Trial Examination 2002

VCE Biology Unit 4

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of Booklet

Section	Number of questions	Number of questions to be answered	Number of marks
A	25	25	25
B	5	5	50
			Total 75

Materials

Question and answer booklet of 19 pages.

Answer sheet for multiple-choice questions.

At least one pencil and an eraser.

Instructions

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

All written responses should be in English.

At the end of the examination

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

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2002 VCE Biology Unit 4 Written Examination.

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer all questions.

All questions should be answered on the answer sheet for multiple-choice questions, in pencil.

You should spend approximately 30 minutes on this section.

A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No mark will be given if more than one answer is completed for any question.

Question 1

DNA can be cut by enzymes called

A. endonucleases.
B. DNA ligases.
C. DNA polymerases.
D. primers.

Question 2

The function of PCR is to

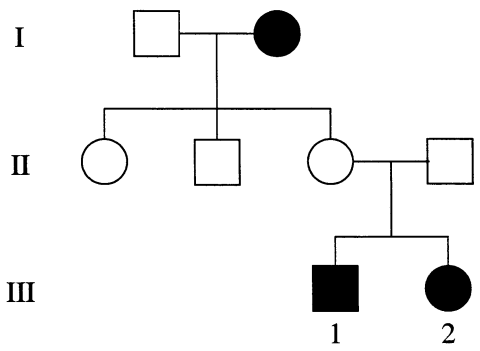
A. separate fragments of DNA.
B. isolate fragments of DNA.
C. replicate fragments of DNA.
D. join fragments of DNA.

Question 3

Bacterial DNA is found

A. in chromosomes within the nucleus.
B. only in plasmids.
C. in linear chromosomes and plasmids.
D. in circular chromosomes and plasmids.

Questions 4–5 refer to the following pedigree.



Question 4

The above pedigree is consistent with which of the following patterns of inheritance for individuals showing the trait (shaded)?

A. autosomal dominant
B. autosomal recessive
C. sex-linked dominant
D. sex-linked recessive

Question 5

The chance of a child born to III 1 and III 2 being heterozygous for this trait is

A. 0
B. $\frac{1}{4}$
C. $\frac{1}{2}$
D. 1

Question 6

Protein synthesis is determined by instructions from DNA. The correct process involved in protein synthesis and where it occurs is

	Process	**Site**
A.	DNA synthesis	Nucleus
B.	Translation	Nucleus
C.	Transcription	Nucleus
D.	Transcription	Ribosomes

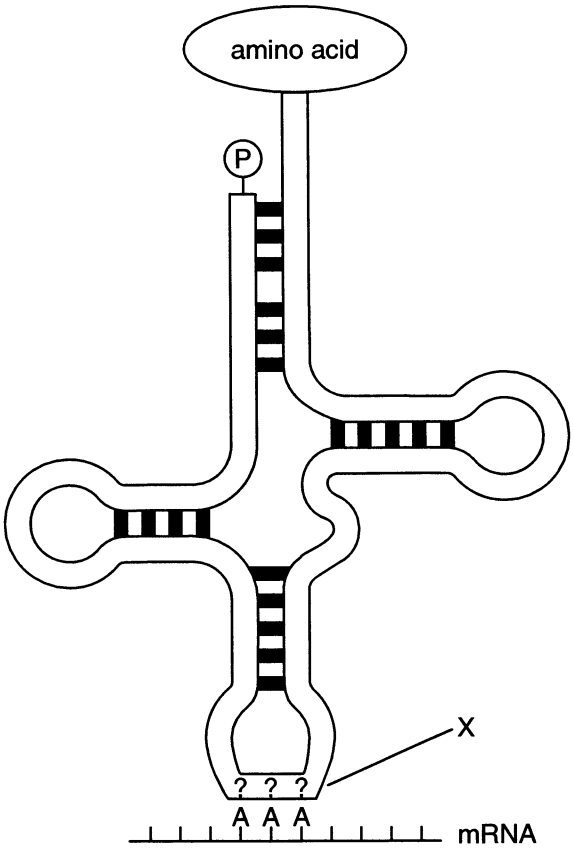
Question 7

When mRNA is compared to the DNA strand from which it was copied, the mRNA

A. is shorter as exons are removed.
B. has the same phosphate and sugar, but different nitrogenous base in some of its nucleotides.
C. is complementary.
D. is double stranded.

