Australian Education Academy Pty Ltd
2006

BIOLOGY

TRIAL EXAMINATION UNIT 4

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

Student's name: _____

Directions to students

This examination consists of **25 multiple choice** questions (25 marks) and **6 short answer** questions (50 marks). Answer all questions.
All working and answers should be written in the spaces provided.
The marks allotted to each part of each question appear at the end of each part.
There are **75 marks** available for this task.

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These questions have been written and published to assist students in their preparations for the 2006 Biology Examination 4. The questions and associated answers and solutions do not necessarily reflect the views of the Victoria Curriculum and Assessment Authority.

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SECTION ONE – Multiple Choice Questions

Instructions for Section One.

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 correct answer and indicate your choice on the Multiple Choice Answer Sheet by crossing the letter of the correct answer.

Each question will be given **one** mark. Marks will not be deducted for incorrect answers.

Question 1

What distinguishes a diploid cell from a haploid cell?

A. Whether the cell is prokaryotic or eukaryotic
B. Whether the cell divides by mitosis or meiosis
C. The number of types of genes
D. The number of homologous chromosomes

Question2

Mendel crossed a true-breeding pea plant having pinched pods with a true-breeding pea plant having inflated pods. All the F1 plants had inflated pods. The F1 plants were self-pollinated and 1000 F2 plants were produced. About how many plants would you expect of each phenotype in the F2 generation?

A. 1000 pinched and no inflated
B. 750 pinched and 250 inflated
C. 750 inflated and 250 pinched
D. 500 inflated and 500 pinched

Question 3

In chickens, males have two identical sex chromosomes called W, and females have two different sex chromosomes, one W and one Z.

A. The genetic makeup of the egg determines the sex of the chick
B. A rooster inherits both his W chromosomes from his father
C. The genetic makeup of the sperm determines the sex of the chick
D. A hen inherits her single Z from her father

Question 4

Certain dominant alleles are so important for normal development that mutant recessive alleles, called lethal alleles, lead to the death of the homozygous recessive organism. In many cases, the heterozygote has a normal phenotype. Consider the mating of two such heterozygotes. Among their surviving progeny, what fraction will be heterozygous?

A. One-quarter
B. Three-quarters
C. One-half
D. Two-thirds

Question 5

Which of the following statements correctly indicates a correlation between the way alleles behave in crosses and the way homologous chromosomes behave in meiosis?

A. They assort independently
B. There are two sets in parents and one set in gametes
C. They show separation, or segregation
D. All of the above

Question 6

If you blocked the formation of the mitotic spindle with a drug, all the following processes could occur except:

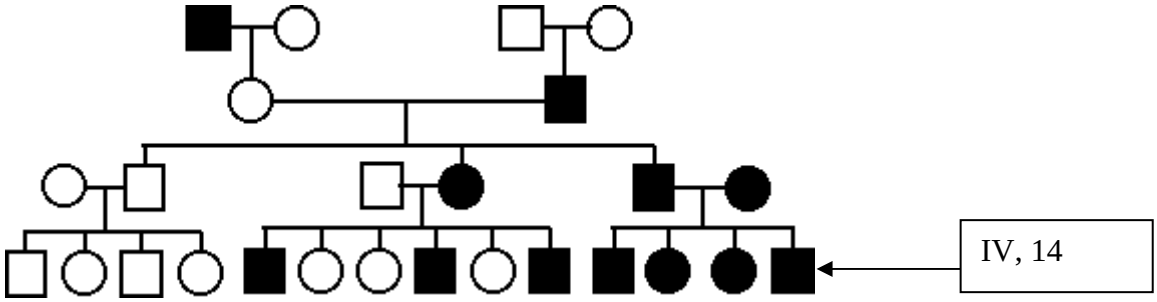
A. Chromosome separation during anaphase
B. Prophase
C. Formation of sister chromatids
D. DNA replication

Question 7

When Gregor Mendel crossed two true-breeding strains of peas, one with long stems and the other with short stems, he found that all their offspring had tall stems. Why weren't there any short-stemmed plants?

