

Student Name.....



Chemistry Physics Biology
Psychology

VCE BIOLOGY 2002

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	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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VCE Biology 2002 Year 12 Written Exam 2 Unit 4 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 2002 Year 12 Written Exam Semester 2 Unit 4

Multiple Choice Section

Question 1.

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

- A. AA x AA
- B. Aa x Aa
- C. AA x aa
- D. Aa x aa

Question 2.

The diploid number for orang-utans is 48. A sperm cell from a male orang-utan would contain

- A. 24 autosomes.
- B. 22 autosomes.
- C. an X and Y chromosome.
- D. an X or Y chromosome.

Question 3.

Figure 1 is a drawing of a cell from an organism with a diploid number of six.

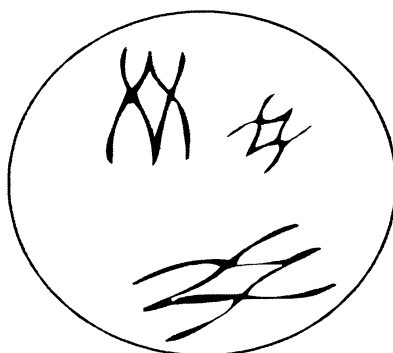


Figure 1

It would be reasonable to conclude that this cell is undergoing

- A. mitosis.
- B. the first division of meiosis.
- C. the second division of meiosis.
- D. cytokinesis.

The following information relates to Questions 4 and 5.

In humans, the allele for right-handedness is dominant over the allele for left-handedness.

Question 4.

It would be reasonable to assume that

- A. if both parents are left handed, some of their children will be right handed.
- B. if both parents are right handed, then some of their children might be left handed.
- C. right handed children must have two parents that are right handed.
- D. if one parent is left handed and one parent is right handed, then all their children will be right handed.

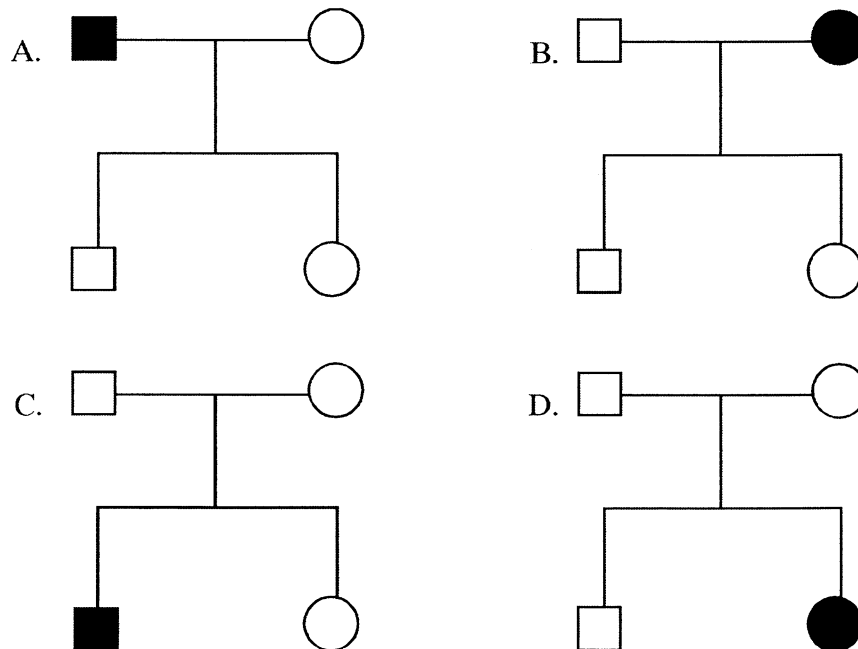
Question 5.

The number of different genotypes for a left-handed person is

- A. one.
- B. two.
- C. three.
- D. four.

Question 6.

The pedigree that could be due to an X-linked dominant mode of inheritance is



The following information relates to Questions 7 and 8.

In fruit flies, two pigments that control eye colour are determined by separate genes. The alleles for these genes are shown below.

Gene 1 B- brown pigment produced
 b- brown pigment not produced

Gene 2 S- scarlet pigment produced
 s- scarlet pigment not produced

Question 7.

Wild type eyes are produced when both pigments are present. Which of the following genotypes would produce wild type eyes?

- A. BBSs
- B. bbSS
- C. Bbss
- D. bbss

Question 8.

Which of the following gamete combinations would produce flies with scarlet eyes?

- A. bS x Bs
- B. Bs x bs
- C. bs x bS
- D. BS x bS

The following information relates to Questions 9 and 10.

Figure 2 shows the relative percentages of nitrogen bases extracted from four different nucleic acid samples.

Figure 2

Sample	Guanine	Adenine	Cytosine	Thymine	Uracil
One	28	28	22	22	0
Two	22	28	22	28	0
Three	22	22	28	28	0
Four	28	22	22	0	28

Question 9.

According to **Figure 2**, which sample is made up of single-stranded RNA?

- A. Sample One
- B. Sample Two
- C. Sample Three
- D. Sample Four

Question 10.

According to **Figure 2**, which sample is made up of double-stranded DNA?

