STAV Publishing 2007

Student name

BIOLOGY
Unit 4
Trial Examination

QUESTION AND ANSWER BOOK

Total writing time: 1 hour 30 minutes

Structure of book

Section	Number of questions	Number of marks
A	25	25
B	6	50
	Total	**75**

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied

- Question and answer book of 16 pages with a detachable answer sheet for multiple-choice questions inside the front cover.

Instructions

- Detach the answer sheet for multiple-choice questions during reading time.
- Write your **name** in the space provided above on this page and 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 book.

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STAV Publishing
2007

BIOLOGY
Unit 4 Trial Examination
MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **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.
- Mark your answer by placing a **CROSS** through the letter of your choice.

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

SECTION A - Multiple Choice Questions

Specific instructions for Section A

This section consists of 25 questions. You should attempt **all** questions.

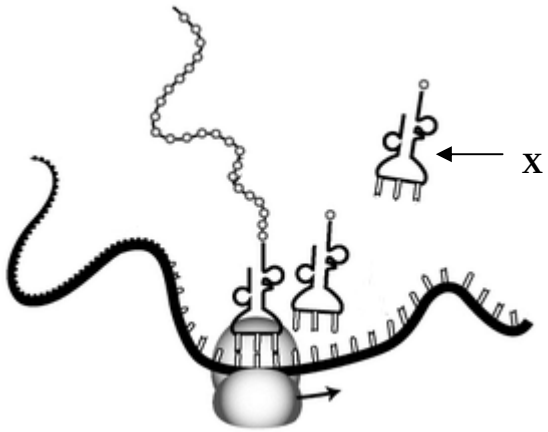
Each question has four possible correct answers. Only **one** answer for each question is correct. Select the answer that you believe is correct and indicate your choice on the Multiple Choice Answer Sheet by crossing the letter that corresponds with your choice of the correct answer.

If you wish to change an answer, erase it and cross your new choice of letter.

Each question is worth **one** mark. **No** mark will be given if more than one answer is completed for any question. Marks will **not** be deducted for incorrect answers.

Questions 1 and 2 refer to the following information.

The diagram below refers to a process that takes place somewhere in the cell.



Question 1

The process referred to is:

A. translation and takes place in the cytosol of the cell.
B. transcription and takes place in the nucleus of the cell.
C. translocation and takes place in the nucleus of the cell.
D. transformation and takes place in the cytosol of the cell.

Question 2

The structure labelled **X** represents:

A. a molecule of ribosomal RNA.
B. a section of DNA.
C. a molecule of transfer RNA.
D. a section of mRNA.

Question 3

Identical twins who have been separated at birth provide ideal case studies enabling scientists to study:

A. the effect of the environment on gene expression.
B. the effect of genes on the environment.
C. the effect of gender on gene expression.
D. the effect of genes on the phenotype.

Question 4

Copy DNA or cDNA is DNA that has been made from mRNA. A piece of cDNA that includes a particular gene is made up of 5.7 kilo bases. The polypeptide made from this piece of cDNA would consist of:

A. 17100 amino acids.
B. 5700 amino acids.
C. 1900 amino acids.
D. 190 amino acids.

Question 5

During the process of DNA replication:

A. The DNA is broken into fragments by restriction enzymes, duplicates itself and is rebuilt using DNA ligase.
B. The double helix opens up and new nucleotides pair with the exposed complimentary bases in the original strand forming two helices of DNA each one with one of the original strands of DNA.
C. The double helix opens up when the hydrogen bonds are broken between base pairs and RNA forms base pairs with the complimentary DNA base pairs.
D. The original DNA helix duplicates itself using the enzyme DNA polymerase forming a new double helix with two new strands.

Question 6

The process of formation of mRNA results first of all in the formation of preRNA or primary RNA. The formation of mRNA from pre RNA involves:

A. the removal of introns.
B. the removal of exons.
C. union with ribosomes.
D. wrapping the pre RNA around histones for support.

