. Table 5 details the main causes of CJD.

Table 5

Form of CJD	Description
Non-Genetic	This form of CJD occurs when the normal protein in the brain undergoes a spontaneous change to the abnormal form, thereby causing the disease. Similar forms occur when the abnormal protein is eaten or transmitted through surgical procedures.
Genetic	Inheriting an abnormal gene that codes for the abnormal protein causes this form of CJD. Only one copy of the gene is needed for this form of CJD to develop.

- a. A male with one child was diagnosed with the non-genetic form of CJD when he was in his forties. What is the likelihood of his child inheriting the disease from his father? Justify your answer.

(1 mark)

The genetic form of CJD is very rare and is believed to be due to a mutation on the short arm of chromosome 20.

- b. What is meant by the arm of a chromosome?

(1 mark)

A study was done on a German family that had several individuals who died from CJD. The mutation that caused CJD was a point mutation in the gene coding for the normal protein. The mutation caused the GAG triplet to be changed to AAG. The mutation also caused the loss of a restriction site for the enzyme BSMA 1. When the normal allele is digested with BSMA 1, two small fragments are produced, while the mutant allele produces a single larger fragment.

- c. i. How many amino acids in the normal protein would be changed as a result of this mutation?

(1 mark)

- ii. What is a restriction site?

(1 mark)

Figure 5 shows the results of a gel electrophoresis for two individuals from the German family. One of the two individuals is known to have hereditary CJD.

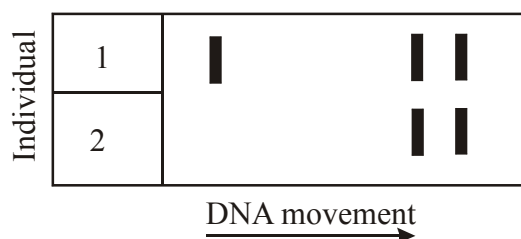


Figure 5

Refer to Figure 5.

- d. i. Which of the two individuals has hereditary CJD? Justify your answer.

(1 mark)

- ii. Explain why it can be concluded from the gel that hereditary CJD is a dominant, rather than a recessive, disorder.

(1 mark)

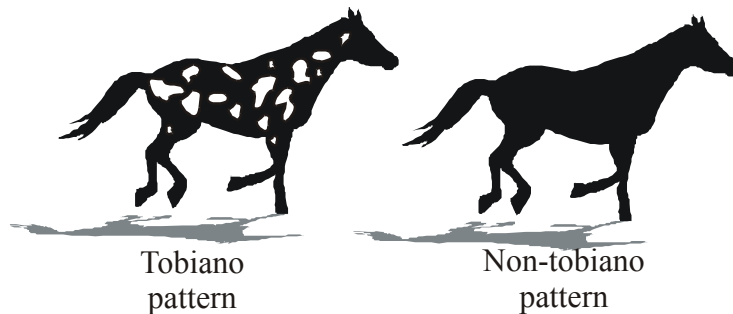
- e. To produce the gel shown in Figure 5, geneticists used a technique known as PCR. What was the reason for using this technique?

(1 mark)

Total = 7 marks

Question 2.

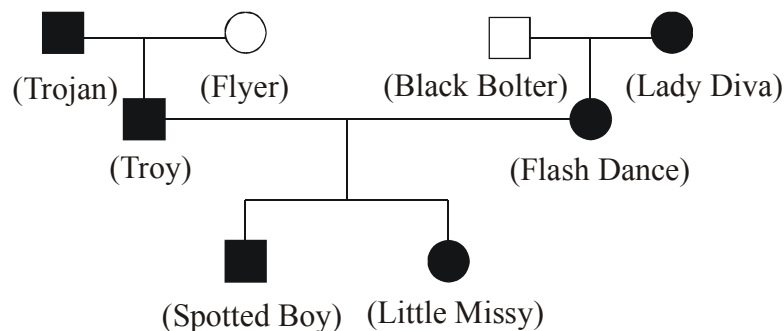
One trait in horses is known as the tobiano white spotting pattern. This pattern is dominant over the recessive non-tobiano. Both a tobiano and non-tobiano horse are shown in Figure 6.