- A. Sample One
- B. Sample Two
- C. Sample Three
- D. Sample Four

Question 11.

Which of the following best describes the life cycle of a eucaryotic cell from a mammal?

- A. $2N \rightarrow \text{Meiosis} \rightarrow 1N \rightarrow \text{Fertilization} \rightarrow 2N$
- B. $1N \rightarrow \text{Meiosis} \rightarrow 2N \rightarrow \text{Fertilization} \rightarrow 1N$
- C. $2N \rightarrow \text{Mitosis} \rightarrow 1N \rightarrow \text{Fertilization} \rightarrow 2N$
- D. $1N \rightarrow \text{Mitosis} \rightarrow 1N \rightarrow \text{Fertilization} \rightarrow 2N$

Question 12.

Diploid strains of watermelon produce fruits that have seeds while triploid strains usually produce fruits that lack seeds. Which of the following gives the best explanation for the seedless triploid varieties?

- A. triploid strains are not able to successfully complete meiosis.
- B. triploid strains don't produce flowers.
- C. triploid strains are usually grown in drier areas.
- D. bees don't pollinate triploid strains.

Question 13.

During mitosis, sister chromatids are genetically identical. However, sister chromatids in meiosis usually show subtle differences in their DNA. The best reason for this is that

- A. a cell undergoing meiosis is more prone to mutations than a cell undergoing mitosis.
- B. crossing over occurs in meiosis but not mitosis.
- C. meiosis is a more complex process than mitosis.
- D. a cell at the start of meiosis has more genetic variation than a cell at the start of mitosis.

Question 14.

Distances between genes on the same chromosome are measured in

- A. micrometres.
- B. marker units.
- C. map units.
- D. elongation factors.

The following information relates to Questions 15 and 16.

Figure 3 shows a phylogenetic tree for flightless birds from the Southern Hemisphere.

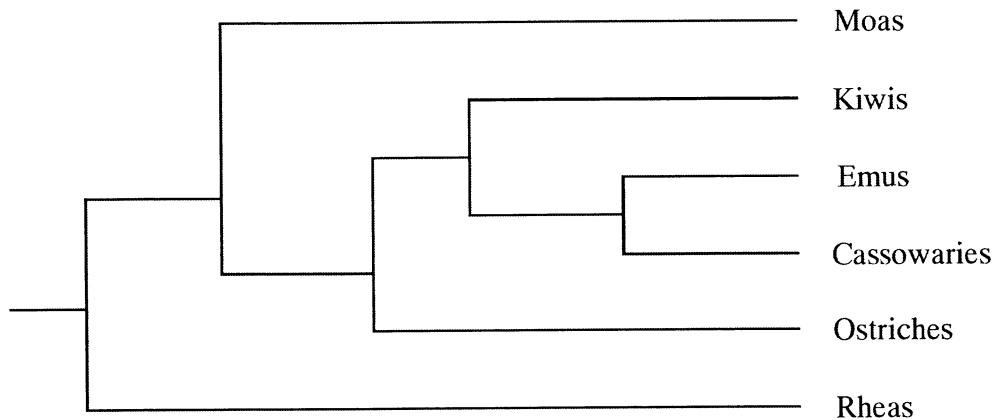


Figure 3

Question 15.

According to **Figure 3**, kiwis are most closely related to

- A. moas.
- B. cassowaries and emus.
- C. ostriches and rheas.
- D. rheas.

Question 16.

These species are found in South America, Africa, Australia, New Zealand and New Guinea. These landmasses were once joined in a single continent called Gondwana. Another landmass that was part of this super continent is

- A. North America.
- B. Japan.
- C. Hawaii.
- D. India.

Question 17.

Genetic drift would be most evident in

- A. small populations where all adult individuals reproduce.
- B. small populations where only some adult individuals reproduce.
- C. large populations where all adult individuals reproduce.
- D. large populations where only some adult individuals reproduce.

Question 18.

The hominid genus, *Australopithecus*, evolved in

- A. Australia.
- B. Europe.
- C. Africa.
- D. Asia.

Question 19.

Creutzfeldt Jakob Disease (CJD) is a fatal disorder of the brain. About ten per cent of all cases of CJD are caused by a rare autosomal dominant gene that becomes active in middle age. A pedigree for this disorder is shown in **Figure 4**. Shaded individuals are affected.

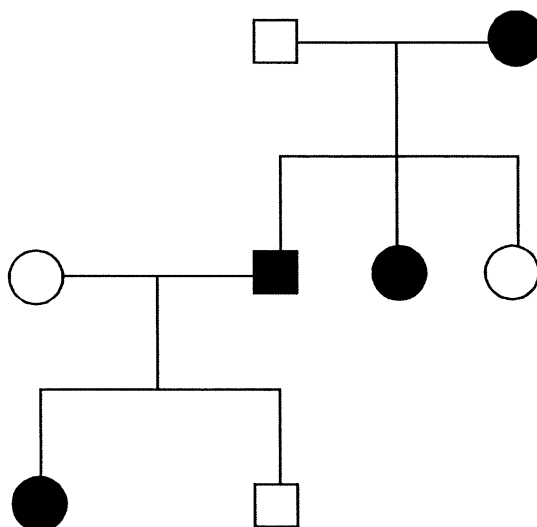


Figure 4

From the information given and your own knowledge, it would be reasonable to conclude that

- A. females are more likely to inherit CJD.
- B. affected males would only develop a mild version of CJD.
- C. twenty-five per cent of children from two affected parents would be expected to develop CJD.
- D. if two unaffected parents have a child that develops CJD, then it is most likely that the child has a non-hereditary form of CJD.