Question 7

The diploid number of a particular plant species is 8. A student examining a section of plant tissue under the microscope noticed a dividing cell that contained 2 groups of chromosomes, each group containing 4 double stranded chromosomes. This cell was most likely in:

A. prophase I of meiosis.
B. anaphase I of meiosis.
C. anaphase II of meiosis.
D. telophase II of meiosis.

Question 8

An example of apoptosis is:

A. death of heart muscle tissue following a heart attack.
B. death of cells after severe frost-bite.
C. production of a cancerous tumour.
D. death of plasma cells after an infectious disease has been overcome.

Questions 9 and 10 refer to the following information.

Coat colour in guinea pigs is under genetic control. Yellow coat colour in guinea pigs is produced by the homozygous genotype C^YC^Y. A cream colour, due to a mixture of white and yellow hairs, results from the heterozygous genotype C^YC^W and a white colour from the homozygous genotype C^WC^W. Two individuals who are cream in colour are mated.

Question 9

The expected theoretical phenotype would be:

A. 1/4 yellow, 1/2 cream, 1/4 white.
B. all cream like the parents.
C. 1/2 yellow and 1/2 cream.
D. 1/3 yellow, 1/3 cream, 1/3 white.

Question 10

This type of coat colour in guinea pigs is an example of:

A. co-dominance as both the yellow allele and the white allele are expressed.
B. multiple alleles as there are 3 possible colours.
C. dominant and recessive traits as yellow dominates over white.
D. partial dominance as the yellow allele is only partially dominant over the white allele.

Questions 11 and 12 refer to the following information.

Turner's Syndrome is an example of chromosomal aneuploidy, i.e. a variation in chromosome number. In the case of Turner's Syndrome the individual has only one X chromosome.

Question 11

The best diagnostic tool for Turner's Syndrome would be:

A. biochemical analysis of oestrogen.
B. karyotyping.
C. pedigree analysis.
D. DNA profiling.

Question 12

A person with the Turner genotype would phenotypically be:

A. male as males only have one X chromosome.
B. female as there is no Y chromosome.
C. unisexual being phenotypically uncertain regarding gender.
D. normal female as only one X chromosome is ever activated in a cell.

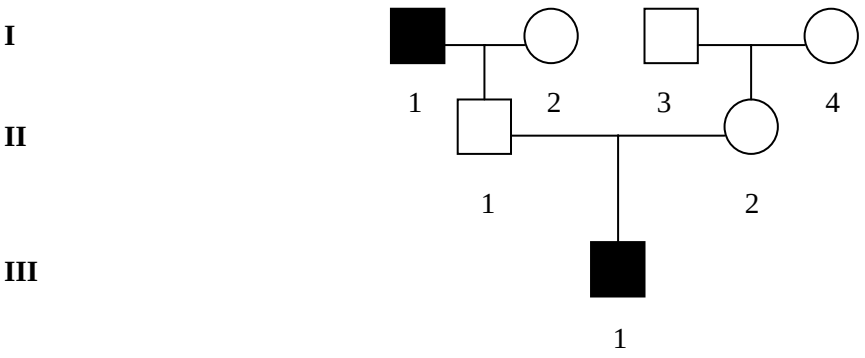
Question 13

Hevea brasiliensis is a tree that produces the substance latex or natural rubber. The yield of latex is controlled by 4 polygenes. This means that:

A. individual trees of Hevea *brasiliensis* either produce the latex or don't produce it.
B. the 4 genes are all linked.
C. the production of latex shows a continuous variation.
D. *Hevea brasiliensis* shows 4 distinct varieties in latex production.

Question 14

The pedigree below shows the inheritance of the X-linked recessive allele that causes colourblindness in humans.



The son **III** 1 has inherited the condition even though his parents **II** 1 and **II** 2 do not have the condition. The grandparent from whom the son **III** 1 must have inherited the defective allele would be:

A. his father's father.
B. his father's mother.
C. his mother's mother.
D. his mother's father.

Question 15

Fossils are an important source of evidence for evolution because:

A. DNA can be extracted from fossilized bones and evolutionary relationships made.
B. fossils of different kinds of organisms are found in rocks of particular ages and therefore appear in a consistent order throughout the world.
C. the fossil record is complete for most organisms alive today, thereby giving an overall picture of their evolution.
D. fossilisation occurs best in an environment with low oxygen.

