Acknowledgements

SECTION 1

Pages 4 & 5 'Structural complexity of territories: preference, use of space and defence in commensal house mice, *Mus domesticus*', pp. 765–772, Samantha J. Gray et al, *Animal Behaviour*, vol 60, 2000.

Page 6 Fiddler Crab actogram in natural conditions from www.cbt.virginia.edu/tutorial/OTHERRHYTMSTIDAL.html

Page 7 Fiddler crab actogram in laboratory conditions from *The Biological Rhythms and Clocks of Intertidal Animals*, p. 34, John D. Palmer, Oxford University Press,1995.

Page 8 Adapted from 'Goal Orientation by Blindfolded Humans After Long-Distance Displacement: Possible Involvement of a Magnetic Sense', pp. 555–557, R. Robyn Baker, *Science*, vol. 210, 31 October 1980.

SECTION 2

Page 11 Operon adapted from http://students.nhmced.edu/academics/info/divisions/nsci/biol/operon.htm.

Page 15 Hominoid DNA classification adapted from *Year 13 Biology 2000: Student Resource and Activity Manual*, p. 243, Richard Allan and Tracey Greenwood, Biozone International, 1999.

Adapted from 'Molecular analysis of Neanderthal DNA from the northern Caucasus', p. 492, I. V. Ovchinnikov et al, *Nature*, Vol. 404, 30 March 2000.

Page 16 Hominid tool pictures from www.palomar.edu/anthropology/tutorial.html

SECTION 3

Page 17 Newspaper extract from *The Vancouver Sun*, 22 March 2000, www.global-reality.com/biotech/ARTICLES/news143.htm.

Page 18 DNA autorad from www.biology.arizona.edu/molecular_bio/problem_sets/Recombinant_DNA_Technology/07Q.htm.

SECTION 4

Page 19 Biological control quote from http://helios.bto.ed.ac.uk/bto/microbes/control.htm

Biodiversity quote from www.mfe.govt.nz/about/current/biodiversity.html

Genetic engineering quote from *New Zealand Herald*, 19 October 2000, www.nzherald.co.nz/storydisplay.cfm?thesection=news&thesubsection=&storyID=155938&reportID=53009.

No. 208

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

University Entrance, Bursaries and Scholarships Examination

BIOLOGY: 2001

QUESTION BOOKLET

Time allowed: Three hours
(Total marks: 200)

INSTRUCTIONS

Write your answers in the appropriate spaces in ANSWER BOOKLET No. 208/1 (purple cover).

This paper is divided into four sections. Answer **ALL** questions in Sections 1 to 3 and only **ONE** essay topic in Section 4.

Allocation of marks and suggested times you should allow for answering each section are as follows:

Section 1:	Animal Behaviour and Plant Responses (page 2)	50 marks: 45 minutes
Section 2:	Genetics and Evolution (page 9)	90 marks: 80 minutes
Section 3:	Techniques and Processes in Molecular Biotechnology (page 17)	20 marks: 20 minutes
Section 4:	Contemporary Biological Issues – Essay Topics (page 19)	40 marks: 35 minutes

Check that this Question Booklet has all of pages 2 – 19 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS QUESTION BOOKLET AT THE END OF THE EXAMINATION

(Turn over

SECTION 1: ANIMAL BEHAVIOUR AND PLANT RESPONSES

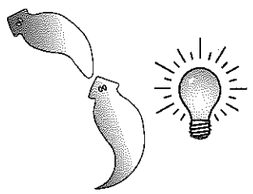
(50 marks: 45 minutes)

Instructions: Answer all parts of all questions in this section. The space allocated in the Answer Booklet is a guide to the length and, in some cases, the format of the answers that are required.

QUESTION ONE (12 marks)

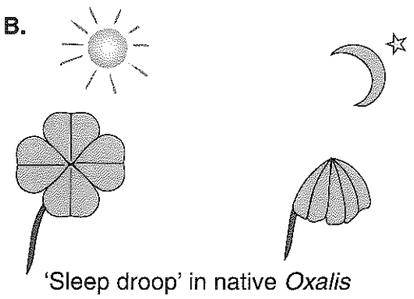
The following diagrams illustrate four different orientation responses of organisms.

A.



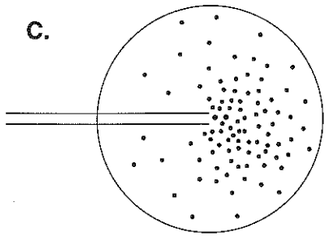
Response of Planaria to light

B.



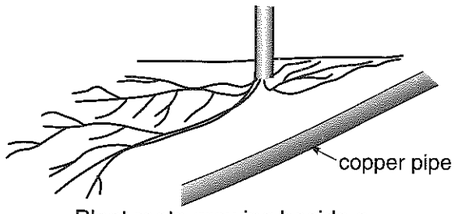
'Sleep droop' in native *Oxalis*

C.



The bacteria *E. coli* move towards the end of a tube containing glucose.

D.



Plant roots growing beside a copper pipe.

(a) **Name** in full, including direction where applicable, the orientation response shown in each diagram above. (8 marks)

(b) Suggest how each organism might benefit from the response shown. (4 marks)

QUESTION TWO (8 marks)

Many organisms show cooperative behaviour. For cooperative behaviour to have evolved, there must be an advantage that outweighs the disadvantage of having to share resources.

(a) For each underlined organism below, give ONE advantage it gains from cooperative behaviour.