Question 20.

Part of the genetic code as it appears in mRNA is shown in **Figure 5**.

mRNA	Amino Acid	mRNA	Amino Acid
UUU	phenylalanine	UGU	cysteine
UUC	phenylalanine	UGC	cysteine
CUU	leucine	ACG	threonine
AAG	lysine	CGC	arginine

Figure 5

If a DNA sequence was changed from AAG to ACG, the corresponding change in the amino acid produced would be

- A. lysine to threonine.
- B. lysine to cysteine.
- C. phenylalanine to cysteine.
- D. leucine to arginine.

Question 21

Lethal alleles are those that result in the death of an organism. Which of the following lethal alleles would be the most likely to persist in a population?

- A. a dominant allele that is expressed in childhood.
- B. a dominant allele that is expressed in early adulthood.
- C. a recessive allele that is expressed in childhood.
- D. a recessive allele that is expressed in early adulthood.

The following information relates to Questions 22 and 23.

Biologists set up two laboratory populations of fruit flies and bred them for 100 generations. One population acted as a control and was bred using a normal growth medium. In the second (experimental) population, a drier growth medium was used. In this population, the biologists selected flies at each generation that were able to survive on this drier medium. In both populations, 20 flies (10 male and 10 female) were selected to breed at each generation.

Figure 6 shows the results of this experiment.

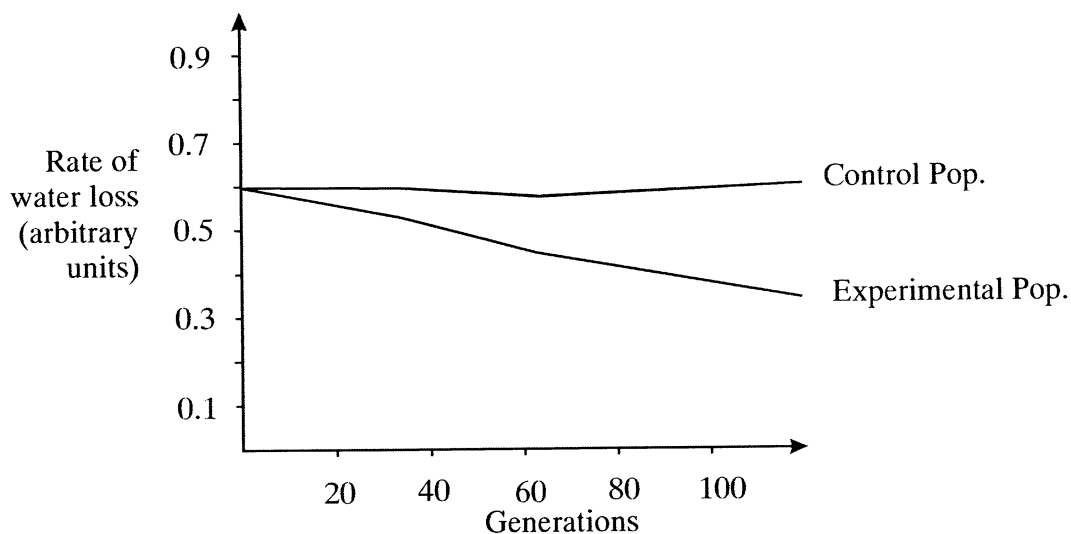


Figure 6

Question 22.

From the data shown in **Figure 6**, it would be reasonable to conclude that the rate of water loss in fruit flies

- A. is under the control of one gene with two alleles.
- B. is under the control of one gene with three alleles.
- C. shows discontinuous variation.
- D. is an example of polygenic inheritance.

Question 23.

In this experiment,

- A. the control population would have been cultured at a higher temperature than the experimental population.
- B. flies in the experimental population would be better adapted than flies in the control population if bred on the normal growth medium.
- C. flies from the control population would have been randomly selected for breeding at each generation.
- D. flies from the experimental population would have been randomly selected for breeding at each generation.

Question 24.

Humans have occupied the high altitudes of the Andes Mountains for more than 10,000 years. **Figure 7** shows the predicted changes that would occur in the two alleles of a gene (A and a) over the duration of human habitation (600 generations) in this region.