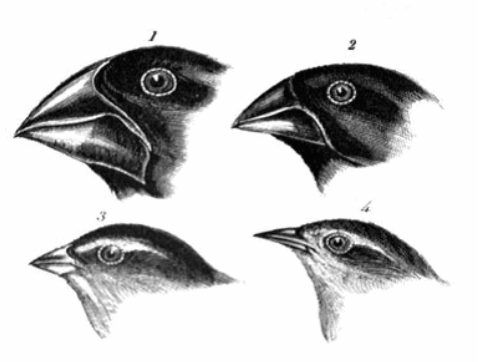
Question 16

When European botanists travelled around the world they noticed similar vegetation in different parts of the world with similar climates. The plants in these different areas were not related. These similarities are due to:

A. analogous evolution.
B. genetic drift.
C. divergent evolution.
D. convergent evolution.

Question 17

The finches below were first studied by Darwin on the Galapagos Islands. They show something called adaptive radiation.

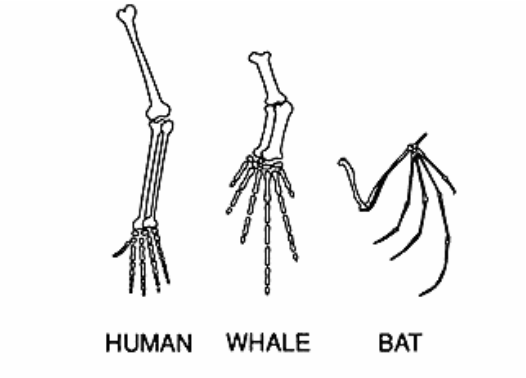


The best explanation for the fact they show adaptive radiation is:

A. ancestor birds arriving on the island that were all genetically different.
B. high predation rate leading to some birds being selected for.
C. high mutation rate especially of genes governing beak size and shape.
D. a variety of different habitats that could be readily occupied.

Question 18

The flippers of the whale, the human hand and the wing of the bat, look different but they have a similar bone structure.



These structures are:

A. homologous, thereby indicating that these species underwent convergent evolution.
B. homologous, thereby indicating that these species underwent divergent evolution.
C. analogous, thereby indicating that these species underwent divergent evolution.
D. analogous, thereby indicating that these species underwent convergent evolution.

Question 19

Gene flow is best described as:

A. the movement of genetic material from the nucleus to the cytoplasm in the form of mRNA.
B. the transmission of genetic traits from parents to offspring.
C. the movement of genes into or out of a population due to migration.
D. the movement of genes from one chromosome to another due to dislocation.

Question 20

Genetic engineering has resulted in goats producing milk that contains human blood clotting protein. This is best achieved by:

A. mixing the human gene into the milk.
B. vaccinating the goats with serum containing the human genes.
C. injecting the human genes into the udders of goats where it can be taken up by cells.
D. inserting the human gene into fertilized eggs of the goat.

Question 21

A small population of frogs lives in a habitat that has remained unchanged for a long period of time. Genetic drift will affect this population by:

A. accelerating the appearance of new traits.
B. promoting the survival of frogs with favourable characteristics.
C. increasing the number of alleles for specific traits.
D. reducing genetic diversity.

Question 22

Evolutionary relationships between organisms can be deduced using the concept of a molecular clock. This implies that:

A. changes in the amino acids of a particular protein occur at a constant rate over time.
B. organisms evolve at the same rate.
C. all biomacromolecules change at the same rate.
D. all genes mutate at the same rate.

Question 23

Two populations of birds were isolated from each other over a long period of time due to a geographical barrier. These two populations would be classified as having become separate species if:

A. the two populations differ in at least 10 inheritable traits.
B. sterile hybrids are produced when members of the two populations mate.
C. the nucleotide sequence in the DNA of the two populations is different.
D. the amino acid sequence of similar enzymes is different.

Question 24

DNA profiling is a useful technique in criminal cases as even a pinhead-sized spot can provide sufficient DNA because:

A. there are large amounts of DNA in a single cell.
B. DNA can be amplified using polymerase chain reaction.
C. DNA contains 4 different nucleotide bases.
D. DNA can be amplified using restriction enzymes.