(i) An ant in an ant colony.

(ii) A dolphin in a school of dolphins herding fish for food.

(iii) *Rhizobium* bacteria living in nodules on the roots of a legume. (4 marks)

In fish species such as cod, the female produces large numbers of eggs. In contrast, in many bird species such as sparrows, the female produces only a few eggs.

(b) Explain how the sparrow species is able to survive so successfully considering each female only produces a few eggs. (2 marks)

(c) Give ONE advantage and ONE disadvantage to the cod of its reproductive strategy. (2 marks)

QUESTION THREE (13 marks)

Mice are small mammals that are vulnerable to predation. They usually live in groups consisting of a dominant male with several females and their offspring. Dominant male mice have a territory that they defend.

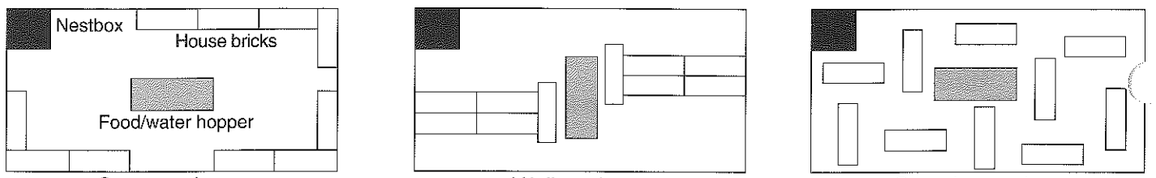
Male mice without a group to belong to will often intrude into another mouse's territory.

(a) Suggest ONE reason why this might happen. (1 mark)

(b) State ONE method that the resident male mouse may use to mark his territory. (1 mark)

A series of experiments were carried out to establish how the territorial defence by male mice was affected by the physical structure of the habitat.

Three types of experimental enclosure were used as shown below.



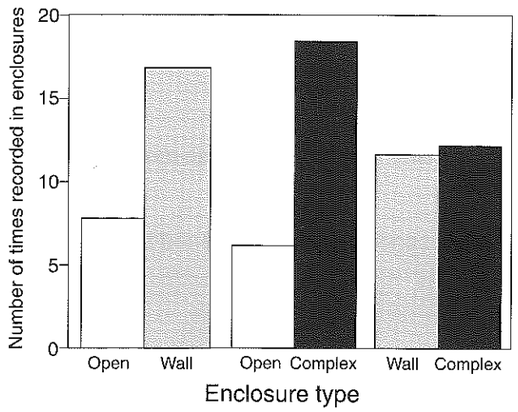
(c) Match each of the following locations found around a home with one of the enclosure types used in the experiment:

(i) empty garden shed

(ii) ceiling space

(iii) garage full of cars, machinery and equipment. (3 marks)

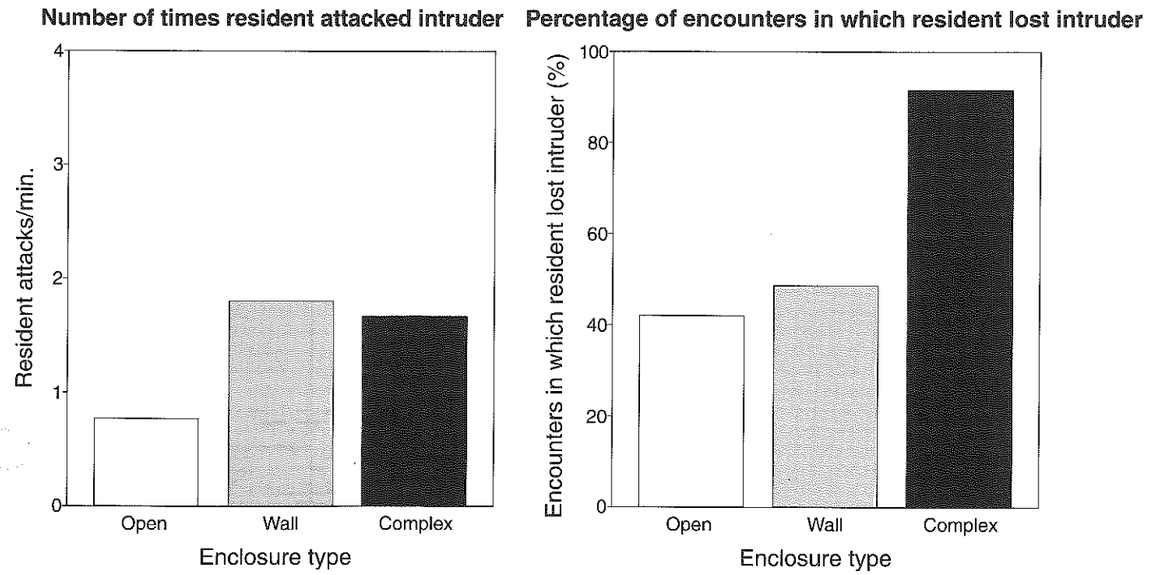
In the first experiment, the male mice were released individually and were given a choice between two types of enclosures. The results are shown in the graph below.



(d) Which type of enclosure did the males **least** prefer? (1 mark)

(e) Suggest a behavioural reason for this preference. (1 mark)

In the next experiment, a foreign male mouse was introduced into the enclosure after a male had been resident for 48 hours. The number of times the resident mouse attacked the intruder and the number of times the resident lost (could no longer see) the intruder were recorded.