Question 8

tRNA molecule



Using the above diagram and your knowledge, the bases at X on the tRNA molecule

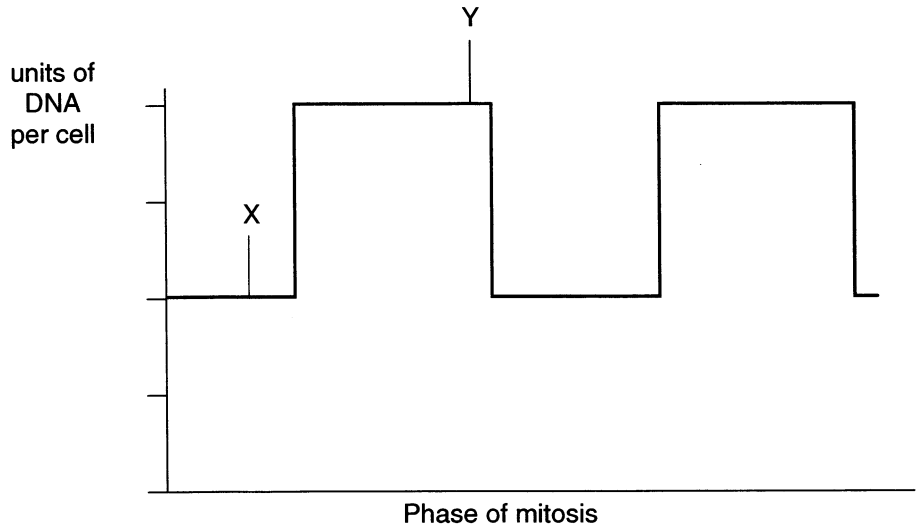
A. are an anticodon TTT.

B. are an anticodon UUU.

C. pair with the anticodon of mRNA AAA.

D. represent an amino acid.

Questions 9 – 10 refer to the following



Question 9

At point X

A. chromosomes would be visible.

B. DNA replication would have started.

C. the cell would be functioning.

D. the nuclear membrane would have disappeared.

Question 10

At point Y

A. chromosomes would be visible.

B. homologous chromosomes would have paired.

C. separate individual chromatids would be visible.

D. there would be twice as many chromosomes visible than at stage X.

Question 11

In mitosis

A. crossing over occurs in anaphase.

B. two haploid daughter cells result.

C. the chromosomes separate as a result of cytokinesis.

D. the nuclei of the daughter cells are genetically identical to the nucleus of the parent cell.

Questions 12 – 15 refer to the following information

There is a breed of dog called Mexican hairless. Dogs of this breed may be hairless or hairy. When the hairy dogs are mated, they tend to produce larger litters and never produce hairless offspring. When the hairless dogs are mated, their litters are smaller.

A pair of hairless dogs, Consuela and Gonzales, were mated and produced the following litters:

Year	Hairless	Hairy
1998	4	0
1999	4	3
2000	6	2
2001	2	3

Other breeders of Mexican hairless dogs always obtained similar overall ratios.

Question 12

It is reasonable to conclude that

A. Consuela is homozygous for the hairless condition.

B. the hairless gene is sex-linked.

C. the puppies which are hairy are homozygous.

D. the hairless puppies are of two different genotypes.

Question 13

What is the chance that a hairy dog in the 2000 litter is heterozygous?

A. 0

B. $\frac{1}{4}$

C. $\frac{1}{3}$

D. $\frac{2}{3}$

Question 14

What is the chance that a hairless puppy is born in 2002 to Consuela and Gonzales?