A. No recombination occurred and the short-stem trait was lost during meiosis
B. The phenotype of the heterozygote shows the dominant trait
C. The short-stem trait is not hereditary
D. No short-stemmed plants survived

Refer to the diagram below for questions 8 and 9



Question 8

The mode of inheritance of the gene that is causing the trait is:

A. Autosomal dominant
B. X linked recessive
C. X linked dominant
D. Autosomal recessive

Question 9

The genotype for individual IV, 14 is: (assuming A= dominant and a = recessive)

A. X^aY
B. X^AY
C. aa
D. AA

In questions 10 and 11 below, a segment of DNA has one strand with the following sequence of bases.
A G C G C A T A G C A A

Question 10

The complementary strand of DNA is

A. U C G C G U A U C G U U
B. T C G C C G A T C G T T
C. T C G C G T A T C G T T
D. T C G C A T T A C A U U

Question 11

The mRNA molecule coded for by the original strand is
:

A. T C G C G T A T C G T T
B. U C G C G U A U C G U U
C. U A C A T T U C A G G G
D. U C G G C A T T U G G C

Question 12

Transcription of DNA into mRNA is catalysed by:

A. DNA polymerase
B. RNA synthase
C. RNA polymerase
D. DNA ligase

Question 13

DNA fingerprints used as evidence in a murder trial look something like supermarket bar codes. The pattern of bars in a DNA fingerprint:

A. The order of genes along particular chromosomes
B. The presence of various-sized fragments of DNA
C. The exact location of a specific gene in a genomic library
D. The order of bases in a particular gene

Question 14

The immediate goal of the Human Genome Project is to:

A. Develop new technologies for studying DNA
B. Map all the human genes and determine the nucleotide sequence of the entire human genome
C. Find cures for human genetic disorders
D. Compare the genomes of a large number of individuals from different parts of the world

Question 15

In recombinant DNA experiments,_____ is used to cut pieces of DNA and _____ joins the resulting fragments to form recombinant

A. Plasmids and RNA polymerase
B. Restriction enzymes and a plasmid
C. Restriction enzymes and ligase
D. Restriction enzymes and DNA polymerase

Question 16

A geneticist found that a particular mutation had no effect on the polypeptide encoded by a gene. This mutation probably involved:

A. Deletion of the entire gene
B. Insertion of one nucleotide
C. Substitution of one nucleotide
D. Deletion of one nucleotide

Question 17

Boa constrictors have tiny pelvic girdles and leg bones within their bodies. Since these structures are nonfunctional, they are called:

A. Vestigial
B. Polygenic
C. Analogous
D. Homologue

Question 18

If a population includes 250 individuals homozygous dominant (AA: red flowers), 250 individuals heterozygous for this gene (Aa: red flowers), and 125 homozygous recessive (aa: white flowers), what are the frequencies of the alleles for red and white?

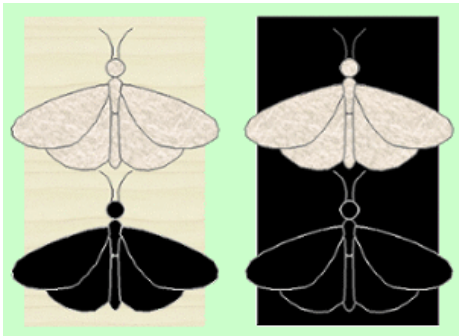
A. 0.75 red, 0.25 white
B. 0.6 red, 0.4 white
C. 0.5 red, 0.5 white
D. 0.25 red, 0.75 white

Question 19

If a population becomes isolated from other populations of the same species and then genetic divergence occurs, what happens?

A. Speciation
B. Genetic drifts form
C. Extinction
D. Mutations

Questions 20 and 21 refer to the diagram below.



Question 20

English peppered moths evolved different colourings in response to:

A. Temperature
B. Predation by bats
C. A change in their environment
D. Introduction of a new predator

Question 21

The appearance of a new allele as seen in the peppered moths is a result of:

A. Crossing over
B. Mutation
C. Sexual reproduction
D. Recombination

Question 22

Fossils in the genus Australopithecus are thought to represent branches on the tree of life intermediate between apes and humans because:

A. They show many features that are intermediate between apes and humans
B. They show a mixture of the features of apes and humans
C. They are dated at between 5 and 10 million years old
D. They seem to have disappeared just as modern humans became common in Europe

Question 23

The forelimbs of birds and bats are:

A. Homologous
B. Convergent
C. Analogous
D. Both analogous and convergent

Question 24

Which of the following does **not** come under the category of genetic drift?