(f) Describe the effect that enclosure type had on each of the following interactions and suggest a reason for each:

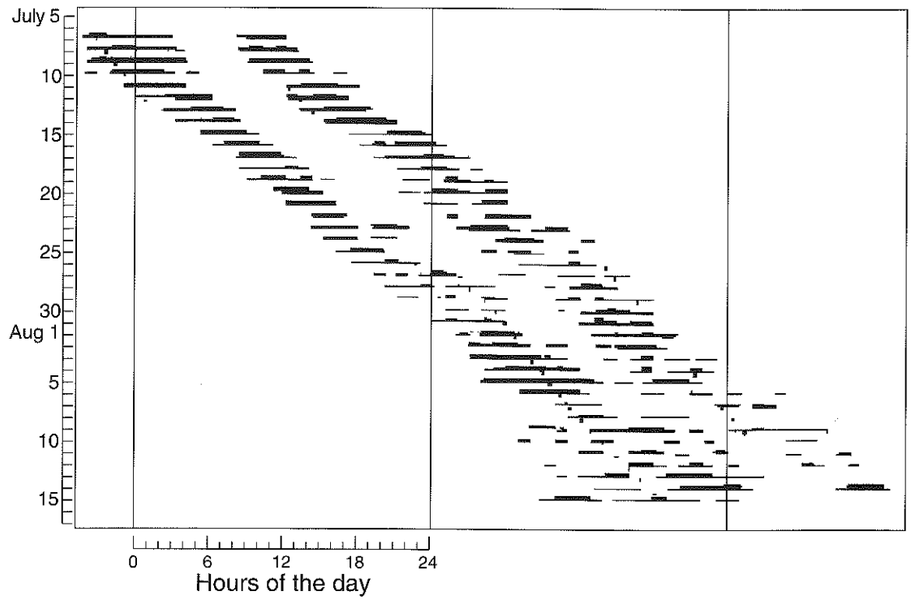
(i) number of times the resident attacked the intruder

(ii) how often the resident mouse lost the intruder. (4 marks)

(g) Mice can be a problem in homes. Describe how the knowledge gained from these experiments can be applied in homes to reduce mice populations. (2 marks)

QUESTION FOUR (8 marks)

Fiddler crabs live on estuary mudflats. The actogram below shows the activity pattern of a fiddler crab in **normal environmental conditions**.

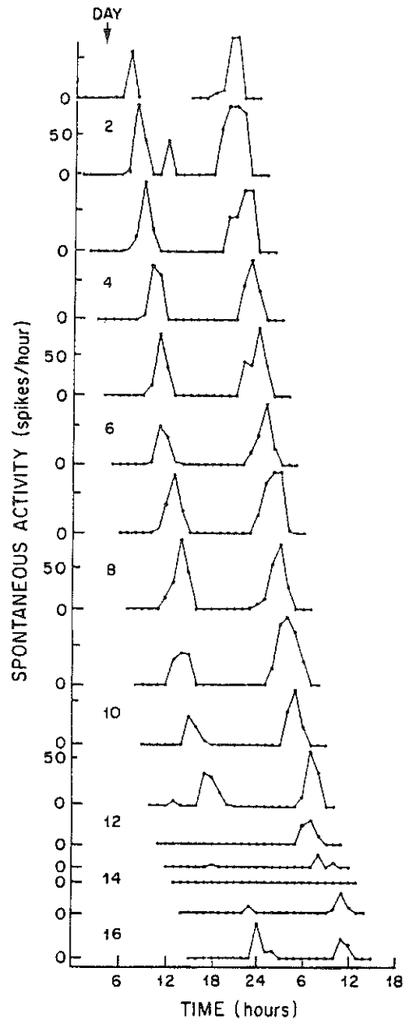


(a) How many periods of activity does the crab have in a 24-hour period? (1 mark)

(b) Name the environmental factor likely to be influencing this activity pattern. (1 mark)

(c) Explain why the crab's activity starts later each day. (1 mark)

Another fiddler crab was placed under constant environmental conditions in the laboratory. The activity pattern for the next 16 days is shown below.



(d) What do these results suggest about the control of the activity pattern in this crab? (1 mark)

(e) Calculate the **period** of the rhythm under constant environmental conditions in the laboratory. (1 mark)

(f) Name the type of **biological rhythm** exhibited by the fiddler crabs and give a reason for your answer. (2 marks)

The activity of many organisms is controlled by an internal biological clock.

(g) Describe ONE benefit an internal biological clock provides an individual compared with relying on external environmental cues. (1 mark)

(Turn over

QUESTION FIVE (9 marks)

Nomadic migration is a way of life for many African tribes.

(a) Define **migration**. (1 mark)

(b) Give ONE reason why nomadic tribes migrate. (1 mark)

The position of the sun in the sky is one of the navigation methods used by animals when migrating.