A. $\frac{3}{4}$

B. $\frac{1}{4}$

C. $\frac{1}{3}$

D. $\frac{2}{3}$

Question 15

From the information above, it is reasonable to conclude that

A. hairless dogs with identical alleles die prior to birth.

B. hairy phenotype is dominant.

C. hairy dogs are of two possible genotypes.

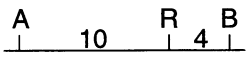
D. hairless dogs are of two possible phenotypes.

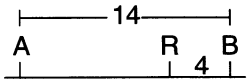
Question 16

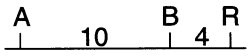
The genes for blood cell shape, amylase production and rhesus blood group are located on chromosome 1. In the general population the majority of people have normal shaped blood cells (b), rhesus positive blood group (R) and produce amylase (A). The remainder of the population usually have elliptical blood cells (B), rhesus negative (r) and don't produce amylase (a). However, it has been found that

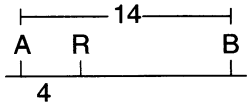
- 10% of the population have normal blood cells (b) and have rhesus negative blood group (r)
- 4% have rhesus negative blood group (r) and produce amylase (A)
- 14% have normal blood cells (b) and no amylase production (a)

From this information it is reasonable to conclude that the position of the genes on chromosome 1 are

A. 

B. 

C. 

D. 

Question 17

Human ABO blood type is an example of

A. polygenic inheritance.
B. multiple alleles.
C. incomplete dominance.
D. sex-linked inheritance.

Questions 18–20 refer to the following information.

Echidnas of Australia, aardvarks of Africa and armadillos of South America all have a similar diet of ants and use similar features such as long snouts and sticky tongues to catch and eat the ants.

Question 18

This feeding behaviour is an example of

A. adaptive radiation.
B. parallel evolution.
C. convergent evolution.
D. divergent evolution.

Question 19

When the bodies of each group are compared, the body covering, size and lifestyles are all different. The echidnas' hair is modified to spines and they reproduce via eggs.

It is reasonable to conclude that

A. spines developed in individuals as a defence mechanism against predators.
B. natural selection is important in the development of body covering but not size.
C. echidnas, if taken to South America, would in time develop similar features to the armadillos.
D. selective pressures favoured the development of spines by natural selection.

Question 20

In a small isolated population, the frequency of a particular allele was 10%. After many generations the frequency was again determined and found to be 0% in the population. There had been no change in the environment in this time.

The biological term to explain the change is

A. genetic drift.
B. gene flow.
C. Hardy-Weinberg equilibrium.
D. evolution.

Questions 21–23 refer to the following information.

On a farm near the Murray River in northern Victoria, salting has occurred due to excessive irrigation. The water table is raised and salts in the soil reach the surface, killing many plants.

A paddock of pasture has been planted and when the salting occurred most of the grasses were killed. The land was left and over many years, stands of grass were noticed, scattered throughout the salt plain. Seeds were collected and when grown in controlled conditions it was found that 60% of the offspring were salt tolerant. Five years later the patches of grass in the same area were again tested, and now 80% of the offspring were salt tolerant.

Question 21

From this information and your knowledge, it is reasonable to conclude that

A. the salt caused a mutation which suited the grass to grow in salty conditions.
B. the original grass population lacked variation for salty conditions.
C. salt increases a plant's reproductive rate.
D. salt resistance is genetically determined.

Question 22

The change in the population is due to the process of

A. natural selection.
B. evolution.
C. gene flow.
D. genetic drift.

Question 23

The change in the population over the years is called

A. natural selection.
B. evolution.
C. gene flow.
D. genetic drift.

Question 24

One characteristic that hominids share with most other primates is

A. nails instead of claws.
B. bipedal stance and gait.
C. arms shorter than legs.
D. opposable digits on hands and feet.

Question 25

Modern man has much less hair than its prehistoric ancestors. A suitable reason for this would be that

A. the wearing of clothes reduced the need for hair.
B. the loss of hair enabled more effective cooling during hunting.
C. more heat could be absorbed so that areas with a cold climate could be colonised.
D. permanent settlement provided a more stable environment.