- a. Some horse breeders specialise in producing the tobiano trait. Explain why a horse that is homozygous for the tobiano trait would be very desirable to a horse breeder.

(1 mark)

The pedigree in Figure 7 shows three generations of horses. Shaded individuals show the dominant tobiano trait.



- b. Explain why “Troy” and “Flash Dance” can both be regarded as heterozygotes for the tobiano trait.

(2 marks)

- c. From the pedigree, what is the chance that “Spotted Boy” is homozygous for the tobiano trait?

(1 mark)

At present, there is no direct DNA test for the tobiano gene. However, a gene that codes for a blood protein is known to be closely linked to the tobiano gene. This blood protein gene has two alternative forms that show co-dominance. See below.

AL-A : produces the blood protein Albumin A

AL-B : produces the blood protein Albumin B

- d. What is meant by co-dominance?

(1 mark)

The breeder wished to establish with greater certainty whether “Spotted Boy” was homozygous for the tobiano trait. He consulted a diagnostic laboratory that asked him to supply blood samples of all the horses in the pedigree shown in Figure 7. For each blood sample, the amount and type of albumin present was measured. Unusually, one of the two forms of albumin is nearly always tightly linked to the tobiano trait. The results of the analysis are shown in Figure 8.

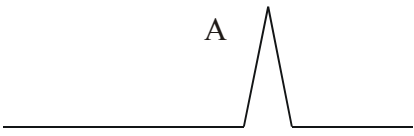
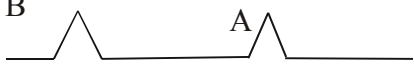
Horse	Amount and Type of Albumin
Trojan Lady Diva Spotted Boy	B 
Flyer Black Bolter	 A
Troy Flash Dance Little Missy	B  A

Figure 8

- e. From the results shown in Figure 8, which of the two forms of albumin (A or B) is tightly linked to the tobiano trait.

(1 mark)

- f. Is “Spotted Boy” heterozygous or homozygous with respect to the tobiano trait? Justify your answer.

(2 marks)

Total = 8 marks

Question 3.

Figure 9 shows the fossilised lower jawbone of a mammal.

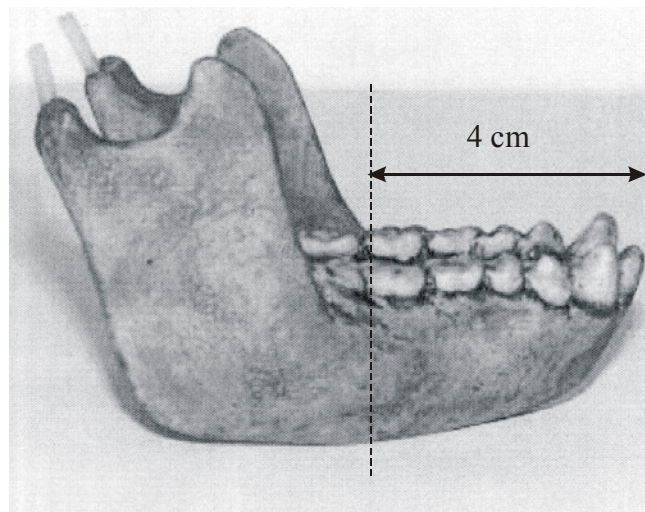


Figure 9

- a. State two inferences that can be made about an animal from observation of its jawbone.

1. _____

2. _____

(2 marks)

The middle ear of all modern mammals contains three bones (the malleus, incus, and stapes) that are used in hearing. The lower jaw of modern mammals is made up of a single bone. The earliest mammals evolved from reptiles in the Mesozoic era between 200 and 250 million years ago. The oldest known ancestors of the mammals, known as the early therapsids, had a middle ear that contained just one bone, the stapes. Fossil records show that the lower jaw of early therapsids was made up of several bones. Two of these bones evolved into the malleus and incus of modern mammals.

- b. What term describes structures that have a common origin?