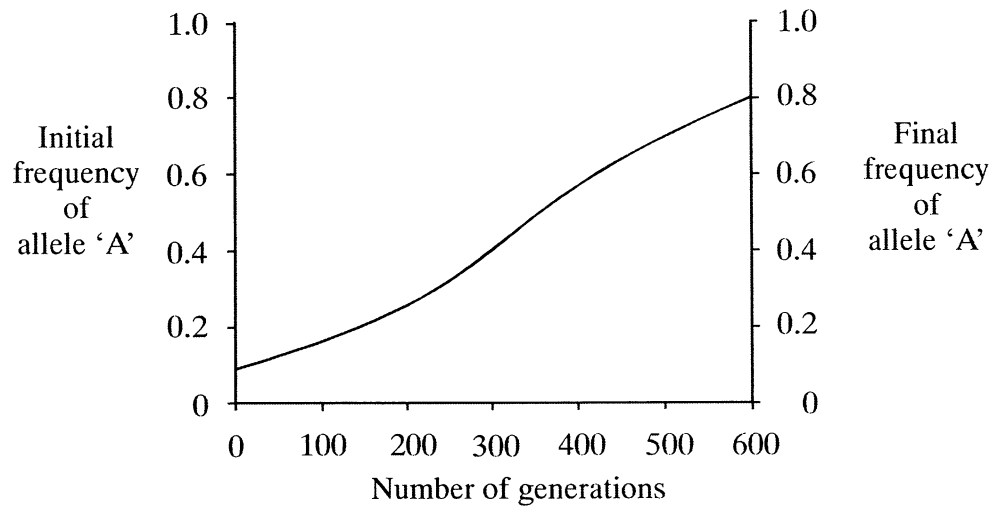


Figure 7

According to **Figure 7**,

- A. the frequency of the two alleles is changing as a result of genetic drift.
- B. the 'A' allele has been favoured by natural selection over the past 600 generations.
- C. the frequency of the 'a' allele after 300 generations is 0.4.
- D. the 'a' allele was favoured by natural selection after 100 generations had passed.

Question 25.

Which of the following would increase the genetic variation in a population?

- A. emigration of individuals from the population.
- B. a population bottleneck.
- C. mutation.
- D. genetic drift.

Short Answer Section

Question 1.

Baker's yeast (*Saccharomyces cerevisiae*) is a unicellular fungus. Its cells can exist as either haploid or diploid colonies. Haploid colonies produce gametes that fuse to form diploid cells. Diploid colonies are capable of producing haploid spores that develop into colonies.

- a. When would meiosis occur in Baker's yeast?

_____ (1 mark)

Baker's yeast has one gene that controls the colour of the growing colonies. Colonies can be either red or cream coloured. A second gene determines whether growth can occur on plain agar plates. Some colonies require the addition of the amino acid, tryptophan, while others are able to grow without it. The alleles for these two genes can be represented as:

Gene 1 A - cream colonies Gene 2 B - able to grow on plain agar
 a - red colonies b - needs tryptophan added to the agar

- b. For the genotypes listed, indicate whether growth of the colony occurs on each type of agar. Answer this question by writing either **Growth** or **No Growth** in the blank spaces. If growth occurs, also indicate the colour of the colony.

Genotype of Colony	Plain Agar	Agar with Tryptophan
Ab		
AaBb		
aabb		

(3 marks)

- c. Write down a genotype that matches the following descriptions.

i. a red coloured haploid colony that can grow on both types of agar. _____ (1 mark)

ii. a cream coloured diploid colony that can only grow on agar with tryptophan.

_____ (1 mark)

- d. Why do all organisms need amino acids, such as tryptophan?

_____ (1 mark)

Total = 7 marks

Question 2.

Alkaptonuria is a rare autosomal recessive disorder. Affected individuals have urine that turns black when exposed to the air. A pedigree for this disorder is shown in **Figure 8**. Shaded individuals are affected.

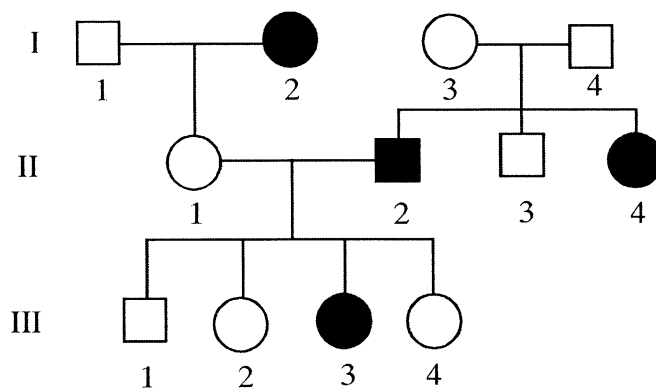


Figure 8

- a. What evidence is there from the pedigree that alkaptonuria is an autosomal recessive trait?

(2 marks)

Alleles for this disorder can be assigned as follows:

N- normal n- alkaptonuria

Use these alleles to answer parts b. and c.

- b. What is the genotype of the following individuals?

i. Individual I - 2 _____ (1 mark)

ii. Individual II - 1 _____ (1 mark)

- (c). Name an individual from the pedigree whose genotype is uncertain.

_____ (1 mark)

Alkaptonuria is on chromosome 9 and is known to be linked to the gene controlling the ABO blood types. The gene controlling the ABO blood types has three alleles. The alleles I^A and I^B are co-dominant over the recessive i allele.

Figure 9 shows the blood groups of the same family from **Figure 8**. Shaded individuals have alkaptonuria. Blood type is indicated in brackets.