SECTION B – SHORT-ANSWER QUESTIONS

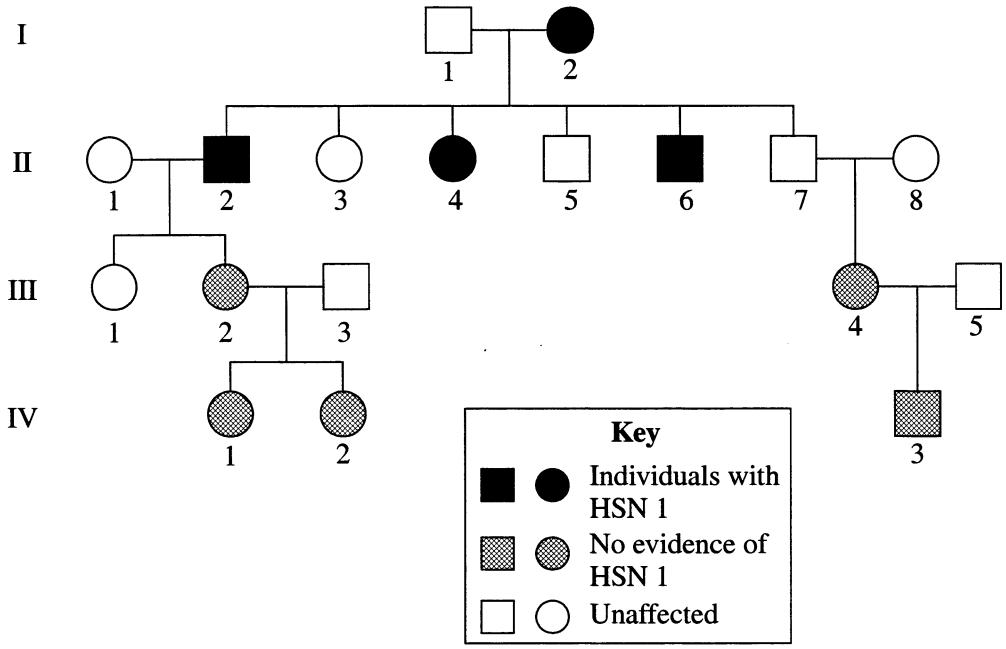
Instructions for Section B

Answer all questions. You should spend approximately 60 minutes on this section.

Question 1

Hereditary Sensory Neuropathy Type 1 (HSN 1) is a degenerative disease of the nervous system. It is inherited as an autosomal dominant condition and the age of onset is usually at about 25 years of age.

Pedigree of a family in which HSN 1 is present



a. What evidence in the above pedigree suggests that the mode of inheritance of HSN 1 is autosomal dominant?

3 marks

b. Assign genotypes to the following individuals:

i. I 2

_____

1 mark

ii. II 2

_____

1 mark

iii. II 7

_____

1 mark

c. **i.** What is meant by the term *heterozygous*?

_____

_____

1 mark

ii. Is individual II 3 homozygous or heterozygous?

_____

_____

1 mark

iii. Explain your answer to **c. ii.**

_____

_____

_____

_____

2 marks

d. **i.** What is the chance that individual IV 3 will develop the disease?

_____

1 mark

ii. Explain your answer to **d. i.**

_____

_____

1 mark

e. **i.** What is the chance that individual III 2 will develop the disease?

_____

1 mark

ii. Explain your answer to **e. i.**

_____

_____

1 mark

Scientists have now identified the gene for HSN 1 on chromosome 9. It is responsible for a particular enzyme for lipid biosynthesis. They have also been able to identify 3 point mutations as being responsible for HSN 1.

f. **i.** What is a point mutation?

_____

_____

1 mark

ii. Describe how such a point mutation could result in a change in amino acid sequence of the enzyme.