A. The founder effect
B. The bottleneck effect
C. Sexual recombination
D. Gene flow

Question 25

Natural selection acts directly on:

A. The phenotype
B. The genotype
C. The entire genome
D. Each allele

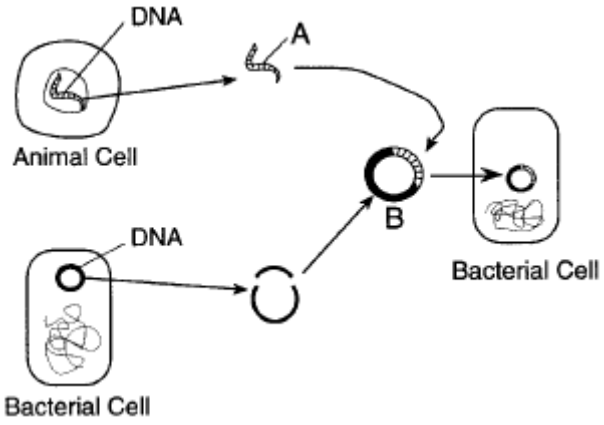
SECTION TWO: Short Answer Questions

Instructions for Section Two:

This section consists of **6** questions. There are **50 marks** in total for this section. Write your answers in the spaces provided. You should attempt all the questions.

Question 1

Refer to the diagram below to answer the following questions:



(a) Structure A is made up of what type of molecule?

(1 mark)

(b) Structure A contains the:

(1 mark)

(c) Structure B represents

(1 mark)

(d) The technique illustrated in the diagram is known as:

(1 mark)

(e) Describe how the technique shown above can be used to make human insulin in bacterial cells such as E. Coli.

(2 marks)

(f) Explain how enzymes such as restriction enzymes and DNA ligase are involved in this process.

(2 marks)

(Total 8 marks)

Question 2

(a) Listed in the table below are the steps involved in protein synthesis. In the table below place them in the correct order.

	Stage of Protein synthesis
mRNA molecules carrying a specific code determined by the base sequence of the DNA template move from the nucleus to the cytoplasm.	
Amino acids are put into position on the ribosome with instructions from the triplet codes of tRNA and mRNA	
DNA serves as a template for the synthesis of mRNA from RNA nucleotides in the nucleus. transcription: transfer of the genetic message from DNA to mRNA RNA polymerase -- enzyme which catalyses this transfer	
Strands of mRNA carrying codons transcribed from DNA, move to the ribosomes in the cytoplasm. codon: a triplet in a RNA molecule triplet: grouping of three nitrogenous bases in DNA or RNA molecules	
Different triplets of nitrogenous bases in tRNA molecules pick up specific amino acids in the cytoplasm and carry them to mRNA at the ribosomes.	
With the aid of enzymes and ATP (energy), the amino acids are bonded to form a polypeptide chain (protein) on the ribosome	
mRNA strands become associated with rRNA on the ribosomes. (rRNA -- arranges date between mRNA and tRNA	

(3.5 marks)

(b) Discuss the process of protein synthesis and the possible problems caused by a frame shift mutation

(2 marks)

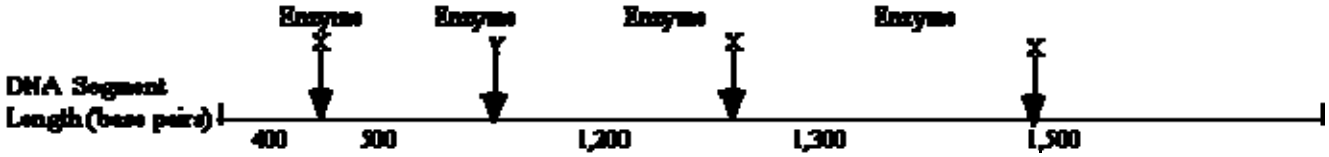
(c) A base substitution does not always result in a completely new amino acid. Explain how this could be the case.