(1 mark)

All modern mammals (monotremes, marsupials and placentals) have a middle ear containing three bones. Figure 10 shows a phylogenetic tree outlining the evolution of these three main mammal groups. Some additional information has been added.

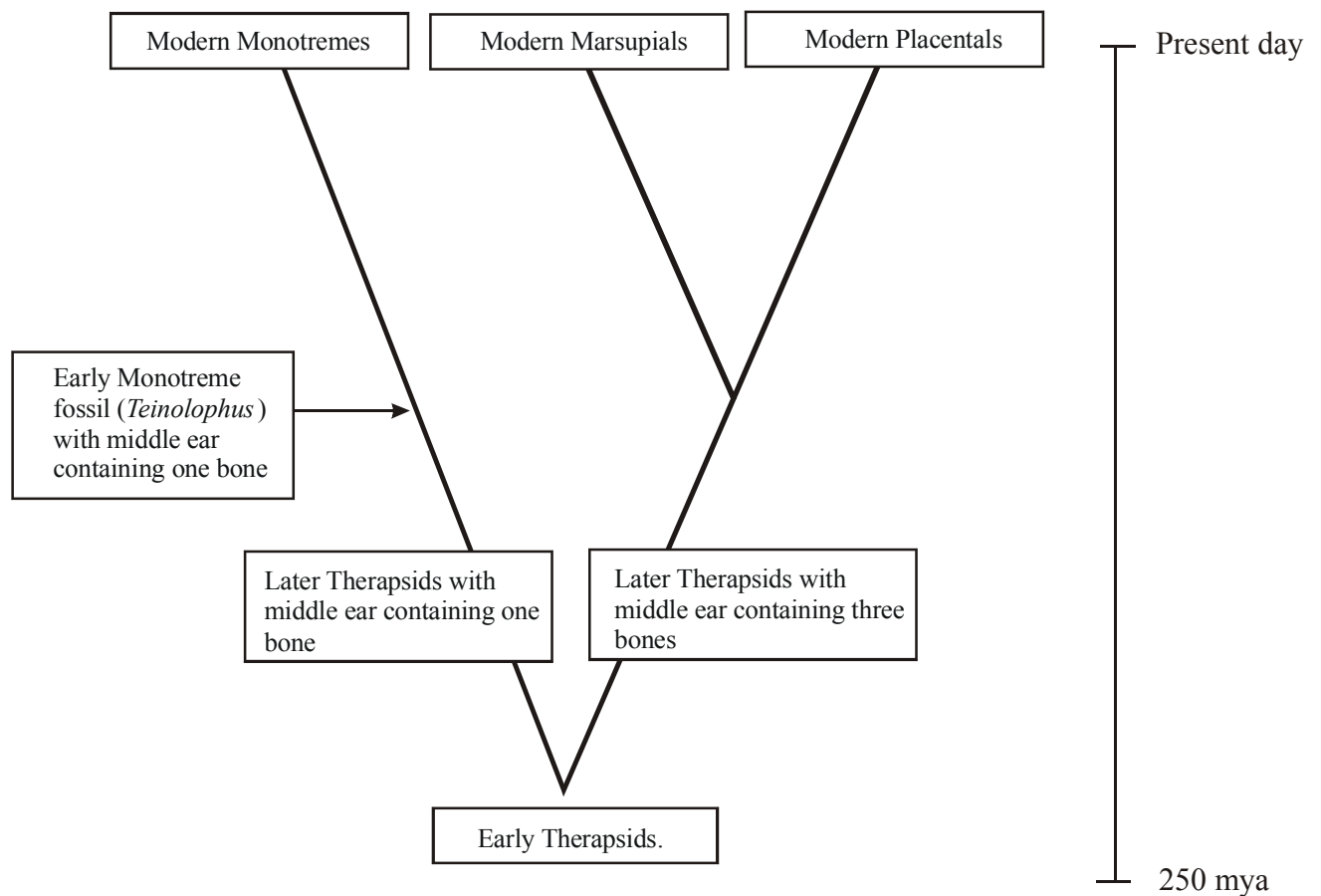


Figure 10

A fossil jawbone of a monotreme called *Teinolophus* (See Figure 10) was found recently in southeastern Victoria. This jawbone indicated that the middle ear of this animal contained only one bone. Biologists believe that this is evidence for convergent evolution in the development of middle ears in mammals.

c. What is convergent evolution?