_____

_____

_____

_____

2 marks

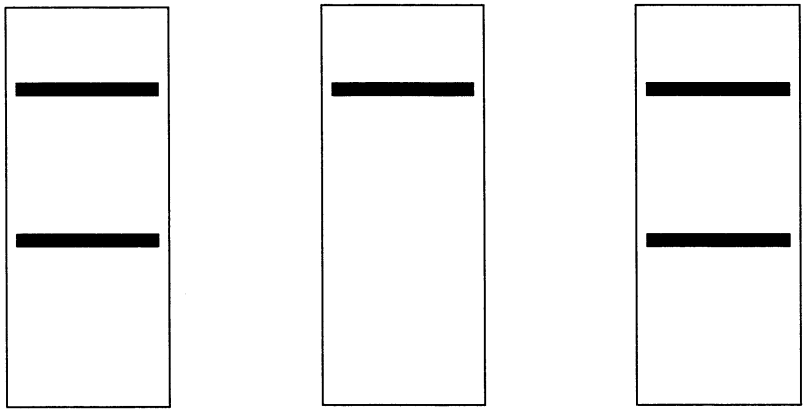
All afflicted individuals of this disease in Australia are direct descendents of a woman who migrated from England in the 19th Century. There are no known cases in New Zealand.

g. What biological term is used to account for the higher proportion of affected individuals in Australia compared with New Zealand?

_____

1 mark

Prenatal testing is now available to diagnose HSN 1. The DNA from individuals I 1, II 2 and IV 1 was digested into fragments and the fragments were separated by gel electrophoresis. The results from the gels corresponding to the HSN 1 gene are shown below.



h. Do the results of the DNA testing indicate if individual IV 1 will inherit the disease? Explain.

2 marks

i. What are the genotypes of the parents of individual IV 1? Explain.

2 marks

Total 22 marks

Question 2

Bananas have many different varieties and when analysed are found to have different chromosome numbers as shown below.

Variety	Chromosome no.
A	33
B	77
C	22
D	55

a. Varieties A, B and D do not produce seeds. Name and describe a method which could be used to make new individuals.

2 marks

b. Variety C was found to be the wild type. Name the process which produced variety A and explain how it occurs. You may use a diagram to assist your answer.

3 marks

Total 5 marks

Question 3

Two plants of the same species have the following characteristics controlled by two genes.

Plant A	Plant B
hairy oval leaves	hairless round leaves

The plants were crossed and all the F_1 offspring had hairy round leaves. Both plants were also self-pollinated and each was found to be pure breeding.

a. By what process are ova and pollen produced?

_____

_____

1 mark

b. Define the term pure breeding.

_____

_____

_____

_____

2 marks

c. From the information provided, assign alleles for each phenotype.

_____

_____

2 marks

The F_1 offspring were crossed and the following results were obtained from many crosses.

Appearance	Number produced
hairy oval	227
hairy round	490
hairless oval	20
hairless round	263

d. **i.** What is the genotype of the F_1 offspring?

_____

1 mark

ii. What relationship exists between the two genes? Explain.

2 marks

e. Explain why the number of hairless oval offspring is so low.

2 marks

Total 10 marks

Question 4

Hermit crabs can be classified as either left-handed or right-handed, depending on which claw is the bigger of the two. Most 'non-hermit' crabs have symmetrical tails that fit closely under their bodies, but the king crab has an asymmetrical spiral tail. The hard-tailed crab is another related 'non-hermit' crab. Scientists have suggested that the king crab and hermit crabs are closely related. Geneticists have used DNA sequencing to study features that a number of crabs have in common. DNA sequencing involves the use of RNA probes with a known base sequence.

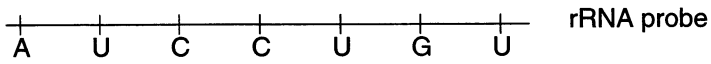
a. Give a definition of a genetic probe.

_____

_____

1 mark

A probe with a known base sequence was made and mixed with DNA of unknown sequence. The base sequence of the RNA probe is shown in the figure below.