(2 marks)

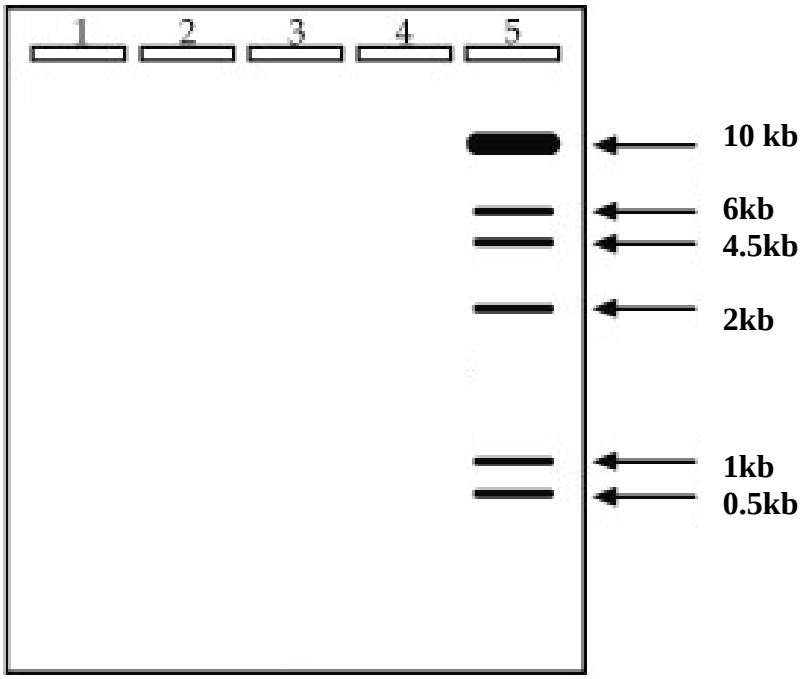
(Total 7.5 marks)

Question 3

The diagram below shows a segment of DNA with a total length of 4,900 base pairs. The arrows indicate reaction sites for two restriction enzymes (enzyme X and enzyme Y).



(a) The fragments above were placed in well 3. On the diagram below represent the results of running the fragments through the gel



(2.5 marks)

(b) Explain how the principles of gel electrophoresis allow for the separation of DNA fragments.

(2 marks)

(c) Describe the results you would expect from electrophoretic separation of fragments from the following treatments of the DNA segment above. Assume that the digestion occurred under appropriate conditions and went to completion.

i. DNA digested with only enzyme X

(1 mark)

ii. DNA digested with only enzyme Y

(1 mark)

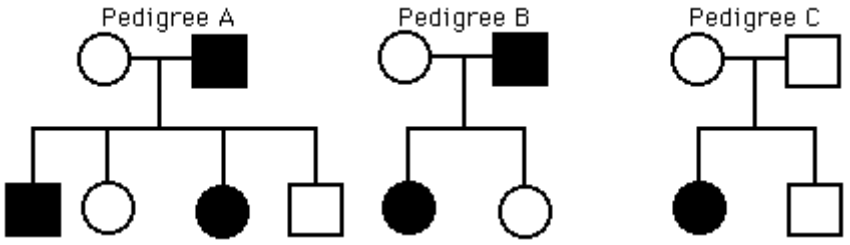
iii. Undigested DNA

(1 mark)

(Total 7.5 marks)

Question 4

(a) For each pedigree (A, B and C), state, by answering **Yes or No** in the appropriate blank space, whether transmission of the trait can be accounted for on the basis of each of the listed simple modes of inheritance.



	Pedigree A	Pedigree B	Pedigree C
Autosomal Recessive			
Autosomal Dominant			
X-linked Recessive			
X-linked Dominant			

(3 marks)

(b) Two parents who are both carriers (heterozygotes) for a recessive disease have a one in four chance that their child has the disease.
Unfortunately, genetic counsellors often hear such parents say this is not a problem as they only plan to have three children.
Suppose their first two children were disease-free. What is the chance that the third has the disease?