(c) What other information is needed when using the position of the sun to find direction? (1 mark)

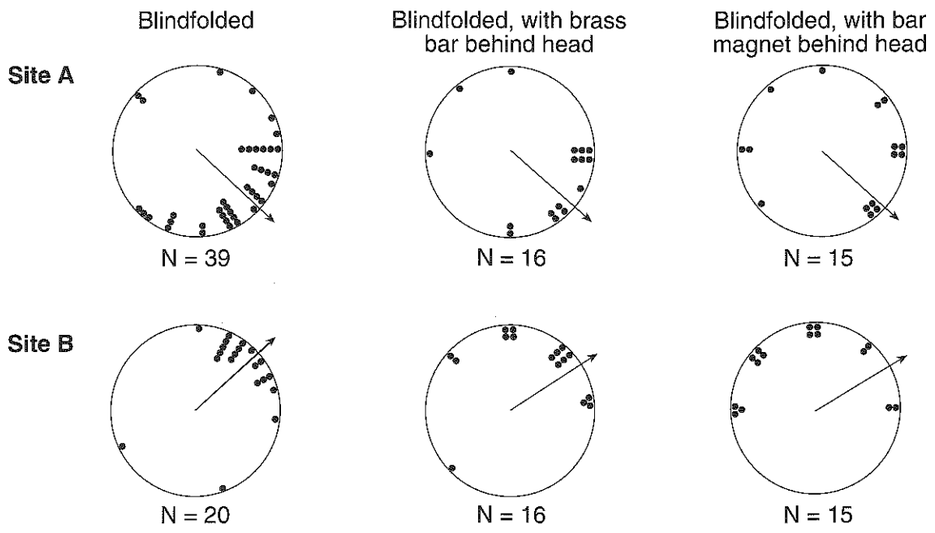
(d) If bad weather obscures the view of the sun or stars, suggest ONE other traditional navigation method that could be used by a nomadic tribe. (1 mark)

A study was done in Britain to test the hypothesis that humans are able to use the Earth's magnetic field as a navigational cue in the absence of other cues.

Individuals were blindfolded and driven by a complicated route to one of two sites 40–50 km from home. Whe they stopped, each person while still blindfolded was asked to indicate in which direction they thought home was. In a second experiment, the group was again blindfolded but, in addition, half the group had a bar magnet behind their heads and the other half had a brass bar. Neither group knew which type of bar they had.

(e) What was the purpose of the brass bar? (1 mark)

The following data are based on the results from this study. Each dot represents a single individual's **estimate** of the direction of home. The line represents the **actual** direction of home.



(f) Describe TWO patterns that can be seen in the graphs. (2 marks)

(g) Suggest a suitable conclusion for these results. (1 mark)

(h) Suggest a problem with the design of this experiment. (1 mark)

SECTION 2: GENETICS AND EVOLUTION

(90 marks: 80 minutes)

Instructions: Answer all parts of all questions in this section. The space allocated in the Answer Booklet is a guide to the length and, in some cases, the format of the answers that are required.

QUESTION ONE (10 marks)

(a) In protein synthesis, what is the **name** of the process that creates a strand of mRNA from DNA? (1 mark)

(b) Three types of RNA are involved in protein synthesis. Write down the **letter** of the row that correctly matches each type of RNA with the function at the top of the column. (1 mark)

	Transports amino acids	Serves as a template for translation	Provides a site for synthesis of polypeptides
A	mRNA	tRNA	rRNA
B	rRNA	mRNA	tRNA
C	tRNA	mRNA	rRNA
D	mRNA	rRNA	tRNA
E	tRNA	rRNA	mRNA

(c) The sequence of mRNA below codes for part of a polypeptide chain. Use the information in the mRNA table to write down the sequence of amino acids it codes for. (2 marks)

A C G U A U A A C U G A C A G U A A

mRNA table:

Second Position

First Position	U	C	A	G	Third Position
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		Stop	Stop	A
			Stop	Try	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Iso	Thr	Asn	Ser	U
					C
	* Met		Lys	Arg	A
					G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

* and start

(d) Write down the mRNA codon that is complementary to the anticodon **UGC**. (1 mark)

A scientist produced mRNA from a sample of DNA. The DNA and mRNA were then separated and purified. The base compositions of each DNA strand and the mRNA were analysed. The results are shown in the table below.

	Base % composition				
	A	**G**	**C**	**T**	**U**
DNA Strand 1	15.1	32.0	28.0	24.9	0
DNA Strand 2	25.2	27.8	31.7	15.3	0
mRNA	15.0	31.9	27.8	0	25.3

(e) Explain why there are zeros (0) in the table. (2 marks)

(f) Write down the number of the DNA strand that was the template for the mRNA, and give a reason for your choice. (2 marks)

The relationship between DNA and a protein can be shown by the following diagram.

DNA in nucleus ⟶ mRNA ⟶ protein in cytoplasm

(g) Suggest a reason why there is an intermediary (mRNA) between the DNA and the protein it encodes. (1 mark)

QUESTION TWO (10 marks)

For each of the following genetic crosses (a) and (b), identify:

(i) the dominant characteristic(s)

(ii) the type of inheritance pattern shown, and give a reason for your choice.

(a) **Parents**: red-eyed female fly crossed with white-eyed male fly
F1 generation: all pink eyes
F2 generation: 22 red eyes : 43 pink eyes : 20 white eyes (3 marks)

(b) **Parents**: homozygous rough, hard pea crossed with homozygous smooth, soft pea
F1 generation: all rough, hard peas

Cross 2: F1 pea crossed with homozygous smooth, soft peas
F2 generation: 115 rough, hard peas : 110 smooth, soft peas : 8 rough, soft peas : 12 smooth, hard peas (4 marks)

(c) Two genes control flower colour in peas.