Question 25

There has been strong opposition to the use of genetically modified crops in Australia. These crop plants have foreign genes inserted into their genome. One of the main arguments against genetically modified crops is:

A. New genes need to be inserted each generation therefore it is not cost effective to plant genetically modified crops.
B. The crops are subject to selection pressures and will therefore be altered.
C. The possibility of the inserted foreign gene being transferred to wild plants of closely related species to the crop plants.
D. These foreign genes alter the phenotype of the crop plants.

END OF SECTION A

SECTION B - Short Answer Questions

Specific instructions for Section B
This section consists of 6 questions. There are 50 marks in total for this section. Write your responses in the spaces provided. You should attempt **all** questions. Please write your responses in **blue** or **black ink**.

Question 1

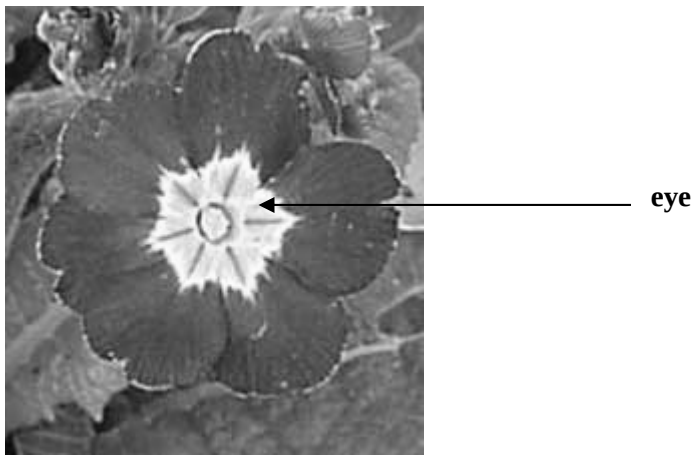
In some species of dogs the colour of the coat depends on the action of 2 genes. One gene controls coat colour with the black (**B**) coat colour being dominant to brown (**b**). At another locus on another chromosome there is an inhibitor gene that controls the expression of coat colour. The inhibitor allele (**I**) prevents the expression of the coat colour alleles and is dominant to its alternative allele (**i**) that allows the expression of the coat colour alleles. Failure to express the colour alleles results in a white coat.
A white male dog, heterozygous for the two genes, is crossed with a white female that is also heterozygous for the two genes. They produce a litter of 10 puppies: 6 white, 3 black and one brown.

a Using the alleles given, complete the following table giving **all** possible genotypes for the dogs.

	Male parent	**Female parent**	**White puppies**	**Black puppies**	**Brown puppy**
Genotype(s)					

(6 marks)

The eye or centre of the Chinese primrose, *Primula sinensis*, is under genetic control. Normally it has a yellow eye. A recessive mutation occurred in this gene, resulting in a very large yellow eye (called Primrose Queen). Another mutation occurred in the same gene resulting in a white eye (called Alexandra).



b How many alleles can any one primrose flower have in its cells for "eye" colour?

_____

(1 mark)

The alleles for "eye" colour are represented below.

Phenotype	Genotype
Alexandra	A
Normal	a^n
Primrose Queen	a

c What is the dominance order of these alleles?

_____

(1 mark)

An Alexandra plant is crossed with a normal plant and the following offspring are produced.

40 Alexandra
20 Normal
18 Primrose Queen

d What are the genotypes of the parents?

_____

(1 mark)

e What are the genotypes of the offspring?

Alexandra_____

Normal_____

Primrose Queen_____

(3 marks)

Total 12 marks

Question 2

Warfarin is an anticoagulant (prevents blood clotting) and has been used as a rat poison. Rats eat the warfarin and die from internal bleeding. Warfarin prevents vitamin K from interacting with blood clotting proteins. Some rats have a single gene mutation on chromosome one that makes them resistant to warfarin. Rats that are both homozygous and heterozygous for this mutation show resistance to warfarin.

a What type of inheritance is shown by rats to warfarin? Explain your answer.

_____

_____

_____

_____

(2 marks)

b Choose appropriate symbols to represent the genotypes of the rats and the corresponding phenotypes.