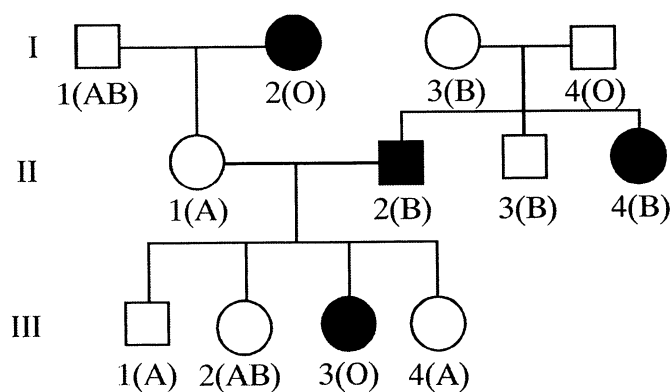
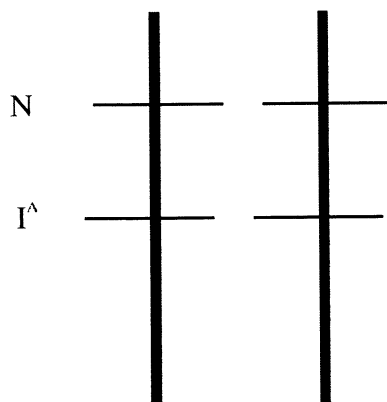


Figure 9

Parts of the two copies of chromosome number 9 from individual II - 1 are shown below. One chromosome is labelled with the alleles for alkaptonuria and blood type.



- d. i. Is the **labelled** chromosome of Individual II - 1 derived from her mother or father?

(1 mark)

- ii. On the **unlabelled** chromosome shown above, write down the alleles that Individual II - 1 received from her other parent.

(1 mark)

- e. What must be the genotype of Individual II - 2 for both these genes?

(1 mark)

- f. Individuals II - 1 and II - 2 are expecting a fifth child. A doctor takes a sample of blood from the developing foetus and finds out that it has blood type B. What can be concluded from this about the chances of the child having alkaptonuria? Explain your answer.

(3 marks)

Total = 11 marks

Question 3.

Marine Plain in Antarctica contains sediments that are between 4 and 5 million years old. Recently, the fossilised remains of a new species of dolphin, named *Australodelphis mirus*, have been found. The specimen was incomplete and consisted of a large number of bone fragments scattered on eroding sediments near a small body of water.

- a. i What is a fossil?

(1 mark)

- ii. Why are most fossils found in sediments?

(1 mark)

- iii. Some of the bones from the dolphin were missing. Give two possible causes for this.

Cause 1 _____

Cause 2 _____

(2 marks)

The skull of *Australodelphis mirus* is very long and has a narrow upper jaw with no teeth. It is very similar to skulls of modern day beaked whales. However, other skeletal features show that they are not closely related.

- b. What evolutionary process can give rise to similar features in animals that are not closely related?

(1 mark)

Total = 5 marks

Question 4.

Albinism is caused by the inability of certain cells called melanocytes to produce the pigment, melanin. **Figure 10** is a flow chart showing how two parents, who are both carriers for albinism, can produce an albino child. Each step is represented by a number.

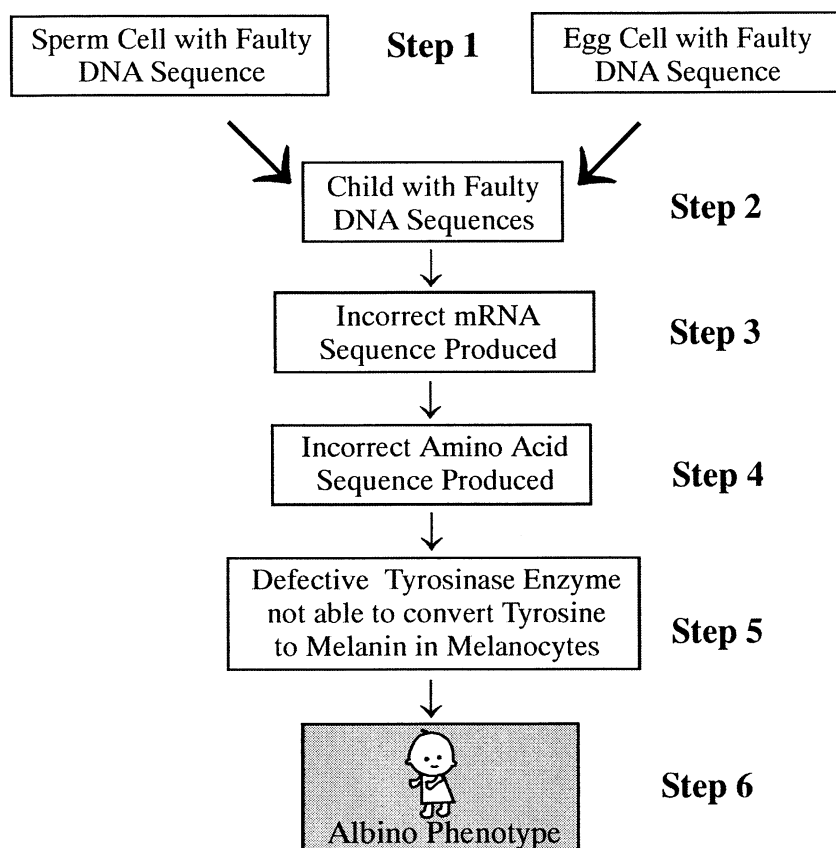


Figure 10

- a. In **Figure 10**, which **STEP** represents
 - i. transcription? _____ (1 mark)
 - ii. translation? _____ (1 mark)
- b. What substance does the normal version of the gene code for?
 _____ (1 mark)
- c. By referring to the product of this gene, explain why a heterozygote displays the normal, rather than the albino, phenotype.