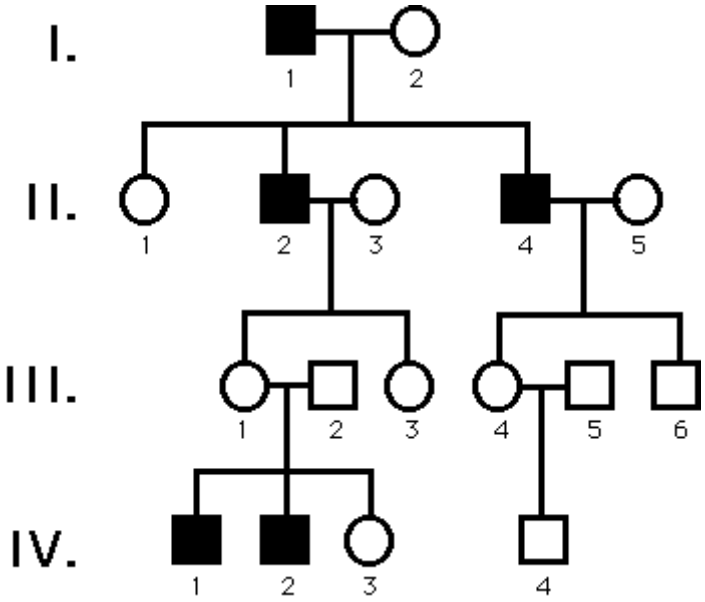
(2 marks)

Haemophilia is a disease in which the blood fails to clot. The most common form, primarily affecting males, is caused by a mutation in a gene coding for a clotting protein (factor VIII) inherited as an X-linked recessive phenotype.

(c) A couple of been told they are having a boy. The parents are an unaffected male and carrier female. What is the chance their son will have haemophilia?

(2 marks)

(d) In the pedigree shown below, assume that the trait is fully penetrant and that none of the matings are consanguineous. Also consider whether the causative allele is rare or common in the general population.



i. Why could a trait represented by solid symbols not be due to a rare autosomal dominant?

(1 mark)

ii. What type of inheritance could explain this pedigree?

(1 mark)

(Total 9 marks)

Question 5

In Drosophila, the allele for normal body color is dominant over the allele for black body color. A second gene controls wing shape. The shape can be either normal or vestigial which is recessive. A cross is made between a homozygous wild type fly and fly with black body and vestigial wings. The offspring were then mated to black body, vestigial winged flies. The following segregation ratio was observed:

Phenotype	**# Observed**
Wild Type	510
Normal, vestigial	500
Black, normal	492
Black, vestigial	498

(a) Assign allelic symbols for each trait:

Normal body colour: _____

Black body colour: _____

Normal wings: _____

Vestigial wings: _____

(2 marks)

(b) Using the data above are these two genes linked? Show the working out to support your answer.

(3 marks)

(c) Two flies that are heterozygous for normal body colour are crossed. What is the chance of an offspring being heterozygous for the trait?

(2 mark)

(Total 7 marks)

Question 6

Hominids are modern human beings and our ancestors, generally defined as the primates who habitually walk erect. The hominids in the table below are listed roughly in order of appearance in the fossil record

Species	**Approximate date of appearance**
A. afarensis	3.6mya
A. africanus	3mya
H. erectus	2mya
H. sapiens	200,000

(a) The skulls below correspond with the species shown in the table above. In the table below match the skull with the corresponding species name.

Skull sample	Hominid Species
	
	
	
	

(2 marks)

(b) List a skull characteristic that suggests a skull shown in the table above is H. sapiens

_____

(1 mark)

(c) What method could be used to determine the absolute age of the H. erectus fossil?

(1 mark)

(d) What method could be used to determine the relative age of the H. erectus fossil?

(1 mark)

(e) Give a possible reason why some fossils are incomplete upon discovery

(1 mark)

(f) Pongids such as chimpanzees, gorillas and orangutans do not have the ability to walk erect for long periods of time. List an advantage humans have over pongids due to walking erect.

(1 mark)

Speciation is the process by which one or more populations of a species become genetically different enough to form a new species. This process often requires populations to be isolated for a long period of time.

(g) Outline the main steps involved in the process of speciation.

(3 marks)

(h) In terms of alleles what effect can The Founder Effect have on a population?

(1 mark)

(Total 11 marks)

End of Examination