Symbols _____

Phenotype	possible genotype(s)
Warfain resistant	_____
Warfarin sensitive	_____

(2 marks)

It has been shown that rats that are homozygous for the warfarin resistant allele have great difficulty absorbing vitamin K from their food and require twenty times the amount of vitamin K that rats homozygous for the normal allele require. Rats that are heterozygous for the warfarin allele require only 2 to 3 times the amount of vitamin K of the non-resistant rats. When populations of these rats were examined it was found that there was a much larger number of heterozygotes in the population with regard to the warfarin gene than would be expected.

c Explain why the number of heterozygotes would be larger than expected in the population.

_____

_____

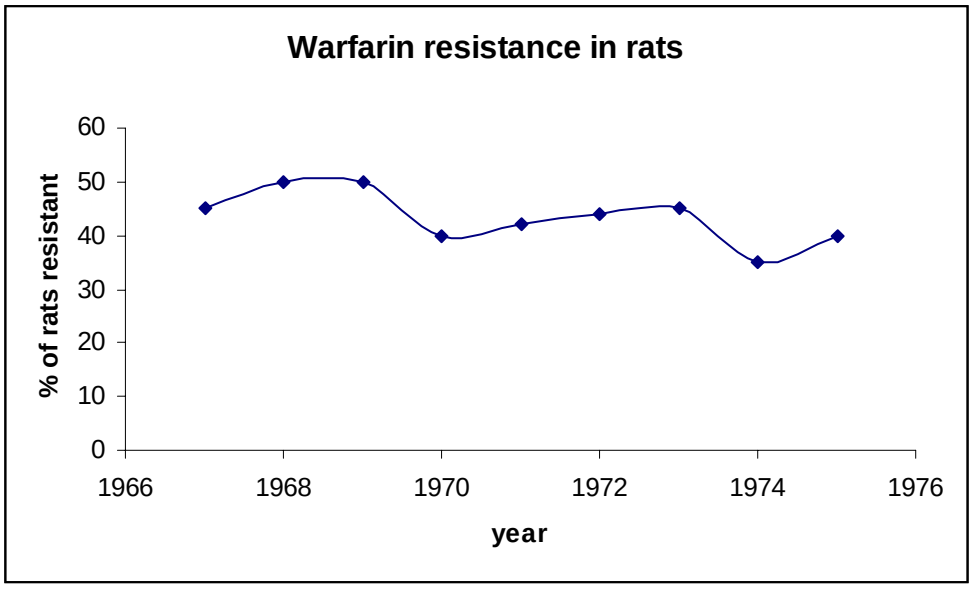
_____

_____

_____

(2 marks)

When warfarin was first introduced as a poison into the rat population there was a steady decline in the rat population over about ten years. Over the same period the resistance in the rat population increased and then stabilized as shown in the graph below.



d Outline what you would expect to happen in a population that is no longer exposed to warfarin.

_____

_____

_____

_____

_____

_____

(2 marks)

Total 8 marks

Question 3

Severe Combined Immunodeficiency or SCID is an X-linked recessive disorder. It is very rare, affecting only 1 in 100,000 births and only male babies. SCID is due to mutations in the gene that encodes the common gamma chain, a receptor protein on the T cells and B cells. The result is a complete failure of the immune system to fight infections. Sufferers of SCID usually die within a year of infection.

a What is meant by an X-linked recessive disorder?

_____

_____

_____

(2 marks)

b Why has this condition only been found in boys?

_____

_____

_____

_____

(2 marks)

In 2000 a group of French research scientists treated 10 male infants suffering from SCID. The scientists used an altered retrovirus to place the normal gene into the patient's own bone marrow cells that develop into T cells and B cells.

c What term is given for this procedure?

_____

(1 mark)

The challenge of developing the successful procedure named in **c** above for any specific condition is considerable.

d Suggest **two** challenges that scientists need to deal with in order to use this procedure for a specific condition?

_____

_____

_____

_____

(2 marks)

Unfortunately two of the patients in the French trial developed leukaemia, a form of cancer caused by genes called oncogenes. This resulted in a stop to further clinical trials until just recently.

e Suggest how these two patients could have developed leukaemia as a result of the procedure named in **c** above.