(1 mark)

- d. With reference to *Teinolophus* shown in Figure 10, explain why biologists regard the development of hearing in monotremes as an example of convergent evolution with the development of hearing in marsupials and placentals.

(3 marks)

- e. Suggest a reason why evolution favoured the development of a middle ear with three bones over a middle ear with one bone in all groups of mammals.

(1 mark)

Total = 8 marks

Question 4.

Low density lipoprotein (LDL) is a form of cholesterol, sometimes referred to as “bad cholesterol.” It is deposited on the walls of arteries and can cause strokes and heart attacks. An elevated level of LDL in the body is known as hypercholesterolaemia. It can be caused by a poor diet, a lack of exercise or smoking. There is also an inherited form of the disease known as familial hypercholesterolaemia. This disorder is dominant.

When LDL enters the bloodstream, it usually becomes attached to receptor sites on targeted cells and is then absorbed. A gene called LDLR codes for the production of these receptors. In familial hypercholesterolaemia, the mutant LDLR gene produces receptor sites that are unable to attach to LDL.

- a. What is meant by the term dominant?

(1 mark)

- b. What protein is produced by the gene controlling familial hypercholesterolaemia?

(1 mark)

- c. Explain why a sufferer of familial hypercholesterolaemia has high levels of LDL circulating in the bloodstream.

(2 marks)

Figure 11 shows a pedigree for a family where hereditary hypercholesterolaemia occurs. Shaded individuals have the disease.

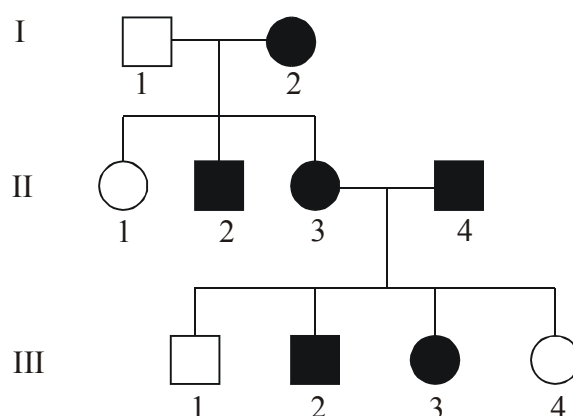


Figure 11

- d. From the pedigree, state why familial hypercholesterolaemia cannot be X-linked dominant.

(1 mark)

Blood samples were taken from the four individuals in the third generation and analysed for LDL concentration. Table 6 shows the results of this analysis.

Table 6

Individual	LDL Concentration (mg/dL)	Medical Assessment
III – 1	168	High
III – 2	242	Very High
III – 3	228	Very High
III – 4	88	Normal

- e. What is the most likely reason that Individual III – 1 has a high LDL concentration in his blood? Justify your answer.

(2 marks)

Total = 7 marks

Question 5.

Horned lizards are characterised by the presence of protective bony outgrowths from the skull. They are believed to be an adaptation that protects the lizards from being eaten by predators. Figure 12 shows these protective horns.

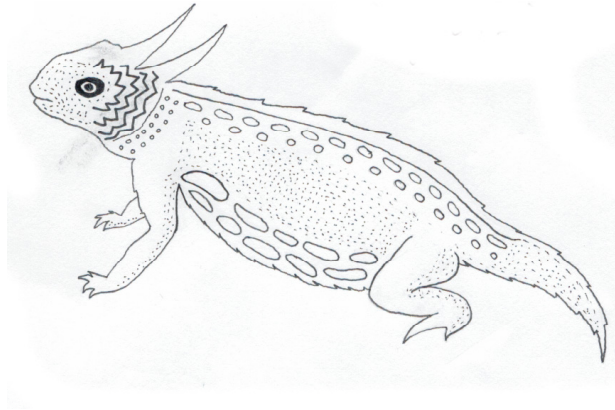


Figure 12

- a. What is meant by the term “adaptation”?