Parents: homozygous purple-flowered pea plant crossed with homozygous white-flowered pea plant
F1 generation: all purple flowers
F2 generation: 81 purple-flowered : 62 white-flowered

What is the type of inheritance pattern shown? Give a reason for your choice. (2 marks)

(d) Give the **number** of possible genotypes for the white-flowered plants in the **F2** generation for the cross in (c) above. (1 mark)

QUESTION THREE (11 marks)

DNA is often referred to as the 'Blueprint for Life' because:

- it carries a large amount of genetic information
- it can be accurately replicated to produce copies that can be inherited
- the genetic information can be corrected if mistakes occur.

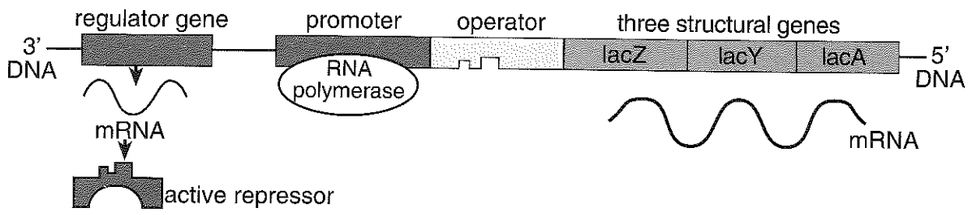
(a) Explain how DNA can carry large amounts of genetic information. (2 marks)

(b) Describe the mechanism that ensures accurate replication of DNA. (1 mark)

(c) Explain why it is necessary for DNA replication to produce accurate copies. (2 marks)

(d) Sometimes accurate copies of the DNA are not made because a **mutation** has occurred. Give ONE advantage and ONE disadvantage of mutations to the species. (2 marks)

The following diagram represents a typical operon in bacteria.

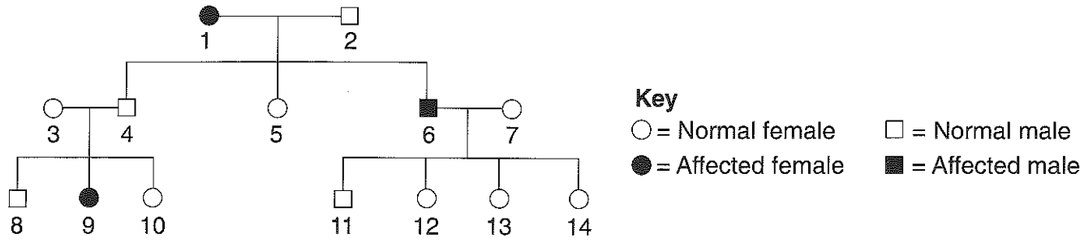


(e) Describe the role of the active repressor in this operon. (2 marks)

(f) Give ONE reason why it is an **advantage** for bacteria to be able to control the production of certain enzymes. (2 marks)

QUESTION FOUR (7 marks)

Study the pedigree below, which shows the inheritance of a form of blindness caused by retinal degeneration traced through three generations in one family.



(a) Is the allele for retinal blindness **dominant**? Give a reason for your choice. (2 marks)

(b) Is the allele for retinal blindness **sex linked recessive**? Give a reason for your choice. (2 marks)

(c) Describe how a **named** environmental factor can affect the phenotype of an organism. (2 marks)

(d) Environmental factors can regulate gene expression. Suggest a reason why this is important for the survival of the organism. (1 mark)

QUESTION FIVE (7 marks)

The three genes B, F and S are all found on the same chromosome in fruit flies.

Breeding experiments produced the following crossover frequencies.

Gene pairs	Crossover frequency (%)
F–B	35
B–S	10
S–F	25

(a) In the space provided in your Answer Booklet, construct a chromosome map to show the relative positions of the genes. Indicate the map distances involved. (2 marks)

In a plant, leaf colour, hairiness and shape are controlled by three linked genes. Red, hairy and pointed leaves are all dominant characteristics. A heterozygous plant has the following genotype.

$$\frac{R\ \ H\ \ T}{r\ \ h\ \ t}$$

(b) Give the likely alleles of the **gametes** produced by this plant as a result of the following:

(i) no crossing over (1 mark)

(ii) a single crossover between R and H. (2 marks)

(c) Crossing over can have evolutionary significance. Explain how. (2 marks)

QUESTION SIX (6 marks)

(a) Group the following examples into pre- and post-zygotic isolating mechanisms by writing the corresponding letter in the correct column in your Answer Booklet.

A	If two *Nasonia* wasps from different species interbreed, all offspring die.
B	Two pine species, *Pinus radiata* and *Pinus muricata*, release pollen at different times of the year.
C	In many species of *Drosophila,* sperm inseminated from a different species is killed in the vagina.
D	Pied and collared flycatcher birds live in overlapping areas in Europe. Each has evolved distinct plumage that aids in mate selection.