(5 lines, 2 marks)

Total = 5 marks

Question 5.

Modern day sloths are arboreal (tree-dwelling) mammals native to Central and South America. Today there are five species belonging to two genera: the three-toed sloths (*Bradypus*) and the two-toed sloths (*Choloepus*). At one time, there were a large number of sloths (about 40 genera) that included large ground dwelling species, some as big as elephants. However, by about 10,000 years ago, almost all species of sloth had become extinct.

- a. What term describes the rapid evolution of a large number of closely related species?

_____ (1 mark)

An attempt was made to extract DNA from the fossilised remains of an extinct ground sloth. The DNA was found to contain only 1100 base pairs from the ground sloth that could be amplified.

- b. i. Give an example of a base pair.

_____ (1 mark)

- ii. Name the process used to amplify DNA.

_____ (1 mark)

The DNA of the ground sloth was compared to modern day two-toed and three-toed sloths. The number of base differences between the three species is shown in **Figure 11**.

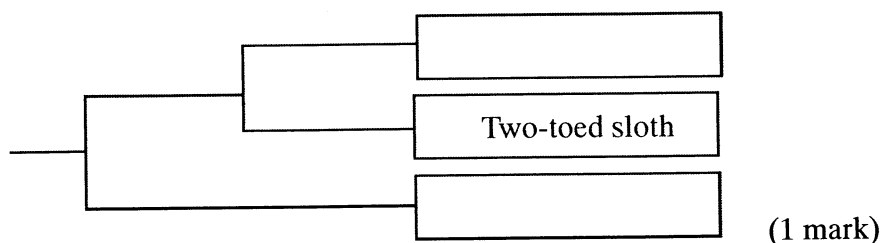
	Ground Sloth	Two-toed Sloth	Three-toed Sloth
Ground Sloth	0	68	92
Two-toed Sloth	68	0	84
Three-toed Sloth	92	84	0

Figure 11

- c. According to **Figure 11**, which species (the two-toed or three-toed sloth) is more closely related to the extinct ground sloth? Justify your answer.

_____ (2 marks)

- d. From the data in **Figure 11**, complete the phylogenetic tree below by writing the names of the two other sloth species in the boxes.



Much of the DNA extracted from the fossil ground sloth was contaminated with “foreign” DNA. Biologists suspected that this was due to the fossil material having been in the ground for several thousand years.

- e. Which organisms are the probable source of the “foreign” DNA?

_____ (1 mark)

- f. The fossil DNA from the ground sloth came from a cave in the sub-Antarctic conditions at the tip of South America. Suggest how these conditions may favour the preservation of DNA.

 _____ (1 mark)

- g. Some biologists believe that the arrival of humans was responsible for the mass extinction of sloths in the late Pleistocene. If this was the case, suggest why some tree-dwelling species, but no ground dwelling species, survived into the present day.

 _____ (1 mark)

Total = 9 marks

Question 6.

- a. Speciation often comes about by geographical isolation. Describe the steps that occur after such isolation that can result in one species evolving into two.

 _____ (3 marks)

In scrubland in California, a species of stick insect comes in two varieties. One variety has stripes while a second variety lacks stripes. They both can feed on the same shrubs but each variety tends to favour a particular food plant. The stick insects are also preyed upon by birds and lizards. **Figure 12** gives some information about two different food plants that the stick insects feed on.

Variety of Stick Insect	Percentage found on Food Plant 1	Percentage found on Food Plant 2	Relative Degree of Camouflage on Food Plant 1	Relative Degree of Camouflage on Food Plant 2
Striped Variety	80	20	High	Low
Non-striped Variety	20	80	Low	High

Figure 12

Refer to Figure 12.

- b. i. Describe the selection pressure that is operating on the two varieties of stick insect.

(1 mark)

- ii. Explain why the striped variety of stick insect favours Food Plant 1.

(1 mark)

Biologists have also found that in random mating trials, striped individuals preferred to mate with other striped individuals and non-striped individuals also preferred to mate among themselves.

- c. Suggest a behaviour which might be evolving that would prevent a striped stick insect from mating with a non-striped stick insect.

(1 mark)

Total = 6 marks

Question 7.

Foraminifera are single-celled organisms that secrete shells of lime. They are plentiful in the world's oceans, existing as free-floating (planktonic) species or as species that live in sediments. One free-floating species, *Neogloboquadrina pachyderma*, is a useful indicator of past climate changes. During warm periods, the shells of *N. pachyderma* tend to coil to the right. In cooler periods, shells tend to coil to the left. See Figure 13.