(1 mark)

Horned lizards are preyed upon by butcherbirds. These birds attack the lizards from behind and bite the neck at the back of the skull. If successful, the bite breaks the lizard's neck, killing it instantly. The butcherbird then takes the dead lizard to a tree where it is impaled on a sharp branch. The bird then pulls apart the prey and eats it. Butcherbirds tend to use the same tree as a feeding site. Biologists carried out a study on the size of the horns from living lizards and compared these to the size of the horns found on dead lizards from the feeding sites of butcherbirds. The results are shown in Figure 13.

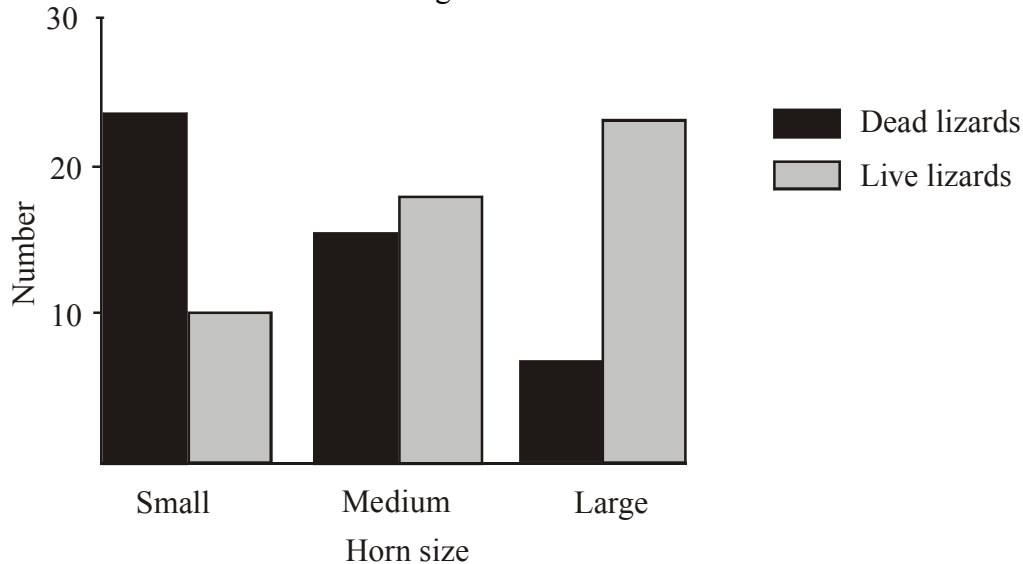


Figure 13

Biologists stated that the data showed evidence of natural selection in operation.

- b. By referring to Figure 13, state what trait was being favoured by natural selection.

(1 mark)

- c. Explain how natural selection could bring about the changes in the trait you referred to in part b.

(3 marks)

d. In this study, what is the selective agent?

(1 mark)

e. Horn length is controlled by polygenic inheritance. Explain what this statement means.

(1 mark)

Total = 7 marks

Question 6.

In 2003, on a small Indonesian island called Flores, a new hominid called *Homo floresiensis* was discovered. Scientists found the remains of seven individuals in the Liang Bua Cave. The cave site where the fossils were found, also included the remains of fire hearths used for cooking, as well as stone tools. Adults of this new hominid were about one metre tall, with a brain size less than a third of modern humans. The hominid fossils, dubbed “hobbits” because of their small size, ranged in age from 94,000 to 13,000 years old. The scientists found the hobbit fossils below a 12,000-year-old volcanic ash layer. The remains of modern humans were only found above this ash layer.

a. i. What is a hominid?

(1 mark)

ii. What term is used to describe the method of dating a fossil by its position in the layers of sediment?

(1 mark)

iii. Give two reasons why hominid fossils are often found in caves.

1. _____

2. _____

(2 marks)

b. Scientists believe that *Homo floresiensis* hunted a primitive, dwarf elephant called a stegodon. Suggest how scientists came to this conclusion.

(1 mark)

Figure 14 shows one interpretation of the human evolutionary tree and the position of *Homo floresiensis*.