The probe hybridises completely with the DNA sequence.

b. What is the base sequence of the unknown DNA strand where the probe binds?

_____

1 mark

c. What do the letters A, U, C, G and T represent?

_____

_____

1 mark

Using an RNA probe with a known base sequence, DNA fragments from different crabs were sequenced. The results for a short section of DNA, bases 202 – 234 are shown below.

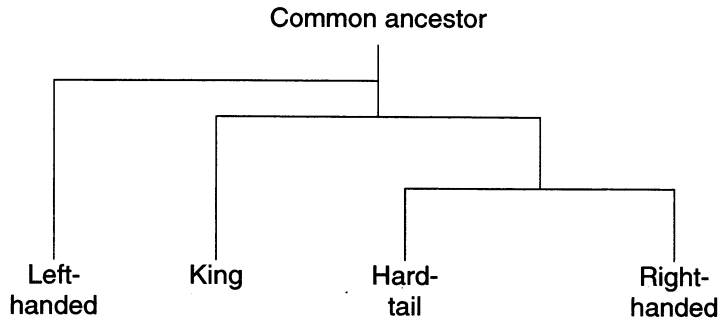
	DNA sequences of bases 202 to 234
King crab	A T T A C T T A G G T T A G A A T A A T T A G G
Hard-tailed crab	A T T A A T T A G G T G T A G T A A T T T T A T A
Right-handed crab	A T T A A T T A G T T A A T T A T T T G T A
Left-handed crab	A T T T A A T T G T T G G T T T A A A G A A T T A A G T
	202 210 230 234

It has been suggested that the more similar the sequences, the more closely related the crabs are.

Using the four DNA sequences, the table below shows the number of base differences between the different crabs.

	Hard–tailed	**Right-handed**	**Left-handed**	**King**
Hard-tailed	–	7	17	11
Right-handed	7	–	18	12
Left-handed	17	18	–	14
King	11	12	14	–

Based on the results shown above, the following ancestral relationship for these crabs is suggested.



d. Is it more likely that the common ancestor of the king crab and the left-handed hermit crab was left-handed or right-handed? Explain your answer.

3 marks

Fossil evidence shows that hermit crabs have lived in oceans for the last 50 million years.

e. Explain how this time could have been determined.

3 marks

Total 9 marks

Question 5

The study of mitochondrial DNA has been used to compare populations and individuals within populations. A detailed study of a population of northern right whales has shown that there are only 5 varieties of mitochondrial DNA in this population. Mitochondrial DNA is passed along the female line, from mother to offspring. By comparison, the variation in nuclear DNA is much greater.

a. Why is there greater variation in the nuclear DNA?

2 marks

b. Populations with limited variety in their mitochondrial DNA due to inbreeding, have a low reproduction rate and are more vulnerable to disease. Explain.

2 marks

Total 4 marks

END OF EXAMINATION

Neap.
advancing education

Trial Examination 2002

VCE Biology Unit 4

Suggested Solutions

 58 Pelham St Carlton VIC 3053 Tel: (03) 9663 2523 Fax: (03) 9663 7182

SECTION A

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

SECTION B

Question 1

a. It could be dominant, as every affected individual has an affected parent. (1)
It must be autosomal, as both males and females are affected (1) and there is an unaffected female (III 1) with an affected father (II 2). (1)