(4 marks)

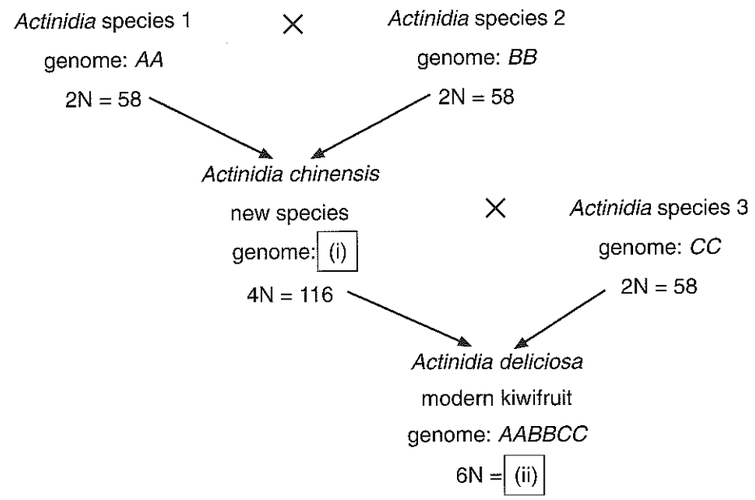
(b) Explain how the isolation of populations is important for the formation of new species. (2 marks)

QUESTION SEVEN (7 marks)

Modern kiwifruit (*Actinidia deliciosa* var *deliciosa*) is a hexaploid (6N) and has probably evolved as a result of polyploidy. Two other species of *Actinidia* are thought to have hybridised as part of the evolution of the modern kiwifruit.

(a) Define **polyploidy**. (1 mark)

A possible ancestry of the evolution of modern kiwifruit is shown below.



(b) In your Answer Booklet, complete the two boxes marked (i) and (ii) in the diagram above. (2 marks)

Polyploidy in plants often results in the instant formation of a new species.

(c) Name this type of speciation. (1 mark)

(d) Describe a possible sequence of events that could produce a new plant species from a single polyploid plant. (3 marks)

(Turn over

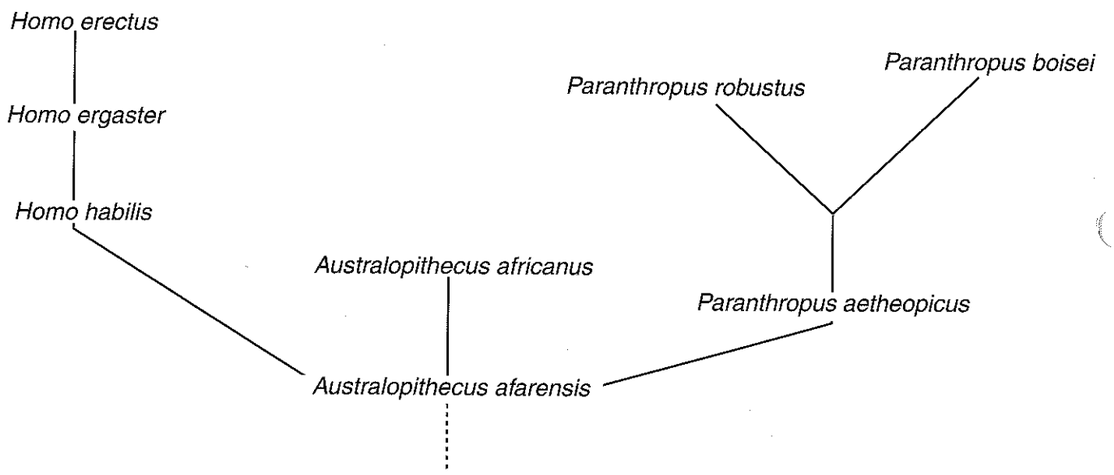
QUESTION EIGHT (11 marks)

In the table below, List A identifies six hominid species while List B contains six statements relating to those species.

List A	List B
1. *Australopithecus afarensis*	A. This species had a brain size of about 450 cc, with massive molars and a large jaw.
2. *Australopithecus africanus*	B. This species almost certainly used fire and was the first to migrate out of Africa.
3. *Paranthropus robustus*	C. The first fossilised footprints to show evidence of bipedalism were made by this species.
4. *Homo habilis*	D. This species was extremely intelligent and able to adapt to living in a wide range of climates.
5. *Homo erectus*	E. A lightly built scavenger living in open woodland and savannah of Southern Africa around 3–2.5 million years ago.
6. *Homo neanderthalensis*	F. Nicknamed 'Handy Man', this is the oldest species known to use stone tools.

(a) In the appropriate space in your Answer Booklet, write the letter of the statement from **List B** that matches the species in **List A**. (6 marks)

The following diagram illustrates the early part of the hominid family tree.



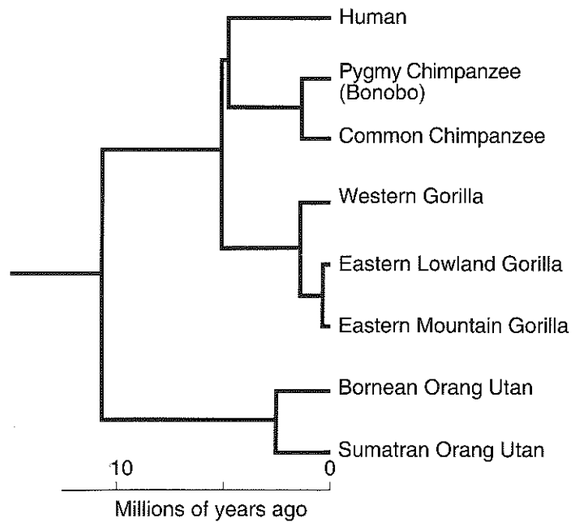
(b) Name the type of evolutionary pattern exhibited in the above diagram. (1 mark)

(c) List TWO physical characteristics that distinguish the *Paranthropus* species from the *Homo* species. (2 marks)

(d) The *Homo* species coexisted alongside the *Paranthropus* species for approximately 1.5 million years. Explain why the *Homo* species were more adaptable than the *Paranthropus* species. (2 marks)

QUESTION NINE (6 marks)

The diagram below shows a hominoid family tree based on DNA similarities. Use this diagram to answer question (a).