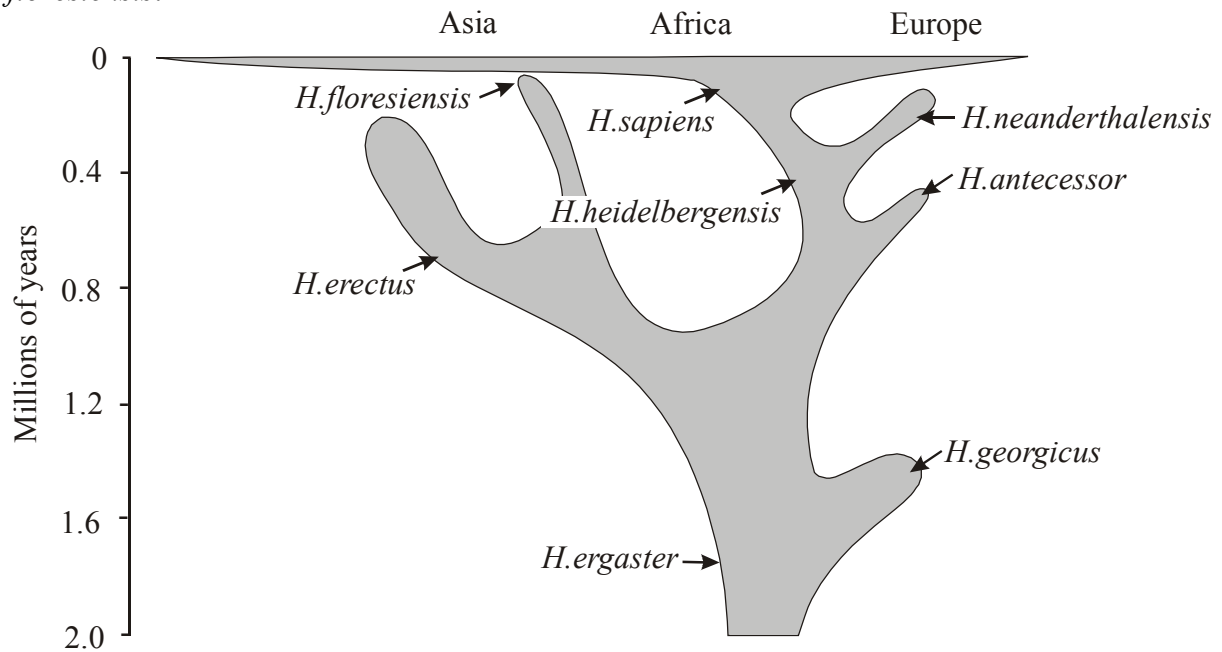


Figure 14

- c. i. According to Figure 14, where did modern humans first evolve?

(1 mark)

- ii. If modern humans had come in contact with *H. floresiensis*, would you have expected them to freely interbreed? Justify your answer.

(1 mark)

Total = 7 marks

Question 7.

Geospiza fortis is a medium sized ground finch found on the small island of Daphne Major, one of the Galapagos Islands. They have a diet consisting of a range of different sized seeds. There is considerable variation in both body and beak size. Larger beaks are better for large seeds but can also be used to eat small seeds. Small beaks are mainly suitable for small seeds and are not very useful for large seeds.

In 1976 and 1977 there was a severe drought, causing a sharp drop in the production of seeds eaten by the ground finches. Figure 15 shows the effect of this drought on the numbers of ground finches on this island.