_____

_____

_____

_____

(2 marks)

The boys who were successfully treated survived as they were able to produce normal T and B cells.

f If these boys survive to reproductive age, would they be able to pass the condition SCID down to their sons? Explain your answer.

_____

_____

_____

_____

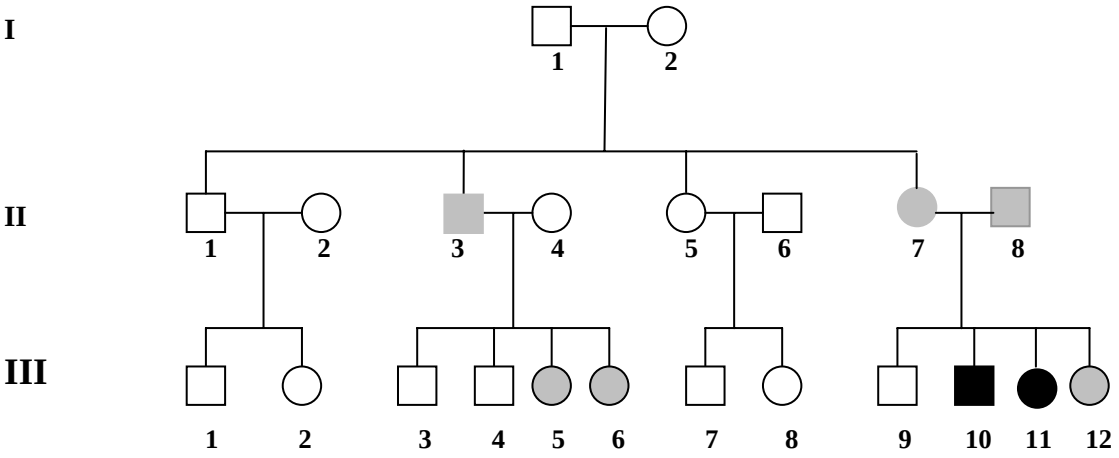
_____

(2 marks)

Total 11 marks

Question 4

Friedreich's ataxia is an inherited disease that causes progressive damage to the nervous system. Friedreich's ataxia is due to a mutation in the X25 gene that codes for the protein frataxin, a 210 amino acid protein. The onset of symptoms usually occurs between the ages of 5 and 15 years. The following pedigree shows the inheritance of Friedreich's ataxia in a particular family. Individuals shaded grey are carriers and individuals shaded black have the condition.



a Using the information in the pedigree explain the mode of inheritance of Friedreich's ataxia.

_____

_____

_____

_____

(2 marks)

The mutation in this gene results in GAA triplet repeats. Normal alleles have 7-22 GAA repeats whereas mutant alleles have 20 – 2000 GAA repeats in intron 1 of the Frataxin gene. These repeats interfere with transcription.

b What do the letters G and A stand for?

G_____

A_____

(2 marks)

c What is transcription?

_____

_____

(1 mark)

GAA codes for the amino acid leucine.

d Would this amino acid be added to the polypeptide chain in multiple numbers? Explain your answer.

_____

_____

_____

_____

(2 marks)

Diagnosis of Friedreich's ataxia is done by taking DNA from the region of the gene containing the GAA repeats, amplifying it and running it on an electrophoresis gel.