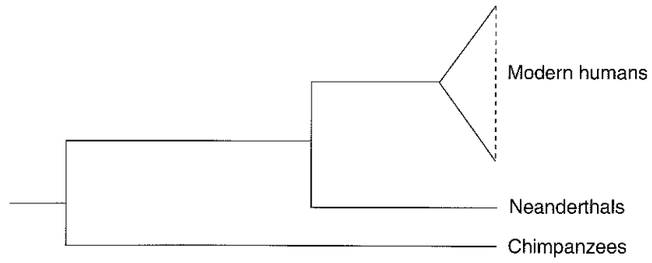
(a) Name the hominoid group that is most closely related to humans. (1 mark)

(b) Describe how DNA evidence is used to determine evolutionary relationships. (2 marks)

In the last four years, biologists have successfully extracted bits of DNA from Neanderthal fossils.

(c) Name the process the biologists would have used to get multiple copies of the Neanderthal DNA for analysis. (1 mark)

The following diagram shows the genetic relationship between modern humans and Neanderthals, based on is DNA analysis.



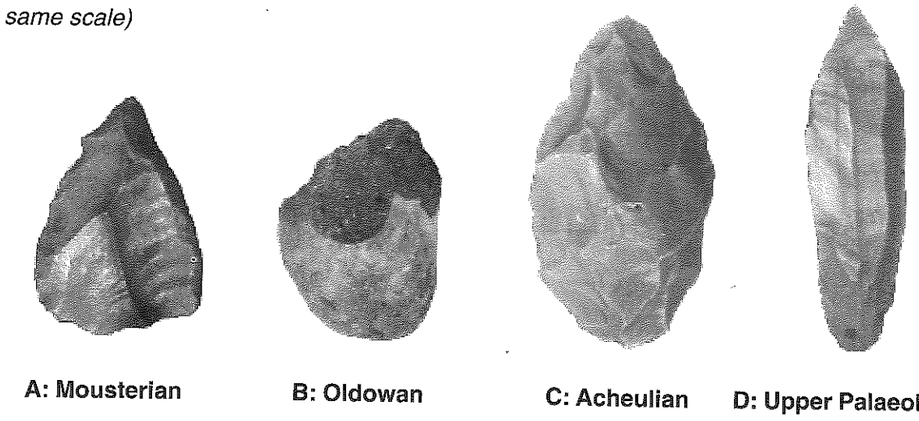
(d) What does this diagram suggest about the evolutionary relationship between modern humans and Neanderthals? (2 marks)

(Turn over

QUESTION TEN (15 marks)

Tools are an important part of the cultural evolution of modern humans. Representative pictures of the four main tool cultures are shown below.

(Not to same scale)



A: Mousterian **B: Oldowan** **C: Acheulian** **D: Upper Palaeolithic**

(a) Arrange the tools in order from earliest to most recent. Write the letters in the correct order in your Answer Booklet. (2 marks)

(b) In the space in your Answer Booklet, write the name of the hominid species which is associated with the development of each tool culture. A list of hominid species is provided in the Answer Booklet. (4 marks)

(c) Describe THREE ways that the development of these tools contributed to the cultural evolution of hominids. (3 marks)

(d) Choose THREE of the following subject areas and explain how the use of **fire** by hominids may have changed or affected that area.

(i) Diet

(ii) Physical evolution

(iii) Social organisation

(iv) Geographic range

(v) Lifespan.

(6 marks)

SECTION 3: TECHNIQUES AND PROCESSES IN MOLECULAR BIOTECHNOLOGY

(20 marks: 20 minutes)

Instructions: Answer all parts of all questions in this section. The space allocated in the Answer Booklet is a guide to the length and, in some cases, the format of the answers that are required.

QUESTION ONE (10 marks)

Read the following newspaper article extract carefully, and then answer questions (a) and (b) that follow.

> The young Coho salmon swimming in the vat look pretty much like any other of their species *Oncorhyncus kitusch*. They have the same bluish sheen; the same black spots scattered along their backs; the same white-gummed grimaces. But these fish are definitely different.
>
> For one thing, they're about three times longer than the average one-year-old Coho and about 30 times heavier.
>
> These particular young Coho are some of the thousands of genetically modified fish at the Department of Fisheries and Oceans' West Vancouver research laboratory. They differ from their unaltered wild brethren in that they have extra genes, genes put there by scientist Bob Devlin and his colleagues.
>
> The genes, which regulate growth, came from other salmon. They were injected into a batch of Coho eggs. As the new fish grew, their genes incorporated the introduced DNA.
>
> At maturity, both kinds of salmon (transgenic and normal) will be about the same size – between 2.5 and 5.5 kilograms. But the normal Coho will have taken four years to get there, the transgenic only two.

(a) Briefly describe the role played by each of the following recombinant DNA tools in the production of **transgenic salmon**:

(i) Restriction enzymes

(ii) PCR (Polymerase Chain Reaction)

(iii) DNA ligase. (3 marks)

(b) What is the advantage of producing salmon containing the growth gene? (2 marks)

Female salmon prefer the biggest male as a breeding partner.