3 marks

b. **i** Nn — 1 mark

ii. Nn — 1 mark

iii. nn — 1 mark

c. **i** Two alleles for a particular trait are different. — 1 mark

ii. homozygous — 1 mark

iii. As HSN 1 is an autosomal dominant disease, any individual known to be unaffected (e.g. those older than 25 without the condition) must lack the dominant allele and have two of the same recessive allele. — 2 marks

d. **i** zero chance — 1 mark

ii. As both of the maternal grandparents (II 7 and II 8) are unaffected by HSN 1, the mother (III 4) must also be unaffected. Therefore, both parents III 4 and III 5 are homozygous recessive and cannot pass HSN 1 to their child. — 1 mark

e. **i** $\frac{1}{2}$ or 50% if they are younger than 25 years, but 0% if older than 25 years. — 1 mark

ii. The mother (II 1) is unaffected and the father (II 2) must be heterozygous for HSN 1. Assuming individual III 2 is less than 25 years of age, there is a 50% chance that she will have received the HSN 1 allele from her father and develop the disease when she is about 25. If the child is over 25 years of age, she has passed the age of onset, therefore the chance of developing HSN 1 is 0%. — 1 mark

f. **i** A change to one nucleotide only, or a change in a single base. — 1 mark

ii. The point mutation would change the base sequence in the DNA. (1)
This would alter the RNA transcribed, resulting in a different amino acid. (1)

2 marks

g. Founder effect — 1 mark

h. Yes, because the IV 1 DNA profile is the same as for II 2 (1)
and this individual did have HSN 1. (1)

2 marks

i. The father (III 3) is unaffected, hence is homozygous recessive (nn).
The mother (III 2) must be heterozygous (Nn) for the child to be affected. — 2 marks

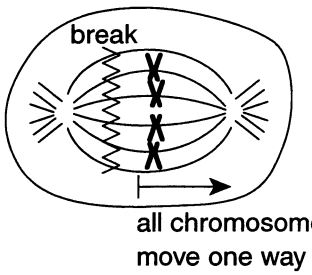
Total 22 marks

Question 2

a. Asexual reproduction, which involves cutting, growing this piece into a new individual graft and connecting a piece onto a different rootstock.

2 marks

b. Total non-disjunction.



The spindles attached to the chromosomes break on one side and the chromosomes end in one gamete. When this is fertilised, the zygote has 3 of each chromosome.

3 marks
Total 5 marks

Question 3

a. Meiosis or gametogenesis.

1 mark

b. Each gene is homozygous and has identical alleles at a particular locus.

2 marks

c. Hairy – H
Hairless – h
Round – R
Oval – r
or any other suitable letter.

2 marks

d. **i** $\frac{Hr}{hR}$

1 mark

ii. The two genes are linked. (1)
They are on the same chromosome 2 map units apart. (1)

2 marks

e. During metaphase I, homologous chromosomes touch and exchange genes (crossing over). Due to the close proximity of the genes, this event would be infrequent, hence the number of hairless oval offspring is low.

2 marks
Total 10 marks

Question 4

a. A short section of ribosomal RNA with a base sequence complementary to the test section of DNA to be identified/localised.

1 mark

b. The DNA sequence where the probe binds is T A G G A C A

1 mark

c. A – adenine
U – uracil
C – cytosine
G – guanine
T – thymine

1 mark

d. Right handed, because there are only 12 base differences between king crabs and right-handed crabs, whereas there are 14 differences between king crabs and left-handed crabs.

3 marks

e. Radioisotope dating (1), which involves testing rocks that contain fossils (1) and calculating the percentage of elements with a known half-life. (1)
Dating of the rocks above and below the layer containing the fossil could also be determined.

3 marks
Total 9 marks

Question 5

a. There is greater variation in nuclear DNA as a result of sexual reproduction, crossing over and recombination. (1) Mitochondrial DNA is inherited unaltered as it is passed on directly. (1)

2 marks

b. There is much less variation in genotypes (1) and there is a possibility of an increase in the homozygous recessive genotypes. (1)

2 marks
Total 4 marks

Neap.
advancing education

Trial Examination 2002

VCE Biology Unit 4

Section A answer sheet

Student's Name: _____

Teacher's Name: _____

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out.
Marks will **not** be deducted for incorrect answers.
No mark will be given if more than **one** answer is completed for any question.

All answers must be completed like **this** example: A **B** C D

Use pencil only

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

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

 58 Pelham St Carlton VIC 3053 Tel: (03) 9663 2523 Fax: (03) 9663 7182