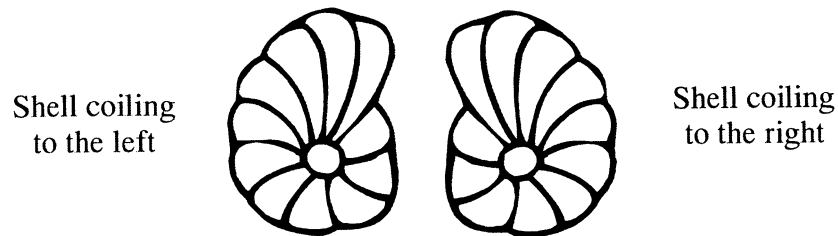


Figure 13

- a. Give one reason why *N. pachyderma* is readily found as a fossil.

(1 mark)

A biologist analysed the coil patterns of *N. pachyderma* over the last 160,000 years. Her results are shown in Figure 14.

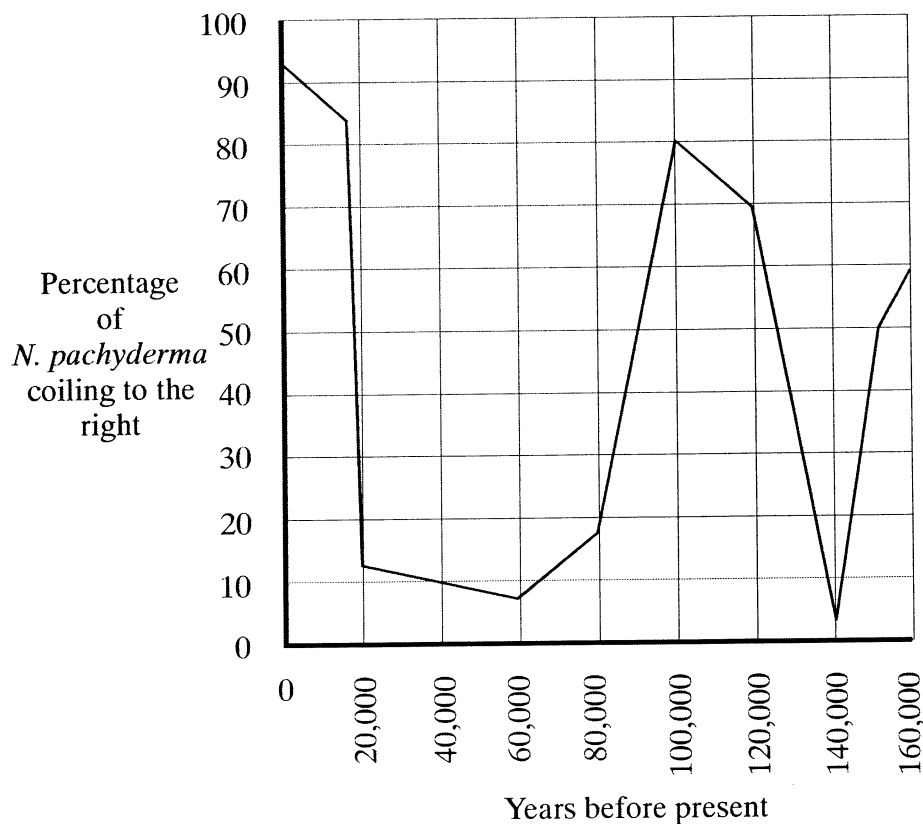


Figure 14

Refer to Figure 14 to answer part b.

- b. i. What has happened to global temperatures over the last 20,000 years? Justify your answer.

(1 mark)

- ii. During the past 160,000 years, when have global temperatures been the coolest?

(1 mark)

In many areas, planktonic and sediment dwelling foraminifera are found. **Figure 15** shows the relationship between the percentage of planktonic foraminifera and ocean depth.