(c) Describe how this preference would affect the spread of the growth gene through a wild salmon population if genetically modified salmon were accidentally released. (1 mark)

(d) Outline the steps involved when *Agrobacterium* is used as a **vector** to produce a transgenic **plant**. (4 marks)

(Turn over

QUESTION TWO (10 marks)

(a) Southern Blotting is one method of DNA profiling. The steps in this process, given below, have been mixed up. Write the letters in the correct order in your Answer Booklet. Two have been completed for you.

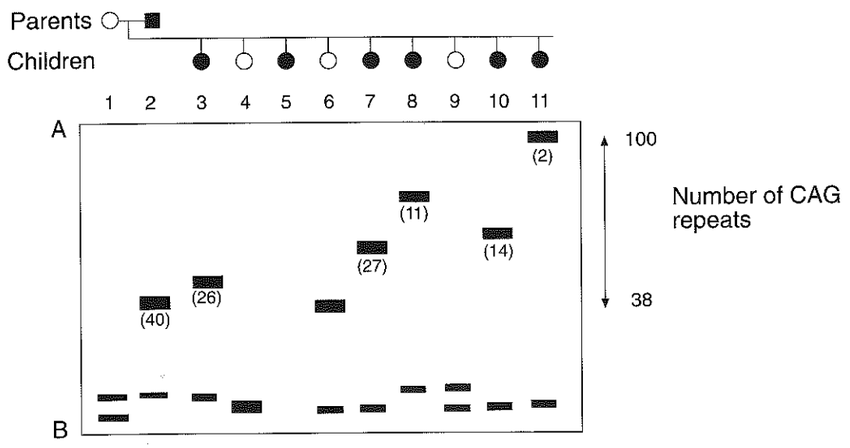
A.	Use a photographic or X-ray film to produce an autoradiograph.
B.	Transfer DNA fragments to a solid filter sheet.
C.	Extract DNA from source.
D.	Separate DNA fragments using gel electrophoresis.
E.	Cut DNA into fragments using restriction enzymes.
F.	Add radioactive probes.

(4 marks)

(b) What property of DNA provides the basis for DNA profiling? (1 mark)

Huntington's disease in humans is caused by a genetic defect on chromosome 4. The mutation results in a sequence of bases, CAG, being repeated more than 37 times. A genetic test is now available for Huntington's disease. The test involves isolating the section of DNA containing the CAG repeats by using a probe. The section is then run through gel electrophoresis.

The data below show the results of the genetic test run for one family. In this family, the father ■ developed the symptoms for Huntington's disease when he was 40. Six of his nine children also have symptoms (indicated by ●). The number in brackets below the fragment shows the age at which symptoms first appeared.



(c) Children 4, 6 and 9 do not yet have Huntington's disease. Use the information from the gel to predict which (if any) of these children are likely to get the disease. Give reasons for your prediction.
(2 marks)

(d) Describe the relationship between the age of onset of symptoms and the number of CAG repeats.
(1 mark)

(e) At which end, A or B, were the DNA samples loaded onto the gel? Give a reason for your choice.
(2 marks)

SECTION 4: CONTEMPORARY BIOLOGICAL ISSUES – ESSAY TOPICS

(40 marks: 35 minutes)

INSTRUCTIONS

1. *Write an essay on ONE of the topics listed below.*
2. *You should write about 500 words in total (2–3 pages). The space in your Answer Booklet is more than adequate and should not be exceeded.*
3. *A space has been provided in your Answer Booklet to plan your essay. This plan will not be marked.*
4. *Marks will be awarded for:*
   - *presenting an essay that answers the question* *(30 marks)*
   - *communicating knowledge and ideas logically and clearly.* *(10 marks)*

(Total = 40 marks)

LIST OF TOPICS

EITHER:

Topic 1: Biological Control

'Natural environments tend to be balanced environments, where organisms depend on one another and also constrain one another by competition for resources… But human influences can upset this balance and this is most evident when an exotic organism is introduced on purpose or by accident.'
University of Edinburgh website

With respect to an organism that is **EITHER a pest OR a weed** in New Zealand*, describe how your organism upset the balance in the environment when it was introduced into New Zealand*. Describe the biological control methods that are used to control your pest or weed and the implications of using these methods. Give your reasoned opinion on whether the biological control methods are likely to further upset the environmental balance.

OR:

Topic 2: Biodiversity in Aquatic Environments

'Loss of biological diversity is the number one environmental issue facing New Zealand. This country has been isolated from any other major land mass for so long that our land, fresh water and inshore waters have a very high proportion of flora and fauna found only in this country.'
New Zealand Ministry for the Environment website

Describe the biological diversity in **EITHER** a named **freshwater OR coastal marine environment** in New Zealand*, highlighting some of the indigenous flora and fauna found in that area. Discuss the methods currently used to conserve biological diversity of indigenous species in this aquatic environment and the impact these methods have on people and other organisms. Give your reasoned opinion on whether loss of biological diversity is the number one environmental issue facing New Zealand* today.

OR:

Topic 3: Genetically Modified Organisms

'Members of the public with no axe to grind probably want three questions answered: What can go wrong (with Genetic Engineering)? How likely is it? Are the benefits worth accepting that degree of risk?'
New Zealand Herald Editorial, 19 October 2000

With respect to **EITHER plant crops OR farm animals** in New Zealand*, describe how named organisms have been genetically modified so that they are different from their natural equivalents. Describe the likely benefits of the development and use of genetically modified organisms and discuss the possible risks. Give your reasoned opinion on whether the benefits are worth accepting the degree of risk involved.

* Candidates who attend a Pacific Island school may write about an example from their own country.