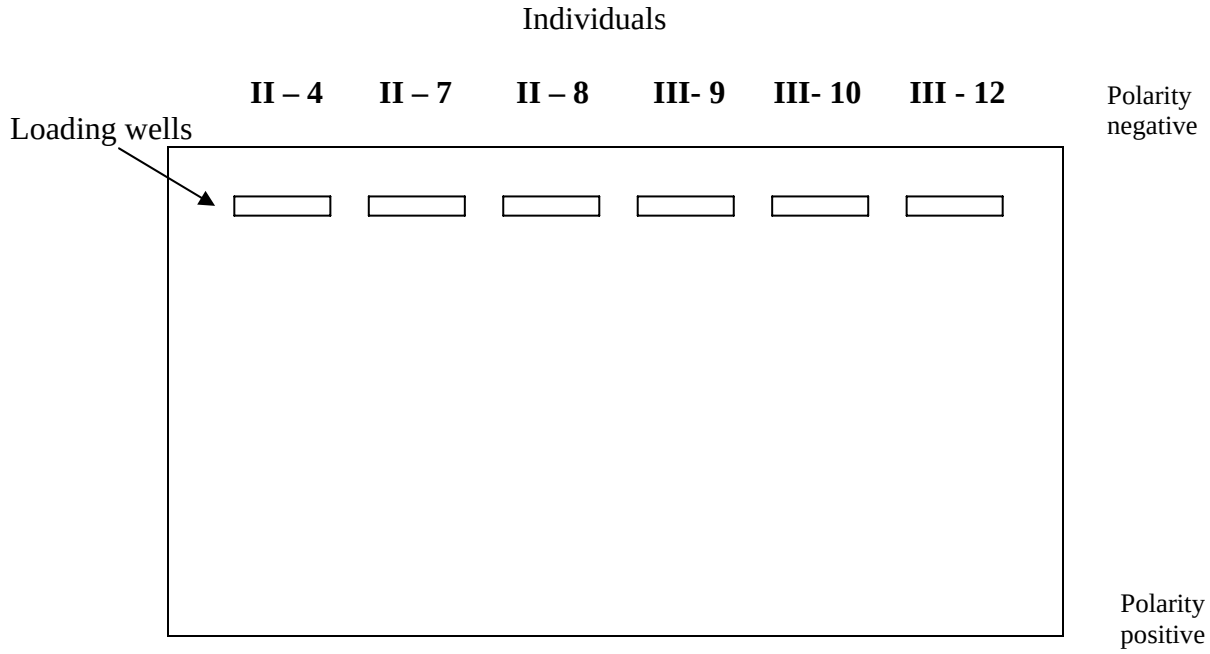
e Name the procedure used to amplify the DNA.

_____

(1 mark)

The diagram below represents a gel electrophoresis. Normal alleles show a band of 1.4kb, whereas an individual with 1000 trinucleotide repeats shows a band at 4.5kb.

F Using the information in the pedigree, draw the possible individuals' DNA banding patterns as would be expected in a gel electrophoresis.



(3 marks)

Total 11 marks

Question 5

The Northern elephant seal (*Mirounga angustirostris)* was hunted almost to extinction in the 19th century for its oil rich blubber. The population dropped to between 100-1000 individuals. In the early 20th century, protection by law has resulted in the numbers recovering to approximately 100,000. This, however, has resulted in a loss of genetic diversity.

a What is genetic diversity?

_____

(1 mark)

b Why is a loss of genetic diversity such an issue?

_____

_____

(1 mark)

c Why does the loss of genetic diversity often occur in populations of endangered species?

_____

_____

_____

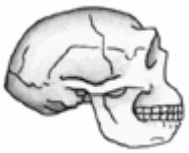
_____

(2 marks)

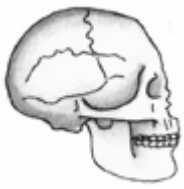
Total 4 marks

Question 6

The following diagrams are of a different ancestral species and modern man. The skull of Ancestor 1 has different structural features compared to modern man.



Ancestor 1



Modern man

a **Two** structural differences between the ancestral skull and the skull of modern man are given below. For each structural difference suggest a reason for the change.

Structural difference one is **reduced canine teeth** in modern man compared to ancestor 1.

Reason for the change

_____

_____

_____

(1 mark)

Structural difference two is a **reduced brow ridge** in modern man compared to ancestor 1.

Reason for the change

_____

_____

_____

(1 mark)

The skull below is of another ancestor of modern man.

Ancestor 2

b Would ancestor 2 be more closely or less closely related to modern man than the individual labelled ancestor 1? Explain your answer.

_____

_____

_____

_____

_____

(2 marks)

Total 4 marks

END OF EXAMINATION

Acknowledgements
Websites: www.marymount.k12.ny.us/.../translation.gif
www.pbs.org/.../images/session1/finches.gif
www.ekcsk12.org/.../comparativeanatomy1.gif
flowers109.tripod.com/primrose.html
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