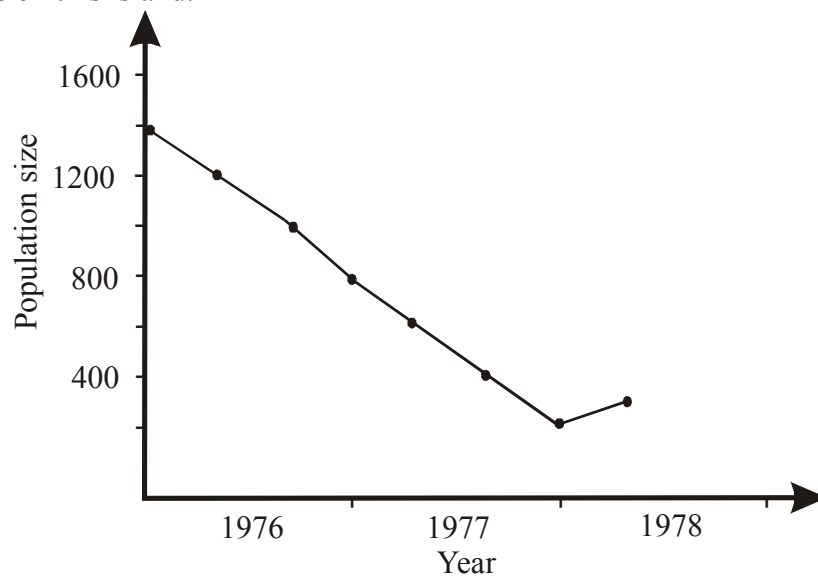


Figure 15

- a. i. What term describes a rapid drop in the population size of a species, such as ground finches, due to environmental influences, such as drought or disease?

(1 mark)

- ii. Give a brief quantitative statement about how the population of ground finches was affected by the drought.

(1 mark)

One plant that grew well during the drought produced seeds in large, tough fruits. These seeds can be eaten by birds with large beaks but those with smaller beaks are unable to crack open the fruit to get to the seeds.

During the drought, the change in the average beak size of ground finches was measured. See Figure 16.

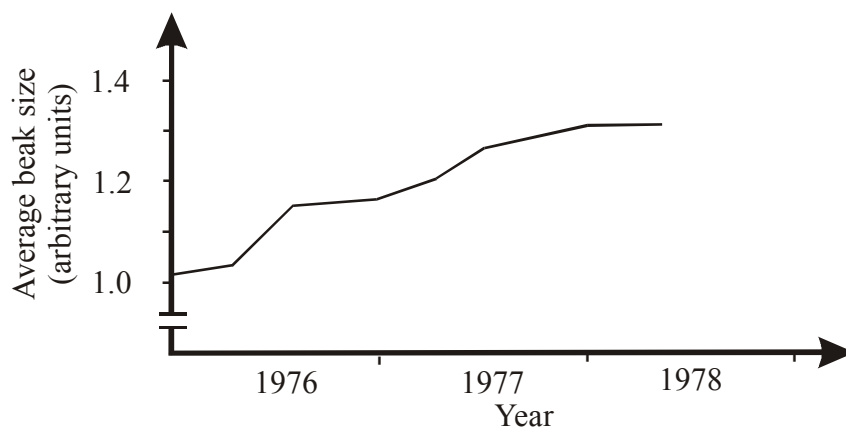


Figure 16

- b. State one conclusion that can be drawn from the data shown in Figure 16.

(1 mark)

It has been shown that beak size in ground finches is related to the expression of a gene called *Bmp4*. This gene codes for a protein necessary for the growth of the tissue that will form the beak. In birds with larger beaks, this gene is switched on earlier in embryonic development.

- c. What is meant when a gene is said to be “switched on”?

(1 mark)

- d. Explain how a larger beak would form in a ground finch if the *Bmp4* gene was switched on earlier in development.

(2 marks)

Total = 6 marks

End of task

Suggested Answers VCE Biology Year 12 Exam Unit 4

Multiple Choice Section.

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

Short Answer Section

Question 1.

- There is no chance that the disease will be passed on to his child because the father has a non-genetic form of CJD OR the disease in the father does not affect the gametes he produces (1).
- The arm of a chromosome is the part of a chromosome above or below the centromere (1).
- One amino acid (1).
 - A restriction site is a sequence of bases where a DNA molecule is cut by a restriction enzyme (1).
- Individual One has hereditary CJD since the gel shows that one allele has produced a large DNA fragment that is characteristic of the mutant allele (1).
 - The gel confirms that hereditary CJD is dominant because Individual One, who has CJD, has only one mutant allele rather than two (1).
- PCR is used to make multiple copies of a particular segment of DNA (1).

Question 2.