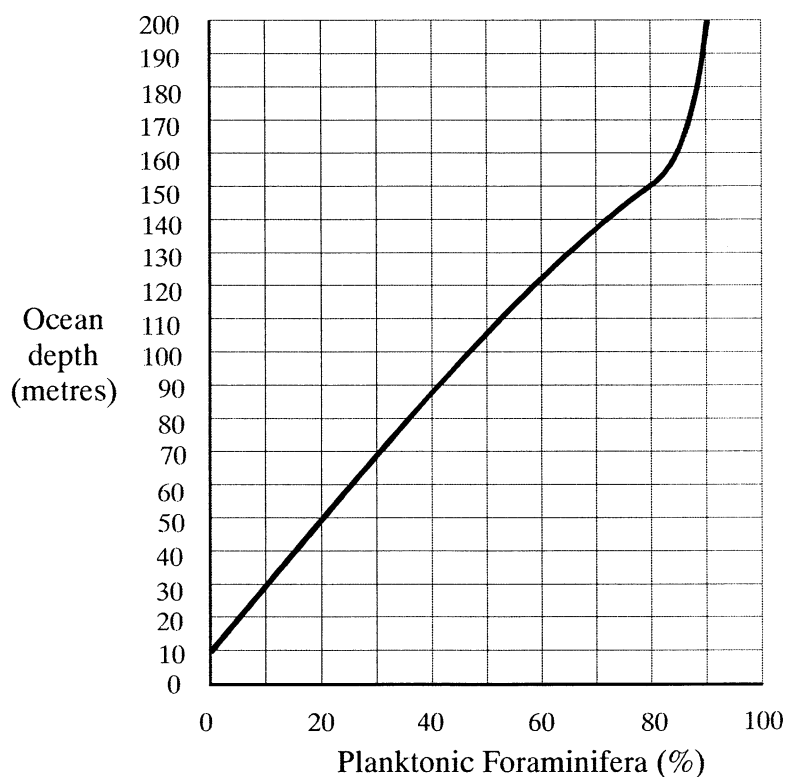


Figure 15

Refer to Figure 15 to answer parts c. and d.

- c. What is the minimum depth in which planktonic foraminifera are found?

(1 mark)

- d. i. Consider a region of the ocean that is 50 metres deep at present. What is the expected proportion of planktonic formaminifera in this region?

(1 mark)

- ii. If sea levels rise by 100 metres in this same region, what changes would you expect to occur to the percentage of planktonic foraminifera?

-
-
- (1 mark)
- e. Apart from the environment, name another factor that might influence whether the shells of foraminifera coil to the left or right.
-

(1 mark)
Total = 7 marks

End of Task

SUGGESTED ANSWERS

Multiple Choice Section

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

Short Answer Section

Question 1

- a. Meiosis would occur when diploid yeast cells produce haploid spores (1).
b.

Genotype of Colony	Plain Agar	Agar with Tryptophan
Ab	No Growth	Growth (cream)
AaBb	Growth (cream)	Growth (cream)
aabb	No Growth	Growth (red)

(3 x 1)

- c. i. aB (1).
ii. AAAbb or Aabb (1).
d. All organisms require amino acids to build proteins (1).

Question 2

- a. Alkaptonuria is recessive since individuals I 3 and I 4, both of whom are not affected, have children that are affected (1). Alkaptonuria must also be autosomal and not X-linked since individual II 4, who is an affected female, has a father not affected (1).
b. i. nn (1).
ii. Nn (1).
c. Individual I-1 or II-3 (1).
d. i. Father (1).
ii. The second chromosome should be labelled with a 'n' at the top and a 'i' at the bottom (1).
e. $\frac{nI^B}{ni}$ (1).
f. The child will most likely have alkaptonuria (1). Inheriting blood type B implies that the foetus has inherited the gamete, nI^B , from the father and has most likely inherited the gamete, ni , from the mother (1). However, if crossing over has occurred between these two genes in the mother, then the child will not have alkaptonuria (1).

Question 3

- a. i. A fossil is an object that displays evidence of the previous existence of life (1).
ii. Fossils are usually found in sediments as these help preserve the remains of the organism (1).
iii. Any TWO of the following causes (2).
 - Some bones may have been eaten by a predator.
 - Some bones may have been exposed to the air and have since eroded.
 - Some bones may still be preserved nearby.
 - Some bones may have been scattered by the wind/water.
 - Any other reasonable suggestion.
b. Convergent Evolution (1).

Question 4

- a.
 - i. Step 3 (1).
 - ii. Step 4 (1).
- b. Tyrosinase (1).
- c. Carriers have one normal allele that is able to produce the enzyme, tyrosinase (1). As a consequence, their melanocytes are able to produce melanin, resulting in the normal phenotype (1).

Question 5

- a. Adaptive Radiation (1).
- b.
 - i. Cytosine/Guanine OR Adenine/Thymine (1).
 - ii. Polymerase Chain Reaction (1).
- c. The two-toed sloth (1) since it has fewer base differences when compared to the three-toed sloth (1).
- d. The species in the upper box should be the ground sloth and the species in the lower box should be the three-toed sloth (1).
- e. Bacteria OR Fungi (1).
- f. Very cold conditions would reduce the rate at which the bonds in the DNA are broken (1).
- g. Tree-dwelling species were able to escape from human predators more readily (1).

Question 6

- a. After a species is geographically isolated, the two new populations experience different environments (1). Over time, natural selection causes the evolution of differences between the two populations (1). When they come in contact again, these differences prevent them from interbreeding (1).
- b.
 - i. There is selection pressure for the stick insects to feed on food plants that give them better camouflage. (1).
 - ii. The striped variety is better camouflaged from predators when feeding on food plant 1 (1).
- c. Any one of the following behaviours (1).
 - The two varieties of stick insect may breed at different times of the year.
 - The two varieties of insect may have different courtship displays.
 - The two varieties of stick insect may make different calls.
 - Any other reasonable suggestion.

Question 7

- a. Any one of the following (1).
 - The lime shell is readily preserved.
 - They are abundant in the oceans.
- b.
 - i. Global temperatures have risen since there has been an increase in the proportion of *N. pachyderma* that have shells that coil to the right (1).
 - ii. 140,000 years ago (1).
- c. 10 metres (1).
- d.
 - i. 20% (1).
 - ii. The proportion of planktonic foraminifera would rise from 20% to 80% (1).
- e. Genotype (1).