- A horse that is homozygous for the tobiano trait would be desirable since all its offspring would also show the same trait, irrespective of the genotype of the other parent (1).
- Troy and Flash Dance are heterozygotes since they both display the tobiano trait, indicating that they carry one allele for the dominant tobiano pattern (1). Both horses must also carry the normal allele as both had a parent with the normal phenotype (1).
- From the pedigree, the chance that Spotted Boy is homozygous for the tobiano trait is one third (1).
- Co-dominance refers to a trait where both alleles of a particular gene are fully expressed in the phenotype (1).
- The tobiano trait is strongly linked to Albumin B (1).
- Spotted Boy is most likely homozygous for the tobiano trait (1) since his blood analysis indicates that he only has Albumin B present and no Albumin A (1).

Question 3.

- Any two of the following (2).
 - The size of the animal can be inferred from its jawbone.
 - The age of the animal when it died can be inferred from its teeth.
 - The diet of the animal can be inferred from its teeth.
 - The evolutionary relationship of the animal can be inferred by comparing its jawbone with other animals.
- Homologous (1).
- Convergent evolution is the process whereby two groups of organisms develop similar traits independently of each other due to similar selection pressures (1).

- d. Figure 10 shows that both marsupials and placental mammals inherited a middle ear with three bones from an early therapsid ancestor (1). The fossil, *Teinolophus*, however, suggests that this development had yet to occur in the evolutionary line leading to monotremes (1). This implies that monotremes independently evolved a middle ear with three bones (1).
- e. A middle ear with three bones was probably more sensitive to sound than a middle ear with one bone (1).

Question 4.

- a. Refers to the phenotype that is expressed in an organism that is heterozygous for the trait in question (1).
- b. Receptor sites for low density lipoprotein (1).
- c. A sufferer of familial hypercholesterolaemia has only one allele (rather than two) that produces effective receptor sites for LDL (1). As a consequence, only a reduced amount of LDL is absorbed, resulting in elevated levels of LDL in the bloodstream (1).
- d. Familial hypercholesterolaemia cannot be X-linked dominant since individual II-4 has not passed the trait down to his daughter III-4 (1).
- e. The pedigree indicates that Individual III-1 does not have familial hypercholesterolaemia (1). As a consequence, the high levels of LDL in his blood are most likely due to a poor diet/smoking/lack of exercise (1).

Question 5.

- a. An adaptation is any trait of an organism that helps it survive or reproduce (1).
- b. Longer horns (1).
- c. In the population of horned lizards, there was variation in the length of the horns protecting the neck (1). Those individuals that had longer horns were more likely to survive an attack by butcherbirds compared to those with shorter horns (1). Over several generations, this selection pressure would result in an increase in the horn length of these lizards (1).
- d. The selective agent is predation by butcherbirds (1).
- e. Polygenic inheritance refers to a trait that is controlled by many genes (1).

Question 6.

- a.
 - i. A hominid is any human-like organism belonging to the family, *Hominidae* (1).
 - ii. Relative dating (1).
 - iii. Any two of the following (2).
 - Hominids used caves for shelter.
 - Hominids sometimes buried their dead in caves.
 - Caves provided protection from scavenging animals.
 - Caves provided protection from the destructive effects of wind/rain/sun.
 - Any other reasonable suggestion.
- b. Any one of the following (1).
 - Stegodon bones may have been found with cut marks from primitive stone tools.
 - Stegodon bones may have been found in the fire hearths.
 - Any other reasonable suggestion.
- c.
 - i. Africa (1).
 - ii. They would not be expected to freely interbreed as modern humans and *H. floresiensis* belonged to different species (1).

Question 7.

- a.
 - i. Population bottleneck (1).
 - ii. During the drought from 1976 to 1977, the population of ground finches dropped from 1,400 to 200 individuals (1).
- b. Over the period of the drought, the average beak size of ground finches increased (1).
- c. A gene that is switched on is producing its protein product in particular tissues (1).
- d. If the *Bmp4* gene is switched on earlier in development, it means that one of the proteins necessary for beak growth will be produced earlier in the developing embryo (1). This suggests that the beak will be growing for a longer time, resulting in a larger beak (1).